13 LNG COMPONENT CONSTRUCTION

13.1 INTRODUCTION

This chapter, *Chapter 13*, describes the extent and nature of the construction of the LNG Component, including the types and methods of construction, the construction equipment to be used and the items to be transported onto the construction site. Construction stages and timeframes are also discussed. LNG Component construction activities include:

- all onshore activities on Curtis Island within the LNG Facility site boundary
- construction and commissioning of a Materials Offloading Facility (MOF) and LNG loading/propane unloading jetty within the intertidal and marine areas adjacent to the site
- construction and operation of staging areas on Gladstone mainland required to support these activities.

Construction of Ancillary Infrastructure is described in more detail, with:

- construction of new Shipping Channel and Swing Basin included in *Volume 2, Chapter 14*
- issues associated with the proposed bridge across The Narrows, and associated roads, (Curtis Island Bridge/Road Access) including construction, have been included in *Volume 2, Chapter 9* (note that QGC is not seeking approval for the bridge and associated roads).
- However, as previously noted, these activities do not form part of the proposed activities directly associated with the Queensland Curtis LNG (QCLNG) Project.

13.1.1 Construction Timeframe, Staging and Method

Construction activities are anticipated to commence in 2010 (refer *Volume 2, Chapter 5*), with construction of two LNG processing units or "trains" initially. Construction of LNG Train 2 will commence shortly after construction of Train 1, with construction of the two trains occurring largely concurrently and with approximately six to twelve months between commissioning of Train 1 and Train 2.

Train 2 commissioning is planned for 2014 and commencement of Train 3 construction nominally planned for 2018. Consequently, the following description of construction methodologies is focussed on Trains 1 and 2, with all estimates of personnel requirements, fuel, equipment, logistics and other items relating only to construction of Trains 1 and 2 unless otherwise stated.

The methodology for construction of Train 3 is assumed to be similar, although site civil and bulk earthwork for all three trains will be undertaken during the first stages of construction activities and numerous items of plant infrastructure (MOF, jetty, flares) will be constructed for Trains 1 and 2 and will not require

duplication for Train 3.

For the purpose of description in this EIS, construction activities have been divided into five stages:

- **Stage 1**: Site Preparation
- **Stage 2**: Civil Work, Foundations and Structures
- **Stage 3**: Mechanical and Electrical Installation and Testing
- **Stage 4**: Systems Strength and Integrity Testing
- **Stage 5**: Energisation and Introduction of Hydrocarbons.

While these stages are anticipated to occur largely sequentially, there is some overlap in the scheduling with some of the works in separate stages planned to be undertaken concurrently.

The overall construction philosophy for the LNG Component is to employ some level of pre-assembly of key modules (assembly outside Australia and import to site as a completed module). This approach is aimed at overcoming labour constraints where specific skills are not available in the Australian labour market or where modules are proprietary vendor modules which cannot be sourced in Australia.

A preliminary overview of pre-assembled modules includes the following, although these may vary with further refinement of design:

- refrigeration gas compressors
- cold boxes
- cryogenic piperack
- jetty trestles
- LNG tank water falls
- gas turbine generators
- boil-off gas (BoG) compressors
- pre-assembled Vessels V1201 and V1202 Column units.

The construction description provided below is based on the importation of these pre-assembled modules.

Construction activities will focus on the LNG Facility on Curtis Island. Transhipment of personnel, some materials and equipment will occur from Auckland Point on the Gladstone mainland. An indicative layout of the Auckland Point facility is provided in *Figure 2.13.4.* and *Figure 2.13.7.* Construction works at Auckland Point (installation of fences, gates, hardstand areas, lighting, ferry pontoon, roads, ancillary temporary buildings and associated infrastructure) will be undertaken early in the Project and concurrently with early Stage 1 works on the Curtis Island site (e.g., construction of the MOF).

The layout for the LNG Facility has been undertaken with consideration (as far as practicable) to:

- minimise earthworks (i.e. aim to achieve balance of cut and fill)

- minimise vegetation clearing
- minimise disturbance to intertidal and marine flora and fauna
- utilise existing ridgelines to provide visual plant shielding from public viewpoints
- ensure onshore facilities are located above the storm surge level (refer also to *Volume 5, Chapter 2*).

Detailed design and construction of all buildings and structures will be undertaken, at a minimum, in accordance with the *Building Code of Australia* and the *Queensland Building Act 1975* and *Building Regulation 2003*, where applicable in terms of cyclone and earthquake ratings.

The LNG Facility boundary encompasses approximately 268 ha above highest astronomical tide (HAT) with an additional indicative wet lease area (below HAT) of approximately 71 ha. Within the LNG Facility boundary, the plant onshore construction footprint (above HAT) will occupy approximately 140 ha, with additional disturbance within the LNG Facility boundary as required for spoil disposal areas, sediment control structures, access and fire control roads, fencing and other minor works. Some of this will include intertidal and marine facilities. All construction works will occur within the LNG Facility boundary (excluding construction pipeline works which are discussed in *Volume 2, Chapter 12*).

Tidal works will require a resource allocation and a development approval under the *Coastal Protection and Management Act 1995*.

Construction activities will involve a number of Environmentally Relevant Activities (ERAs) as defined under the *Environmental Protection Regulation 2008* (QLD). All appropriate permits and approvals will be obtained.

13.1.2 Stage 1 – Site Preparation: Month 1 – 12

Construction activities will commence with the site preparation package, which will take approximately one year from commencement to complete. Site preparation will include the following works on the LNG Facility site:

- establishment of an initial beachhead to allow mobilisation of personnel and equipment to site early in the Project and in advance of MOF construction. This will initially take the form of a pioneer dock located approximately 600 m south of the proposed LNG jetty location, with primary purpose of this to allow early and unencumbered access to the site including for further detailed site investigation prior to commencement of construction. This pioneer dock may be expanded (subject to ongoing engineering investigation and detailed design) into a more expansive “rock dock” which will be used during Stages 1, 2 and 3 of construction for importation of bulk aggregate to the site. Preliminary design indicates that the rock dock will be a sheet-piled, earth-filled structure. The pioneer dock will be located and designed to avoid the need for dredging as much as practicable.
- establishment of a site security fence around the complete site perimeter

- clearing of vegetation across the footprint of the LNG Plant site, and other areas (eg, firebreaks, perimeter fence access, etc) where vegetation clearing is required
- grubbing root mat
- stripping and placement of topsoils
- hauling and placement of root mat and topsoil to designated disposal sites on Curtis Island within the LNG Facility boundary (refer to designated "Top Strip Placement" areas shown in *Figure 2.13.1).* The volume of root mat and topsoil material is estimated at 1,000,000 m^3
- bulk earthworks, involving the excavation of existing soil materials and placement of the same as compacted engineered fills
- establishment of the MOF along the north-west coast of the site, to receive personnel, cargo and materials required for subsequent construction activities.

A preliminary site benching plan based on preliminary geotechnical data has been prepared. It shows the proposed finished ground surface elevation across the site following the bulk earthworks (see *Figure 2.13.1*). Delineation of the proposed areas of cut and fill are shown in *Figure 2.13.2*.

Based upon topographical and initial geotechnical data, excavation of bulk materials can be largely undertaken by ripping. However, in some deeper areas (where approximately 20 m of overburden soils and rock materials will be removed to achieve formation elevation) the rock is fractured and may be cemented in places requiring light shock blasting to assist with loosening the rock along lines of existing weakness and allow ripping to be undertaken.

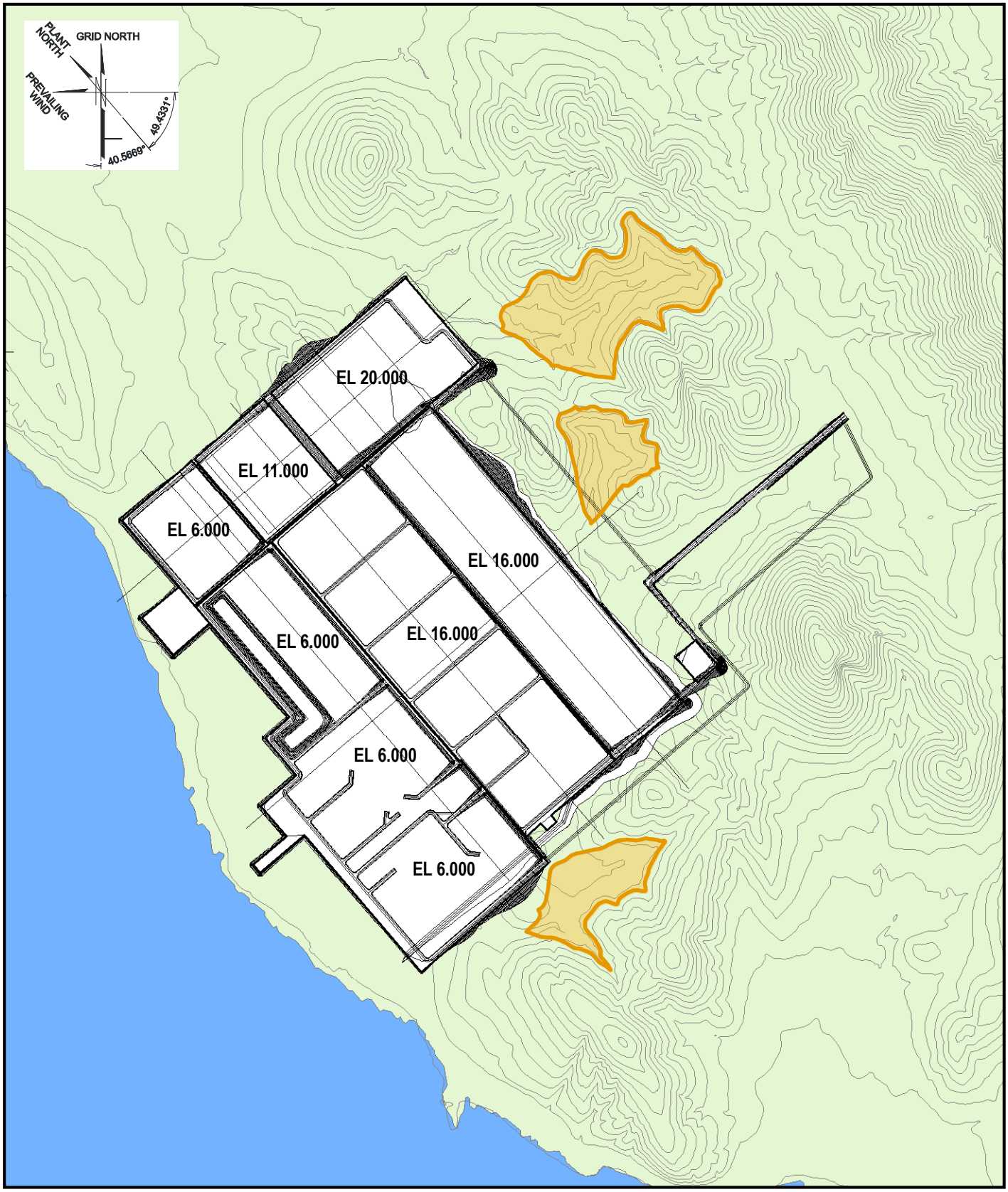
13.1.2.1 Construction of Materials Offloading Facility (MOF)

A key component, and main marine component, of this stage will be the establishment of a Materials Offloading Facility (MOF) to facilitate transfer of materials, equipment, plant and personnel to the LNG Facility site during both construction and operation. While MOF design is subject to further refinement, it is proposed to consist of a sheet-piled cellular cofferdam arrangement, with rock fill causeway between the levelled and graded site onshore.

A key reason for siting the MOF along the shoreline of the LNG Facility was to minimise the impact on mangroves and other marine plants. The final location was selected as it required less mangrove clearing and disturbance compared to other locations. It is estimated that approximately 2.5 ha of mangroves will be directly impacted by construction of the MOF.

Placement of notices to mariners and marker buoys to establish a nominal 300 m construction safety zone around the MOF will occur in consultation with the Regional Harbour Master and as required by Maritime Safety Queensland.

A detailed preliminary layout of the proposed MOF is shown below in *Figure 2.13.3.*



Legend

EL 6.000 Elevation in metres (AHD)

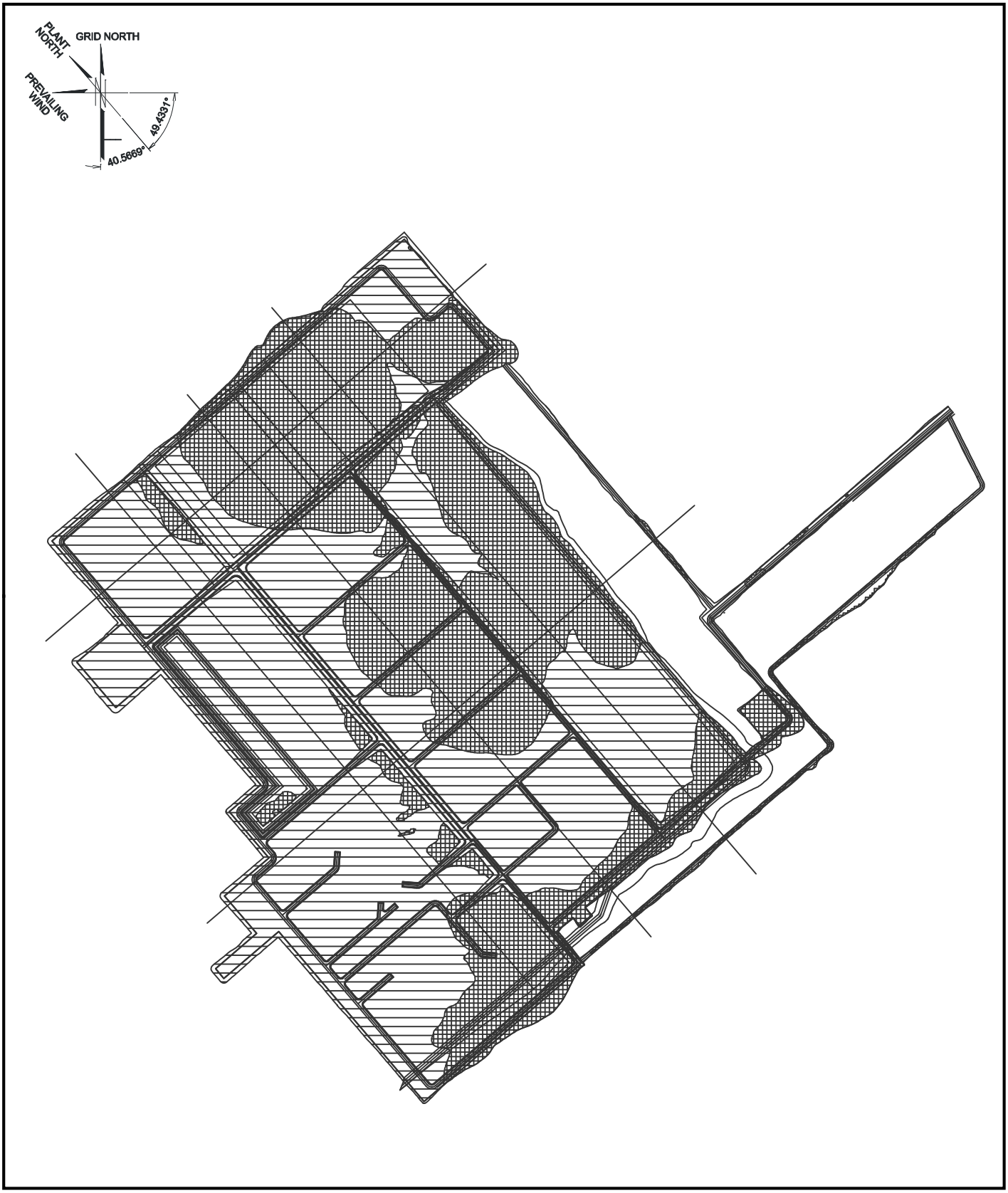
Proposed Site Strip Spoil Placement Areas

