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2. PROJECT DESCRIPTION

This chapter describes the Papua LNG Project – Downstream (the Project) including the new and upgraded components of the existing Papua New Guinea Liquefied Natural Gas Plant (LNG Plant) and marine infrastructure in Caution Bay. Construction, operation, and maintenance activities are described, along with considerations related to the decommissioning of project infrastructure. The Project facilities described in this EIS are subject to further refinement and optimisation during the front-end engineering and design (FEED) process currently being undertaken, as well as during detailed design and construction. The Conservation and Environment Protection Authority (CEPA) will be advised if changes during this process materially adversely affect the impacts currently described in this Environmental Impact Statement (EIS).

2.1 OVERVIEW OF THE PAPUA LNG PROJECT

2.1.1 Background - PNG LNG Project

The Papua New Guinea Liquefied Natural Gas Project (PNG LNG Project), the first LNG development in Papua New Guinea, provides LNG to the Asia-Pacific region. The existing PNG LNG Project commercialises gas reserves in the Hela, Western and Southern Highlands provinces of Papua New Guinea. The gas is transported via the PNG LNG Project pipeline, through Gulf Province to the LNG Plant in Caution Bay, Central Province, 20 km northwest of Port Moresby, where it is liquefied and exported by ship to international gas markets. The LNG Plant is currently operated by ExxonMobil PNG Limited (EMPNG), an affiliate of ExxonMobil.

2.1.2 Papua LNG Project

The Papua LNG Project is a gas development project for the Papua LNG Project Joint Venture participants, which at the date of this EIS are:

- TotalEnergies EP PNG Limited (TotalEnergies, an affiliate of TotalEnergies SA)
- ExxonMobil PNG Antelope Limited and ExxonMobil PNG Elk Limited
- Pac LNG Assets Limited, Pac LNG International Limited, Pac LNG Investments Limited, Pac LNG Overseas Limited and Pac LNG Holdings Limited (affiliates of Santos Limited)
- JX Nippon Oil and Gas Exploration Pty Ltd.[1]

The Papua LNG Project will develop, build, own and operate an integrated LNG project comprising upstream development of the Elk and Antelope gas reservoirs (including processing facilities), a central processing facility (CPF) with connecting pipelines to transport gas and condensate, and a LNG liquefaction facility leveraging the existing PNG LNG Project site in Caution Bay to have an aggregate stream day capacity (SDC) of 6 million metric tons per annum (mtpa). The Papua LNG Project involves two components:

- The Papua LNG Project – Upstream (referred to as the Upstream component)
- The Papua LNG Project – Downstream (the Project and the component described and assessed in this EIS).

Execution of the Upstream component and the Project component is delimited in Caution Bay, with the approximate boundary (i.e., the scope break) between the components located near the fence of the LNG Plant, south of the existing jetty. This delineation between the components was selected based on the

[1]JX Nippon Oil and Gas Exploration Pty Ltd became a Papua LNG Project Joint Venture participant on 6 July 2023. Some documents associated with this EIS, such as technical appendices, were completed before this date. Consequently, the list of Papua LNG Project Joint Venture participants in some EIS documents may not include JX Nippon.

anticipated construction execution methods and ease of infrastructure transitions, with locations and components discussed in Section 2.1.3 and Section 2.4.

The components are described further below, along with the relevant aspects to be constructed and operated for the Upstream component and the Project, respectively.

The proposed responsibility for the construction of the Papua LNG Project facilities in Caution Bay is shown in Figure 2.1. The proposed responsibility for operations of the Papua LNG Project facilities in Caution Bay is shown in Figure 2.2.

2.1.3 Papua LNG Project – Upstream

The Upstream component is being assessed under a separate EIS that was completed in December 2019 by ERIAS Group Pty Ltd and TotalEnergies EP PNG Ltd. The Upstream component will operate in accordance with an applicable Environment Permit as, although interconnected, the two components of the Papua LNG Project have different operators, geographical locations, and development timelines.

Gas will be supplied from the Elk and Antelope reservoirs, located in PRL15 in the Eastern Fold Belt of the Gulf Province which are being developed for the Upstream component.

The Upstream project infrastructure and facilities will include production wells and gas gathering pipelines, a central gas processing facility (CPF), approximately 60 km of onshore pipelines to transport feed gas and field condensate south to the coast, and 260 km of offshore pipelines to the LNG Plant. These Upstream facilities are being constructed and operated by TotalEnergies.

2.1.3.1 Offshore pipelines

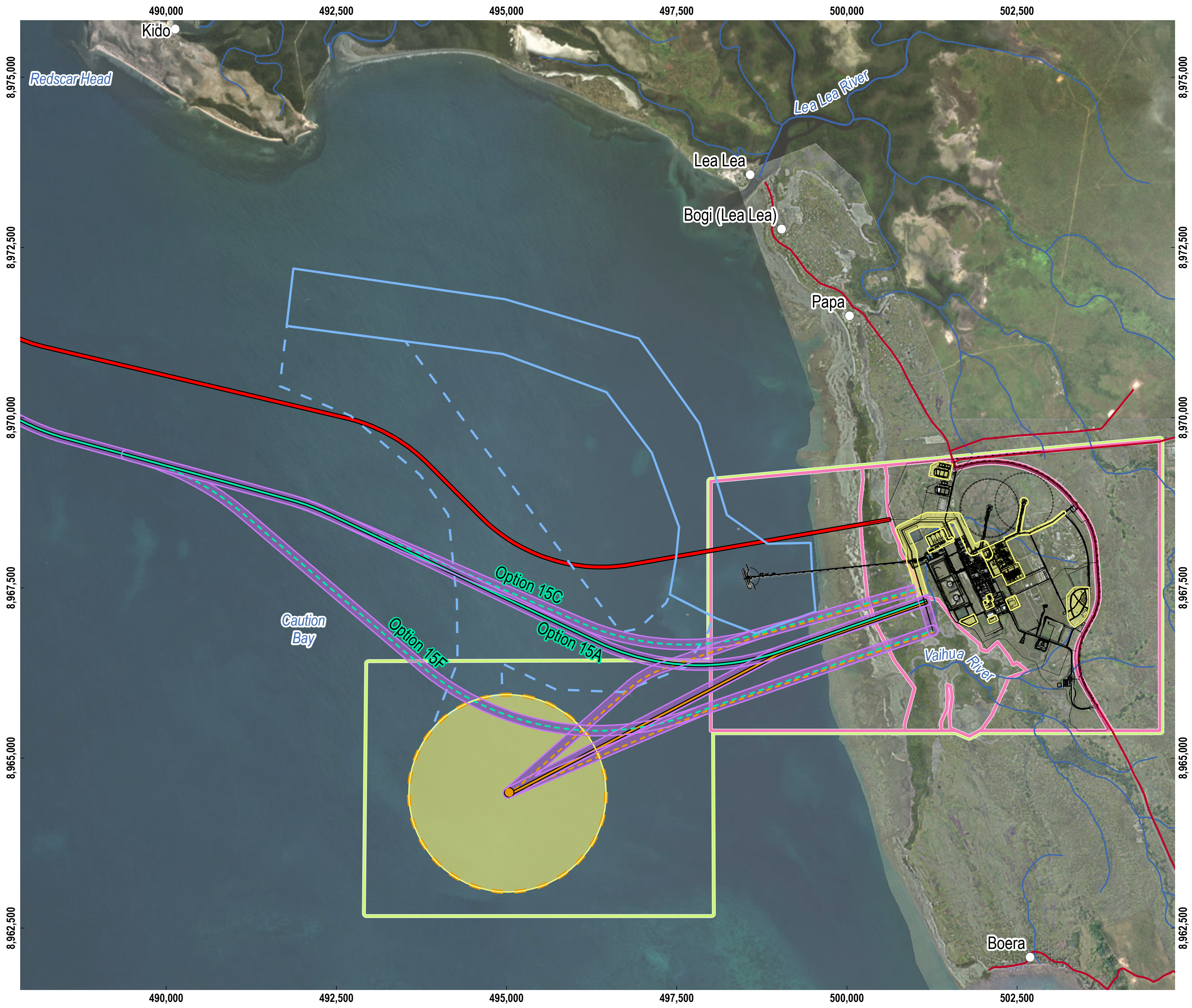
Two new pipelines, one for feed gas (40-inch diameter pipe) and one for field condensate (10-inch diameter pipe), and a fibre optic cable line, will be constructed and operated as part of the Upstream component to deliver product to the LNG Plant. Combined, this Papua LNG feed pipeline infrastructure is referred to as the 'Papua LNG pipelines'. Three options (Option 15A, Option 15C and Option 15F) were considered for the Papua LNG pipelines nearshore routes with Option 15A selected as the preferred route, which will be assessed in a forthcoming addendum to the 2019 Papua LNG Project – Upstream EIS. The Papua LNG pipelines are to be located on the southern side of the existing LNG Plant jetty and traverse the existing LNG Plant lease boundaries (see Figure 2.1).

The Papua LNG pipelines will be laid on the sea floor by a pipelaying vessel and pulled ashore by equipment located on land. Depending on seabed conditions, the pipe will be placed in an excavated trench, or laid by ploughing or jetting. The Papua LNG pipelines will be concrete-coated to weigh them down and for protection from external influences.

In addition to the Papua LNG pipelines, two additional export pipelines (24-inch diameter each) will also be constructed, along with a pipeline end manifold (PLEM) as part of the Upstream component. The new export pipelines will convey naphtha and condensate from the LNG Plant to a catenary anchor leg mooring (CALM) buoy that will be constructed as part of the Project. The CALM buoy, PLEM and the two export pipelines will be designed and operated as part of Project (see Section 2.4.1 and Figure 2.2).

The Papua LNG pipelines and the export pipelines will share the same corridor for the shore crossings. The current design has the export pipelines in one trench and the feed pipeline in another from the start of the shore crossing to the landfall. Once onshore, all pipelines will be placed in single trench.

The construction component within the Caution Bay marine and intertidal environment of all the pipelines associated with the Papua LNG Project (that is, both the Upstream and Project component operated pipelines) will be assessed in the forthcoming addendum to the 2019 Papua LNG Project – Upstream EIS.



LEGEND

- Village
- Road
- Watercourse
- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- Proposed Papua LNG pipelines route alternate
- Existing and proposed plant layout
- PPFL2 boundary
- APPFL boundary
- Current navigational channel
- Proposed navigational channel

Proposed CALM buoy components

- CALM buoy
- Naphtha and condensate pipelines
- Naphtha and condensate pipelines alternate
- CALM buoy navigational area

Papua LNG Project - Upstream

- Construction

Papua LNG Project - Downstream

- Construction

SOURCE
Infrastructure, roads, watercourses and lease boundary from EMPNGA.
Imagery from EMPNGA and Planet Labs.

0 1 2 km
SCALE 1:80,000
PAGE SIZE: A4
PROJECTION: WGS 1984 UTM Zone 55S

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PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 2.1

Proposed facilities in Caution Bay for the Papua LNG Project – Construction

TETRA TECH COFFEY

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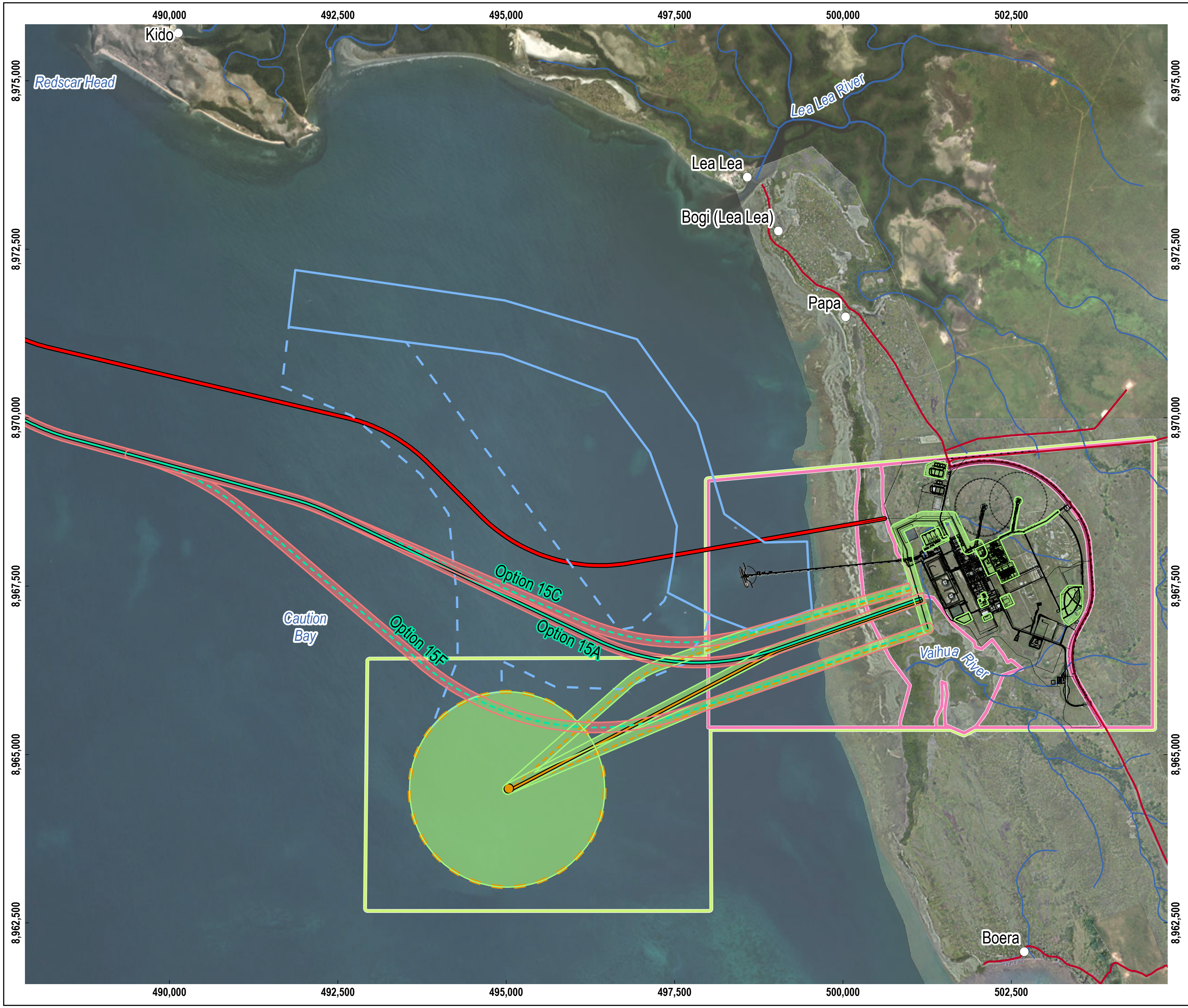
DOC REFERENCE: \\ETSS772GISFS1\DATA$\GIS\300733_EMPNG_PAPUALNGDOWNSTREAM\1_PAPUALNGDOWNSTREAM\GIS\APRX\300733_02_FIGS_A.APRX LAYOUT:300733_02_GIS055_6 SAVED BY: JASON.ORAM 04.07.23 2:31 AM



