19. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES: OFFSHORE PIPELINE

This chapter summarises Appendix 11, Offshore Impact Assessment, and Appendix 3, Resource Use Survey of the Omati–Kikori Delta, which describes the potential physical, biological and marine resource use issues associated with the construction and operation of the offshore section of the LNG Project Gas Pipeline through the Omati River and across the Gulf of Papua. Issues associated with the barging of project-related equipment and supplies from Port Moresby (and potentially overseas) to Kopi are also discussed.

Appendix 11, Offshore Impact Assessment, provides a pre-mitigation impact assessment and recommendations for mitigation. This chapter completes the assessment of residual impacts assuming successful implementation of these mitigations. And for those impacts where no mitigations are proposed, the pre-mitigation impact assessment is presented.

The impact assessment of project-wide archaeological, cultural and social issues are not discussed in this chapter, rather they are addressed in Chapter 22, Project-wide Cultural Impacts and Mitigation Measures, and Chapter 23, Project-wide Socio-economic and Cultural Impacts and Mitigation Measures. Further detail on issues specific to Caution Bay, including those associated with offshore pipeline construction and operation in Caution Bay, are provided in Chapter 21, Environmental Impacts and Mitigation Measures: Marine Facilities.

19.1 General Approach

The general approach and method that this EIS uses to assess environmental impact significance is described in Section 18.1.1, Impact Significance.

Definitions of the types of impacts (direct, indirect and cumulative), magnitude of impacts and sensitivity of the resource/receptor in the marine environment of the Gulf of Papua are described in the sections below.

19.1.1 Types of Impacts

19.1.1.1 Direct and Indirect Impacts

Direct impacts are generally those impacts occurring either within the project footprint (such as habitat disturbance) or as a direct consequence of a project activity (such as a waste discharge).

Indirect impacts are those arising from project facilities or activities, but with a degree of temporal or spatial separation (e.g., the spread of marine pest species). They are by their nature hard to predict except in broad terms.

19.1.1.2 Cumulative and Associated Impacts

A step further removed are impacts arising from actions of third parties, which the presence of the project may enable or assist. Chapter 24, Cumulative and Associated Impacts characterises these impacts as scenarios based on speculative assumptions about the influence that the project may have on what other people may or may not do. For example, in the marine environment, this

might apply to increased boating or fishing activities, or development of other projects with incremental impacts on marine resources or habitats.

19.1.2 Matrix Components

19.1.2.1 Impact Magnitude

The magnitude of an impact reflects:

- The intensity or severity of the impact.
- How long the impact will last.
- Over what spatial extent the impact will occur.

Criteria for assessing the magnitude of an impact (appropriate for the marine environment of the Gulf of Papua and riverine environment of the Omati-Kikori delta) are provided in Table 19.1.

Table 19.1 Magnitude of impact categories and descriptions – offshore pipeline

Category	Description
Very High	Effect likely to have large impact on population, community or ecosystem survival and health, possibly even leading to extinction or system collapse. Impact is widespread, affecting more than 10% of a regional population. Recovery, if possible, is likely to take more than 25 years.
High	Effect likely to have severe negative impact on population, community or ecosystem survival or health. Impact is regional, affecting up to 10% of a regional population. Recovery, if possible, is likely to take up to 25 years.
Medium	Effect will be detectable but not severe; populations or the areal extent of communities may be reduced but unlikely to lead to major changes to population, community or ecosystem survival or health. Impact is local, generally occurring within 10 km of impact site. Recovery is likely to take up to 7 years.
Low	Effect may be detectable but is small and highly unlikely to have any material impact. Impact is limited, affects immediate surrounds of impact area and extends for up to 2 km radius. Recovery is short term up to 3 years.
Minimal	Effect unlikely to be detectable.
Positive	Effect is likely to benefit the population, community or ecosystem.

19.1.2.2 Sensitivity of the Affected Receptor

The sensitivity of the environmental receptor will reflect:

- Its formal status, whether by statutory or attributed conservation status, land use zoning or environmental quality standard.
- Its vulnerability to material damage or loss by the impact in question.
- Its iconic or symbolic importance to cultural value systems.

The sensitivity of the resource/receptor that may be impacted was determined from the existing environment information (see Chapter 11, Receiving Marine Environment: Offshore Pipeline) and classified into categories based on Table 19.2.

Table 19.2 Sensitivity of resource/receptor categories and descriptions – offshore pipeline

Category	Description
Very High	A population of an ecologically or socially important species on an international level, or a site or habitat supporting such a species. A rare, threatened or vulnerable habitat or species and/or a breeding ground or feeding area that is critical to the survival of such species. Resource that provides the sole source of food or income for a local population.
High	A nationally designated site. A sustainable area of priority habitat. A population of an ecologically or socially important species on a national level, or a site or habitat supporting such a species. Site supports 1% or more of national population. Resource that provides a large portion of food or income for a local population.
Medium	A population of an ecologically or socially important species on a regional level, or a site or habitat supporting such a species. Site supports 1% or more of regional population. Resource that provides a medium portion of food or income for a local population.
Low	Sites, populations or resources that enrich the local area. Resource that provides a small portion of food or income for a local population.
Minimal	No ecological or social value or sensitivity.

19.1.3 Assessment of Significance

A matrix of significance was developed that combined the different definitions of magnitude of impacts with the various scales of resource/receptor sensitivity. The matrix is provided in Table 18.1 (see Section 18.1.4, Impact Significance Matrix) and assigns a significance of impact for each of the possible combinations between magnitude of impact and sensitivity of resource/receptor.

19.2 Seafloor Habitats

19.2.1 Issues to be Addressed

19.2.1.1 Construction and Operations

The only issue to be addressed regarding seafloor habitats during construction is direct disturbance to seafloor habitats. During the installation of the offshore pipeline, activities such as

pipelaying, trenching and the placement of anchors associated with anchored laybarges[1] will disturb seafloor habitat.

Once laid, and during operations, areas disturbed during construction will stabilise and sources of disturbance will cease unless the seafloor becomes scoured, which may occur if there are areas along the route where localised lateral currents are sufficiently strong.

19.2.2 Mitigation and Management Measures

19.2.2.1 Construction and Operations

Alternative alignments have not been assessed for the offshore section because, regardless of where it runs, the pipeline must traverse or negotiate the same features of the seafloor: the generally muddy, stable seafloor of the gulf, and the coral sands and reefs to the east of the zone of sedimentation from the large rivers draining into the head of the Gulf of Papua.

Impacts associated with direct disturbance to seafloor habitat are unavoidable but will be confined to the immediate vicinity of construction activities (see Section 19.2.3, Residual Impact Assessment). It therefore follows that the route of least engineering difficulty will also result in the least environmental disturbance and it is this route which is proposed and has been assessed.

Seafloor samples obtained along the proposed route are described as silts and clays, typical of areas of deposition of sediment and for this reason are unlikely to be exposed to strong scouring forces. Engineering means to manage scouring and prevent spanning are available if there are any areas for which the geotechnical surveys (pre-installation) indicate that this might be necessary. The offshore route will be optimised [M190] following interpretation of data collected during a recently completed marine survey (see Section 3.3.1.2, Offshore Pipeline Routing).

