

28. ENVIRONMENTAL IMPACT SUMMARY TABLE

This chapter summarises the predicted environmental and cultural heritage impacts of the proposed PNG LNG Project in tabular form.

28.1 Environmental Impacts

Potential environmental impacts (Tables 28.1, 28.2 and 28.3) are provided for each environmental parameter, with a mitigation number corresponding to the list (in numerical order) in Chapter 29, Summary of Mitigation and Management Commitments.

The residual impact (i.e., the impact remaining after implementation of mitigation) is based on the matrix of the magnitude of impact following mitigation and the sensitivity of the resource or receptor (see Table 18.1). The residual impact is considered a negative impact unless otherwise stated.

The mitigation and management commitments proposed by the EIS are based on industry experience, and their objectives and scope are specific. However, the project as a whole needs to advance to the next stage of engineering design and construction planning before the implementation of the mitigation and management commitments can be defined in sufficient detail to be contractually binding on the contractors that Esso will engage to build the project.

It is the responsibility of Esso to lead this work. It will follow on directly from this EIS and will focus in particular on:

- Fine-scale pipeline route design to avoid or manage localised biophysical, social and cultural heritage constraints.
- The individual environmental management plans for the various project facilities.
- The individual environmental management plans for the logistics program and construction works.
- The environmental management system.
- Baseline monitoring programs to validate the predictions of this EIS.
- Ongoing community consultation and receiving and addressing the grievances of the people on whose land the project is proposed to be built.

Table 28.1 LNG Facilities site impact summary

Potential Impact Description (Before Mitigation)	Magnitude of Impact (After Mitigation)	Sensitivity of Resource/ Receptor	Residual Impact Significance (After Mitigation)	Mitigation and Management Commitment Number
Soils and Landforms				
Acid sulfate soils	Low	High	Minor	M28.
Vegetation recovery	Minimal	Low	Minimal	M12, M23.
Groundwater				
Contamination by construction spills	Minimal	High	Minimal	M25 to M27, M29 to M31.
Contamination by processing and utilities system spills	Low	High	Minor	M25 to M27, M29 to M31.
Contamination by storage facility spills	Medium	High	Moderate	M25 to M27, M29 to M31.
Hydrology and Sediment Transport				
Impacts to water yield, stream flows and bed material load in the Vaihua River and Karuka Creek catchments	*	*	Minimal	M4, M18, M19, M22.
Impacts to water yield, stream flows and bed material load in the North Vaihua River catchment	*	*	Minor	M4, M18, M19, M22.
Water Quality				
Sediment loading			Minor	See 'Impacts to water yield, stream flows and bed material load in the North Vaihua River catchment' under 'Hydrology and Sediment Transport' in this table.
Release of metals and nutrients to surface waters			Minimal	M4 to M7, M11, M24.
Acid drainage			Minor	See 'Acid sulfate soils' under 'Soils and Landforms' in this table.
Discharge of wastewaters			Minor	See 'Discharge of brine and wastewater' under 'LNG Marine Facilities' in Table 28.3.

Table 28.1 LNG Facilities site impact summary (cont'd)

Potential Impact Description (Before Mitigation)	Magnitude of Impact (After Mitigation)	Sensitivity of Resource/ Receptor	Residual Impact Significance (After Mitigation)	Mitigation and Management Commitment Number
Aquatic Ecology				
Introduction of exotic pests and diseases	Minimal	Low	Minimal	M1, M2, M8, M9.
Habitat quality and connectivity	Minimal	Low	Minimal	M4, M18, M19, M22.
Terrestrial Biodiversity				
Habitat loss: introduction of exotic weeds and pathogens	Low	Medium	Minor	M1, M2.
Habitat loss: causeway construction through mangroves	Low	Medium	Minor	M1, M2, M11, M12, M14, M15, M17, M18, M42.
Habitat loss: savanna, open woodlands and gallery forests	Low	Medium	Minor	M1, M2, M4 to M7, M11, M12, M14, M15, M17 to M19, M42.
Habitat loss: Vaihua River ecosystem complex	Low	Medium	Minor	M1, M2, M4 to M7, M11, M12, M14, M15, M17 to M19, M42.
Habitat loss: listed species	Low	Medium	Minor	M1 to M4, M8, M9, M13, M16.
Air Quality				
Dust emissions			Will meet assessment criteria	M32, M34, M42, M45.
Vehicle exhausts			Will meet assessment criteria	M33, M36, M42.
NOx emissions			Will meet assessment criteria	M37, M42 to M44, M49.
BTEX emissions			Will meet assessment criteria	M37, M42, M46, M47.
Noise				
Construction and operations noise levels	Low	High	Minor	M35, M36.
Construction traffic noise	Medium	High	Moderate	M36.
Visual				
Loss of visual amenity			Subjective response only**	M39 to M41.