LEGEND

- Village
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- Naphtha and condensate pipelines
- Naphtha and condensate pipelines alternate
- CALM buoy navigational area

Papua LNG Project - Upstream

- Operations

Papua LNG Project - Downstream

- Operations

SOURCE
Infrastructure, roads, watercourses and lease boundary from EMPNGA.
Imagery from EMPNGA and Planet Labs.

0 1 2 km

SCALE 1:80,000
PAGE SIZE: A4
PROJECTION: WGS 1984 UTM Zone 55S

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PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 2.2

Proposed facilities in Caution Bay for the Papua LNG Project – Operations

TETRA TECH COFFEY

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Pipeline design

The principal design reference for the offshore portion of the Papua LNG pipelines will be AS 2885.4/DNV OS F101, Code for Submarine Pipeline Systems. The short onshore section of the Papua LNG pipelines will be designed principally to AS 2885.1 Pipelines - Gas and Liquid Petroleum - Design and Construction.

The gas pipeline and condensate pipeline will have a nominal design life of 40 years, although are expected to be capable of remaining in service for a longer period. The offshore Papua LNG pipelines will have a constant wall thickness but a variable concrete coating thickness sufficient to stabilise the pipeline on the seabed. The pipelines will self-bury in the seafloor for some of the route and will be installed in a trench in shallow water as they approach the landfall.

Table 2.1 summarises the preliminary design parameters for the Papua LNG pipelines.

Table 2.1 Summary of Papua LNG pipelines preliminary design parameters

Parameter	Feed gas pipeline	Field condensate pipeline
Length within lease boundary (approximate)	6.1 km	5.3 km
Nominal diameter	1,000 mm (40 in)	250 mm (10 in)
Flow rate (approximate)	910 kSm^3/h* (875 Mscf/d†)	8,000 to 15,000 bbl/d‡

*kSm^3/h: thousand standard cubic metres per hour
†Mscf/d: million standard cubic feet per day
‡bbl/d: barrels per day

Papua LNG pipelines route

The Papua LNG pipelines will connect into a short section of onshore pipeline which will be laid to the LNG Plant receiving facilities.

The proposed route for the Papua LNG pipelines (see Figure 2.1) has been determined by several factors, including:

- Taking the most direct line from the tie-in point on land to deep water to avoid effects from surface waves and to minimise the length of the Papua LNG pipelines that needs to be buried.
- Keeping infrastructure footprints close together (such as aligning with the export pipelines).
- Avoiding conflict with existing marine vessel movements, infrastructure, and exclusion zones.
- Reducing potential for environmental impacts, including disturbance to sensitive marine features such as coral and mangroves, and avoiding the cultural heritage restricted area to the south-west of the LNG Plant.
- Considering bathymetry, and the geophysical characteristics of the seabed.

Further optimisation of the final Papua LNG pipelines routing and landfall location will be undertaken during Front End Engineering Design (FEED).

2.1.4 Papua LNG Project – Downstream (the Project)

The Project intends to expand the capacity of the existing LNG Plant located in Caution Bay (Central Province), approximately 20 km north-west of Port Moresby (see Figure 1.2 in Chapter 1 Introduction). The LNG Plant is a component of the PNG LNG Project.

New LNG processing trains are proposed, which will expand the capacity of the integrated LNG Plant by an additional 4 mtpa SDC. Gas for the Project will be supplied from the Elk and Antelope reservoirs in Gulf Province (see Section 2.1.3). An additional 2 mtpa will be routed to the existing LNG Plant trains to utilise latent capacity.

ExxonMobil PNG Antelope Limited (EMPNGA) is the ExxonMobil affiliate responsible for the construction of the Project. Once the Project has been constructed and commissioned, the ExxonMobil affiliate Niugini LNG Operating Company Limited (NLOC), will be responsible for operation of the integrated LNG Plant (both new and existing facilities).

This EIS assesses the following Project components:

- Construction and operation of the Papua LNG Project LNG Plant expansion.
- Construction and operation of the CALM buoy and associated navigational areas and exclusion zones.
- Operation of the PLEM, and naphtha and condensate export pipelines that are connected to the CALM buoy.
- Construction of the onshore portion (after the tie-in point from the Upstream component) of the Papua LNG pipelines (including hydrotest activities).

In Chapter 1 Introduction, the proposed marine facilities for the Project are shown in Figure 1.3 and the proposed onshore facilities for the Project are shown in Figure 1.4.

2.2 DESIGN, SAFETY AND SECURITY

This section describes the design philosophy and specifications for the Project and provides an overview of the safety and security systems that will be implemented.

2.2.1 Design specifications

The Project intends to leverage the existing design and operating philosophies of the PNG LNG Project as much as possible. Project facilities will be designed to maximise synergies with the existing LNG Plant design. High level ‘guiding principles’ have been developed to help govern the design and operating philosophies for the Project. These principles, and the design specifications for the Project, are based on those prepared and used for the PNG LNG Project, where relevant.

Revisions to the specifications relate to aspects such as new or updated industry or regional standards that are applicable to the Project, and from lessons learnt from the PNG LNG Project. Some new specifications are required, including for equipment items that were not associated with the PNG LNG Project.

The design life of the Project will be 30 years, although maintenance and the proving of additional gas reserves could extend the operating life of the integrated LNG Plant.

2.2.2 Safety and security

Prevention of personal injury or loss of life, and physical damage to property and the environment are primary considerations in the design, construction and operation of the Project. Design and protective measures will continue to be considered and provided for all phases of the Project.

Safety aspects of the design are reviewed throughout the life of the Project. Design hazards are identified, and subsequent reduction in risk is prioritised by:

- Elimination of the human interface hazard
- Process design changes or material substitution to reduce hazards
- Administrative and procedural mitigations
- Personal protection equipment or devices.

The Project will incorporate integrated control and safety systems and an information management system to safely operate the integrated LNG Plant and associated infrastructure and facilities. These systems maximise the use of automation to the extent economically justified and minimise local manual control and the need for operator intervention. The systems will be operational at start-up.

Safety and security controls for the Project include:

- Site layout to provide adequate separation between facilities and safe setback distances
- Fire and gas detection, control and alarm systems
- Active and passive fire protection
- Firefighting and incident response capacity
- Plant emergency shutdown systems (automatic and manual) and alarms
- Site security, including fencing, lighting, guards, key control and electronic surveillance
- Safety zones around LNG ships and construction vessels.

2.3 ONSHORE PRODUCTION FACILITIES

This section describes the onshore components of the integrated LNG Plant including the new and existing facilities and infrastructure required to support operation of the new LNG trains. The predicted production rates are also presented for LNG, condensate, and naphtha (a mixture of heavy hydrocarbon liquids produced at the LNG Plant from natural gas).

2.3.1 Production rates

The existing LNG Plant currently produces 8.8 mtpa SDC of LNG and 3.5 thousand barrels per day (KBD) of sweet naphtha. The Project will expand the capacity of the integrated LNG Plant by adding 4 mtpa SDC of new liquefaction capacity, while also providing gas to utilise up to 2 mtpa of latent capacity of the existing LNG trains. This expansion will bring the total capacity at the integrated LNG Plant to approximately 12.8 mtpa SDC.

The LNG Plant will continue to produce sweet naphtha (a by-product of existing LNG Plant production) and begin to produce sour naphtha (a by-product of the Papua LNG production) that will be blended and stored with field condensate prior to export.

The projected SDC production rates during operations for LNG, naphtha and condensate are detailed in Table 2.2.

Table 2.2 LNG Plant stream day capacity summary

Product	Source	Train	Stream day capacity production	Storage
Liquefied natural gas	Existing PNG LNG Project	1, 2	8.8 mtpa	Existing LNG tanks
	Proposed Papua LNG Project	New	4.0 mtpa	
Sweet naphtha	Existing PNG LNG Project	1, 2	3.5 KBD	Existing naphtha tanks
Sour naphtha	Proposed Papua LNG Project	New	3.34 KBD	New condensate tanks
Field condensate	Proposed Papua LNG Project	Direct from the CPF	Max. 16 KBD	New condensate tanks

2.3.2 Processing the gas

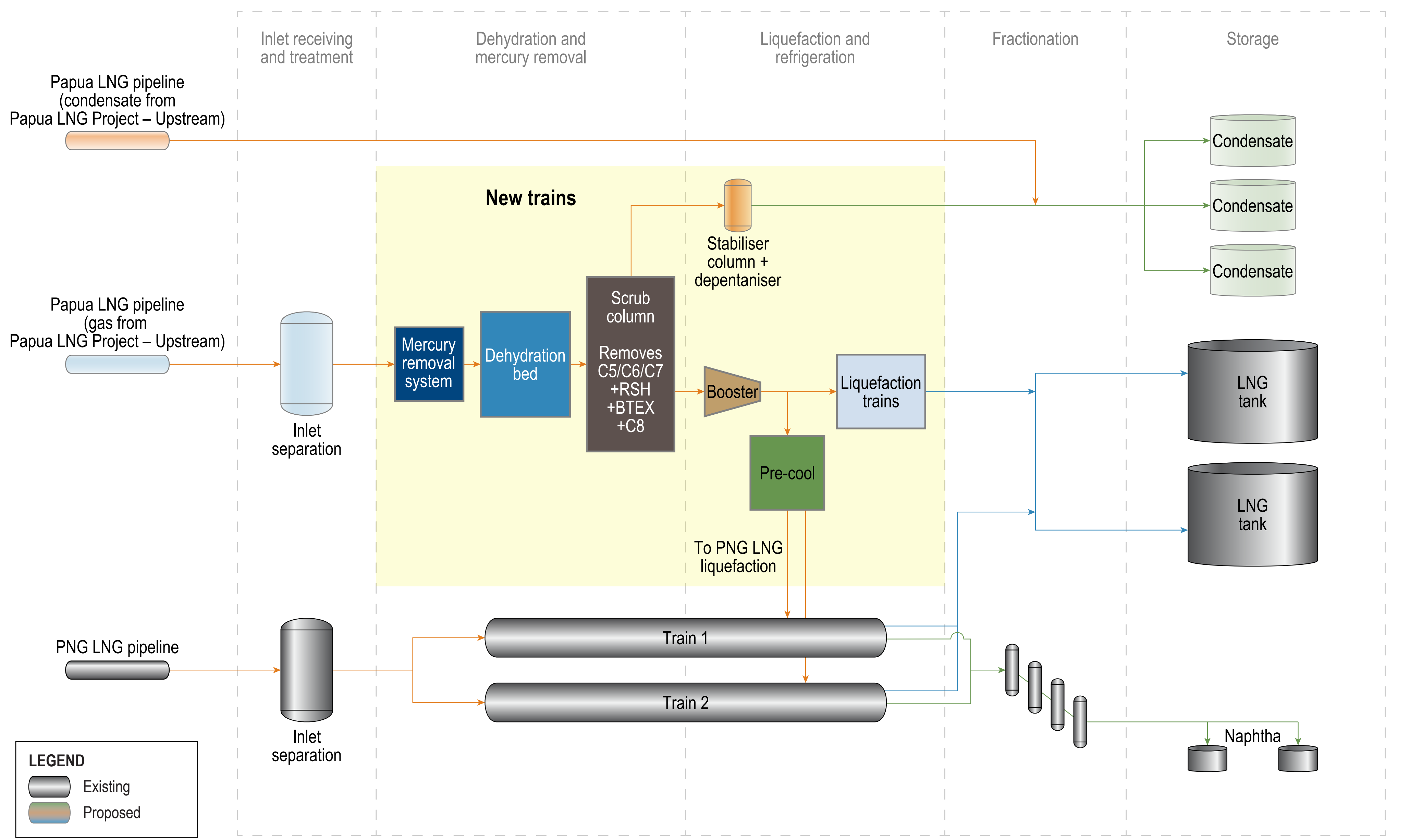
As with the existing trains 1 and 2 (Plate 2.1), processing of the gas into LNG requires removal of impurities and hydrocarbons that are heavier than methane, followed by super cooling to form a liquid. The new trains will utilise single mixed refrigerant (SMR) technology to process the gas.