19.2.3 Residual Impact Assessment

19.2.3.1 Construction and Operations

The extent of disturbance to seafloor habitats during construction will be limited to the areas directly covered by and adjacent to the pipeline and where anchors are deployed (assuming an anchored laybarge is used). The area of disturbance along the pipeline route will be wider where trenching is undertaken (see Section 3.6.3.2, Pipeline Stabilisation and Protection).

When anchoring barges, the typical area of disturbance[2] from a single anchor from the initial anchor drop point until the anchor holds is approximately 50 m^2 (including the area affected by the anchor chains). If an anchored laybarge is used along the entire pipeline route, the area of disturbance[3] along the offshore route from anchor disturbance is expected to be approximately 33 ha. The pipeline will physically cover approximately 43 ha of seafloor[4]. With the exception of

[1] The use of an anchored laybarge and a dynamically positioned laybarge are both under consideration by the project. For the purposes of assessing seafloor disturbance, an anchored laybarge is assumed, as this type of vessel would cause greater seafloor disturbance than a dynamically positioned laybarge.

[2] Observed from the operator's and consultant's previous experience.

[3] Assumptions: area of disturbance from each anchor = 50 m^2, number of anchors per anchored laybarge = 8, length of pipeline = 407 km, distance between each 'stop' of the anchored laybarge = 500 m.

[4] Assumptions: diameter of pipeline = 0.85 m, thickness of pipeline external coating = 108 mm, length of pipeline = 407 km. This calculation does not take into consideration that some of the offshore pipeline will be buried.

the area physically covered by the pipeline, the disturbance to the seafloor habitat is expected to be very localised and temporary, leading to recovery in the short-term. For these reasons, the magnitude of impact as defined in Table 19.1 is minimal.

As discussed in Section 11.3.1, Habitats and Seafloor Characteristics, the benthic habitats along the offshore pipeline route from the Omati River Landfall to the entrance to Caution Bay are comprised mainly of soft clays and silts, with occasional rocky outcrops observed in the eastern portion of the route. These habitats are extensive and were not observed to have any localised areas of particular benthic patterns or differentiation. Additionally, similar groups of benthic infauna were observed throughout most of the surveyed length of the pipeline. Therefore habitats affected by the pipeline will be similar, regardless of the alignment of the pipeline, which will directly disturb only a narrow construction corridor and anchor points comprising a very small area relative to the total habitat area existing in the Gulf of Papua.

As such, the sensitivity of resource/receptor as defined in Table 19.2 is minimal.

Based on the criteria set out in the matrix of significance in Table 19.1, the residual significance of this potential impact is minimal.

19.3 Sea Water Quality and Hydrology

19.3.1 Issues to be Addressed

The issues associated with sea water quality and hydrology are relevant for both the construction and operations phases of the project and are described below.

19.3.1.1 Construction

Increased Suspended Sediment and Sedimentation Rates

Installation of the offshore pipeline, including pipelaying, the placement and retrieval of anchors (if an anchored laybarge is used) and trenching will resuspend bottom sediments and temporarily increase turbidity and sedimentation rates down current of the areas of disturbance. In turn, this decreases light penetration and can smother marine biota.

Alteration of Riverine Barging Route Hydrology

The barges travelling to and from Kopi will navigate through the Omati-Kikori delta (see Section 5.2.1.2, Kopi Shore Base). Wave action (i.e., the wake) caused by these barges while travelling close to riverbanks (to avoid sandbanks on the other side of the channel) may increase the rate of erosion of these riverbanks and contribute to the sedimentation in the Kikori River.

Waste Discharge from Vessels

Water quality may be affected by the discharge of domestic wastes and deck wash (potentially contaminated with oil) from all vessels associated with pipeline installation and the transportation of equipment and supplies to Kopi.

Accidental Spillage of Hazardous Substances

Hazardous and dangerous goods that will be used on the pipelaying vessels include diesel fuel, oxy-acetylene gas (for welding), solvents (for repair of corrosion coatings on the pipe), paints, hydraulic fluids and X-ray sources (for radiography of pipeline welds). Other project-related vessels will also hold fuel. Accidental spillage of these substances or a large-scale spill, such as that caused by a vessel collision, could impact the marine environment of the gulf.

Disposal of Hydrotest Water

Hydrotesting (see Section 3.6.5, Precommissioning Activities) will be performed following pipelaying to confirm pipeline integrity and will involve filling the entire offshore pipeline with water. It is expected that approximately 220 ML of water will be required for the hydrotest procedure and may be drawn from the Omati River at the landfall or from Caution Bay[5].

Once testing is complete, the hydrotest water will be discharged into the Omati River or (less likely) to Caution Bay. The rationale behind selection of abstraction and disposal locations is described in 'Disposal of Hydrotest Water' in Section 19.3.2.1, Construction.

Hydrotest water requires dosing with biocides and an oxygen scavenger to control the growth of sulfate-reducing bacteria while water is inside the pipeline during the testing procedure as the bacteria can form hydrogen sulfide, which, in turn, can corrode the pipeline. Biocides and oxygen scavengers can be toxic to marine organisms. On disposal, organisms in the receiving water will be exposed to residual levels of these chemicals.

Quarantine issues associated with hydrotest water disposal are addressed in Section 19.7, Quarantine.

19.3.1.2 Operation

Alteration of Omati River Hydrology

Pipeline construction earthworks at the Omati River Landfall and the presence of the installed pipeline in the Omati River has the potential to alter channel morphology, with flow-on sedimentation or scouring effects.

It is understood, from consultation with local people from the Kikori-Omati delta area, specifically during the roadshows (see Chapter 9, Stakeholder Engagement) and the findings contained in Appendix 3, Resource Use Survey of the Omati–Kikori Delta, that local people perceive the hydrology of the Kikori River (i.e., the river where the Kutubu Petroleum Development Project crude oil export pipeline has been installed) is changing. Consultation has revealed that local communities commonly hold that sandbanks are forming and banks are eroding and state that the first appearance of sandbanks in the river followed the construction of the crude oil export pipeline and/or commencement of logging activities in the area.

Hence, the local communities feel that the increased levels of sedimentation are associated with these activities. The mechanism by which the oil pipeline could have caused major changes to

[5] Regardless of where the hydrotest water is sourced, extraction will need to meet the conditions set out in an environment (water extraction) permit, issued by the Department of Environment and Conservation (DEC).

the hydrology of the Kikori River is not apparent and, for example, the presence of sandbanks upstream of the pipeline suggests that at least some of the sedimentation effects are not related to pipelaying. Regardless, the same perception may also occur should changes in the hydrology of the Omati River – for whatever reason – be noticed following the construction of the LNG Project Gas Pipeline.

19.3.2 Mitigation and Management Measures

19.3.2.1 Construction

Increased Suspended Sediment and Sedimentation Rates

Pipeline routing has been optimised to minimise the amount of trenching required, which will also minimise the unavoidable impacts of increased suspended sediment and sedimentation rates in the vicinity of pipelaying activities [M190].

Alteration of Riverine Barging Route Hydrology

Barges will be managed to control their wake, thereby reducing the potential for riverbank erosion and downstream sedimentation [M193].

Waste Discharge from Vessels

The project will meet applicable PNG acts and regulations relating waste discharge[6]. These are detailed in Section 8.2.5, Other PNG Legislation and Regulations.