Source Note:
Bechtel Preliminary Drawing No CGK-100-00100-Rev 00A

Projection: UTM MGA Zone 56 Datum: GDA 94

0 125 250 500 m

QUEENSLAND CURTIS LNG A BG Group business	Project	Queensland Curtis LNG Project	Title: Preliminary Site Benching Plan
	Client	QGC - A BG Group business	
ERM Environmental Resources Management Australia Pty Ltd	Drawn KP/JB	Volume 2 Figure 2.13.1	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved DS	File No: 0086165b_EIS_LFC_GIS001_F2.13.1	
	Date 08.07.09	Revision 2	



Legend

- Limits of Area Requiring Cut
- Limits of Area Requiring Fill

Source Note:
Bechtel Preliminary Drawing No CGK-100-00002-Rev 00A

Projection: UTM MGA Zone 56 Datum: GDA 94

0 100 200 400 m

QUEENSLAND CURTIS LNG A BG Group business	Project: **Queensland Curtis LNG Project**		Title: **Areas of Cut and Fill - LNG Plant**
	Client: **QGC - A BG Group business**		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: KP	**Volume 2** **Figure 2.13.2**	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: DS	File No: 0086165b_EIS_LFC_GIS002_F2.13.2	
	Date: 07.07.09	Revision: 2	

MOF construction will be undertaken both from onshore and from floating barges and cranes, with sheet piling for the MOF undertaken from piling rigs working off oceangoing equipment. The sheet piled cofferdam will be pumped out upon completion, and the supporting internal steelwork installed. Upon completion, the interior of the steel sheet piled cofferdam will be in-filled with rock materials and compacted in layers.

It is currently anticipated that rock fill material may be sourced from within the LNG Facility boundary, although geotechnical investigations will confirm the suitability of the material.

When rock fills are placed for the causeway approach to the MOF, silt curtains and booms will be used in the marine environment to minimise migration of suspended solids outside the construction area.

Some dredging is anticipated to support the construction of the MOF and to allow use of the MOF. Volumes and management of dredge material associated with MOF construction is discussed with other dredging elements associated with the Project in *Volume 2, Chapter 10,* and *Volume 6.*

The MOF is a key component of Project logistics throughout construction, operations and decommissioning, and will be constructed to recognised state, national and international standards relating to marine facilities. Indicative volumes of cargo to be shipped through the MOF during construction are summarised in *Section 13.7*.

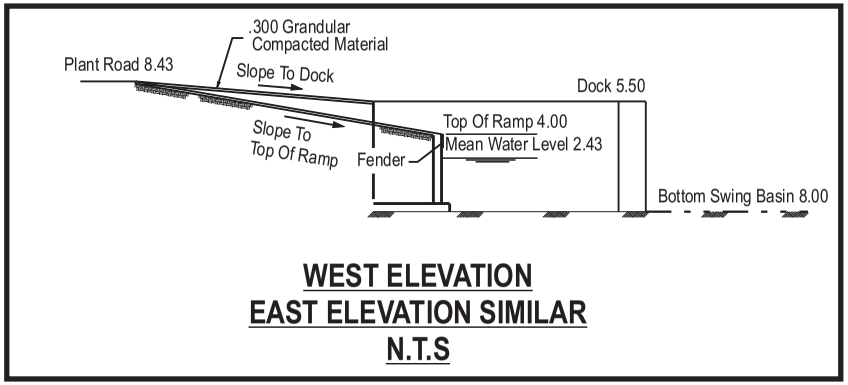
13.1.2.2 Causeway for LNG Jetty

In addition to the works undertaken for MOF construction outlined above, construction of the onshore component of a LNG jetty will commence with construction of an earth and rock causeway extending from the onshore area of the site into the intertidal area. As with the MOF, the location of the jetty has been selected to minimise the amount of mangrove clearing required and marine plant disturbance. It is estimated that up to 0.8 ha of mangroves will be directly impacted by construction of the jetty. The location of the jetty along the foreshore is shown in *Figure 2.13.3.*

13.1.2.3 Onshore Earthworks

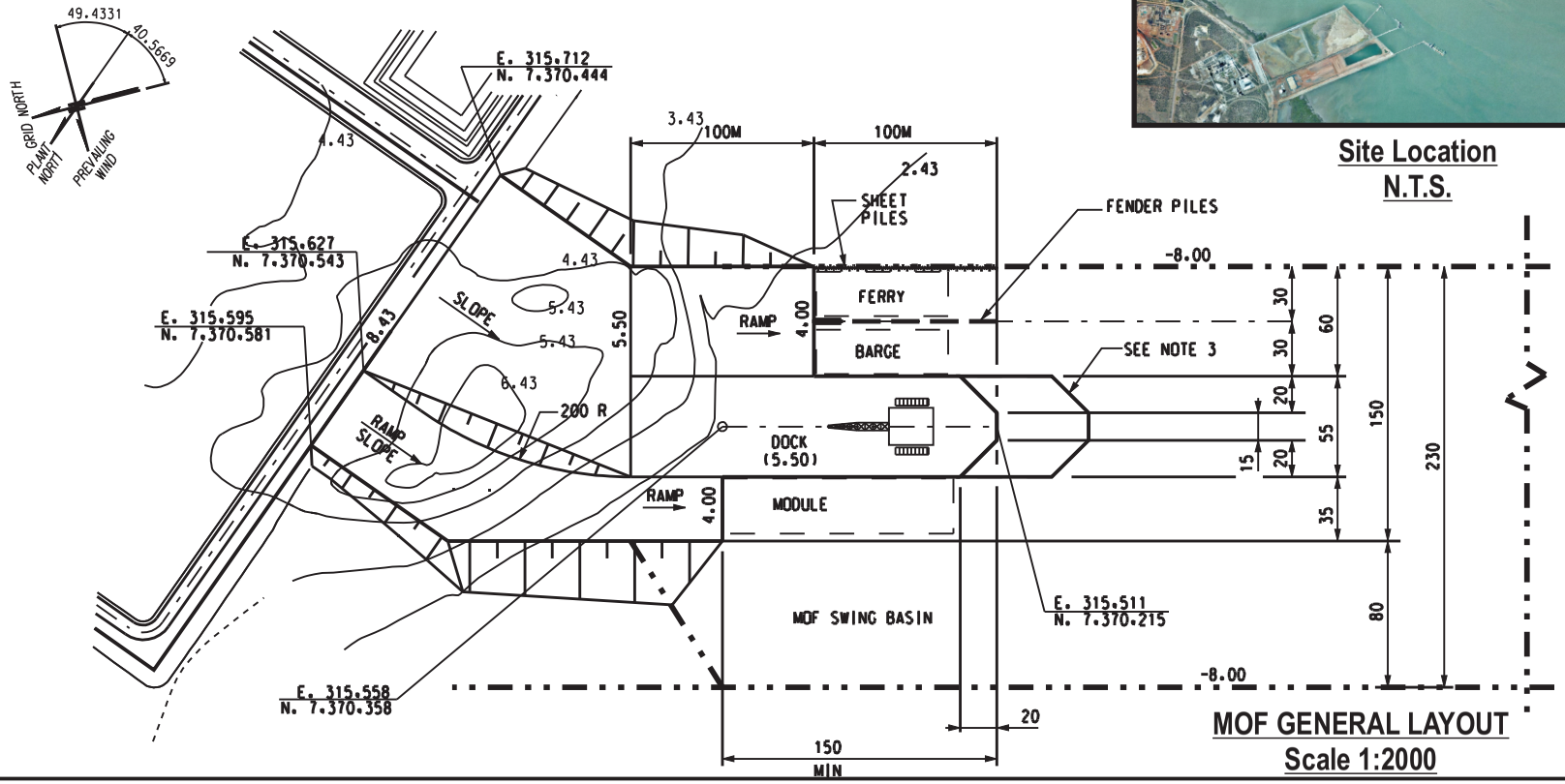
The initial onshore earthworks will primarily involve heavy machinery including excavators, scrapers, graders, compactors, and heavy dump trucks. Control of dust will be undertaken by damping down the site during excavation and haul (refer *Section 13.9* for discussion of water sources proposed).

During the site preparation stage, surface run-off will be controlled using combinations of rock check dams, silt fences, and controlled flows through temporary basins, to ensure that sheet flow run-offs are maximised and sediment carried in suspension is minimised.



WEST ELEVATION
EAST ELEVATION SIMILAR
N.T.S

Site Location
N.T.S.



MOF GENERAL LAYOUT
Scale 1:2000

Notes:
1. All dimensions and elevations are in metres
2. All elevations are in LAT format
3. To be determined for any vessel that will be self-powered and determined from traffic and logistics studies

Source:
Bechtel Drawing No RO-000-00005. Rev A: Marine Offloading Facility, Configuration, Arrangement, Profile, Curtis Island, Australia

Project: Queensland Curtis LNG Project
Client: QGC - A BG Group business
Title: **Indicative Layout of the Materials Offloading Facility**

Drawn: JB | Volume 2 | Figure 2.13.3
Approved: DS | File No: 0086165b_EIS_LFC_CDR002_F2.13.3
Date: 08/07/09 | Revision 2

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Preliminary geotechnical assessment of the site indicates that no major explosive blasting will be required during the site preparation phase. Some minor shock blasting may be required to fracture competent materials for ripping. The location and extent of this has not been finalised as further geotechnical assessment is required.

Towards the completion of Stage 1, the following activities will be undertaken:

- installation of temporary power generation and associated fuel storage and bunding systems, involving setting of mechanical equipment, installation and testing of piping and cabling
- construction of internal site access roads
- a full temporary drainage system will be established, consisting of a system of interconnected drains and sedimentation basins to retain water for re-use during future construction operations and to contain run off and sedimentation
- installation of reverse osmosis plant (for water supply – refer *Section 13.9* for detail) including the routing of the intake and discharge piping locations
- installation of temporary sewage treatment system (refer *Section 13.11*)
- installation of a water distribution network, and power distribution networks throughout the site, which will be for the most part underground, buried and protected
- erection of the on-site temporary concrete batching plant, tied into the established temporary water and power, and haul in and stockpiling of the raw materials to commence Stage 2 (primarily aggregates, cements and concrete admixtures)
- erection of the temporary buildings and ancillary structures (site offices, temporary warehouse, tool rooms, crib houses and welfare facilities for the workforce, plus lighting, communications etc), and commencement of construction of the on site construction camp (refer to *Section 13.3* of this Chapter for further detail)
- mobilisation of the first major construction equipment (including mobile cranes, flat bed trucks, excavators, scaffolding, materials handling equipment and hand tools).

Diesel and other fuel equipment operation and power generation (once installed), cement and reinforcing steel, waste management, food and dry goods, etc for this stage will be sourced from local Gladstone suppliers.

These provisions will be delivered to site by barge or ferries for the duration of the construction phase. Refer to *Section 13.7* of this Chapter for further detail.

13.1.2.4 Management of Cleared Vegetation

Preliminary planning for management of vegetation cleared from across the site involves the following:

- Leaves, branches and small timber will be mulched or chipped on site and, where appropriate, used for site stabilisation and erosion control. The site will be progressively rehabilitated and mulch will be used for progressive

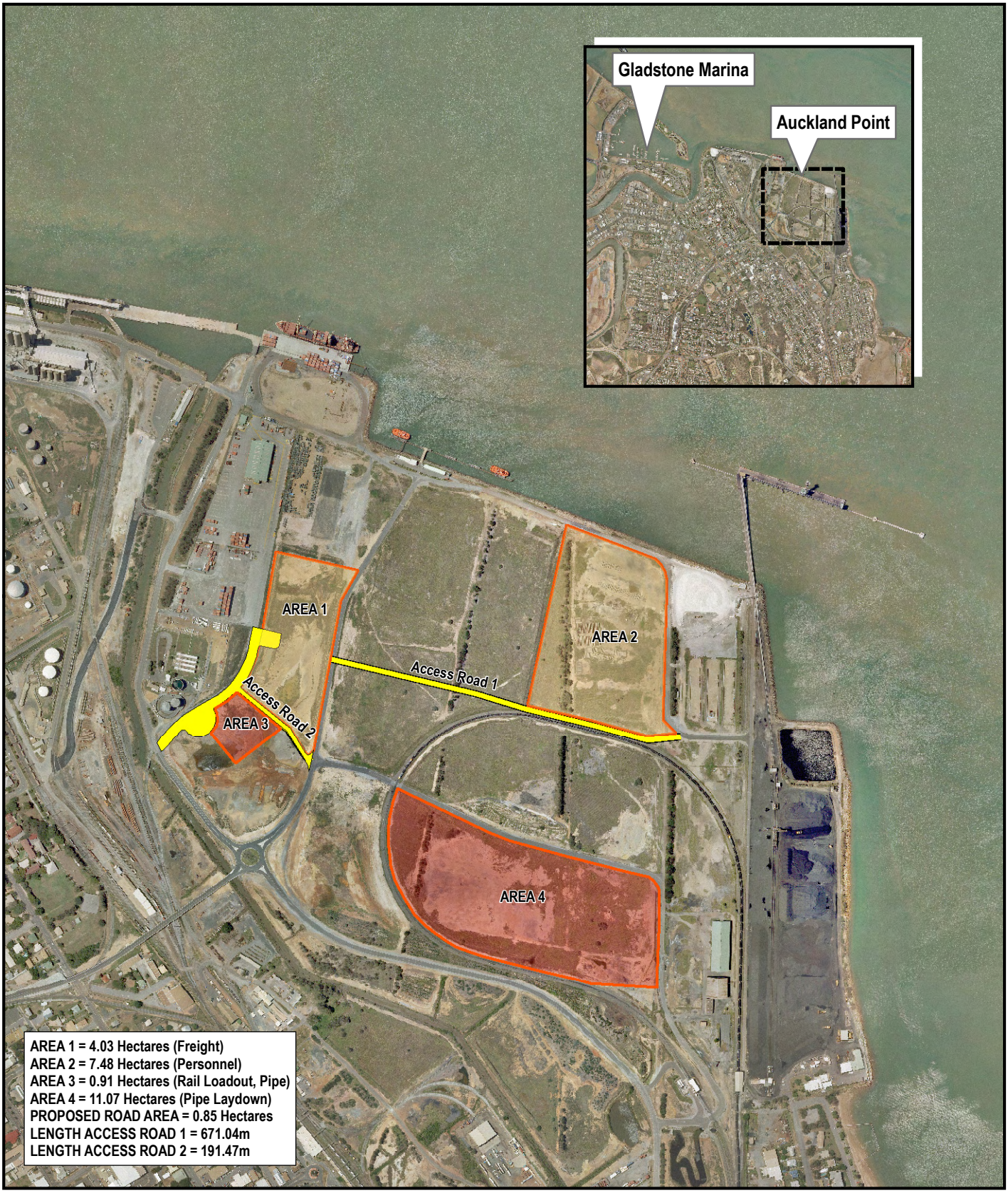
landscaping/re-planting (where appropriate). Any excess mulch will be placed in the spoil disposal areas.