The main steps in LNG processing are shown in Figure 2.3 and include the following:

- Inlet receiving and treatment
  - These systems receive gas from the pipelines, heat it to prevent hydrate (water) formation, and separate out liquids from the gas.
- Dehydration and mercury removal
  - Gas from the inlet and treatment systems is processed to remove moisture and mercury.
- Heavy hydrocarbon removal
  - The sweet, dry gas stream is fed to the heavy hydrocarbon removal system, which includes the heavy hydrocarbon removal cold box, scrub column feed separator and scrub column. Heavier hydrocarbons (such as ethane, propane and butane) are separated off at this stage to avoid freezing in the liquefication step.
- Liquefaction
  - The gas is cooled to below the methane boiling point of around -161ºC. At this temperature, it liquefies to 1/600th of its original volume.
- Refrigeration
  - These systems cool and pressurise the refrigerants used in the liquefaction systems.
- Fractionation
  - The heavier hydrocarbons removed prior to cooling the gas are processed to produce sour naphtha.

The main products produced by the existing LNG Plant include LNG and naphtha. The LNG Plant also supplies gas to the NiuPower Port Moresby Power Station and the Dirio Central Province Power Station for the domestic electricity market.

Sour naphtha recovered from the new fractionation system will be blended with the Papua LNG field condensate and stored in new storage tanks with a total capacity of 110,000 m^3. The blended product is then pumped from the new condensate storage tanks to the CALM buoy, to be loaded onto tankers for shipping.



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PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 2.3

Overview of proposed LNG processing systems

SOURCE
EMPNGA

DATE: 19.07.23 PROJECT: 754-MELEN300733 FILE: 300733_02_F02.03_GRA DOC REFERENCE: \\ETSS772GISFS1\DATA$\GIS\300733_EMPNG_PAPUALNGDOWNSTREAM\2_GRAPHICS\02_EIS\300733_02_GRA007.AI_7

2.3.2.1 Inlet receiving and treatment system

Gas will be delivered to the LNG Plant through the existing PNG LNG pipeline and the new Papua LNG pipelines, which will come ashore to the south of the LNG Plant jetty and will 'tie in' to the integrated LNG Plant facilities (see Figure 1.3 and Figure 1.4 in Chapter 1 Introduction).

No changes are required to the existing PNG LNG pipeline inlet receiving and treatment system for gas feeding trains 1 and 2. Separate inlet receiving, and treatment systems will be provided for the feed gas supplying the new trains (from the Papua LNG pipelines). These systems will provide pressure control for the feed gas, separate out liquids trapped in the gas, and measure the flow rate of gas at a metering station. A high-integrity pressure protection system (HIPPS), or similar safety system, will be installed between the metering stations and separators to protect the facility from a sudden surge in gas pressure down the pipelines.

High-pressure feed gas (6,500 kilopascals absolute) at a temperature of 27.5°C will be delivered to the integrated LNG Plant via the new Papua LNG gas pipelines. The inlet receiving and treatment system for this gas will be common to the new trains. The system warms the gas and regulates gas pressure before the gas is sent to the feed gas separator where liquids are removed. The liquids from the feed gas separator will be routed to the existing inlet liquid separator, which will be shared across all feed gas separators at the LNG Plant.

Prior to arriving at the inlet separation and treatment system, the feed gas will have undergone acid gas removal, dehydration, and dewpoint control at the CPF being constructed and operated by TotalEnergies, which is being assessed in a separate EIS. No liquids should be present under normal operating conditions. Feed gas from the inlet receiving and treatment system will be sent directly to the gas treatment systems (dehydration and mercury removal) for the new trains.

2.3.2.2 Dehydration system

Moisture in the Upstream feed gas needs to be removed before it enters the liquefaction system. The dehydration system (Plate 2.2) for the new trains will be equipped to dry the feed gas down to less than 0.1 ppm(v) of water to avoid freezing and hydrate formation in the liquefaction system. The new trains will be equipped with a dehydration system even though the Upstream feed gas will have been partially dehydrated during conditioning processes. The gas will not require dehydration pre-cooling and dehydration feed separation.

Molecular sieve drier beds adsorb water and mercaptans (organic sulphur compounds with corrosive properties) within the dehydration system for each train. At any time, two of the beds in the system will be in adsorption mode and one in regeneration mode (drying of the molecular sieve adsorbent). The molecular sieves need to be at a certain temperature for operation, which will be achieved through heating of regeneration gas (recovered from other processes) in a furnace. Regeneration gas recovered from the molecular sieves is used as a source of high-pressure fuel gas for the Combined Cycle Power Plant (CCPP, see Section 2.3.4.2).

The Upstream feed gas contains mercaptans, whereas feed gas from the PNG LNG pipeline does not. The dehydration system for the new trains will be equipped with a mercaptan removal bed.

Water released during the dehydration process will normally be directed to the thermal oxidiser (see Section 2.3.4.17).

2.3.2.3 Mercury removal system

Mercury corrodes aluminium, and even very low traces must be removed to prevent damage to the main cryogenic heat exchangers used to super-cool the gas. After dehydration, the dry feed gas will enter the mercury absorber for the new trains to remove any mercury present to less than 10 nanograms per normal cubic metre of gas (ng/Nm^3). The treated gas is then passed through special filters which prevent impurities entering the liquefication system. The adsorbent will be sent off site for mercury recovery and recycling, and incineration of the stripped carbon, as required. Mercury levels in the feed gas are expected to be so low that the adsorbent may not need to be replaced during the life of the Project.

2.3.2.4 Heavy hydrocarbon removal and booster compression system

The heavy hydrocarbon removal and booster compression system is comprised of a heavy hydrocarbon removal cold box, scrub column feed separator and scrub column. The sweet, dry gas is fed into the system and cooled to -31°C through the heavy hydrocarbon removal cold box, then into the scrub column feed separator. The vapor and liquid from the separator are then separately fed to the scrub column through the pressure letdown valve for further cooling. The scrub column, which is pressure controlled, allows removal of the heavy hydrocarbons to meet the LNG product specification. The liquid is then sent to the fractionation column in the fractionation unit, while the overhead gas is sent to the heavy hydrocarbon removal cold box to recover the cold duty. The treated gas from the heavy hydrocarbon removal cold box is fed to the feed gas booster compressor, which compresses the gas to meet the PNG LNG liquefication operating pressure requirements.

The propane pre-cooling system is used to cool the gas routing to the PNG LNG liquefaction system from the feed gas booster compressor discharge after being air cooled. The propane precooling consists of a series of propane coolers to attain the required cooling temperature; feed gas is then sent to the PNG LNG liquefaction systems, whereas air-cooled gas is routed to the new trains (see Figure 2.3).

2.3.2.5 Liquefaction and refrigeration

The air-cooled treated gas will flow to the new SMR liquefiers, while the propane cooled treated gas will flow to the two PNG LNG trains (trains 1 and 2). The SMR process (AP-SMR™)[2] is licenced by Air Products and Chemicals Inc (APCI) and splits the mixed refrigerant into several streams with different compositions at different pressure levels to make cooling more efficient.

Mixed refrigerant will be utilised to pre-cool, liquefy and sub-cool treated feed gas in a main cryogenic heat exchanger (MCHE) to LNG (Plate 2.3). The MCHE is similar to the evaporator plate inside a refrigerator. The exchanger provides a sufficiently large surface area to efficiently transfer heat from the feed gas to the refrigerant. In the main cryogenic heat exchanger, the feed gas will be further cooled and condensed by the refrigerant stream from the refrigeration system. The cold natural gas will exit the liquefaction process at near atmospheric pressure (approximately 101 kPa) and -161°C and will be pumped to the LNG storage tanks.

The refrigeration system is comprised of the mixed refrigerant loop that will have separate, identically designed, refrigeration compression strings as part of a closed-loop circuit for each new train. Each of the refrigerant compressor strings consist of a low pressure mixed refrigerant compression stage and a high pressure mixed refrigerant compression stage driven by an electric motor that is powered by the CCPP (described in Section 2.3.4.2).

No new refrigerant storage or distribution facilities will be required for the Project. However, an additional refrigerant make-up (C5) requirement may be needed, which will be confirmed during FEED. The systems will require 'tie-ins' to the existing refrigerant storage and distribution system.

[2] The AP-SMR™ process uses a single mixed refrigerant loop to liquefy and subcool the natural gas in a MCHE to LNG. The MCHE is a coil wound heat exchanger type.

2.3.2.6 Fractionation

The hydrocarbon liquids recovered in the heavy-hydrocarbon removal system will be sent to the fractionation system to separate the liquids into high-purity hydrocarbon products. The lighter hydrocarbons (C1 to C5; hydrocarbons with one to five carbon atoms) will be distilled from the liquid to produce a condensate product called naphtha (C5 to C9; a hydrocarbon with five to nine carbon atoms). The fractionation system produces mercaptan containing naphtha (sour naphtha), which will be mixed with the field condensate to produce a sour condensate product that will be sent to the condensate storage tanks. The recovered distillate (C1 to C5) will be reinjected into the MCHE as liquefied petroleum gas (LPG).

2.3.3 Storage and loading

The LNG from both the existing and new trains, will be blended in two existing common LNG storage tanks (Plate 2.4 and Plate 2.5).

Sour naphtha recovered from the fractionation system will be blended with the field condensate and will be stored in up to three new condensate tanks (Plate 2.6). The new tanks provide the facilities needed to store the naphtha and condensate until the next condensate vessel arrives at the CALM buoy. The system then loads the vessel, freeing up capacity in the storage tanks.

2.3.3.1 LNG storage and loading

The existing LNG storage tanks operate at a pressure of approximately 105 kPa and a temperature of -161°C. The storage tanks are filled and discharged from the top, to reduce the risk of a leak, and are enclosed within bunds capable of containing 110% of the storage tank volume.

Boil-off compressors control the pressure in the storage tanks. A closed-circuit system captures LNG that ‘boils off’ the storage tank and loading facilities and returns it to the processing circuit. When outside of the boil-off gas control range, other process control and safety systems will be used to protect the tanks. These systems include control of the maximum vacuum in a tank, use of dry, high-pressure feed gas for pressure control, boil-off gas compressors, and venting controls (which will open on high pressure, sending tank vapour to the low-pressure flare system). The existing naphtha loading arm will be replaced with a new LNG loading arm, as all the naphtha will be exported to the CALM buoy.

The LNG storage tanks have four in-tank LNG loading pumps (one of which will normally be in standby mode). Liquefied natural gas is pumped at a rate of 12,000 m^3/hr through the LNG loading line to LNG carriers. A return line sends vapour generated at the LNG Plant jetty during the loading process back to the plant inlet for re-liquefaction.

2.3.3.2 Condensate storage and loading

Sour naphtha will be delivered to up to three new condensate storage tanks and blended with stabilised field condensate from the Papua LNG condensate pipeline, to form a combined sour condensate product.

The transfer of condensate to tankers will be via the proposed export pipelines and CALM buoy (see Section 2.4 Marine facilities).

2.3.4 Supporting facilities

The LNG Plant facilities and infrastructure comprise various systems that support the operation of the plant, such as those for power generation, freshwater supply and wastewater treatment. The existing systems were analysed during the preliminary design process to determine if they had capacity available to support the Project, which are described below.

Facilities and infrastructure required to support the operation of the new LNG trains are distinguished by those that are shared facilities and those that are new facilities. The shared facilities will be common to existing and new trains and will utilise the available capacity of the existing LNG Plant systems, with some modifications and upgrades to provide expanded capacity where required. New facilities will be for the operation of the new LNG trains.

The existing LNG Plant shared facilities and infrastructure that the Project will tie into, modify or expand include:

- Hot oil system
- Service and instrument air system
- Nitrogen system
- Fresh water system
- Desalinated water system
- Fire water supply system
- Potable water system
- Diesel oil storage and distribution system
- Open and closed drain systems
- Sanitary wastewater treatment systems (sewage treatment plant, STP).

New facilities and infrastructure to be constructed include:

- Integrated fuel gas system
- Tempered water system
- Power generation system (CCPP)
- Highly demineralised water system for the Heat Recovery Steam Generators (HRSGs)
- Wet and dry flare systems
- Thermal oxidiser.

The Project facilities described in this EIS are subject to further refinement and optimisation during the FEED process currently being undertaken, as well as during detailed design and construction. This may include removing certain articles of proposed infrastructure completely, using existing infrastructure, or adjusting facility locations within the LNG Plant boundary.