The project will also comply [M188] with the International Convention for the Prevention of Pollution from Ships (MARPOL) (IMO, 1973/1978), which requires:

- Solid food waste to be macerated before disposal and to be disposed of at least three nautical miles from shore.
- Sewage to be comminuted and disinfected before disposal and be discharged at least three nautical miles from shore.
- Deck water potentially in contact with oily surfaces to be passed through oil/water separators before discharge overboard.

Accidental Spillage of Hazardous Substances

As stated above, the project will comply [M188] with the International Convention for the Prevention of Pollution from Ships (MARPOL) (IMO, 1973/1978), which requires:

- The development of a hazardous materials register.

[6] The PNG Parliament is considering four new bills that, if adopted, will bring PNG law into line with international standards and will also result in the two existing acts being repealed (see Table 8.3). The new bills are Marine Pollution (Ships and Installations) Bill, Marine Pollution (Sea Dumping) Bill, Marine Pollution (Preparedness and Response) Bill and Marine Pollution (Liability and Cost Recovery) Bill. While the bills do not yet form part of PNG legislation at the time of writing, requirements and regulations contained in the Marine Pollution (Ships and Installations) Bill give effect to similar relevant provisions and definitions within international conventions such as the MARPOL Convention, Anti Fouling Systems Convention and International maritime dangerous Goods Code.

- Separate storage of paints and other flammable materials.
- Wastes produced by vessels that cannot be discharged under MARPOL (IMO, 1973/1978) to be stored on board and then transferred to approved onshore facilities for treatment, reuse, recycling or disposal.
- Deck water potentially in contact with oily surfaces to be passed through oil/water separators before discharge overboard.
- Radioactive materials to be stored in suitable, adequately marked, purpose-built containers and to be handled by qualified personnel only.

An emergency response procedure capable of dealing with all potential scales of spills will be developed and personnel on project vessels will be inducted into this procedure [M209]. Resources required for responding to a large-scale spill will be made available by the project and identified in this procedure. The emergency response procedure will be informed by risk assessment of major hazards associated with offshore pipeline construction and project marine transportation activities that will be conducted by the project and contractors prior to construction works commencing.

Further details about environmental management plans are provided in Chapter 30, Environmental Management, Monitoring and Reporting.

Disposal of Hydrotest Water

Water used for hydrotesting will be discharged under an environment (waste discharge) permit. The project will comply with the requirements this permit, which is issued by the Department of Environment and Conservation (DEC) [M187].

To mitigate impacts to the receiving environment, the project has considered several different abstraction and disposal location scenarios and these are provided in Table 19.3. Due to the large volume of saline hydrotest water that will be used, disposal of this water on land is not a feasible or environmentally acceptable option; the adverse impacts involved in land disposal (e.g., flooding land with saline water which would likely drain to freshwater streams and potentially contaminate non-saline groundwater) would substantially outweigh those associated with marine disposal.

Caution Bay and the Omati River are both feasible options for sourcing hydrotest water. The preferable option for disposal of hydrotest water is in the Omati River as the Omati River is subject to tidal influence and any discharges are likely to be diluted rapidly. However, if the water is abstracted from Caution Bay, it is possible to dispose of the water in Caution Bay, although this option is not preferred, as Caution Bay is more biologically sensitive than the Omati River and will also receive discharges from the LNG tank hydrotest process and brine from the desalination process (see Section 21.3, Sea Water Quality) [M205].

Table 19.3 Hydrotest water source and disposal options – offshore

Water Supply Option	Water Disposal Option		Rationale
	Omati River	Caution Bay	
Omati River (brackish water)	Feasible	No	Omati River is tidally influenced and turbid. Water within Caution Bay is relatively clear seawater, with sensitive coral and seagrass habitats. In addition, compliance with water clarity criteria of Environment (Water Quality Criteria) Regulation 2002 is considered unlikely.
Caution Bay (seawater)	Feasible	Not preferred	Caution Bay is more biologically sensitive that the Omati River and it will already receive discharges of brine and LNG tank hydrotest water from the LNG Facilities site.

The exact details of discharge into the Omati River (the most likely discharge option) are not yet specified, but location, depth, rate and tidal period of discharge, as well as outlet engineering will be considered to maximise dilution rates of discharged hydrotest water.

A hydrotest water disposal management plan will be developed to minimise impacts associated with discharge of hydrotest water. The plan will adhere to the conditions set out in the environment (waste discharge) permit [M187].

Procedures to reduce the solids component of the hydrotest water will include cleaning the inside of the pipe prior to placement on the seafloor. Further, the hydrotest water will, if necessary, be filtered prior to filling and emptying the pipeline to remove most solid material.

19.3.2.2 Operation

Alteration of Omati River Hydrology

The LNG Project Gas Pipeline will be buried in the bed of the Omati River to protect the pipeline and limit potential causes of interruptions to natural bed sediment transport processes [M194].

In addition, the project has commenced sedimentation and geomorphologic characterisation studies of the Omati River to collect baseline data to characterise the portion of the riverbed on which the proposed LNG Project Gas Pipeline will be laid so that any future changes can be compared to preconstruction conditions. The project will collect approximately two years[7] of baseline monitoring data prior to construction works [M186].

[7] Monitoring baseline data of the Omati River will be collected twice during the year to characterise seasonal variations.

19.3.3 Residual Impact Assessment

19.3.3.1 Construction

Increased Suspended Sediment and Sedimentation Rates

The extent of detectable increases in suspended sediment and sedimentation rates from marine pipelaying activities is expected to be within the same general vicinity and less than 2 km from the impact source. Being from the same location, the disturbed sediments are likely to be of similar particle size that naturally settle in the area. The duration of the impact will be limited to the period when the pipelaying and trenching activities are occurring.

Pipelaying is expected to progress at a rate of 300 to 720 m per day in the Omati River and from 2 to 3 km per day across the Gulf of Papua, and occur for approximately 15 months. Trenching (for the required sections of the offshore pipeline) is scheduled to last approximately one year. For the reasons discussed above, the magnitude of impact as defined by Table 19.1 is low.

At the Omati River end of the pipeline, suspended sediment levels are naturally high due to sediment loads being carried into the marine environment by the Omati and Kikori rivers (see Section 11.2.5, Water Quality). Marine biota inhabiting this area are adapted to these turbid conditions and are unlikely to be impacted by short-term increases in levels of suspended sediment. Further offshore and away from the influence of the Omati–Kikori delta, the waters have naturally lower levels of suspended sediment; however, as discussed in Section 11.3.1, Habitats and Seafloor Characteristics, conditions conducive to the establishment of sediment-sensitive habitat, such as coral reef and seagrass, do not occur along the offshore pipeline route until close to the entrance to Caution Bay.

As discussed in Section 10.5.2, Aquatic Resource Use, the Omati River and all side creeks and tributaries are utilised by local communities for subsistence fishing; and this activity is important for their livelihood. However, as the Omati River naturally has high levels of suspended sediment, fisheries resources are unlikely to be impacted by project-derived increases in suspended sediment and turbidity during pipelaying activities.

