



Browse LNG Precinct



Browse Liquefied Natural Gas Precinct Strategic Assessment Report

(Draft for Public Review)
December 2010

Appendix A-2

Scope of the Strategic Assessment

BROWSE LNG PRECINCT

Scope of the Strategic Assessment

Executive Summary

The Browse LNG Precinct¹ encompasses the construction and operation of Liquefied Natural Gas (LNG) processing facilities and associated infrastructure to be located on the Kimberley coast. The location selected for the LNG Precinct is in the vicinity of James Price Point, as determined by the site selection process undertaken by the Department of State Development (formally the Northern Development Taskforce) and WA State and Commonwealth Government. The development is based on the recovery of hydrocarbons from the Browse Basin gas fields and involves construction and operation of facilities to process hydrocarbons into LNG and associated products, marine facilities and other associated infrastructure.

The Department of State Development is acting as the *proponent* of the LNG Precinct and associated activities. It is expected that separate *project proponents* will eventually implement actions described within the scope of the LNG Precinct proposal. Subject to additional appraisal work, further technical studies and government approvals, commissioning of LNG processing facilities and subsequent gas export is being targeted from 2015. Construction will commence following completion of the Strategic Assessment and issue of all relevant environmental, heritage and other approvals.

In recognition of the importance of such a project, the State Government of Western Australia entered into an agreement with the Commonwealth Government to undertake a strategic assessment of a preferred Precinct site and an assessment of the national heritage values of the West Kimberley region (Strategic Agreement 2008). This Agreement recognizes the environmental and heritage values of the Kimberley, as well as the significant economic potential of the development of Browse Basin gas reserves (NDT 2008c).

The Strategic Assessment Agreement (SAA) principally provides the basis for an impact assessment and environmental approvals of the LNG Precinct and the associated activities under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) and the *WA Environmental Protection Act 1986* (Western Australia). Draft *Terms of Reference* for the Strategic Assessment were agreed in the SAA and finalised following extensive public comment. The Strategic Assessment will include the site selection process completed by the Department of State Development, culminating in the selection of James Price Point. The reports of the site selection have already been made public. The Strategic Assessment documentation will include a synthesis of the various studies, including advice from the independent WA Environmental Protection Authority that provided advice to the Minister for Environment that the impacts from an LNG Precinct at James Price Point are likely to be manageable.

This document provides an outline of the scope of the Strategic Assessment for the assessment of impacts from the LNG Precinct and associated activities and is in line with the final Terms of Reference. Specifically it aims to:

- Describe the site and outline the proposed Browse LNG Precinct development;
- Identify and describe the relevant environmental factors;
- Present the risk assessment process and identify potential environmental and social impacts (known at this early stage of the project); and
- Detail the scope of studies and investigations to address the potential impacts and their proposed timing.

The process for the Strategic Assessment will follow a general model for an assessment. Scoping and impact assessment of environmental and social factors is to be informed by detailed engineering and project design, information gathered in baseline studies and through consultation with stakeholders including regulators, NGOs, traditional owners, tourism operators, aquaculture industry and the general public.

The State Government and the Shire of Broome are undertaking the development of a Dampier Peninsula Land Use Plan and a Town planning scheme for Broome. These planning processes will be completed prior to the submission of the Strategic Assessment Report and will provide an overall planning context within which the LNG Precinct and ancillary infrastructure can be considered and approved. The range of management arrangements to ensure the implementation of the LNG Precinct complies with the approvals granted under the EPBC Act will be documented in the „Plan’ for the LNG Precinct to be contained within the Strategic Assessment „Report’.

¹ Any reference to Kimberley LNG Precinct or similar terms in other earlier documentation, or figures in this document, should be read as Browse LNG Precinct

The various inputs to the Strategic Assessment and how they are intended to be documented within the final Strategic Assessment Report are illustrated below. The final contents may vary, however the broad structure outlined below is expected to be maintained and is in line with the Terms of Reference under the Strategic Assessment Agreement.

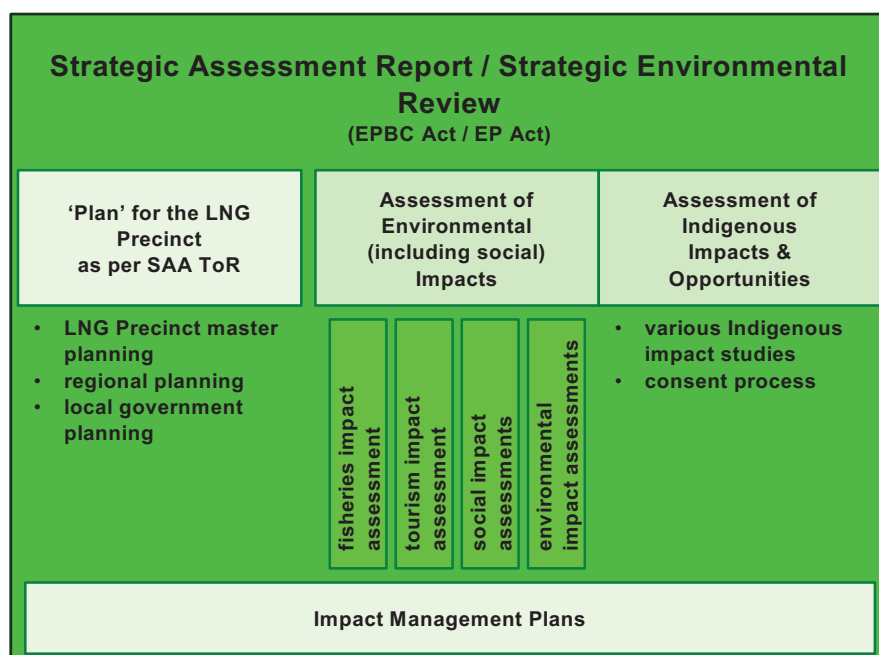


Figure ES-1 – Scope of the SAR/SER

The scoping exercise has been undertaken to reflect the full LNG Precinct, based on a 50 million tonnes of LNG per annum capacity LNG Precinct. The facilities described in this document are nominally based on two independent processing plants within the LNG Precinct. This is to ensure that all potential impacts are allowed for as far as practicable. This document is not intended to define the basis for ownership, operation or dictate common-user facilities. It is expected that the future definition of any common user facilities will in general be within the bounds set by the Strategic Environmental Review with respect to potential environmental impacts.

The activities, facilities and other characteristics that are a part, or related to the Browse LNG Precinct and considered within this scoping exercise have been split into three different categories:

- A. LNG Precinct: The core elements of LNG development, including associated infrastructure necessary to process and export hydrocarbons and LNG (all actions within the scope of the approvals under the Strategic Assessment Agreement);
- B. Indirect Activities/Actions as a Result of the LNG Precinct (indirect actions that are considered in the impact assessment but not part of the approvals); and
- C. Related Projects (outside the scope of the Strategic Assessment, but relevant for the consideration of cumulative effects).

The distinction between the different categories has been adopted to ensure that it is clear that this scoping exercise and subsequent impact assessment applies to the **Category A: LNG Precinct** only, and as such which activities may subsequently be undertaken in association with approvals under the EPBC and EP Acts, while giving consideration of the assessment of related projects and other activities within the Strategic Assessment.

The following table summarises the activities and facilities which are the basis for the scope of the LNG Precinct.

Table ES-1: Browse LNG Precinct – Treatment of Activities for Strategic Assessment

Component	Examples	Implications for / treatment of the component in the Strategic Assessment
A. LNG Precinct:		
1. LNG Facilities Complex	<i>Hydrocarbon processing facilities, product storage, plant utilities and other equipment necessary to treat and process hydrocarbon reservoir feedstock associated with LNG processing</i>	Within the scope of the Strategic Assessment for approvals purposes. Activities are expected to become the responsibility of derived LNG Project Proponents or the LNG Precinct Proponent (or designated third party).
2. LNG Precinct Associated Infrastructure	<i>Integral infrastructure for LNG Facilities Complex:</i> <ul style="list-style-type: none"> • Jetties, berths & channel • Pipelines to state waters • Administrative buildings and maintenance support services <i>Other associated infrastructure:</i> <ul style="list-style-type: none"> • Integrated marine and offloading facility • Operations and construction/maintenance workforce accommodation • Roads connecting the LNG Precinct to public road and within associated infrastructure components • Service provider facilities • Precinct light industrial area 	Scope of activities reflected in the impact assessment <u>and</u> management planning for the Strategic Assessment.

Activities detailed in the table above are expected to be phased. The following provides an indicative² timeline for development activities:

Table ES-2: Anticipated Development Schedule for LNG Precinct and Foundation Development

Project Phases	Timeline
Phase I: Commencement of construction of pioneer facilities, infrastructure preparations	Notionally 2010/11
Phase II: Construction of LNG Precinct facilities for first proponent (Typical LNG project)	6-12 months after Phase I
Phase III: Operation (Typical LNG project)	4-5 years after commencement of Phase II
Phase IV: Decommissioning	~30-40+ years after commencement of Phase III

The scoping exercise considered the current state and features of the existing natural and social environment. A significant amount of information has already been gathered for the James Price Point location and a study program is underway to supplement this. This document provides a summary of the current knowledge in order to inform the initial assessment of impacts and identification of key risks. Only data from reputable sources have been utilised and appropriate reference has been provided. The scoping exercise included consideration of the need for additional information on the existing environment. Rationale and outline scopes for these studies have been developed and are presented in this document.

² 1 Note: indicative timelines only. Actual timelines are dependant on considerations such as location of site selected (requirement for additional geotech or other early works and associated approvals), selection of the LNG Precinct for use by LNG Project Proponent(s) and initial project capacity selected (appraisal drilling still ongoing).

The scoping exercise centred on the application of a systematic approach to identify potential impacts. An interaction matrix approach was utilised to identify the range of potential impacts based on potential interactions between a) the receiving environment (“environmental factors” in this document, including social factors), and b) environmental stressors (“environmental aspects” in this document, including social factors). An initial risk assessment was completed to evaluate and classify the complete register of impacts associated with each environmental aspect. Potential impacts with high and severe risk-rated potential impacts were evaluated in further detail and outline study scopes have been included in this scoping document.

The development of outline scopes to assess the potential impacts for each environmental aspect is intended to ensure appropriate studies and assessment methodologies are identified to complete the impact assessment. All potential impacts are proposed to be addressed in the impact assessment within the Strategic Assessment report, with the following treatment of impacts based on the initial risk assessment.

Severe Risk:	Detailed investigations and detailed evaluation in the Strategic Assessment. Approach to impact assessment provided in this document.
High Risk:	Detailed investigations and detailed evaluation in the Strategic Assessment. Approach to impact assessment provided in this document.
Medium Risk:	Evaluation of potential for impact to be covered in the Strategic Assessment. Approach to be aligned with the generic impact assessment approach.
Low Risk:	Brief discussion in the Strategic Assessment. To be addressed in relevant management plans, works approvals or licences for the Project. Further investigations may be undertaken and reported in the Strategic Assessment reports if confidence level is low.
< Low Risk:	Very brief notation in the Strategic Assessment. To be addressed in subsequent Environmental Management Plans, works approvals or licenses for the Project if required.

Assessment approaches have been developed for key environmental aspects (e.g. impacts from light). The scope of the Strategic Assessment will include assessment of potential environmental (including social) impacts from:

- Vegetation/habitat clearing;
- Site disturbance/excavation;
- Runoff;
- Altered fire regime;
- Wastes (disposal);
- Marine discharges (including non-routine events);
- Terrestrial wastes and discharges;
- Atmospheric emissions;
- Dust emissions;
- Greenhouse gas (GHG) emissions;
- Physical presence;
- Light emissions;
- Noise and vibration;
- Sediment deposition and turbidity
- Terrestrial introduced pests;
- Invasive marine species;
- Vessel movements;
- Groundwater abstraction;
- Soil/Groundwater contamination; and
- Change to landforms (coastal etc).

The assessment approach proposed includes the recognition of the potential need for an iterative process. Significant residual risk may require the need for further consideration of alternatives and subsequent assessment of associated impacts. The inclusion of alternatives analysis within each of the environmental aspects is expected to be included in the Strategic Assessment.

Detailed social impact assessment, including specialised assessments of key social sectors (indigenous, tourism, fisheries, etc), are also being undertaken by the State Government on behalf of the Precinct proponent. These are intended to interface with the environmental impact assessment within the Strategic Assessment. The range of impact assessment studies will be informing each other, with relevant impacts on the natural environment being used in the indigenous community impact assessment, for example.

The approach proposed for the reporting of impacts in this document finally considers the assessment of impacts from the perspective of each environmental and social factor. For example, the overall potential impact on marine reptiles will be evaluated based on the cumulative impact contribution from the range of relevant environmental aspects, which in the case of marine reptiles would include noise and vibration, routine and non-routine marine discharges, light emissions, site disturbance and excavation and vessel movements. The assessment of potential impacts on each factor ensures that

a more complete picture of impacts on the natural and social environment is presented. **Tables ES-3 and ES-4** provide a summary of the culmination of the impact assessment scoping exercise, for environmental and social factors respectively.

The Strategic Assessment will utilise the impact assessment process to determine the need for relevant management and mitigation measures. These will form the basis for management plans that will document the expectations for the implementation of actions carried out as part of the construction and operation of the LNG Precinct. Management arrangements will also be documented to specify the manner in which activities in the Precinct are to be conducted, as well as to provide a link to the broader planning arrangements intended to govern sustainable management of the region.

Table ES-3: Summary of Initial Assessment of Inherent Environmental Risk Ratings (by Factor)

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Marine Reptiles	Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Medium	<p>1) In a regional context, the Lacepede Islands are known to be an important nesting and inter-nesting habitat for green turtles (Scoping Report Sect. 5.2.6.3). Conservation significant turtle species are known to occur within the James Price Point coastal area, however current information suggests that potential nesting areas are likely to be located further to the south of the James Price Point coastal area (Scoping Report Sect. 5.2.6.3), this is to be confirmed through further investigations.</p> <p>2) The JPP coastal area is not known to be a high use zone for turtle nesting however, noise and vibration generating activities such as marine blasting, dredging and nearshore construction may have the potential to impact marine reptile foraging behaviour</p>
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	<p>1) As above</p> <p>2) Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event.</p>
	Light Emissions	10.9	Precinct operation, supporting infrastructure.	Medium	<p>1) As above.</p> <p>2) The JPP coastal area is not known to be a high use zone for turtle nesting. As a result it is considered that light emissions may have the potential to result in minor short term impacts on marine reptiles.</p>
	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	<p>1) As above.</p> <p>2) Marine waters of the Kimberley coast are known to have highly turbid waters (Scoping Report Sect 5.2.3.2) and it is considered likely that this would also be the case at the James Price Point coastal area. There are some uncertainties regarding this claim (of natural high turbidity) which are to be investigated in field studies. Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term.</p>
	Site Disturbance	10.6	Marine dredging and drilling, nearshore construction and	Medium	<p>1) As above.</p> <p>2) It is considered unlikely that nearshore excavations would disturb important</p>

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	and Excavation		pipeline installation.		nesting areas.
	Vessel Movements	10.10	Product transport, Precinct construction and support.	Medium	<i>In a regional context, the Lacepede Islands are known to be an important nesting and inter-nesting habitat for green turtles (Scoping Report Sect. 5.2.6.3). Conservation significant turtle species are known to occur within the James Price Point coastal area, however current information suggests that potential nesting areas are likely to be located further to the south of the James Price Point coastal area (Scoping Report Sect. 5.2.6.3), this is to be confirmed through further investigations.</i> <i>Constant vessel movements may have the potential to disturb feeding and movement patterns however ship strike is considered unlikely given likely speed limits that would be implemented and slow speed of larger tankers.</i>
Benthic Primary Producers	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction.	Medium	<i>Seagrass beds are known to occur in the James Price Point coastal area and provide feeding habitat for Dugongs and habitat for other marine fauna (Scoping Report Sect 5.2.6.4 & 5.2.5.3). Marine waters of the Kimberley coast are known to have highly turbid waters (Scoping Report Sect 5.2.3.2) and it is considered likely that this would also be the case at the James Price Point coastal area. There are some uncertainties regarding this claim (of natural high turbidity) which are to be investigated in field studies.</i> <i>Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term.</i>
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	<i>Seagrass beds are known to occur in the James Price Point coastal area and provide feeding habitat for Dugongs and habitat for other marine fauna (Scoping Report Sect 5.2.6.4 & 5.2.5.3).</i> <i>Should a non-routine event occur it is considered that it may impact seagrass habitats and dependant marine fauna species. Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event</i>
	Site Disturbance and Excavation	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Medium	<i>Seagrass beds are known to occur in the James Price Point coastal area and provide feeding habitat for Dugongs and habitat for other marine fauna (Scoping Report Sect 5.2.6.4 & 5.2.5.3). Site disturbance as a result of dredging, pipeline installation and nearshore construction works may result in the removal of dugong foraging habitat. It is considered that this would result in moderate impacts, should seagrass beds be</i>