- Merchantable timber may be made available to the local Gladstone community where there is a feasible volumetric request. After clearing and grubbing, the selected logged timber will be loaded on to trucks and shipped across from Curtis Island to the mainland on ferries via Auckland Point (refer *Figure 2.13.4* and below). This will only occur on an as-needed or demand basis. Minimal stockpiling will occur at Auckland Point in order to avoid double handling.
- Timber which is unsuitable for milling or which exceeds the local capacity for timber use will be disposed of at the municipal waste disposal facility as green waste for mulching. This will be subject to agreement on volumes, costs associated with hauling, handling and with any landfill operators, and on capacity being available within the Curtis Island soil disposal areas (within the LNG Facility boundary) where this material could also be handled.

This approach forms the basis of the current assessment outlined in this EIS. Refinement of this approach is ongoing, and additional options for management and disposal continue to be assessed. These options are focussed on reducing the potential impact on Gladstone municipal infrastructure arising from transport and disposal of timber from the site, and include the following:

- clearing, grubbing and shredding of timber and co-disposal with site strip material in the spoil disposal areas
- clearing, grubbing and possibly controlled burning of felled timber on site followed by disposal of the ash mixed in the soil stockpile and disposal areas on site
- combination of moving merchantable timber back to Gladstone on an on-demand basis, combined with burning, mulching and shredding of the balance of the materials.

These options will be assessed in more detail during the Project Front-End Engineering and Design (FEED) stage based upon understanding of the community interest in the available materials, and the associated cost, schedule and risks of large scale logging movements over water.



Legend

- Plant and Trans-shipment of Personnel Holding Area
- Pipe Laydown Area
- Proposed Road

Source Note:
Aerial Photo - Department of Infrastructure and Planning for QCLNG Project

Projection: UTM MGA Zone 56 Datum: GDA 94

0 75 150 300 m

N

QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: Auckland Point Logistics Site Layout
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JB	Volume 2 Figure 2.13.4	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: GB	File No: 0086165b_EIS_LFC_GIS004_F2.13.4	
	Date: 07.07.09	Revision: 5	

13.1.3 Stage 2 – Civil Work, Foundations and Structures: Month 12 to Month 20

13.1.3.1 Onshore Facilities

Foundation construction for the permanent plant at the LNG Facility will commence with the LNG storage tanks. This will involve excavation and dewatering (as required) of the area to the designed formation level (and management of any acid sulphate soils (ASS), as discussed in *Volume 5, Chapter 4*), and the placement of a reinforced concrete base. Within the processing facility areas, construction of the reinforced foundations for the compressors, pipe racks and other major equipment will commence.

Further foundation construction will be undertaken throughout the site for the interconnecting pipe racks, buildings, structures and supporting equipment which are located outside of the main processing areas. These are smaller than the major components discussed above.

Concrete will be batched within the batching plant on Curtis Island within the LNG Facility site boundary and delivered to the work areas using agitator trucks. A combination of concrete pumps and skips suspended from mobile cranes will be used for placement of concrete.

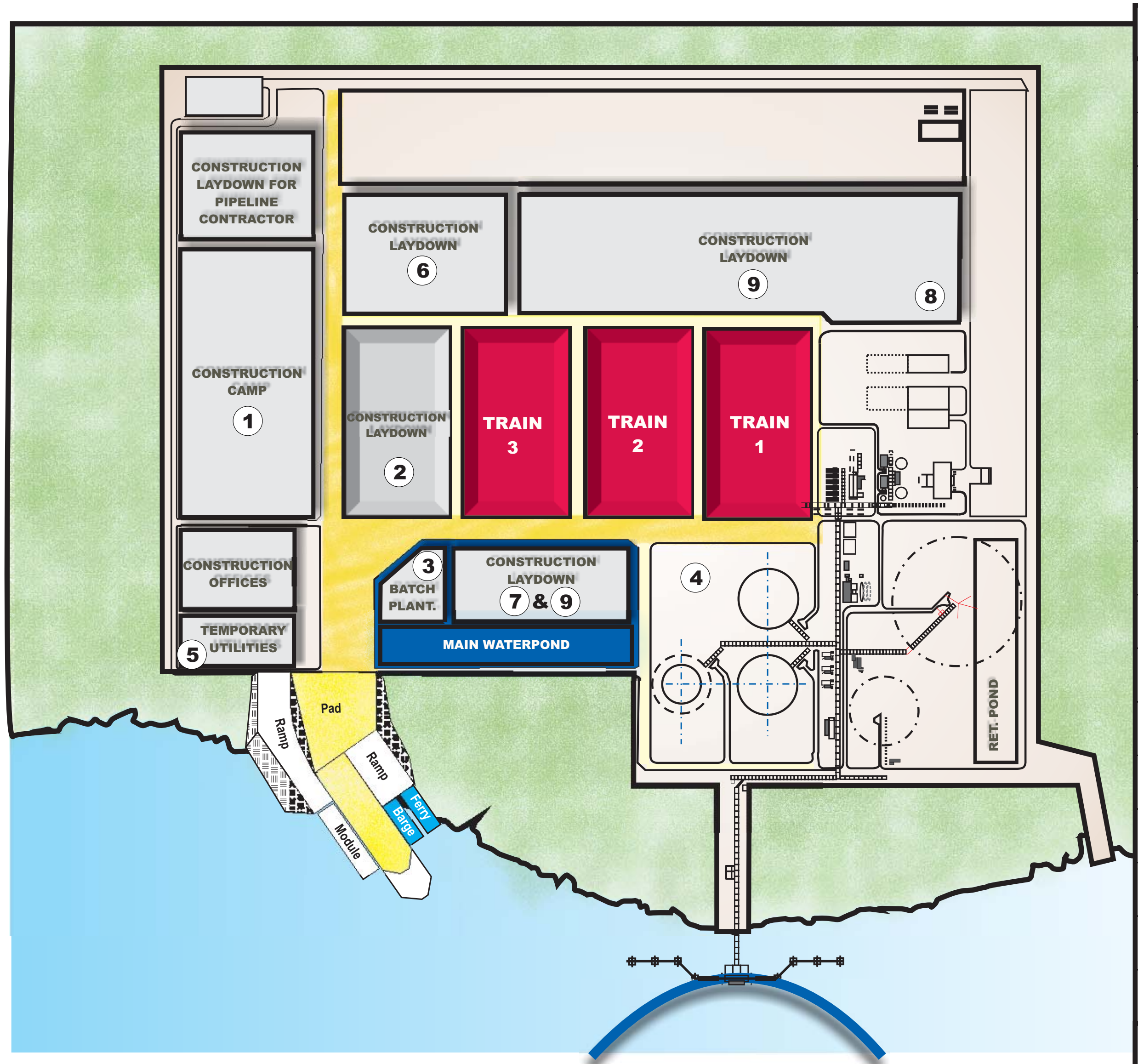
Throughout the processing facility areas, underground piping and containment vessels for drainage will be constructed. Duct banks for underground power and control cables, will also be constructed, installed and tested.

Once the underground and foundation scope of works is largely completed, a final grade will be conducted to allow for a safe, flat and stable work area to allow for the above ground mechanical installation works.

As with all foundation construction, excavation will make significant use of mechanised equipment such as excavators, Bobcats, dump trucks and walk-behind compaction equipment. Final trim at formation level may involve some hand work, but this is anticipated to be relatively limited.

To the maximum extent possible, the materials that arise from excavation works will be re-used as backfill upon completion. However, given that some excavated ground will be replaced by concrete, there will be some surplus of materials. These materials will be stockpiled within the site for re-use as grading materials, and only upon completion of all excavation works will any final surplus be disposed of within the site boundary. Disposal areas for site strip and grub materials will be progressively stabilised and revegetated.

An indicative site layout for Stage 2 construction phase and beyond is provided in *Figure 2.13.5.*



AREA	DESCRIPTION	Approx. Size (m^2)
1	Construction Camp	180,000
	Area allocated - 300m x 600m	
2	Gas train construction laydown and handling	122,500
	Area allocated - 350m x 650m	
3	Batching plant and aggregate storage	10,000
	Area allocated - 100m x 100m including silos, stockpiles, washdown, etc.	
4	Tank subcontractor laydown and office area	70,000
	Area allocated - 350m x 200m	
5	Temporary utilities, incl. desalination, water and waste water treatment, power generation for camp	17,500
	Area allocated - 70m x 250m	
6	Bechtel warehouse, climate controlled storage and controlled laydown	37,500
	Area allocated - 150m x 250m	
7	Marine subcontractor laydown and office area	14,000
	Area allocated - 70m x 200m	
8	Buildings subcontractor laydown	12,000
	Area allocated - 80m x 150m	
9	Miscellaneous shake-out area	As needed
Approximate TOTAL		500,000

Source:
Figure Adapted from Bechtel Oil, Gas and Chemicals, Inc. 2008 and 2009.
Queensland Curtis LNG Project:
CTR #47.2 – SITE LOGISTICS STUDY – PART 2
(Rev 002 issued 9 Feb 2009). Unpublished report.
Bechtel document number G0R-1T00-00007

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Project: Queensland Curtis LNG Project
Client: QGC - A BG Group business
Drawn: JB | Volume 2 | Figure 2.13.5
Approved: DS | File No: 0086165b_EIS_LFO_CDR001_F2.13.5
Date: 08/07/09 | Revision: 2

Title: **Indicative Site Layout during & beyond Stage 2 Construction**

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13.1.3.2 Key Activities

Concrete Batching

Significant quantities of raw materials for concrete will need to be hauled to the Curtis Island site for the duration of Stages 1 and 2 of construction and continuing into Stage 3. Aggregates and cements will be sourced from local suppliers on the mainland and transported to Curtis Island using dumb barges and tug boats, or using bulk road trucks transported on barges.

It is anticipated that cement will be sourced from within the Gladstone region and transported to site by truck on vehicular ferries via Auckland Point. Over the course of construction (all Stages) approximately 130,000 m^3 of permanent plant concrete and an additional 10,000 m^3 of concrete for temporary works will be required. This will require the following approximate quantities of raw materials:

- 42,000 tonnes of cement
- 110,000 tonnes of sand
- 160,000 tonnes of aggregate.

A concrete batching plant will be commissioned and built for the construction works. The plant that will meet the following performance criteria:

- all waters including waters from batching and wash down waters where possible, will be recycled through the plant
- all batching of raw materials must be done in a closed system to prevent emissions to the atmosphere prior to batching water being introduced

Sealed silos for cement and fly-ash storage will be provided for storage of cement bulks, with aggregates and sands stored in open stockpiles.

Bulk Materials and Aggregate

In addition to the cement, sand and aggregate required for concrete batching, additional aggregate and rock materials are required for:

- final grading
- temporary gravel for access roads, working pads and sheeting
- road sub base and base materials
- marine coastal armour and scour protection.

An indicative summary of cement, sand, aggregate and other bulk earth and rock materials required for all Stages of construction is provided in *Table* 2.13.1 below, although these are likely to vary subject to ongoing geotechnical investigation and refinement of detailed Facility design.

Table 2.13.1 Indicative Volumes of Cement and Aggregates for Construction

	Material	Tonnes
Materials for concrete batching	Cement	42,000
	Sand	110,000
	Aggregate	160,000
Other bulk materials and aggregate requirements	Final Grading	60,000
	Temporary Gravel for pads & sheeting	20,000
	Road Sub base	20,000
	MOF and scour protection	450,000

Bulk aggregates will be offloaded at Curtis Island into trucks at the rock dock. Where materials are transported by truck on vessels, these will also be handled through the rock dock. The storage and incoming delivery rates of raw materials will be related to the usage requirements at the construction site with the aim of ensuring that delivery frequencies and stockpiles are maintained to levels to support construction activities.

Aggregates and other bulk materials may be transported to Curtis Island by barge to minimise transit of these materials through Gladstone City. The specifications of the materials required are being aligned with locally available materials required for the construction works, at which time sourcing of these materials will be finalised. Transport and logistics assessments have currently assumed minimal transport of aggregate through Gladstone, but this assumption will be subject to variation following final determination of aggregate source.

Preliminary logistics associated with the transport of these materials to the site by barge and ferry movements is discussed in further detail in *Section 13.7*.

13.1.3.3 Marine Facilities

The construction of the permanent marine facility (LNG jetty) for the export of LNG cargo will commence along with the civil and concrete installation program. Construction of the jetty will involve the installation of tubular section piled foundations, driven using floating marine diesel powered hammers to secure the piles in bedrock and onshore equipment working through the intertidal areas.

This facility, called the trestle (when it is combined with the topside piping, steel and cable), will extend from the causeway (established during Stage 1) to the jetty head. The piled foundations will extend into the coastal zone with established mangrove growth (minimising the causeway footprint through the

mangrove line), such that upon construction completion, the mangroves will be allowed to re-establish.

The piled foundations for the trestle will extend from the shoreline approximately 160 m west into the channel, towards the jetty head. Upon completion of the installation and testing of the piles, concrete pile caps will be cast over the water, from temporary deck structures supported off the installed piles. The concrete will be delivered from the onsite batching plant, using conventional mixing trucks working from flat barges. The concrete will be pumped into place, also making use of skips where pumps cannot easily access.

Dredging works associated with construction of the swing basin and channel also form part of the construction of the marine facilities, and will be undertaken largely concurrently with construction of the jetty. Discussion of the required dredging activities is provided in *Volume 2, Chapter 10* and *Volume 6*.

Jetty construction (and operations) will be undertaken in accordance with applicable industry standards as referenced in *Table 2.13.2* below.

Table 2.13.2 Industry Standards Applicable to Construction of Marine Facilities

Organisation	Applicable Standard/Guidelines
International Maritime Organization (IMO)	International Convention for the Prevention of Pollution from Ships (MARPOL). Latest edition with amendments and MEPC resolutions. International Ship & Port Facility Security (ISPS) Code and SOLAS Amendments 2002, 2003 Edition.
British Standards Institution	British Standard Code of Practice for Marine Structures (BS 6349) – Parts 1-6. Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations (BS EN:1473).
Society of International Gas Tankers and Terminal Operators, Ltd (SIGTTO)	Site Selection and Design for LNG Ports and Jetties, Information Paper No. 14. Guidelines for Ship to Shore Access for Gas Carriers. LNG Operations in Port Areas.
Oil Companies International Marine Forum (OCIMF)	International Safety Guide for Oil Tankers & Terminals (ISGOTT) (with International Chamber of Shipping and International Association of Ports and Harbours) Prediction of Wind Loads on Large Liquefied Gas Carriers (with SIGTTO) Prediction of Wind and Current Loads on VLCCs. Mooring Equipment Guidelines. Guidelines and Recommendations for the Safe Mooring of Large Ships at Piers and Sea Islands.

