









TOTAL E&P PNG LIMITED

PAPUA LNG

Upstream Environmental Impact Statement

Volume 2: Environmental and Social Baseline

Part 22
Marine and River Traffic and Transport Baseline Report

TOTAL
TOTAL E&P PNG LIMITED

Papua LNG Project
Total E&P PNG Limited

Marine and River Traffic and Transport Baseline Report

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Executive Summary

Background

Total E&P PNG Limited (TEP PNG) is proposing to develop the Papua LNG Project (the Project) to commercialize the natural gas resource present in the Elk-Antelope gas field in Gulf Province, Papua New Guinea (PNG). As part of the Project environmental, social and health impact assessment (ESHIA) a number of environmental and social baseline studies (ESBS) have been undertaken to characterize the existing environment. This marine and river traffic and transport baseline study has been commissioned to provide a baseline characterization of commercial and coastal shipping, fishing vessels and village small watercraft used across the Project Area of Influence.

Project Area of Influence

The Project Area of Influence (PAOI) includes rivers, land and villages that area likely to be affected by the Project including predictable direct, indirect and some cumulative impacts. The PAOI includes PRL-15, onshore export pipeline corridor, Purari River and three Purari Delta distributaries. The PAOI also includes the offshore export pipeline corridor that extends from the nearshore waters of Orokolo Bay in Gulf Province, across the offshore waters of the Gulf of Papua, and the nearshore waters of Caution Bay in Central Province.

The onshore PAOI includes about 39 villages and one government station with a combined mid-2016 population of 12,750. Most of the villages are located along the riverways of the PAOI, which allows ready access to the river main channels for watercraft transportation of people and goods. The PAOI also includes approximately 272,680 ha of the Purari catchment.

Methods

This study was primarily a desktop study with inputs of information and data from various field surveys carried out in the PAOI.

The primary means of assessment were as follows:

- Bibliographic review involving a desktop review of existing published and unpublished literature.
- Examination of internet databases on marine traffic density, the types, size and frequency of vessels, existing international shipping lanes and coastal shipping routes and ports of call.
- Examination of internet databases on estuarine and river traffic density, the types, size and frequency of vessels, and key river transport corridors and routes.
- Identification and characterization of commercial vessels visiting inland river ports, such as shallow-draft container ships, barges, tugs and landing craft to operating oil and gas fields and mines, as well as oil and gas and mining exploration areas and logging camps.
- Assessment and characterization of the Gulf of Papua Prawn Fishery areas and trawler routes in the Gulf of Papua.
- River traffic surveys of the Purari River and three waterways of the Purari River Delta; namely, the Purari, Wame-Varoi and Urika-Ivo distributaries.

- Community level surveys and data collection at riverine and coastal villages in the PAOI, as part of the social baseline studies (SBS).
- Household surveys and data collection from individual households from a selection of villages across the PAOI, also as part of the SBS.
- Reviews and incorporation of baseline data from other projects operating within the PAOI or in neighboring areas.

Results

Marine Traffic and Transport

International Shipping Traffic

International shipping lanes within the Gulf of Papua and northern Coral Sea were examined and almost all international shipping lanes were outside the Gulf of Papua, with the exception of one shipping lane plied by crude oil tankers taking on comingled crude oil/condensate at Oil Search's Kumul Marine Terminal. Another international shipping lane to ExxonMobils's PNG LNG Marine Terminal in Caution Bay crosses the export pipeline corridor within Caution Bay. This shipping lane is used by LNG carriers (110 return trips/year) that are assisted, towed, berthed and unberthed by four LNG-proof tugs.

Coastal Shipping Traffic

Coastal shipping routes within the Gulf of Papua mainly centred on commercial vessels sailing to and from Port Moresby (POM) and the inland river ports in Western Province (e.g., Kiunga) and Gulf Province (e.g., Kikori, Kopi, Baimuru and Herd Base). The busiest route was the POM-Kiunga route (212 return trips/year) which is also the key route for shallow-draft copper concentrate bulk carriers (102 return trips/year) transhipping copper concentrate from the Ok Tedi copper mine to a silo ship moored in POM harbor. Two of the coastal shipping routes cross the Project's proposed export pipeline corridor; namely barge traffic to Herd Base (190 return trips/year) and logging barges (26 return trips/year) to a logging camp on the Purari River near Evara village.

Fishing Vessel Traffic and Fishing Areas

There are nine trawl fishing grounds of the Gulf of Papua Prawn Fishery (GoPPF), three of which cross the Project's export pipeline corridor. These are the GoPPF reporting areas of Orokolo Bay, West Kerema and Iokea, which include the transit routes of trawlers accessing the trawling grounds within these areas. In addition, almost all trawlers to and from POM to the GoPPF reporting areas cross the export pipeline corridor near its approach to and within Caution Bay.

Coastal Village Watercraft Traffic

Nearshore small watercraft traffic is common alongshore of Orokolo Bay where there is a large number of villages. Typical watercraft includes dugout canoes, outrigger dugout canoes and outboard-driven banana boats and dinghies. Transits include:

- Alongshore transits of Orokolo Bay village watercraft cross the nearshore section of the export pipeline corridor (Orokolo village watercraft transits to Purari Delta and vice versa).

- Offshore transits of Orokolo Bay village watercraft perpendicular to the coast cross the nearshore section of the export pipeline corridor (Orokolo Bay village watercraft transits to GoPPF trawlers fishing 5.5 km (>3 nm) offshore in the GoPPF Orokolo Bay trawling area).
- Nearshore transit of village watercraft in and out of the Purari Delta via Aivai Passage (route to be taken by TEP PNG contracted vessels) allowing coastal trade with Apiope and Aumu villages, as well as access to estuarine fishing areas and mangroves the delta.

River Traffic and Transport

Commercial River Traffic

Commercial river traffic in the PAOI includes two TEP PNG Papua LNG Exploration contracted barge landing crafts, which undertake approximately 190 return trips/year between Port Moresby and Herd Base (PRL-15) on the Purari River. TEP PNG Papua LNG Exploration also operate two small, high-speed vessels (barge-punts) to transfer local staff (at shift change), goods and equipment to various locations across PRL-15 and neighboring villages.

In addition, Rimbunan Hijau (PNG) Limited, a subsidiary company of the Malaysian company Rimbunan Hijau (RH), owns a number of logging concessions in Western and Gulf provinces. The PAOI is affected by two logging operations:

- Vailala Block 3: comprising 196,200 ha southeast of the Purari River.
- Baimaru Block 3: comprising 320,960 ha northwest of the Purari River (including PRL-15).

Currently, 45-m-long log ships (landing craft) ply the Purari River to access a logging camp near Evara in Vailala Block 3. The log ship traffic is currently approximately 26 return trips/year. The log ship route to and from Baimuru Block 3 operation and Port Moresby lies outside the PAOI.

Village Watercraft River Traffic

A total of 430 village watercraft were observed during the eight-day first river traffic survey covering a total of approximately 135 km of river, and equating to a crude estimate of river traffic density of 3.3 vessels/km. River traffic density would be much higher in those river reaches in the vicinity of villages, where villagers travel up and down river to tend their gardens, collect firewood, hunt, fish and gather bush materials.

The types of village watercraft included dugout canoes and outboard-driven large dugout canoes, banana boats and dinghies. Dugout canoes formed about 92% of vessels recorded with 78% of them being moored by river banks or stored on land. The (large by comparison to others in the PAOI) villages of Kairimai and Ara'ava on the Wame River had the highest number of watercraft, accounting for 50% of all dugout canoes observed during the first traffic survey.

The use of watercraft is an integral part of life for people living along the rivers and villagers were observed undertaking a variety of activities such as:

- Fishing – Approximately a third of observations were of people either fishing or transiting with fishing equipment on board. A variety of fishing techniques were observed including line fishing, gill nets and traditional scoop nets and traps.
- Transiting – Just under half of observations made were of watercraft in transit.

- Transporting goods/collecting materials – Garden produce such as bananas, sago and other materials such as firewood and building timber were the most common goods transported.

The survey data revealed that outboard motor-driven large dugout canoes, banana boats and dinghies were used primarily as people movers transiting longer distances to other villages to sell and buy food, materials and other products.

During the second river traffic survey, a total of 111 dugout canoes, banana boats and dinghies were recorded, of which 96% were dugout canoes. A total 84% of the observed dugout canoes were either moored along the Purari River banks or stored on land, especially at the villages of Poroi 2, Poroi 3 (Suarido), Subu and Subu 2 on the Purari River between Herd Base and Wabo.

The community level survey provided some high-level information on river traffic as observed by village leaders. The majority of traffic generally occurs within one to four hours travel from villages for the purposes of accessing food gardens, sago processing sites, hunting and gathering sites or to go fishing (although it is not uncommon for people to travel for longer and stay in garden houses for the duration of the activity).

Leaders of villages located along the Wame-Varoi distributary reported the number of passing traffic from other villages to be greater than ten watercrafts/day. At the majority of other villages along the Urika-Ivo and Purari distributaries, passing traffic from other villages is low (<10 watercrafts/day). Along the Purari River around PRL-15 (Herd Base to Wabo), no villagers reported observing more than 10 watercrafts (from other villages) passing their location in a day.

The higher number of passing watercraft along the Wame-Varoi distributary may be reflective of the location of the Kapuna Health Centre (between Ara'ava and Kairimai on the Wame-Varoi distributary) and its role in providing medical assistance to people from around the region.

An additional aspect of the community level survey is village leader's perceptions or observed effects of barges on villages and villagers' use of the rivers. The main concern of all villagers about barges is the erosion of river banks caused by passing barges or other commercial vessels. The second most concern was barge bow waves or propeller wash inundating dugout canoes and causing them to capsize.

1. Introduction

1.1 Project Overview

Joint venture partners, Total E&P PNG Limited (TEP PNG) (40.13%), ExxonMobil (XOM) (37.03%) and Oil Search Limited (Oil Search) (22.84%), are currently planning the development of the Elk-Antelope gas field, which is located in the Gulf Province, Papua New Guinea. TEP PNG, a wholly owned subsidiary of TOTAL S.A. has the largest interest in the Elk-Antelope gas field and is the operator of the Papua LNG Project (the Project) on behalf of the other joint venture partners.

The Elk-Antelope field, located within Petroleum Retention License 15 (PRL-15), is a significant gas discovery in Papua New Guinea consisting of a gas reservoir with several trillion cubic feet of gas reserves located approximately 120 km inland from the township of Kerema, and 340 km northwest of Port Moresby.

The Project will comprise upstream production well development and associated infrastructure at the gas field within PRL-15, construction of an upstream central processing facility (CPF) and delivery of gas and condensate via onshore and offshore export pipelines to a LNG Plant site at Caution Bay, Central Province, 20 km northwest of Port Moresby. The design life for the Project will be 25 years.

The Project area comprises the physical footprint of the various Project components and associated infrastructure as detailed below.

- Production, processing and related facilities (within PRL-15):
  - Wellpads and the associated gathering system (including flowlines and trunkline).
  - CPF.
  - Logistics base and river offloading facilities, accommodation camps, airstrip, roads and bridges.
  - Quarries and communications infrastructure.
  - Initial section of the onshore export pipeline.
- Onshore pipeline (outside PRL-15):
  - Remainder of the onshore export pipeline to a shore crossing on the Gulf coast including valve stations.
  - Temporary laydown areas and camps.
  - Quarries and communications infrastructure.
- Transport (river) corridors:
  - River transport routes— the Purari, Urika-Ivo and Wame-Varoi rivers.
- Offshore pipeline:
  - Offshore section of the export pipeline to a LNG Plant site, Caution Bay.

1.2 Study and Objectives

This Marine and River Traffic and Transport Baseline Report is one of several stand-alone reports that will be used to compile an Environmental and Social Baseline Study (ESBS) report for the Project's EIS/ESHIA.

The key objectives of the marine and river traffic and transport study are to:

- Characterize current levels of shipping in the offshore waters of the Gulf of Papua, where the Project's pipe-laying ship will traverse the Gulf of Papua along the proposed export gas pipeline route, currently shown as the export pipeline corridor.
- Characterize the types, size (tonnages) and density of international and coastal shipping traffic and identify destination ports along the Gulf Province and Central Province coastline.
- Identify the main shipping channels in the Gulf of Papua and determine if they cross the proposed alignment of the export pipeline corridor from Gulf Province to the proposed LNG plant site at Caution Bay.

- Identify existing TEP PNG exploration support vessel and barge movements in the lower Purari River to Herd Base near the mouth of Kuku Creek.
- Consult with ESBS environmental and social scientists to collate and present information and data on coastal and river navigation uses by local people. *Note: The report does not include baseline information on nearshore marine traffic by local people at Caution Bay as relevant environmental and social baseline surveys had not been undertaken at Caution Bay at the time of writing.*
- Provide baseline information and data to inform the assessment of the Project's interaction with and residual impacts on current marine and river traffic and navigational uses.

2. Regulatory Framework and Standards

This section of the report outlines the regulatory requirements for social baseline studies (and more broadly social impact assessment) for large-scale petroleum projects in Papua New Guinea as they relate to the study.

2.1 Papua New Guinean Authorities

There are three key marine and river traffic and transport stakeholders in Papua New Guinea:

- National Maritime Safety Authority (NMSA) – NMSA control all shipping lanes and shipping transit routes in PNG's Exclusive Ecomomic Zone (EEZ) waters. This includes coastal shipping traffic as well as vessels entering the major rivers to various river ports in the Gulf Province.
- PNG Ports Corporation Limited (PNGPCL) – PNGPCL controls marine traffic within PNG's declared ports (e.g., Daru, Halifax Harbour and Port Moresby). This also includes marine traffic in Caution Bay.
- National Fisheries Authority (NFA) – NFA have responsibility for managing fisheries and or other marine biological resources in Papua New Guinea. They have some responsibility (along side NMSA) over the prawn trawlers and other fishing vessels the Gulf of Papua.

2.2 Papua New Guinean Legislation

The Project is regulated under two primary PNG laws:

- *Environment Act 2000*, which is administered by the Conservation and Environment Protection Authority (CEPA).
- *Oil and Gas Act 1998*, which is administered by administered by the Department of Petroleum and Energy (DPE).

Table 2.1 lists other acts and regulations that govern the maritime sector in Papua New Guinea and which are relevant to the marine and river traffic and transport baseline study.

Table 2.1 – Other Legislative Acts Relevant to the Study

Legislation and Regulations	Description / Implications
Acts	
Marine Pollution (Ships & Installations) Act 2013	Repeals the Prevention of Pollution of the Sea Act 1979 (Chapter 371) and Prevention of Pollution of the Sea Regulation 1980. This act regulates all forms of marine pollution from ships and offshore installations, and implements the MARPOL Convention and Antifouling System (AFS) Convention.

Table 2.1 – Other Legislative Acts Relevant to the Study (cont'd)

Legislation and Regulations	Description / Implications
Marine Pollution (Ballast Water Control) Act 2013	Incorporates relevant provisions of the International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 (IMO, 2004). Makes provisions to prevent, reduce and control the introduction of harmful aquatic organisms or pathogens.
Marine Pollution (Sea Dumping) Act 2013	Regulates the incineration and dumping of waste and other matter at sea. Repeals the Dumping of Wastes at Sea Act 1979. This act regulates the dumping of wastes at sea and implements the London Dumping Protocols.
Marine Pollution (Preparedness and Response) Act 2013	Makes provisions for the effective response to and control of spills of oils, chemicals or any other pollutants from vessels within PNG waters. This act mandates a comprehensive system for responding to and cleaning up oil spills and other marine pollution incidents in Papua New Guinea and provides for cooperation with neighboring countries in the event of major pollution emergencies.
Marine Pollution (Liability and Cost Recovery) Act 2013	Repeals the Protection of the Sea (Shipping Levy) Act 2004, This act provides for the establishment of a National Maritime Pollution Fund and also provides a comprehensive regime for ships to carry compulsory insurance against marine pollution and for the payment of damages to PNG citizens in the event of marine spills.
Shipping Act, 1975	The main act dealing with matters, such as registration of ships, safety of ships, international maritime conventions, safety certificates, surveys and inspections, load lines, crew welfare and certificates of competency, navigational aids, pilotage areas, coastal trade permits and licensing.
Merchant Shipping (Standards of Training, Certification and Watchkeeping for Seafarers Convention) Regulation 2002	Regulation designed to bring Papua New Guinea in line with the basic requirements on training, certification and watch keeping for seafarers on an international level.
Merchant Shipping (Navigational Aids) Regulation 2006	Regulation relating to the acquisition, establishment, maintenance and alteration of navigational aids.
Merchant Shipping (Pilotage) Regulation 2006	Licensing of pilots, including training, and competency in handling specialist types of vessels (e.g., LNG tankers and large bulk carriers).
Merchant Shipping (Safety) Regulation 2006	Conducting ship and hull surveys by marine surveyors and issuance of safety certificates for cargo ships
Merchant Shipping (Dangerous Goods) Regulation 2007	Update of NMSA safety regulations with respect to carrying dangerous goods.
Merchant Shipping (Vessel Registration) Regulation 2006	Update of NMSA vessel registration regulations. Provision for ship audits and issuing safety certificates.
Merchant Shipping (Safe Ship Management Systems) Regulation 2006	Update of NMSA safety regulations with respect to safe ship management systems.