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					disturbed.
	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	Medium	The marine environment of the James Price Point coastal area is relatively undisturbed and it is considered unlikely that invasive marine species currently exist there. Ballast water discharge and contaminated ships and equipment may have the potential to introduce IMS during construction and operation. Should IMS be introduced they have the potential to outcompete and displace native fauna which may in turn affect the local marine ecosystem whilst also impacting local pearling and aquaculture industries.
	Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	Current information suggests that potential habitat for coral communities within the James Price Point coastal area is relatively sparse (Scoping Report Sect. 5.2.6.1). Noise and vibration generating activities during construction and operation are considered unlikely to impact coral communities.
	Light Emissions	10.9	Precinct operation, nearshore construction, vessel operation	Low	Current information indicates that potential habitat for coral communities within the James Price Point coastal area is relatively sparse (Scoping Report Sect. 5.2.6.1). It is likely that coral communities would be avoided where possible. Potential effects of light on coral spawning have been considered, however it is determined unlikely that coral would be adversely impacted as a result of light emissions during construction and operation.
Fish	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	High	The marine environment of the James Price Point coastal area is relatively undisturbed and it is considered unlikely that invasive marine species currently exist there. Ballast water discharge and contaminated ships and equipment may have the potential to introduce IMS during construction and operation. Should IMS be introduced they have the potential to outcompete and displace native fauna which may in turn affect the local marine ecosystem whilst also impacting local pearling and aquaculture industries.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	Conservation significant fish species are known to occur off the coast of the Dampier Peninsula. No site specific fish fauna surveys are available for the James Price Point coastal area, so assumptions of species present are based on nearby or regional surveys and are also directly related to the physical environmental characteristics. At James Price Point important fish habitats such as mangroves and estuaries are mostly absent. Sandy beach flats which are relatively exposed compared to other locations are the predominate feature and as such fish fauna is expected to be temporarily present during the high tides to feed on invertebrates (ESD Sect. 5.2.6.5). Should a non-routine event occur it is considered that it may impact marine water and habitat quality for fish species. Management and control measures would be

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event
	Site Disturbance and Excavation	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	1) Rationale as above. 2) Nearshore activities such as dredging, pipeline installation works and nearshore construction may result in localised impacts to some habitats however the area of potential impact is likely to be relatively small.
	Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	1) Rationale as above. 2) It is considered likely that noise impacts would be transient and temporary during construction.
	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction.	Low	1) Rationale as above 2) Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term.
	Light Emissions	10.9	Precinct operation, nearshore construction, vessel operation	Low	1) Rationale as above. 2) Light has the potential to attract fish species or alter cycles however it is unlikely that light emissions would impact important habitats, particularly for conservation significant species.
Marine Mammals	Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	High	1) Conservation significant marine mammals species (Whales and Dugong) are known to occur in the James Price Point coastal area while a significant portion of the humpback whale population migrates past this area. (Scoping Report Sect 5.2.6.4). 2) Noise and vibration generating activities such as marine blasting, dredging and nearshore construction may have the potential to impact marine mammal behavior.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel	Medium	1) Rationale as above. 2) Should a non-routine event occur it is considered that it may impact marine water and habitat quality for marine mammal species. Management and control measures would be implemented as part of Precinct design and operation which

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
			movements.		are likely to reduce the likelihood, and impact of a non-routine event.
	Site Disturbance and Excavation	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Medium	1) Rationale as above. 2) Site disturbance as a result of dredging, pipeline installation and nearshore construction works may result in the removal of dugong foraging habitat. It is considered that this would result in moderate impacts, should seagrasses be disturbed as a result of marine excavation activities.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction.	Medium	1) Rationale as above. 2) Marine waters of the Kimberley coast are known to have highly turbid waters (Scoping Report Sect 5.2.3.2) and it is considered likely that this would also be the case at the James Price Point coastal area. There are some uncertainties re this claim (of natural high turbidity) which are to be investigated in field studies. Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term
	Light Emissions	10.9	Precinct operation, nearshore construction, vessel operation.	Medium	1) Rationale as above. 2) While conservation significant species are known to occur it is considered unlikely that light emissions would disrupt feeding or movement patterns.
	Vessel Movements	10.10	Product transport, Precinct construction and support.	Medium	1) Rationale as above. 2) Constant vessel movements may have the potential to disturb feeding and movement patterns while ship strike is considered unlikely given that larger tankers would move at slow speeds when approaching and existing the Precinct and likely speed limits for smaller vessels.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Marine Water Quality	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction.	High	Conservation significant fish, marine mammal and reptile species are known to occur within the James Price Point coastal area. While the surrounding waters are generally free of pollutants, marine waters of the Kimberley coast are known to have highly turbid waters (Scoping Report Sect 5.2.3.2) and it is considered likely that this would also be the case at the James Price Point coastal area. There are some uncertainties re this claim (of natural high turbidity) which are to be investigated in field studies. Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	Marine waters of the James Price Point coastal area provide habitat for a variety of marine species and communities whilst also supporting indigenous and recreational activity. Commercial fisheries also occur nearby along with pearling leases. Should a non-routine event occur it is considered that it may impact marine water quality. Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event.
	Vessel Movements	10.10	Product transport, Precinct construction and support.	Low	While marine waters are already known to be highly turbid and subject to tidal flushing, constant vessel movements have the potential to stir-up bottom sediments which may affect water quality however this is unlikely to result in long or medium term impacts
Marine Sediment Quality	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A number of activities associated with the development have the potential to result in a non-routine discharge event and may have the potential to contaminate marine sediments and reduce habitat quality for dependant species. Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event.
	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction.	Low	Disturbance of marine sediments and subsequent habitats will occur as a result of dredging and trenching activities. Impacts as a result of sediment deposition may also occur however, there are naturally high turbidity levels and sediment flushing due to the high tidal flux.
Terrestrial Flora	Vegetation and	10.11	Precinct preparation and excavation and supporting	High	No state or commonwealth declared rare flora species have been recorded within the James Price Point coastal area however, <i>Pittosporum moluccanum</i> is listed as a priority

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
incl TEC's	Habitat Clearing		infrastructure.		4 species and was recorded 2.5 km south of James Price Point (Scoping Report Sect 5.3.4.3). Additional surveys will be conducted to confirm the presence or absence of declared flora species and the impact of habitat removal would be considered in relation to habitat availability within the James Price Point coastal area and broader Dampier Peninsula. Monsoon Vine Thicket TEC is known to occur along the James Price Point coastal area (Scoping Report Sect 5.3.4.2). The extent and condition of this community will be confirmed and it is likely that removal of this community would be avoided where possible. Should vine thicket be removed as a result of Precinct construction the likely impact would be considered in relation to the communities extent within the James Price Point coastal area and broader Dampier Peninsula.
	Groundwater Abstraction	10.15	Support construction and operation	Medium	There is some potential for ongoing abstraction to affect surrounding groundwater dependant vegetation types however, the existing groundwater and hydrological conditions and presence of dependant vegetation communities is unknown.
	Introduced Pests	10.8	Precinct Construction	Medium	Weed species are already known to occur on the Dampier Peninsula and James Price Point coastal area (Scoping Report Sect. 5.3.4.3) and have the potential to out-compete native flora species. There is the potential for the introduction of new pests to the James Price Point coastal area as a result of Precinct construction and operation however there is also the potential for improved management of natural resources to occur.
	Altered fire regime	10.13	Precinct operation and supporting infrastructure	Medium	TECs including vine thickets are at risk of impact from an altered fire regime. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley.
Species of Ethno-biological Significance	Vegetation and Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	High	Culturally significant flora and fauna species are likely to occur within the James Price Point coastal area. For example indigenous food products ("bush products") that are harvested for use by local Indigenous people (Scoping Report Sect 5.4.4.2). Vegetation removal as a result of onshore construction has the potential to result in the removal of habitats which support culturally significant flora and fauna species. The significance of this habitat removal will be considered in relation to habitat availability within the James Price Point coastal area and broader Dampier Peninsula.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Altered Fire Regimes	10.13	Precinct Operation and Supporting Infrastructure		Potential for loss of species of ethno-biological significance including the Gubinge which is known to be present in vine thickets and throughout the Dampier Peninsula. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley.
Terrestrial Fauna and Declared rare and Protected Fauna	Vegetation and habitat clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	High	Based on database search results conservation significant fauna species are known to occur within the area (Scoping Report Sect. 5.3.5.1) and the James Price Point coastal area may provide habitat for some of these species. Vegetation and habitat clearing associated with onshore and nearshore construction activity is likely to result in the removal of habitat for both conservation significant and more common fauna species. The significance of this habitat removal would be considered in relation to habitat availability within the James Price Point coastal area and the broader Dampier Peninsula.
	Introduced Pests	10.8	Precinct Construction and operation	Low	It is considered likely that introduced fauna species currently inhabit the Dampier Peninsula and James Price Point coastal area and are likely to be competing with native species. There is the potential for the introduction of new pests to the James Price Point coastal area as a result of Precinct construction and operation however there is also the potential for improved management of natural resources to occur.
	Light Emissions	10.9	Precinct operation, supporting infrastructure.	Medium	Conservation significant species (for example birds) may occur within the James Price Point coastal area. While it is anticipated that increased lighting will be required for the Precinct, it is likely that they would be restricted to an area surrounding the Precinct facilities.
	Groundwater Abstraction	10.15	Support construction and operation	Medium	Groundwater abstraction is likely to occur to supply water during construction and operation. There is some potential for ongoing abstraction to result in groundwater drawdown and salt intrusion which would affect subterranean fauna habitats.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	At present there is little information on the groundwater conditions at the James Price Point coastal area. Should subterranean fauna habitats be identified there is the potential for them to be impacted as a result of a non-routine discharge or leak.
	Noise and Vibration	10.1	Precinct operation and gas processing.	Medium	The James Price Point coastal area is known to provide habitat for conservation significant fauna species. Noise and vibration as a result of onshore construction and plant operation has the potential to disturb fauna nesting and foraging habitats. It is

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					likely that this would represent a minor disruption to a portion of the population. While it is possible that conservation significant sea and migratory bird species may periodically occur within the James Price Point coastal area current information suggests that the presence of specific seabird roosting or nesting habitat within the James Price Point coastal area is considered unlikely (Scoping Report Sect 5.2.6.6). While important migratory bird habitats are not expected to be present it is likely that it could be used for occasional foraging by conservation significant species (ie JAMBA, CAMBA). Noise and vibration generating activities may have the potential to disrupt foraging activity.
	Site Disturbance and Excavation	10.5	Marine dredging and drilling, nearshore construction and pipeline installation.	Medium	There is little existing information on the presence and abundance of subterranean SRE's within the James Price Point coastal area and site excavation activities have the potential to remove some potential habitat areas, should they occur. Short Range Endemic (SRE) species such as land snails, earthworms and spiders occur in vine thicket communities in the Kimberley, including those mapped within the James Price Point coastal area (Scoping Report Sect. 5.3.5.4). Should vine thicket communities occur within the proposed development area it is possible that areas of habitat would be removed.
	Physical Presence	10.14	Plant operation and supporting infrastructure	Low	It is possible that conservation significant sea and migratory bird species may periodically occur within the James Price Point coastal area. Current information indicates that the presence of specific seabird roosting or nesting habitat within the James Price Point coastal area is considered unlikely (Scoping Report Sect 5.2.6.6). There is some evidence that birds could potentially be impacted by gas flares and potential impacts on migrating birds will be considered
	Vehicle Movements	9.0	Supporting infrastructure and Precinct operation	Low	Conservation significant fauna species are known to occur within the James Price Point coastal area and there is the potential for death and injury as a result of increased vehicle activity.
	Altered fire regime	10.13	Precinct operation and supporting infrastructure	Medium	The simplification of the vegetation due to a lack of fine scale fire-induced mosaics can have consequences for small fauna with limited home ranges. Changes fire regimes are among the threatening processes which have the potential to impact on species (EPA May 2006).
					The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					sustainable fire regime in the Kimberley.
Soils and Geomorphology	Runoff	10.4	Construction activities, site clearing, stormwater management	Medium	Site clearing and excavation is would disturb soils and alter landforms. There is the potential for increased runoff and erosion to occur, particularly considering the high erosion potential of pindan soils and high volume rainfall events however this is likely to result in only minor and temporary impacts.
	Site Disturbance and Excavation	10.5	Precinct construction and supporting infrastructure.	High	It is considered unlikely that ASS occur within the James Price Point coastal area however, this will be further considered during preliminary geotechnical investigations. There is some potential for increased soil salinity as a result of site preparation activities and dust suppression.
					While the James Price Point coastal area is relatively flat site contouring will be required and it is likely that coastal geomorphology will be altered as a result of nearshore construction and site preparation works.
	Waste Disposal	10.4	Result of construction and operation activities	Low	Waste disposal would occur throughout the construction and operation of an LNG facility within the James Price Point coastal area. It is considered unlikely that soil contamination would occur should appropriate waste management and disposal occur.
	Altered Fire Regimes	10.13	Precinct operation and supporting infrastructure	Medium	Frequent fires can result in further land degradation when exposed soils erode and litter layers are lost. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley
Surface and Groundwater	Site Disturbance and Excavation	10.5	Precinct construction and supporting infrastructure.	High	At present there is little information on the groundwater conditions at the James Price Point coastal area. There is the potential for saltwater intrusion to occur as a result of excavation activities and the composition of soil used in site preparation, likely impacts will be further considered once groundwater conditions are further understood. Existing information suggests that there are no major water courses within the James Price Point coastal area. There are some minor water courses to the north and south however these are unlikely to be directly disturbed.
	Terrestrial Wastes and	10.4	Nearshore construction activities, Precinct operation,	High	Major waterways do not appear to be present within the James Price Point coastal area. Site drainage would be collected in storage ponds however there is the potential for site

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Discharges		product storage and distribution. Vessel movements.		drainage including hydrocarbons and chemicals to enter local drainage systems (including groundwater) particularly under extreme rainfall events.
	Groundwater Abstraction	10.15	Support construction and operation	Medium	Groundwater abstraction is likely to occur to supply water during construction and operation. There is some potential for ongoing abstraction to affect surrounding watercourses and creeks however the existing groundwater and hydrological conditions are unknown.
	Waste Disposal	10.4	Result of construction and operation activities	Low	Waste disposal would occur throughout the construction and operation of an LNG facility within the James Price Point coastal area. While the extent of groundwater systems is to be determined it is considered unlikely that contamination would occur should appropriate waste management and disposal occur.
	Runoff	10.4	Construction activities, site clearing, stormwater management	Low	Water courses to not appear to be present within the James Price Point coastal area and erosion that may occur as a result of increased runoff is considered to represent a minor short-term impact.
Air Quality	Dust Emissions	10.9	Terrestrial site clearing and extraction activities as well as vehicle movements.	Medium	The James Price Point coastal area currently has high air quality conditions with the exception of some smoke as a result of bushfire and dust. There is potential for dust emissions during clearing and site excavations to reduce current air quality conditions.
	Greenhouse Gas Emissions	10.9	All aspects but primarily gas processing.	High	Operation of facilities within the LNG Precinct would result in the release of greenhouse gases, however its contribution to climate change is currently unknown (therefore likelihood and consequence ranking not currently defined). This aspect is conservatively ranked as high taking into account and recognising the global nature of the issue of climate change.
	Altered fire regime	10.9	Precinct operation and supporting infrastructure	Medium	Atmospheric emissions from bush fires contribute particulates as well as greenhouse gas. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley.
Tidal Regimes, Currents and Hydrodynamics	Physical Presence	10.14	Nearshore jetty, pipelines and marine infrastructure	Medium	Nearshore facilities such as jettys and a vessel harbour have the potential to impact local scale marine hydrodynamic conditions. This may result in residual impacts on benthic habitats and seagrasses.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Ecosystem Integrity	Altered Fire regime	10.13	Precinct operation and supporting infrastructure	Medium	<i>Altered fire regime has potential to lead to biodiversity loss with some plants, particularly fire-sensitive ones, unable to recover. At this stage it has not been possible to totally quantify those losses. Further land degradation caused when exposed soils erode, litter layers are lost, shrubs disappear and a homogenous landscape is produced. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain more sustainable fire regime in the Kimberley.</i>
	Introduced Pests	10.8	Precinct construction and operation	Low	<i>Weed species are already known to occur on the Dampier Peninsula and James Price Point coastal area (Scoping Report Sect. 5.3.4.3) and have the potential to outcompete native flora species. It is considered likely that introduced fauna species currently inhabit the Dampier Peninsula and James Price Point coastal area. There is the potential for the introduction of new pests to the James Price Point coastal area as a result of Precinct construction and operation however there is also the potential for improved management of natural resources to occur.</i>
	Invasive marine species	10.7	Precinct construction and operation	High	<i>The marine environment of the James Price Point coastal area is relatively undisturbed and it is considered unlikely that invasive marine species currently exist there. Ballast water discharge and contaminated ships and equipment may have the potential to introduce IMS during construction and operation. Should IMS be introduced they have the potential to outcompete and displace native fauna which may in turn affect the local marine ecosystem whilst also impacting local pearling and aquaculture industries.</i>