2.3.4.1 Hot oil system

The hot oil system provides the process heat required for the LNG Plant and can accommodate changing feed gas characteristics of all the processing trains. Excess capacity in the existing hot oil system will be used to cater for integrated LNG Plant demand together with one additional shell and tube heat exchanger, one additional hot oil expansion drum, one hot oil collection drum and one hot oil drain pump.

The system circulates a thermal-fluid-based oil (Therminol 66) heated via exchangers using the heat exhaust from the gas turbines to raise the hot oil supply temperature. Hot oil from processes that require high temperatures is then directed to low temperature users.

Photo credit: ExxonMobil PNG Ltd (pnglng.com)

Plate 2.1
Aerial view of LNG Plant trains 1 and 2

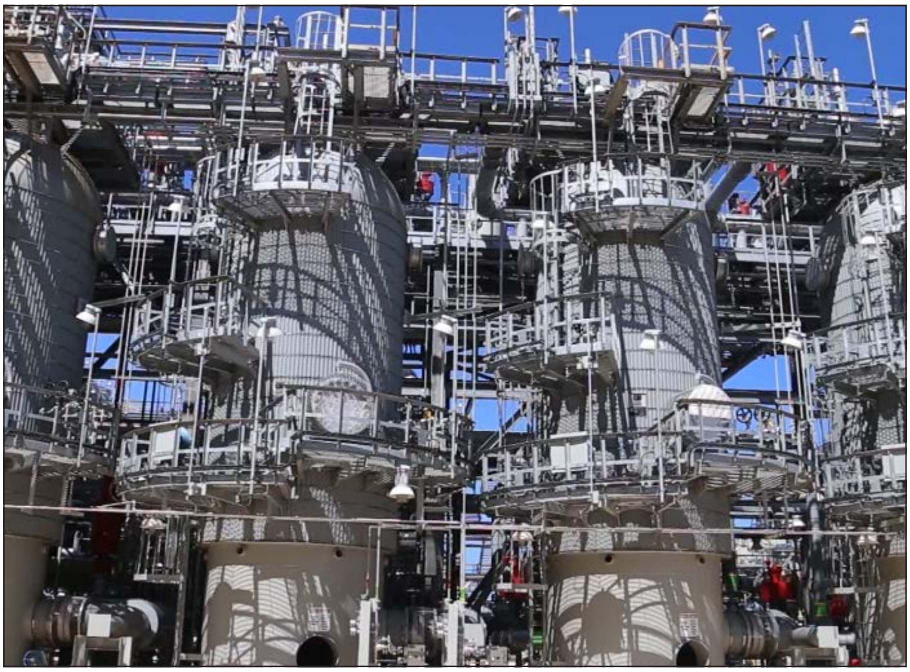

Photo credit: ExxonMobil PNG Ltd (pnglng.com)

Plate 2.2
LNG Plant dehydration system

Photo credit: ExxonMobil PNG Ltd (PNG LNG Environmental and Social Report – Annual 2018)

Plate 2.3
LNG Plant main cryogenic heat exchanger

Photo credit: ExxonMobil PNG Ltd (PNG LNG Environmental and Social Report – Annual 2018)

Plate 2.4
LNG storage tanks and connecting pipework

Photo credit: Tetra Tech Coffey

Plate 2.5
LNG storage tanks

Photo credit: ExxonMobil PNG Ltd (pnglng.com)

Plate 2.6
Naphtha storage tanks

2.3.4.2 Power generation system

The power generation system supplies electricity for LNG processing, and the operation of utilities and other areas, such as the LNG and condensate storage tanks, the LNG Plant jetty, and camps.

Three gas turbine generators (GTGs) currently provide electricity for the LNG Plant, driven by high-pressure fuel gas. An additional generator is utilised during LNG loading. Three additional generators are located at the LNG Plant for sparing.

A new CCPP will be utilised to provide electric power for the integrated LNG Plant. The CCPP will consist of four gas turbine generators, four HRSGs and two steam turbine generators. The CCPP will provide sufficient power to the integrated LNG Plant, therefore three of the seven PNG LNG GTGs will be repurposed as cold standby for the integrated LNG Plant.

Three existing essential diesel generators facilitate a 'black start' of the LNG Plant (that is, restoring plant power without relying on the external electric power transmission network). Three additional essential diesel generators will be added to the existing three. These generators will also be used to provide essential power for selected loads that may be required in the event of an extended outage of the primary power generation system.

Table 2.3 summarises the estimated power demand for the LNG Plant for the current load, Project and total demand for the integrated LNG Plant.

Table 2.3 Electrical power base load, growth and contingency estimates

Facilities	Power demand (kilowatts)
Existing power demand	44,300
Project power demand (with 15% contingency)	193,400
Estimated total demand with the Project	237,700

2.3.4.3 Service and instrument air system

The service and instrument air system supplies dry compressed air for instruments, nitrogen generation, and pneumatic tools. Several additional components will be added to the system to meet the capacity requirements of the Project, including one air compressor package to compress the air and an instrument air receiver. An additional air compressor package and drain separator, and instrument air receiver are required to cater for the service air and instrument air demand of the Project facilities, to maintain a basis of one full air compressor as spare.

2.3.4.4 Nitrogen system

The LNG Plant uses nitrogen gas for a range of process and maintenance purposes including purging of equipment on start-up and shutdown, as a make-up to refrigerant circuits in the LNG trains, to maintain inert atmospheres, and to purge various equipment. Purged gas is vented to the flare systems.

The LNG Plant currently has two types of nitrogen generation packages. A cryogenic-type generation package can produce approximately 700 Nm^3/hr. Pressure-swing adsorption (PSA) type packages each produce approximately 350 m^3/hr of nitrogen. Additional PSA packages will likely be added to the two existing PSA packages.

2.3.4.5 Freshwater system

The existing freshwater system desalinates seawater taken from Caution Bay and distributes it to various users at the LNG Plant. Seawater is pumped to the desalination system using a seawater intake pump mounted on the seawater intake located on the LNG Plant jetty. The current intake of seawater for the freshwater system is approximately 49.2 m^3/h. The seawater intake rate will increase to approximately 59.2 m^3/h to cater for additional water demand for the Project. The existing seawater intake is located on the LNG Plant jetty and has enough capacity to accommodate the increased intake. During construction, a temporary desalination unit will also be required to provide additional water resources to support construction activities, for domestic, civil, and testing purposes.

Extracted seawater is pre-treated using a series of filters and clarifiers before undergoing reverse osmosis to produce fresh water. This desalinated water is stored in dedicated tanks prior to distribution. The water is pumped directly to other water systems (service water system, tempered water system and firewater system), or is processed further to meet the water quality required for the potable and demineralised water systems. An upgrade to the existing freshwater processing system is required to support the Project.

Wastewater produced from the desalination process includes backwash and rinse water, which may contain traces of chemical additives, and brine. These streams are sent to the retention pond for final settling to meet the required water quality criteria before discharging into the sea via a mixing pit. Brine is currently discharged at a flow rate of approximately 22.9 m^3/h. The discharge of brine water and other treated wastewater from the retention pond will increase to approximately 284 m^3/h during construction of the Project and 82.4 m^3/h during operation in a no rain scenario. A secondary retention pond for discharge during the operations phase of the Project is also being considered and evaluated. The existing mixing pit and outfall location will be utilised for the secondary retention pond, if required.

During construction, the existing retention pond will manage the increased volumes of surface runoff from the process area as well as brine from the existing and temporary desalination facilities. Water from the retention pond will then transfer to the mixing pit where it also mixes with non-process area stormwater. From the mixing pit, these flows then form part of a continuous discharge to the sea at the existing outfall, in compliance with permit discharge criteria.

2.3.4.6 Demineralisation water system

Desalinated water from the freshwater system is supplied to the demineralised water treatment system which produces deaerated, demineralised water and distributes it to users such as the gas turbines (for washing), and the tempered cooling water system. The design capacity of the existing system is sufficient to meet the demand for demineralised water from existing operations and the Project.

2.3.4.7 Highly demineralised water system

The highly demineralised water system includes a dedicated seawater intake pump, a desalination unit and storage tank. The highly demineralised water system will supply the make-up water for the steam system. Steam blowdown from the HRSGs or other steam and condensate system losses will be replaced by the feed from the highly demineralised water system. The system will produce make-up water equivalent to 5% of the total mass of steam produced by the HRSGs. The make-up water will flow to the steam condensate tanks where the flow rate will be controlled. Reverse osmosis and electro-deionisation technologies will likely be required for the system outlet stream to meet boiler feed water make-up specifications. The highly demineralised water system will also address the make-up water demand for the CCPP cooling tower.

2.3.4.8 Firewater supply system

The fire protection system includes both passive techniques and active techniques. Passive fire protection does not rely on activation and will be applied where immediate protection is required for a limited period. Active fire protection will be used where long duration firefighting is needed.

The existing firewater supply system will need to be updated to support the Project. The system includes water mist systems for the gas turbine drivers, fixed clean agent fire extinguishing system for the marine terminal control shelter and fire hoses and portable fire extinguishers are located throughout the plant. The existing fire truck will be available for response to support firefighting efforts against incipient fires and grass fires.

2.3.4.9 Potable water system

Potable (tap) water is provided to camp and other buildings as well as to safety showers and eye washes. The treated potable water is transferred to a storage tank and pumped to users. Additional equipment or upgrades are required to meet the demands of the Project.

2.3.4.10 Diesel oil storage and distribution system

The diesel oil storage and distribution system receives, stores and distributes diesel oil for use in the LNG Plant. Diesel is transported to the site by truck and loaded into the diesel storage tank. A pump system transfers the diesel to users such as firewater pumps, diesel generators and vehicle fuelling areas. The current design capacity of this system can cater for both existing diesel demand and that of the Project and no upgrades are required.

2.3.4.11 Open and closed drain system

An existing system of open and closed drains separate clean from potentially contaminated surface water. The Project will use existing and new drainage systems.

Drainage systems will direct the surface stormwater to the sedimentation pond for settlement, where solids will be contained, and water directed into the sea. Closed drains direct potentially contaminated runoff, washdown, spills and firewater from sealed (bunded) process areas for various forms of treatment. Oil-contaminated surface runoff and chemical contaminated water will be collected and treated through existing systems.

2.3.4.12 Sanitary wastewater treatment systems

Sanitary wastewater is generated from toilets, washrooms, kitchens and buildings.

For the PNG LNG Project, treated wastewater from an existing STP is disposed of to a leach field (surface irrigation) dedicated to existing operations that has been approved and is currently operational, as of February 2023. The leach field irrigation system is located to the southeast of the existing retention pond.

An additional leach field is being considered as a potential option to accommodate the increased volume of sanitary wastewater discharge during Project operations. Ongoing engineering evaluations are occurring in this regard; however, the expansion is not proposed as part of current approvals associated with this EIS for the Project.

For the Project, a new STP will be developed, located within the LNG Plant process area. Sanitary wastewater will be collected at sanitary collection pits prior to being pumped to the new STP. Treated sanitary wastewater will be sent to the existing retention pond, prior to being discharged to sea via the mixing pit. Excess sludge from the sanitary wastewater treatment facility will be dewatered and incinerated.

2.3.4.13 Waste management facilities

Waste will be generated throughout the life of the Project including non-restricted waste (such as domestic garbage, plastic, wood, scrap metal and tyres) and restricted waste (such as waste oil, oily contaminated waste and fuels, batteries and medical waste).

The LNG Plant has existing waste management facilities for storage, segregation, treatment and disposal, including engineered landfills for non-restricted wastes. The onsite waste management facilities are managed by a third-party waste management company which also utilises its facility for storage and disposal. Options being reviewed for waste facilities for the Project include:

- Temporary onsite storage and segregation of waste, with transport to, and disposal at, a third-party waste management facility.
- Onsite incinerator for disposal of liquid wastes only and engineered solid waste landfill within the integrated LNG Plant for disposal of non-restricted waste. An ExxonMobil-approved waste management facility will be used for restricted waste.

During construction, some temporary facilities will be established to manage waste, including waste segregation and storage areas. Waste will be either incinerated, landfilled or shipped for offsite disposal depending on the nature of the waste. Hazardous waste will be stored temporarily in designated areas and exported to ExxonMobil approved facilities for final disposal.

The management systems for solid and liquid restricted and non-restricted waste generated by the Project are described in Chapter 16 Waste Management.

2.3.4.14 Fuel gas system

A new fuel gas system common to the new trains will be constructed.

Sources of Project gas will be:

- Boil off gas from the LNG storage tanks
- Marine boil of gas from the LNG ships during loading
- Make-up fuel gas from the sweet gas stream downstream of the dehydration system
- Liquefied petroleum gas (LPG) vapour from the existing fractionation units of the LNG Plant and new facilities.

A new fuel gas system will cater to the Project fuel gas requirement, and a boil off gas compressor will be installed, that will be the same as the existing boil off gas compressor at the LNG Plant. The LNG Plant and Project fuel gas systems will be interconnected at the boil off gas compressor discharge. The Project fuel gas system will provide supply to the existing LNG Plant fuel gas system to enable black-start of the LNG Plant when LNG Plant trains are not available.

2.3.4.15 Tempered water system

The tempered water system is a closed-loop cooling water system, where cooling water is continuously circulated via a dedicated circulation pump. A new system common to the new trains will be constructed, including a header tank, air cooler and three circulation pumps.