Table 2.1 – Other Legislative Acts Relevant to the Study (cont'd)

Legislation and Regulations	Description / Implications
Merchant Shipping (Deck Cargoes) Regulation 2007	Update of NMSA safety regulations with respect to deck cargoes.
Merchant Shipping (Load Lines) Regulation 2007	Regulation designed to bring Papua New Guinea in line with the International Convention on Load Lines (LL), 1966, which Papua New Guinea has ratified.
Merchant Shipping (Prevention of Collisions) Regulation 2007	Regulation based on protocols of the International Regulations for Preventing Collisions at Sea 1972.
Merchant Shipping (Safe Containers) Regulation 2007	Regulation designed to bring Papua New Guinea in line with the International Convention for Safe Containers (CSC) 1972, which Papua New Guinea has ratified.
Merchant Shipping (Tonnage Measurement) Regulation 2007	Regulation designed to bring Papua New Guinea in line with the International Convention on Tonnage Measurement of Ships (TONNAGE), 1969, which Papua New Guinea has ratified.
Merchant Shipping (Navigational Aids Levy) Regulations 2014	Domestic and foreign-registered ships visiting a port are required to pay a levy per gross tonne per-voyage basis.
National Maritime Safety (Regulatory Functions Levy) Regulation 2014	Domestic and foreign-registered ships visiting a port are required to pay a levy per gross tonne per-voyage basis.

2.3 International Conventions and Agreements

The international conventions and environmental agreements to which Papua New Guinea is a signatory, relevant to this study are listed in Table 2.2.

Table 2.2 – International Conventions and Agreements

Convention or Agreement	Description
Conventions relating to the Project's Maritime Activities:	
United Nations Convention on the Law of the SEA (UNCLOS), 1994	Law of the Sea Convention is the international agreement that resulted from the third United Nations Conference on the Law of the Sea (UNCLOS III), which took place between 1973 and 1982. The Law of the Sea Convention defines the rights and responsibilities of nations with respect to their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.
International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended*	Specifies minimum standards for the construction, equipment and operation of ships, compatible with their safety. Includes surveys of ships to ensure compliance
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 (Intervention Convention)*	Affirms the right of a coastal State to take such measures on the high seas as may be necessary to prevent, mitigate or eliminate danger to its coastline or related interests from pollution by oil or the threat thereof, following upon a maritime casualty

Table 2.2 – International Conventions and Agreements (con'd)

Convention or Agreement	Description
International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL)*	Requires member states to minimize the risk of marine pollution from ships, in particular oil tankers This convention has six annexes: ♦ Prevention of pollution by oil and oily water ♦ Prevention of pollution by noxious liquid substances in bulk ♦ Prevention of pollution by harmful substances carried by sea in packaged form ♦ Prevention of pollution by sewage from ships ♦ Prevention of pollution by garbage from ships ♦ Prevention of air pollution from ships
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978*	Establishes basic requirements on training, certification and watchkeeping for seafarers on an international level
Convention on the International Regulations for Preventing Collisions at Sea (COLREGS) 1972*	Replaces the Collision Regulations of 1960 and gives guidance in determining safe speed, the risk of collision and the conduct of vessels operating in or near traffic separation schemes
International Convention on Maritime Search and Rescue (SAR), 1979*	International system covering coordination, search and rescue of persons in distress at sea
International Convention for Safe Containers (CSC), 1972	Facilitate the international transport of containers by providing uniform international safety regulations, and avoids divergent national safety regulations
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (and the 1996 London Protocol)*	International control and prevention of marine pollution by prohibiting the dumping of certain hazardous materials, which requires a dumping permit
International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), 1990	Ships are required to carry a shipboard oil pollution emergency plan. Ships are required to report incidents of pollution to coastal State authorities (e.g., NMSA) who will detail the actions that are then to be taken
International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS), 2001	Prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems
International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004	Prevents the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments
International Convention on Load Lines (LL), 1966*	Provides determinations of the freeboard of ships by subdivision and damage stability calculations and takes into account the potential hazards present in different zones and different seasons
International Convention on Tonnage Measurement of Ships, 1969 (TONNAGE)*	Provides for gross and net tonnages, which form the basis for manning regulations, safety rules and registration fees. Both gross and net tonnages are used to calculate port dues

Table 2.2 – International Conventions and Agreements (cont'd)

Convention or Agreement	Description
Other conventions and agreements:	
Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (SPREP), 1990	Protection, development and management of the South Pacific marine and coastal environment
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1975 and Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 2006. (London Protocol)	Regulates the use of the sea as a depository for waste materials

Notes: * denotes that Papua New Guinea has ratified the convention.

2.4 International Standards

The International Finance Corporation (IFC) Performance Standards (PS) most relevant to the marine and river traffic and transport baseline study are:

- PS 3: Resource Efficiency and Pollution Prevention – This PS outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices. It recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. There are some risks of water pollution associated with increased marine and river traffic (IFC, 2012b).

- PS 4: Community Health, Safety and Security – This PS addresses the client's responsibility to avoid or minimize the risks and impacts to community health, and safety that may arise from project related-activities such as increased barging along riverways.

- PS 6: Biodiversity Conservation and Sustainable Management of Living Resources – This PS recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. Those ecosystem services relevant to the marine and river traffic and transport baseline study are provisioning services, which are the products people obtain from ecosystems including the means of transport used in obtaining the products (IFC, 2012d).

2.5 Industry-specific Codes and Guidelines

There are a number of industry codes and guidelines that guide marine traffic regulations and requirements. The key codes and guidelines that may relevant to the Project are summarized in Table 2.3.

Table 2.3 – Industry-specific Codes and Guidelines

Code / Standard	Objective	Relevance to Papua LNG Project
International Safety Management (ISM) Code	The Code provides an international standard for the safe management and operation of ships and for pollution prevention, and requires a safety management system (SMS) to be implemented	Adherence of Project-contracted ship management to the ISM code
International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code)	The IBC Code provides an international standard for the safe carriage in bulk by sea of dangerous chemicals and noxious liquid substances listed in chapter 17 of the Code	Applies to export LNG tankers at Caution Bay and fuel barges to Herd Base
American Bureau of Shipping (ABS) shipping rules and guidelines (various)	The ABS is a classification society that develops and verifies standards for the design, construction and operational maintenance of marine-related facilities	Project owned or chartered ship/vessel construction and design
International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code)	Provides an international standard for the shipping of dangerous goods The code prescribes standards of design and construction of ships and the equipment they should carry, with due regard to the nature of the products involved	Project infrastructure and design
OVMSA guidelines	Offshore Vessel Management and Self Assessment (OVMSA): A Best Practice Guide for Offshore Vessel Operators published by the Oil Companies International Marine Forum (OCIMF)	Marine terminal integrated management systems

In Table 2.3, reference to the American Bureau of Shipping (ABS) rules and guideines is an example of an international classification society associated with the oil and gas industry. The PNG National Maritime and Safety Authority (NMSA) does not specify that ABS rules and guidelines should be implemented in PNG waters. The ABS is simply one of the various international classification societies, who may be recognised by the NMSA. The other classification societies are:

- Bureau Vertitas (BV).
- Det Norske Veritas (DNV).
- Lloyds Register (LR).
- Nippon Kaiji Kyokai (NKK).
- Germanischer Lloyd (GL).
- China Classification Society (CCS).
- RINA Services S.p.A.
- Korean Register of Shipping (KR).

The NMSA is more likely to be interested in the following standard documents issued by a recognised classification society, which would satisfy the NMSA that vessels in PNG waters comply with the following:

- Material test certificates.
- Stamped vessel drawings.
- Tonnage Certificates.
- Stamped stability books.
- Ship Safety Construction Certificates.
- Statements/Certificates of Compliance.
- International Oil Pollution Prevention Certificates.
- Interim Class Certificates.
- MARPOL Certificates.
- International Labour Organization (ILO) Certificates.
- Coatings Certficates.
- Quality Management Certficates.

2.6 TOTAL Company Standards

TOTAL general specifications Environment (GS EP ENV 001) and Social Baseline Study (GS HSE SDV 101) outline the importance of identifying local environmental and social sensivities during baseline studies including restricted areas, marine fisheries and maritime transportation.

3. Study Area

3.1 Project Area of Influence

The PAOI is the area that is likely to be affected by the Project, its activities and its facilities that are directly owned, operated or managed by the upstream Project (including by Project contractors). This definition includes predictable direct, indirect and some cumulative impacts arising from the Project, including indirect impacts on biodiversity and ecosystem services upon which affected communities' livelihoods are dependent.

The upstream PAOI encompasses the areas associated with development of the upstream Project including:

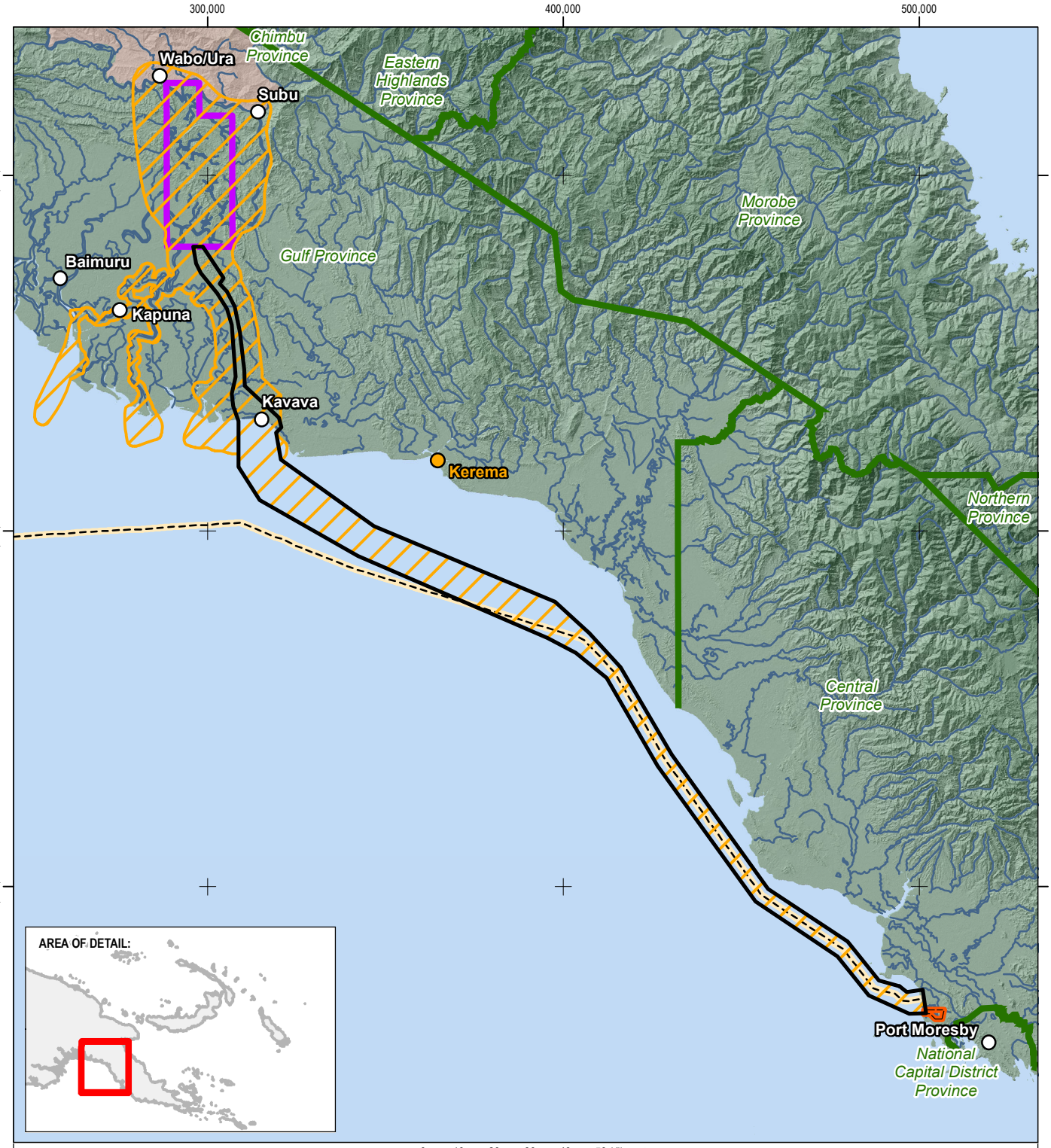
- Facilities, infrastructure and related activities within Petroleum Retention License (PRL)–15 including well pads and gathering system, trunkline, central processing facility (CPF), logistics base, airstrip, accommodation camps, wharf and access roads.
- Export Pipeline Corridor onshore and offshore between the CPF and LNG Plant site at Caution Bay.
- Riverways along which Project vessels will travel to and from PRL-15.
- Marine transport route between Caution Bay and the upstream riverways route to PRL-15.
- Kerema, as it is likely that goods and services and workers will be sourced from or transit through this provincial center.

The boundary for the upstream PAOI incorporates the communities and environment that are likely to be affected by the upstream Project and in doing so acknowledges the intricate link between the environment and the people who inhabit the area. Those people are dependent on the environment (land, air, water (fresh and marine) and natural resources) for their subsistence and as such any potential impact on the environment equates to potential impact on the livelihood and wellbeing of those people. The upstream PAOI is shown in Figure 3.1.

3.2 Study Area

The study area for the marine and river traffic and transportation baseline study corresponds with the PAOI with a key focus on marine and freshwater areas and riverine and coastal villages. That is:

- Marine areas – Proximal nearshore sections of the export pipeline corridor in Orokolo Bay and Caution Bay and offshore export pipeline corridor in the eastern Gulf of Papua.
- Estuarine and riverine areas:
  - Purari delta distributaries, including the Purari, Wame-Varoi and the Urika-Ivo arms.
  - Purari River between Herd Base and Wabo village.



SCALE: 1:1,600,000 @ A4

0 10 20 30 40 50 Kilometres

COORDINATE SYSTEM: PNG94 PNGMG94 Zone 55

- Provincial capital included in the upstream project area of influence
- Towns and villages
- Province boundaries
- Waterways
- PNG LNG Project offshore pipeline route
- Crater Mountain Wildlife Management Area
- Export pipeline corridor
- Upstream project area of influence
- PRL-15 License
- LNG Plant site

N

TITLE: Upstream Project Area of Influence

FIGURE: Figure **3.1**

PROJECT: Papua LNG Project

DOCUMENT NUMBER: R_041-79928 **REVISION:** E

DATE: 3/05/2017

DATA SOURCES:

Towns and villages, provincial capitals, export pipeline corridor (ERIAS Group 2017). Upstream project area of influence digitised by Mipela GeoSolutions based on data supplied by ERIAS Group (2017). PNG LNG Project offshore pipeline route, PRL-15, LNG Plant site, waterways (TOTAL 2016). Crater Mountain Wildlife Management Area (IUCN and UNEP-WCMC (2016), The World Database on Protected Areas (WDPA), Cambridge, UK: UNEP-WCMC. Available at: www.protectedplanet.net). DEM (Planet Observer 2015). Province boundaries derived by Mipela GeoSolutions (2016).

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4. Existing Information

4.1 Prior Studies within the Study Area

Existing literature was searched for previous studies or surveys undertaken in the PAOI. An emphasis was placed on information and data on coastal and river transport, and the types of vessels used by local people and those of artisanal and commercial fisheries in the study area. Table 4.1 lists key studies that have been carried out within the PAOI and from which information or data was extracted to support this report on marine and river traffic and transportation.

Table 4.1 – Prior Studies in the PAOI

Source	Relevant Topics Covered
External Published Reports:	
Haines (1978)	Subsistence fishery of the Purari Delta
Warrillow (1978)	Subsistence resources use Pawaia people of upper Purari River
Stevens (1980)	Fisheries of the Purari Delta
Ulijaszek (1980)	Subsistence fishing in coastal Elema community of Gulf Province
Poraituk and Ulijaszek (1981)	Molluscs in subsistence diet of Purari Delta villagers
Moore and Reynold (1982)	Barramundi (*Lates calcarifer*) of the Gulf of Papua
Gwyther (1983)	Importance of Purari Delta to the Gulf of Papua prawn trawl fishery
Haines (1983)	Fish fauna and ecology of the Purari Delta
Haines and Stevens (1983)	Subsistence and commercial fisheries of Purari Delta and Gulf of Papua
Petr (1983)	The Purari: A high rainfall river basin
Ulijaszek and Poraituk (1983)	Nutritional status of the people of the Purari Delta
Toft (1983)	The Pawaia people of the upper Purari River
DES (2008)	Elk/Antelope Gasfield Project EIS
Coffey (2009)	PNG LNG EIS Caution Bay and overlapping gas pipeline corridor
Anatec (2014)	Kerema to Port Moresby pipeline shipping study

4.2 Studies in Neighboring Areas

Table 4.2 lists key publications for neighboring areas that have a focus on the Kikori and Omati delta complex to the west of the Purari Delta and the PAOI. The sources in Table 4.2 provided socio-economic and cultural information relating to marine and river transport, as well as information on subsistence, artisanal and commercial fishing vessels and watercraft.