Table ES-4: Summary of Initial Assessment of Social Impacts (by Factor)

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Palaeontology	Atmospheric emissions	10.12	Terrestrial site clearing and construction activities as well as vehicle movements. Gas processing, operation of machinery	Medium	<i>There is potential for local deposition effects of atmospheric emissions on heritage sites. Current information indicates that areas of known aboriginal heritage value in the JPP area are composed of artefact and midden scatters (Scoping Report s. 5.3.10.3). No petroglyphs (rock art) that may be susceptible to erosion from atmospheric deposition are known to occur in the area.</i>
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	<i>Marine noise and vibration that may potentially arise from the Precinct construction and operation is considered highly unlikely to result in significant impacts on marine archaeological heritage values.</i>
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	<i>In a regional context, areas along the Kimberley coast are known to have dinosaur footprints (Scoping Report s.5.3.10.2). The presence or absence of similar palaeontological evidence on the intertidal platform in the JPP coastal area is not currently known. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.</i>
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	<i>In a regional context, areas along the Kimberley coast are known to have dinosaur footprints (Scoping Report s.5.3.10.2). The presence or absence of similar palaeontological evidence on the intertidal platform in the JPP coastal area is not currently known. The short term nature of potential impacts arising from sedimentation and turbidity, and the natural high turbidity in coastal waters, indicates that adverse impacts are unlikely. However potential impacts from higher sedimentation warrant further consideration.</i>
	Site disturbance/excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	High	<i>Seabed disturbance associated with the installation of marine infrastructure could have localised impacts on archaeological heritage. In a regional context, areas along the Kimberley coast are known to have dinosaur footprints (Scoping Report s.5.3.10.2). The presence or absence of similar palaeontological evidence on the intertidal platform in the JPP coastal area is not currently known. The potential effect on areas of heritage value warrants further consideration.</i>
	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Medium	<i>Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless present a risk of disturbance to areas of archaeological heritage value. Heritage studies will be completed in collaboration with traditional owners, to ensure disturbance to areas of archaeological significance are</i>

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Environmental Heritage					avoided where practicable.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Terrestrial discharges are considered unlikely to impact on heritage sites as the selection and layout of the development area gives consideration to the location of these.
	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could impact sensitive sites. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local environmental heritage values warrants further investigation.
	IMS	10.7	Vessel movements and nearshore construction works	Low	Increased shipping and vessel movements increases potential for invasive marine species posing threat to conservation areas. However, the LNG Precinct area is located outside the boundaries of reserves, therefore potential impacts on areas of environmental heritage value are assessed to be highly unlikely.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event is considered to have low probability of occurrence. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Physical Presence - Marine	10.14	Nearshore jetty, pipelines and marine infrastructure, site works and clearing	Medium	Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities will cause changes to landscape in vicinity of the development. However, the LNG Precinct area is located outside the boundaries of reserves, therefore potential impacts on areas of environmental heritage value are assessed to be unlikely.
	Physical Presence - terrestrial	10.14	Clearing, site works, roads, plant, buildings	Medium	The physical presence of the LNG Precinct facilities and in the increased traffic and number of people in the area has potential to impact environmental heritage values in the local area. Site disturbance will be limited to the development area and footprint will be minimised. Disturbance to areas of conservation significance are to be avoided where practicable.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction.	Medium	Sedimentation/deposition that may potentially arise from the Precinct construction and operation is considered unlikely to result in significant impacts on environmental heritage values. The short term nature of potential impacts arising from sedimentation and turbidity, and the natural high turbidity in coastal waters, indicates that adverse

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					impacts are unlikely. However potential impacts from higher sedimentation warrant further consideration.
	Site disturbance/excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure is considered unlikely to impact on areas of environmental heritage. The LNG Precinct area is located outside the boundaries of reserves, therefore resultant impact on areas of environmental heritage value are assessed to be low.
	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Medium	Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless present a risk of disturbance to areas of environmental heritage value. Disturbance to areas of conservation significance are to be avoided where practicable.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Terrestrial discharges are considered unlikely to impact on heritage sites as the selection and layout of the development area gives consideration to the location of these.
	Vegetation/Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Medium	Clearing of areas of conservation significance are to be avoided, and the footprint of infrastructure will be optimised to minimise disturbance where practicable..
Aboriginal Heritage	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could impact sensitive sites. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local aboriginal heritage values warrants further investigation.
	Physical Presence - marine	10.14	Nearshore jetty, pipelines and marine infrastructure	Medium	Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities will cause changes to landscape in vicinity of the development. Further aboriginal heritage and ethnographic studies are required.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of Traditional Owners/site custodians to visit and maintain Aboriginal sites and undertake cultural practices.
	Physical Presence -	10.14	Clearing, site works, roads, plant, buildings	Medium	The physical presence of the LNG Precinct facilities and in the increased traffic and number of people has the potential to impact Aboriginal heritage sites in the local area. Land disturbance will be limited to the development area and the footprint will be

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	terrestrial				<i>minimised. Disturbance to areas of Aboriginal heritage significance are to be avoided where practicable, as agreed with Traditional Owners during the design/layout process.</i>
	Site Disturbance/Excavation - terrestrial	10.5	Marine dredging and drilling, nearshore construction and pipeline installation.	Medium	<i>Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless present a risk of disturbance to areas of indigenous heritage value. Heritage studies will be completed in collaboration with traditional owners, to ensure disturbance to areas of aboriginal significance are to be avoided where practicable.</i>
	Site disturbance/excavation – marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	High	<i>Seabed disturbance associated with the installation of marine infrastructure could have localised impacts on Aboriginal heritage. Many sites of indigenous cultural significance are located along the coast. A high proportion of sites in the JPP coastal area listed on the DIA database are composed of artefact and midden scatters (Scoping Report s.5.3.10.3). The final site for the Precinct will be agreed with the traditional owners to ensure areas of highest indigenous heritage value are avoided. Further aboriginal heritage and ethnographic studies are required.</i>
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	<i>A non-routine event is considered to have low probability of occurrence. Terrestrial discharges are considered unlikely to impact on heritage sites as the selection and layout of the development area gives consideration to the location of these.</i>
	Vehicle Movements	9.0	Construction, operation of facilities	Medium	<i>Increased traffic and roads may lead to greater access to areas of heritage significance and risk to disturbance of sites.</i>
Colonial Heritage	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	<i>The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could impact sensitive sites. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local colonial heritage values warrants further investigation.</i>
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	<i>Marine noise and vibration that may potentially arise from the Precinct construction and operation is considered highly unlikely to result in significant impacts on colonial heritage values.</i>
	Site Disturbance/Excavation -	10.5	Product transport, Precinct construction and support.	Medium	<i>Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless present a risk of disturbance to areas of colonial heritage value. Disturbance to areas of heritage significance are to be avoided</i>

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	terrestrial				where practicable.
Visual Amenities	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could have local visual impacts (e.g. changes in smoke haze events and geographical extent of burn zones). It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local visual amenity warrants further investigation.
	Atmospheric emissions	10.12	Terrestrial site clearing and excavation activities as well as vehicle movements. Gas processing, operation of machinery	Medium	There is potential for visible emissions to arise from the construction and operation of the LNG Precinct facilities, which could impact visual amenity value of the local area.
	Introduced Pests - terrestrial	10.8	Site clearing, increased traffic, use of fill	Medium	Introduced species (weeds, pests etc) have potential to change the nature of the landscape which could consequently impact local amenity values.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	High	Light associated with marine facilities has the potential to impact visual amenity of area in the vicinity of the development. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area, however the geographical extent of potential light effects on amenity values warrants further investigation.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event has potential to adversely affect the local amenity values of the surrounding area. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Physical Presence - marine	10.14	Nearshore jetty, pipelines and marine infrastructure	High	Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities has potential to change local landscape values and therefore affect visual amenity along the coastal area.
	Physical Presence - terrestrial	10.14	Clearing, site works, roads, plant, buildings	Severe	The physical presence of the LNG Precinct facilities will change visual amenity of the development area and surrounds. The extent of potential impact on visual amenity values of the local area will depend on the physical infrastructure characteristics, topography and proximity of social receptors, however a change in current visual

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					amenity is inevitable. This aspect warrants further investigation.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	Activities that may lead to local sedimentation/deposition effects could potentially affect amenity of the local coastal area. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area. Potential impacts to visual amenity in a local context warrants further investigation.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure is anticipated to have limited impact to visual amenity and tourism in the local area.
	Site Disturbance/ Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	High	Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless result in a change to the visual amenity of area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area. However potential visual amenity impacts warrant further investigation.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release. Terrestrial discharges are unlikely to cause visual impacts or alter condition, therefore no significant impact on visual amenity is anticipated.
	Vegetation/ Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	High	Clearing will be limited to the development area and footprint will be minimised. The clearing of vegetation will nonetheless result in a change to the visual amenity of area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area. However potential visual amenity impacts warrant further investigation.
	Vehicle Movements	9.0	Construction, operation of facilities	High	Increased traffic will likely result in a change of visual amenity. Existing unpaved roads/tracks may require upgrading and/or expansion to accommodate LNG Precinct-related traffic. Potential traffic impacts on visual amenity in a local context warrants further investigation.
	Vessel movements	10.9	Product transport, Precinct construction and support.	High	Introduction of large vessels to the region has potential to impact visual amenity in the vicinity of the Precinct development and associated vessel transit routes, and warrants further investigation.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Mining	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Low	<i>The Precinct development zone of the James Price Point area is not likely to be required for mining activities. Therefore the risk of site clearing/excavation activities associated with the LNG Precinct on existing or future mining activities is assessed to be low.</i>
	Use of infrastructure and services	9.0	Precinct construction and operation	Medium	<i>Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, will increase pressure on the airport, airline services and accommodation services which will cause negative impacts for the mining and tourism sectors.</i>
	Restricted Areas	9.0	Precinct construction and operation	Medium	<i>Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of mining companies looking to explore for and/or develop mineral deposits. Whilst the general area may be prospective for mineral sands and construction materials, there is not a significant level of interest in the area at present in terms of title applications.</i>
	Increased demand for labour	9.0	Precinct construction and operation	High	<i>The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like mining, to compete for labour.</i>
	Vegetation/Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Low	<i>The Precinct development zone of the James Price Point area is not likely to be required for mining activities. Therefore the risk of vegetation clearance associated with the LNG Precinct on existing or future mining activities is assessed to be low.</i>
Agriculture	Atmospheric emissions	10.12	Terrestrial site clearing and excavation activities as well as vehicle movements. Gas processing, operation of machinery	Low	<i>There is potential for local deposition effects of atmospheric emissions on vegetation. However this is considered to represent a low risk to agricultural activities which are well removed from the Precinct development area.</i>
	Introduced Pests - terrestrial	10.8	Site clearing, increased traffic, use of fill	Medium	<i>Introduced species (weeds, pests etc) have potential to be introduced to the area from the import and transport of materials, equipment and personnel, and expansion/upgrade of road access. Should pest species be established in the area, there is potential for indirect secondary impacts on other land uses in the local area. The James Price Point coastal area is some distance from major pastoral leases in the southern portion of the Dampier Peninsula, however potential pest effects on local traditional agricultural practices warrants further investigation.</i>

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the activities of Aboriginal people associated with the harvest of wild gubinge (bush plumb) in the vine thicket areas.
	Runoff	10.4	Construction activities, site clearing, stormwater management	Medium	Runoff from LNG Precinct development has potential to impact on groundwater resources if incorrectly managed. Runoff will be diverted and controlled so as to ensure low risk to groundwater resources, thereby minimising the risk of secondary impacts on agricultural activities in the region.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like pastoralism/agriculture, to compete for labour.
	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Low	The Precinct development zone of the James Price Point area is not for agricultural use. On the Dampier Peninsula there are small horticultural and agroforestry businesses (Scoping Report s. 5.3.4.2). The Gubinge is grown and harvested by local traditional owners on the Dampier Peninsula, representing a traditional agricultural practice. The nearest pastoral leases are more than 50km to the west and south-west of JPP, therefore the risk of LNG Precinct affecting these agricultural areas is assessed to be low.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Medium	A non-routine event is considered to have low probability of occurrence. Terrestrial discharges have the potential to impact on groundwater resources, with consequent effects on other agricultural land users. The James Price Point coastal area is remote from major pastoral leases in the southern portion of the Dampier Peninsula, however potential effects on local traditional agricultural practices warrants further investigation.
	Vegetation/Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Low	The Precinct development zone of the James Price Point area is not for agricultural use. On the Dampier Peninsula there are small horticultural and agroforestry businesses (Scoping Report s. 5.3.4.2). The Gubinge is grown and harvested by local traditional owners on the Dampier Peninsula, representing a traditional agricultural practice. The nearest pastoral leases are more than 50km to the west and south-west of JPP, therefore the risk of LNG Precinct affecting these agricultural areas is assessed to be low.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Commercial Fishing	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	Medium	Increased shipping and vessel movements increases the potential for invasive marine species to be introduced in the local area. Should introduced species establish in the area, there is potential to impact on commercial fishing activities in the area. Strict IMS inspection and management protocols are anticipated to minimise risk of introduction, however the risk of introduced pests on these activities warrants further investigation.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	Medium	Light associated with marine facilities has potential to disturb fishing operations. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from other users of the broader coastal area. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area. However potential impact from light on commercial fisheries warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase pressure on the port, and other services which may cause negative impacts for the commercial fishing sector.
	Commercial Fishing	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the activities of commercial fishers in and around James Price Point.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like commercial fishing, to compete for labour.
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	A number of both WA State and Commonwealth managed fisheries operate in the coastal inshore areas of the Kimberley (Scoping Report s.5.3.4.3). These fisheries cover a broad geographic area and are not limited to the James Price Point coastal area. Noise impacts associated with the LNG Precinct are expected to occur primarily during construction and installation phases. Taking into account the short-term and temporary nature of nearshore noise-generating activities, it is not anticipated to result in significant disturbance to commercial fishing operations in the region.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel	Medium	A non-routine event is considered to have low probability of occurrence. Commercial fisheries cover a broad geographic area along the Kimberley coast and are not limited to the James Price Point coastal area. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
			movements.		<i>nature and fate of any release and warrants further consideration.</i>
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	<i>Dredging during construction and ongoing maintenance may potentially increase sedimentation and may have the potential to disturb commercial fishing activities. The marine waters of the Kimberley region are known to have high natural turbidity throughout year due to high tidal flux. Taking into account the short term nature of potential impacts, the natural high turbidity and low density of commercial fishing operations in the area, significant impacts are not anticipated.</i>
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	<i>Seabed disturbance associated with the installation of marine infrastructure could lead to localised impacts on habitat. Disturbance will be limited to the minimum necessary for the development, and anticipated to represent a small proportion of the total fish habitat along the coastal zone. Short-term activities are considered unlikely to affect commercial fishing operations.</i>
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	<i>Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb commercial fishing activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on commercial fishing operators, warrants further investigation.</i>
Aquaculture	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	High	<i>Increased shipping and vessel movements increases the potential for invasive marine species to be introduced in the local area. Should introduced species establish in the area, there is potential to impact on aquaculture (including pearling) activities in the area. Strict IMS inspection and management protocols are anticipated to minimise risk of introduction, however the risk of introduced pests on these activities warrants further investigation.</i>
	Light emissions – marine	10.9	Precinct operation, nearshore construction, vessel operation	Medium	<i>Light associated with marine facilities has potential to disturb aquaculture (including pearling) operations. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area. However potential impact from light on aquaculture (pearling) farms in the local JPP coastal area warrants further investigation.</i>
	Use of infrastructure and services	9.0	Precinct construction and operation	High	<i>Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase pressure on the port, and other services which may cause negative impacts for the agriculture sector.</i>
	Use of infrastructure	9.0	Precinct construction and operation	High	<i>Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase</i>