Organisation	Applicable Standard/Guidelines
	Safety Guide for Terminal Handling Ships Carrying Liquefied Gases in Bulk.
Permanent International Association of Navigation Congresses (PIANC)	Guidelines for the Design of Fender Systems. Joint PIANC-IAPH Report on Approach Channels, A Guide for Design (Vol 1&2). Beneficial Uses of Dredged Material – A Practical Guide.
National Fire Protection Association (NFPA):	NFPA 59A, Production, Storage and Handling of Liquefied Natural Gas (LNG). NFPA 307, Construction and Fire Protection of Marine Terminals, Piers, and Wharves.

13.1.4 *Stage 3 – Mechanical and Electrical Installation and Testing – Month 20 to Month 40*

Major deliveries of equipment and materials for the mechanical installation, will commence when the MOF and temporary facilities are available to receive these items. Deliveries are anticipated and planned within the overall construction program to coincide with the planned delivery of commodities purchased from both global and local suppliers.

Deliveries will include structural steel, mechanical equipment, electrical equipment, piping materials, plus all other consumable materials that are used during construction of a major project. Deliveries of materials will be by ferry, barge or direct charter vessels; with offloading handled through a combination of self-lift capability from vessels' cranes, roll-on roll-off or by suitably rated cranes located on the wharf.

Where materials are delivered earlier than needed for installation, or in batches, these will be staged, inspected and stored within designated materials handling areas. These areas will be a combination of open, covered and climate controlled, appropriately sized for the planned materials deliveries and storage durations.

Mechanical installation will involve the erection of structural steel and the setting of the first primary pieces of major mechanical and electrical equipment on foundation anchor bolts. Structural steel erection and equipment setting will involve using mobile cranes which will lift equipment into prepared foundations from either flat bed trucks or Self Propelled Mobile Transporters (SPMT).

However, some larger pieces of equipment, including the absorber and regenerator columns within the main processing facilities will involve major engineered lifts involving multiple cranes, equipment, skilled personnel and specialised supervision.

While the steel is being erected, pipe spools and straight-run pipe will be installed and welded. Cabling to distribute electrical power, control systems and safety shutdown systems, will also be routed in cable trays supported from the same structural steel.

Once mechanical installation is significantly advanced, major modules (as summarised in *Section 13.7*) will arrive from local and global suppliers. These modules are major pieces of pre-fabricated, pre-assembled and tested equipment supplied from specialised companies sourced for their specific technical excellence in process plants and code stamped piping/equipment.

These modules range from approximately 500 tonnes up to 2,000 tonnes and will be delivered to the MOF on ocean-going barges which will either be self-powered or pulled by tractor tugs. Approximately 20 to 25 deliveries of these modules are anticipated throughout the construction schedule. As these modules enter into the Port of Gladstone, the tug/barge masters will be under the control and direction of the Harbour Master and the Pilots of the Gladstone Ports Corporation (GPC).

Where cargos are imported into Australia from international suppliers, quarantine and customs inspection will be required. This is described in further detail in *Section 13.7*.

The modules will arrive at the MOF, and will be largely unloaded using roll-on roll-off methods using SPMTs. It is intended that deliveries will be timed such that the major pieces of equipment can be rolled off the delivery barge and driven directly to their foundations without intermediate storage or handling.

The modules will involve major pipe racks and associated mechanical equipment, refrigeration gas compressors, major heat exchangers, piping from the LNG storage tanks and the jetty topsides. The jetty topsides are the unique item amongst the modules, in that they will not be handled from the land, but will be delivered directly to the LNG jetty site and lifted into position using cranes mounted off barges and floating on the water.

With the Modules set in place, and the equipment that is effectively "standalone" set on foundation, the task of interconnecting all of these components will commence. This will involve installation of the remaining pipe spools, structural steel, power and instrumentation cables between all equipment and modules. This will advance the installation of individual components into completed systems ready for integrity testing and commissioning activities. Equipment engaged in this work will involve mobile cranes working from elevated mobile platforms and scaffolding.

13.1.5 Stage 4 – Systems Integrity Testing – Month 30 to Month 45

When the installation work is completed, all of the mechanical, electrical and control systems will be tested for integrity. For the piping systems, the testing will involve a combination of water, air and inert gas testing using helium and nitrogen.

Any water used will be sourced from the retention basins on site with make-up water sourced from water produced from a reverse osmosis plant. Upon completion of testing, the water will be returned through the site drainage system.

Electrical inspection and testing will be conducted and involves the functional checking of the power generation equipment and distribution systems, cabling, instrumentation and safety shutdown systems responsible for the automated plant control.

13.1.6 Energisation and Introduction of Hydrocarbons – Month 35 to Month 55

Upon satisfactory completion and testing of the mechanical, electrical and control systems, the completed LNG plant is handed over to the Commissioning and Start-Up team. This team is responsible for preparations and introduction of energy sources (specifically power and hydrocarbons) to commence the initial operation, safety checks and plant testing.

This phase will include pre-commissioning, commissioning and plant start-up which for the purposes of the QCLNG Project have been defined as described below.

Pre-commissioning works will include checks, cleaning and tests required to ensure that permanent equipment and build materials have been installed and are ready for commissioning. The typical pre-commissioning activities include cold function checks for instruments, circulation of non-process fluids for cleaning of vessels and piping systems, installation of the orifice plates, loading the first fill, nitrogen purging, leak testing, inerting of the completed systems.

Following pre-commissioning works, **LNG Plant commissioning** will be undertaken involving verification of the functional operability of the elements/sub elements within a system through a structured program of calibration, testing and certification to ensure the equipment/system/sub system has been completed and is ready for introduction of Process/Commissioning fluids and/or power up of equipment.

During the commissioning stage it is verified that facilities can be started and will operate within the design parameters and specifications. Commissioning will involve operating the equipment at a sub-system level and then at a system level to prove readiness for handover and subsequent start up.

Start-up involves the introduction of process fluids/hydrocarbons into the facilities to manufacture product (LNG) according to specifications, design parameters, design volumes and design availability. Start up is done after completion of the pre-commissioning and commissioning activities and once all tests on completion are performed. It is performed to prove that the facilities are complete and ready to receive hydrocarbons and other process fluids to manufacture product. All governance requirements are to be met at this stage.

It will also be necessary to provide appropriate training to operations personnel. In summary, this Stage involves:

- pre-commissioning and testing, involving alignment and clearance checks on the mechanical equipment, electrical testing and instrumentation and loop checks
- service and process commissioning, involving ordering and testing of plant and equipment including hydrotests and nitrogen gas tests through the process system
- training of operations personnel involving site induction, occupational health and safety training and operational, maintenance and emergency procedures training.

Nitrogen will be used to inert the process plant pipework prior to commencement of the cool-down process for the LNG systems. Plant pipework is dried using hot dry dew-pointed process gas.

During start-up of a LNG processing unit or "train, it will be necessary to flare gas at certain points in the process to ensure the gas specifications are met at all points in the facility. A description of flaring is provided in *Volume 5 Chapter 9*.

The liquefaction units will be cooled to operating temperature and LNG will begin to be produced and stored in LNG storage tanks. The rate of production will be slowly increased until first cargo.

13.2 CONSTRUCTION WORKFORCE

13.2.1 Workforce Numbers

13.2.1.1 Construction Labour Force (Stages 1 to 4)

While there may be some minor staggering of shifts, in general shifts will commence no earlier than 6 am and be complete no later than 6 pm. Minimal night time works are anticipated, although night works may be required for short periods (indicatively three to four weeks) for slip forming tanks and for other uninterruptible activities or where schedule adjustment is required (e.g. due to adverse weather).

Construction labour will be made up of craft personnel involved with direct and indirect work activities. These craft will be employed by the Engineering, Procurement and Construction (EPC) Contractor and through selected specialty subcontractors for specific identified work scopes (LNG storage tanks, marine facilities, site preparation etc.). However, the entire workforce will be under the day-to-day direction of the Engineering, Procurement and Construction (EPC) Contractor.

Direct activities are those where craft personnel are engaged with the installation and testing of the permanent plant facilities such as pipe fitters, concrete finishers, steel erectors, millwrights. Indirect activities are those where the craft personnel are involved in supporting services required to facilitate a construction operation such as temporary works, clean up, housekeeping, equipment maintenance, welfare facility maintenance, warehousing and materials storage. Peak numbers for direct and indirect craft personnel for the two-train facility are approximately 1,200, with up to a further 300 craft supporting indirect work. A breakdown of the workforce by discipline over the construction phase is depicted in *Figure 2.13.6.*

Construction supervision (field non-manual personnel) will be provided through a combination of field engineers, supervisors, superintendents and site management. With the planned craft manpower peaks, approximately 200 construction supervisors will be engaged at peak in direction of the craft workforce for a total peak construction workforce (craft and field non-manual personnel) of approximately 1500 personnel (plus additional craft supporting indirect work and other QGC supervisory and personnel).

13.2.1.2 Commissioning Labour Force (Stages 5)

Approximately 150 personnel will be involved with the commissioning effort, once the plant has been constructed, inspected and tested, and prior to the introduction of energy sources, specifically electrical energy and hydrocarbons. These personnel will be made up of skilled technicians and supervisors, specialising in these operations.

13.2.2 Workforce Source

As far as practical, the construction workforce for the LNG Component will be sourced from Gladstone City and the surrounding region. Additional craft personnel that cannot be sourced from the Gladstone region will be sourced from elsewhere within Australia or internationally. Assumptions about hiring personnel from the local labour pool, and proposed accommodation options, are outlined below. However, assumptions may be subject to significant variation due to local labour market conditions, and will depend in large part on whether other major construction projects are underway concurrent with QCLNG Project construction works.

In general it is intended that the construction workforce will be housed as follows:

- Approximately 1,050 local craft and field-non manual personnel will live at their current residences in Gladstone City or surrounding region and commute to Curtis Island daily out of Auckland Point, subject to local labour market availability.
- Up to 450 non-local craft personnel will be accommodated in the purpose-built construction camp (capacity up to 1,200 personnel, dependant upon the degree to which local labour can be utilised) to be built within the LNG

Facility footprint on Curtis Island. Early in the construction phase (prior to construction of the Curtis Island construction camp) some of these personnel will be accommodated in mainland hotels and rental accommodation up to a level that does not place stress on local short-term accommodation supply and while a construction camp is being constructed (indicatively 200 non-local persons – refer Volume 8, Chapter 6 for further detail). These persons will commute to and from the project site daily along with local Gladstone personnel. However, further employment of non-local personnel above this level will trigger the accommodation of non-local personnel in the proposed island camp. It is anticipated that these non-local personnel will return to Gladstone City or beyond on weekends.

- Non-local field non-manual (FNM) personnel will be housed largely within the Gladstone region commuting to Curtis Island daily out of Auckland Point.

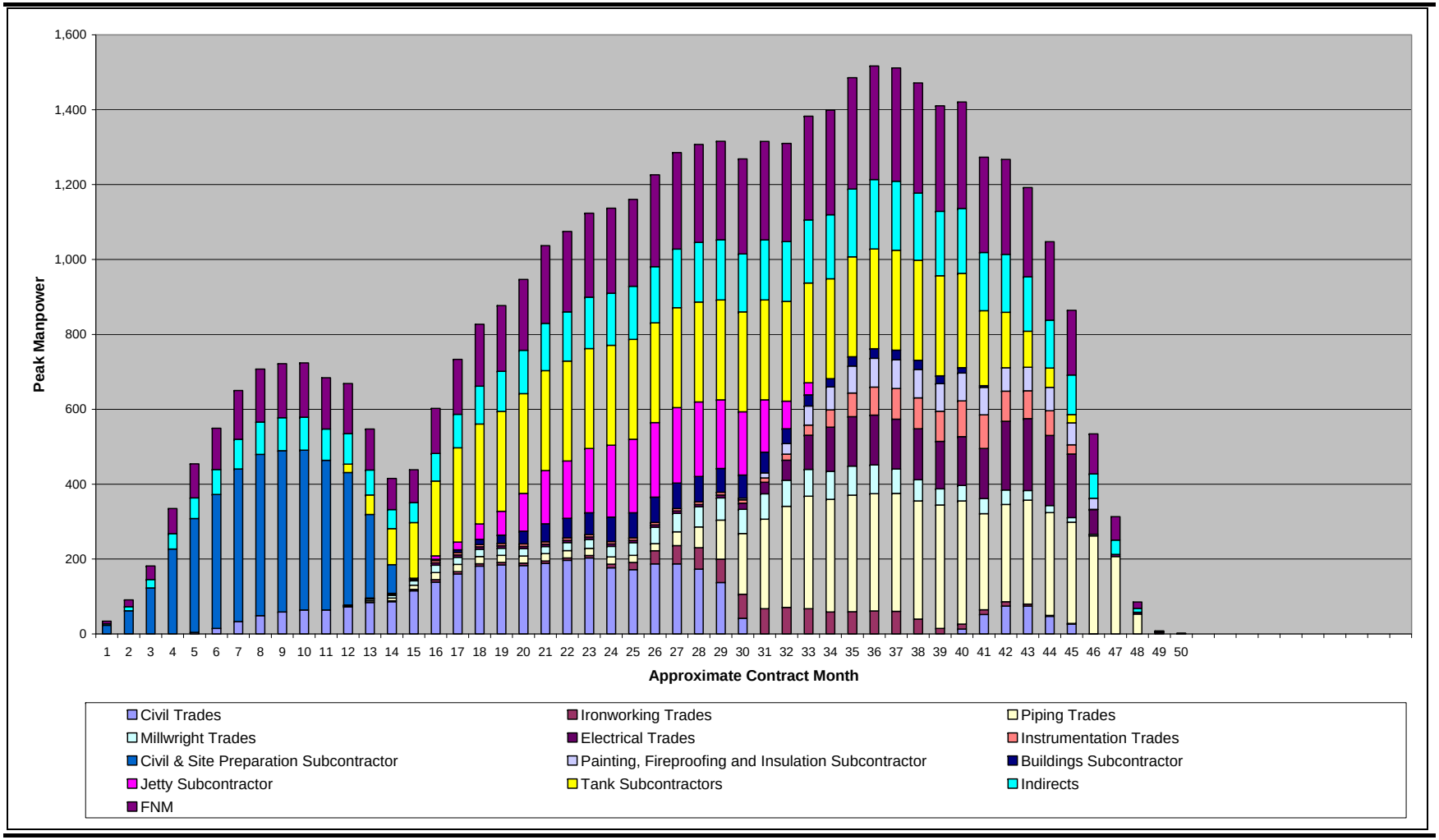
Further details of accommodation for the construction workforce on Curtis Island are provided in *Section 13.6.*. Details of transport requirements to and from site are provided in *Section 13.7* and in *Volume 5, Chapter 14.* Assessment of housing availability in the Gladstone region is provided in *Volume 8, Part A*.

13.3 MATERIAL AND EQUIPMENT REQUIREMENTS & FABRICATION DETAILS

The site development activities on Curtis Island will include mobilisation of heavy earth-moving equipment, anticipated to include but not be limited to the following:

- bulldozers (anticipated Caterpillar D8 minimum due to rock ripping)
- motor graders (Caterpillar 160 or equivalent)
- heavy rollers (Caterpillar 825 and Caterpillar CS76 or equivalent)
- excavators (Caterpillar 325 or equivalent)
- front-end loaders (Caterpillar 966 or equivalent)
- dump trucks (20-30 tonne haul capacity)
- sheet pile drivers
- concrete batching plant
- temporary fencing materials
- bulk aggregates for concrete
- steel sheet piles and whaler beams
- marine equipment for furnishing MOF and LNG jetty.