While the offshore pipeline route traverses prawn trawl grounds (see Section 11.4.1, Commercial Fisheries), increases in suspended sediment and resulting sedimentation are unlikely to impact prawn populations, as prawns in the area are regularly exposed to increased levels of suspended sediment from prawn trawling equipment disturbing the seafloor and from natural resuspension of sediment by the action of waves and ocean currents.

For reasons discussed above, the sensitivity of resource/receptor is low, and the residual significance of this potential impact is therefore minor.

Alteration of Riverine Barging Route Hydrology

The barges associated with the construction of the project will add to the existing level of marine traffic along the barging route (at a frequency of approximately 2.7 vessel per week in each direction) over the course of approximately 3 years (see Section 5.2.1.2, Kopi Shore Base). The potential increased erosion and downstream sedimentation arising from this low level of barge traffic on river systems at the scale of the Kikori River will be limited to this duration and of low magnitude.

The sensitivity of the Omati–Kikori delta, including the Kikori River (and other channels that the barge traffic will utilise), to hydrological changes would under most circumstances be considered low, as this environment is dynamic and undergoing natural accretion and channel changes (see Section 10.2.7.2, Kikori River System). However, as local people have expressed concern about the hydrological changes in the river (see above), the sensitivity of the resource/receptor is considered medium.

Hence the significance of this potential residual impact is assessed as minor.

Waste Discharge from Vessels

The discharge of appropriately treated domestic waste and uncontaminated deck wash will be rapidly diluted by the receiving waters of the Gulf of Papua and discharged in compliance with national legislation and regulations and international conventions. It is unlikely, therefore, that changes to water quality from the disposal of domestic waste and deck wash will harm marine biota where discharge occurs. For these reasons, the magnitude of impact is minimal.

As discussed in Section 11.3.1, Habitats and Seafloor Characteristics, the benthic habitats along the offshore pipeline route from the Omati River Landfall to the outskirts of Caution Bay are extensive with no areas of particular or localised environmental value. While endangered species, such as dugongs or whales were not observed in the Gulf of Papua during the present surveys, they may occur occasionally. Even so, it is highly unlikely that they would approach vessels close enough to be affected by the normal discharge of domestic waste and deck wash. For these reasons, the sensitivity of resource/receptor is low.

The residual significance of this potential impact is therefore minimal.

Accidental Spillage of Restricted Substances

The magnitude of any residual impact is dependent on the volume and the substance or substances accidentally spilled into the marine environment. The worst-case scenario, however unlikely, would be a vessel collision resulting in the spillage of a large quantity of fuel, as there will be only low inventory volumes of other restricted substances. A quick response through the implementation of the project's emergency response procedure would lessen the severity of impact to the environment by limiting the degree of spread from the initial spillage site.

A fuel spill may still cause extensive impacts to marine biota and fishery resources. Spill response planning that will be conducted during FEED and detailed design will be incorporated into the project environmental management plan. This will mitigate the potential for occurrence of major hazards (see Chapter 27, Environmental Hazard Assessment), such as product spills in marine waters. Therefore, the magnitude of impact is assessed as low.

Seafloor habitats along the area traversed by the offshore pipeline through the Gulf of Papua are, as mentioned above, similar and do not have particular environmental sensitivities. However, local communities heavily rely for their livelihood upon the marine resources in the Omati River and other coastal areas that may be impacted in the event of a large-scale spill.

For these reasons, the sensitivity of resource/receptor is high and the significance of this potential residual impact is assed overall as minor.

Disposal of Hydrotest Water

Approximately 220 ML of hydrotest water will be discharged. If the water were discharged continuously, the process would take between 7 and 10 days, corresponding to an average discharge rate ranging from 0.37 to 0.25 m^3/s respectively.

The hydrotest water will contain small quantities of an oxygen scavenger (e.g., Champion OS-2), originally dosed at 100 mg/L, and a biocide (e.g., Bactron B1150), originally dosed at 200 mg/L. Material safety data sheet information states that Champion OS-2 is a reducing agent, biodegradable and slightly toxic to aquatic fauna and that Bactron B1150 has a degradation rate of 64% in 28 days under aerobic conditions, which would be encountered in the receiving environment.

Table 19.4 gives the aquatic toxicity data (effect of concentration to 50% of standard test organisms after a particular time) for Bactron B1150.

Table 19.4 Aquatic toxicity data for Bactron B1150

Test	Organism	Test Type	Result
Algae	*Skeletonema costatum*	EC50 72 hr	1.2 mg/L
Crustacean	*Acartia tonsa*	EC50 48 hr	0.21 mg/L
Fish	Sheepshead minnow	EC50 90 hr	64 mg/L

While the exact location, depth and rates of discharge and details of discharge process are not yet known; a preliminary sensitivity analysis indicates rapid dispersion is achievable. Assuming discharge in the Omati River (at the currently proposed Omati River Landfall shown in Figure 6.12, the river is approximately 1.5 km wide and tidal conditions are estimated to flush approximately 93 million m^3 of water[8] past this point over each six-hour tidal cycle. Therefore, it is estimated that hydrotest water discharged during each six-hour tidal cycle would be diluted with Omati River water to 0.008% of the total water volume at the discharge point.

Concentrations of Champion OS2 and Bactron B1150 in receiving waters six hours after discharge to the Omati River at the Omati River Landfall are estimated to be 0.008 and 0.017 mg/L respectively, indicating that concentrations will be well below levels harmful to the aquatic organisms listed in Table 19.4. While these organisms do not necessarily inhabit the Omati River, they give a general indication of the toxicity of Bactron B1150. Given that the concentration of Bactron B1150 would be less than 12 times that to affect the most sensitive organism in Table 19.4 six hours after discharge, it is unlikely to affect the aquatic organisms living in the Omati River.

These preliminary calculations indicate that rapid dispersion is achievable and on present assessment, the magnitude of impact is assessed as low.

Potentially, hydrotest water from the onshore sections of the pipeline may also be discharged in the Omati River. Volumes are not known and depend on reuse and alternative discharge

[8] Assumptions: Surface area of the Omati River upstream from the landfall location = 46.8 km^2 (calculated using Royal Australian Survey Corps Topographical Survey Map - sheet 7782), tide cycle = 6 hours, typical water level change per tide cycle = 2 m.

locations, which were still under consideration at the time of writing this document (see Section 18.5, Water Quality). If the onshore pipeline hydrotest water is discharged to the Omati River, the overall volume and time of discharge to the Omati River would increase. While it is assumed that the hydrotest water from the onshore pipeline will contain the same residual levels of the chemical additives, this is conservative as lower concentrations of these chemicals are normally used for freshwater.

The Omati River is a dynamic environment and, as discussed above, is subject to a high volume of water turnover from both tidal flushing and freshwater inputs from upstream tributaries. For reasons discussed above, the sensitivity of resource/receptor is assessed as low.

The resulting significance of this potential residual impact on water quality is assessed as minor.

19.3.3.2 Operation

Alteration of Omati River Hydrology

The residual impact relating to local community-perceived causes of potential changes to the hydrology of the Omati River cannot be assessed through the process described in Section 19.1, General Approach. Nevertheless, hydrological monitoring data collected from the ongoing baseline studies in the Omati River can be used to determine if the hydrology of the river was changing prior to construction.

If the hydrology of the Omati River changes post-construction, the baseline data can be used to determine if the changes were likely due to the project and what mitigations measures, if any, are required.