* Resource sensitivity has not been considered in the assessment of hydrology and sediment transport, as these are not dependent on resource sensitivity. See Table 20.1 for the impact criteria used.

** Perception of change to visual amenity is subjective and cannot be interpreted via the matrix.

Table 28.2 Upstream project area impact summary

Potential Impact Description (Before Mitigation)	Magnitude of Impact (After Mitigation)	Sensitivity of Resource/ Receptor	Residual Impact Significance (After Mitigation)	Mitigation and Management Commitment Number	
Landform and Soils					
Hides Ridge:	Short term	Medium	High	Moderate	M64 to M67, M70, M71, M74, M75, M77, M82, M89, M90, M93, M116, M119 to M124, M141, M155.
	Medium term			Minimal	
Juha to Hides area:	Short term	Low	High	Minor	M74, M82, M83, M90, M119, M121 to M124, M155.
	Medium to long term			Minimal	
Homa deviation:	Short term	Medium	Medium	Minor	M74, M119, M121 to M124, M141, M152, M155, M157, M158, M160, M164.
	Long term			Minimal	
Swamps and wetlands of the Kikori delta:	Short term	Low	High	Minor	M115, M119, M121 to M124, M155, M162, M165.
	Medium to long term			Minimal	
Plant sites:	Short term	Low	Low	Minor	M119, M155, M159.
	Medium to long term			Minimal	
Quarries:	Short term	Low	Low	Minor	M67 to M69.
	Medium to long term			Minimal	
Groundwater					
Contamination: drilling fluids	Minimal	Very High	Minimal	M125 to M127.	
Contamination: accidental spills	Minimal	Low	Minimal	M130, M131.	
Water Resources and Hydrology					
Water yield	*	*	Minimal	M159.	
Stream-flow regime: Hydrotest water abstraction and disposal	*	*	Minimal	M51, M145.	
Watercourses crossings	*	*	Minimal	M140, M141, M142, M153, M155, M160, M162, M163.	

Table 28.2 Upstream project area impact summary (cont'd)

Potential Impact Description (Before Mitigation)	Magnitude of Impact (After Mitigation)	Sensitivity of Resource/ Receptor	Residual Impact Significance (After Mitigation)	Mitigation and Management Commitment Number
Water Resources and Hydrology (cont'd)				
Increased sediment loadings to watercourses and lakes	*	*	Minimal	M64, M71, M75, M77, M82, M83, M85, M152, M161.
Water Quality**				
Increased total suspended sediment	*	*	Minimal	M122, M127, M136, M142 to M144, M164.
Increase in metals concentrations	*	*	Minimal	M122, M127, M136, M164.
Contamination of watercourses by sewage and spills	*	*	Minimal	M127, M130, M131, M133 to M135, M146, M147 to M150, M151, M164.
Biodiversity				
Habitat loss	Minimal	Very High	Minimal	M65, M66, M75, M76, M77, M87, M119, M120.
Edge and barrier effects:	Minimal	Very High	Minimal	M75, M76, M77, M119, M120.
Most areas	Low		Moderate	
High-altitude karst areas	Minimal		Minimal	
Most species	Medium		Moderate	
Arboreal species in high karst	Minimal	Very High	Minimal	M74 to M77, M82, M119, M120, M141.
Erosion, movement of spoil and changes to hydrology:	Medium		Moderate	
Most areas and species	Minimal	Very High	Minimal	M56 to M59, M86, M87, M111, M178.
Arboreal species in high karst	Medium		Moderate	
Death of fauna	Minimal	Very High	Minimal	M56 to M59, M86, M87, M111, M178.
Flora or fauna impacts from spills; hydrotest water disposal; dust, noise, lights and other disturbances; and physical damage and disturbance to caves	Minimal	Very High	Minimal	M74, M75, M77, M82, M85, M87, M119, M120, M145, M147.
Fire	Low	Very High	Moderate	M60, M61.
Pests, weeds and diseases	Low	Very High	Moderate	M50 to M54, M80, M117, M118.
Hunting and collecting	Minimal	Very High	Minimal	M57, M58.