Figure 2.13.6 Total Construction Manpower Breakdown by Disciplines



Construction warehousing on site will be provided for storage of materials and equipment that is sensitive to exposure to the elements. The following are indicative of the construction warehousing planned:

- a main warehouse (including an area of climate controlled storage)
- tool shop
- paint and hazardous materials storage.
- Three classes of material storage will be required:
- Class I Storage – Outdoors and Open Air
- Class II Storage – Indoors and Not Climate Controlled
- Class III Storage – Indoors and Climate Controlled.

An indicative summary of Class II and III storage areas is provided in *Table 2.13.3*.

Table 2.13.3 Indicative Class II and III Storage Areas for Construction

Commodity	Class II Storage (Warehouse) m^2	Class III Storage (Climate Controlled) m^2
Civil	283	0
Structural steel	143	0
Piping and commodities	352	0
Major equipment	435	0
Modules	0	0
Electrical equipment	253	0
Instrumentation bulks	64	18
Electrical bulks	0	0
Refractory, insulation and paint	150	0
Temporary facilities and distributable	562	0
Totals	2,242	18

The following factors will be taken into account in the detailed sizing, layout, and design of construction warehouses:

- space for general storage, unpacking and sorting of all warehoused materials
- office space to accommodate buyers, clerks and warehouse workers (these personnel feature among the field non-manual staffing, but are not necessarily accommodated within the main site office facilities)
- additional space for bin storage, general storage and locked storage area for instruments, (calibration area if required), piping and electrical materials
- warehousing space for temporary materials, construction tools and equipment
- whenever possible, construct permanent facility warehouses during the initial phases of the project and use these warehouse facilities as construction warehouses

- fire resistant construction materials for warehouse construction and design the facility with the fire suppression facilities required by *Building Code of Australia* and the *Queensland Building Act 1975* and *Building Regulation 2003*
- an unloading dock in warehouses whenever practical
- ventilation
- tool rooms as close as practical to the work site, sized to accommodate the number of craft served
- storage of flammable materials such as paints, oils, gases and hazardous materials will meet safety and regulatory requirements
- smoke or heat detectors will be incorporated in the design of the buildings and tied to an alarm system
- all buildings will contain an adequate number of the appropriate type of fire extinguishers to extinguish or delay the spread of fire
- open storage areas for crated or cardboard boxed materials will be protected by fire hydrants. A fire hydrant will be located within 15 m of each warehouse or office building
- adequate site drainage around storage areas and warehouses. Shallow ditches will be used to allow crossing by equipment, or storage areas kept narrow to allow servicing with a crane from the roadway
- paved areas for material lay down, wherever practical
- access to warehouses and lay-down areas during all working hours
- warehouses and lay-down areas to be as close as practical to work site to reduce man hours and transportation of equipment.

13.3.1 On-site Fabrication

On-site fabrication will in general be kept to a minimum, but a few small facilities will be required to handle minor fabrication. These will typically include an allowance for the following:

- carpenters/joiners working area for civil construction activities
- rebar bending shop for minor reinforcement work that is not delivered to the site pre-bent
- small bore pipe fabrication shop
- pipe supports/minor steel structures fabrication shop.

On-site equipment maintenance and parking area will also be provided. This will typically consist of an open area for parking equipment when it is not in use on the Project, or is awaiting maintenance/repair. A covered equipment maintenance shop will also be provided, which will house the equipment superintendent and the maintenance teams who are responsible for care of the construction equipment fleet.

The preliminary concept for these structures is an array of steel shipping containers modified as required to function as offices or workshops, with a spanning sheet metal roof structure with clearance to allow for access of the equipment that could routinely require indoor maintenance. A concrete grade slab with drainage will be provided to facilitate safe wash-down of spills to a

central sump.

13.3.2 Fuel Storage

Diesel will be stored on site in bunded above-ground, double-containment. Total capacity will be approximately 2,000 m^3 with storage compliant with API 650 (American Petroleum Institute standard for Welded Steel Tanks for Oil Storage) and AS-1940 (Australian Standard for the Storage and Handling of Flammable and Combustible Liquids).

13.3.3 On-site Blasting and Painting Facilities

The majority of steel that is procured in the field for use as minor supports will be provided from the supplier painted and/or galvanized. However, modification and minor fabrication works will take place at the site, requiring preparation of the base metal, and application of a compatible primer. This will be undertaken in a small paint booth or booths specifically designed for containment of blast media and management of resulting odours and chemicals.

A small blast facility may also be installed within a minor steel structure covered with either a fire retardant material, or sheet metal, with an air compressor and drier system provided for small handheld appliances. This entire facility would be anticipated to be approximately 100 m^2.

13.3.3.1 *Concrete Batching Plant*

The LNG storage tanks are anticipated to place the largest demand on single and continuous operation of the batching plant facility and drive the anticipated production rate requirement.

Forecast demand for concrete indicates that delivery and unloading of one barge of each aggregate type will be required every one to two days throughout the peak concrete production. This assumption has been carried through into the development of the program for delivery of aggregates over water to Curtis Island.

Minimal delivery of aggregate by road transport via Auckland Point is currently anticipated, with bulk delivery anticipated using coastal barges sourcing aggregate from outside the Port of Gladstone.

13.3.3.2 *On-site Laboratories*

The following temporary laboratories will be provided with facilities established onsite:

- non-destructive examination (NDE): This laboratory will consist of a facility to process and read images of completed welding taken in the field. The use of new digital technologies will be reviewed for applicability to the Project which may alter the configuration and use of this facility
- concrete, soils and reinforcement testing.

These facilities are typically housed within modified 40-foot steel shipping containers and are to be accommodated on a grade slab with utilities.

13.3.3.3 *Miscellaneous Buildings and Structures*

The following summarises other smaller structures that are likely to be used on site during construction:

- welder testing shop
- equipment maintenance shop (steel frame, metal clad, grade slab with contained drainage for spills)
- crib huts (one crib hut accommodates between 12 and 15 personnel)
- brass alley at MOF
- brass alley at Auckland Point
- perimeter security huts.

13.4 STORAGE REQUIREMENTS

It is intended that materials and equipment during the construction phase are stored:

- within the footprint of the LNG Facility on Curtis Island
- within some minor lay-down and temporary storage within the Auckland Point facility.

No significant long-term storage outside these areas is currently planned for activities associated with LNG Facility construction.

13.5 SITE SECURITY

Appropriate security risk assessments and mitigations plan will be developed to address security risks as they are identified in risk studies. Security plans will be aligned with emergency response and evacuation planning, law enforcement agencies and prevailing Queensland laws and regulations. Site security plans and procedures will be developed to cover:

- construction site isolation
- appropriate signs and warnings
- controlled site access via a badge access systems
- necessary training and orientation requirements
- a private security firm to provide security personnel for the site
- public safety officers, police, constable or other law enforcement organisations to provide security for public on public property, roads or other public infrastructure
- port security.

13.6 ACCOMMODATION

Construction personnel engaged from within the Gladstone region will continue to live in their current residences and commute daily to the Curtis Island construction site, staging out of Auckland Point.

For non-local personnel, a temporary construction camp on the Curtis Island site is planned. It is expected that up to 400 persons will use this facility. However, due to the possibility that a lower percentage of local labour may be available than currently anticipated, the camp is to be indicatively sized for up to 1,000 personnel, primarily to house non-local craft and non-local supervision from month 12 onwards. The camp will be located within the footprint of the LNG Facility (refer *Figure 2.13.5*).

Final size and layout of the camp will be refined as the workforce is engaged and the assessment of availability of local labour (housed in Gladstone and surrounding region) is refined, but will include the following:

- bedrooms, ensuites and amenities (as determined based on final labour availability with Gladstone)
- recreational areas
- dining facilities, including food storage and preparation facilities
- laundry
- camp clinic
- safety/orientation building
- camp office
- maintenance workshop
- security guard house
- foundations
- roads

- water treatment and distribution internal to the camp
- sewage treatment and collection internal to the camp
- firewater distribution
- telecommunications internal to the camp
- camp lighting
- fencing and walkways.

The construction camp is planned as a "wet camp" and will be compliant with applicable liquor licensing requirements.

Detailed design of the construction camp and all associated facilities will incorporate applicable requirements of the *Building Code of Australia,* the *Building Act 1975* (Qld) and *Building Regulation 2003* (Qld); and the *Disability Discrimination Act 1992* (Commonwealth).

Disease vector and vermin control will be the responsibility of the EPC contractor during construction. The EPC facility ES&H Supervisor, Medical Officer and the Administration/Camp Manager (as applicable) will have joint responsibility to ensure risks associated with food and catering facilities, sanitation, potable water quality, pest and infestation control, and accommodation air quality are identified and controls are implemented.

Suitable and sufficient sanitary facilities will be provided at readily accessible places to maintain hygiene standards. Sanitary facilities will be:

- adequately ventilated
- kept clean and orderly
- separate facilities provided for men and women.

Measures to manage mosquitoes and biting insects will be put in place and developed with reference to Queensland Health "*Guidelines to minimise mosquito and biting midge problems in new development areas*" (March 2002). A draft EMP addressing mosquitoes and biting midges for construction and operations phases of the Project has been prepared and is included in *Volume 11* of this EIS, although this will be further refined by the EPC contractor prior to commencement of construction.

13.7 TRANSPORT REQUIREMENTS AND INFRASTRUCTURE

13.7.1 Personnel

As stated previously, construction works are planned to operate on a 9/90 schedule (with nine days/90 hours a fortnight, broken down as five working days on, two days off, four working days, three days off). Daily transportation of personnel is planned to and from Auckland Point (Gladstone) and the MOF (Curtis Island) (refer *Figure 2.13.3* and *Figure 2.13.4).*

Personnel transportation will be undertaken using a combination of water taxis

(approximate capacity 170 persons, for fast transit of small numbers of personnel) and larger ferries capable of carrying approximately 400 persons.

While final specifications of these vessels have not been determined, it is expected that they will be similar in size and configuration to existing vessels currently operating in Moreton Bay in south-east Queensland. Photos of vessels similar to those proposed are shown in *Plate 2.13.1, Plate 2.13.2* and *Plate 2.13.3*[1], with the layout of the marine facilities shown in Plate 2.13.2 and Plate 2.13.3 being similar to those proposed for Auckland Point.

Large ferries will have a drop-down bow for embarkation and debarkation of personnel, and to allow ferries to be used for vehicular transport when personnel are not in transit.

Given the proposed split of personnel accommodation between the construction camp on Curtis Island and the mainland, the numbers of personnel travelling daily will depend upon:

- the stage of construction
- the stage of shift schedule, with local personnel travelling daily throughout the schedule and all personnel assumed to travel at the completion of each fortnight
- the number of workers sourced from the local Gladstone area.

At peak construction (i.e. approximately month 35 with up to 1,500 total personnel) it is assumed that:

- approximately 1,100 personnel (craft and field non-manual (FNM)) will depart the Curtis Island site daily and return to Gladstone and surrounds via Auckland Point
- at major shift end, approximately 95 per cent of the construction workforce (1,450 persons) will depart the Curtis Island site via Auckland Point.

Indicative ferry movements (total number of ferry movements required, and ferry movements per month) are shown in *Figure 2.13.8.*

1 Photographs taken by G. Boddington, January 2009.

Plate 2.13.1 Indicative Example of proposed Water Taxi

Plate 2.13.2 Example of proposed Vehicle Ferry

Plate 2.13.3 Indicative Configuration Ferry and Pontoon

Figure 2.13.7 Indicative Layout Auckland Point Pontoon

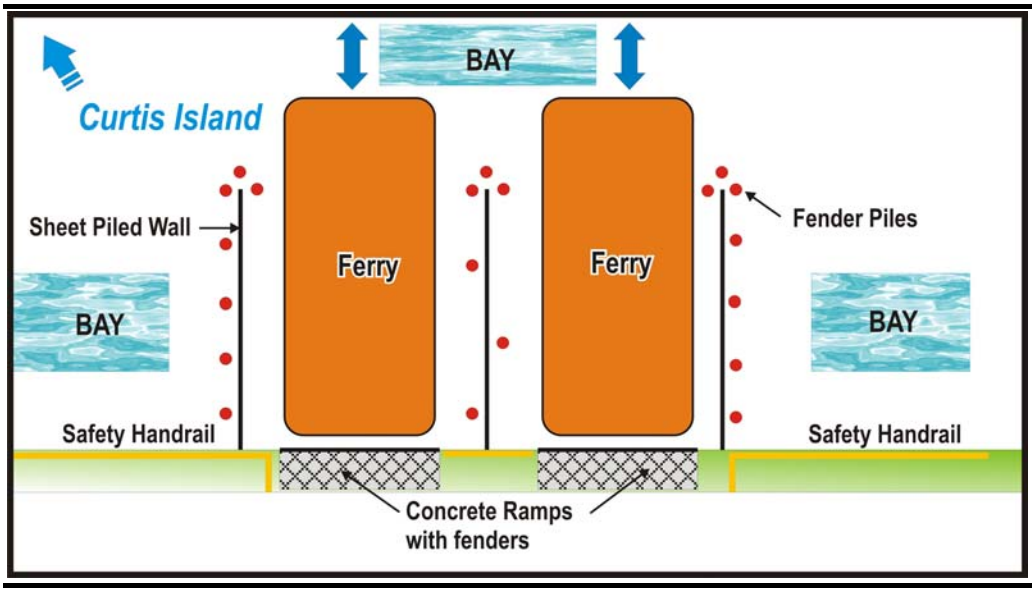
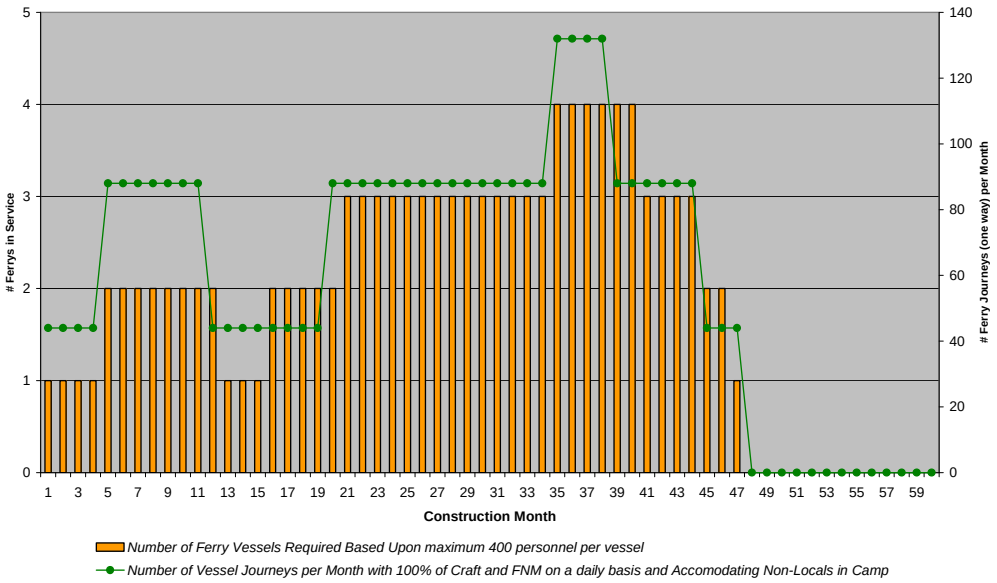


Figure 2.13.8 Indicative Personnel Ferry Movements by Construction Month



Note: Number of Ferry movements and Ferry Journeys based on #'s of personnel. After Month 46 numbers decrease sufficiently that water taxis will be used instead of the larger ferry

An assessment of traffic and transport impacts and traffic management during the construction phase is provided in *Volume 5, Chapter 14*.