2.3.4.16 Wet and dry flare systems

Flare systems are provided in gas processing facilities to safely dispose of hydrocarbon fluids (gases and liquids). Such fluids can be released from pressure safety and blowdown valves during a process outage caused by disruptions to operations, and during start-up and shutdown of the plant, maintenance activities, and emergencies.

The current flare system at the LNG Plant consists of a wet (hot) flare system, dry (cold) flare system and tankage (low-pressure) gas flare system. New cold (dry) and hot (wet) flare systems, with the same configuration as the existing systems, will be provided to support the new trains, located to the east of the existing flare stack (see Figure 1.3 in Chapter 1 Introduction). These new systems will be dedicated to the new trains and no tie-ins will be provided between the existing, and new, wet and dry flare systems.

The new flare systems will be sized to accommodate the largest expected single event requiring gas release. For an LNG Plant, this is typically the discharge from a blocked refrigerant compressor. The flares will be designed to provide smokeless flaring over a maximum range of operation, and all flare headers will be continuously purged with low-pressure fuel gas.

The low-pressure flare demand of the new facilities will be met by the existing flare system. This system will provide pressure relief for the LNG storage tanks and loading system, and the boil-off gas system.

2.3.4.17 Thermal oxidiser

The thermal oxidiser is an incinerator that will convert hydrocarbons and mercaptans in the mixed gas stream into carbon dioxide and sulphur oxides. The system will be designed to meet all emissions limits. The necessity of engineering controls such as quenchers or scrubbers will be assessed during FEED.

2.3.4.18 Fences and access

Changes to some existing fencing will be required, as well as upgrades to entrance gates and internal roads. These are discussed further below.

Fences

All permanent project infrastructure at the LNG Plant (on land) will be within perimeter and security fences. Some minor realignment of the existing fences will be required. A temporary laydown area will be located within the perimeter fence but outside the LNG Plant security fence.

The purpose of the security fence (see Plates 2.7, 2.8 and 2.9) is to prevent access to the LNG Plant site during construction and operation to those persons who do not have appropriate authorisation to enter. The entire length of the fence is equipped with an electronic intrusion detection system. A 6-m-wide public road is located between the perimeter and security fences, and access to the site is provided from this road via three existing entrance gates.

Temporary fences will be erected during construction for safety and security purposes including at the location of upgrades to existing utilities, around material storage areas, and office locations.

Site roads and walkways

The Project will use a combination of existing and new roads and walkways within the LNG Plant site. Existing roads and walkways link the process, utilities, diesel storage and flare areas, and camp facilities, and are illuminated at night. Additional roads and walkways will be provided in the areas where new facilities and plant will be constructed. Areas requiring heavy truck traffic and delivery vehicles have concrete paving, for example, all entrances, gates, waste enclosures, service docks, and service yards. All new roads and walkways will have adequate lighting.

Photo credit: Tetra Tech Coffey

Plate 2.7
LNG Plant security fence

Photo credit: Tetra Tech Coffey

Plate 2.8
LNG Plant security fence (close up)

Photo credit: Tetra Tech Coffey

Plate 2.9
LNG Plant security fence and bypass road

2.4 MARINE FACILITIES

Marine facilities at the LNG Plant site include an existing LNG Plant jetty extending approximately 2 km offshore into Caution Bay. The existing berth at the LNG Plant jetty provides a platform that allows LNG and naphtha from the storage tanks to be loaded onto LNG carriers. The berth currently manages an estimated 110 to 120 LNG carriers (based on 164,000 m^3 LNG carriers) and 10 to 12 naphtha tankers at the berth annually. The expansion of the LNG Plant will increase ship traffic, with approximately 60 to 70 additional LNG carriers and 10 to 12 additional condensate cargos per year.

2.4.1 CALM buoy and export pipelines

The CALM buoy concept has been selected for the expansion of the existing marine facilities to accommodate the increase in LNG and non-LNG liquids production and subsequent increase in the number of vessels. This concept will delink the non-LNG liquids (naphtha and condensate) from LNG offloading at the existing berth. The concept includes a second shipping channel, additional navigational and monitoring systems, and approximately 7 km of subsea pipelines for the naphtha and condensate. The CALM buoy option is shown on Figure 2.1 and Figure 2.2. Additional upgrades to the existing berth are being considered to improve maintainability such as the installation of a maintenance crane and replacement of the existing condensate loading arm with an LNG loading arm.

The CALM buoy will have a multi-product swivel and dedicated offloading hoses for each product. The buoy has an estimated hull diameter of 12 m and a height of 5 m. The mooring system will have six chains with estimated length of 400 m each. Two under-buoy hoses will be installed, connecting the CALM buoy to the PLEM (Section 2.4.1.1), that will potentially be arranged in a Chinese lantern configuration, where the two symmetrical hoses curve radially outwards (Figure 2.4).

The location of the CALM buoy will require approximately 7 km of subsea export pipeline(s) for the naphtha and condensate that will be constructed as part of the Upstream component, though these pipelines will be operated as part of the Project operations (as such, the operation of the export pipelines is assessed in this EIS). For the landfall portion of the export pipelines, these pipelines will be co-located with the Papua LNG pipelines and installed within the same onshore trench. Trenching will be required for all pipelines less than 15 m water depth. The offshore pipeline construction activities up until the scope break are assessed in the 2019 Papua LNG Project – Upstream EIS with additional assessment to be provided in a forthcoming EIS addendum. During operations, the CALM buoy will be subject to a 500-m-radius exclusion zone always restricting access by all public vessels, and a 1,200-m-radius exclusion zone that applies during offloading, for approximately two days twice per month. A 1,650 m radius ‘hazard to navigate zone’ will also always apply to signify that caution is required, however public vessel access will not be restricted between the 1,200 m and 1,650 m radius areas.

Further optimisation of the final export pipelines routing and landfall location will be undertaken during FEED.

2.4.1.1 PLEM design

The export pipelines will terminate at the PLEM. The PLEM will be designed to have piping for each product and allow for pigging. There will be pig launchers and receivers onshore and four remote actuated valves controlled by the CALM buoy hydraulic power unit. Operation of the PLEM will be managed as a component of the Project and is assessed in this EIS, while impacts associated with installation of the PLEM will be assessed as part of a forthcoming addendum to the 2019 Papua LNG Project – Upstream EIS.

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FIGURE 2.4

Chinese lantern configuration

SOURCE
Royal HaskoningDHV, 2022

TETRA TECH COFFEY

2.5 WORKFORCE, ACCOMODATION AND TELECOMMUNICATION

This section describes the Project workforce required for construction and operations, accommodation facilities for workers, the strategy for transportation of materials and personnel, and the telecommunication system. Workforce and accommodation assumptions and proposed arrangements are based on incorporating the requirements of both the Upstream and Project construction activities.

2.5.1 Workforce

Workforce requirements for the Project are described below for both construction and operation phases. The Project is expected to leverage the skillset and experience of the directly employed workforce and contractors of the PNG LNG Project. The comprehensive PNG LNG Project workforce development approach has resulted in a workforce of approximately 2,700 people, comprising 91% Papua New Guineans, as of 2023.

2.5.1.1 Construction

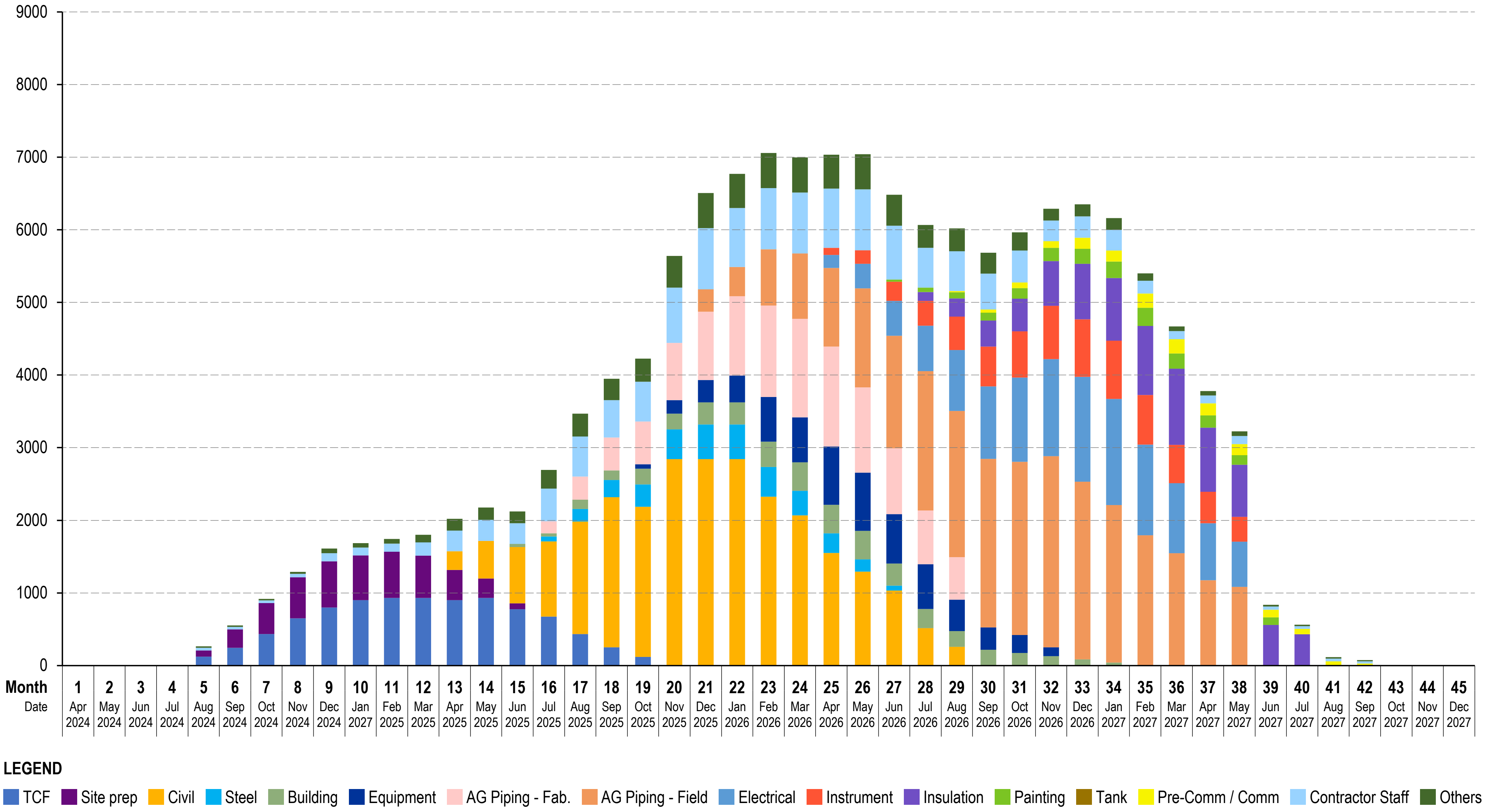
An estimated peak construction workforce of between 5,000 and 7,000 personnel will be needed to construct the Project over the planned four-year period. Figure 2.5 shows the distribution of total workforce numbers for the Project over the four-year construction period. The estimated workforce numbers are representative and will be revised during FEED. Many construction positions involve working a rotating shift and will be filled on an as-needed basis. Rosters for different personnel will also vary. For example, positions that require people to work a rotating shift of 28 days-on and 14 days-off, will require three people to perform two positions. The actual number of people employed during construction therefore will be different from the number of full-time equivalent positions.

The workforce will consist of Papua New Guinean and expatriate employees, contractors, and support staff. Depending on the phase of construction, the total workforce positions to be filled by Papua New Guineans are estimated to be around 20% with an ambition to maximise the opportunities to Papua New Guineans, where possible, through the National Content Plan. The National Content Plan development includes a combination of fair, transparent measures intended to maximise the opportunities for PNG recruitment and workforce development. If recruitment efforts prove unsuccessful to identify PNG citizens with necessary skills, recruiting efforts will then consider international labour sources. Recruitment of foreign nationals will be conducted in full compliance with the Department of Labour and Industrial Relations Work Permit Guidelines governing foreign employment in PNG. An equal opportunity recruitment system will be established that is transparent and open to all regardless of race, political opinion, colour, creed, or gender.

2.5.1.2 Operation

The Project will require a mix of expatriate personnel and Papua New Guineans. Recruitment and hire of Papua New Guineans will occur, with comprehensive general and project-specific skills training provided prior to and after start-up. Expatriate operations staff will provide needed operations experience and serve as mentors to the Papua New Guinean staff to accelerate skill development, where required. The number of expatriate staff is expected to steadily decline over time as Papua New Guineans acquire competency and experience in accordance with training plans. Operation will involve long-term, permanent positions. Personnel will work a 28 day on/28 day off rotation with 12-hour shifts for most LNG Plant operations, maintenance/turnarounds[3], and key logistics positions.

[3] Turnarounds are scheduled periods of non-production at the LNG Plant, when maintenance, cleaning, inspection, and repair activities are carried out.