Burial of the pipeline in the river will avoid interruption of bed sediment transport processes, scour and flow-on sedimentation effects throughout the operational phase of the project. This assessment is based on the advice provided in a specialist study, undertaken by Moroka (2005) for the PNG Gas Project, which investigated erosion and sedimentation in the lower Omati River. The magnitude of impact is therefore assessed as minimal.

The hydrology of the Omati River is dynamic and undergoing natural changes (see Section 10.4.2.5 Estuarine Habitats). For this reason, the sensitivity of resource/receptor is low.

The resulting significance of this potential residual impact is minimal.

19.4 Marine Fauna

19.4.1 Issues to be Addressed

Marine fauna issues will arise during both construction and project operations.

19.4.1.1 Construction

Issues associated with marine fauna that will occur during construction of the offshore pipeline are described below.

Interaction of Vessels with Marine Mammals and Other Large Marine Fauna

As discussed in Section 11.3.2, Marine Fauna, a number of species listed by the International Union for the Conservation of Nature and Natural Resources (IUCN), such as dugongs and turtles and some species of whales and dolphins, inhabit the Gulf of Papua. Additionally, the Omati–Kikori delta is inhabited by two species of freshwater turtle (see Section 10.4.6.1, Freshwater Turtles) that are classified by the IUCN as vulnerable and one species that is classified as lower risk (IUCN, 2007).

These animals could be injured by collisions with the project-related vessels.

Underwater Noise

The pipelaying[9] and supporting vessels will operate 24 hours per day and emit underwater noise that will add to existing underwater noise (see Section 11.2.6, Underwater Noise). Noises generated during pipelaying will have the potential to interfere with the behaviour of nearby marine mammals that communicate and/or navigate using sound.

Light Emissions

The vessels associated with construction of the offshore pipeline will operate 24 hours per day using artificial lighting, which will have the potential to attract marine fauna including seabirds, fish, squid and larger predatory species.

Artificial light can also affect turtle movements, particularly when travelling to or from nesting beaches.

Interference with Tropical Rock Lobster Migration and Breeding

Adult tropical rock lobsters undertake annual migrations from the reefs of the Torres Strait and the northern Great Barrier Reef across the Gulf of Papua to the reefs off Yule Island and further to the east (see Figure 11.3). This takes place from August to December each year and is related to lobster breeding, with the lobster spawning at the end of the migration path (see Section 11.3.2, Marine Fauna).

The proposed pipeline route will travel for approximately 100 km past the lobster spawning grounds on the coastal reefs of Yule Island (see Figure 11.3). Although Figure 11.3 shows the pipeline route passing through the spawning area, the figure is somewhat diagrammatic: in fact the lobsters spawn on the coastal reefs, which have all been avoided by the pipeline route. Nevertheless, the lobsters will need to migrate past the proposed pipeline route to reach the spawning grounds.

As pipelaying is anticipated to take approximately 15 months, it will potentially coincide with – and potentially interfere with – at least one lobster migration and spawning season.

[9] At the time of writing, the use of an anchored laybarge and a dynamically positioned laybarge were both being considered by the project. For the purposes of assessing impacts relating to underwater noise, a dynamically positioned laybarge is used, as the noise characteristics of the thrusters on dynamically positioned vessels typically exceed noise levels from anchored laybarges. This assessment is therefore conservative.

19.4.1.2 Operations

Issues associated with marine fauna that will occur during operations are described below.

Interference with Tropical Rock Lobster Migration

As mentioned above, adult tropical rock lobsters undertake annual migrations from the reefs of the Torres Strait and the northern Great Barrier Reef across the Gulf of Papua to the reefs off Yule Island and further to the east. The lobsters migrate along the seafloor and do not swim in the water column; therefore, the offshore pipeline may present an obstacle to their migratory route.

19.4.2 Mitigation and Management Measures

Mitigation and management measures for marine fauna issues will be applied during both project construction and operations.

19.4.2.1 Construction

Interaction of Vessels with Marine Mammals and Other Large Marine Fauna

A marine fauna observation procedure will be implemented, requiring all sightings and encounters with marine mammals (such as whales and dugongs) and turtles to be documented in an observation log [M189]. This is consistent with practices for other marine operations for the oil and gas industry generally and increases awareness of whales and other large marine fauna in the vicinity. This function does not require a dedicated person and can be completed by the responsible person on watch, in the event that large mammals are seen, using appropriate forms and identification posters that will be provided.

In the event of any close approach (e.g., within 500 m) by marine mammals or turtles, which would potentially put the animals in danger of collision, the vessel crew will be alerted. Once alerted, support vessels and other project-related vessels will be able to reduce speed or take avoiding action. Although the pipelaying vessel will operate with equipment (e.g., anchors and the pipeline itself) on the seafloor and consequently its ability to take avoiding action will be limited, it will be moving at slow speeds, thereby minimising the chance of colliding with a marine mammal or turtle.

In reality, close approaches by such species are unlikely, but cannot be discounted.

Underwater Noise

There is little that can be done to change or reduce the underwater sound spectra from the vessels involved in pipelaying, particularly the dynamically positioned laybarge. Modelling of sound attenuation from the most intense source indicates no risk of physiological damage unless the animal is within a few tens of metres from source (see Annex A of Appendix 11, Offshore Impact Assessment), and as pipelaying activities will be continuous, animals cannot suddenly be exposed to these noise levels without detection from greater distances.

Maintaining observation of marine mammals and turtles (as proposed for vessel interactions) will alert crew to take action (e.g., slowing and waiting for the animals to move away), if practicable [M189].

Light Emissions

The source of light will move as the construction progresses, and will not become established in any particular location. Apart from not illuminating the deck at night more than is necessary for safe operations, no mitigation measures to address this impact are proposed [M195].

Interference with Tropical Rock Lobster Migration and Breeding

The pipelay period of 15 months and trenching period of approximately one year means that it is probable that these construction activities will coincide with at least one migration and spawning season, which occurs each year some time between August to December. If practicable, construction will be timed to avoid works in the 100-km-long section of proposed pipeline route that coincides with part of the lobster migration and spawning area during the adult lobster migration period.

19.4.2.2 Operations

Interference with Tropical Rock Lobster Migration

Once laid, it has been demonstrated that lobsters can climb over a concrete-coated pipeline (CSIRO, 1996). The offshore pipeline is therefore not expected to present any barrier to lobster migration during the operational phase of the project and will have no bearing on management of the tropical lobster fishery in Papua New Guinean or Australian waters.

No ongoing mitigation and management measures are proposed.

19.4.3 Residual Impact Assessment

The residual impacts on marine fauna from construction and operation of the project are assessed below.

19.4.3.1 Construction

Interaction of Vessels with Marine Mammals and Other Large Marine Fauna

It is highly unlikely that collisions between large marine fauna and project-related vessels will occur for the following reasons:

- The piplelaying vessel will travel at slow speeds (300 m to 3 km per day); therefore, animals would have to collide with the vessel, not vice versa**.**
- While the support vessels and other project-related vessels will travel at greater speeds than the pipelaying vessel, they will be able to take avoiding action if a marine mammal or other large marine fauna is sighted.
- Sounds associated with the pipeline installation activities will likely temporarily deter marine animals from entering the immediate areas of activity (see ‘Underwater Noise’ below).
- Marine mammals, with the exception of dolphins, are not commonly seen in the parts of the Gulf of Papua traversed by the pipeline.