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	and services		operation		pressure on the port, and other services which may cause negative impacts for the aquaculture (including pearling) industry.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like aquaculture, to compete for labour.
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	In a regional context, major aquaculture / pearling operations occur at Cygnet Bay, Beagle Bay and Deepwater Point (Scoping Report s. 5.3.4.4). A few pearling leases are offshore James Price Point, although well removed from the LNG Precinct area. Noise impacts associated with the LNG Precinct are expected to occur primarily during construction and installation phases. The nearshore infrastructure is anticipated to be located away from active aquaculture operations. Taking into account the short-term and temporary nature of noise-generating activities, it is not anticipated to result in significant disturbance to aquaculture operations in the region. This risk ranking will be reviewed in the event that marine blasting is a requirement for the construction phase.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event is considered to have low probability of occurrence. A few pearling leases are offshore James Price Point, although removed offshore from the LNG Precinct area. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	In a regional context, major aquaculture / pearling operations occur at Cygnet Bay, Beagle Bay and Deepwater Point (Scoping Report s. 5.3.4.4). A few pearling leases are offshore James Price Point, although well removed from the LNG Precinct area. It is possible that trenching and/or dredging activities for the nearshore infrastructure may contribute to short-term increases in turbidity, however it is understood that naturally high turbid water conditions do occur already. The potential for sedimentation/turbid plumes arising from the LNG Precinct development zone to affect nearby aquaculture sites warrants further investigation.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure could lead to localised impacts on habitat. Disturbance will be limited to the minimum necessary for the development, and anticipated to represent a small proportion of the total fish habitat along the coastal zone. Short-term activities are considered unlikely to affect aquaculture (including pearling) operations.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb aquaculture activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on commercial fishing operators, warrants further investigation.
Tourism	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could have impacts on local tourism activities. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local tourism warrants further investigation.
	Atmospheric emissions	10.12	Terrestrial site clearing and excavation activities as well as vehicle movements. Gas processing, operation of machinery	Medium	There is potential for visible emissions to arise from the construction and operation of the LNG Precinct facilities, which could impact amenity to tourism. Flare tip design and controls are anticipated to make this scenario unlikely to result in adverse impacts.
	Use of Infrastructure and Services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, will increase pressure on the airport, airline services and accommodation services which will cause negative impacts for the tourism sector, particularly during peak season.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of tourists in and around James Price Point.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like tourism, to compete for labour.
	Introduced Pests - terrestrial	10.8	Site clearing, increased traffic, use of fill	Medium	Introduced species (weeds, pests etc) have potential to change the nature of the landscape which could consequently impact tourism values.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	High	Light associated with marine facilities has the potential to impact visual amenity of area in the vicinity of the development, which could affect tourism. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area, however the geographical extent of potential light effects on amenity values warrants

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					further investigation.
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	High	<i>In the vicinity of the site, marine noise and vibration could potentially affect amenity of the local area with follow-on effects on local tourism uses. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from tourism and other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area.</i>
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	<i>A non-routine event is considered to have low probability of occurrence. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from tourism and other users of the broader coastal area. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.</i>
	Physical Presence - marine	10.14	Nearshore jetty, pipelines and marine infrastructure	High	<i>Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities has potential to change local landscape values and possibly interact with activities.</i>
	Physical Presence - terrestrial	10.14	Clearing, site works, roads, plant, buildings	Medium	<i>The development area not likely to be available for other land uses. The physical presence of the LNG Precinct facilities will affect amenity of the local area with follow-on effects on local tourism uses. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from tourism and other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area.</i>
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	<i>Activities that may lead to local sedimentation/deposition effects could potentially affect amenity of the local coastal area with follow-on effects on local tourism uses. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from tourism and other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area. The short term nature of the impacts and the natural high turbidity indicate minor consequence of effects, however potential impact to visual amenity warrants further investigation.</i>
	Site disturbance/excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	<i>Seabed disturbance associated with the installation of marine infrastructure is anticipated to have limited impact to visual amenity and tourism in the local area.</i>

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Sports and recreation	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	High	Clearing will be limited to the development area and footprint will be minimised. The clearing of vegetation will nonetheless result in a change to the visual amenity of area, thereby altering the tourism potential of the local area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area. However potential impacts on existing and/or future tourism warrants further investigation.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	The construction and operation of facilities within the LNG Precinct will result in the generation of a range of solid, liquid and semi-liquid wastes requiring handling, storage and disposal. Waste re-use and recycling opportunities will be explored to minimise total volumes requiring disposal. Waste disposal will be at approved facilities however the temporary storage may result in localised visual impacts, which may have flow-on effects on local tourism values. The potential impact is considered minimal.
	Vegetation/Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	High	Clearing will be limited to the development area and footprint will be minimised. The clearing of vegetation will nonetheless result in a change to the visual amenity of area, thereby altering the tourism potential of the local area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area. However potential impacts on existing and/or future tourism warrants further investigation.
	Vehicle Movements	9.0	Construction, operation of facilities	High	Increased traffic on the Dampier Peninsula may disturb existing tourist traffic. It is anticipated that tourist traffic will be regulated to maintain safety buffer zones and ensure public health and safety risks are minimised. Potential traffic impacts to tourism in a local context warrants further investigation.
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb tourism activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on tourism operators, warrants further investigation.
	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could have impacts on local sports and recreation activities. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local recreation activities warrants further investigation.
	Atmospheric	10.12	Terrestrial site clearing and excavation activities as well as	Low	There is potential for exposure from emissions (e.g. dust) to recreational users of the area. It is anticipated that an appropriate buffer zone will be defined to maintain suitable

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	emissions		vehicle movements. Gas processing, operation of machinery		separation distance from the LNG Precinct from other users of the broader coastal area, therefore a low risk of impact to recreational users.
	Introduced Pests - terrestrial	10.8	Site clearing, increased traffic, use of fill	Medium	Introduced species (weeds, pests etc) have potential to be introduced to the area from the import and transport of materials, equipment and personnel, and expansion/upgrade of road access. Should pest species be established in the area, there is potential for indirect secondary impacts on other land uses in the local area. Potential pest effects on local recreational activities warrants further investigation.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	Medium	Light associated with marine facilities has the potential to impact visual amenity of area in the vicinity of the development. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area. However potential impact from light on recreational users along the coastal area warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	Low	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is highly unlikely to cause negative impacts on sport and recreation activities.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of people undertaking sport and recreation activities in the James Price Point area.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event is considered to have low probability of occurrence. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Physical Presence - marine	10.14	Nearshore jetty, pipelines and marine infrastructure	High	Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities has potential to change local landscape values and possibly interact with activities.
	Local population increases (temp or permanent)	9.0	Precinct construction and operation	High	Due to an increase in population associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, should direct and indirectly employed workers chose to reside in Broome, there will be additional demand for/competing use of sporting and recreation activities/facilities.
	Physical Presence -	10.14	Clearing, site works, roads, plant, buildings	Medium	The development area is not likely to be available for other land uses and some limited access restricted areas will cause disturbance to existing recreational activities in the immediate development area. It is anticipated that an appropriate buffer zone will be

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	terrestrial				defined to maintain suitable separation distance from the LNG Precinct from recreational and other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	Activities that may lead to local sedimentation/deposition effects could potentially affect amenity of the local coastal area. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from recreational users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area. Potential impacts to recreational amenity and uses in a local context warrants further investigation.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure is anticipated to have limited impact to sports and recreational uses in the local area.
	Site Disturbance/ Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Low	Clearing will be limited to the development area. However the development of the LNG Precinct will preclude the use of the immediate area for camping and other recreational activities. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from recreational users of the broader coastal area.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Should it occur, terrestrial discharge is unlikely to impact areas outside of the development area of the LNG Precinct. Therefore potential impact on sports/recreation values is assessed to be low.
	Vegetation/ Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Low	Clearing will be limited to the development area. However the development of the LNG Precinct will preclude the use of the immediate area for camping and other recreational activities. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from recreational users of the broader coastal area.
	Vehicle Movements	9.0	Construction, operation of facilities	High	Increased traffic on the Dampier Peninsula may disturb existing recreational users. It is anticipated that recreational traffic will be regulated to maintain safety buffer zones and ensure public health and safety risks are minimised. Potential traffic impacts on sports / recreational uses in a local context warrants further investigation.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on sport/recreation values, warrants further investigation.
Recreational Fishing	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	Medium	Increased shipping and vessel movements increases potential for invasive marine species. Should introduced species establish in the area, there is potential to impact on recreational fishing activities in the area. Strict IMS inspection and management protocols are anticipated to minimise risk of introduction, however the risk of introduced pests on these activities warrants further investigation.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	Medium	Light associated with marine facilities has the potential to impact visual amenity of area in the vicinity of the development. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area. However potential impact from light on recreational fishing activities along the coastal area warrants further investigation.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of recreational fishers around James Price Point.
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	Marine construction activities such as piling and dredging may have the potential to affect fish species. However it is unlikely that such impacts would affect recreational fishing off the James Price Point coastal area. Areas of recreational fishing cover a broad geographic area and are not limited to the James Price Point coastal area. Noise impacts associated with the LNG Precinct are expected to occur primarily during construction and installation phases. Taking into account the short-term and temporary nature of nearshore noise-generating activities, it is not anticipated to result in significant disturbance to recreational fishing activities in the region.
	Use of infrastructure and services	9.0	Precinct construction and operation	Medium	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase pressure on the port, and other services which may cause negative impacts for recreational fishing.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event is considered to have low probability of occurrence. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	Activities that may lead to local sedimentation/deposition effects could potentially affect amenity of the local coastal area. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from recreational users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area. Potential impacts to recreational amenity and uses in a local context warrants further investigation.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure is anticipated to have limited impact to sports and recreational uses in the local area.
	Site Disturbance/ Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	High	Site disturbance to some areas of the shoreline will impact recreational fishing activities within the development area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Should it occur, terrestrial discharge is unlikely to impact areas outside of the development area of the LNG Precinct. Therefore potential impact on sports/recreation values is assessed to be low.
	Vessel movements	10.7	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb recreational fishing activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on recreational fishing activities, warrants further investigation.
	Groundwater Abstraction	10.15	Support construction and operation	High	Water abstraction may be required to supply water to facilities within the LNG Precinct. Water abstraction will be in accordance with allocation plans, as agreed with relevant Government agencies. It is possible that water abstraction may affect water supply and availability for other users in the local area, and warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to increase demand for potable water and put additional pressure on ground water resources in the region.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Waste management	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Medium	The construction and operation of facilities within the LNG Precinct will result in the generation of a range of solid, liquid and semi-liquid wastes requiring handling, storage and disposal. Waste re-use and recycling opportunities will be explored to minimise total volumes requiring disposal. Waste management infrastructure required to support the Precinct may have impacts on other land uses.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to increase demand for waste management services and facilities and put additional pressure on associated infrastructure in the region.
Transport	Vehicle movements	9.0	Construction, operation of facilities	High	Increased traffic anticipated to arise from the LNG Precinct construction and operation will likely disturb existing traffic in the local area, between Broome and the development zone. Potential traffic impacts on existing road traffic in a local context warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to result in increased vehicle, marine and air traffic which will put additional pressure on associated infrastructure in the region.
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb maritime transport activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on maritime transport, warrants further investigation.
Land tenure	Physical Presence - terrestrial	10.14	Clearing, site works, roads, plant, buildings	Medium	The development area is not likely to be available for other land uses. James Price Point is currently unallocated Crown land which has a native title claim over it by the Goolarabooloo Jabirr Jabirr Native Title Claimants. The final site allocation includes a Land Use Agreement to ensure land tenure issues are fully addressed.
Terrestrial Conservation Areas	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Medium	The LNG Precinct area is located outside the boundaries of reserves, therefore potential impacts on areas of environmental heritage value are assessed to be unlikely. Clearing of areas of conservation significance to be avoided where practicable.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Vegetation/ Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Medium	The LNG Precinct area is located outside the boundaries of reserves, therefore potential impacts on areas of environmental heritage value are assessed to be unlikely. Clearing of areas of conservation significance to be avoided where practicable.
Local population increases (temporary/permanent)	General Population	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in an increase in the general population of the region due to people being attracted by significant direct and indirect opportunities associated with the developments and lead to increased demand for goods and services in the region.
	Indigenous Population	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct may result in an increase in the Indigenous population of the region due to people being attracted by significant direct and indirect opportunities associated with the developments and lead to increased demand for goods and services in the region.
	Local Employment	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries to compete for labour.
	Indigenous Employment	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries to compete for labour.
	Cost of Living	9.0	Precinct construction and operation	High	Due to an increase in population associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct and the demand from the projects themselves, upward pressure may be exerted on the regional cost of living due to competing demand for supply constrained goods and services.
	Housing Prices	9.0	Precinct construction and operation	High	Due to an increase in population associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, should direct and indirectly employed workers chose to reside in Broome, there will be upward pressure exerted on housing prices.
	Regional Prices Index	9.0	Precinct construction and operation	High	Due to an increase in population associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct and the demand from the projects themselves, upward pressure may be exerted on the regional prices index due to competing demand for supply constrained goods and services.

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Use of infrastructure and services	Local Employment	9.0	Precinct construction and operation	High	Additional use of local infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the infrastructure and services sectors in the region and lead to wage increases in order for other industries to compete for labour.
	Indigenous Employment	9.0	Precinct construction and operation	High	Additional use of local infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the infrastructure and services sectors in the region and lead to wage increases in order for other industries to compete for labour.
	Housing Prices	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase the population in Broome and cause upward pressure on housing prices.
	Regional Prices Index	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase the demand for supply constrained goods and services in Broome and cause upward pressure on the cost of living/regional prices index.
	Power	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to increase demand for power and put additional pressure on power supply and infrastructure in the region.
	Telecommunications	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to increase demand for telecommunications services and put additional pressure on associated infrastructure in the region.
	Health	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to result in increased demand for health services which will put additional pressure on associated infrastructure in the region.
	Education	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to result in increased demand for education services which will put additional pressure on associated infrastructure in the region.

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Local Employment	9.0	Precinct construction and operation	High	Additional use of local infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the infrastructure and services sectors in the region and lead to wage increases in order for other industries to compete for labour.
	Indigenous Employment	9.0	Precinct construction and operation	High	Additional use of local infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the infrastructure and services sectors in the region and lead to wage increases in order for other industries to compete for labour.
	Housing Prices	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase the population in Broome and cause upward pressure on housing prices.
	Regional Prices Index	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase the demand for supply constrained goods and services in Broome and cause upward pressure on the cost of living/regional prices index.
Increase demand for labour	Health	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like the health sector, to compete for labour.
	Education	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like the education sector, to compete for labour.

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1 Introduction

1.1 *Proposal overview*

The Browse LNG Precinct³ encompasses the construction and operation of Liquefied Natural Gas (LNG) processing facilities and associated infrastructure to be located on the Kimberley coast. The location selected for the LNG Precinct is within the James Price Point coastal area (see Figure 1.1), as determined by the site selection process undertaken by the Department of State Development (DSD, formerly the Northern Development Taskforce) and Western Australian and Commonwealth Governments.