Table 4.2 – Prior Studies in Neighboring Areas

Source	Publication or Study	Areas
Enesar Consulting (2005)	PNG Gas Project EIS	Kikori Delta and Gulf of Papua
NSR (1990)	Kutubu Petroleum Development Project EP	Kikori Delta and Gulf of Papua
Coffey (2009)	PNG LNG Project EIS	Kikori-Omati deltas, Gulf of Papua and Caution Bay
ERIAS Group (2016d)	Pasca A Development Project EIS	Offshore Gulf of Papua and Gulf of Papua Prawn Fishery (GoPPF)

4.3 Quality and Adequacy of Existing Information

Prior studies in the PAOI and studies in neighboring areas provided useful information and data pertinent to the Project. Information gaps were addressed by the following field surveys:

- River Traffic Survey 1 (refer Section 5.3.1.1).
- River Traffic Survey 2 (refer Section 5.3.1.2).
- Social baseline surveys (refer Section 5.3.2).

The two river surveys provided river traffic information and data, which allowed characterization of the Wame-Varoi and Purari distributaries in the Purari River delta. The two surveys were carried out at the same time as ancillary activities during the Project's water quality and aquatic ecology surveys.

5. Methods

5.1 General Approach

This study was based on a literature review, and analysis of existing information and data gathered during the targeted field surveys of coastal and riverine villages during the social and freshwater baseline surveys described below.

5.2 Data Sources

Data sources for the study included:

- Literature and previous studies outlined in Section 4.
- PNG legislation and relevant international guidelines, policies and standards for the purposes of identifying key environmental areas and focus points for the EIS/ESHIA.
- Existing studies and reports on marine and river traffic and transport in the PAOI and surrounding region by PNG authorities:
  - PNG Ports Corporation Limited (PNGPCL).
  - National Fisheries Authority (NFA).
  - National Maritime Safety Authority (NMSA).
- Project-specific information provided by TEP PNG, particularly information and data available from existing marine and river transport vessels associated with current exploration in the upstream Project area.
- The marine fisheries and resources baseline study undertaken for the ESBS, which provides information and data on the commercial fisheries of the Gulf of Papua.

5.3 Field Surveys

5.3.1 River Traffic Surveys

Two baseline river traffic surveys were undertaken during the ESBS freshwater and estuarine biodiversity surveys. During the surveys, observations were made of transiting and stationary (e.g., moored or stored on land) watercraft during daylight hours (between 0700 hrs and 1800 hrs) at the freshwater and estuarine ecology baseline sampling sites or during transit between the sites. Attachment 1 presents the proforma that was used to log information and data during the river traffic surveys.

When a watercraft was encountered a handheld Garmin™ GPS, or survey vessel GPS, was used to record the coordinates (i.e., latitude and longitude) of the location of the sighting and, where possible, a photograph was taken. Subsequently, the photographs were then referenced to their specific locations using the time stamp of the photos and an AMOD™ AGL3080 GPS Photo Tracker or a HoudahGeo™ geocoding software, either of which geotags the photographs to the exact place where they were taken. The geotagged photographs were converted to KML (Keyhole Markup Language) files, which were zipped to form KMZ files for viewing in

GoogleEarth™ satellite imagery maps. However, given the brevity of many watercraft encounters, the photographs also provided a useful record for extracting additional information, such as the activities being undertaken (e.g., villagers fishing or transiting) as well as determining the numbers, gender and approximate ages of any persons onboard.

5.3.1.1 River Traffic Survey 1

The first river traffic survey (ERIAS Group, 2017a) was undertaken between the 16th and 23rd January 2016 onboard the survey vessel SV *Browse Enterprise* or its ancillary boat to access shallow creeks (e.g., Oeha Creek in the Purari River distributary) and along the following estuarine and river reaches:

- Purari Delta:
  - Wame-Varoi distributary.
  - Upper Ivo River of the Urika-Ivo distributary.
  - Purari River distributary and Oeha Creek.
- Purari River between Ivo River confluence and Herd Base.

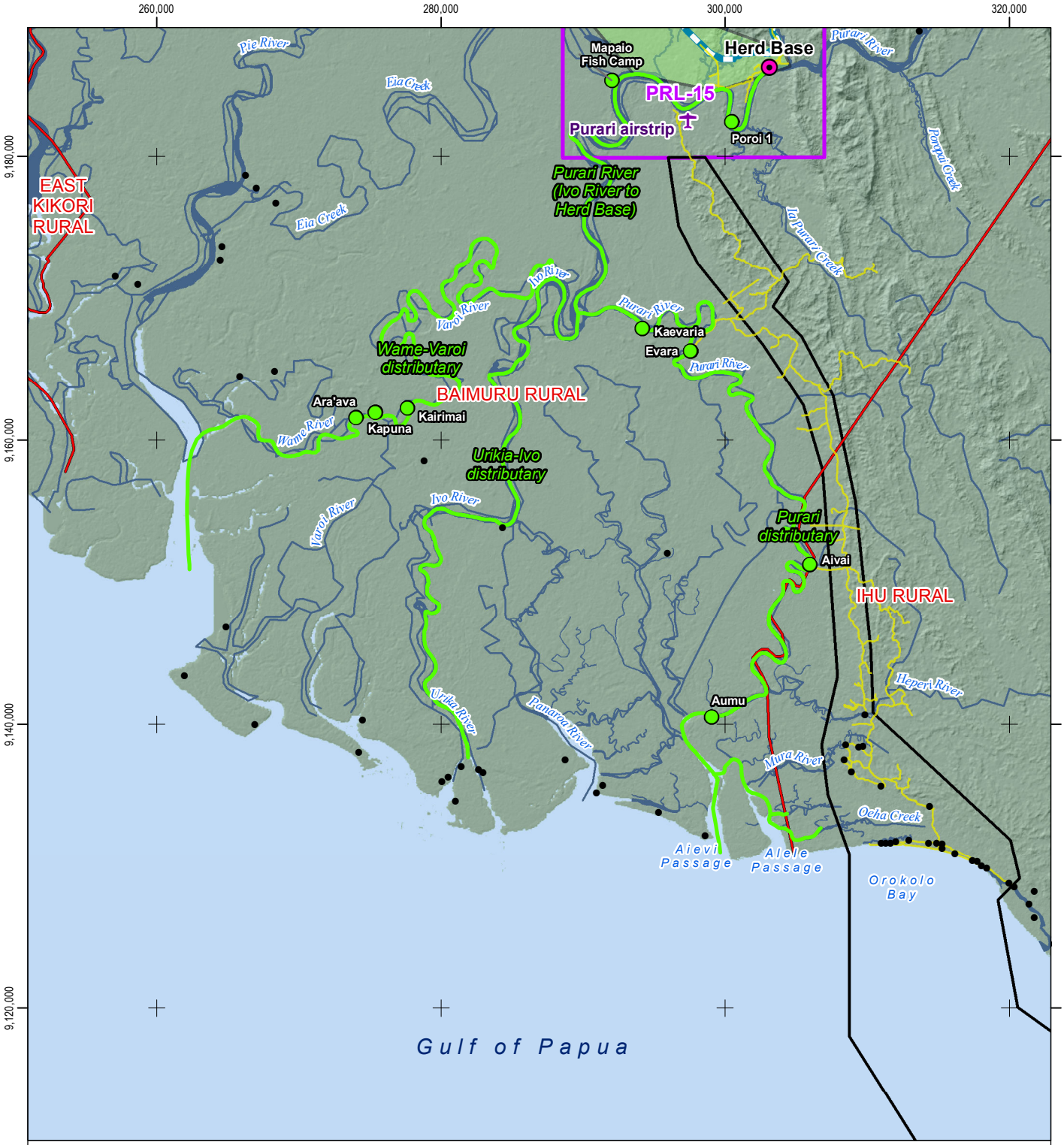
Figure 5.1 shows the estuarine and riverine routes taken during the first survey. Counts of watercraft were made at the following villages:

- Wame-Varoi distributary: Ara'ava, Kapuna, Kairimai.
- Purari Distributary: Aumu, Aivai, Evara, Kaevaria.
- Purari River (between Ivo River confluence and Herd Base): Mapaio Fish Camp, Poroi 1.

5.3.1.2 River Traffic Survey 2

The second river traffic survey was undertaken on 20th February 2017 (ERIAS Group, 2017a) onboard the survey vessel SV *The Bullet* and along the 75-km-long reach of the Purari River between Herd Base and the decommissioned Hou Creek Base.

Figure 5.2 shows the route taken along the Purari River during the second survey. Counts of watercraft by the river bank or stored on land were made at Poroi 2, Poroi 3 (Suarido), Subu and Subu 2.



SCALE: 1:400,000 @ A4

0 4,000 8,000 12,000 16,000 Metres

COORDINATE SYSTEM: PNG94 PNGMG94 Zone 55

- Towns and villages
- Tracks
- Local level government boundaries
- Waterways
- Waterbodies
- Trunkline corridor
- PRL-15

Existing Facilities

- Base camp
- Purari airstrip

Proposed Facilities

- CPF, logistics base and airstrip area
- Export pipeline corridor
- Survey locations
- River traffic survey route 1

N

Not all Host LLG Communities have been verified in the field.

TITLE: River Traffic Survey 1: Estuarine and Riverine Routes

FIGURE: 5.1

PROJECT: Papua LNG Project

DOCUMENT NUMBER: R_124-80534 **REVISION:** A

DATE: 8/06/2017

DATA SOURCES:

Facilities, CPF, logistics base and airstrip area, export pipeline corridor, towns and villages, survey locations, waterways, tracks, PRL-15, hillshade supplied by ERIAS Group and TOTAL (2015-2016). LLG Boundaries from HDX and then spatially adjusted to align with background and coastal boundaries removed. River traffic survey route digitised by Mipela GeoSolutions (2017).

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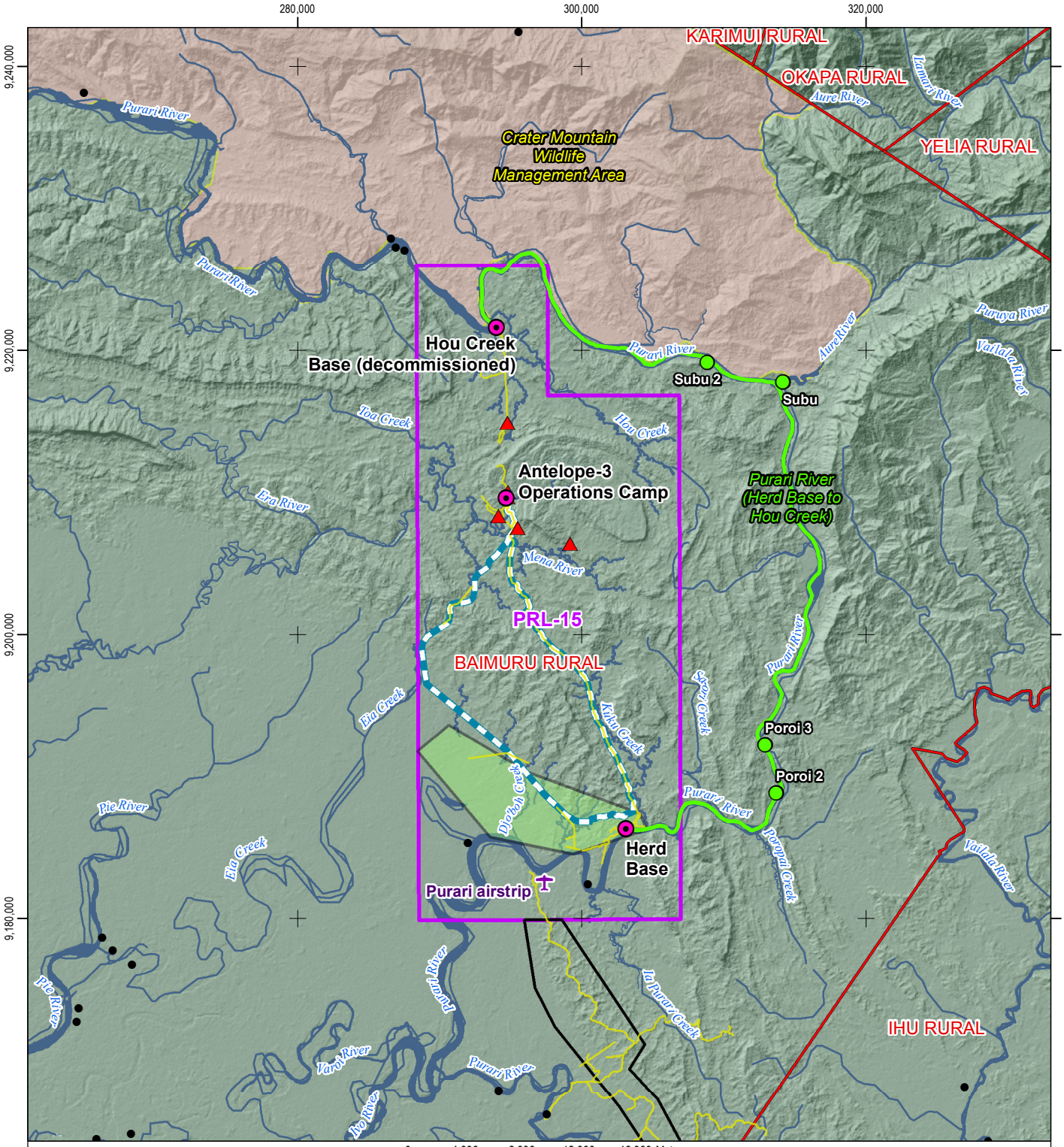
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SCALE: 1:400,000 @ A4

0 4,000 8,000 12,000 16,000 Metres

COORDINATE SYSTEM: PNG94 PNGMG94 Zone 55

- Towns and villages
- Tracks
- Local level government boundaries
- Waterways
- Waterbodies
- Trunkline corridor
- PRL-15
- Crater Mountain Wildlife Management Area

Existing Facilities

- Base camp
- Purari airstrip

Proposed Facilities

- Wellpad
- CPF, logistics base and airstrip area
- Export pipeline corridor
- Survey locations
- River traffic survey route 2

N

Not all Host LLG Communities have been verified in the field.

TITLE: River Traffic Survey 2: Purari River Route

FIGURE: 5.2

PROJECT: Papua LNG Project

DOCUMENT NUMBER: R_124-80535 **REVISION:** A

DATE: 8/06/2017

DATA SOURCES:

Facilities, CPF, logistics base and airstrip area, export pipeline corridor, towns and villages, survey locations, waterways, wellpads, tracks, PRL-15, hillshade supplied by ERIAS Group and TOTAL (2015-2016). LLG Boundaries from HDX and then spatially adjusted to align with background and coastal boundaries removed. River traffic survey route digitised by Mipela GeoSolutions (2017).

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T:\Projects\ER1002 Elk Antelope LNG Project EIS-ESHIA\Work Requests\R_124 - Marine and River Traffic and Transport\ER1002-R_124-80535-River Traffic Survey2-Figure 5.2-A.mxd

5.3.2 Social Baseline Surveys

Community and household level surveys were conducted throughout the PAOI in May/June 2016 and August/September 2016 (Table 5.1). Detailed information about the sampling framework and field survey methods is provided in the Upstream Community and Demographics Baseline Report (Finlayson, 2017; Part 14 of ESBS Dossier).

Table 5.1 – Villages/Stations Covered in the Social Baseline Surveys

Surveys	Villages/Station	Number
Community-level surveys only	Kavava, Mapaio, Mareke, Ara'ava, Kaivukavu, Larihairu, Marea, Hepere, Avavu, Ikinu, Huruta, Aumu, Lariau, Oru, Arehava No. 2, Hohoro	16
Community-level and household surveys	Iuku, Harevavo, Evara, Wabo, Maipenairu, Herakela, Kapai 2, Kairu'u, Apiope, Poroi 2, Upaia, Akoma, Ura, Mariki, Kilavi, Ere, Kaevaria, Wabo Station, Aivai, Subu 2, Subu, Poroi 3 (Suarido), Poroi 1, Paevera, Kairimai	25
Household surveys only	Aiere, Mapaio Fish Camp	2

The community level survey (ERIAS Group, 2016a) provided detailed information on:

- Watercraft usage by people of villages along the coastlines of Orokolo Bay and the Purari Delta, and along the Purari Delta distributaries and the Purari River as far upstream as Wabo.
- Primary river transport routes.
- Seasonal effects on river transport.
- Distance travelled from primary residence in pursuit of activities using watercraft, such as travel to:
  - Riverbank gardens and cultivated or wild sago.
  - Preferred fishing areas.
  - Forest and mangroves (e.g., food, building materials, firewood, hunting, medicines).
  - Collection of estuarine and marine produce (e.g., mud crabs, molluscs, turtles, and sharks).
  - Nearshore travel to collect trash fish from passing prawn trawlers.
  - Migration and mobility (e.g., travel to fish and food markets).
- Commercial vessels (e.g., barges and log ships) using the Purari River including the:
  - Volume of ship or barge traffic (i.e., number of vessels per week) passing the surveyed villages.
  - Effects of passing vessels on the surveyed villages and river banks.