13.7.2 Materials and Equipment

Preliminary logistic planning indicates a total of approximately 3,500 deliveries of cargo and freight to the MOF are anticipated during construction, with some 2,000 deliveries making use of the vehicular ferries that will be operating on a routine basis to support the Project. From this, it can be concluded that approximately 1,500 specific freight deliveries will be made to Curtis Island.

Table 2.13.4 Indicative Breakdown of Cargo Volumes Delivered to Curtis Island

Item Description	Quantity	UOM	Transport Type	# Vessels (approx.)[1]
Site Work, Temporary Facilities and Consumables (Month 1 to Month 20)				
Power Generation Equipment	4,000	tonnes	Bulk	4
Temporary Desalination Unit	500	tonnes	Bulk	1
Temporary Wastewater Treatment Plant	500	tonnes	Bulk	1
Temporary Facilities- Buildings	5,000	tonnes	Bulk	5
Scaffolding Mobilisation	8,000	tonnes	Bulk	8
Equipment and Large Tools Mobilisation	10,000	tonnes	Bulk	10
Concrete Batching Plant	2,000	tonnes	Bulk	2
Equipment Maintenance	45,900	tonnes	Bulk	46
Permanent Camp Equipment (and Furnishings)	5,000	tonnes	Container	13
Construction Site Offices (and Furnishings)	2,500	tonnes	Container	6
Warehousing and Tool Cribs	2,000	tonnes	Container	5

Item Description	Quantity	UOM	Transport Type	# Vessels (approx.)[1]
Small Tools and Consumables Mobilisation	1,500	tonnes	Container	4
Equipment and Large Tools Demobilisation	10,000	tonnes	Bulk	10
Scaffolding Demobilisation	8,000	tonnes	Bulk	8
Small Tools Demobilisation	1,500	tonnes	Bulk	2
Consumables (direct and subcontract)				
Diesel	50,000	tonnes	Bulk	50
Food	5,000	tonnes	Container	13
Miscellaneous Construction Consumables	90,000	tonnes	Bulk	90
Materials Offloading Facility Construction (Complete Mth 12)				
Sheet Piling	2,400	tonnes	Bulk	2
Temporary Batching Plant Equipment	2,000	tonnes	Bulk	2
Rock for Shore Protection	200,000	tonnes	Aggregate	118
Causeway Construction and MOF Infill Materials	150,000	tonnes	Aggregate	88
Major Subcontract Scope Elements (Construction Window Month 12 to Month 40)				
Site Preparation and Early Civil Works (Month 3 to Month 14)				
Heavy Equipment and Tool Mobilisation	5,000	tonnes	Equipment	17
Heavy Equipment and Tool Demobilisation	5,000	tonnes	Equipment	17
Pioneer Facilities (Offices, Camps, Crib Huts etc.)	1,000	tonnes	Container	3
Pioneer Temporary Facilities (Gensets, cables, lights etc.)	1,000	tonnes	Container	3
Temporary Batching Plant Equipment	1,000	tonnes	Container	3
Aggregates for MOF Concrete	1,500	tonnes	Aggregates	0
Cement for MOF Concrete	300	tonnes	Bulk	0
Miscellaneous Materials Deliveries	2,000	tonnes	Container	40
Buildings (Month 22 to Month 40)				
Heavy Equipment and Tool Mobilisation	1,000	tonnes	Equipment	3
Heavy Equipment and Tool Demobilisation	1,000	tonnes	Equipment	3
Pioneer Facilities (Offices, Camps, Crib Huts etc.)	750	tonnes	Container	2
Pioneer Temporary Facilities (Gensets, cables, lights etc.)	750	tonnes	Container	2
Miscellaneous Materials Deliveries	2,000	tonnes	Container	40
Storage Tanks (Month 12 to Month 44)				
Tower cranes	8,000	tonnes	Bulk	8
Mobile Cranes	2,000	tonnes	Bulk	2
Tools, Equipment and Consumables	1,000	tonnes	Container	3
Reinforcement and Embeds	10,000	tonnes	Bulk	10
Steel Plate	16,500	tonnes	Bulk	17
Pipe and Fittings	3,000	tonnes	Bulk	3
Steel Structure	2,000	tonnes	Bulk	2
Electrical and Instrumentation	3,000	tonnes	Bulk	3
Paint	500	tonnes	Container	1
Perlite	1,000	tonnes	Container	3
Miscellaneous Materials Deliveries	4,000	tonnes	Container	40
Demobilisation of equipment	10,000	tonnes	Bulk	10
Permanent Plant Jetty and Structures (Month 18 to Month 36)				
Mobilisation Activities	3,000	tonnes	Bulk	3

Item Description	Quantity	UOM	Transport Type	# Vessels (approx.)[1]
Miscellaneous Materials Deliveries	4,000	tonnes	Bulk	4
Demobilisation Activities	3,000	tonnes	Bulk	3
Bulk Materials (Gas Train, Offsites and Utilities) (Construction Month 12 to Month 39)				
Civil Works				
Aggregate for Final Grading	100,000	tonnes	Aggregate	59
Aggregate for Concrete (including tank)	270,000	tonnes	Aggregate	159
Cement for Concrete (including tank)	42,000	tonnes	Bulk	42
Rebar/ Anchor Bolts & Embeds	15,000	tonnes	Bulk	15
Structural Works				
Steel	7,500	tonnes	Equipment	25
Piping				
UG Pipe/Fittings & Hydrants	1,500	tonnes	Equipment	5
Pipe Straight	4,000	tonnes	Equipment	13
Valves & In-Line Instruments	500	tonnes	Equipment	2
Piping Specialties	1,000	tonnes	Equipment	3
Pipe Spools	4,000	tonnes	Equipment	13
Paint	1,000	tonnes	Container	3
Insulation	1,000	tonnes	Container	3
Equipment Bulks				
Pumps & Drivers	79	Each	Equipment	4
Compressors, Blowers, Fans & Drivers -	124	Each	Equipment	10
Exchangers	144	Each	Equipment	10
Tanks & Storage Facilities	9	Each	Equipment	2
Materials Handling & Processing	16	Each	Equipment	2
Water Treatment	6	Each	Equipment	2
Electrical Equipment (Distribution / Transformers)	89	Each	Equipment	5
Columns & Vessels	43	Each	Equipment	10
Module Shipments				
Gas Compressors	10,800	tonnes	Equipment	6
Cold Boxes	6,000	tonnes	Equipment	6
Main Substation	350	tonnes	Equipment	1
Propane Condensor Substation -	275	tonnes	Equipment	
Loading and Jetty Substation	100	tonnes	Equipment	
Cryogenic Piperack	6,000	tonnes	Equipment	4
Utilities	500	tonnes	Equipment	2
Gas Turbine Generator Equipment -	2,400	tonnes	Equipment	3
Potable and Service Water Treatment	750	tonnes	Equipment	1
Effluent Treatent -	250	tonnes	Equipment	
Boil Off Gas Compressors	450	tonnes	Equipment	1
Firewater and Demin. Water Treatment	500	tonnes	Equipment	1
Tank Waterfalls	500	tonnes	Equipment	1
Jetty Trestle Topsides	1,600	tonnes	Equipment	2
Electrical and Instrumentation				
Electrical and Instrumentation Bulks	20,000	tonnes	Bulk	20

Note 1: # Vessels is based on preliminary assessment of cargo volumes and assumed vessel types, and will vary as detailed engineering design and logistical studies are completed.

In addition to the materials planned for construction of the LNG Facility listed in *Table 2.13.4*, it is anticipated that approximately 260 km of pipeline for the Export Pipeline will be imported via Auckland Point. Implications of this for traffic impacts are described in *Volume 5, Chapter 14.*

The Auckland Point marshalling area is primarily aimed at personnel movements and for staging of materials and freight that comes from Gladstone and the surrounding region (handled on vehicular ferries).

Equipment and materials for the Project will be sourced worldwide. Approximately, 50 to 70 per cent of the Project's cargo will be shipped using multi-purpose Project vessels (break-bulk).

All break-bulk cargo and containers will be subject to quarantine inspections during discharge/unloading. The level of inspection is subject to the nature and origin of the cargo and will be determined in consultation with the Australian Quarantine and Inspection Service (AQIS).

Therefore, international cargo will be handled in a combination of ways:

1. Break bulk carriers will stop off at the Port of Brisbane as part of their routine passage and offload LNG Component cargo to the wharves. This offloaded cargo will be transported to Gladstone using a combination of coastal vessels and road transportation. Customs clearance and AQIS inspections will be undertaken as part of normal Port procedures.

   While the use of coastal vessels will be the primary mechanism for transport to Gladstone, small shipments of individual items that cannot be marshalled to allow for the effective use of a chartered coastal vessel will require that they are transported by road or rail and handled through Auckland Point.

2. Charter vessels having a capacity 10,000 dead weight tonnes (DWT) carrying cargo for the LNG Facility will be coming from international waters and discharging the cargo directly to the MOF. These will be predominantly containerised and packaged deliveries. However, some bulk deliveries are anticipated, given that not all materials will fit within the volume of fixed shipping containers.

3. Modules and major pre-assembled elements of the work and other over-sized cargo coming from overseas will be handled on barges with maximum weights anticipated to be 2,000 tonnes. Approximately 20 to 25 deliveries of modules and major pre-assemblies are anticipated.

To facilitate inspections by the AQIS, a Quarantine/Bonded Area will be established on Curtis Island prior to the cargo being moved into the Project site for staging, technical inspection and release for installation. In the event that materials or equipment imported from overseas are offloaded at Auckland Point (not currently anticipated), the Project will work with AQIS to ensure that

appropriate quarantine inspection facilities are provided.

Packaging materials generated from the cargo will be handled in accordance with the requirements of the AQIS for documentation and consignment notes, timber handling, fumigation and disposal.

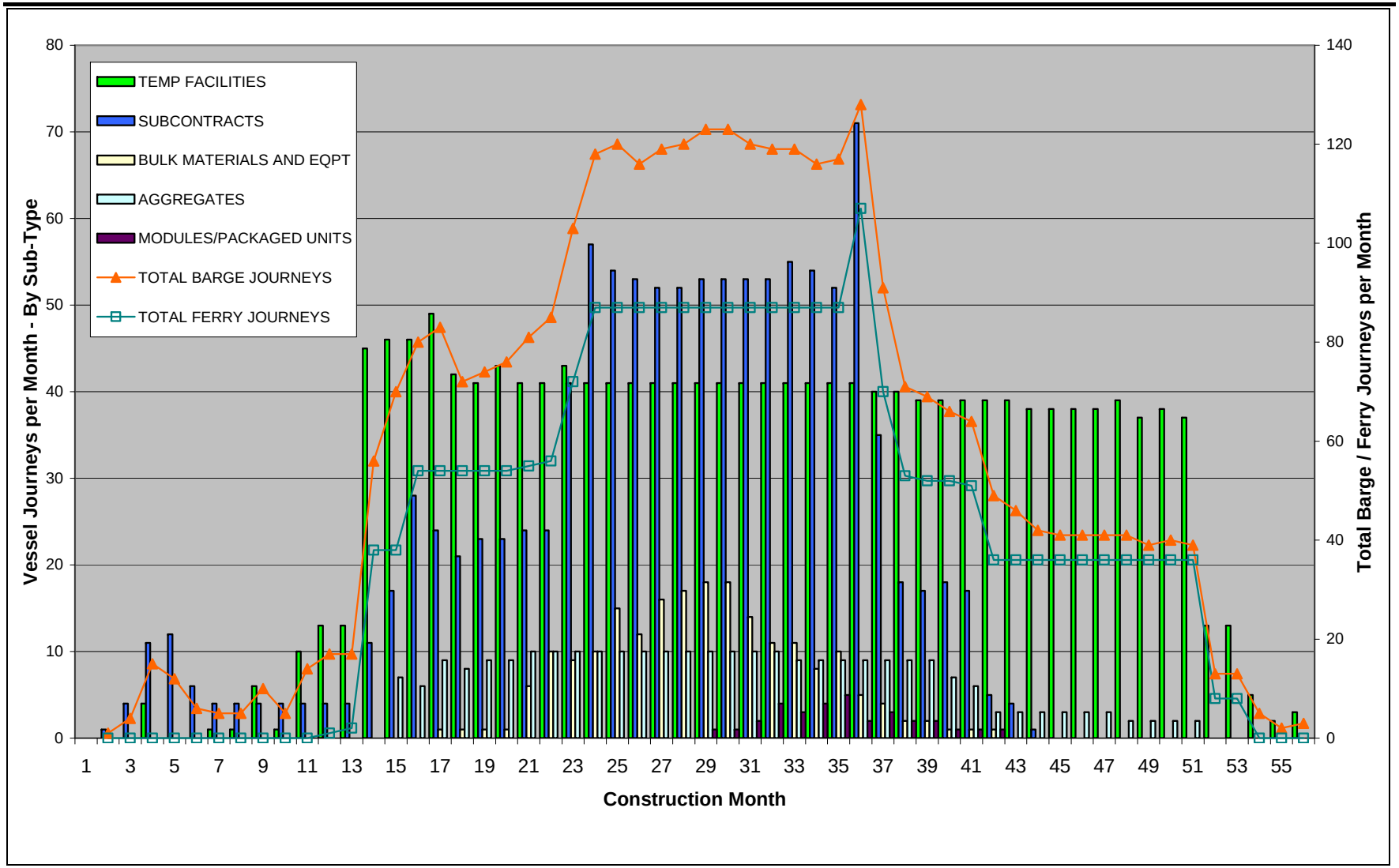
Major materials purchased and/or moved through the Gladstone region will include the following:

- construction equipment mobilised from local and regional sources
- cement (purchase and transport in trucks via ferry for direct blowing into the silos on Curtis Island)
- aggregates (transport to Curtis Island on bulk aggregate carriers and/or trucks on barges/ferries)
- diesel (source and purchase of fuels from a recognised supplier of petrochemical products, and transport in approved road transportation equipment that is driven onto barges/ferries equipped with spill containment and clean-up equipment)
- food and food-related items for catering services (transport as containerised shipments, with refrigeration units for fresh and/or perishable goods)
- locally-procured fabricated items (for example minor steel structures, small tools, equipment etc.)
- solid wastes generated from construction (including timber) as discussed in *Volume 5, Chapter 17*
- other minor consumable items (lubrication oils, greases, welding consumables, basic hardware materials including nails, screws, glues etc.).

Construction equipment and tools will be mobilised through the MOF and/or rock dock. Where these are sourced globally they will be handled under AQIS temporary import requirements. Major construction equipment, which may not be new and may have been operating in other countries, will be subject to clearance by AQIS, which may be undertaken by AQIS inspectors invited to participate in pre-departure inspections to review the removal of contaminants and cleanliness prior to the equipment arriving in Australia.