The development is based on the recovery of hydrocarbons from the Browse Basin gas fields, located north of Broome (**Figure 1.1**). Subject to additional appraisal work, further technical studies and government approvals, commissioning of LNG processing facilities and subsequent gas export is being targeted from 2015.

The proposed Browse LNG Precinct comprises gas processing and liquefaction complex(s), LNG and condensate storage tanks, and supporting utilities such as accommodation facilities, desalination plant and waste water treatment plant etc. The processing plants would be fed by a number of hydrocarbon trunklines, bringing feedstock hydrocarbons from the offshore Browse gas fields for onshore processing. To allow for the export of hydrocarbons and provide supporting infrastructure, a number of marine facilities will be required. The Integrated Marine Facilities (IMF) will involve product loading berths, a Material Offloading Facility (MOF), small vessel harbour, and other facilities to support the offshore Browse gas infrastructure. A more detailed description of the facilities is provided in **Section 3**.

³ Any reference to Kimberley LNG Precinct or similar terms in other earlier documentation, or figures in this document, should be read as Browse LNG Precinct

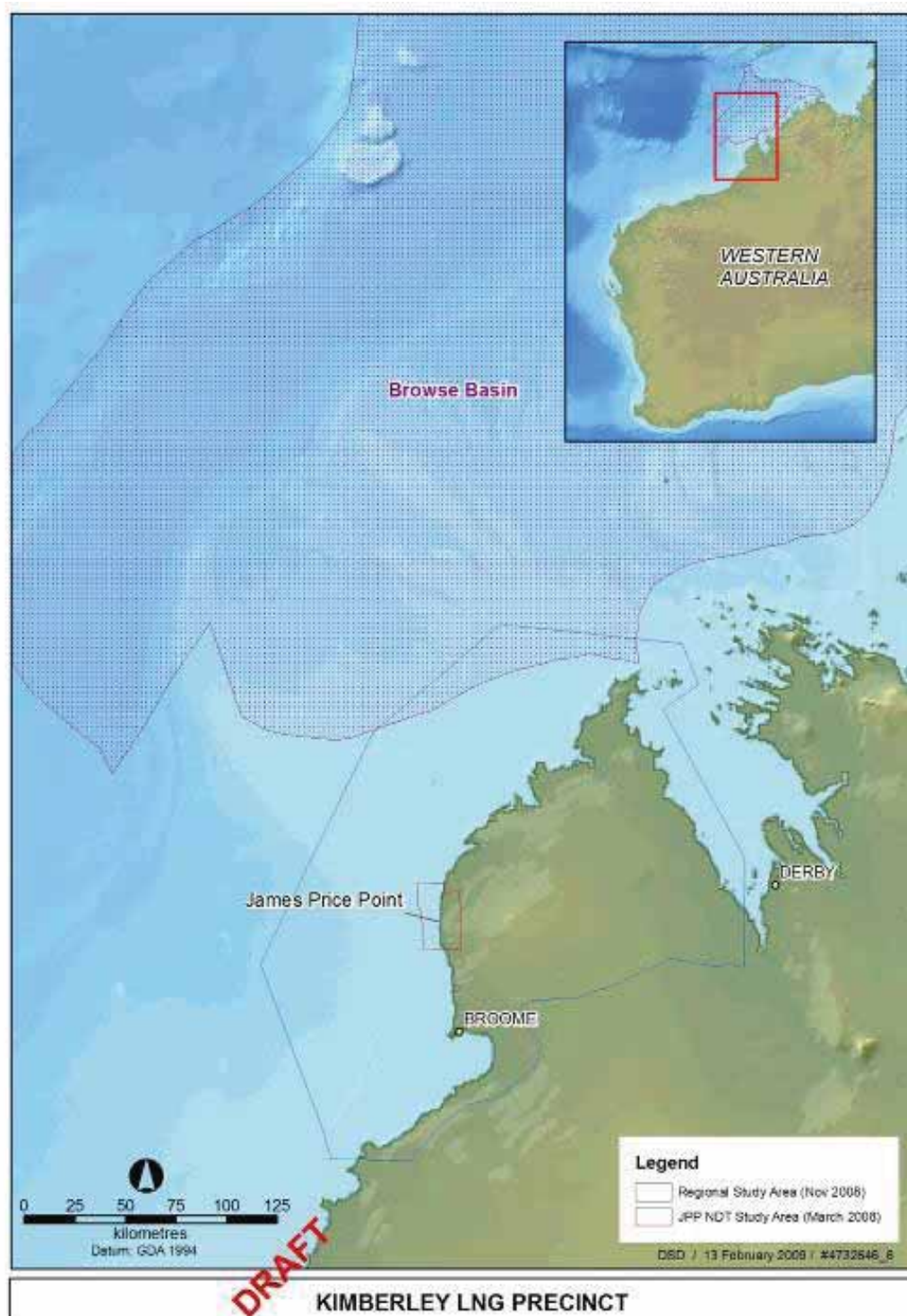


Figure 1.1: Browse Basin and Kimberley Region

1.2 Purpose of Document

This document has been developed through the scoping process of a Strategic Assessment (SA) for the Browse LNG Precinct.

Scoping is an important part of the assessment process, as it allows early identification of what are believed to be the key issues. The Strategic Assessment (SA) report can then focus its efforts on these most important issues in terms of collecting information on the existing conditions, engaging stakeholders, understanding the impacts and developing the measures to avoid or control and monitor them.

The purpose of this document is to outline the scope of the Strategic Assessment. Specifically it aims to:

- Describe the site and outline the proposed Browse LNG Precinct development
- Identify and describe the relevant environmental factors
- Present the risk assessment process and identify potential environmental and social impacts (as currently understood at this early stage of the project); and
- Detail the scope of environmental and social studies and investigations to address the potential environmental and social impacts and their proposed timing.

This document, and the corresponding scope of studies proposed to be undertaken to support the Strategic Assessment, has been prepared in consultation with key regulatory authorities.

1.3 Structure of Document

The remainder of this document is structured as follows:

Section 2: The Environmental Impact Assessment Process: This section provides a description and overview of the process for undertaking the Strategic Assessment, as informed by the State and Commonwealth agencies and outlined in the Terms of Reference for the Strategic Assessment Agreement. This section also provides a summary overview of the site selection process coordinated by the Northern Development Taskforce.

Section 3: Summary of the Browse LNG Precinct Development: This section provides an overview of the project components for the Precinct, and area of interest for the studies and investigations necessary to support the Strategic Assessment. As the Master Plan for the Precinct has been refined, the detail provided to describe the Precinct will be updated accordingly to inform the Strategic Assessment.

Section 4: Emissions, Discharges and Wastes: This section provides a summary of the various emissions, discharges and wastes associated with the construction, commissioning and operational phases of the Browse LNG Precinct. The actual rates and total discharge amounts have not been indicated due to the relative immaturity of concept design.

Section 5: Existing Environmental Description: This section provides a description of the existing terrestrial, marine and social environments at a regional context (Kimberley / Dampier Peninsula) and at a local context (i.e. the preferred site of the James Price Point coastal area).

Section 6: Impact Summary: This section outlines the risk assessment method adopted for the scoping phase, and identifies the key environmental impacts associated with the proposal. The risk-based approach has been used to inform the determination of the scope of investigations to assess these impacts.

Section 7: Baseline Physical Studies and Investigations Program: This section outlines the relevant physical studies and investigations required to inform the Strategic Assessment. These are based on the impacts and level of risk determined through the process outlined in Section 6.

Section 8: Baseline Biological Studies and Investigations Program: This section outlines the relevant biological studies and investigations required to inform the Strategic Assessment. As per **Section 7**, these are based on the impacts and level of risk determined through the process outlined in **Section 6**.

Section 9: Baseline Biological Studies and Investigations Program: This section outlines the relevant biological studies and investigations required to inform the Strategic Assessment. As per **Section 7**, these are based on the impacts and level of risk determined through the process outlined in **Section 6**.

Section 10: Baseline Social Studies and Investigations: This section outlines the relevant social studies and investigations required to inform the Strategic Assessment. As per **Section 7**, these are based on the impacts and level of risk determined through the process outlined in **Section 6**.

Section 11: Summary of Impacts by Factor: This section provides an overarching summary of the identified environmental and social aspects correlating to each environmental factor. Under each environmental factor heading, potential impacts are summarised and the inherent risk rating from the risk assessment is also provided.

Section 12: Engineering Inputs: This section discusses the requirement for specific engineering and design inputs in order to inform the SA studies and investigations.

Section 13: Stakeholder Consultation: Stakeholder consultation is an integral component of the Strategic Assessment process, continuing from the broad consultation efforts underpinning the NDT process to date. This section provides a description of the stakeholder consultation program that will be implemented to support the Strategic Assessment.

Section 14: Peer Review: A description of the proposed peer review process is provided.

Section 15: References: A bibliography of all literature sources cited in the Scoping Report.

Section 16: Abbreviations and Acronyms

The following maps are appended to this Scoping Report:

Map 1: Land Tenure and Aquaculture Areas

Map 2: Aboriginal Heritage Sites, Native Title and Communities

Map 3: Mining and ENCOM Permits and Bathymetry

Map 4: Environmentally Significant Areas

Map 5: Cyclone Tracks 1906 to 2000

Technical appendices supporting this Scoping Report are outlined below:

Appendix A: State-Cwth Terms of Reference for the Strategic Assessment

Appendix B: EPBC Act Protected Matters Report

Appendix C: Activities and Related Environmental Aspects Matrix

Appendix D: Environmental and Social Factors

Appendix E: List of Potential Impacts on Physical, Biological and Social Factors

Appendix F: Risk Rating Table

Appendix G: Environmental Impact Summary Table

Appendix H: Social Impact Summary Table

Appendix I: Browse LNG Precinct SEA Studies Program

Appendix J: Applicable Standards, Policies, Guidelines and other Obligations

Appendix K: Stakeholder List

This document does not include detail on the alternative options considered, nor the basis for justifying the proposal and selecting the preferred location. This information is presented in referenced site selection documents prepared by the Northern Development Taskforce throughout 2007 and 2008 (as discussed in Sections 2 and 3.6)

2 Assessment and Approvals Process

The Northern Development Taskforce (NDT), now Department of State Development (DSD), was established in 2007 to negotiate and coordinate the range of issues associated with the development of the Browse Basin balanced against the wilderness, tourism, environmental and heritage values of the Kimberley.

The main purpose of the NDT was to manage across-government planning processes and stakeholder consultation with regard to the selection and development of a suitable location for the processing of Browse Basin gas reserves in the Kimberley. The establishment of a single LNG processing Precinct on the Kimberley coast, the “Browse LNG Precinct”, is intended to provide the location and common-user infrastructure required to ensure the efficient development of Browse Basin gas reserves, the ability to prevent costly duplication of ports, airports and accommodation, and a means to limit environmental and heritage impacts on the Kimberley (NDT 2008).

A prime consideration for the NDT was to recommend a location for the processing of natural gas from the Browse Basin by one or more operators, giving full consideration to Indigenous, community, environmental, and heritage issues along with other economic activities. The process for the selection of a preferred site is outlined below.

The NDT's responsibilities associated with the completion of the Strategic Assessment have been assumed by the DSD subsequent to the dissolution of the NDT in December 2008.

2.1 Sustainability

The State Government has committed to develop a process which will accommodate sustainable development in the Kimberley. In doing so it has adopted a strategic approach to the development of gas resources in the Browse Basin.

The scope of the NDT included negotiation and coordination of issues associated with development of Browse Basin gas reserves. The role of the Taskforce has been to manage across-government planning processes and stakeholder consultation regarding the selection and development of a suitable location or locations for the establishment of an LNG processing Precinct in the Kimberley.

A key element of the NDT's work programme was a comprehensive site evaluation process, to ensure that all key environmental, social and heritage factors were fully taken into account before resolving on a preferred site, in line with the WA Governments' State Sustainability Strategy and the SAA Terms of Agreement.

This process is described in more detail in the following section.

2.2 Site Selection Process

2.2.1 Evaluation of Sites within the Kimberley

The NDT was tasked with the responsibility of managing the cross-governmental planning and stakeholder consultation processes to identify a suitable site location in the Kimberley for an onshore LNG processing hub.

The taskforce consisted of a number of Director Generals and Chief Executive Officers (CEOs) from the following government departments and decision making authorities, each representing the various facets required in the identification of a suitable site location:

- Department of Industry and Resources, now DSD (Chair);
- Department of Environment and Conservation (DEC);
- Department of Indigenous Affairs (DIA);
- Department of Planning and Infrastructure (DPI);

- Office of Native Title (ONT);
- Kimberley Development Commission (KDC); and
- Tourism Western Australia.

The process for the selection of a preferred site adopted by Government under the Strategic Agreement consisted of five phases. This included:

Phase I – Identification of Suitable Coastal Locations using Geographic Information System (GIS) and Technical Site Selection Criteria: The identification of potentially suitable coastal locations was determined following a GIS based assessment. Technical criteria alone were then used in determining which sites were not technically viable.

In accordance with the SAA Agreement between the Commonwealth and Western Australian Governments, an initial review of possible sites for a multi-user LNG Precinct to service the Browse Basin gas reserves was undertaken.

Phase II – Sites Identified as Technically Viable Assessed for Regional Constraints: Upon the determination of those sites which were technically viable, these were then assessed for regional constraints using comprehensive environmental, social and physiographic criteria.

A preliminary technical assessment was completed of 43 sites that were previously identified by industry and Government as having some potential for development.

Phase III – Evaluation of Social, Environmental and Economic Risk Factors for each Site using Multi-criteria Analysis: Analysed technically viable sites underwent an evaluation of their environmental, social and physiographic criteria using a multi-criteria matrix aimed at ranking each site from least sensitive to most sensitive.

As part of the evaluation process, the NDT developed a site-selection methodology and jointly with DEWHA identified site-selection criteria derived from best practice models which have been used previously by industry and government. The site selection criteria were related to environmental, social, Indigenous, community and tourism interests and were subsequently incorporated into a multi-criteria matrix. The site selection criteria were released for four weeks public comment.

From the original 43 sites, the NDT Interim report (July 2008) recommended eleven sites for further evaluation of their suitability, based on an analysis of technical and environmental constraints identified at each site.

Phase IV – Comparison of Selected Feasible Sites: Results from the multi-criteria analysis used to identify a select few sites worthy of comprehensive on-ground technical, environmental and cultural evaluation.

In October 2008 a two-part Site Evaluation Report was released by the NDT. The reports were prepared following comprehensive site evaluation and stakeholder consultation involving over one hundred people with professional expertise in oil and gas, the environment, heritage, fishing, pearling, planning, tourism and Aboriginal culture.

The reports recommended four sites, all of which were supported by the Traditional Owners, for further evaluation as having the potential to be used as a site for a multi-user LNG processing Precinct:

- Gourdon Bay (situated south of Broome);
- James Price Point (located on the Dampier Peninsula);
- North Head (located on the Dampier Peninsula); and
- Anjo Peninsula (situated in the far north of WA).

The Site Evaluation report was subject to a public comment period from the 15 October to 11 November 2008, and was submitted to the EPA for advice under Section 16e of the *Environmental*

Protection Act 1986 (EP Act), in accordance with the Strategic Assessment Agreement entered into between the State and Commonwealth Governments in February 2008.

Phase V – Determination of Preferred Site: Upon the conclusion of the site selection process, a single site was selected that was assessed to be most desirable from an environmental, social and physiographic perspective.

The Taskforce continued to evaluate the four sites, undertaking geotechnical assessments of the sites, completing environmental studies and holding further consultations with industry, the Kimberley Land Council, Aboriginal communities and local Government.

The *Northern Development Taskforce (NDT) Final Site Selection Report (NDT, 2008d)* made recommendations on the nomination of a preferred location in the Kimberley for the establishment of a multi-user LNG processing Precinct. This report recommended the nomination of James Price Point coastal area (**Fig 1.1**) as the preferred location for a Browse LNG processing Precinct. These findings were supported by the Section 16e advice issued by the EPA under the *EP Act* (EPA 2008), which concluded that for the James Price Point location, based on the site assessment, environmental risks and impacts are likely to be manageable. This site is to be subject to a Strategic Assessment process to be submitted to the EPA and DEWHA.