In addition, notes were taken of villagers' perceptions of the Project, which provided baseline information on existing levels of Project-related (i.e., current exploration phase) barges and log ship river traffic and transport.

Household survey information collected relevant to this study included numbers and usage of following watercraft:

- Paddle-driven dugout canoes.
- Outboard motor-driven dugout canoes.
- Outboard motor-driven banana boats and dinghies.
- Paddle- or sail-driven outrigger canoes at coastal villages.
- Outboard engines stored.

5.4 Limitations

At the time of writing, National Maritime Safety Authority (NMSA) had not responded to TEP PNG's request to access their Automatic Identification System (AIS) database, which contains shipping traffic, density and routing data. Notwithstanding, various credible online fleet monitoring websites (e.g., marinetraffic.com and fleetmon.com) were accessed to provide a similar but limited level of marine traffic information and data suitable for this baseline characterization.

The river traffic surveys did not include the Urika-Ivo distributary of the Purari Delta as they were conducted as part of the freshwater and estuarine biodiversity surveys (which did not include the Urika-Ivo distributary due to time and logistics constraints). Nonetheless, the data collected from the other distributaries is considered suitable to extrapolate to indicate likely community traffic on the Urika-Ivo distributary for impact assessment purposes. A traffic survey of the Urika-Ivo distributary may be required should that distributary be used by Project-related vessels.

6. Baseline Characterization

The following sections provide a baseline characterization of existing levels of:

- Offshore and nearshore marine traffic and transport:
  - Types of ships and other vessels.
  - Marine traffic density.
  - Shipping lanes and routes.
  - Arrival and departure ports.
- Estuarine and riverine shipping traffic and transport:
  - Commercial estuarine and river traffic (ships and barges).
  - Subsistence and artisanal watercraft.

6.1 Marine Traffic and Transport

6.1.1 International Shipping Traffic

International shipping lanes and other routes were examined in relation to the PAOI. Figure 6.1 shows the marine traffic density and key routes of international and domestic shipping for 2015 (Marinetraffic.com, 2017). As well as the historical marine traffic shown in Figure 6.1, individual ships are also shown (i.e., the red, green, orange, light blue and purple arrows). This is a product of the snapshot (i.e., a screen capture) taken on 9 March 2017 and as such the presence and location of individual ships is immaterial to this report (but could not be removed from the figure).

In Figure 6.1 shipping routes with relatively high marine traffic density are shown by different colors, which, for Papua New Guinea, in the present study, approximate to the following frequencies:

- Red: indicates >1,500 vessel trips/year.
- Orange: 1000 to <1,500 vessel trips/year.
- Yellow: 500 to <1,000 vessel trips/year.
- Green: 250 to <500 vessel trips/year.
- Blue: <250 vessel/trips/year plus individual ship tracks.

Note that the Purari River is shown as green, which denotes river traffic frequency of between 250 and 500 vessel trips/year. River traffic associated with TEP PNG's exploration phase is 380 vessel trips/year. This is discussed further in Section 6.3. The eight main international shipping lanes and other major routes in the Gulf of Papua are shown in Figure 6.2 and described in Table 6.1.

All but one of the international shipping routes are located outside of the PAOI, the exception being Route 8, which is the route taken by export LNG carriers and condensate tankers visiting the PNG LNG in Caution Bay.

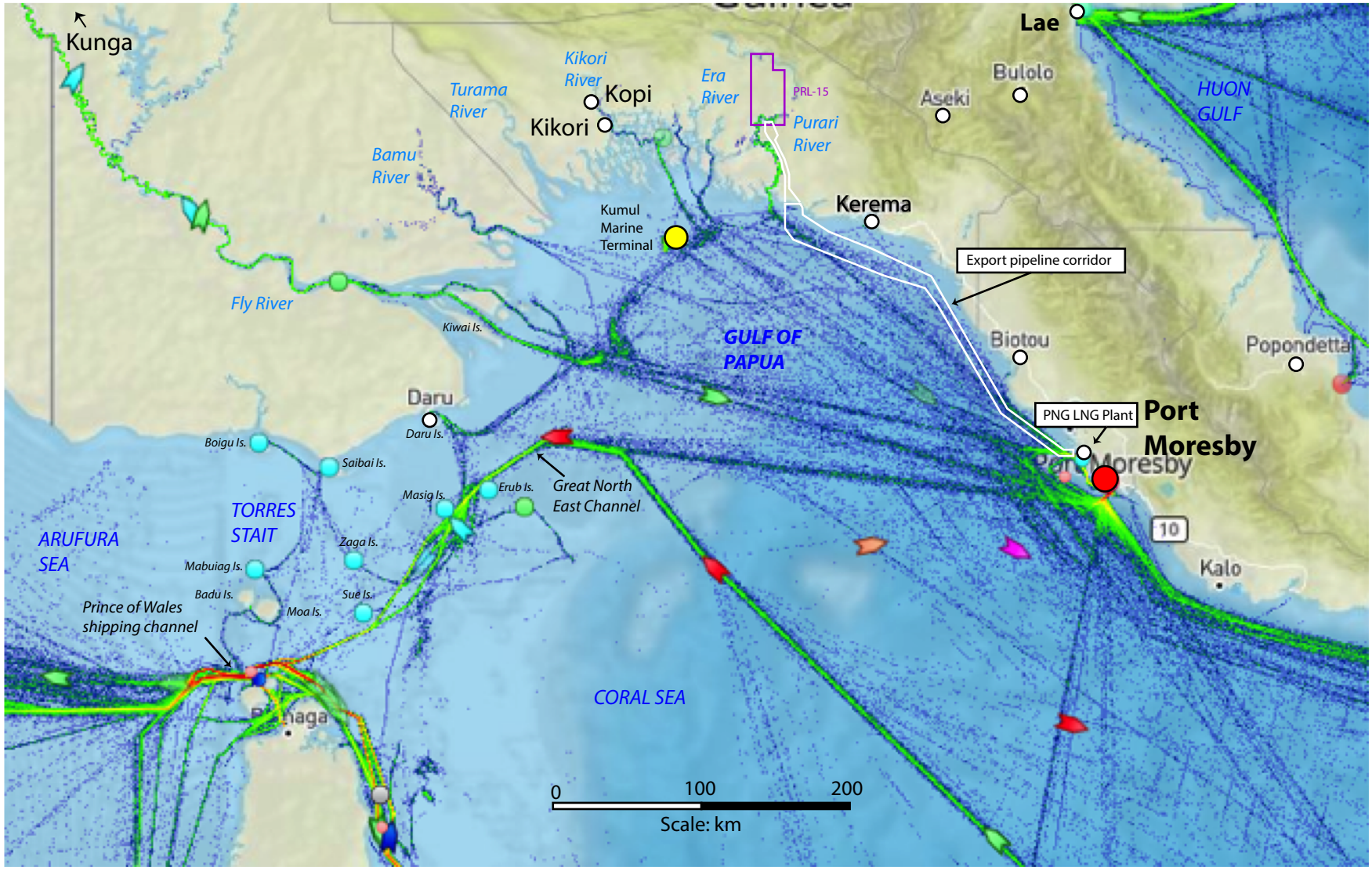
Table 6.1 – International Marine Shipping Route Traffic Densities in Proximity to the PAOI

Route No.	Description	Vessels per Year	Source
1	Great North East Channel: ship traffic from Papua New Guinea and eastern seaboard of Australia*	1,128	Anatec (2014)
2	Eastern seaboard of Australia – Southeast Asia via Torres Strait	–	(Australian data not included)
3	Port Moresby – Southeast Asia via Torres Strait	1,128	Anatec (2014)
4	Port Moresby – East Asia via Vitiaz Strait	1,350	(estimate)
5	Port Moresby – Eastern seaboard of Australia	1,024	Anatec (2014)
6	Southeast Asia Condensate/Crude Oil tankers – Kumul Marine Terminal	34	Oil Search (2017); Dudding, M (pers. com.)
7	East Asia Condensate/Crude Oil tankers – Kumul Marine Terminal	34	Oil Search (2017); Dudding, M (pers. com.)
8	East Asia (Japan/China/Chinese Taipei) LNG carriers and condensate tankers – PNG LNG Marine Terminal	232[#]	ExxonMobil (2017)

Notes: * PNG shipping traffic only. [#] Includes six condensate tankers per year. The shading denotes a shipping route that impinges upon or crosses the Project's export pipeline corridor.

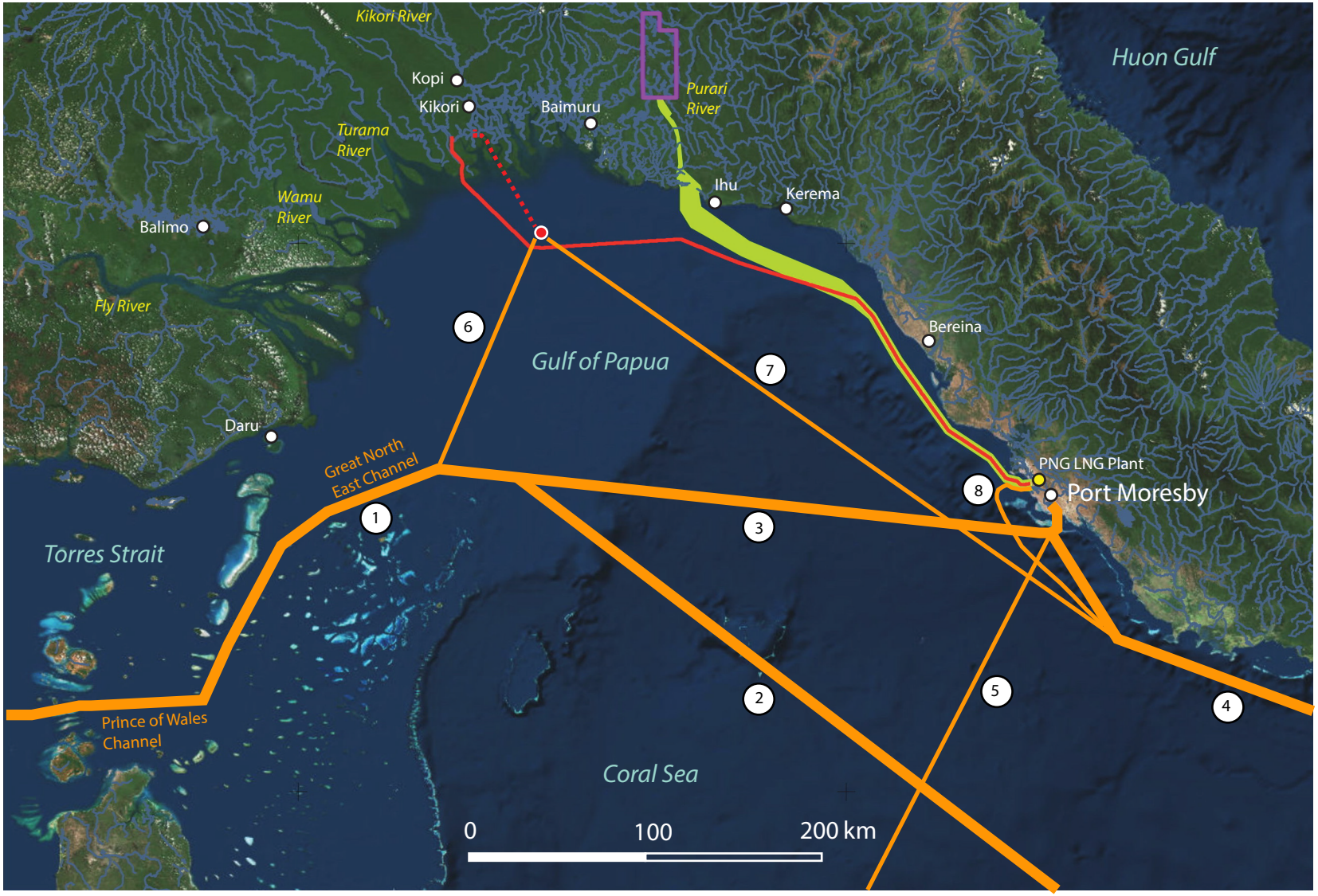
In terms of international shipping impinging upon or crossing the Project's export pipeline corridor, international LNG tankers (traffic density of 220 vessels/year) and condensate tankers (traffic density of 12 vessels/year) arrive and depart from the PNG LNG Marine Terminal, although the percentage of overall international marine traffic is less than 5% of the total for Port Moresby and Caution Bay areas.

Table 6.2 presents the current fleet of five LNG carriers operated or leased by ExxonMobil though other international LNG carriers also visit the PNG LNG Marine Terminal. Note smaller vessels (e.g., LNG-proof tugs or pilot boats) associated with assisting visiting LNG carriers and carrying out activities at the PNG LNG Marine Terminal are not included in Table 6.2 as they are classified under coastal shipping traffic (see Section 6.2.2).



Source: Screenshot of marine traffic density for the year 2015 taken on 9 March 2017 based on information and data from MarineTraffic.com (2017).
The colored arrows are the locations of ships present at the time the screen shot was taken.

	EnviroGulf Consulting	Date: 8.05.2017	ERIAS Group	Marine Traffic Density and Key Shipping Routes	Figure No: 6.1
		File Name: 167-F6.1 / Rev: 1	Papua LNG Project		



Source: Base map prepared by Mipela GeoSolutions (2017) and information and data from MarineTraffic.com (2017)

	EnviroGulf Consulting	Date: 8.05.2017	ERIAS Group	Main International Shipping Routes	Figure No: 6.2
		File Name: 167-F6.2 / Rev: 1	Papua LNG Project		

Table 6.2 – Contracted LNG Carriers Regularly Visiting the PNG LNG Marine Terminal

Vessel	Length (LOA*) (m)	Beam (m)	Mean Draft (m)	Dead Weight Tonnage (DWT) (t)	Gross Tonnage (t)	LNG Capacity (m^3)	Year Built
Spirit of Hela	298	46	106	99,200	114,277	175,103	2009
Gigera Laitebo	298	46	10.7	87,000	114,277	173,870	2010
Papua	290	47	10.2	96,319	114,166	172,000	2015
Kumul	290	47	6.4	96,254	114,166	172,000	2016
LNG Flora	272	47	9.8	67,554	106,151	127,000	1993

Source: LNG carrier names (ExxonMobil, 2017). * LOA = Length overall. Data from IMO and MarineTraffic.com (2017)

6.1.2 Coastal Shipping Traffic

Figure 6.3 shows the principal coastal shipping routes from Port Moresby to the Western, Gulf and Central provincial seaports and river ports. Table 6.3 provides summary information about these coastal shipping routes. The routes used by logging barges vary as different forest areas are targeted for logging and, as such, are not included in Table 6.3 but described in text.

Table 6.3 – Main Coastal Shipping Routes in the Gulf of Papua and Inland Waterways

Route No.	Details	Typical Vessels	Return Trips per Year
1	POM – Daru	Cargo vessels and fuel tankers supplying Daru township	15*
2	POM – Kiunga[1]	OTML copper concentrate bulk carriers	102
		OTML cargo (barges and containers)	25*
		Horizon Oil's Elevala Gas Condensate Project	15*
		Talisman Energy's Stanley gas condensate Project	15*
		ExxonMobil P'nyang Gas Project	10*
		Kiunga township	45*
		Sub-total	**212**
3	POM – Bamu River	Port Moresby–Bamu River. Panakawa timber processing (veneer) and Kamusie Sawmill in the Wawoi and Guavi tributaries of the Bamu River	15*
4	POM – Kikori and Kopi	Supplies to oil and gas operations (e.g., Juha, Agogo, Kutubu, Moran and Gobe, Hides Gas Conditioning Plant), oil and gas exploration (e.g., Oil Search's Muruk-1 gas field) and Kikori township	120*

[1] The number of copper concentrate bulk carrier trips (i.e., 102 return trips/year) was based on the 381,075 t/year of bulk dried concentrate exported from the Ok Tedi mine during 2014 via Kiunga river port (OTML, 2014) and OTML's two dedicated bulk carriers (i.e., *Fly Prosperity* and *Fly Alliance*), which have a dried concentrate carrying capacity of 3,700 t each. Other shallow-draft general cargo and container ships, barge landing craft and tug-towed barges serve the Horizon Oil Elevala Gas/Condensate Project, the Talisman Energy Stanley Gas Field Development Project and the ExxonMobil P'nyang Gas Development Project. In addition, the town of Kiunga is served by various other shallow-draft container ships and towed barges.