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PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 2.5

Estimated workforce distribution over the four-year construction period

SOURCE
EMPNGA

TETRA TECH COFFEY

The permanent operations and maintenance workforce is expected to increase by approximately 50 technician personnel to support the integrated LNG Plant. Support staff is anticipated to increase and will be evaluated throughout FEED. The existing operations camp is sufficient to meet increased capacity from the Project. Due to the proximity to Port Moresby, some positions at the LNG Plant will be non-rotational, with personnel living in accommodation in Port Moresby.

2.5.2 Accommodation

Accommodation for workers on the Project will mainly be in camps located on the LNG Plant site.

2.5.2.1 Pioneer camp

Both onsite and offsite options for pioneer camps are being considered to accommodate the approximately 500 workforce and staff requiring accommodation. This workforce will be involved in site preparation such as construction of the company and subcontractor camps for the construction phase. The onsite option will utilise available capacity of the existing operations camp and a new build to be located immediately to the south of the existing operations camp. Laundry, housekeeping and cleaning, waste collection, and security services will be provided at the new build camp and will utilise the medical and catering facilities of the existing operating camp. Third-party managed offsite camp options will also provide and manage the same required amenities and utilities.

2.5.2.2 Construction camps

Construction camps for company and contractor personnel will be established to cater for the workforce and staff requiring accommodation, numbering between approximately 4,000 to 6,000. These estimated workforce numbers will be refined during FEED. Construction camps will be located on the LNG Plant site, to the southwest and to the north of the existing operations camp. The location of camps and associated facilities and utilities are shown on Figure 2.6. The bed capacity also includes an estimated 50 beds required to accommodate personnel associated with the Upstream construction activities, associated primarily with installation of the Papua LNG pipelines and the export pipelines.

Camp facilities, boundary roads and utilities will be provided and maintained by the construction contractor. Catering, laundry, housekeeping and cleaning, waste collection, and security services will be provided at EMPNGA camps, while construction contractors and subcontractors will be responsible for operating and servicing their camps (including the above services).

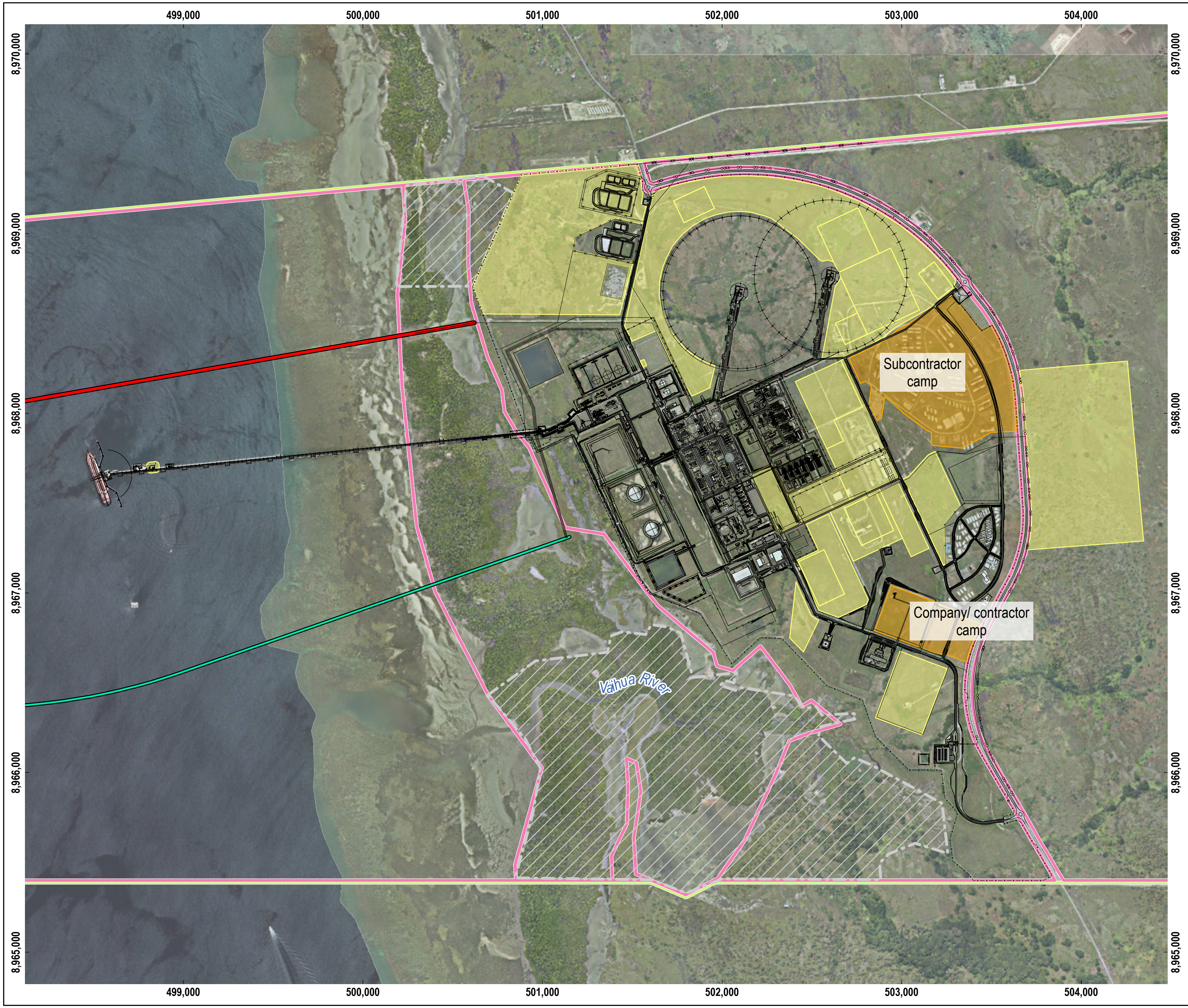
2.5.2.3 Operations camp

The existing operations camp (Camp A) for the operations workforce is located in the south-east section of the LNG Plant (see Figure 2.6).

The existing operations camp will not be expanded. The existing Camp A has approximately 500 operational beds, of which approximately 300 personnel represent the steady state requirement on site. This provides approximately 200 beds for overflow capacity for events such as major maintenance programs and unplanned events.

The staffing change from a 28/28 rotation to the walk-in/out strategy for local workers decreases the overall camp requirement during operations from 300 to 200 by 2026.

Camp A is anticipated to meet the capacity of the integrated LNG Plant.



LEGEND

- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- Existing and proposed plant layout
- Temporary construction area
- Temporary camp
- PPFL2 boundary
- APPFL boundary
- Cultural heritage restricted area

SOURCE
Infrastructure, cultural heritage and lease boundary from EMPNGA.
Imagery from EMPNGA and Google Earth.

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FIGURE 2.6

Temporary construction areas and camp locations

TETRA TECH COFFEY

DATE: **18.07.23** PROJECT: **754-MELEN300733** FILE: **300733_02_F02.06_GIS**

2.5.2.4 Camp utilities

A range of utilities will service the existing and temporary camps including electricity, potable water, wastewater treatment, and firewater systems (see Section 2.3.4 Supporting facilities).

The LNG Plant power generation system will supply electricity to the existing operations camp via buried distribution cables. The existing operations and temporary camps will each be equipped with back-up diesel generators. Contractors and subcontractors will be responsible for procuring any additional electrical equipment or consumables as required.

The LNG Plant potable water system will be upgraded or expanded to provide water to the existing and temporary camps to meet an assumed daily requirement of 360 litres per person per day. Domestic wastewater and sewage will be stored in holding tanks for transport to sewage treatment plant facilities. The existing firewater system will be upgraded or expanded to cover both the existing and temporary camps. The LNG Plant firewater tank will back-up the camp systems.

2.5.3 Telecommunications systems

The existing communications link between the LNG Plant and Port Moresby will provide internal voice, data, control and security telecommunication, and access to external networks for the Project. The telecommunications and security systems that will be integrated into existing systems include public address and general alarms, page party system (for control room and field communication), cabling, ship-to-shore communication, security closed circuit television, access control and a wireless network.

The existing communications tower at the LNG Plant will also support other local services, including VHF FM mobile radio, AM marine and AM aviation radio antennas. New telecommunication cabinets will be installed inside new substations and equipment rooms, and cabinets will be extended as required to provide sufficient capacity.

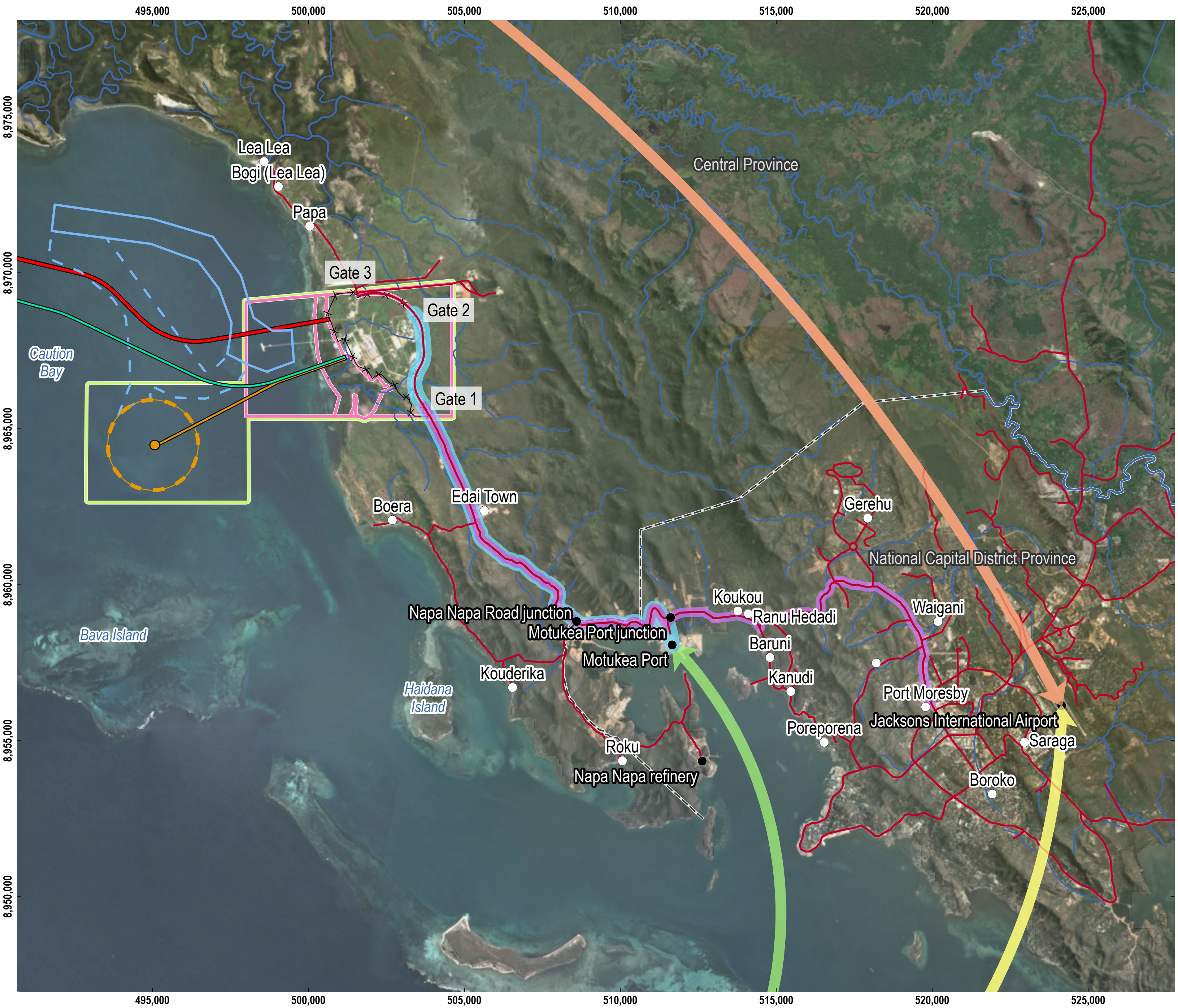
2.6 LOGISTICS STRATEGY

The Project will require the transport of people and materials to the LNG Plant by air, sea and road (Figure 2.7). The logistics strategy for the Project aims to provide orderly movement of personnel into, out of and within Papua New Guinea, organise a transportation network across all modes of transport and ensure logistics infrastructure and support arrangements are in place to operate the Project.

Most construction material will be imported by ship via Motukea Port and trucked to site along the Lea Lea Road. For these activities, the road to Motukea Port may require repairs or upgrade, including relocation of overhead cables, to accommodate heavy and/or overweight vehicles and transport of large modules. Transport of construction and operations personnel from Port Moresby will also occur along this road. The main entrance to the LNG Plant may also need to be upgraded, as will the existing bypass road outside the fence between Gate 1 and Gate 3 (see Plate 2.9).

An estimated 200,000 tonnes of cargo are expected to be imported through Motukea Port over the four-year construction period. The bulk of the cargo will be shipped and transported to the LNG Plant in the second year of construction (with a conservative peak of approximately 100,000 tonnes in quarter four of year two, though notably less during other periods) and moved by truck along the highway each month, with a peak of approximately 500 truck movements per month. Heavy haul of modules and other large equipment such as compressor packages and gas turbine generators will require approximately 20 movements over a period of approximately three months.