Table 28.2 Upstream project area impact summary (cont'd)

Potential Impact Description (Before Mitigation)	Magnitude of Impact (After Mitigation)	Sensitivity of Resource/ Receptor	Residual Impact Significance (After Mitigation)	Mitigation and Management Commitment Number	
Biodiversity (cont'd)					
Improved access	Low	Very High	Moderate	M62, M63, M88 to M91.	
Noteworthy areas – Juha:	Direct	Minimal	Very High	Minimal	
	Indirect				Moderate
Noteworthy areas - Hides Ridge:	Direct and indirect	Low	Very High	Moderate	
Noteworthy areas - high-altitude forests:	Direct	Minimal	Very High	Minimal	
	Indirect				Moderate
Noteworthy areas – caves:	Direct and indirect	Low	High	Minor	M105 to M110.
Noteworthy areas - upland streams		Low	High	Minor	M54, M60, M61, M85.
Noteworthy areas – sinkhole swamps and swamp forests:	Direct and indirect	Low	High	Minor	M54, M60, M61, M92, M115, M162.
Noteworthy areas – upland streams:	Direct and indirect	Low	High	Minor	M50, M52, M54, M57, M61.
Noteworthy areas - stream refuges in unstable landscapes:	Direct	Medium	High	Moderate	M54, M57, M58, M60, M61, M85.
	Indirect	Low	High	Minor	
Other noteworthy areas	Direct and indirect	Medium to Minimal	High	Moderate	M52 to M54, M60 to M63, M80, M117, M118.
				Minimal	
Conservation areas – Kikori River Programme:	Direct and indirect	Low	Very High	Moderate	M52 to M54, M60 to M63, M80, M117, M118.
Conservation areas – WMA:	Direct	Medium	Very High	Moderate	M50, M52, M54, M57, M61, M152.
	Indirect			Low	

Table 28.2 Upstream project area impact summary (cont'd)

Potential Impact Description (Before Mitigation)	Magnitude of Impact (After Mitigation)	Sensitivity of Resource/ Receptor	Residual Impact Significance (After Mitigation)	Mitigation and Management Commitment Number
Biodiversity (cont'd)				
Conservation areas – WWF Most areas: Direct	Low	High	Minor	M50, M52, M54, M61.
Agogo/lwo: Direct	Medium		Moderate	
Indirect	Low		Minor	
Impacts to listed species: Direct and indirect	Low to Minimal	High	Minor	M53, M54, M58, M87 to M90, M105 to M110.
			Minimal	
Air Quality				
Dust emissions			Will meet assessment criteria	M178.
Vehicle exhausts			Will meet assessment criteria	M176, M177.
NOx emissions			Will meet assessment criteria	M180, M181.
BTEX emissions			Will meet assessment criteria	M179, M181.
Noise				
Pipeline construction noise levels	Low	High	Minor	M169, M171, M173 to M175.
Drilling construction noise	***	High	Will meet assessment criteria at 500 m at night	M170 to M175.
Operations noise levels	Minimal	High	Minimal	M170 to M175.

*See Table 18.11 for the specific impact criteria for water resources and hydrology.

**Aquatic ecology residual impacts mirror those for water quality. For the meaning of 'minimal' in relation to aquatic ecology, see Table 18.17.

***Medium before mitigation. Consultation with affected landholders will be undertaken to agree on appropriate mitigation measures.