Any impact would be to individual animals and very unlikely to affect a population of the species. For these reasons, the magnitude of impact is assessed as minimal.

As discussed in Section 11.3.2, Marine Fauna, several marine mammals and turtles that inhabit the Gulf of Papua are listed as vulnerable by the IUCN. While the Gulf of Papua is not a known breeding area or special feeding ground for these species, they do occur and are occasionally caught in prawn trawl nets (see Plates 11.7 and 11.8).

As discussed in Section 10.4.6.1, Freshwater Turtles, the Omati–Kikori delta is inhabited by two species of freshwater turtle that are classified by the IUCN as vulnerable and one species that is classified as lower risk (IUCN, 2007).

For this reason, the sensitivity of resource/receptor is high.

The residual significance of this potential impact is therefore assessed as minimal.

Underwater Noise

The residual impact assessment of underwater noise is based on a specialist report prepared by Curtin University of Technology, which is provided as Annex A of Appendix 11, Offshore Impact Assessment.

The assessment involved modelling the sound characteristics from a known vessel scaled to represent a dynamically positioned pipelaying vessel. The modelling is conservative, as the thrusters from a dynamically positioned vessel would result in greater underwater noise emissions than an anchored laybarge.

Sound attenuation was modelled at three sites along the proposed offshore pipeline route as follows:

- One western site near the Omati River end of the pipeline route (where the bottom sediment is soft and silty).
- Two eastern sites near the Caution Bay end of the pipeline (where the bottom sediment is harder and sandier).

The above sites are considered to be representative of the two seafloor types that exist along the proposed pipeline route. Soft silty seafloors are generally more absorptive of sound than are the consolidated sandy seafloors to the east near Caution Bay, which more readily reflect noise and result in slightly higher noise propagation.

Modelling showed that while the vessel will be audible for more than 20 km from the noise source, the noise is too low (i.e., less than a threshold underwater noise level of 180 dB re 1 µPa) to produce detectable physiological effects on marine mammals, such as temporary hearing loss. Some masking of low level sounds that some animals use for communication may occur.

However, the level at which underwater noise is considered ‘loud’ to marine mammals is about 140 dB re 1 µPa, which the modelling shows is limited to 2.2 to 2.3 km of the vessel at the western point and 700 m of the vessel at the eastern point.

Even so, animal response behaviour may be variable. Some whales may be inquisitive and approach the source of sound while others may exhibit avoidance behaviour. Ranges of avoidance behaviour are likely to occur between 1 and 10 km from the vessel, with responses

occurring at larger distances from the noise source at the eastern end of the pipeline route (because of the more sound-reflective seafloor).

The duration of this impact will be limited to when the pipelaying and trenching activities are occurring. Offshore pipelaying is expected to progress at a rate of 1 to 3 km per day, and trenching (for the entire offshore pipeline) is scheduled to take approximately one year.

For reasons discussed above, the magnitude of impact is assessed as low.

As discussed in Section 11.3.2, Marine Fauna, several marine animals that inhabit the Gulf of Papua are listed by the IUCN, although the Gulf of Papua is not a known breeding area or special feeding ground for these species. However, because of the international conservation status of the species, the sensitivity of resource/receptor is assessed as high.

The significance of this potential residual impact is therefore assessed as minor.

Light Emissions

Decking lights on the vessels will be kept to the lowest practicable levels needed to maintain safe working conditions. Lighting at night may attract fish and other marine animals, but as light sources will move with the operation at a rate of 1 to 3 km per day, it will not become a fixed fish attracting device. Being so far offshore light is not likely to affect orientation of turtles moving to or from nesting beaches and no adverse impacts to flora and fauna are therefore predicted. Hence, the magnitude of light impact on marine mammals and fish behaviour is assessed as minimal.

As discussed in Section 11.3.2, Marine Fauna, several species of turtle and marine mammals that inhabit the Gulf of Papua are listed by the IUCN. The route is predominantly well offshore of land and the offshore Gulf of Papua is not a known breeding area or special feeding ground for these species. However as the potential exists for these activities to occur in the region, the sensitivity of the resource/receptor is assessed as high.

The significance of this potential residual impact is therefore assessed as minimal.

Interference with Tropical Rock Lobster Migration and Breeding

The pipeline route will cross the migration pathway of the rock lobsters but it avoids the reefs (near Yule Island and to the east) where the lobsters spawn at the end of their migration, and where the diver-based artisanal fishery is based (see Section 11.4.1.2, Tropical Rock Lobster Fishery).

Once spawning takes place, lobster larvae are pelagic and not likely to be impacted by construction. Hence the only impact to the rock lobsters is to any individuals that happen to be under the anchors or the pipeline at the time it is laid on the seafloor. This can be avoided if it is practicable to schedule the pipelaying outside the period of the migration. This may not be possible and if this is the case, a small-scale loss of individuals does not pose any threat to the overall population and stocks of lobsters, particularly in relation to historical fishing activities, which included trawling for migrating lobsters (see Section 11.4.1.2, Tropical Rock Lobster Fishery). Therefore, the magnitude of impact is assessed as minimal.

Any significant disruption to rock lobster migration could potentially affect their life cycle (involving their migration to and spawning on the reefs of Papua New Guinea and subsequent recruitment back to the reefs of Northern Queensland and Torres Strait) and impact the overall rock lobster population, which would, in turn, affect the commercial rock lobster fishery, and on this basis, the sensitivity of resource/receptor is high.

However, on the basis of the avoidance of the reefs where these animals spawn and are fished, and the worst-case impact at the level of individuals injured or killed during pipelaying, the magnitude of impact is low and the resulting significance of this potential residual impact is assessed as minor.

19.4.3.2 Operations

Interference with Tropical Rock Lobster Migration

The ability of tropical rock lobsters to crawl over a 26-inch-diameter pipeline has previously been demonstrated (CSIRO, 1996). This is smaller than the 34-inch-diameter pipeline proposed for the project (see Table 3.1 in Chapter 3, Transporting the Gas), but given the rough surface of the concrete coat, which will assist animals to gain a foothold, the presence and operation of the pipeline is not likely to interfere with the annual rock lobster migration. On this basis, the magnitude of impact is minimal.

As discussed above in Section 19.4.3.1, Construction, the sensitivity of resource/receptor is assessed as high.

The resulting significance of this potential residual impact is therefore minimal.

19.5 Marine Fisheries

19.5.1 Issues to be Addressed

19.5.1.1 Construction

Issues associated with marine fisheries that will occur during construction of the offshore pipeline and transportation of equipment and supplies via barge to Kopi are described below.

Interaction with Commercial Fisheries

For reasons of safety, fishing boat operators will be required to keep clear of project vessels involved in the installation of the pipeline and observe a 500-m safety exclusion zone[10] around the pipeline installation vessel. Fishing boat captains will need to select alternative locations to obtain their catches if, at any time, pipeline construction activities pass through their preferred fishing grounds. As there are no other commercial fisheries along the pipeline route, is likely that this will only apply to prawn trawling operations, which are traversed by the offshore pipeline route (see Section 11.4.1.1, Gulf of Papua Prawn Fishery).