2.2.2 Evaluation of Sites outside the Kimberley

The process for selecting the LNG Precinct, as set out in the SAA, included an analysis of alternative gas processing options outside of the Kimberley, focussing on locations that already have substantial industrial infrastructure, inclusive of floating LNG. DEWHA engaged consultants GHD Pty Ltd, to prepare a comparative analysis of the feasibility of alternative locations for the development of a multi-user LNG Precinct outside of the Kimberley region.

The comparative analysis considered over 50 possible locations along the Western Australian Pilbara coastline, three along the Northern Territory coast and three options for offshore structures in northern Australian waters. The study team identified these sites through consultation with key stakeholders and a review of relevant literature.

The NDT engaged WorleyParsons to undertake specific site reviews to provide the technical basis to commence the assessment of the Precinct under the strategic assessment process. As part of this process, the development of onshore LNG facilities outside of the Kimberley region was considered.

The results of the initial site evaluation process are presented in the NDT Final Report (2008), and supporting documents, are available on the DSD website: www.dsd.wa.gov.au.

2.3 Strategic Assessment Agreement

The Browse LNG Precinct, although located within State jurisdiction, is subject to formal environmental impact assessment under the provisions of the Western Australian *Environmental Protection Act 1986 (EP Act)* and also the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* based on the potential that the development may impact matters of National Environmental Significance (NES) including:

- National heritage places;
- Ramsar wetlands of international significance;
- Threatened species and ecological communities;
- Migratory species; and
- Commonwealth marine areas.

In recognition of the importance of such a project, the State Government of Western Australia entered into an agreement with the Commonwealth Government to undertake a strategic assessment of a preferred Precinct site and an assessment of the national heritage values of the West Kimberley region (Strategic Agreement 2008). This Agreement recognizes the environmental and heritage values of the Kimberley, as well as the significant economic potential of the development of Browse Basin gas reserves (NDT 2008c).

The Strategic Assessment Agreement was established under Section 146(1) of the Commonwealth *EPBC Act*. It provides for the assessment of impacts of actions under the Plan for a Common-user Liquefied National Gas Precinct on all matters protected by Part 3 of the *EPBC Act* and is intended to meet the strategic assessment provisions of Section 38 of the *EP Act* (WA) through a concurrent and collaborative process.

Under Section 38 (Division 1, Part IV) of the *EP Act*, the WA Environmental Protection Authority can carry out a Strategic Environmental Assessment (SEA) of Strategic Proposals that it considers likely to have a significant effect on the environment. The State currently has no administrative procedures for undertaking an SEA, however has indicated that the process should be undertaken in accordance with procedures for an ERMP (Environmental Review and Management Plan) level of assessment. In doing so the intent is to meet not only State requirements but also the requirements of the *EPBC Act* and the Terms of Reference outlined for the Strategic Agreement as discussed in **Section 2.3.1**. Where differences exist between ERMP procedures and the Terms of Reference, the specific requirements of the Terms of Reference will be applied.

2.3.1 Strategic Assessment Agreement Terms of Reference

It is intended under the Strategic Assessment Agreement that an assessment will be undertaken in accordance with **Figure 2.1** and the approved Terms of Reference (Strategic Agreement 2008), thus meeting the requirements of both the *EPBC Act* and the *EP Act*.

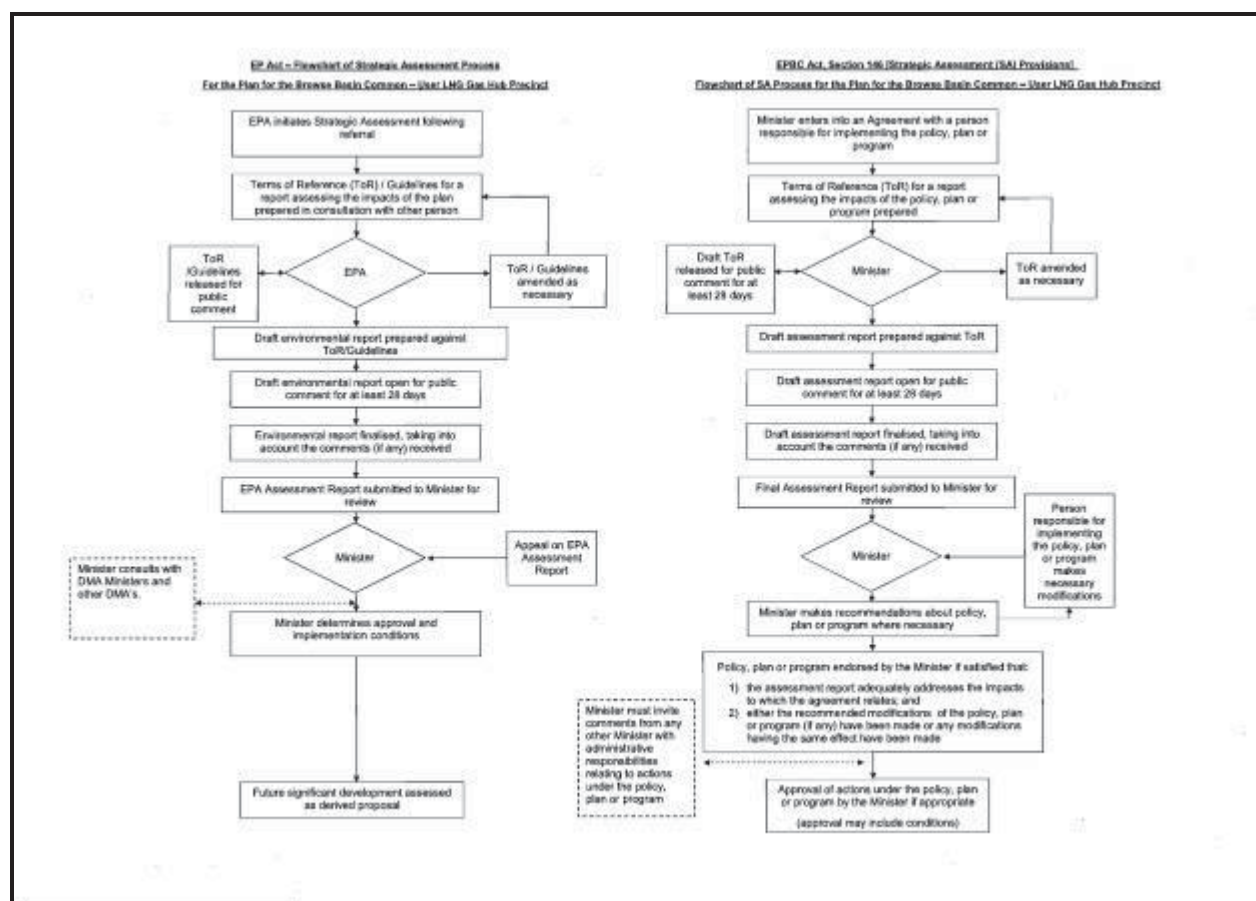


Figure 2.1 Flowchart of Strategic Assessment Process under *EP Act* (WA) and *EPBC Act* (Cwth)

This scoping document is intended to expand on and complement the provisions of the Terms of Reference for the Strategic Assessment. Table 2.1 below demonstrates how the Strategic Assessment Report (SAR)/Strategic Environmental Review (SER) will align with the strategic assessment agreement Terms of Reference.

The Terms of Reference is included as **Appendix A**.

Table 2.1 Alignment of SAR/SER with the Strategic Assessment Agreement ToR

Vol / Sect#	SAR/SER proposed scope/structure		
	Section	Description of contents	SAA/ToR Reference
A	Summary of the Strategic Assessment Report / Strategic Environmental Review		
		Summary of the entire Strategic Assessment Report / Strategic Environmental Review information in at executive summary-level but readable as stand-alone (i.e. contains relevant key figures and tables).	
B	Plan for the LNG Precinct & the Strategic Assessment		
1	Introduction & Background	Introduction to the Strategic Assessment and the Browse LNG Precinct	ToR s1 Project Purpose
2	Plan for the Browse LNG Precinct	The formal 'Plan' established for the establishment, management and operation of the LNG Precinct to meet the requirements of the Strategic Assessment Agreement and associated Terms of Reference. <i>The Report must include a detailed description of the Plan to which the Agreement relates, including (but not limited to)....</i>	ToR s2 Description of the Plan
2.1	Basis of the Plan (Strategic Assessment Process)	<i>...how the plan has been developed and its legal standing...</i>	ToR s2 Description of the Plan
2.2	LNG Precinct Proponent & Project Proponents	<i>...identifying the person(s) or authority responsible for its adoption or implementation, and their jurisdiction...</i>	ToR s2 Description of the Plan
2.3	Organisational Structure & Responsibilities	<i>...identifying the person(s) or authority responsible for its adoption or implementation, and their jurisdiction...</i>	ToR s2 Description of the Plan
2.4	Legislative Basis and Control of the LNG Precinct	<i>...the legal structure under which owners, managers and users of the Precinct will participate in the Precinct...</i>	ToR s2 Description of the Plan
2.5	Land and Asset Tenure Basis	<i>...the basis of land/asset tenure...</i>	ToR s2 Description of the Plan
2.6	LNG Precinct Management Arrangements	<i>...a description of the management arrangements required to ensure the Plan is implemented successfully...</i>	ToR s2 Description of the Plan
2.7	Overview of Activities of Precinct as part of the Plan	<i>...identifying the actions or classes of actions that are a subject of the Plan, including the short, medium and long term aspects of the actions or classes of actions at or associated with the Precinct.</i>	ToR s2 Description of the Plan
2.8	Description of the Activities within the Plan (Project Description)	Detailed description of the scope, timing and broad nature of each element within the strategic assessment scope – including direct and indirect activities as a result of the Precinct. <i>These could include relevant construction, operational and decommissioning aspects as well as a comprehensive description of each type of development or facility comprising the Precinct and its associated infrastructure...</i>	ToR s2 Description of the Plan
3	Project Focus	<i>... rationale for the need to develop the Precinct. The Report must include an analysis of the impacts as they relate to the bio-physical, social and economic aspects of the development proposal associated with the development of the Precinct...</i>	ToR s3 Project Focus

Vol / Sect#	SAR/SER proposed scope/structure		
	Section	Description of contents	SAA/ToR Reference
4	Alternatives and Site Selection Process	The Report must include a copy of the finalised Site Selection Criteria, and a comprehensive description of how the proposed site(s) for the Precinct were identified including (but not limited to) consideration of:....(see ToR)	ToR s4 Short-listing Process (Site Selection)
5	Arrangements for Management of the LNG Precinct and Associated Activities	<p>Description of the legal and/or contractual (or other commercial arrangement) processes and/or controls that will be put in place to control actions/activities and ensure they are undertaken in accordance with the Plan including;.... <i>describe arrangements that will be in place under or associated with the Plan that are intended to ensure that development and operation of the Precinct and associated actions and classes of actions are undertaken in a manner designed to avoid impacts</i></p> <p>Include specification of further approvals required for particular classes of actions, process for assessing actions under the Plan.</p> <p>This section is not the detailed management and mitigation measures that need to be implemented to control construction and operations and manage the impacts from these activities, which is discussed in the Management Plan section.</p>	ToR s8 Proposed Management Arrangements
6	Environmental, Social and Health Management Plan	<p>Detailed ESH management plan (roll-up of the management plans specifically established in SER/SAR Volume C and D) specifying the safeguards, management and mitigation measures developed from the impact assessments to avoid significant environment and indigenous impacts.</p> <p><i>... must include a description of legislation, policies, performance and mitigation measures that are relevant to the implementation of the Plan, the actions and classes of actions undertaken under the Plan, to avoid, minimise, manage and mitigate the associated environmental and Indigenous impacts...</i></p>	ToR s8 Proposed Management Arrangements & ToR s9 Proposed Safeguards and Mitigation Measures
6.1	Management Plan(s)	Details of the proposed management plans needed to specify the safeguards, management and mitigation measures developed from the impact assessments to avoid significant environment and indigenous impacts.	ToR s9 Proposed Safeguards and Mitigation Measures
6.2	Environmental Monitoring Programs	Details of the proposed monitoring plans needed to monitor and report on the proposed safeguards, mitigation and offset measures in the short and long term.	ToR s9 Proposed Safeguards and Mitigation Measures
7	Consultation Undertaken	Description of all consultation undertaken by Precinct Proponent and other relevant organisation in relation to the development of the LNG Precinct and the Strategic Assessment.	ToR s11 Consultation SAA s6.4, 6.5 Draft Report and Collation and Assessment of Public Comments
C	Environmental Impact Assessment and Management Planning		
1	Description of Existing Environment	Detailed description of the existing environment (including National Heritage values, indigenous environmental values and indigenous cultural heritage values), in the project area, locality and region as appropriate to support the background of the impact assessment	ToR s5 The Environment Likely to be Affected
2	Description of the LNG Precinct Activities and Associated Environmental Aspects	Details of the features of the LNG Precinct and the scope of the strategic assessment, with provision of information relating to the environmental aspects (ie sources of impact) that was used as a basis for the impact assessment	ToR s2 Description of the Plan
3	Assessment of	Risk-based assessment of potential impacts on the natural as per the Scope of Strategic Assessment Report document. This	ToR s6 Environmental

Vol / Sect#	SAR/SER proposed scope/structure		
	Section	Description of contents	SAA/ToR Reference
	Environmental Impacts	section addresses impact by environmental <i>aspect</i> (i.e. the stressor).	impacts
5	Assessment of Social (including Health) Impacts	Risk-based assessment of potential impacts on community, including health and wellbeing, as per the Scope of Strategic Assessment Report document.	ToR s6 Environmental impacts, ToR Attachment C Strategic Assessment – Endorsement Criteria
5	Assessment Of Impacts By Factor	Collation of impact assessments by natural and social factor to provide view of accumulated potential impacts experienced by each receptor and the environment as an ecosystem. Includes an evaluation of the degree to which the Strategic Assessment endorsement criteria can be met.	ToR s6 Environmental Impacts, ToR Attachment C Strategic Assessment – Endorsement Criteria
5.1	Impacts on Various Environmental Factors	Sections collating the impacts by each key environmental factors (receptors) identified in the Scope of Strategic Assessment.	ToR s6 Environmental Impacts
5.2	Impacts on Matters of NES	A summary and collation of the potential impacts on relevant matters of National Environmental Significance.	ToR s6 Environmental Impacts
5.3	Impacts on National Heritage	Detailed explicit assessment of the collation of impacts on National Heritage values and assessment of the significance. Would draw on the national Heritage Assessment being undertaken in parallel.	ToR s6 Environmental Impacts
6	Management Plan	Detailed management plan specifying the safeguards, management and mitigation measures developed from the impact assessments in section 0o avoid significant environment and indigenous impacts. <i>... must include a description of legislation, policies, performance and mitigation measures that are relevant to the implementation of the Plan, the actions and classes of actions undertaken under the Plan, to avoid, minimise, manage and mitigate the associated environmental and Indigenous impacts...</i>	ToR s9 Proposed Safeguards and Mitigation Measures
7	Consultation Undertaken To Support Impact Assessment	Description of the range of consultation specifically relating to the environmental impact assessment	ToR s11 Consultation
D	Assessment of Potential Indigenous and Management Planning		
1	Description Of Existing Condition	Detailed description of the existing indigenous community profile in the project area, locality and region as appropriate to support the background of the impact assessment.	ToR s5 The Environment Likely to be Affected
2	Description Of Sources Of Impact And Opportunities	Detailed description of the potential sources of impact and opportunities associated with various activities part of the LNG Precinct Plan to support the indigenous impact assessment	ToR s6 Environmental impacts
3	Assessment Of Indigenous Impacts	Detailed description of the existing environment in the project area, locality and region as appropriate to support the background of the impact assessment. Including heritage sites, informed	ToR s7 Indigenous Impacts
4	Indigenous Impacts & Opportunities Management Plan	Detailed description of the management plans proposed to mitigate indigenous impacts and ensure indigenous opportunities are maximised through development and operation of the LNG Precinct and associated activities.	ToR s6 Environmental Impacts ToR s8 Proposed Management Arrangements

Vol / Sect#	SAR/SER proposed scope/structure		
	Section	Description of contents	SAA/ToR Reference
5	Consultation Undertaken in relation to the Assessment of Indigenous Impacts	Details of consultation with relevant indigenous people.	ToR s7 Indigenous Impacts ToR s11 Consultation...
5.1	Consent of Traditional Owners in Implementation of the Plan	Overview of the Traditional Owner involvement and process to establish consent for implementation of the Plan.	ToR s7 e) whether Traditional Owners have given informed consent...