Table 6.3 – Main Coastal Shipping Routes in the Gulf of Papua and Inland Waterways (cont'd)

Route No.	Details	Typical Vessels	Return Trips per Year
5	POM – Baimuru	Supplies to Baimuru township	15*
6	POM – Purari River	Supplies to TEP PNG's gas exploration in PRL-15 (Herd base) on the Purari River	190**
		Log ships to Evara logging camp on the Purari River	24
7	POM – Ihu	Supplies to Ihu township	26*
8	POM – Kumul MT	Svitzer's tugs or offshore supply vessels servicing Kumul Marine Terminal (MT).	35
9	POM – PNG LNG MT	Four tugs and pilot boat servicing PNG LNG Marine Terminal (MT) in Caution Bay	200*
10	POM – PNG ports	Coastal shipping to PNG's eastern and northern ports	550*

Notes: * estimates **information provided by TEP PNG
The shading denotes a coastal or river shipping route that impinges upon the PAOI. POM denotes Port Moresby.

The main coastal shipping route in the Gulf of Papua is from Port Moresby to the river port at Kiunga (Route 2) on the North Fly River, which has an estimated 212 return trips/year representing a shipping traffic density of 424 vessels/year. This route however does not impinge upon or cross the Project's export pipeline corridor.

The coastal shipping routes within the PAOI are Routes 6, 7 and 9 and these are characterized below:

Route 6: Port Moresby – Herd Base: Herd Base is the river port and destination for TEP PNG's two contracted barge landing craft, which supply goods and equipment to the current exploration activities of the Project. The two barge landing craft are the MV *Balimo Chief* and MV GFS *Marine 01* (see Section 6.3.1 for details), which undertake a total of 190 return trips/year for the two barges or 95 return trips/year for each barge.

Route 7: Port Moresby – Ihu in Gulf Province: Gulf Province currently has three passenger vessels that service ports within the Province; namely, the MV *East/West Kikori*, MV *Baimuru* and MV *Ahi* (The National, 2016). It is anticipated that Ihu will be served part-time by one of these vessels, although the frequency of the service to Ihu is not known at the time of writing. It is anticipated that there will likely be fortnightly visits (26 return trips/year) to Ihu.

Route 9: Port Moresby – PNG LNG Marine Terminal: Besides the international LNG carriers visiting the PNG LNG Marine Terminal to load LNG (see Section 6.2.2.1), ExxonMobil has contracted four state-of-the-art LNG-proof tugs to assist in towing and maneuvering LNG carriers in the shipping channel and turning basins, as well as berthing and unberthing LNG carriers at the PNG LNG Marine Terminal. The LNG-proof tugs are equipped with gas detectors and gas-tight dampers on all air inlets and outlets. All electric deck equipment including towing winches, navigation lights, outside lights and emergency stop buttons are of explosion-proof design (Smit Lamnalco, 2017). Table 6.4 lists the contracted tugs that operate regularly within Caution Bay and at the PNG LNG Marine Terminal.

Table 6.4 – LNG-proof Tugs Operating at the PNG LNG Marine Terminal

LNG-Proof Tug	Length (LOA*) (m)	Beam (m)	Mean Draft (m)	Dead Weight Tonnage (DWT) (t)	Gross Tonnage (GRT) (t)	Year Built
SL Siage	32	13.0	5.2	275	495	2014
SL Logohu	32	13.0	5.8	275	495	2014
SL Korowi	32	13.0	5.6	275	495	2014
SL Jamba	32	13.2	5.8	275	495	2014

Source: ExxonMobil (2017). * LOA = Length overall. SL vessel prefix denotes Smit Lamnalco class

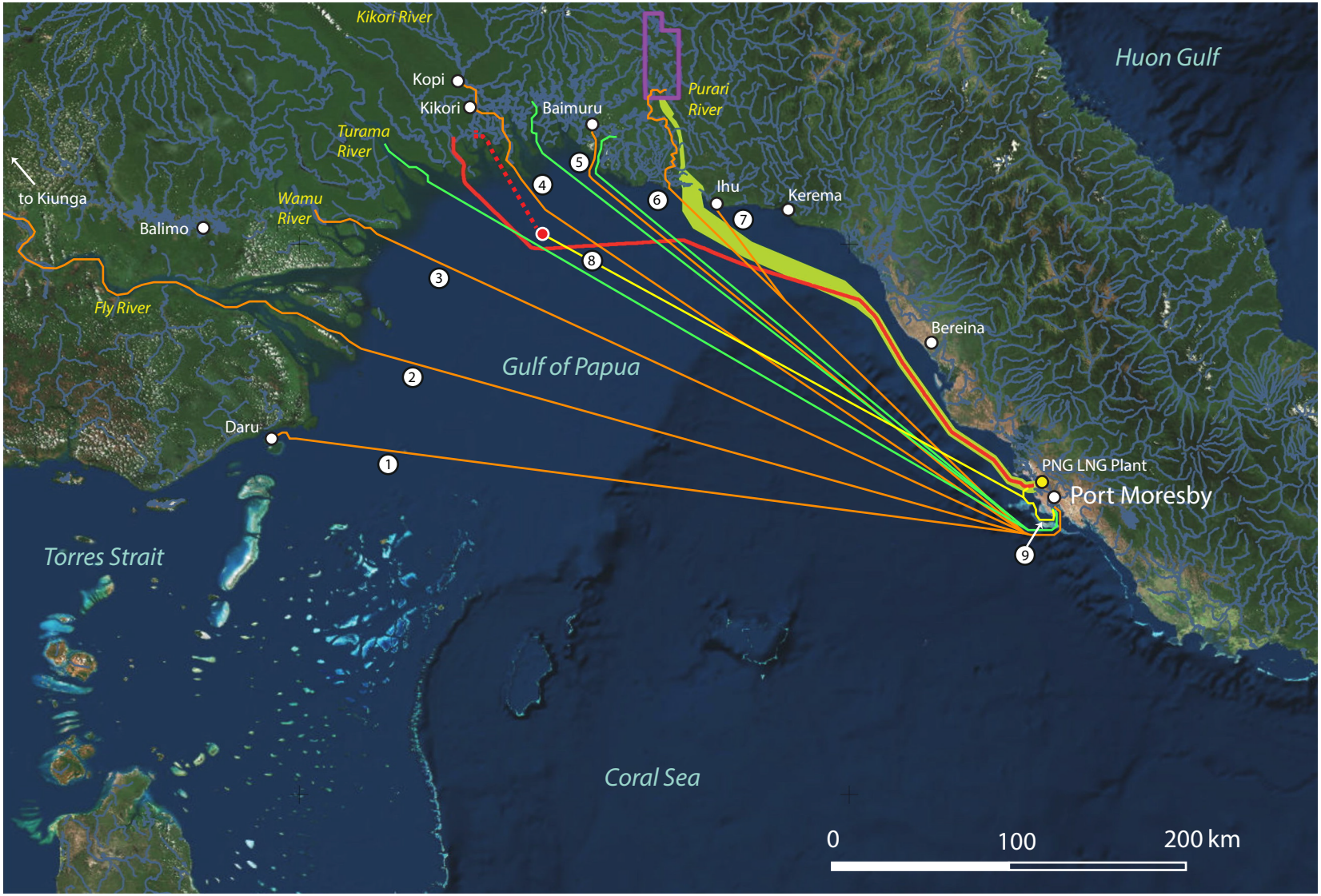
Currently, the contracted LNG-proof tugs are based in Port Moresby and spend much of their time at the PNG LNG Marine Terminal and within Caution Bay. The tugs require refueling in Port Moresby at Napa Napa Refinery or via fuel barges in Port Moresby.

There are other shipping routes within Caution Bay that require additional attention due to their presence in the Project's export pipeline corridor within the bay and its northern approaches. Figure 6.4 shows the marine traffic density and the key shipping routes in Caution Bay and its northern and southern approaches and Table 6.5 provides information about each of these key routes.

Figure 6.4 shows marine traffic density for the year 2015, as well as individual ships and tugs on 9 March 2017. Definitions of the marine traffic density colors in Figure 6.4 are given in Section 6.1.1 above. The light blue circles in Caution Bay are four LNG-proof tugs at the PNG LNG marine terminal waiting to assist a visiting LNG carrier (red arrow symbol within Caution Bay) to berth or deberth at the LNG loading jetty at ExxonMobil's Marine Terminal.

Table 6.5 details the main coastal shipping traffic routes in the vicinity of Caution Bay. The shipping traffic that impinges upon the Project's export pipeline corridor includes routes 3 through 8.

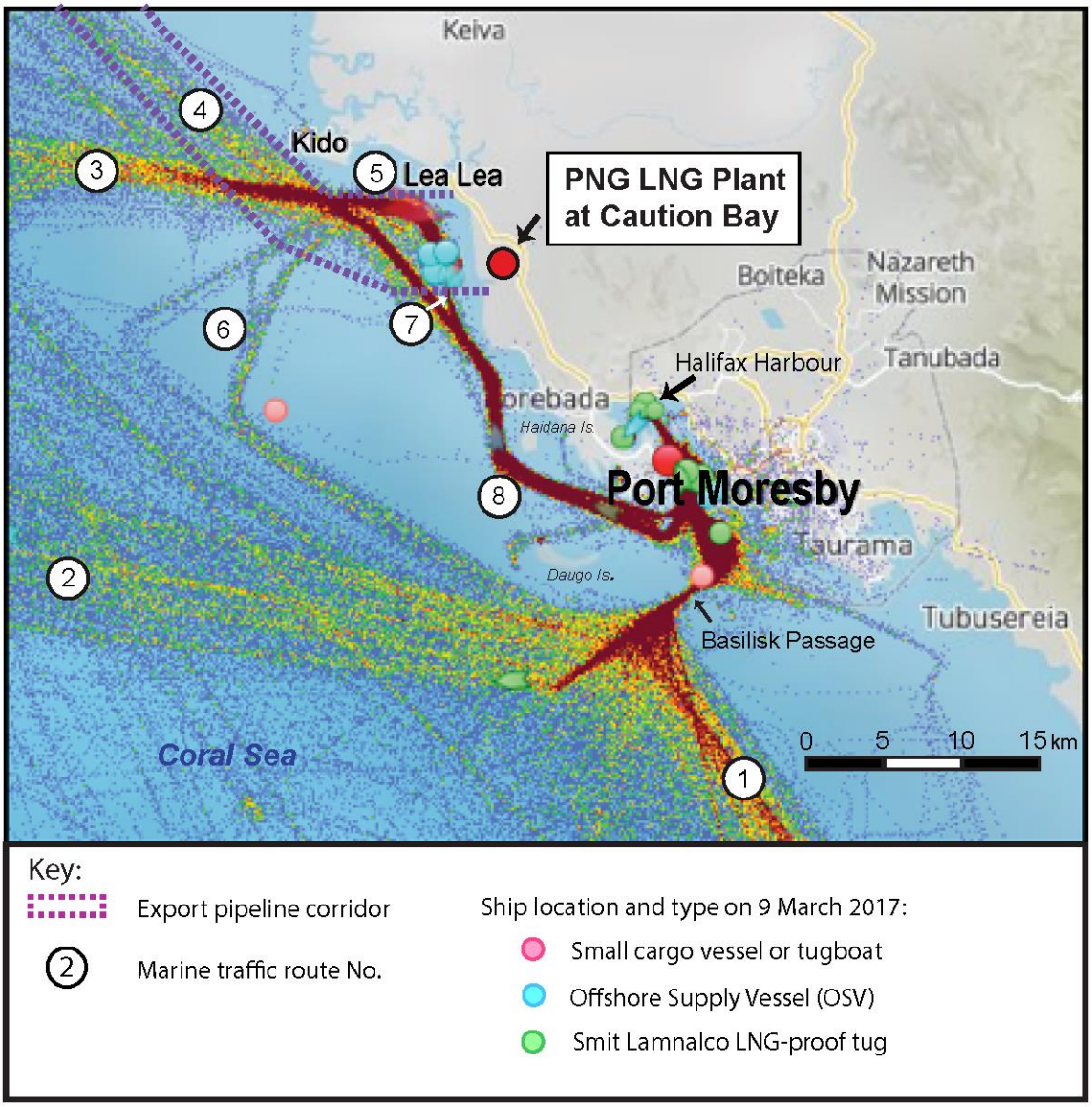
The main coastal shipping route in the Gulf of Papua is from Port Moresby via Caution Bay to the Gulf of Papua and the Torres Strait (Route 8), which has a total marine traffic density of about 1,610 vessels/year. High traffic density is also associated with Routes 3, 4 and 7 having values of 388, 828 and 350 vessels/year, respectively. LNG carriers, crude oil carriers (Kumul Marine Terminal) and container ships operate on 24-hour basis, so there are unlikely to be peak or off-peak times where volumes are more or less. When Port Moresby is congested, ships remain at anchor waiting on berthage.



Source: Marine traffic density screenshot taken on 9 March 2017 based on information and data from MarineTraffic.com (2017)

	EnviroGulf Consulting	Date: 8.05.2017	ERIAS Group	Coastal and River Shipping Routes	Figure No: 6.3
		File Name: 167-F6.3 / Rev: 1	Papua LNG Project		

Figure 6.4 – Marine Traffic Density 2015 and Ships/Tugs March 2017 Within Caution Bay and Coral Sea



Source: Marine traffic density screenshot taken on 9 March 2017 based on information and data from MarineTraffic.com (2017)

Table 6.5 – Main Coastal Shipping Traffic and Routes in the Vicinity of Caution Bay

Route No.	Details	Typical Vessels	Vessels per Year*
1	POM via Basilisk Passage – eastern and northern PNG and via Vitiaz Strait to East Asia	LNG carriers, general cargo ships, refueling tankers, container ships, landing craft, passenger ships, tugs and specialty craft etc.	1,450
2	POM via Basilisk Passage – Western Province and Torres Strait	Bulk dried copper concentrate ships, general cargo ships, container ships carriers, crude oil tankers, trawlers, timber ships, landing craft, passenger boats, tug-towed barges etc.	1,332
3	POM via Caution Bay – western Gulf of Papua (Fly and Bamu rivers) and Torres Strait	Some LNG carriers (to or from Torres Strait), barge landing crafts, trawlers, tug-towed barges, log ships, timber ships, and general cargo vessels	388
4	POM via Caution Bay – northern Gulf of Papua (Turama, Kikori and Purari rivers)	General cargo vessels, barge landing crafts, trawlers, tug-towed barges, log and timber ships, and tug boats to Kumul Marine Terminal	828
5	PNG LNG Marine Terminal – western shipping channel approach to Caution Bay from Coral Sea	LNG carriers, LNG-proof tugs to meet, tow and escort LNG carriers to the PNG LNG Marine Terminal	1,160
6	Coral Sea – PNG LNG Marine Terminal	Southwestern approach or departure of some LNG carriers to and from the PNG LNG Marine Terminal to the Coral Sea	30
7	POM – Caution Bay	Shallow-water craft between POM and Caution Bay, such as LNG-proof tugs, pilot vessels and small outboard-driven banana boats/dinghies to villages	350
8	POM via Caution Bay – Gulf of Papua and Torres Strait	General cargo ships, container ships, trawlers, log timber barge landing craft, etc.	1,610

Notes: *Estimates. The shading denotes a coastal shipping route that impinges upon the Project's export pipeline corridor in Caution Bay or its approaches. POM denotes Port Moresby.

6.1.3 Commercial Fishing Traffic

The principal commercial fishing undertaken in the PAOI is the Gulf of Papua Prawn Fishery (GoPPF). The GoPPF covers trawling grounds in both Western Province and Gulf Province for which separate commercial licenses are issued. The prawn fishery is regulated under the *National Fisheries Act 1998*, the Fisheries Regulations 2000 and Gulf of Papua Prawn Fisheries Management Plan under the direction of the National Fisheries Authority (NFA). The NFA grants fishing entitlements to fishing vessel owners on a single-year basis however is moving to five-year leases, with the possible introduction of statutory fishing rights.

In general the fishing grounds extend seaward of the three-nautical-mile (3 nm) limit to approximately the 40 m depth contour but typically in the depth range of 10 m to 35 m. In previous years before 2015, the shore to the 3-nm limit was a restricted zone and out-of-bounds to commercial fishing vessels including the GoPPF trawlers. However, in recent years, the NFA has made a number of policy changes, such that a small number of licensed trawlers now have access to the 2-nm to 3-nm zone based on joint venture agreements with the prawn resource owners (i.e., local communities of Gulf Province who have customary rights to the marine biological resources out to the 3 nm limit adjacent to their lands). This allows for profit sharing on the value of the prawn catch by trawlers operating within the 3-nm limit (Liviko, pers. com., 2015).