[10] Various acts (e.g., the *Australian Offshore Petroleum Act 2006* and *United Kingdom Petroleum Act 1987*) suggest a minimum 500-m exclusion zone around permanent offshore oil and gas facilities to avoid ship collision.

Barges travelling to Kopi will add to existing levels of shipping traffic in the area and these barges will need to keep clear of fishing vessels actively fishing, as other vessels transiting the Gulf of Papua currently do.

Interaction with Subsistence Fisheries and Small Craft

As with commercial vessels, operators of small craft, such as canoes and banana boats, will be required to keep clear of vessels involved in the installation of the pipeline. This will apply mostly in the Omati River and nearshore areas, where operators of small fishing craft will need to select alternative fishing areas if, at any time, pipeline construction activities pass through their preferred fishing grounds.

A safety hazard will apply to small craft; if, out of curiosity, operators of these craft approach too close to the pipeline installation vessels.

Waves caused by the barges travelling through the Omati–Kikori delta have the potential to swamp small craft, such as banana boats and canoes. In addition, local people would not be able to fish using nets along the barge route while barges are passing through.

19.5.1.2 Operations

Issues associated with marine fisheries that will occur during operations are described below.

Entanglement of Anchors or Fishing Gear with Installed Pipeline

There is potential for anchors or fishing gear (e.g., ropes, cables and trawl nets) to become entangled with the pipeline, mainly in areas where spanning of the pipeline could occur (e.g., due to the effects of seafloor scouring). This could lead to loss of fishing gear, which, in turn, may pose a threat to the safety of the fishing vessel and crew. The pipeline will be concrete-coated and is therefore not susceptible to damage from conventional fishing gear or anchors of a size utilised by large vessels typically found in the Gulf of Papua (see Chapter 27, Environmental Hazard Assessment, for further details on the risk of pipeline rupture from anchors and fishing gear).

19.5.2 Mitigation and Management Measures

Mitigation and management measures for marine fisheries issues will be applied during both construction and operation of the project and are discussed below.

19.5.2.1 Construction

Interaction with Commercial Fisheries, Subsistence Fisheries and Small Craft

A community awareness program will be carried out to inform inhabitants of villages near the offshore pipeline route (this will mainly apply near the landfall locations and where smaller vessels operate) regarding the offshore pipeline construction activities [M183]. Information on the timing of and the dangers associated with approaching pipelaying vessels will be passed on during the program. Local people will be requested to remain clear of the pipelaying vessels for their own safety. Consultation will include relevant aspects of access, safety and exclusion zones. The project will limit interfering with, or restricting local fishers' access to, fishing camps during construction activities in the Omati River as far as practicable [M184].

Likewise, the National Fisheries Authority and commercial fishing fleets who operate in the vicinity of the offshore pipeline route will be informed of offshore pipeline construction activities, including timing of construction activities and the safety exclusion zone [M198].

The project will notify local communities in the Omati–Kikori delta area about project barge traffic and the associated dangers of approaching barges [M185]. Barges will be managed to control their wake and prevent accidents with smaller boats [M193].

Barges travelling through the Gulf of Papua will follow normal maritime regulations to avoid interactions with commercial shipping vessels.

19.5.2.2 Operations

Entanglement of Anchors or Fishing Gear with Installed Pipeline

As-laid information on the pipeline location will be provided to the PNG hydrographer's office for incorporation into navigation charts [M200]. This will assist in reducing the likelihood of anchors or fishing gear becoming snagged on the pipeline, as non-project vessels using navigation charts will be aware of where the pipeline has been laid and will therefore be able to avoid undertaking activities in this area that may damage their equipment. A procedure for the evaluation and payment of compensation to vessel owners or skippers who can prove that they have sacrificed gear fastened on the pipeline will be developed and documented in the project environmental management plan [M201].

In addition, optimisation of pipeline design and pipelay techniques during FEED and detailed design will consider engineering techniques that may reduce the likelihood of anchors or fishing gear becoming entangled, including span reduction and trenching of the pipeline in parts of the Omati River and Caution Bay (see Section 3.6.3.2, Pipeline Stabilisation and Protection) [M199].

19.5.3 Residual Impact Assessment

The residual impacts on marine fisheries of construction and operation of the project are assessed below.

19.5.3.1 Construction

Interaction with Commercial Fisheries

The commercial fishing grounds in the Gulf of Papua are extensive following an arc across the whole Gulf of Papua from the Fly River delta to the boundary of the Gulf and Central provinces, following the 20 to 40 m depth contours. In comparison, the temporary and moving safety exclusion zone that will be applied during pipelaying activities is small and any inconvenience will be highly localised and of short duration. Operators of commercial fishing vessels will be informed in advance of and regularly updated about pipelaying activities. They will therefore know where they can fish and be able to avoid travelling to fishing grounds in the vicinity of the offshore pipeline route during pipelaying activities.

The barges travelling to Kopi will add to the existing level of commercial shipping in the area, however, maritime regulations exist to mitigate interactions between commercial vessels.

On consideration of these factors, the magnitude of impact on commercial fisheries is assessed as low.

As discussed in Section 11.4.1.1, Gulf of Papua Prawn Fishery, the number of prawn trawlers operating in the Gulf of Papua has declined in recent years due to the increased cost of fuel and subsequent decreased profitability of the fishery. The industry is currently vulnerable, and reduced catch rates or increased fuel usage could decrease the number of trawlers operating. For these reasons, the sensitivity of resource/receptor is assessed as medium.

Therefore, the significance of this potential residual impact is assessed as minor.

Interaction with Subsistence Fisheries and Small Craft

The geographic extent of this issue is limited to areas where small craft operate, such as in the Omati River, a short distance out from the Omati River mouth and along the barging route through the Omati–Kikori delta (and within Caution Bay – see Section 21.6, Subsistence Fisheries and Marine Traffic).

The duration of impacts in a particular area will be short, as pipelaying activities in the Omati River are expected to progress at a rate of 300 to 720 m per day. Pipelaying offshore in the Gulf of Papua will be faster, progressing at a rate of 2 to 3 km per day. Through consultation, inhabitants of nearby villages will know in advance where they can fish and can avoid travelling within the vicinity of the offshore pipeline route during pipelaying activities. There are numerous fishing areas in creeks and tributaries that will provide alternative fishing grounds during the time that pipelaying activities are underway in any particular area.

People currently using the barging route would be accustom to dealing with marine traffic, as the route proposed by the project is currently used by barges bringing supplies to Kopi and Kikori. Fishing, as observed during a resource use survey undertaken in April 2008 (see Appendix 3, Resource Use Survey of the Omati–Kikori Delta), was limited along the barge route and much greater levels of fishing activity were observed in areas were barges were not known to traverse. Therefore, the increase in quantity of barge traffic is unlikely to affect resource use along the barging route.

On this basis, the magnitude of impact is assessed as low.

As described in Section 10.5.2, Aquatic Resource Use, subsistence fishing provides an essential source of daily food for inhabitants of villages near the Omati River Landfall. For these reasons, the sensitivity of resource/receptor is assessed as high.

The residual significance of this potential impact is assessed as minor.