An indicative breakdown of cargo deliveries to the MOF, on the basis of vessel journeys per month, is provided in *Figure 2.13.9*. It should be noted that this breakdown is based on preliminary logistics planning only and is subject to further refinement.

Figure 2.13.9 Indicative Cargo Deliveries to Curtis Island MOF, by Construction Month



13.8 ELECTRICITY/ENERGY

Power requirements on the Curtis Islands site during LNG Facility construction will be met through use of diesel powered generators. While power requirements (and consequently diesel consumption) will vary subject to the construction phase, it is estimated that peak construction power requirements will be in the order of 15 MVA for approximately18months.

No use of mains power is currently proposed for the works on Curtis Island, and no transmission/distribution lines are proposed outside the site boundary. However, this will be evaluated as the work progresses and as infrastructure is developed in the LNG Facility and surrounds.

13.9 WATER SUPPLY AND MANAGEMENT

Early in the construction schedule (for no longer than the first 12 months), there will be relatively few personnel on the Curtis Island site. During this early period, fresh water will be brought to the site on barges or ferries, contained in road tankers and iso-containers.

The water will have been treated at source and suitable for use as clean construction water, primarily for dust control and water make-up for concrete activities involved with the construction of the MOF and other minor temporary facilities.

At this stage of the Project, potable water for drinking will be purchased and bottled and supplied to the site as necessary. While the volume required will vary due to weather conditions and the consequent variation in water required for dust control, this would be in the order of 20 m^3 to 40 m^3 per day (one to two tanker trucks per day).

While a source for this water has not been finalised, preliminary assessment of bulk water availability in the Gladstone region indicates that this volume of bulk water should be available through the Gladstone Area Water Board. Also, the impact on the bulk water supply network will be relatively minor, although it is noted that the "*ability of the bulk water system to cope with additional demand depends on the considerable demands placed on the system by other new industries such as Stage 2 of the Alumina refinery at Yarwun and the Gladstone Pacific Nickel plant*."[2]

2 GHD (2009). Queensland Curtis LNG Project: *Draft Gladstone Infrastructure Audit*. (unpublished report for BG Australia, Rev 42/15574/51470, issued for information February 2009).

13.9.1 Moisture Condition of Backfill

Excavated materials that have been encountered during initial site investigations indicate that the materials that are most suitable for re-use as fills will require approximately 50 to 60 litres of water for moisture conditioning per cubic metre of fill. Current benching evaluation and calculation of earthworks quantities indicate that backfill will be approximately 1,800,000 m^3, layered and compacted over approximately six months during Stage 1 of construction activities. It is therefore anticipated that, at peak, approximately 900 m^3 to 1,000 m^3 of water will be required per day for moisture conditioning.

Water supply for moisture conditioning is planned to be through desalination of seawater using reverse osmosis (RO). This would utilise a floating barge moored near the shoreline of the LNG Facility, with a minimum of two or three days storage requirement on board and with a reverse osmosis unit rated between 60 m^3 and 90 m^3 per hour, running on a 10-hour basis.

Power generation for the RO would come from the site generation capacity, with power cables suspended to the moored barge, to avoid the requirement for re-fuelling over water and make use of the Project's fuel supply chain.

As the site development activities progress, the sedimentation basins can be established on the site, the make-up from the RO will be supplemented by harnessing run off – moving to the Projects baseline assumption on waste minimisation with the RO units onshore.

13.9.2 General Water Supply and Management

Retention ponds will be constructed on site during Stage 1 of construction, and integrated into the temporary site drainage system. Rainfall runoff into these retention ponds will be the primary source of water following construction of these retention ponds. Location and capacity of proposed retention ponds are shown in the Civil Site Drainage Plan included as *Figure 2.13.10*.

A stormwater filtration plant, combined with dosing, natural flocculation, pressure filters and sedimentation through the retention pond, will be provided to treat the impounded stormwater that will be recycled for use.

Desalination of seawater using RO will be used as a second source of water, with RO plants moved from barge-mounted operation to on-shore operation when bulk earthworks on site are complete. RO will form a source of make-up water for periods where rainfall does not provide sufficient water supply.

The RO process utilises permeable membranes to separate the dissolved salts in the water. Two streams will result from the RO plant: one to the water treatment facility to supply the construction camp with fresh drinking water (where the permeated water from the RO plant, also termed as product water, will be disinfected using ultra-violet tubes prior to pumping it to the users); and the second being the make-up to the impounding basin.

The arrangement will be valved in such a way that the make-up to the impounding basin can be isolated when rainfall and surface water run-off are already supplying sufficient feed water.

The RO brine stream is proposed to discharge at the end of the MOF by means of a polyline with diffuser at the discharge point.

As noted in *Volume 2, Chapter 9,* hydrodynamic modelling has been undertaken for discharge streams for both construction and operations, and water quality implications and potential impacts on marine biota are addressed in *Volume 5, Chapters 8 and 11* of this EIS.

13.9.2.1 Estimated Water Utilisation

With the exception of water required for conditioning of backfill materials, the single largest volume of water required during construction will be for hydrotesting on LNG storage tanks and propane tanks prior to commissioning. This will require a volume of approximately 100,000 m^3, sourced from retention ponds on site with make-up from RO as required.

Tanks will be hydrotested sequentially with re-use of some or all water as the water will be drained back into retention ponds at completion of hydrotesting of each tank.

It is currently assumed that no biocides or corrosion inhibitors are required for hydrotest water. Although, some level of treatment may be required to meet requirements of API620 Appendix Q.8.3.

The estimated potable and service water demand during the construction phase of the LNG Component is provided in *Table 2.13.5* (excluding water required for conditioning of backfill):

Table 2.13.5 Indicative Water Utilisation during Construction

Water Demand	Total	Peak Rate
Hydrotest water (note 1)	100,000 m^3	-
LNG plant concrete work (note 2)	40,000 m^3	-
Site preparation/dust control	6,000 m^3	-
Potable water (note 3)	40,000 m^3	-
Water used for "flushing"	4,000 m^3	-
Feed water (seawater) (note 3)	-	1-60 m^3/hr
Potable water demand rate (note 3)	-	1-30 m^3/hr

Note 1: Based on largest tank and re-using water to test other tanks and piping.

Note 2: Based on 0.214 m^3 water per m^3 of concrete

Note 3: Based on peak manpower loading of 1,500 people over a construction duration of 55 months with potable water demand of 300 litres/person/day. Does not include hydrotest water, which is anticipated to be produced from impounded storm water runoff and made-up with desalinated seawater.

13.9.2.2 Water Distribution Network

The construction of the temporary water distribution network will be incorporated to the maximum extent possible within the permanent plant firewater distribution ring main, which services all parts of the facility. This is primarily a buried system in compliance with regulatory codes of fire protection.

Smaller scale grade-level, skid-mounted electrical driven pumps capable of supplying the rates as required in *Table 2.13.5*, at the appropriate pressures for filling large piping systems, will be tied into this system, with the primary water holding tank early in the program being the main sedimentation basin. The main firewater ring is anticipated to be up to 16" in diameter, with the temporary facilities extensions to suit construction needs up to 8" and servicing all areas throughout the temporary and permanent plant.

This main will distribute water for testing, flushing, cleaning and firewater until such time the permanent plant firewater system is commissioned and operational.

13.9.2.3 Water Flush

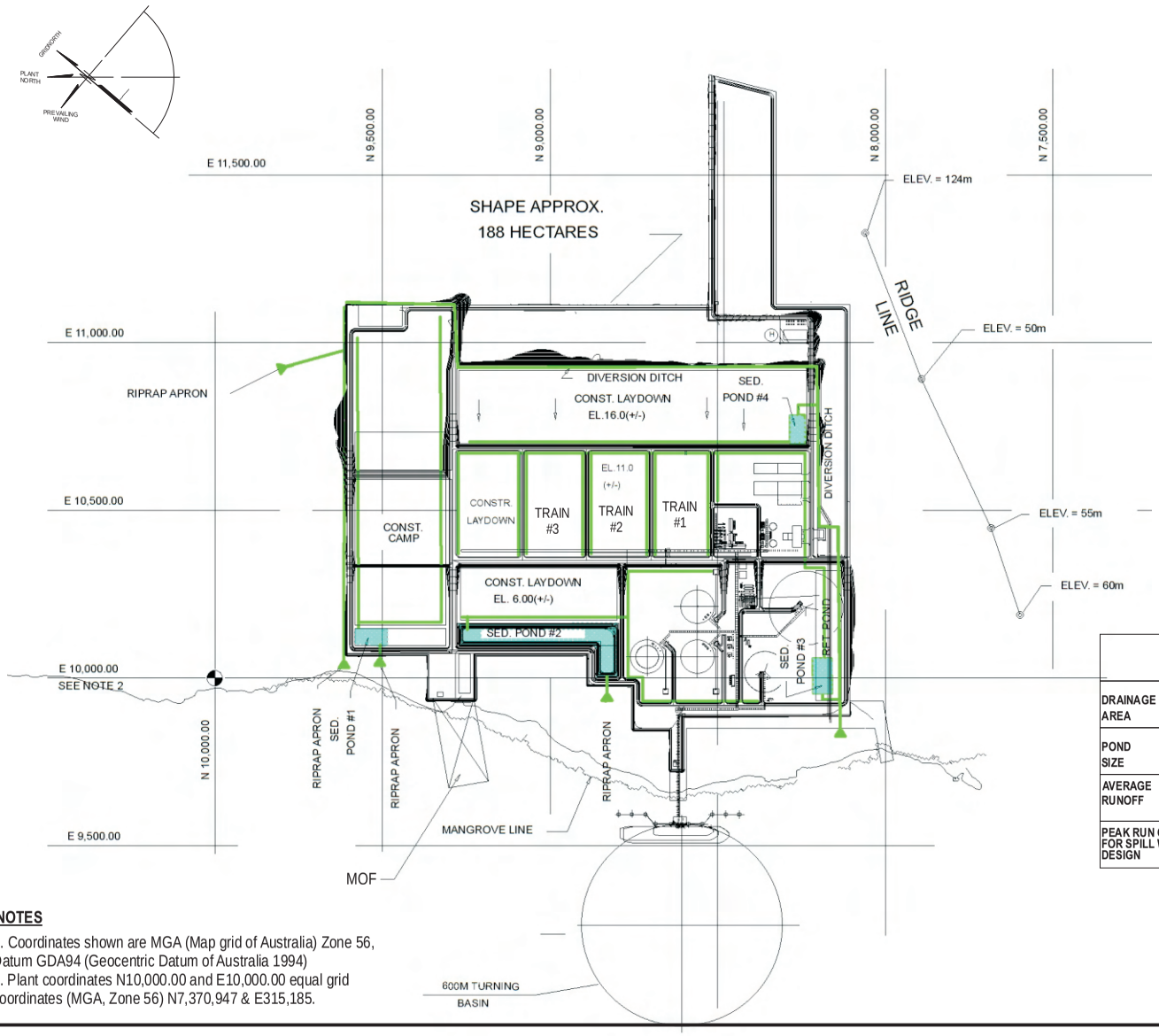
During the commissioning phase, piping system for various services will be flushed with fresh water. Sources for flushing water will be clean impounded stormwater prior to commissioning of the firewater system. Water used during flushing will be collected in the sedimentation pond and will be treated prior to re-use for other services.

13.10 STORMWATER

13.10.1 Construction Water Run Off Management Options

During initial site clearing (Stage 1), various combinations of silt fences, stone check-dams, hay bale dams and/or other means will be utilised to reduce erosion and control sediment load in runoff. At all times, the intention will be to reduce the possibility of a rill being generated, which results in higher velocity flows and transfer of sedimentation, with sheet flow being the intention.

During site preparation, two major sedimentation basins will be constructed as the major earthworks progress. These are envisaged to be high-density polyethylene (HDPE) (or similar) lined basins, into which the temporary site drainage system will be routed. Outfall structures will be installed (overflow points and rip-rap aprons), along with high level overflows, which will allow storm conditions over and above the design basis to spill directly to the Gladstone Harbour.



Notes:

1. Diversion ditches are provided to. Intercept run off from surrounding hills.
2. Drainage from diversion ditches will be discharged to the bay thru rip-rap Aprons.
3. Silt fence shall be provided aroundthe construction areas.
4. Stone dikes and other methods shall be used to trap sedimentsin the ditches.
5. Sedimentation pond design criteria:
   A.10 year 6hour storm
   B. Average hourly rainfall of 6 hour storm i=23mmperhour
6. Storm drainage design criteria:
   25 year 1 hourrainfallintensity, i=80mm per Hour
7. Pond location and design provided in this sketch is conceptual only. Final designwillbedeveloped during the feed.
8. Sediment pond no.2 is oversized for use as source of hydrotest water.

	POND#1	POND#2	POND#3	POND#4
DRAINAGE AREA	30.0Hec	32.0Hec	44.8Hec	24.6Hec
POND SIZE	84mx42mx3m	25,900sqm	105mx52mx3m	75mx40mx3m
AVERAGE RUNOFF	1.34cm/sec	1.43cm/sec	2.00cm/sec	1.10cm/sec
PEAK RUN OFF FOR SPILL WAY DESIGN	5.8cm/sec	6.2cm/sec	8.7cm/sec	4.8cm/sec

NOTES

1. Coordinates shown are MGA (Map grid of Australia) Zone 56, Datum GDA94 (Geocentric Datum of Australia 1994)
2. Plant coordinates N10,000.00 and E10,000.00 equal grid coordinates (MGA, Zone 56) N7,370,947 & E315,185.

Legend

- Water Collection
- Water Storage

Source Note
Bechtel Preliminary Drawing SK-C-00-00001

0 200 400 800

N

Project: Queensland Curtis LNG Project
Client: QGC - A BG Group business
Volume 2 Figure 2.13.10
File No:00861656_EIS_LFC_CDR003_F2.13.10
Drawn KP/JB
Approved DS
Date 08/07/09
Revision 2

Title: Preliminary Site Civil and Drainage Plan

Environmental Resources Management Australia Pty Ltd

The site temporary drainage system will pass through all construction areas. Any water being used for hydrotesting and flushing of piping will also be routed to this drainage system, which in turn flows to the sedimentation basins. Detailed design of stormwater drains and sedimentation ponds will be based on the following criteria:

a. Sedimentation Ponds: 10-year, six-hour storm, with average intensity of six-hour storm 23 mm per hr

b. Stormwater Drains: 25 year, one-hour rainfall with intensity of 80 mm per hr

Runoff from outside up-gradient of the construction site boundary will be diverted around the site and discharged directly into Gladstone Harbour.

In normal operating conditions, the sedimentation basins will impound all drainage water, and be used as storage for the pressurised ring main which will run through the site carrying temporary construction (and fire protection) water. Within the main sedimentation basin, which is long and narrow, the water will be treated, screened and dosed to bring it into acceptable standards for use as hydrotesting water, and monitoring/recording systems will be installed to provide auditable records for future reference.

It is intended to cross connect the two sedimentation basins, such that the maximum amount of retained water can be re-used within the water make up. This will reduce the operations of the RO plant, which will then only be required for make up to potable water for the construction camp. The peak water demand is for the hydrotesting of the LNG storage tanks, when water will be required to fill the tanks up in a period of approximately 30 days.