Table 28.3 Marine facilities and offshore pipeline impact summary

Potential Impact Description (Before Mitigation)	Magnitude of Impact (After Mitigation)	Sensitivity of Resource/ Receptor	Residual Impact Significance (After Mitigation)	Mitigation and Management Commitment Number
Offshore Pipeline				
Disturbance to seafloor habitats	Minimal	Minimal	Minimal	M186, M190, M191.
Increased suspended sediments	Low	Low	Minor	M186, M190, M191, M193.
Alteration of riverine barging route hydrology: construction	Low	Medium	Minor	M193.
Waste discharges	Minimal	Low	Minimal	M188.
Accidental spills	Low	High	Minor	M188.
Disposal of hydrotest water	Low	Low	Minor	M187, M196.
Alteration to Omati River hydrology: operations	Minimal	Low	Minimal	M186, M194.
Interaction with marine mammals	Minimal	High	Minimal	M189.
Underwater noise	Low	High	Minor	M189.
Light emissions	Minimal	High	Minimal	M195.
Interaction with commercial fisheries	Low	Medium	Minor	M198, M200.
Interaction with subsistence fishers and small craft	Low	High	Minor	M183 to M185.
Fishing equipment or anchors entangling with pipeline	Minimal	High	Minimal	M199.
Marine traffic:				
• Gulf of Papua	Low	Low	Minor	M192, M195.
• Omati-Kikori delta	Medium	Medium	Minor	
Introduction of non-native marine flora and fauna	Medium	Low	Minor	M196, M222.
LNG Marine Facilities				
Coastal processes at Vaihua River	Low	High	Minor	M223.
Increased suspended sediment during construction	Medium	High	Moderate	M204, M207, M208, M211, M215 to M217.
Increased suspended sediment during operations	Low	Medium	Minor	M207, M211.
Disposal of dredged material ¹	Medium	Low	Minor	M211, M218.
Disposal of hydrotest water	Minimal	Low	Minimal	M187, M196, M214.
Discharge of brine and wastewater	Low	Medium	Minor	M205, M206, M219.
Accidental spills of restricted substances	Low	High	Minor	M209.
Discharge from vessels	Low	Medium	Minor	M210.

Table 28.3 Marine facilities and offshore pipeline impact summary (cont'd)

Potential Impact Description (Before Mitigation)	Magnitude of Impact (After Mitigation)	Sensitivity of Resource/ Receptor	Residual Impact Significance (After Mitigation)	Mitigation and Management Commitment Number
LNG Marine Facilities (cont'd)				
Loss of marine habitat at the Materials Offloading Facility	Medium	High	Moderate	M208.
Loss of marine habitat during pipelaying	Low	High	Minor	M190.
Shipping collisions with marine mammals	Minimal	High	Minimal	M189.
Underwater noise	Low	High	Minor	M212, M213.
Effects of lighting on marine fauna	Low	High	Minor	M220.
Interaction with subsistence fisheries and marine traffic; pipelaying	Low	High	Minor	M203, M221.
Interaction with subsistence fisheries – LNG Facilities exclusion zones	See discussion in Section 21.6.3.2, Operations.			M221.
LNG Facilities site – exclusion from mangrove resource utilisation	See discussion in Section 21.7, Mangrove Resource Utilisation.			M221.
Introduction of non-native marine flora and fauna	Low	High	Minor	M222.

1 This residual assessment is based on an estimated volume of 200,000 m³ of dredge material. If further project optimisation during FEED and detailed design results in a larger final volume of material to be dredged and disposed than has been assessed thus far, further modelling and assessment of impacts to receiving waters will be conducted in parallel with the engineering design optimisation as necessary (see Section 21.3.3.1, Construction).

28.2 Cultural Heritage Impacts

Impacts to aspects of cultural heritage that have the potential to occur as a result of the proposed PNG LNG Project were assessed with consideration for:

- **Valence:** whether the impact will be positive or negative (almost all impacts to cultural heritage are considered negative).
- **Nature:** whether the impact will be direct (e.g., physical disturbance of a site), indirect (e.g., introduction of additional people to the vicinity of a site) or cumulative (i.e., both direct and indirect).
- **Duration:** the project stage or stages during which the impact will occur; i.e., the preparatory and early works (referred to as FEED), construction, operation or closure stage or stages.
- **Extent:** the geographical scale at which the impact may be registered. The extent of the impact is considered, in some respects, a crude measure of the significance of the impacted

site. Most impacts are of local significance, but some are of regional or national significance (or of significance at more than one extent).

- **Magnitude:** the anticipated magnitude of the impact, ranging from high (greatest disturbance) through medium to low (least disturbance).
- **Likelihood:** the likelihood of the impact occurring in the event that the project proceeds, expressed as uncertain, probable or confident (expected).

The impact matrix used for the PNG LNG Project is shown in Box 28.1.

Box 28.1 Example cultural heritage impact matrix*

Valence	Nature	Duration	Extent	Magnitude	Likelihood
Positive	Direct	FEED	Local	High	Uncertain
Negative	Indirect	Construction	Regional	Medium	Probable
	Cumulative	Operation	National	Low	Confident
		Closure			

* For the purposes of impact assessment, the duration 'FEED' relates to the stage during which preparatory and early works will be conducted.

The impact matrix used for the PNG LNG Project is the same as that used during the PNG Gas Project. The matrix was used to summarise the written assessment of potential impacts to individual cultural heritage sites and categories of sites so that the large number of sites in the project area could be assessed and compared through a common medium. The impact matrices were used to assess impacts that could occur were the project to proceed without mitigation.