19.5.3.2 Operations

Entanglement of Anchors or Fishing gear with Pipeline

The likelihood of anchors or fishing gear becoming entangled with the pipeline is low as the pipeline is expected to self-bury for most of its length in soft sediments (such as those found in the prawn trawling grounds). A pipeline inspection and maintenance program undertaken in 2002 of the existing 88-km-long crude oil export pipeline servicing the Kumul Marine Terminal operated by Oil Search Limited, which has self-buried for approximately half its length, supports this

statement. In addition, span reduction techniques will be utilised in areas of seafloor where the pipeline has or is likely to exceed design guidelines; and the pipeline will be trenched in parts of the Omati River and Caution Bay (see Section 3.6.3.2, Pipeline Stabilisation and Protection).

On this basis, the magnitude of impact is minimal.

As discussed above, the number of prawn trawlers operating in the Gulf of Papua has declined in recent years due to the increased cost of fuel and subsequent decreased profitability of the fishery. The industry is currently vulnerable, and loss of fishing gear and/or anchors could decrease the number of trawlers operating.

Additionally, a potential safety risk to vessel and crew exists in the event of trawl gear hooking up on bottom obstructions, such as pipelines, if gear is not released or power to deck winches is not disengaged in a timely manner. For these reasons, the sensitivity of resource/receptor is assessed as high.

The significance of this potential residual impact is assessed as minimal.

19.6 Marine Traffic

Marine traffic issues will arise during construction of the offshore pipeline and while barges are transporting equipment and supplies to Kopi.

19.6.1 Issues to be Addressed

19.6.1.1 Construction

Interference with Shipping

For reasons of safety, commercial shipping vessels will be required to keep clear of project vessels involved in the installation of the pipeline and observe a safety exclusion zone of 500 m around the pipeline installation vessel. If, at any time, pipeline construction activities pass through their preferred navigational route, the commercial shipping vessels will need to alter course as necessary to keep outside the safety exclusion zone, which may increase their travel times.

Project barges travelling to Kopi will add to existing levels of shipping traffic in the area and may interfere with existing maritime traffic.

19.6.2 Mitigation and Management Measures

19.6.2.1 Construction

Interference with Shipping

Normal maritime communication systems will be established to alert other shipping to the locations of construction activities, and deck lighting at night on all project vessels will be maintained for safety purposes [M192, M195].

19.6.3 Residual Impact Assessment

19.6.3.1 Construction

Interference with Shipping

The Gulf of Papua is a large body of water, and commercial shipping vessels can use many routes to cross the area. Observance of a 500-m safety exclusion zone around the pipelaying vessel is unlikely to add additional travel time to the commercial shipping vessels. Conversely, the number of routes available to commercial vessels travelling in Omati River is limited. Observance of a 500-m safety exclusion zone in Omati River is likely to cause inconvenience to commercial vessels travelling through the area.

While the barges travelling between to Kopi will add to existing levels of marine traffic, they are will be operating like any standard vessel and are unlikely to interfere with existing marine traffic.

Vessels currently operating in the area should be following normal maritime regulations and hence observance of these regulations would not cause additional inconvenience.

On this basis, the magnitude of impact is assessed as low in the Gulf of Papua and assessed as medium in the Omati–Kikori delta.

Commercial shipping vessels will easily be able to alter course to avoid pipelaying activities and stay outside the safety exclusion zone in the Gulf of Papua. In the Omati River, the ability to alter course is limited, particularly in areas where water depths sufficient for large vessels may be restricted to the main river channel. On this basis, the sensitivity of resource/receptor is assessed as low in the Gulf of Papua and assessed as medium in the Omati River.

The significance of this potential residual impact is assessed as minor in both the Gulf of Papua and the Omati River.

19.7 Quarantine

19.7.1 Issues to be Addressed

Quarantine will only be an issue for the offshore component of the project during construction as no shipping activities are proposed during operations. Quarantine issues associated with ships involved in LNG export are discussed in Section 21.8, Quarantine.

19.7.1.1 Construction

Introduction of Non-native Marine Flora and Fauna

A potential pathway for the introduction of non-native marine flora and fauna into PNG waters is the presence of non-native organisms in ballast water discharged in PNG waters from project ships, the presence of non-native organisms on the hulls of the vessels associated with the construction of the offshore pipeline and transportation of equipment and supplies between Port Moresby and Kopi. This issue is not unique to the project and is applicable to any vessel entering PNG waters.

Hydrotest water is also a potential pathway for the introduction of non-native marine flora and fauna, if hydrotest water is not sourced from and disposed to the same location (see Table 19.3 in Section 19.3, Sea Water Quality and Hydrology). If the source and discharge locations are the same location the hydrotest water will not pose a quarantine risk, hence the issue addressed here only relates to water potentially sourced from Caution Bay and disposed of in the Omati River.

Introduced marine pests cause problems to ecosystems through competition with existing native species for resources, alteration of localised gene pools and modification of physical environments.

19.7.2 Mitigation and Management Measures

19.7.2.1 Construction

Introduction of Non-native Marine Flora and Fauna

The project will establish and enforce a project-wide quarantine management plan [M222]. The plan will follow International Maritime Organization requirements and industry good practice with respect to ballast water discharge and hull cleaning to prevent the introduction of pest species. It is anticipated that the (presently draft) PNG Marine Pollution (Ships and Installations) Bill is intended to give effect (i.e., have force of law) in relation to prevention of pollution by oil, noxious liquid substances, harmful packaged substances, sewage, garbage and by anti-fouling systems: the latter giving effect to provisions of the Anti Fouling Systems Convention, with respect to phasing out of tin-based anti-fouling systems [M188]. As Kopi may become an international port directly receiving goods from overseas, the provisions of the PNG Marine Pollution (Ships and Installations) Bill will apply at that time.

An oxygen scavenger and a biocide will be added to the hydrotest water (see Section 19.3, Sea Water Quality and Hydrology) to control marine organisms present in the water [M196]. Further, the hydrotest water will, if necessary, be filtered prior to filling and emptying the pipeline to remove most solid material.

19.7.3 Residual Impact Assessment

19.7.3.1 Construction

Introduction of Non-native Marine Flora and Fauna

With the quarantine management protocols in place, it is unlikely that non-native organisms will be introduced into PNG waters, either during discharge of ballast water or via the hulls of vessels associated with the project.

Dosage of hydrotest water with biocidal and oxygen-removing treatment chemicals, together with the high pressure within the pipeline during hydrotesting will create a hostile environment for organisms. Habitats at the source (e.g., Caution Bay) and discharge locations (e.g., Omati River) are dissimilar, and so the successful colonisation of species from open, clear saline waters in the vicinity of the turbid discharge location is unlikely.

In the unlikely event that this was to occur, the impact may be extensive (i.e., the organism or organisms may spread to other parts of Papua New Guinea) and long-term (i.e., it is often not

possible to eradicate introduced marine pests). On this basis, the magnitude of impact is assessed as medium.

The susceptibility of tropical waters, such as the Gulf of Papua, to the introduction of non-native marine pests is lower than temperate waters, as tropical waters have a high diversity of species and, as a result, have fewer available niches for pest species to occupy.

Most tropical species have a wide distribution, so the risks of local introductions of species not already present or of temperate species becoming established is low. For these reasons, the sensitivity of resource/receptor is assessed as low.

The significance of this potential residual impact is assessed as minor.