Smaller sensitive equipment and time constrained shipments may be transported by air to Jacksons International Airport in Port Moresby and trucked to the LNG Plant.



LEGEND

- Village
- Point of interest
- Road
- Watercourse
- PNG LNG pipeline
- Proposed Papua LNG pipelines route
- LNG Plant security fence
- PPFL2 boundary
- APPFL boundary
- Current navigational channel
- Proposed navigational channel

Proposed CALM buoy components

- CALM buoy
- Naphtha and condensate pipelines
- CALM buoy navigational area

Transport and logistics

- Air transport (PNG)
- Air transport (overseas)
- Sea transport (freight)
- Road transport (freight)
- Road transport (people)

SOURCE
Logistic routes (indicative only) from Tetra Tech Coffey.
Infrastructure, roads, watercourses and lease boundary from EMPNGA.
Provinces from NSO.
Imagery from Planet Labs.

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PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 2.7

Logistics overview

TETRA TECH COFFEY

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2.7 CONSTRUCTION

The Project involves the expansion of an existing LNG facility, leveraging the available capacity in existing systems. As such, most of the onshore construction is required in pre-disturbed areas that have little or no existing facilities and infrastructure present but are located within the LNG Plant lease. Construction in some brownfield areas will coincide with the ongoing operation of the existing LNG Plant facilities.

Construction planning will identify the key interactions between project work and existing operations, risks associated with these interactions, and plans to mitigate the risks. The majority of undisturbed onshore work areas associated with the Project are adjacent to existing brownfield sites and include the new process trains, new facilities common to the new trains, the new wet and dry flare system, and new condensate storage tanks. Brownfield areas will include all areas where tie-ins are required between project and existing components such as structural elements, piping, electrical, instrumentation and controls, as well as building modifications (for example, the control centre). Marine facilities, including the CALM buoy represent a greenfield site.

The following sections describe the timing, sequencing and main activities associated with construction of the Project. Information on the construction workforce and accommodation and logistics for construction is provided in Section 2.5 Workforce, accommodation and telecommunication and Section 2.6 Logistics strategy, respectively.

2.7.1 Project schedule and sequencing

Construction of the Project is expected to take approximately four years. The indicative Project development schedule is shown in Figure 1.5, Chapter 1 Introduction. Site preparation will commence in parallel with some elements of the detailed design process. Commissioning and start-up are expected to commence from 2027 onward.

The sequence of construction activities has been developed based on the following principles:

- The new trains will be constructed at the same time, with a sequential start-up of each individual train.
- Systems common to each new train will be constructed and commissioned as required for the preceding train.
- Critical works to tie-in new systems to existing systems, which require shutdown of either one or both existing trains, will be undertaken within planned shutdown periods.

2.7.2 Temporary construction areas

Temporary facilities will be required during construction and include laydown areas, offices, workshops, concrete batching plants and desalination plant. These facilities will be located within the existing LNG Plant lease boundaries. A temporary construction laydown area will be located outside of the LNG Plant fence line.

Temporary laydown and storage areas are required during construction to receive, store and partially assemble project materials and equipment. Large and/or heavier permanent equipment will be directly delivered to its installation site to avoid the inefficiency of double handling.

Laydown areas will be located within the temporary construction areas (see Figure 2.6) accounting for site topography, efficient traffic routes to work areas and delivery routes from the main gate, and the timing of construction works.

These areas will be used for temporary offices, warehouses and tool stores, construction equipment storage and maintenance areas, workshops, and fabrication yards. Suitable firefighting systems, including fire hydrants, fire extinguishers and warning signals, will be provided for all warehouses and laydown areas. The temporary construction areas are detailed in Table 2.4 and will require approximately 342 ha of land.

A typical laydown area is designed with a centre two-lane roadway and laydown areas on either side of the roadway. This layout allows trucks and cranes to access material from the road. Materials that cannot be stored in open areas or require a special environment, such as air conditioning, will be accommodated within warehouses.

Table 2.4 Temporary construction areas and estimated required land areas

Area	Approximate land area required (ha)
Batch plant	2.5
Civil and building laydown	7
Office facilities	9
Contractor material control laydown	4.3
Electrical and instrument laydown	4.5
Equipment laydown	1.8
Piping / paint / insulation laydown	9.3
Steel structure laydown	12.2
Subcontractor office	4.4
Warehouse	10.9
Water storage	2
Temporary desalination plant	0.1
Temporary water intake	0.4
Company / contractor camp	13.9
Subcontractor camp	48.5
Identified potential usage areas	84.5
Common spaces	10.5
Stockpiles	116.2
Total temporary areas	*342*

2.7.3 Temporary camp construction

Temporary construction camps (see Section 2.5.2 Accommodation) will be set up to accommodate the construction workers building the Project. Most of the utilities (such as power and water supply) required to run the camps will be provided through the existing utilities at the LNG Plant. Some services such as waste management will be provided at each camp, along with back-up diesel generators.

Accommodation and other buildings for construction camps will be prefabricated in modularised form to facilitate transportation to the site by road. The buildings will be lifted off trucks by a crane, set into place on prepared foundations and connected to services (electricity, water, sewage, and telecommunications) as required. The temporary camp construction will require approximately 63 ha to develop.

2.7.4 Site preparation

Work will be required to prepare the site for the main construction activities by establishing temporary infrastructure and facilities that will be used throughout construction, and which allow the workforce to be mobilised to the site.

The main activities in this phase are focused on making the site secure and safe for the workforce and preparing the construction areas. Accommodation camps (see Section 2.5.2 Accommodation) will be established, along with two concrete batching plants, and utilities such as for water and wastewater, power and telecommunications. The main gate entrance and access/haul road inside the security fence (see Section 2.3.4.18 Fences and access) will also be upgraded.

Site preparation in areas where new facilities will be located (greenfield areas) includes vegetation clearance, grading and foundation excavation, and installing surface water drainage systems.

2.7.4.1 Vegetation clearance

Onshore areas proposed for construction (in particular uncleared areas) will be surveyed and marked out. The extent of site clearance and incidental site disturbance will be minimised by the demarcation of areas that require clearing and by confining traffic to designated tracks and laydown areas.

The LNG Plant site is largely already cleared of vegetation, although some remnant patches will need to be cleared, including an approximately 60 ha laydown area located outside of the security fence to the east of the LNG Plant. Clearing of vegetation for construction of new infrastructure and facilities will be undertaken to minimise the potential for soil erosion from exposed surfaces. Vegetation will be cut as close as possible to the ground without striking the earth. Cut vegetation will be carried to a designated stockpile area for later reuse for soil stabilisation and rehabilitation works and will not infringe upon areas required for maintenance and operations.

Apart from areas required for permanent infrastructure and access, the area cleared during construction will be reinstated, noting the need to maintain short grass within the LNG Plant security fence. The permanent disturbance area for the Project is expected to be approximately 70 ha for the LNG Plant (on land), including 4.5 ha for pipeline trenching from the tie-in point to the LNG Plant and associated utilities and infrastructure, and 18 ha (subsea) for the export pipelines[4] and CALM buoy.

2.7.4.2 Grading and foundation excavation

Greenfield construction sites will be graded and excavated to the designed levels and slope to provide a base for the new and expanded accommodation camps, new LNG trains, waste management facilities, storage tanks, a retention pond and associated infrastructure. These activities will be undertaken using front-end loaders, bulldozers, graders, excavators, rollers, and dump trucks. No drilling or blasting is expected to be required. Water trucks, water sprays or dust suppressants will be used as necessary to manage dust. Areas will be trimmed to final grade and compacted.

During grading, topsoil (the top layer of fertile soil, including all plant matter that has not been cleared) will be progressively stripped and either used in rehabilitation works or stockpiled in spoil areas on the site. Topsoil will be respread over the final surfaces of areas designated for rehabilitation and landscaping to support regrowth. Where topsoil is stockpiled for later use, stockpiles will be stabilised, and erosion control measures implemented in accordance with the Project's environmental management plan.

Excavated cut material will be used for fill where suitable, and any surplus will be deposited outside of the northern fence. Approximately 2.65 million cubic metres of material is expected to be temporarily stockpiled over the construction period. Any additional fill needed for construction will be sourced from in-country

[4] The construction of the export pipelines is an Upstream component, and associated impacts are therefore not assessed in this EIS. However, as the export pipeline system and CALM buoy form part of the integrated LNG Plant that will be the responsibility of NLOC during the operations phase, and are a key aspect of the overall operation of the Papua LNG Project, the approximate area of disturbance is provided here. Specific detail and further information regarding pipeline installation activities will be provided in the forthcoming addendum to the 2019 Papua LNG Project – Upstream EIS.

quarries or imported from overseas sources. Aggregate for concrete production will be produced on site (or trucked in) and stockpiled for use in the construction of facility foundations.

2.7.4.3 Surface water drainage

Additional site drainage (including permanent and temporary drainage systems) will be established where necessary to reduce the potential for soil erosion and discharge of sediment-laden water to local drainage lines and the marine environment. The surface water drainage system will divert clean surface water runoff away from areas to be disturbed and will collect sediment-laden water from disturbed areas in sediment traps, settlement ponds or similar structures prior to discharge to the sea.

2.7.5 Construction at the LNG Plant

Activities during construction of new and upgraded components at the LNG Plant will include steel and piping erection, equipment setting, welding, and electrical and instrument installation, insulation and coating. Various laydown areas, workshops and other temporary buildings, such as offices and warehouses, will be required. Temporary facilities will be dismantled either before or after the facility begins operations.

Cranes will be used to offload and assemble large equipment items on site. Tower cranes will be assembled on site for erection of various equipment and plant, particularly piping erection and equipment setting. Smaller cranes will move construction materials and equipment around the site.

The new trains will be constructed by conventional ‘stick-built’ (on-site piece-by-piece) methods with some skid-mounted or modular equipment being brought to site. Structural steel and pipework will be prefabricated and may be modularised for transport to the site. Construction of the utilities will commence in parallel with that of the new LNG trains. New utilities and additional components of existing utilities will largely arrive at the LNG Plant site in prefabricated modules and will be taken by truck to their respective locations for final assembly and erection.

The new wet and dry flare systems will be constructed after the construction of the fuel gas system and prior to the introduction of fuel gas. The flare stack components will arrive prefabricated for assembly on site.

The construction sequence for new and upgraded components of the LNG Plant will be based on the construction contractor’s execution plan. A typical construction execution plan would include elements of:

- Foundations, subsurface drains and electrical. Following site preparation, equipment foundations, subsurface drains and electrical cables will be installed. The foundation construction for the new LNG trains and storage tanks will begin shortly after early site preparation. Two concrete batching plants will supply concrete to mixing trucks which will pour the foundations for the new trains.
- Steel and pipe installation. Structural steel and pipework will be installed. Bolted connections for steel structures will be considered to minimise hot work activity as much as possible. Cranes will be used for steel and pipe installation during construction. Most structural steel needed for the construction of the LNG trains will be prefabricated in overseas workshops before being shipped to Papua New Guinea.
- Equipment setting. Large equipment will be lifted into place by crane before being set in the correct position and bolted to the foundations.
- Welding and radiography. Once the structural steel and equipment erection has taken place, the piping assemblies will be welded together. Crews will perform tie-in welds, weld inspection and repair, coating, coating inspections and coating repairs. Welds will predominantly be inspected by radiography. Other inspection methods (for example, magnetic particle, ultrasonic testing) may also be employed.
- Electrical and instrumentation. Once equipment has been set up and the piping assembled into position, finishing works will include installation of electrical components and instrumentation. The Project will

integrate with existing Integrated Control and Safety System without the need for shutdown of the LNG Plant. The system network will be extended via fibre optic cables from the existing buildings.

- Insulation and painting. Major vessels that are not insulated prior to delivery to the site will be insulated in the horizontal position at the appropriate laydown area before lifting into place. Select equipment and pipework will be insulated, painted, and where required fireproofed with a fire-retardant coating.

The Project will require 12 systems at the existing LNG Plant to be ‘tied-in’ to the new and upgraded systems to integrate the expansion with current operations. These include tie-ins to the LNG process systems, utility, effluent and firefighting systems, LNG export lines and vapour return lines, condensate lines, control systems, and telecommunications. A tie-in execution strategy will be developed to reduce the tie-in work required in shutdown periods. There are over 90 non-critical tie-ins required for the project. Tie-in work for the Project includes piping, electrical, instrumentation and controls. Noncritical tie-ins include piping tie-ins that do not require a production outage or reduction and will be planned and executed steadily over the construction period. The electrical system tie-ins include high and medium voltage, electrical control and management system expansion. Electrical tie-ins are non-critical and can be completed during production. Other non-critical tie-ins include an instrument air system, a nitrogen generation system and a demineralised water system. Critical tie-ins are those that require production outage or reduced rates. Critical tie-ins for the Project include a LNG rundown tie-in, two hot oil tie-ins and two gas transfer lines into the existing trains 1 and 2 main cryogenic heat exchanger inlet tie ins.

A shutdown is planned for the LNG Plant during the construction stage of the Project. This planned shutdown will be used as the key opportunity to undertake tie-in works, so minimising potential disruption to plant operation.