While the impact matrix supports the communication of potential impacts, it does not allow impacts to be assessed definitively. The presentation of impacts in the matrix format requires assumptions about the location and type of disturbance (e.g., the alignment of a pipeline within the associated cultural heritage survey corridor), which have the potential to affect the outcome of the assessment, particularly with regard to the nature, duration and magnitude of the impact. The extent of an impact is closely related to the extent of the significance of the assessed site and can be assessed with a degree of confidence, particularly when the site is surveyed on the ground; however, there is some ambiguity about the assessment of magnitude, with the assessment potentially being a combination of the significance of the site (often well known, although uncertain in areas with limited access) and the degree of physical disturbance that will actually occur at the site (often uncertain, due to the preliminary nature of project information available at the time of assessment and the potential for mitigation).

Therefore, the cultural heritage impact assessment that has been undertaken allows for planning on a large scale; however, further field verification is required for many sites as the project proceeds, to confirm the accuracy of the recorded survey information (and the contingent impact

assessments) and to gauge the nature of consultation required to develop and implement a cultural heritage management plan, as per mitigation number M230 (see Table 29.4 in Chapter 29, Summary of Mitigation and Management Commitments).

As part of the extensive process of preconstruction cultural heritage survey that will be conducted during FEED and detailed design (see Section 2.4, Common Construction Activities), ongoing consultation will be held with relevant stakeholders to obtain their agreement on mitigation measures proposed and to meet the requirements of PNG cultural heritage laws and international guidelines for management of cultural heritage as they apply to the project. A major objective of project planning and design is to avoid cultural heritage sites where possible, particularly where they are assessed as being significant. Sites that have been specifically recommended for avoidance will not be impacted by the project to the extent practicable, as documented by mitigation measures M248, M249, M250, M253 and M257 (see Table 29.4 in Chapter 29, Summary of Mitigation and Management Commitments).

The potential impacts to aspects of cultural heritage (Table 28.4) summarise the impact assessments presented in specialist reports on the cultural heritage of the project area (see Appendix 26, Social Impact Assessment). A summary description and an indication of the likely extent (local, regional or national) of each impact are provided along with the relevant mitigation numbers, which correspond to the mitigation and management commitments presented in Chapter 29, Summary of Mitigation and Management Commitments.

Table 28.4 Potential impacts to aspects of cultural heritage

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
<i>Project-wide</i>		
Disturbance to or loss of currently unknown cultural heritage sites.	To be determined during preconstruction surveys	M234, M243, M262. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Disconnection of communities from cultural heritage sites and loss of sites from oral tradition.	Site-dependent	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
<i>Juha to Hides (Indicative Sites*)</i>		
Indirect and cumulative disturbance to sites IKR, ILF, ILJ, ILK, ILN, ILO, ILP, ILQ, ILR, ILW, IMJ, IMN, IMO, IMS, IMY, LSK and LSO due to increased visitor traffic.	Local	M235. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to sites IKE, IKF, ILC, ILG, ILH, ILI, ILJ, ILL, ILM, ILS, ILT, ILU, ILV, ILX, ILY, IMB, IMC, IMD, IME, IMF, IMG, IMI, IMK, IML, IMM, IMP, IMQ, IMR, IMT, IMU, IMV, IMW, IMZ, INB, INC, IND, LSA, LSC, LSD, LSG, LSH, LSI, LSL, LSM, LSR, LSS, LST, LSU, LSV, LSW, IKR, ILF, ILJ, ILK, ILN, ILO, ILP, ILQ, ILR, ILW, IMJ, IMN, IMO, IMS, IMY, LSK and LSO due to increased visitor traffic.	Local	M235. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

Table 28.4 Potential impacts to aspects of cultural heritage (cont'd)