2.4 Derived Proposals

Once a decision is made that a Strategic Proposal may be implemented (with any conditions), the Department of State Development proposes that actions (i.e. proposals for development) within the Precinct, known as “Project Proposals”, can be undertaken by third parties. To ensure that the actions are carried out as planned under the Strategic Assessment approvals, specific management arrangements will be established in the Plan for the LNG Precinct. The Precinct proponent or delegated third party will be responsible for ensuring that actions undertaken are in accordance with these provisions.

It is expected that the arrangements in place under the approved Plan will ensure that actions cannot be undertaken by third parties unless adequate evidence is provided to meet the expectations detailed in the Plan. Specific mechanisms are to be developed that ensure that demonstration, via a controlled process, is provided to ensure; all environmental issues have been adequately assessed under the Strategic Assessment; that no significant new or additional information has been raised; and there are no significant changes to the environmental factors (i.e. the various components of the environment). This process is then expected to deliver an outcome that enables the third party proponent (“Project Proponent”) to be the proponent of a “derived proposal” under the Precinct Proposal.

Providing all other approvals are in place, the Project Proponent may proceed with the derived proposal in accordance with the conditions set for the Precinct.

If the Project Proposal(s) are to be within the scope of the Strategic Proposal approval, and as such do not require additional primary environmental approval, future derived proposals should be identified and described in the Strategic Assessment to the fullest extent possible. This will ensure that both the environment is adequately protected, and appropriate conditions are in place as the basis for approval. As such a suitable level of engagement with potential future Project Proponents is required to obtain the level of detail required regarding future proposals within the Precinct and ensure the impacts are appropriately assessed.

2.5 Assessment Process

As the Precinct Proponent, the State Government will be responsible for ensuring that environmental approvals and land access arrangements are in place accordingly. The Precinct is to be assessed to obtain Commonwealth and State impact assessment approvals through a Strategic Assessment process as outlined in the Strategic Agreement (SA 2008).

The process for the Strategic Assessment will follow a general model for an assessment (as depicted in **Figure 2.2**). This figure shows the scoping and impact assessment being informed by detailed engineering and project design, information gathered in baseline studies and through consultation with stakeholders including regulators, non-government organisations (NGOs), traditional owners, tourism operators, aquaculture industry and the general public.

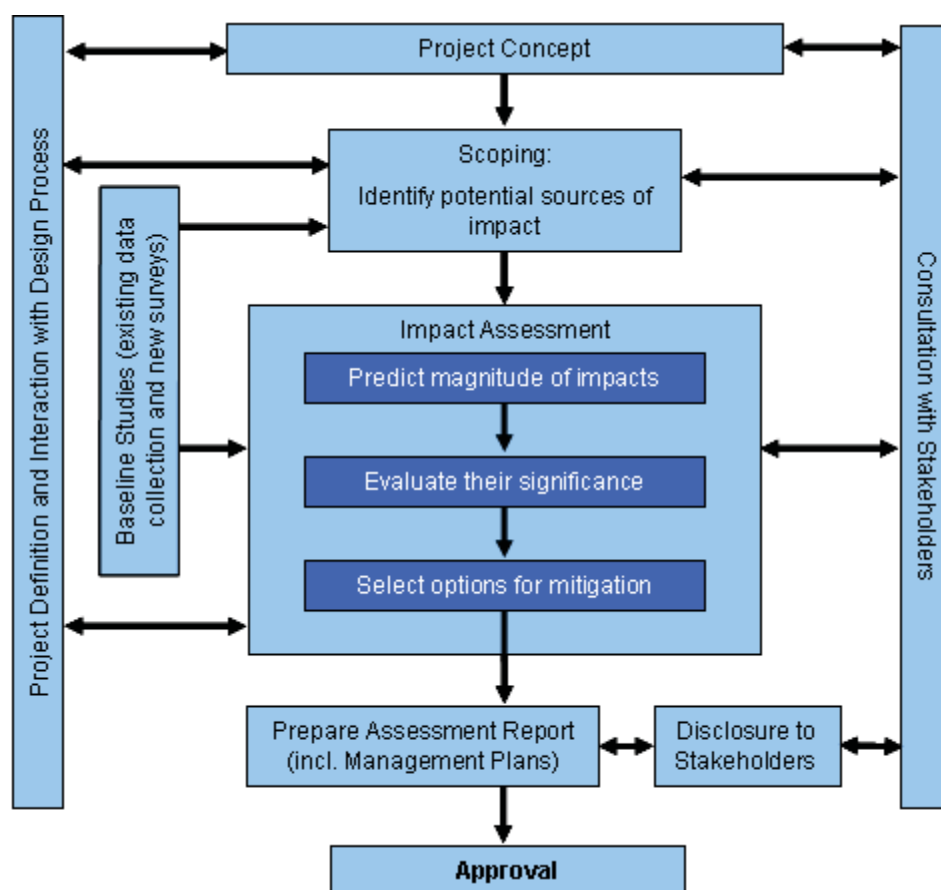


Figure 2.2 – Generic Assessment and Approvals Process

2.5.1 Roles and Responsibilities for Assessment

To explain roles and responsibilities for the assessment process, the three key stages as shown in Figure 2.2 can be considered as:

- Understanding the environment;
- Predicting impacts, proposing alternatives and assessing effectiveness of potential mitigation and management of impacts; and
- Preparation of assessment reports to inform an approvals decision.

The key roles and responsibilities of the various parties to the assessment process for each of these stages are outlined in Table 2.2 below.

Table 2.2 Roles/responsibilities of Key Parties to the Strategic Assessment Process

Assessment Stage	Party	Role
Understanding the environment	Precinct Proponent	Lead party responsible for the collection of data required to inform the impact assessment.
	Project Proponent(s)	Assist in the scoping of baseline studies and investigations with aim to ensure that they cover all potential impacts associated with future development within the Precinct. Responsible for the execution of some studies and investigations where agreed.
	DEC/DEWHA	Provide advice and guidance in the scoping of studies.

Assessment Stage	Party	Role
	EPA/DEWHA	<i>Set guidelines/policies standards for the manner in which data is to be collected, significance criteria etc.</i>
Predicting impacts	Precinct Proponent	<i>Define activities with potential for impact, undertake risk assessment and quantify the impacts. Consideration of alternatives to avoid & reduce impacts or propose mitigation measures and appraise likely effectiveness in consultation with likely Project Proponents</i>
	Project Proponent(s)	<i>Advise Precinct Proponent of project components, provide detailed engineering input necessary to undertake assessment (emissions, discharges etc.) and advise on alternatives and options for mitigation.</i>
	DEC/DEWHA	<i>Provide advice and guidance throughout the assessment process</i>
	EPA/DEWHA	<i>Set guidelines/policies standards for the manner in which data is to be collected, significance criteria etc.</i>
Assessment report and approvals	EPA/DEWHA	<i>Prepare assessment reports and draft conditions, after seeking advice from other Decision Making Authorities (DMAs).</i>
	EPA	<i>Make recommendation on whether the proposal is environmentally acceptable and recommend conditions.</i>
	State/Cwth Ministers	<i>Approve/Not approve proposal under EP and EPBC Act and set conditions.</i>

Throughout the assessment process there is a program of ongoing consultation/engagement of the broad community including all tiers of government, NGOs, Traditional Owners, industry groups and the general community. This is discussed in **Section 9**.

2.5.2 Strategic Assessment and Matters of National Environmental Significance

The assessment described in this scoping document is intended to cover all relevant environmental and social factors, including those specifically covered by legislation such as the Commonwealth *EPBC Act* and the WA *EP Act*. In relation to the *EPBC Act*, the scope of the assessment has been developed to ensure Matters of National Environmental Significance (NES) have been considered and included where the LNG Precinct has the potential to impact on these elements of the environment. **Table 2.3** below provides a reference to the relevant sections for each of the matters protected under the *EPBC Act*.

Table 2.3 Approach for Assessment to Address Matters of NES under EPBC Act

Matter Protected	Reference to Description of NES Matter	Reference to Approach for Impact Assessment
Matters of National Environmental Significance		
World Heritage properties	s. 5.4.10 Heritage	s. 2.6 Heritage Assessment s. 9.0 Baseline Social Studies and Investigations Program
National heritage places	s. 5.4.10.1 Natural Heritage s. 5.4.10.3 Aboriginal Heritage	s. 2.6 Heritage Assessment s. 9.0 Baseline Social Studies and Investigations Program
Wetlands of international importance	s. 5.3.8 Terrestrial Conservation Areas	s. 8.6 Terrestrial Fauna s. 10 Assessment of Identified Environmental Aspects
Listed threatened species and ecological communities	s. 5.2.6.3 Reptiles s. 5.2.6.4 Marine Mammals s. 5.2.6.8 Commonwealth Protected Fauna (Marine) s. 5.3.4.2 Threatened Ecological Communities s. 5.3.5.1 Commonwealth Terrestrial Protected Fauna	s. 8 Baseline Biological Studies and Investigations program s. 10 Assessment of Identified Environmental Aspects (in particular s.10.1, s. 10.2, s.10.6, s.10.7)
Migratory species	s. 5.1.6.3 Reptiles s. 5.1.6.4 Marine Mammals s. 5.1.6.8 Commonwealth Protected Fauna (Marine) s. 5.2.7.1 Commonwealth Terrestrial Protected Fauna	s. 8 Baseline Biological Studies and Investigations program, in particular: - s. 8.3 Marine Mammals - s. 8.6 Terrestrial Fauna s. 10 Assessment of Identified Environmental Aspects (in particular s.10.1, s. 10.2, s.10.6, s.10.7)
Commonwealth marine areas	s. 2.3 Strategic Assessment Agreement s. 5.2.6.7 North-west Marine Region – Quondong Point	s. 7 Baseline Physical Studies and Investigations Program s. 8 Baseline Biological Studies and Investigations Program s. 10 Assessment of Identified Environmental Aspects (in particular s.10.5, s. 10.7)
Nuclear actions (including uranium mines)	Not applicable	Not applicable
Other Matters		
The environment, where actions proposed are on, or will affect Commonwealth land and the environment	s. 5.2.6.3 Reptiles s. 5.2.6.4 Marine Mammals s. 5.3.5.1 Commonwealth Protected Fauna (Marine)	s. 7 Baseline Physical Studies and Investigations Program s. 8 Baseline Biological Studies and Investigations Program s. 10 Assessment of Identified Environmental Aspects
The environment, where Commonwealth agencies proposing to take an action	s. 2.3 Strategic Assessment Agreement	Not applicable

2.6 Reporting on the Strategic Assessment

The various requirements of the Strategic Assessment Agreement will be met through the completion of a range of planning activities, impact assessment and management plan tasks as shown in Figure 2-3. The assessment of environmental impacts (including social) is a key component of the Strategic Assessment and this document is intended to include that scope. As such, throughout this document the environmental impact assessment, as a key component of the Strategic Assessment is referred to as the “Strategic Assessment”, although it should not be considered without inputs from the broader work plan as shown in the figure below. The “Plan” will be informed by the outcomes of the assessment of environmental impacts and the Indigenous impact assessment outcomes as well as local planning, Precinct master planning etc.

Documentation of the outcomes of the assessment will be via the development of a „Report’, or Strategic Assessment Report (under the EPBC Act) and Strategic Environmental Review (under the EP Act). The „Report’ is intended to cover all dimensions of the Strategic Assessment as illustrated in **Figure 2.3**, which provides a high level overview of how the various requirements of the Strategic Assessment will be documented.

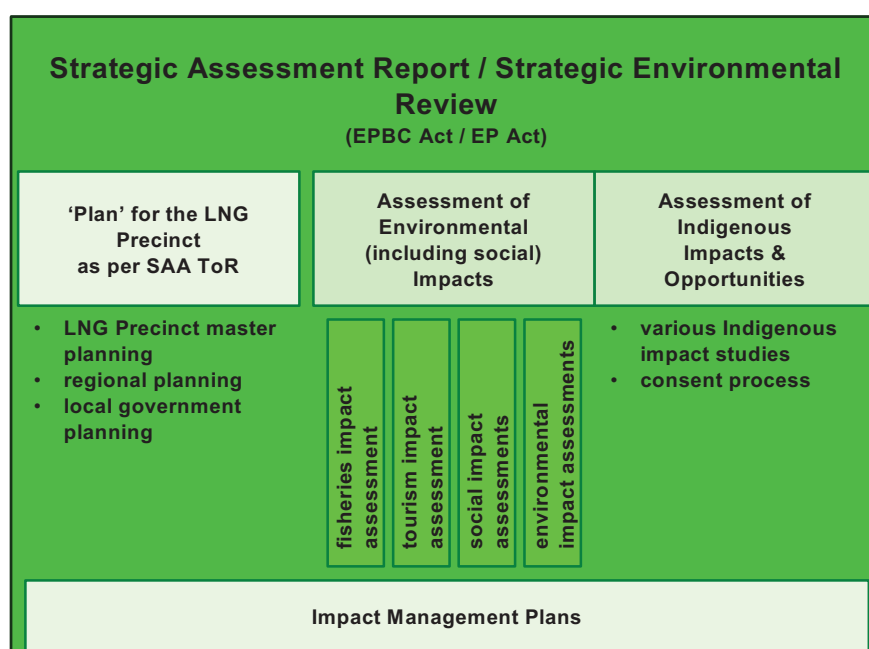


Figure 2.3 – Scope of the SAR/SER

The table of contents for the „Report’ are expected to be in line with this structure.

2.7 National Heritage Assessment of the Kimberley

The Strategic Assessment Agreement acknowledged the outstanding natural, Indigenous and historic heritage values of the Kimberley region. In addition to the Strategic Assessment of the Precinct, the State and Commonwealth Governments agreed to immediately commence a formal assessment of the National Heritage (and potentially international heritage) values in accordance with the requirements set out in the *EPBC Act* (under the heritage provisions) and as part of a strategic assessment of broader land use development within the Kimberley Region. This assessment commenced via the National Heritage Assessment (NHA) process and will be reported on via separate documentation from the SAR/SER.

The assessment area for the NHA was accepted by the Australian Heritage Council (AHC) and the assessment commenced in June 2008. The assessment will be undertaken in parallel to the strategic assessment of the Browse LNG Precinct. It is anticipated that the NHA will be completed by mid 2010, with the National Heritage Council delivering the findings of the assessment and any

recommendations for the area to be considered for listing expected to be made to the Commonwealth Minister for the Environment.

2.8 Proponent

The Department of State Development is acting as the Proponent for the Browse LNG Precinct i.e. "Precinct Proponent", on behalf of the WA Minister for State Development. In addition there are potentially a number of "Project Proponents", i.e. industries that would be expected to construct and operate facilities within the Precinct, which would fall under the scope of the Browse LNG Precinct.

Details of the Precinct Proponent are outlined in **Table 2.4** below.

Table 2.4: Details for Precinct Proponent

Name of Precinct Proponent (Person or entity proposing to plan the Precinct):
WA Department of State Development (on behalf of the Minister for State Development)
Address of Proponent:
1 Adelaide Terrace East Perth WA 6004
Key contact for the proposal:
Nick Hopkins, 08 92220555
Internet http://www.dsd.wa.gov.au

2.9 Schedule for Assessment

The schedule for the assessment and approvals of the Browse LNG Precinct is in accordance with the Strategic Agreement and associated Terms of Reference. This schedule incorporates the Site Selection Process and National Heritage Assessment and supports a target construction start up date of Q1 2011, pending a derived decision on works proposed by Project Proponents.

Table 2.5 outlines some of the key activities and proposed timing for stages of the assessment and approval process. A number of the key technical studies have already commenced in order to gather sufficient baseline data to support the impact assessment process and align with development schedules. These stages will be supported by concept design and engineering and a stakeholder engagement program.