2.7.5.1 Water intake, use and discharge during construction

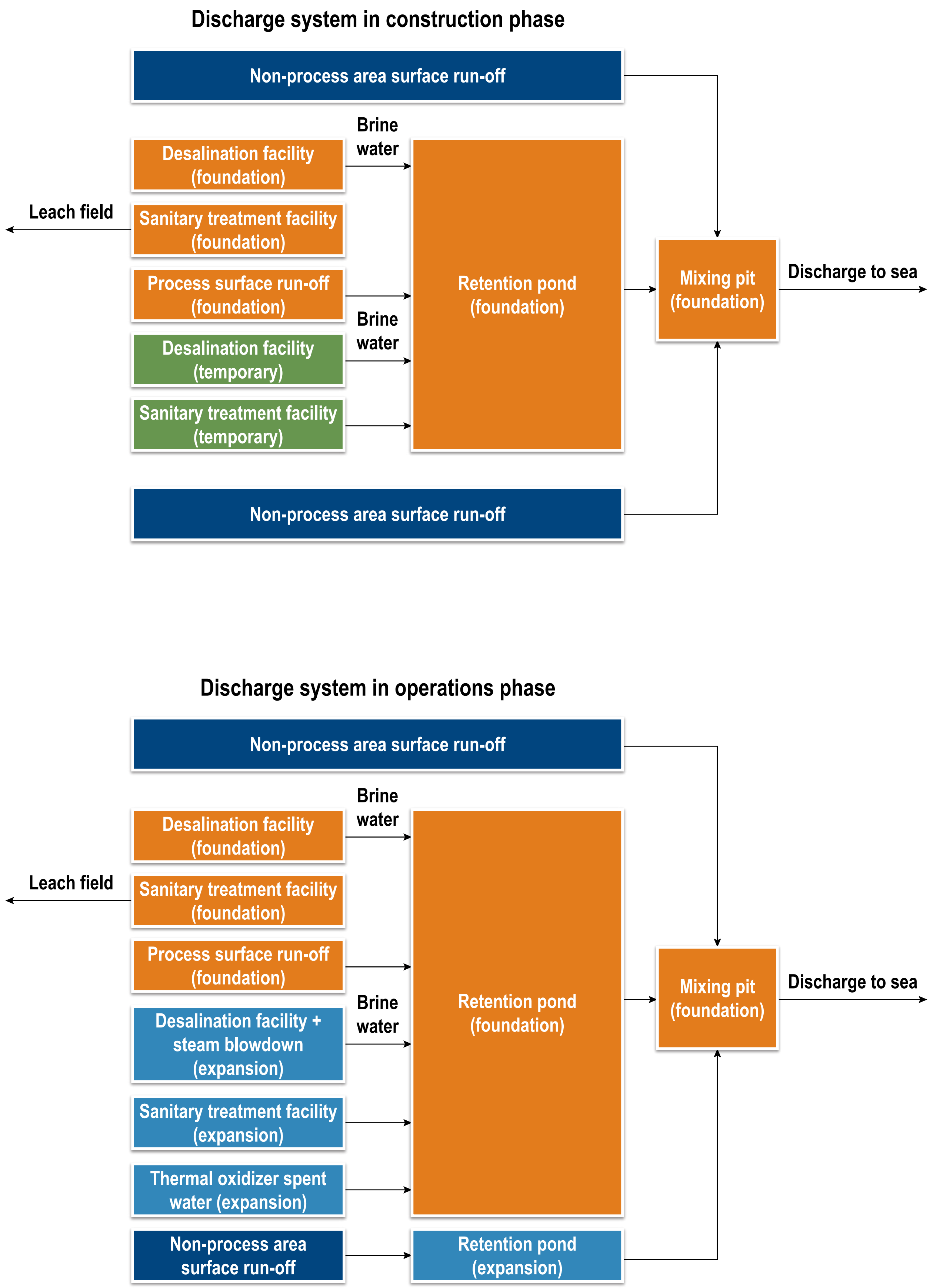
An additional seawater intake facility is proposed to provide water for domestic, civil and testing uses during construction at the LNG Plant. The seawater intake will be installed on the existing LNG Plant jetty trestle and will provide most of the water used during construction, and for testing purposes.

The seawater will be pumped to a temporary desalination plant where the salt content of the water is reduced so it can be used for the following purposes:

- Domestic use – offices, camps, kitchens, and portable toilets at site.
- Civil uses – concrete curing, equipment washing, dust control, soil compaction and those used in batch plant.
- Testing uses – hydrostatic test of pipes, tanks and equipment will use water as pressure medium for testing.

Used domestic water will be treated in the sanitary wastewater treatment systems and the treated water will flow into the retention pond, then through the mixing pit before being discharged to sea. Surface water drains will collect water generated during civil works such as for equipment washing and dust control, as well as water used to test equipment, pipes and tanks. Figure 2.8 shows the general flow of water during construction at the LNG Plant.

Water consumption is expected to peak in year 3 of construction at approximately 67,000 m^3/month and stay at that consumption volume for around 14 months before it declines in year 4. Most of the water is used for domestic purposes (approximately 64,000 m^3/month) following by civil uses then testing uses. During the peak construction water consumption period, the desalination plant will process approximately 300,000 m^3 of seawater per month and will discharge brine water at a rate of 180,000 m^3/month.



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PAPUA LNG PROJECT – DOWNSTREAM

FIGURE 2.8

General flow of water and wastewater during construction and operations

SOURCE
EMPNGA 2023

TETRA TECH COFFEY

Groundwater extraction is also being investigated as a potential water supply option, though investigations regarding feasibility that are sufficient for CEPA notification and approval have not yet been completed and hence groundwater extraction has not been assessed in this EIS. A water bore investigation involving five bore wells over four hours will be completed, with new wells drilled from the surface to a depth of 20 to 40 m.

The well locations will be determined following soil resistivity surveying and proposed extraction volumes and rates will be calculated. The estimated groundwater consumption requirement is summarised in Table 2.5.

Table 2.5 Estimated groundwater required to meet fresh water consumption requirements

Water use	Litres per hour	Number of wells required based on recovery rates			
		0.2 litres per second	0.5 litres per second	1.0 litres per second	2.0 litres per second
Steam make-up	15,275	33	13	6	3

2.7.5.2 Storage tank construction

Construction of the new condensate storage tanks and loading facilities, boil-off gas system and interconnecting pipelines will commence in parallel with construction of the new LNG trains.

The material and equipment required for construction will be trucked to the LNG Plant from the port and transported to their respective laydown areas.

The new condensate storage tanks will be constructed of welded steel. The storage tank roofs will be constructed at ground level inside the storage tank walls and then lifted into position by compressed air. Bridging sections will then be inserted between the main body of the roof and the outer cylindrical wall to lock the roof in place. Tank filling and carrier loading systems will be installed on top of the tanks, and the tanks enclosed within bunds.

2.7.5.3 CALM buoy construction

The CALM buoy will require the establishment of a second shipping channel, and additional navigational and monitoring systems. The dual subsea pipeline system for the naphtha and condensate that will connect to the CALM buoy and PLEM will be constructed as part of the Upstream works. The CALM buoy is proposed to be positioned approximately 6,750 m from the coastline at approximately 23 m water depth. Such depth is necessary for the tankers to ensure safety of operations and is influenced by the maximum draft of the tankers with additional vertical clearances. The CALM buoy will be delivered to the site completely constructed, offloaded, and moored to the seabed. Once mooring is complete, the export pipelines will be hooked to the buoy. Exclusion zones will be established for the protection of operations and the public.

2.8 OPERATIONS AND MAINTENANCE

The operation of the Project will be fully integrated with the existing operations for the LNG Plant and marine facilities. Operational and maintenance systems will also apply to the new trains, utilities and supporting infrastructure. The key elements of these systems are described in the sections below.

2.8.1 Control systems

The integrated LNG Plant and associated facilities will operate under the existing Integrated Control, Safety and Information Management System (ICSS) designed for safe, reliable and efficient performance.

The integrated LNG Plant central control centre will monitor and control the operation of the plant and loading of LNG and condensate. The integrated LNG Plant will be as fully automated as practical.

The ICSS will display the process data and alarms at the integrated LNG Plant and at each gas conditioning plant. The central control room at the integrated LNG Plant and control rooms at the gas conditioning plants will also operate the Papua LNG pipelines feeding the integrated LNG Plant via the ICSS. Monitoring and control of the Papua LNG pipelines will occur 24-hours-a-day. The status of valves on the Papua LNG pipelines, as well as pressures and temperatures at the main line valve sites will be monitored from the ICSS.

The control centre will also oversee the metering of inlet gas from the Papua LNG pipelines. Custody transfer of LNG and naphtha/condensate will be measured by the respective carriers or tankers and verified by meters at the integrated LNG Plant.

Liquefied natural gas and naphtha/condensate loading operations will include storage tank product level measurements, loading arm connection, product transfer activation from the central control room, monitoring of loading rates and confirmation of product transfer close.

As with the existing facilities at the LNG Plant, new facilities and infrastructure are designed to respond automatically to an emergency, backed-up by specific procedures for situations such as gas leaks, fire or liquid spills. Emergency response equipment (for example, spill booms and dispersant) to account for the expanded facilities at the integrated LNG Plant will be acquired prior to commissioning and start-up. Chapter 17 Environmental Hazard and Risk Management describes the systems in place for the Project to manage environmental hazards and risks associated with operations, including relevant standards, operating philosophies and specifications.

2.8.2 Commissioning and start-up

The operational and maintenance procedures are expected to be similar to those in place at the existing LNG Plant.

Commissioning and start-up activities will involve testing the new and upgraded components of the integrated LNG Plant and associated utilities and infrastructure for correct operation. Testing will involve safety checks on electrical components, instrumentation and valves, and leak testing to ensure integrity of the piping.

Approximately 46,000 m^3 of fresh water will be required for hydrotesting of tanks and pipes at the integrated LNG Plant. Water will be sourced from the desalination plant and discharged to meet water quality criteria. Treatment and discharge options will be evaluated during FEED.

2.8.3 Environmental and social management

EMPNGA and NLOC operate in accordance with ExxonMobil's Environmental Management System, which was prepared under the Environment Policy. Project activities will also be undertaken in accordance with relevant elements of ExxonMobil's Operations Integrity Management System. The Project will leverage the PNG LNG Project construction environmental and social management plans to develop new plans for the necessary scope. Since NLOC will be responsible for the integrated LNG Plant, the PNG LNG Project production environmental and social management plans and associated procedures and documentation will be updated, as required, to account for the integrated facilities and approval requirements.

Further details are provided in Chapter 18 Environmental and Social Management, Monitoring and Reporting.

2.8.4 Maintenance

The inspection and maintenance program currently in place for the PNG LNG Project will be implemented for the Project. Inspection and maintenance activities will be undertaken per Equipment Strategies by full-time, trained personnel.

Planned maintenance will be scheduled and coordinated to achieve an anticipated field (Upstream gas field and gas processing infrastructure) and LNG Plant availability of 94%. The integrated LNG Plant will be designed and operated to achieve an anticipated availability of 96%.

Piping, valving and equipment will be designed so that sections of the plant can be isolated for maintenance work. Vents and drains will allow for safe and effective depressurising, draining, and purging of equipment.

Plant data and equipment performance monitoring systems will collect and plot data, monitor critical rotating equipment and process data so that it can be accessed locally and remotely for troubleshooting and predictive maintenance. The system will be capable of being accessed in Papua New Guinea and remotely.

2.9 DECOMISSIONING

Decommissioning is assumed to be undertaken for all facilities at the LNG Plant at the same time (including the marine facilities, PNG LNG Project pipeline and Papua LNG pipelines). Project decommissioning activities will comply with applicable regulatory requirements that are in force at the time of decommissioning, as well as standard industry practices. Closure and decommissioning plans will be prepared for the individual plant facilities prior to planned closure and any decommissioning activities taking place. The nominal design life of project facilities and infrastructure is 30 years. Decommissioning procedures and regulatory requirements of the day will reflect advances in technology, new information, different monetary and other values for land and materials.

Commitments to specific procedures cannot at this stage anticipate future circumstances. While specific decommissioning activities and procedures have not been determined for the Project, a range of options exist that are discussed further below.

Individual items of equipment may be decommissioned during operations when they have no further foreseeable use. Reuse and recycling alternatives will be considered where feasible, for example removal and use by another operator or sale to a third party, or access to the plant and equipment by new production fields.

If the above options are not feasible, the facilities (or parts thereof) and associated infrastructure will be decommissioned. Larger equipment may require a life-cycle analysis of the energy, safety, resource and environmental implications of recovery and recycling alternatives.

The current standard international industry practice for decommissioning offshore pipelines is to flush the pipeline of hydrocarbon liquids and vapour, flood it with seawater, seal openings with mechanical plugs and abandon all offshore sections of pipeline in place to minimise the disturbance of removal. Should equipment and pipelines be decommissioned in this manner, they will be made safe by being depressurised, purged and flushed of hydrocarbons to ensure that the process does not result in adverse hydrocarbon releases. Underground pipelines would then be filled with water and capped. The subsea pipelines may be safely abandoned in situ and remain buried, to avoid impacts that would arise from physical removal.

Navigation charts for offshore areas will be updated to identify any remaining marine structures.

Appropriate funds will be made available for rehabilitation and maintenance for the process of decommissioning.