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
<i>Juha to Hides (Indicative Sites*) (cont'd)</i>		
Indirect disturbance to sites IKA, IKB, ILE and LSJ located downstream of the pipeline construction disturbance area due to the potential deposition of material eroded as a result of construction and operation of the pipeline, and alteration of the river hydrology during construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to burial caves IKI, IKJ, IKK, ILZ and IMH due to increased visitor traffic.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to sites IKC, IKD, IKG, IKH, IKL, IKS, IKX, IKY, ILB, IMX, INA*, LSB, LSE, LSN, LSP, LSQ, LSX, LSY, LSZ, LTA and LTB due to construction, operation and post-operation landscape remediation activities.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
<i>Hides to Kutubu</i>		
Direct disturbance to sites within the Tipuripu area due to site establishment, construction and upgrade of access to the alternative Hides Gas Conditioning Plant site (an alternative option to the proposed Hides Gas Conditioning Plant site in the Ketereanda area).	Regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance to sites HD163, HD165, HD182, HD200, HD206, HD207, HD208, HD209 and HD117 in the Hides Wellpad A area due to construction.	Regional	M261. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to sites HD183, HD185, HD159, HD224, HD210, HD212 and HD201 in the Hides Wellpad A area due to construction.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance to sites HD133, HD135, HD137, HD138, HD141, HD147, HD148, HD152, HD163 to 168, HD171, HD173, HD178, HD181, HD191, HD122 to HD125 and HD232 to HD233 due to upgrading and maintenance of the road from Hides to Nogoli.	National	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance to sites HD312 and HD313 within the environs of the Hides Gas Conditioning Plant and industrial area (Ketereanda area) due to construction.	National [†]	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance to sites HD304 to HD307 within the area surrounding the Hides Gas Conditioning Plant site (Ketereanda area) due to construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance to sites BE075 to BE080, BE082, BE083, BE090 to BE093, BE095 and BE115 due to construction of the LNG Project Gas Pipeline along the Homa to Iduwi alignment.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

Table 28.4 Potential impacts to aspects of cultural heritage (cont'd)

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
Hides to Kutubu (cont'd)		
Indirect disturbance to sites BE001 BE075 and BE124 to BE169 located at least 1 km from the expected Homa to Iduwi alignment.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Hides to Kutubu (Indicative Sites*)		
Direct disturbance of HD312 to HD314, HD317, HD320, HD321, HD326, HD338 and HD342 due to pipeline construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to sites HD330, HD340, HD341, HD342, HD343, HD322, HD323 and HD325 to HD339 due to pipeline construction and operation (indirect) and increased visitation and resettlement in the vicinity of the sites (cumulative).	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance of sites AG133 to AG135, AG138, AG141, AG145, AG147, AG148, AG152, AG153, AG157, AG159, AG160, AG162, AG163, AG164 and AG175 due to pipeline construction.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance of sites HR103 to HR108, HR101, HR125 to HR144, HR148, HR146, HR154 and HR183 due to pipeline construction.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance of sites HR100, HR102, H108 (a), HR109, HR110 HR115, HR118, HR119, HR127 (a), HR152, HR158, HR165, HR170, HR124, HR166, HR177, HR178 and HR180 in the Hides Ridge area.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance of sites JH100 to JH123 in the Juha area.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance of sites LK071 to LK077 in the Wage Creek pipeline deviation area.	Local	M260. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to sites ID004, ID006, ID008, ID013, ID017, ID027, ID047, ID053, ID069, ID092, ID093 and ID097 due to expansion of the existing road corridor and increased road use.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to sites DA001, DA048, DA057, DA065, DA071, DA072, DA073, DA074 and DA077 due to pipeline construction, road corridor development and increased road use.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

Table 28.4 Potential impacts to aspects of cultural heritage (cont'd)

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
<i>Hides to Kutubu (Indicative Sites*) (cont'd)</i>		
Indirect disturbance of HP051 due to pipeline construction and operation.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to BA004 and BA006 due to expansion of the road corridor.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect disturbance of HP053 due to pipeline construction and operation.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
<i>Kutubu to Kaiam</i>		
Direct disturbance to the open burial area LK045 located near the western end of Moro Camp.	Local	M260. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct and indirect disturbance to caves and rock shelters LK046, LK048, Lk049 and LK050 in the Moro Camp area due to further road, pipeline, camp and/or airstrip development.	Local	M260. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect disturbance to burial sites LK040 and LK041.	Local	M260 and M261. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect disturbance to burial sites LK039, LK042, LK043, LK047 and LK055.	Local	M260 and M261. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect disturbance to rock art and burial sites in the southeastern area of Lake Kutubu LK001 to LK037 and LK056 to LK063.	Local	M260. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct and indirect disturbance to caves and rock shelters FF006, FF056, FF057, FF101, FF108, FF109, FF115, FF116 and FF161 located throughout the Foi-Fasu area due to further road, pipeline, camp and/or airstrip development.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