The GoPPF operates a current fleet of eight trawlers in the Gulf of Papua (10 trawlers are currently licensed by the NFA but two are non-operational either being overhauled or re-equipped). Due to prevailing weather and changeable sea states, the trawlers are generally large (24 to 30 m in length), although smaller vessels occasionally trawl in the more sheltered inshore waters. The trawlers are of three types:

- Twin-rigged trawlers with two trawl nets and one small trial sample net.
- Quad-rigged trawlers with four trawl nets and one small trial sample net.
- Stern trawlers with one trawl net and one small trial sample net.

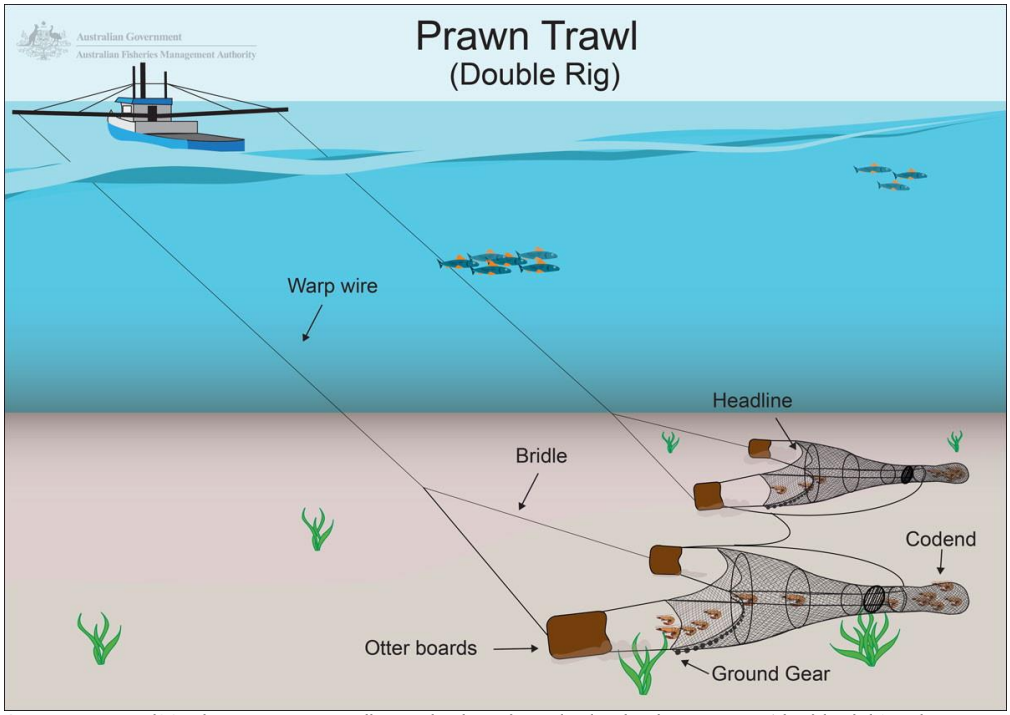
Plate 6.1 shows the FV *Siwi*, which is a twin-rigged prawn trawler and Plate 6.2 shows the mode of trawling.

Plate 6.3 shows one of the trawl net cod-ends being emptied into to the vessel's main sorting tray for subsequent retention of prawns and discarding the by-catch mainly of fish. Coastal villagers sail out by outrigger canoes to the prawn trawlers and collect discarded or 'trash' fish thrown overboard (see Section 6.1.4).



Photo credit: Vapara Toiwa (FV *Siwi* crewman).

Plate 6.1 – Twin-rigged Prawn Trawler FV *Siwi* Raising Trawl Nets in the Gulf of Papua



Source: AFMA (2017). Note: In Australia a twin-rigged trawler is also known as a 'double rig' trawler.

Plate 6.2 – Mode of Trawling Operation of a Prawn Trawler



Source: Barre Kare (National Fish Authority).

Plate 6.3 – Prawn Trawl Net Cod-end Being Emptied into the Main Sorting Tray

In general, the prawn trawlers remain at sea for an extended period of time (about four to five weeks). Trawling takes place on a 24-hour basis for approximately 250 days per year during an eight- month open season (April to November). Trawlers typically spend four to five days in port unloading their product, provisioning and refueling. All GoPPF vessels must be equipped with a Vessel Monitoring System (VMS), whereby the coordinates of each vessel are recorded each day by the NFA.

The main prawn trawling areas of the GoPPF and the density of vessels that were actively trawling in 2016 are shown in Figure 6.5. Note that the vessel density units in Figure 6.5 are arbitrary and represent 'points per square kilometer', which is based on vessel data filtered to 3 knots that is a proxy for active trawling. The arbitrary vessel density unit ranges in Figure 6.5 was designed to allow a differentiation of colors to delineate and clearly show high, moderate and low vessel densities.

Table 6.6 presents a list of the major trawling grounds and their presence or not within the Project's area of influence.

Table 6.6 – GoPPF Trawling Grounds in Relation to the Project's Area of Influence

Fishing ground No.	Name	Nearest Coastal Towns / Villages	Relation to Export Pipeline Corridor
1	North Fly	Offshore of Bamu Delta	Outside
2a	West Cape Blackwood	Goari and Dopima (Goaribari Is.)	Outside
2b	East Cape Blackwood	Cape Blackwood to Kaimari (Kaimari Is.)	Outside
3	Purari	Mariki (Kaimari Is.) to west Purari Delta	Partially inside
4	Orokolo Bay	Orokolo Bay villages to east of Ihu	Partially inside
5	West Kerema Bay	Offshore of Kerema town	Partially inside
6	Kerema Bay		
7	Freshwater Bay	Port Chalmers to Lalapipi	Outside
8	Iokea	Lalapipi to Iokea	Outside
9	South Fly	Kiwai, offshore of Fly Delta	

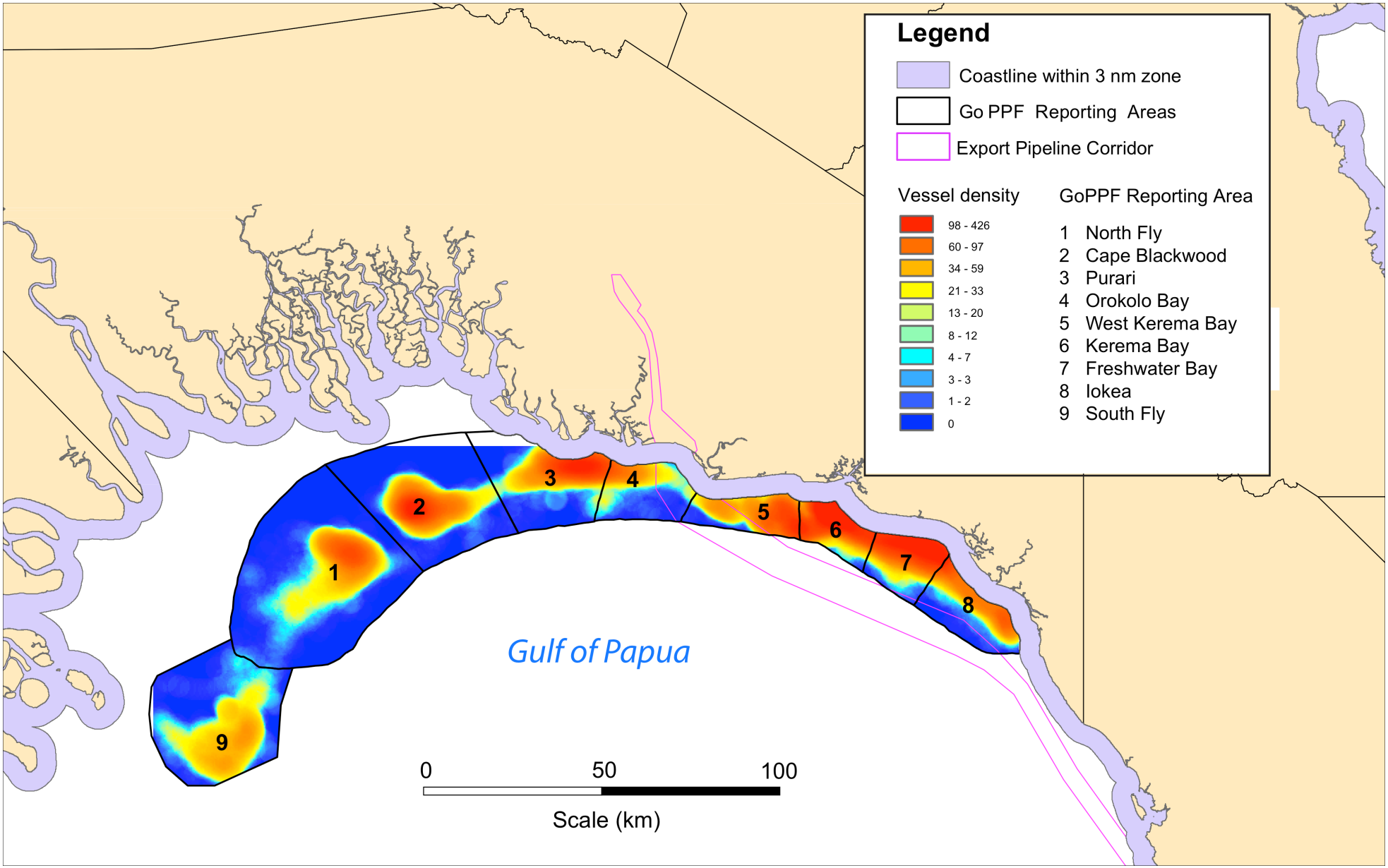
Source: Fishing ground names (ERIAS Group, 2017c; Liviko, 2012).

Inspection of Table 6.5 reveals that three prawn-trawling areas impinge upon the PAOI:

- Area 3 (Purari) that is partially within the shipping channel approach to the Purari River.
- Area 4 (Orokolo Bay) that is partially inside the export pipeline corridor.
- Area 5 (West Kerema Bay) that is partially inside the export pipeline corridor.

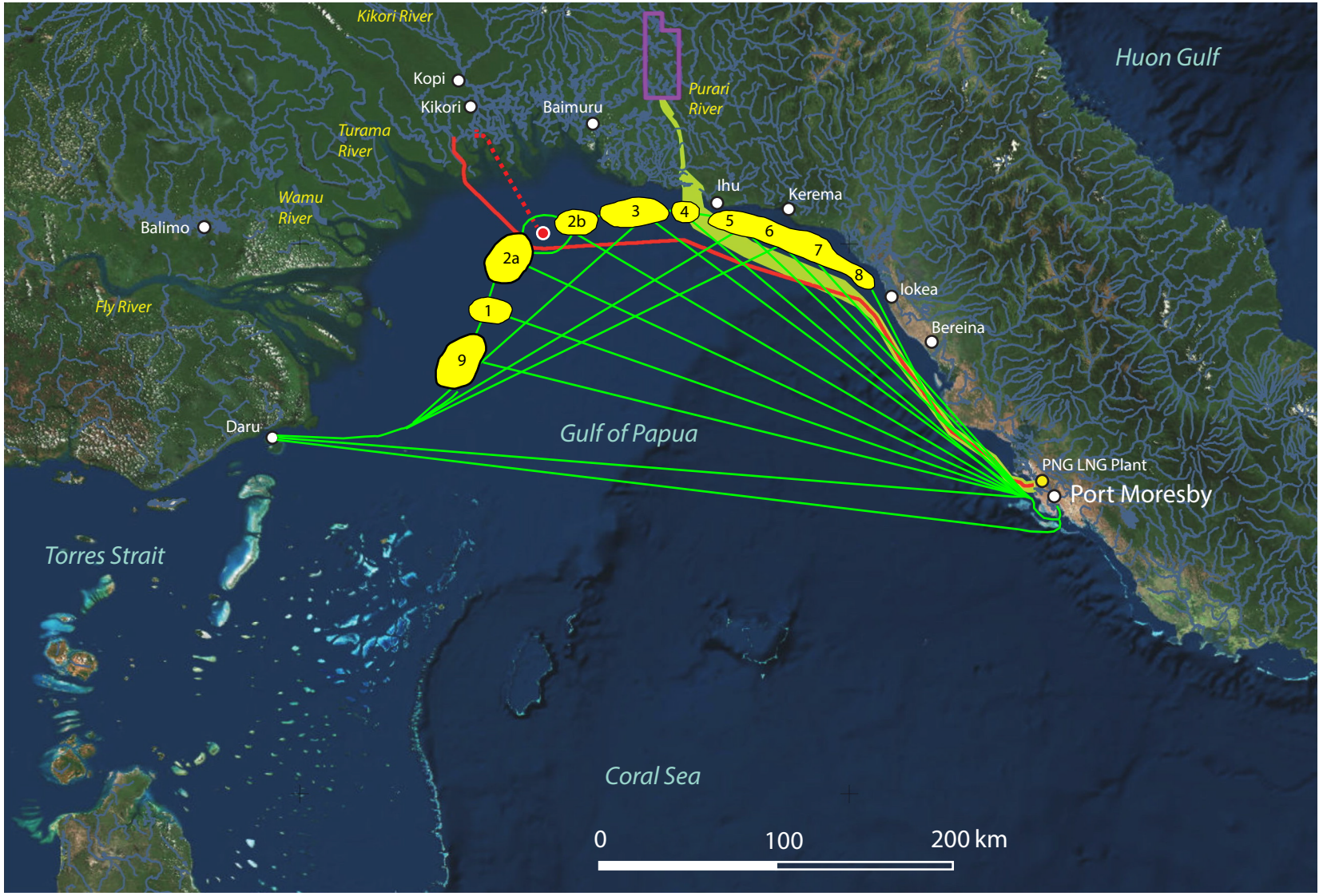
Figure 6.6 shows the transit routes taken by the trawlers between the prawn trawling areas and between the trawling areas and Port Moresby, where the trawler fleet is stationed.

Figure 6.6 shows the main transit paths taken by prawn trawlers to their fishing grounds and most of the GoPPF fleet crosses the Project's export pipeline corridor within Caution Bay and its northern approach. In general, trawlers leaving their home base in Port Moresby do not use the Basilisk Passage south of Port Moresby but take an inshore route to the west between Lolorua Island and Daugo Island to Caution Bay and thence to the Gulf of Papua fishing grounds. The exception is those trawlers that fish within the South Fly (Area 9) trawling ground and may call in to Daru Port (for refuelling) before transiting to Port Moresby.



Source: Base map and Gulf of Papua Prawn Fishery information and data from Flynn (2017)

EnviroGulf Consulting	Date: 8.05.2017	ERIAS Group	Gulf of Papua Prawn Fishery (GoPPF) Reporting Areas and Density of Trawling	Figure No: 6.5
	File Name: 167-F6.5	Rev: 1	Papua LNG Project	



Key:

- PNG LNG gas pipeline
- Export pipeline corridor
- PRL-15
- Kumul Marine Terminal
- Crude oil pipeline
- GoPPF trawler routes
- GoPPF fishing grounds

Names of fishing grounds:

1	North Fly
2a	West Cape Blackwood
2b	East Cape Blackwood
3	Purari
4	Orokolo Bay
5	West Kerema Bay
6	Kerema
7	Freshwater Bay
8	Iokea
9	South Fly

Source: Base map by Mipela GeoSolutions and ERIAS Group; GoPPF trawler transit routes prepared by EnviroGulf Consulting

EnviroGulf Consulting	Date: 8.05.2017	ERIAS Group	Gulf of Papua Prawn Fishery (GoPPF) Trawler Transit Routes	Figure No: 6.6
	File Name: 167-F6.6 / Rev: 1	Papua LNG Project		

6.1.4 Marine Nearshore Village Watercraft Traffic

Villagers living along the coastlines of Orokolo Bay and the Purari Delta regularly transit along the coast to sell marine produce in the Purari Delta villages and purchase inland produce, as well as accessing fishing areas and mangroves in the delta and fishing in nearshore and offshore waters.

Table 6.7 provides a breakdown of the type and number of watercraft owned by coastal villagers. The number of canoes, dinghies and outboards owned by each household was recorded during the household survey. However as only approximately 30% of households were surveyed in each village, data has been extrapolated to estimate the total number of canoes, dinghies and outboards in each village.