Stormwater management is described in detail in *Volume 5, Chapters 9 and 17* and a site water balance is presented in *Volume 5, Chapter 9.*

During construction works prior to establishment of sewered site facilities, portable toilets will be available on-site, supplied and maintained by a licensed contractor, with off-site disposal to an appropriately licensed facility.

A conceptual plan for the proposed stormwater management system is presented in *Figure 2.13.10.*

13.11 SOLID AND LIQUID WASTE MANAGEMENT

A detailed construction waste inventory, and description of waste management, is provided in *Volume 5, Chapter 17*, with a brief summary included below.

13.11.1 *Summary of Construction Waste Streams*

It is anticipated that the following waste streams will be generated from general construction activities:

- trees, brush, vegetation (one off waste stream during site preparation)
- general inert construction debris
- office waste
- site generated food waste
- sanitary waste (office, job site)
- first-aid station waste
- dunnage and scrap timber
- waste oil and oily wastes
- waste adhesives
- waste paint and solvents
- waste antifreeze/radiator coolant
- empty aerosol cans
- empty material containers
- scrap metal (e.g., rebar, cable, piping)
- used welding rods.

The following waste streams will be generated from the camp operations supporting construction:

- office waste
- camp generated rubbish
- camp generated food waste
- sanitary waste
- medical waste.

QGC's objective is to prioritise the prevention and minimisation of waste generation, and effectively manage wastes, in a manner that minimises impact on the environment and is also cost effective. A step-wide approach will be implemented with the following order of preference:

- prevention and reduction
- reuse
- recycle and recovery
- treatment
- disposal.

A waste reduction program will be implemented to reduce the amount of wastes generated during construction. The waste minimisation program will be addressed by systematically assessing opportunities for reduction at source, reuse, recycling, and recovery of materials or conversion of waste into useable materials.

Waste materials will be evaluated for reuse and recycling potential before it is classified as wastes. Waste material will be segregated to enable recycling or other disposal mechanisms. Non-recyclable wastes generated will be disposed of in mainland waste disposal facilities/treatment facilities using

appropriately licensed contractors.

13.11.2 Indicative Construction Waste Amount

The following waste streams listed in *Table 2.13.6* will be generated predominantly from the camp and camp operations (total over all stages of construction).

Table 2.13.6 Indicative Total Volumes of Construction Camp Wastes

Waste Stream	Indicative Amount
Sewage	240,000 m³
Sewage treatment plant solids	650 m³
Food waste	350 tonnes
Domestic waste	520 tonnes
Paper	180 tonnes
Plastics	60 tonnes
Glass	30 tonnes
Metals	40 tonnes
Other	205 tonnes

A secondary sewage treatment plant will be operated on site, with liquid effluent discharged into Gladstone Harbour and treatment plant solids removed from site for disposal at existing facilities in the Gladstone region (refer *Volume 5, Chapter 17* for discussion of waste management).

Apart from construction camp waste, other constructions wastes over Stages 1 to 4 of construction include:

- general construction waste: 42,000 tonnes (approximately 1,450 tonnes per month at peak)
- used batteries: 1,150 units
- used oil filters (drums): 220
- solvent wastes: 57,400 litres.

Solid and solvent wastes will be managed and temporarily stored on site, with removal from site by an appropriately licensed waste management contractor for disposal on the mainland. No final disposal of solid or solvent wastes is anticipated on the LNG Facility site.

Further detail of construction waste generation and management is included in *Volume 5, Chapter 17*.

13.12 NOISE EMISSIONS

Construction noise on the LNG Facility site will be generated by piling (sheet

piling for MOF, piling for LNG jetty), by earthmoving works and equipment, plant assembly, concrete batching plant operation, pneumatic testing, line cleaning and pressure testing of pipework and pressure vessels on site. An assessment of construction noise sources and impacts has been undertaken and is included in *Volume 5, Chapter 13* of this EIS.

13.13 AIR EMISSIONS

Air emissions predicted to be generated during LNG Facility construction are described in detail and assessed in *Volume 5, Chapter 12.*

13.14 ALTERNATIVES CONSIDERED

13.14.1 LNG Facility Construction Workforce Accommodation Alternatives

This section provides a summary of the proposed workforce accommodation strategy options for the construction phase of the LNG Facility. *Volume 8* of this EIS details how these facilities will operate and the potential impacts from construction workforce accommodation facilities.

13.14.1.1 Summary of Alternatives Considered

Four initial options for the construction workforce accommodation were considered as shown in *Figure 2.13.11* and described in *Table 2.13.7* below. These initial options were assessed at a high level on the basis of an indicative workforce of 2,000 personnel at peak, which was subsequently refined as described in *Section 13.14.1.2* and therefore provide a worst case scenario.

Table 2.13.7 Construction Workforce Accommodation Options

	Option A	Option B	Option C	Option D
Total workforce	2,000	2,000	2,000	2,000
Local Gladstone	1,100	1,100	1,100	1,100
Imported	900	900	900	900
Accommodation	100% mainland 1,100 private dwellings, 900 in camp at Aldoga	100% mainland 1,100 private dwellings, 900 in camp at Calliope	100% island	55% mainland, 45% island 1,100 private dwellings, 900 in camp on Curtis Island

Construction Camp Option A

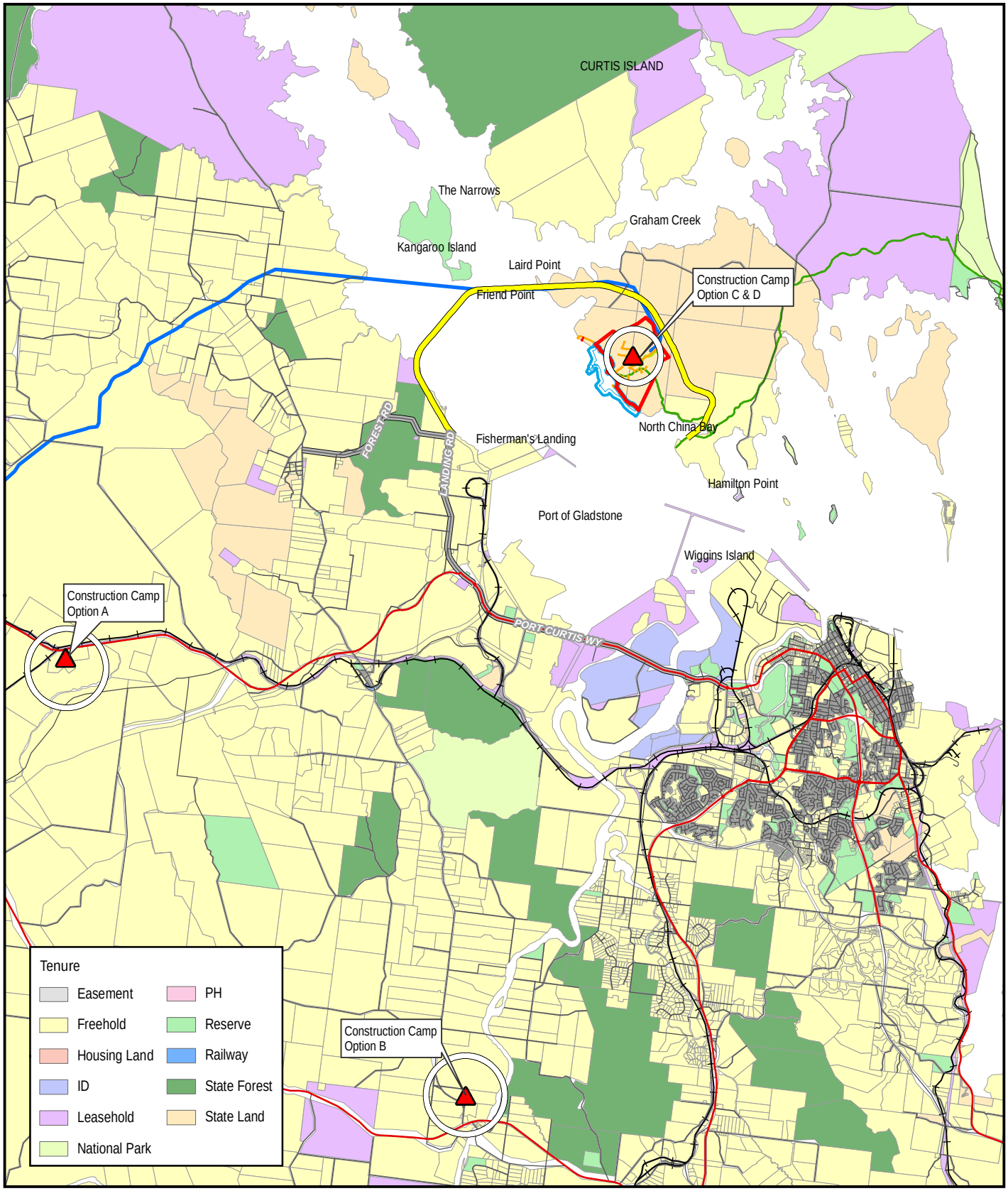
Accommodation

Under Option A, up to 900 non-local personnel accommodated within a construction camp will be located on the mainland in the vicinity of Lot 200 on SP116496 (refer to *Figure 2.13.11*). The remainder of the workforce will utilise existing accommodation either within Gladstone City or in nearby townships.

Transport

Under Option A, daily transfers of personnel from the construction camp to the Curtis Island construction site will be by:

- buses provided by the Project to/from from the construction camp to Auckland Point
- ferry between Auckland Point and the Curtis Island site
- local personnel (not living in the construction camp) will arrange their own transport from to/from their place of residence to Auckland Point, using a daily ferry between Auckland Point and the Curtis Island site.



Legend

- Proposed QCLNG Site Boundary
- Proposed Wetlease Area
- Proposed Export Pipeline
- Proposed Curtis Island Road/ Bridge Corridor
- Construction Camp Option
- Main Highways
- Local Roads
- Railway
- Existing Track

Source Note:
Cadastral/Tenure Currency: August 2008, Department of Natural Resource and Water
StreetPro Australia - Pitney Bowes MapInfo
Curtis Island Road/Bridge - Connell Wagner

Projection: UTM MGA Zone 56 Datum: GDA 94

0 375 750 1,500 m

N

QUEENSLAND CURTIS LNG
A BG Group business

Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business
Title	Alternative Construction Camp Locations for the LNG Facility

ERM
Environmental Resources Management Australia Pty Ltd

Drawn	JB	Volume 2	Figure 2.13.11
Approved	GB	File No: 0086165b_EIS_LFC_GIS005_F2.13.11	
Date	08.07.09	Revision 0	

Disclaimer:
Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only.
ERM does not warrant the accuracy of any such Maps and Figures.

Construction Camp Option B

Accommodation

Under Option B, 900 non-local personnel accommodated within a construction camp will be located on the mainland in the vicinity of Lot 4 and 5 on CTN1898 (refer to *Figure 2.13.11*). The 1,100 local remainder of the workforce will utilise existing accommodation either within Gladstone City or in nearby townships. This option is effectively equivalent to the proposed site of the Gladstone Workers' Accommodation Village Precinct as described in the Gladstone Construction Workers' Accommodation Precinct - Precinct Planning Report for the Gladstone Economic and Industry Development Board and Department of Infrastructure and Planning.[3]

Transport

As for Construction Camp Option A.

Construction Camp Option C

Accommodation

Under Option C, all 2,000 personnel, regardless of origin, will be accommodated during the extended shift period within the construction camp located on Curtis Island within the LNG Facility site boundary, described as part of Lots 10 and 27 on DS220. A variety of shift rotation periods have been considered, ranging from a 10-days-on and four-days-off shift rotation to a 9/90 arrangement (nine days / 90 hours worked each fortnight on a five-days-on, two-days-off; four-days-on, three-days-off rotation).

Transport

Option C assumed transfer of all 2,000 construction personnel between Gladstone City and Curtis Island only at the start and end of each shift rotation. At the completion of each shift rotation, local personnel will return to their local or regional place of residence for the off-shift period. Of the 900 non-local personnel, it is estimated that approximately 160 would source short-term accommodation locally or regionally, approximately 250 would fly out of Gladstone City or Rockhampton City and approximately 490 would drive to other centres outside of the Gladstone/Rockhampton region.

3 SKM, 2009. *Gladstone Construction Workers Accommodation Precinct - PRECINCT PLANNING REPORT*. Report for the Gladstone Economic and Industry Development Board and Department of Infrastructure and Planning, January 2009

Construction Camp Option D

Accommodation

Under Option D, 900 non-local personnel will be accommodated within the construction camp located on Curtis Island (i.e. Part of Lots 10 and 27 on DS220). The 1,100 remainder of the workforce will utilise existing accommodation arrangements, either within Gladstone City or in nearby townships.

Transport

Under Option D, daily transit of 1,100 local personnel to and from the construction site on Curtis Island to Auckland Point will be via ferry, with transport from Auckland Point to their place of residence to be arranged by each individual (i.e. car parking facilities will be provided at the Auckland Point staging area).

At completion of shift rotation, all 2,000 personnel (apart from a skeleton crew manning the construction site during the off-shift period), will be transferred from the construction site on Curtis Island to Auckland Point via ferry. One thousand, one hundred local personnel will return to their local or regional place of residence for the off-shift period. Of the 900 non-local personnel, it is estimated that approximately 160 would source short-term accommodation locally or regionally, approximately 250 would fly out of Gladstone City or Rockhampton City and approximately 490 would drive to other centres outside of the Gladstone/Rockhampton catchment.

13.14.1.2 Reason for Selection of the Preferred Alternative

Based on this preliminary assessment of options a revised (hybrid) workforce and accommodation option was framed that involved a reduced total workforce number (based on refinement of construction methodology and scheduling), an alternative accommodation approach and a different transport arrangement.

Table 2.13.8 Revised Construction Workforce Accommodation Options

	Revised Option
Total workforce	1,500
Local Gladstone	1,100
Imported	400
Accommodation	73% mainland, 27% Curtis Island 1,100 private dwellings 400 in camp on Curtis Island

Under this revised option, now adopted as the Project base case, non-local personnel would initially be accommodated in mainland hotels and rental accommodation up to a level that did not place stress on the local short-term accommodation supply and while a construction camp was being constructed (indicatively this could be in the order of approximately 200 non-local persons – refer to *Volume 8* for further detail).

A description of the construction workforce requirements and the assumed availability of local construction labour for the LNG Facility are provided in *Volume 2, Chapter 6.*

Technical

There are no unmanageable technical constraints for any of the options outlined. However, constructing a smaller camp will reduce the Project ecological and social footprint and improve site management during the construction phase.

Social

Many communities are opposed to construction camps located in or near to residential areas.

Many industrial communities are now encouraging local housing options over construction camps. Therefore, a hybrid option, which utilises both local accommodation and a construction camp on Curtis Island ensures flexibility in workforce dynamics is maintained while minimising and effectively managing social implications from these camps. The hybrid option also reduces the day-to-day impact on local community services and infrastructure.

Environmental

A mainland construction camp with associated transport of workers to and from the LNG Facility site will have a number of environmental and social impacts including: traffic, greenhouse gas (GHG) emissions; and waste (solid and liquid). These impacts can be minimised through the hybrid accommodation approach. All other options had similar GHG emissions and similar traffic impacts that did not significantly change the environmental impact from one option over another. However, the hybrid option of splitting the workforce between the mainland and Curtis Island minimises the environmental and social impacts.