Table 28.4 Potential impacts to aspects of cultural heritage (cont'd)

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
<i>Kutubu to Kaiam (cont'd)</i>		
Indirect disturbance to burial and settlement sites FF060, FF061, FF068, FF098, FF105, FF106, FF107 and FF117.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance to sites FF058, FF059, FF062, FF063, FF064, FF065, FF066 and FF100 located in the Tamatigi village/KP30 area due to pipeline construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance of spirit sites GB006 and GB008 due to pipeline and road construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct and indirect disturbance of former settlement sites GB009, GB013, GB012 and GB016 and burials located close to the pipeline route.	Local	M234. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
<i>Kaiam to Goaribari Island</i>		
Direct disturbance to sites KG1, KG2 and KG3 due to pipeline construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to sites KG4 to KG7, KG10, KG19 to KG21, KG23, KG25, KG44, KG91 and KG94 to KG101 due to pipeline construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Cumulative disturbance to sites KG52 to KG55, KG61 and KG78 due to wave action along the banks of the southern reaches of the Omati River.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to sites KG64 to KG69, KG72 to KG76, KG80, KG82 to KG86 and KG88 to KG90 located at the mouths of creeks feeding into the Omati River due to wave and current action during pipeline construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to KG11 due to pipeline construction on the adjacent limestone outcrop and clearing of surrounding forest.	Local	M262. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative impacts to sites KG13, KG17, KG26, KG39, KG40, KG51, KG58 to KG60, KG62, KG63, KG70, KG71, KG81 and KG92 due to erosion from increased wave action near the coastline and increased visitation during construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

Table 28.4 Potential impacts to aspects of cultural heritage (cont'd)

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
<i>Kaiam to Goaribari Island (cont'd)</i>		
Direct, indirect and cumulative disturbance to KG14 and KG28 due to pipeline construction and operation.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to KG15 due to pipeline construction and operation.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct impact of human skeletal material in the small limestone cave KG16.	Local and regional	M262. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to sites KG22, KG27, KG77, KG79 and KG110 due to pipeline construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to the old village site of Puriau (KG24) due to further growth of facilities associated with the Kopi Shore Base.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to KG37 due to southern expansion of the storage and facilities area between the Kopi Shore Base and the Kikori River.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to village sites and sacred sites KG29, KG30, KG31, KG32, KG33, KG34 and KG35 due to northern expansion by 50 m or more of the storage and facilities area located between the Kopi Shore Base and the Kikori River.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to the previously excavated ossuary KG42 due to increased visitor traffic.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct, indirect and cumulative disturbance to the complex of sacred sites KG106 to KG108 and KG111 due to pipeline construction and increased visitation.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
<i>Kaiam to Goaribari Island – Kopi Bypass (Indicative Sites*)</i>		
Disturbance to site KG7 located within the immediate vicinity of the Kopi Bypass survey corridor area.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Disturbance to sites KG162 and KG166 within immediate vicinity of the Kopi Bypass survey corridor.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

Table 28.4 Potential impacts to aspects of cultural heritage (cont'd)