Table 6.7 – Types and Numbers of Water Craft used by Coastal Villagers

Village	Location	Total No. of Households in Village	No. of Dugout Canoes in Village*	No. of Banana Boats or Dinghies in Village*	No. of Outboards on Boat or Stored on Land in Village*
Aiere	Pie Estuary	14	28	0	2
Apiope	Purari Estuary	45	98	11	14
Akoma/Kairu'u	Urika Estuary	68	146	0	6
Harevavo	Orokolo Bay	100	93	3	3
Herekela	Orokolo Bay	66	28	15	15
Iuku	Orokolo Bay	80	23	10	6

* Average no. of watercraft/household was multiplied by no. of houses in village to estimate no. of watercraft in village.
Source: ERIAS Group (2016b)

Dugout canoes are the main form of transport for most coastal villages in the PAOI along the Purari Delta front and along the coast of Orokolo Bay. While the Orokolo Bay villages travel regularly by outboard-driven banana boats or dinghies along the coast, the villagers still use dugout canoes for coastal and delta waterway fishing, as well as for collecting mud crabs and shellfish from the Purari Delta mangroves. Plate 6.4 shows an example of a dugout canoe being used for gill-net fishing in the mangroves. The household survey (ERIAS Group, 2016b) indicated the importance of canoes with individual households owning between one and five canoes. The highest number of canoes (146) was observed at the villages of Akoma and Kairu'u in the Urika Estuary, followed by 98 canoes at Apiope in the Purari Estuary (Aivai Passage) and then 93 canoes at Harevavo in Orokolo Bay. The smallest village surveyed was Aiere (14 households) located on the shore of Port Romilly, which forms the lower section of the Pie Estuary.

Outboard motor-driven large dugout canoes, banana boats and dinghies were also prevalent along the coast. The large watercrafts are generally used by villagers for the transiting of people (generally accessing markets, health and/or education facilities, or visiting relatives), goods and garden and marine produce to nearby fish and food markets along the coast. Ocean travel forms part of the journey to the regional center of Kerema for all people in the PAOI with the means and need to go to Kerema. Ocean travel is restricted by seasonal facts such as rough weather and cost (a one-way fare from Orokolo coast to Kerema via motor-driven dinghy is K75). Coastal fishing in the nearshore or further offshore during calmer weather and sea states is generally carried out perpendicular to the coastline. Therefore, village watercraft have the potential to impinge upon the export pipeline corridor during nearshore pipelay operations, as well as offshore

pipelay operations out to 5.5 km (i.e., the 3 nm limit) where GoPPF trawlers may be actively fishing. Coastal villagers travel offshore using outrigger canoes or outboard motor-driven banana boats and dinghies to collect trash fish discarded overboard from prawn trawlers as unwanted by-catch. Plate 6.5 shows an example of trash fish brought to shore in Orokolo Bay.

Similarly, Plate 6.6 shows an outrigger canoe returning with trash fish from a GoPPF trawler.



Plate 6.4 – Dugout Canoe Used for Gill-net Fishing in Mangroves

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Plate 6.5 – Banana Boat Returning with Trash Fish (by-catch) from a GoPPF Trawler



Plate 6.6 – Outrigger Canoe Returning with Trash Fish (by-catch) from a GoPPF Trawler

The numbers and kinds of watercraft listed in Table 6.7 mostly transit parallel to the coast in nearshore waters. As such, the transit routes have the potential to overlap upon export pipelay operations in nearshore waters and at the shore crossing of the future pipeline alignment.

6.2 River Traffic and Transport

Baseline river traffic and transport in the PAOI include:

- Commercial vessel river traffic.
- Village watercraft.

These two sources of river traffic and transport are characterized below.

6.2.1 Commercial Vessel River Traffic and Transport

Commercial river traffic and transport in the Purari River or its delta distributaries are vessels contracted by TEP PNG to supply goods and equipment services to its exploration activities in PRL-15, as well as log barges that travel along the Purari River to Evara. Table 6.8 provides details of Purari River commercial vessels recently observed in the river.

Table 6.8 – Details of Commercial Vessels Observed in the Purari River

Vessel	Length (LOA*) (m)	Beam (m)	Mean Draft (m)	Dead Weight Tonnage (DWT) (t)	Gross Tonnage (GRT) (t)	Year Built
TEP PNG Papua LNG Exploration contracted barge landing craft:						
MV *Balimo Chief*	45.5	11.0	2.0	1,500	498	2014
MV *GFS Marine 01*	64.0	14.0	2.1	1,141	878	2010
Rimbunan Hijau (PNG) Ltd. log ship						
MV *Swift No. 5*	44.9	11.6	3.1	–	442	2001

Source: Landing craft (TEP PNG); Log ship (Rimbunan Hijau, 2017);
* LOA = Length overall – denotes not stated.

6.2.1.1 TEP PNG Project Exploration Vessels

The two barge landing craft servicing TEP PNG are the MV *Balimo Chief* (Plate 6.7) and MV GFS *Marine 01* (Plate 6.8). There is a total of 190 return trips per year for the two barges or 95 return trips per year for each barge.



Photo credit: Consort Express Shipping Limited (contractor to TEP PNG)

Plate 6.7 – TEP PNG's Contracted Barge Landing Craft MV *Balimo Chief*



Photo credit: Consort Express Shipping Limited (contractor to TEP PNG)

Plate 6.8 – TEP PNG's Contract Barge Landing Craft MV *GFS Marine 01*

In addition, TEP PNG uses two small, high-speed vessels (barge-punts) from Herd Base to transfer local staff (at shift change), goods and equipment to various locations across PRL-15 and neighboring villages. From time to time, the barge-punts are used by the Community Affairs team to visit villages along the Purari River, Purari Delta distributaries and on the coast. Plate 6.9 shows the barge-punt named the Baimuru Bullet.

6.2.1.2 Rimbunan Hijau Log Barges

Rimbunan Hijau (PNG) Limited, a subsidiary company of the Malaysian company Rimbunan Hijau (RH), owns a number of logging concessions in Western and Gulf provinces. The PAOI is affected by two logging operations:

- Vailala Block 3, comprising 196,200 ha southeast of the Purari River.
- Baimaru Block 3, comprising 320,960 ha northwest of the Purari River (including PRL-15).



Plate 6.9 – TEP PNG Exploration Barge-punt Baimuru Bullet

A small harvesting operation is currently being undertaken by Frontier Holdings Limited (a subsidiary of RH) in Vailala Block 3, which is located southwest of Herd Base (Booyong, 2017). Logs are transported to a logging camp near the village of Evara on the Purari River. During the first river traffic survey (ERIAS Group, 2017a), a log barge was observed near Evara. Plate 6.10 shows the log ship MV *Swift No.5* at the logging camp. Approximately 26 log ship return trips/year are made.



Plate 6.10 – Log Barge MV *Swift No.5* at Evara Logging Camp

6.2.2 Village Watercraft River Traffic and Transport

Baseline characterization of river traffic and transport arising from village watercraft was based on the findings of the first river traffic survey (ERIAS Group, 2017a), the second river traffic survey (ERIAS Group, 2017b), the community level survey (ERIAS Group, 2016a) and the household survey (ERIAS Group, 2016b).

As described in Section 3.2, riverine traffic and transport was assessed along the:

- Purari River (Wabo to Herd Base) (66 km long).
- Purari River (Herd Base to the coast via three delta distributaries):
  - Purari River and Purari distributary (81 km long).

– Purari River and Wame-Varoi River distributary (80 km long).

– Purari River and Urika-Ivo River distributary (64 km long).

6.2.2.1 River Traffic Survey 1 Results

Table 6.9 presents the total count and types of commercial vessels and village watercraft observed during the first river traffic survey, which focused on the Purari Delta and Purari River upstream to Herd Base (refer Figure 5.1). A total of 433 commercial vessels and village watercraft were observed during the eight-day survey covering a total of approximately 135 km of river, equating to a crude estimate of watercraft density of 3.3 vessels/km. The density of vessels observed during daylight hours was approximately 54 vessels/day of which 12 vessels/day were actively in transit and the remainder (42/vessels/day) were moored by the river banks or stored on land. However, river traffic density and the numbers of vessels passing a given river reach cannot be extracted from the data. River traffic density would be much higher in those river reaches in the vicinity of villages, where villagers travel up and down river to tend their gardens, collect firewood, hunt, fish and gather bush materials (and at certain times of the day/week, refer below). Notwithstanding, the survey data reveal the high importance of dugout canoes to villagers living along the river system.

Table 6.9 – River Traffic Survey 1 Results

Type of Vessel	No. of Active Vessels	No. of Moored or Stored Vessels	Total No. Observed	Total No. Observed with Outboard Motors
Dugout canoe	88	309	397	6
Banana boat	7	22	29	14*
Dinghy	0	3	3	1
Commercial vessel	2	2	4	4
Total	**87**	**336**	**433**	**25**

Source: ERIAS Group (2017a). Note: Survey conducted over eight day period * Includes one banana boat converted to an inboard diesel engine.

Dugout canoes formed 92% of the vessels recorded with 78% of them being moored by the river bank or stored on land. The high proportion of moored or stored dugout canoes may be an artifact of the survey vessel passing villages, or riverbank gardens, at different times of the day. For example, most travel by dugout canoes occurs early morning and late afternoon, while spending time tending gardens, sago making, fishing etc. during the main part of the day.

The (large by comparison to others in the PAOI) villages of Kairimai and Ara'ava on the Wame River (see Figure 5.1 for locations) had the highest number of watercraft, accounting for 50% of all dugout canoes observed during the survey.

The use of watercraft is an integral part of life for people living along the rivers and who were observed undertaking a variety of activities such as:

- Fishing – Approximately a third of observations were of people either fishing or transiting with fishing equipment on board. A variety of fishing techniques were observed including line fishing, gill nets and traditional scoop nets and traps.

- Transiting – Just under half of observations made were of watercraft in transit.

- Transporting goods/collecting materials – Garden produce such as bananas, sago and other materials such as firewood and building timber were the most common goods transported.

The survey data revealed that outboard motor-driven large dugout canoes, banana boats and dinghies were used primarily as people movers over longer transiting distances to other villages to sell and buy fish and food, materials and other products. Plate 6.11 through Plate 6.14 show examples of village watercrafts.



Plate 6.11 – Paddle-driven Dugout Canoe Transporting Women and Children



Plate 6.12 – Outboard Motor-driven Dugout Canoe on Purari River at Herd Base



Plate 6.13 – Converted Banana Boat (inboard diesel) at Evara on Purari River



Plate 6.14 – Aluminum Dinghy with Outboard Motor on Purari River at Evara

6.2.2.2 River Traffic Survey 2 Results

Table 6.10 presents the total count and types of commercial vessels and village watercraft observed during the second river traffic survey, which focused on the Purari River between Herd Base and Hou Creek (refer Figure 5.2). The second survey was carried out and completed within one day on 20 February 2017. Only village watercrafts were observed, as no commercial vessel were present at the time of the survey.

A total of 111 canoes and banana boats were recorded, and 96% were dugout canoes. A total 84% of the observed dugout canoes were either moored along the Purari River banks or stored on land, especially at the villages of Poroi 2, Poroi 3 (Suarido), Subu and Subu 2 (see Figure 5.2 for locations). Around 55% of all vessels observed were at the villages of Poroi 2 and Subu 2. Banana boats were fewer along this reach of the Purari River between Herd Base and the decommissioned Hou Creek Base, and accounted for only 4% of all vessels observed.

Table 6.10 – River Traffic Survey 2 Results

Type of Vessel	No. of Active	No. of Moored or	Total No.	Total No.

	Vessels	Stored Vessels	Observed	Observed with Outboard Motors
Dugout canoe	17	89	106	2
Banana boat	1	4	5	4
Dinghy	0	0	0	0
Commercial vessel	0	0	0	0
Total	**18**	**93**	**111**	**6**

Source: ERIAS Group (2017b). Note: Survey conducted over one day.

6.2.2.3 Community Level Survey Results

Questionnaires used during the community level survey (ERIAS Group, 2016a) provided some high-level information on barges and dugout canoes/dinghies passing villages as observed by village leaders.

Anecdotal information and survey data provide further insight into river transport where the majority of traffic generally occurs within one to four hours travel from villages for the purposes of accessing food gardens, sago processing sites, hunting and gathering sites or to go fishing (although it is not uncommon for people to travel for longer and stay in garden houses for the duration of the activity). It is not uncommon for people from the PAOI to travel significant distances via river transport to access education and/or health facilities and/or to sell or buy goods at a market. For example, students from Aivai and Aumu can travel for up to two days by paddle driven dugout canoe to attend elementary school at Maipenairu and students from most villages across the PAOI needing to access secondary school generally do so via paddle driven dugout canoe or motor dinghy to Kikori or Ihu secondary schools. Table 6.11 shows some of the longer river traffic journeys recorded during community level surveys (ERIAS Group, 2016a).

Table 6.11 – Longer River Traffic Journeys

Originating Village	Purpose for Travel	Duration (time)	Means of Transport
Kaevaria	Access elementary school	1 day	Paddle driven dugout canoe
	Access primary school	1 day	Paddle driven dugout canoe
	Access aid post	1 day	Paddle driven dugout canoe
Aivai	Access elementary school	1–2 days	Paddle driven dugout canoe
	Access primary school	1–2 days	Paddle driven dugout canoe
	Access aid post	2–3 days	Walk and paddle driven dugout canoe
Aumu	Access elementary school	1 day	Paddle driven dugout canoe
	Access primary school	1 day	Paddle driven dugout canoe
	Access aid post	1 day	Walk and paddle driven dugout canoe
Apiope	Access primary school	1 day	Paddle driven dugout canoe
	Access aid post	1 day	Paddle driven dugout canoe
Ara'ava	Access aid post	0.5 hour	Walk and paddle drive dugout canoe

Table 6.11 – Longer River Traffic Journeys (cont'd)

Originating Village	Purpose for Travel	Duration (time)	Means of Transport
Subu	Access elementary school	3–4 hours	Paddle driven dugout canoe

	Access primary school	3–4 hours	Paddle driven dugout canoe
Subu 2	Access aid post	1 day	Paddle driven dugout canoe
Wabo	Access elementary school	0.5 hour	Paddle driven dugout canoe
	Access primary school	0.5 hour	Paddle driven dugout canoe
Hepere	Access primary school	1–2 hours	Walk and paddle drive dugout canoe
	Access aid post	1–2 hours	Walk and paddle drive dugout canoe
Mariki	Access primary school	1–2 hours	Walk and paddle drive dugout canoe
Kapai 2	Access primary school	0.5 hour	Paddle driven dugout canoe
	Access aid post	3.5 hours	Walk and paddle drive dugout canoe
Upaia	Access aid post	2 hours	Walk and paddle drive dugout canoe
Ikinu	Access aid post	0.5 hour	Paddle driven dugout canoe

Source: ERIAS Group (2106a)

Villagers located along the Wame-Varoi distributary reported a higher number of passers-by from other villages per day (refer Table 6.12). This may be reflective of the location of the Kapuna Health Centre (between Ara'ava and Kairimai on the Wame-Varoi distributary) and its role in providing medical assistance to people from around the region.

At the majority of other villages along the Urika-Ivo and Purari distributaries, it is less frequently that villagers' sight passing traffic from other villages, as shown in Table 6.12, where less than 10 village watercraft are reported to pass by those villages per day. Along the Purari River around PRL-15 (Herd Base to Wabo), no villagers reported seeing more than 10 watercrafts from other villages passing their location in a day.

Table 6.12 presents a summary of river traffic travelling past villages in the PAOI based on answers given by village leaders during the community level survey (ERIAS Group, 2016a). An interesting observation is that barges have been observed to pass the villages of Ara'ava and Kairimai on the Wame River. This does not appear to be TEP PNG contracted barge landing crafts as these have been using the Purari River and Purari distributary in the delta. The barges taking the Wame River route may be used to carry general cargo to Wabo, Ura and Wabo Station north of PRL-15 or, perhaps, they may be log ships.

An additional aspect of the community level survey (ERIAS Group 2016a) is village leader's perceptions or observed effects of barges on villages and villagers' use of the rivers. Table 6.13 presents a summary of the findings for the three main distributaries (i.e., Purari, Wame-Varoi and Urika-Ivo) that may potentially be used as transport routes by TEP PNG contracted vessels.

Table 6.12 – River Traffic Passing Villages

Waterway	Village	No. of Passing Barges per Week	No. of Passing Dugout Canoes, Banana Boats or Dinghies per Day from Other Villages
Wame-Varoi distributary	Upaia	1–10	>10
	Aiere	N/A	N/A
	Ara'ava	1–10	>10
	Kairimai	1–10	>10
Urika-Ivo distributary	Mapaio	>10	>10
	Akoma/Kairu'u	0	>10
	Ikinu	1–10	1–10
Purari distributary	Kaevaria	1–10	1–10
	Evara	1–10	1–10
	Aivai	1–10	1–10
	Aumu	1–10	1–10
	Apiope	1–10	>10
Purari River (Herd Base to Wabo)	Poroi 2	1–10	1–10
	Subu 2	1–10	1–10
	Wabo	0	1–10
	Ura/Wabo Stations	0	1–10

Source: ERIAS Group (2106a). N/A denotes data not available.

Table 6.13 – Perceived or Observed Effects of Barges on Villages and Villagers

	Purari River				Wame-Varoi River		Ivo River
Barge effects	**Aumu**	**Aivai**	**Evara**	**Kaevaria**	**Ara'ava**	**Kairimai**	**Mapaio**
Capsizing canoes/boats	Yes	-	Yes	Yes	-	Yes	Yes
Erosion of river banks	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fishing net damage	-	-	Yes	-	-	Yes	-
Fish disturbance	-	-	-	-	Yes	-	Yes
Rubbish dumping	-	-	-	-	-	Yes	Yes
Water pollution	-	-	-	-	-	-	Yes
Oil spills	-	-	-	-	-	-	Yes
Noise pollution	-	-	-	-	-	-	Yes
Loss of household goods	-	Yes	-	Yes	-	-	-
Fish kills	-	-	-	-	-	-	-

Source: ERIAS Group (2016a)

The results in Table 6.13 indicate that the main concern of all villagers about barges is the erosion of river banks caused by passing barges or other commercial vessels. The second most concern was barge bow waves or propeller wash inundating dugout canoes and causing them to capsize. Along the Purari River another concern at two of the villages surveyed was the loss or damage to household goods, such as eating and cooking utensils. Other concerns expressed included fish disturbance in favored fishing areas and general water pollution (rubbish dumping and fuel or oil spills, potentially resulting in contaminated water). Whether or not these concerns were the result of actual occurrences or perceptions of potential outcomes was not tested by this

study, rather this describes responses given to the community level survey team by village leaders.

6.2.2.4 Household Survey Results

Table 6.14 presents the estimated number of watercraft in selected villages in the PAOI. The number of canoes, dinghies and outboards owned by each household was recorded during the household survey. However as only ~30% of households were surveyed in each village, data has been extrapolated to estimate the total number of canoes, dinghies and outboards in each village[2].

The results of the household survey indicate that between one and three dugout canoes are owned by each household or an average of 1.5 canoes/household. This is consistent with findings from 2000 that indicated that there were on average two dugout canoes per household (DES, 2000).

In terms of the numbers of banana boats or dinghies, the extrapolated results may be overstated, owing to multiplying up the number of surveyed households to the total number of households in a village. For example, the household survey indicated that at Evara village on the Purari River, there were an estimated 28 banana boats or dinghies, which is most unlikely. Banana boats and dinghies are used with outboard motors, which are costly. It is more likely that Evara villagers share the common cost of such watercraft and fuel, and which are used mainly for transporting people or goods to market over longer river distances. In the case for Evara village, there is more likely to be less than 10 banana boats or dinghies.

Table 6.14 – Household Survey of Village Watercraft Numbers and Types

Village	Total No. of Households in Village	Estimated No. of Dugout Canoes in Village	Estimated No. of Banana Boats or Dinghies in Village	Estimated No. of Outboards on Boat or Land in Village
Purari River (Wabo to Herd Base):				
Wabo	73	163	19	23
Wabo Station	22	6	3	6
Ura	42	56	3	14
Upaia	41	110	6	9
Subu 2	13	28	3	9
Subu	11	22	0	5
Poroi 3 (Suarido)	8	10	1	1
Poroi 2	44	82	12	31

[2] For each village the average number of watercraft per household was calculated by dividing the nounber of watercraft recorded by the number of households surveyed. The average number of watercraft per household was multiplied by the number of households in the village to get the estimated number of watercraft in each village. As noted, however, it is likely that numbers of banana boats and dinghies in each village are overstated using this method which does not take into consideration factors such as shared ownership.

Table 6.14 – Household Survey of Village Watercraft Numbers and Types (cont'd)

Village	Total No. of Households in Village	Estimated No. of Dugout Canoes in Village	Estimated No. of Banana Boats or Dinghies in Village	Estimated No. of Outboards on Boat or Land in Village
Purari River (Herd Base to Ivo River confluence):				
Poroi 1	10	10	0	4
Mapaio Fish Camp	5	10	0	3
Purari distributary:				
Apiope	45	98	11	14
Aivai	13	30	3	28
Evara	67	110	28	28
Kaevaria	17	22	0	6
Wame-Varoi distributary:				
Aiere	14	28	0	2
Kairimai	19	22	1	4
Urika-Ivo distributary:				
Akoma/Kairu'u	68	146	0	6
Orokolo Bay coast:				
Harevavo	100	93	3	3
Herekela	66	28	15	15
Iuku	80	23	10	6

Source: ERIAS Group (2017b).
Note: Numbers of banana boats, dinghies and outboard motors are likely to be overestimated, owing to multiplying number of households surveyed to total number of households in a village.

7 Conclusions

The objectives of the present report have been met based on information and data obtained from a comprehensive review of the literature and supplemental site-specific data derived from the two marine and river traffic surveys and the social baseline field survey, which were undertaken as part of the Project's baseline characterization.

This report has identified the sensitivities and values that local villagers attach to their riverine environment and village way of life, including ecological values (e.g., fishing areas) and the use of waterways as a means of transporting people and goods. The report has also identified existing concerns of local villagers to current landing craft and barge traffic, as well as potential Project-imposed increases in river barge traffic.

7.1 Marine Traffic and Transport

7.1.1 International Shipping Routes

The international shipping routes do not cross the Project's export pipeline corridor, with the exception of LNG carriers visiting or departing the PNG LNG marine terminal. LNG carriers, mainly from East Asia (China, Chinese Taipei and Japan), cross the export pipeline corridor at its approach to Caution Bay and within Caution Bay itself. There is currently a total of 110 LNG carrier trips per year and about six condensate carrier trips per year.

7.1.2 Coastal Shipping Routes

A number of coastal shipping routes cross the export pipeline corridor in its approach to Caution Bay and within Caution Bay. The main routes are:

- Port Moresby–Ihu, Gulf Province (general cargo and passenger vessels).
- Port Moresby–Purari River (TEP PNG barge landing craft and log barges).
- Port Moresby–Kumul Marine Terminal (Svitzer tug boats and offshore supply vessels via Caution Bay route).

7.1.3 Gulf of Papua Prawn Fishery Areas and Trawler Routes

Most Gulf of Papua Prawn Fishery (GoPPF) trawling areas lie outside the export pipeline corridor, with the exception of two areas:

- Purari GoPPF reporting area.
- Orokolo Bay GoPPF reporting area.

Most trawler routes to and from the GoPPF fishing grounds cross the export pipeline corridor at its approach to Caution Bay and within Caution Bay itself. Very few trawlers take the southern shipping channel from Port Moresby via Basilisk Passage. Most trawlers take the western route past Lolorua Island and Daugo Island via Caution Bay to the Gulf of Papua.

7.1.4 Nearshore Village Watercraft Traffic

Villagers living along the coastlines of Orokolo Bay and the Purari Delta regularly transit along the coast to sell marine produce in the Purari Delta villages and purchase inland produce, as well as accessing fishing areas and mangroves in the delta and fishing in nearshore and offshore waters.

Nearshore village traffic in the vicinity of the export pipeline corridor and barge routes to Herd Base includes:

- Nearshore transits of Orokolo Bay village watercraft parallel to the coast cross the nearshore section of the export pipeline corridor (Orokolo village watercraft transits to Purari delta and vice versa).
- Offshore transits of Orokolo Bay village watercraft perpendicular to the coast cross the nearshore section of the export pipeline corridor (Orokolo Bay village watercraft transits to GoPPF trawlers fishing 5.5 km (>3 nm) offshore in the GoPPF Orokolo Bay trawling area).
- Nearshore transit of village watercraft in and out of Aivai Passage (route to be taken by TEP PNG contracted vessels) allowing coastal trade with Apiope and Aumu villages, as well as access to fishing areas and mangroves in both the Aivai and Alele passages of the delta).

7.2 River Traffic and Transport

7.2.1 Commercial River Traffic and Transport

Commercial river traffic and transport in the Purari River or its delta distributaries are mainly vessels contracted by TEP PNG to supply goods and equipment services to its exploration activities in PRL-15, as well as log barges that travel up the Purari River to Evara.

TEP PNG has two contracted barge landing craft that transport goods from Port Moresby to Herd Base on the Purari River in PRL-15. There are currently a total of 189 vessel trips per year. TEP PNG also has a small barge-punt that is stationed at Herd Base, which makes regular runs between Herd Base and the decommissioned Hou Creek Base, as well as other river transit sites.

Log barges belonging to Rimbunan Hijau (PNG) Limited, travel up the Purari distributary to a logging camp near Evara village. Two shallow-draft log barge landing craft may cross the river routes for Project barging and small vessel use. About 24 log barges per year currently travel to the logging camp at Evara on the Purari River.

7.2.2 Village Watercraft Traffic

The main conclusions about village watercraft are:

- River traffic density is estimated at 3.3 vessels/km.
- Dugout canoes formed 92% of the vessels recorded with 78% of them being moored by the river bank or stored on land.
- Small paddle-driven dugout canoes are used mainly by families to access river bank gardens, hunting and fishing areas, or to visit close-by neighboring villages.

- Large outboard motor-driven dugout canoes, banana boats and dinghies are used for transporting people and their goods over greater river distances, such as to other village fish and food markets.
- Banana boats and aluminum dinghies accounted for 8% of the vessels recorded during the surveys. These boats are primarily used for transporting people.
- The villages of Kairimai and Ara'ava on the Wame-Varoi distributary had the highest number of watercraft, accounting for 50% of all dugout canoes observed during the survey.

7.2.3 Villager Concerns about Passing Barges

The community level survey recorded concerns that villagers have had with commercial vessel traffic (barges) passing their villages. It was not the role of this study to determine whether these concerns were substantiated or perceived. The following concerns were raised:

- The highest concern by all village leaders interviewed was the erosion of river banks due to barge bow waves and propeller wash waves.
- The second highest concern was barge-induced waves capsizing canoes in transit and canoes moored along the river banks at villages.
- Other concerns included barge-induced waves causing a loss of eating and cooking utensils by the river banks, fish disturbance and general water pollution from discarded rubbish, oil spills and contaminated water.

8 Study Team

8.1 Main Technical Report

This Marine and River Traffic and Transport baseline assessment was prepared by David Balloch, Director, EnviroGulf Consulting based on a desktop study.

8.2 Field Surveys

Information on the people involved in the social baseline surveys is provided in Finlayson (2017).

The River Traffic Survey 1 and River Traffic Survey 2 were carried out by Scott Breschkin and Kobus Meulenbroeks of ERIAS Group.

9 Abbreviations and Glossary

9.1 Abbreviations

The following abbreviations are used in this report:

AIS: Automatic Identification System

CEPA: Conservation and Environmental Protection Authority

DEC: Department of Environment and Conservation (forerunner to CEPA)

DWT: Dead Weight Tonnes

EIR: Environmental Inception Report

EIS: Environmental Impact Statement

EP: Environmental Plan (forerunner to the EIS in Papua New Guinea)

ESHIA: Environmental, Social and Health Impact Assessment

FV: Fishing Vessel (vessel class prefix)

GIS: Geographic Information System

GoPPF: Gulf of Papua Prawn Fishery

HSC: High Speed Craft

IMO: International Maritime Organization

km: kilometer

KML: Keyhole Markup Language

KMZ: a compressed (zipped) KML file

m: meter

MV: Motor Vessel (vessel class prefix)

NFA: National Fisheries Authority

nm: nautical mile (1 nm = 1,852 meters)

NMSA: National Maritime Safety Authority

OCIMF: Oil Companies International Marine Forum

OVMSA: Offshore Vessel Management and Self Assessment

PNGPCL: Papua New Guinea Ports Corporation Limited

RV: Research Vessel (vessel class prefix)

SL: Smit Lamnalco (vessel class prefix)

SOLAS: Safety of Life at Sea

TEP PNG: Total E&P PNG Limited

TEU: Twenty-foot Equivalent Unit

9.2 Glossary

Term	Definition
Artisanal fishery	Small-scale fisheries for subsistence or local, small markets, generally using traditional fishing techniques and small boats
Ballast water	Fresh or salt water, sometimes containing sediments, held in tanks and cargo holds of ships to increase stability and maneuverability during transit
Banana boat	A small glassfiber dinghy usually providing a local rapid transit transport service to peole and their goods; typically fitted with an outboard motor
Baseline	A set of reference data sets or analyses used for comparative purposes; it can be based on a reference year or a reference set of (standard) conditions
Bathymetry	Pertaining to the depth and relief of water basins
Benthic	Defining a habitat or organism found on the sea bottom or pertaining to the seafloor (or bottom) of a water body
Catch	to undertake any activity that results in taking fish out of its environment dead or alive; to bring fish on board a vessel dead or alive; the total number (or weight) of fish caught by a fishing operation
Coastal area	Refers to a distance of few hundred meters inland starting from the lowest low-tide point
Comingle	To put together into one mass so that the constituent parts are more or less homogeneous: admix, amalgamate, blend, commix, fuse, intermingle, intermix, merge, mingle, mix, stir
Commercial fishery	A term related to the whole process of catching and marketing fish or shellfish for sale. It refers to and includes fisheries resources, fishermen, and related businesses
Continental shelf	Underwater portion (shelf) of the continent, with moderate inclination, extending seaward from the shore to the edge of the continental slope where the inclination increases rapidly. Sometimes conventionally considered as the continent margin between 0 and 200 meters depths.
Continental slope	Part of the continental margin; the ocean floor from the continental shelf to the continental rise or oceanic trench. Usually to a depth of about 200 meters. The continental slope typically has a relatively steep grade from 3 to 6 degrees.
Coral reef	The massive deposition of calcium carbonate by coral polyps of colonial stony corals and other organisms producing large living hard structures
Crustaceans	A group of freshwater and saltwater invertebrates with jointed legs and a hard shell of chitin. Includes shrimps, crabs, lobsters, and crayfish
Delta	A nearly flat plain of alluvial deposit between diverging branches of the mouth of a river, often, though not necessarily, triangular
Term	**Definition**
Demersal	Living in close relation with the bottom and depending on it. Cods, groupers, crabs, and lobsters are demersal resources. The term usually refers to the living mode of the adult, e.g., demersal fish

Dinghy	A small open boat usualy built from aluminum providing local rapid transport for people and their goods; typically fitted with an outboard motor
Distributary	A branch of a river that does not return to the main stream after leaving it (as in a delta)
Dugout canoe	A canoe made from a hollowed tree trunk
Ecosystem services	The benefits people obtain from ecosystems. These include provisioning services, such as food and water; regulating services, such as flood and disease control; cultural services, such as spiritual and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth
Effort	The amount of time and fishing power used to harvest fish; includes gear size, boat size, and horsepower
Estuary	A coastal ecological ecosystem that is partially enclosed, receives freshwater input from land, and has a horizontal fresh-salt salinity gradient; the average salinity of estuarine waters is defined as being 30 practical salinity units (PSU) for at least 1 month per year
Euryhaline	Organisms able to tolerate a wide range of salinity
Geocoding	Providing geographical coordinates corresponding to (a location)
Geotagging	The process of adding geographical identification metadata to various media such as a geotagged photograph or video
Landing craft	A small boat with a flat bottom that opens at one end and is used to offload or load people, goods and equipment
Navigable waters	Waters that provide a channel for commerce and transportation of people and goods
Nearshore or coastal water	Starts from the lowest low-tide point and extends up to three nautical miles towards the sea
Offshore	Situated at sea beyond the 3 nautical mile coastal water limit
Onshore	Terrestrial or on land
Purari River basin/catchment	A catchment 33,670 km^2 in size that occupies a considerable portion of the central and southern part of mainland Papua New Guinea. It lies between the Kikori and Vailala rivers and extends from the highest mountain of Papua New Guinea, Mount Wilhelm to the Gulf of Papua
Purari River delta	A large area of low, flat depositional land within the Purari River catchment where the Purari River main channel branches into several smaller distributary rivers channels before flowing into the Gulf of Papua
Subsistence fishery	Refers to fishing, other than sport fishing, that is carried out primarily to feed the family and relatives of the person doing the fishing
Total alloable catch (TAC)	A catch limit set for a particular fishery, generally for a year or a fishing season
Watercraft	A boat or other vessel that travels on water
Watercraft	A boat or other vessel that travels on water

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Attachment 1.
Marine and River Traffic Log

Attachment 1: Marine and River Traffic Log

Record No.	Location Description	Latitude	Longitude	Date and time	Type of boat that passed and direction of travel*	Type of boat moored *	Boat dimensions/ capacity	Males	Females	Estimated age (years)	Activity**	Equipment used***	Resource transported or collected	Approximate time spent carrying out activity	Photo ID for vessel	Comments
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
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*** Key:** CV – Cargo vessel, BB – Banana boat, D – Dinghy, ORC – Outrigger canoe, DOC – Dugout canoe
**** e.g.** Fishing, diving, transportation, collecting materials etc.
***** e.g.** Fishing net, fishing line, spear gun, hand spear, diving equipment

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