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
<i>Kaiam to Goaribari Island – Kopi Bypass (Indicative Sites*)</i>		
Direct, indirect and cumulative disturbance to significant sites near the Kopi Bypass survey corridor, including Amukate rockshelter (KG163), Noa swamp (KG9), Kepamo Kaho cave (KG167), Kepamo burial cave (KG168), Kekamoro sacred sinkhole (KG169), Are O'o sacred sinkhole (KG170), Arukai cave (KG171), Nahope cave (KG160), Amoho Kakate cave (KG161), Komo Kouhi cave (KG173), Yaya ancient village (KG174) and Hohokomane cave (KG175).	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Disturbance to oral tradition sites KG12, KG13, KG14, KG41, KG42, KG43, KG110, KG144, KG145, KG149, KG150, KG151, KG152, KG153, KG154, KG155, KG156, KG157, KG158, KG159, KG163, KG164, KG165 and KG172 for which there is uncertainty about whether they are located within the Kopi Bypass survey corridor.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Disturbance to oral tradition site KG157 for which there is uncertainty about whether it is located within the Kopi Bypass survey corridor.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
<i>LNG Facilities</i>		
Direct disturbance to sites ARD, ARG, ARH, ARI, ARJ, ARM, ML4, ML5, ML7, ML9, ML13, ML14, ML15, ML16, ML17, ML18, ML19, ML20, ML21, JD6, JD8, JD9, JD10, JD11, JD12, JD13, JD14, JD15, JD16 (SC5), JD17, AAHL, AAHM, AAHN, AAHO, AAHP, AAHQ, AAHR, AAHS, AAHT, AAHU, AAHV, AAHW, AAHX, AAHY, AAHZ, AAIB, AAIC, AAID, AAIE, AAIF, AAIG, AAIH, AAII, AAIJ, AAIK, AAIL, AAIM, AAIO, AAIR, AAIS, AAIT, AAIU and AAIV located within the LNG Facilities site security fence due to construction activities.	Local	M246, M247, M252, M254, M255. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct disturbance to sites LNG1, LNG2, LNG3, LNG4, ML12 and JD7 located on, or within a few metres of, the proposed LNG Facilities site security fence due to fence construction.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct impact to Sisal Farm/Schimmer airstrip/Fairfax Cattle Station by works undertaken within the proposed LNG Facilities site security fence.	Local	M246, M254, M255. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative disturbance to ML1, ML2, AAIN, JD1, JD2, JD3, JD5, ML3 (Part of SC4), JD4, ML6, ML8, ML10, ML11, Konekaru village, AAIP, AAIQ, ARQ, AAGM, ABG, ABI, AEZ, AFA, AFB, AHY, AOH, AOI, AOJ, AOK, AOL, AOM, AOX, APC, APF, APG, ARE, ARF, ARK, ARL, JDA17 and CB30 due to increased visitor traffic.	Local and regional	M244, M246, M247, M255, M259, M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

Table 28.4 Potential impacts to aspects of cultural heritage (cont'd)

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
LNG Facilities		
Indirect and cumulative impacts to AHW, ANN, ANO, CB10 (SC7), CB11, CB12, CB7, CB8, ASM (some of the SC6 Sites), AADI, ABH, AMG, AMH, AMI, ANA, ANU, AOG, AWL, Ava Garau, Davage, Taubarau, Nemu, Daeroto and Dirora due to changing demographics, settlement patterns and access routes resulting in increased access and, therefore, increased visitor traffic.	Local and regional	M251. M244, M245, M246, M255, M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative impacts to Aemakara due to increased visitor traffic.	Local and regional	M244, M246, M255, M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Offshore		
Indirect and cumulative impacts to CB1 due to increased erosion as a result of the alteration of coastal geomorphology by construction of the LNG Jetty.	Local	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative impacts to CB13, CB14 and CB15 due to village growth (e.g., new house constructions and changing erosion patterns) and increased erosion and sand accretion from LNG Jetty construction.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative impacts may occur to sites CB16, CB17 and CB18 if preconstruction surveys find they are within the marine facilities disturbance area.	Local and regional	M240, M245, M251, M258. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative impacts to site CB4 if it is located within the vicinity of dredging or localised scouring of the shipping channel.	Local	M240, M242, M256. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Direct and indirect impacts to CB6, CB22, CB23, CB24, CB25, CB26, CB27, CB28, CB29, P-39 Airacobra Plane Crash Site and B-24 Consolidated Liberator Plane Crash Site due to construction of the shipping channel, dredging or localised scouring of the seabed.	Local and regional	M240, M242, M251. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

Table 28.4 Potential impacts to aspects of cultural heritage (cont'd)

Description of Potential Impact	Extent of Potential Impact	Mitigation and Management Commitment Number
Offshore		
Direct and indirect impacts to CB5 if the site is located within the vicinity of the shipping channel, dredging or localised scouring of the seabed.	Local, regional national	M240, M242. M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.
Indirect and cumulative impacts to Boera freshwater wells due to increased freshwater requirements and accessibility caused by population growth.	Local and regional	M224, M225, M226, M227, M228, M229, M230, M231, M232, M233, M235, M236, M237, M238, M239, M241.

* Indicative cultural heritage sites were recorded through a various combinations of interview discussions, reference to maps, helicopter flyovers and field visits in the vicinity of the sites; however, indicative sites have not been subject to ground survey.

† The potential impact to sites HD312 and HD313 is recorded as being of national extent because a waisted blade (stone tool) was found in the area (the sites themselves are of local extent). The provenance of the waisted blade is unknown but it is reportedly possible that it comes from outside the area in which it was found. Preconstruction surveys will determine whether there are any other archaeological materials in the area and whether impacts to the site would be of local, regional or national extent.

Environmental Impact Statement
PNG LNG Project