Table 2.5 Key stages and proposed timing for LNG Precinct assessment and approval process

Stage of Process	Timing
Precinct Proponent submit referral of LNG Precinct to State EPA requesting assessment as Strategic Assessment	April 2008
NDT Final Report released, and preferred site announcement made	Dec 2008
Precinct Proponent prepares Draft Scope of the Strategic Assessment	May 2009
Prepare description of the LNG Precinct and Activities based on Master Plan	June 2009
Undertake baseline studies	June - Nov 2009
Prepare description of existing environment	Nov-Dec 2009
Assessment of environmental and social impacts	Dec 2009
Development of Framework Management Plans to support Impact Assessment	Dec 2009
Precinct Proponent prepares draft Plan for the LNG Precinct based on outcomes of impact assessment and in accordance with management plans.	Dec 2009

Stage of Process	Timing
Precinct Proponent submits Draft SAR/SER to State/Commonwealth to seek approval to publish	Dec 2009
Draft SAR/SER open for public comment	Mar 2010
EPA prepares Assessment Report	April 2010
State & Commonwealth Ministers consider SAR/SER & associated Plan for the Precinct and recommendations made	May 2010
Project Proponent seek approval under the Plan for the LNG Precinct	Dec 2010

3 Project Definition

This section provides the basic data on the characteristics of the Browse LNG Precinct and activities that should be considered in the assessment of potential impacts and planning for management and mitigation during the implementation of any proposed activities. It is intended to provide a sufficient level of data to enable scoping-level planning for the Strategic Assessment. Further detail will be developed as the Precinct establishment process progresses.

The information provided in this section forms the basis for the current scope of the SAR. Once the Master Plan for the Precinct is determined, the description will be updated and scope of studies and investigations modified accordingly.

3.1 *Basis for Use*

The information in this section is provided to assist with describing the activities and facilities that will be considered as a part of the Strategic Assessment of the Browse LNG Precinct. It also describes activities and facilities that are considered outside of the scope of the Strategic Assessment for the purposes of approvals, but should be considered in the assessment of impacts from indirect activities and potential cumulative impacts within the Strategic Assessment.

The scale and magnitude of the various characteristics have been written to reflect best estimates of what a 50 million tonnes of LNG per annum capacity LNG Precinct would present. Characteristics may vary depending on a number of factors, including; location-specific constraints, number of proponents provided for within the Precinct, degree of integration and scope of infrastructure included. As such the estimates provided are based on key assumptions that may evolve during the development of the LNG Precinct. Consequently it is important to ensure that implications of these changes are understood and that the initial scoping exercise takes a broad perspective on potential facilities and activities to ensure that it can accommodate these changes wherever practicable.

The facilities described in this document are nominally based on two independent processing plants within the LNG Precinct. This is to ensure that all potential impacts are allowed for as far as practicable. This document is not intended to define the basis for ownership, operation or dictate common-user facilities. It is expected that the future definition of any common user facilities will in general be within the bounds set by this assumption with respect to potential environmental impacts.

The activities, facilities and other characteristics that are a part, or related to the Browse LNG Project are separated into three different categories:

- A. LNG Precinct: The core elements of LNG development, including associated infrastructure necessary to process and export hydrocarbons and LNG;
- B. Indirect Activities/Actions as a Result of the LNG Precinct and a part of the LNG Project; and
- C. Related Projects.

The distinction between the different categories has been adopted to ensure that it is clear that this scoping exercise and subsequent impact assessment applies to the **Category A: LNG Precinct** only, and as such which activities may subsequently be undertaken in association with approvals under the *EPBC Act* and *EP Act*, while giving consideration of the assessment of related projects and other activities within the Strategic Assessment. The actions and facilities covered under each category are broadly described in the **Table 3.1**.

Table 3.1 Browse LNG Precinct – Treatment of Activities for Strategic Assessment

Category	Examples	Implications for / treatment of the category in the Strategic Assessment
A. LNG Precinct:		
1. LNG Facilities Complex	<i>Hydrocarbon processing facilities, product storage, plant utilities and other equipment necessary to treat and process hydrocarbon reservoir feedstock associated with LNG processing</i>	Within the scope of the Strategic Assessment for approvals purposes. Activities are expected to become the responsibility of derived LNG Project Proponents or the LNG Precinct Proponent (or designated third party).
2. LNG Precinct Associated Infrastructure	<i>Integral infrastructure for LNG Facilities Complex:</i> <ul style="list-style-type: none"> • Jetties, berths & channel • Pipelines to state waters • Administrative buildings and maintenance support services <i>Other associated infrastructure:</i> <ul style="list-style-type: none"> • Integrated marine and offloading facility • Operations and construction/maintenance workforce accommodation • Roads connecting the LNG Precinct to public road and within associated infrastructure components • Service provider facilities • Precinct light industrial area 	Scope of activities reflected in the impact assessment <u>and</u> management planning for the Strategic Assessment.
B. Indirect Activities/Actions as a result of the LNG Precinct		
1. Regional planning implications	<ul style="list-style-type: none"> • Planning strategies (Land Release, Housing, Infrastructure, Education & Training, Government Service Plans (Local Government, Health, Police, Welfare Services)) • Provision of other commercial and light industrial areas 	Activities likely to be the responsibility of various State Government Department (s) or the Shire. Unlikely to be the LNG Precinct Proponent or a derived LNG Project Proponent.
2. Indirect infrastructure modifications/additions	<i>'Projects' reasonably contemplated as a result of planning implications or the LNG Precinct requirements at the time of the Strategic Assessment, such as:</i> <ul style="list-style-type: none"> • Changes to the arrangements for waste management / landfills in the region • Changes to the airport, public roads and other transport infrastructure • Changes to Government services 	Scope of activities reflected in the impact assessment via the cumulative impact considerations. Management planning for some dimensions <u>may</u> need to be considered in order to manage impacts associated with the LNG Precinct (in order to progress approvals under the Strategic Assessment).

The State Government and the Shire of Broome are undertaking the development of a Dampier Peninsula Land Use Plan and a Town planning scheme for Broome. These planning processes will be completed prior to the submission of the Strategic Assessment Report and will provide an overall planning context within which the LNG Precinct and ancillary infrastructure can be considered and approved.

3.2 Part A.1: LNG Precinct (LNG Complex)

The following table provides an overview of the components of the LNG Complex. The scope of the facilities actually constructed will vary depending on a number of factors including; degree of integration between project proponents, master-planning layout constraints, feedstock hydrocarbon composition and upstream project configurations. The facilities described below represent the best estimate of the likely maximum scope required for a complex needed for 50 million tonnes per annum (Mtpa) of LNG.

Table 3.2 Summary of LNG Complex Components within the LNG Precinct

Component	Description
Gas processing and liquefaction plant	<ul style="list-style-type: none"> Hydrocarbon processing facilities including gas pre-treatment, conditioning and liquefaction facilities, providing a total nominal capacity of up to a total of ~50 million tonnes per year of LNG capacity. Condensate and LPG/gas processing (associated with LNG production).
Hydrocarbon storage facilities	<ul style="list-style-type: none"> up to 8 LNG tanks with nominal capacity of ~200,000m³ each (or more tanks of a smaller capacity) Up to 4 LPG storage tanks with nominal capacity of ~60,000 m³ each (or more tanks of a smaller capacity) Up to 4 condensate tanks with nominal capacity of ~120,000 m³ each (or more tanks of a smaller capacity)

An example of how an LNG plant may look is provided in **Figure 3.1** below. This photograph represents a gas processing and export facility capable of exporting approximately 10 Mtpa of LNG, 1 Mtpa of LPG and 4 Mtpa of condensate. The actual characteristics of an LNG plant vary, however this image provides a reasonable impression of how facilities may look within the Browse LNG Precinct.

**Figure 3.1 Photograph of an LNG plant**

(Photo courtesy Woodside)

3.2.1 LNG Facility Overview

The LNG facilities within the LNG Precinct will comprise gas processing, liquids processing, liquefaction and storage complex(es) as well as supporting utilities and directly associated infrastructure (site buildings etc) that will be expanded in phases as part of the full development:

3.2.2 Gas processing and Liquefaction Plant

It is anticipated that the gas processing and liquefaction complex will be developed in two halves in order to ensure manageable integrated LNG plants can be developed. Each Plant would likely be developed in stages and could be considered to have an expected nominal capacity of up to 25 million tonnes per annum (Mtpa) of LNG each. Within each plant, this capacity would be provided with a number of parallel LNG processing trains. The processing capacity of each LNG processing train will vary depending on what is optimal for each project proponent which will be influenced by factors

such as size of hydrocarbon resource supporting the development, technology selection and their project economics. It is anticipated that train sizes may vary between approximately 3.2 and 8.5 Mtpa.

Development of each of the LNG plants would be expected to be phased, with an initial start-up capacity of between 3.2 and 15 Mtpa of LNG. Further LNG trains would then be added on an as-needs basis. It is expected that the operational life of these facilities will be at least 30-40 years.

The facilities within the LNG Complex will depend on the design and operating approaches selected by LNG Project Proponents. The following represents facilities that are potentially required:

- Gas pre-treatment, conditioning and liquefaction (LNG) processing trains;
- Condensate and LPG processing facilities;
- Storage (LNG, condensate and potentially LPG);
- Power generation and other utilities to support the LNG complex;
- Flare and fuel system facilities;
- Reservoir CO₂ removal facilities
- Allowance for CO₂ compression facilities should reservoir CO₂ re-injection concepts be selected by LNG Project Proponents⁴;
- Initial and expansion construction laydown areas;
- Operations administration, maintenance and central control room;
- Effluent treatment; and
- Haul roads / access roads.

3.2.3 Process Overview

The likely key processing steps are outlined in **Figure 3.2**.

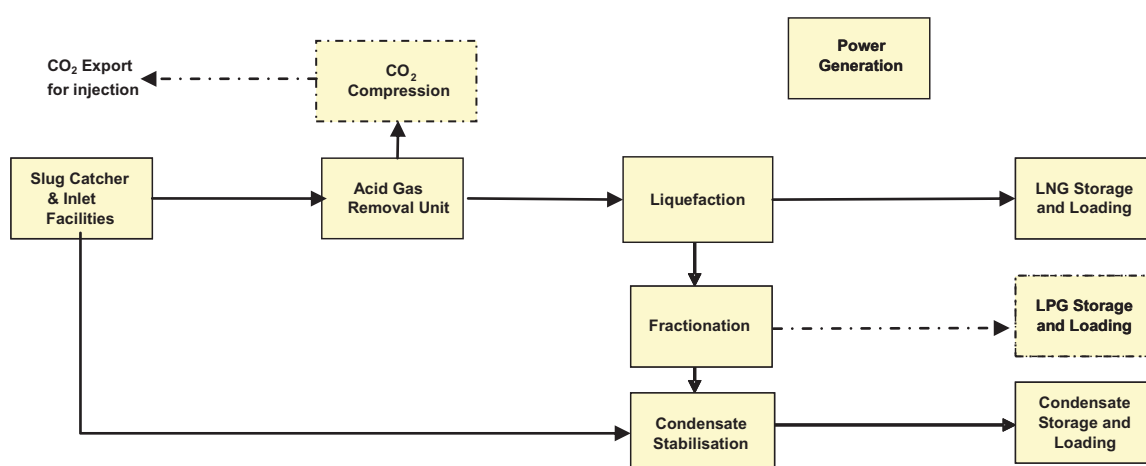


Figure 3.2 - Indicative Process Flow Diagram

⁴ Facilities for the management of CO₂ re-injection are not included in the LNG Precinct scope as the location and use of these facilities is unlikely to be known at the time of the Strategic Assessment and is subject to comprehensive exploration, appraisal and feasibility studies.

The LNG process facility will receive hydrocarbons from the offshore sub-sea pipeline(s), and condition and extract it to produce market quality LNG, condensate (light oil) and potentially LPG (propane and butane) products.

Gas Pre-treatment:

The degree of gas pre-treatment will vary based on the level of treatment of the feed gas offshore and the composition of the field reservoirs. Gas pre-treatment will incorporate a slug catcher (to separate liquids), mono-ethylene glycol (MEG) regeneration, produced water treatment and disposal, and condensate stabilisation.

Liquefaction:

Within the LNG train the CO₂ is removed from the gas to avoid freezing in latter stages of the process. The removed CO₂ can be either vented or re-injected. If re-injection of reservoir CO₂ is adopted by an LNG Project Proponent, CO₂ compression will be required within the LNG Precinct. However the injection of CO₂ into a subsurface reservoir is outside the scope of the Strategic Assessment.

The latter part of the LNG train further conditions and refrigerates the gas to form a liquid. This is achieved via large refrigerant systems enabling the gas to be cooled to -161°C before being sent to storage. Any light liquid hydrocarbons condensed in this process is recovered as condensate and sent to storage for export. LNG trains can potentially incorporate facilities to remove associated LPG's and split into propane and butane products.

Flaring facilities will also form a component of the gas treatment process, allowing the purging of gas for safety and maintenance purposes plus depressurisation of hydrocarbon facilities required in the event of an emergency.

Storage:

Products for export that require storage include LNG, condensate and potentially LPG. Storage volumes will vary depending on design decisions made by LNG Project Proponents and are likely to be subject to further refinement, however they are anticipated to be in the order of:

- Up to eight LNG tanks in the order of approximately 200,000 m³ each;
- Up to four LPG storage tanks up to 60,000 m³ each;
- Up to four condensate storage tanks up to 120,000 m³ each.

Facilities for the storage of hydrocarbon products need to be located as close as reasonably practicable to the coast and the product offloading facilities.

Energy Generation:

The energy generation facilities will provide the electrical and direct drive power for each LNG Plant. This will be achieved using large gas turbines with consideration for waste heat recovery to meet process heat demands where feasible. Diesel may also be used as back-up fuel for some turbines and emergency generators.

The total energy demand will depend on the design of the LNG facilities and would be in the order of 3 GW, split between electrical generation and direct drive for compression within the LNG trains (approximately 60MW/tonne LNG capacity).

Utilities:

Several support facilities will be required for the LNG facility. These will include:

- Buildings: offices, workshops, warehouse, laboratory located on-site
- Water supply (either ground water or desalination)
- Instrument air, nitrogen supply, fire water

- Diesel storage, supply and distribution system
- Sewage and waste water treatment etc.

3.3 **Part A.2: LNG Precinct (Associated Infrastructure)**

The following infrastructure is required to support the facilities proposed within the LNG Precinct (section 3.2 above). These are considered to be integral to the LNG Precinct and are within the scope of approvals under the Strategic Environmental Assessment. A generic layout of the LNG Precinct including the LNG complex and associated infrastructure is provided in **Figure 3.3**.

Table 3.3 Summary of LNG Precinct Associated Infrastructure

Component	Description
Supporting Built infrastructure	<ul style="list-style-type: none"> • Warehouse(s) • Laydown areas • Administration & security building(s) • Control, substation & field auxiliary buildings • Workshops • Laboratory
Marine Port facilities	<ul style="list-style-type: none"> • Export facilities will require approximately one berth for every 10 Mtpa LNG production. Consequently export facilities will be phased inline with the LNG facilities with a total of approximately 6 berths anticipated for the 50 Mtpa LNG capacity Precinct. • Breakwater for the export jetties to create sheltered port (metocean condition-dependant) • Shipping berth pocket, turning basin and channel at acceptable operating depth • Integrated marine facility incorporating a Material Offloading Facility (MOF), vessel all-weather harbouring facilities (tugs and support vessels) and marine support facilities
Pipeline Infrastructure	<p>Provision for pipelines and pipeline corridor(s) from the State Waters limit to the LNG Precinct for:</p> <ul style="list-style-type: none"> • Up to 8 hydrocarbon feedstock pipelines conveying hydrocarbons from offshore Browse Basin gas sources to the LNG Complex: <ul style="list-style-type: none"> ▪ up to 4 gas pipelines (in the order of 1,200 mm in diameter); and ▪ up to 4 liquid pipelines (in the order of 450 mm in diameter). • Option for 2 export pipelines of up to 600 mm in diameter, conveying CO₂ for potential re-injection offshore should a project proponent elect to re-inject reservoir CO₂. • Option for up to 4 export pipelines of around 450 mm in diameter, conveying mono-ethylene glycol (MEG), or other hydrate inhibitor, to offshore facilities should onshore regeneration be selected for flow assurance management. <p>Shore crossings (method dependent on site) and pipeline approach corridors in State Waters, trenched and covered for protection and stabilisation.</p>
Supporting infrastructure	<ul style="list-style-type: none"> • Pioneer construction accommodation facilities • Construction camp for approximately 3,500 people (expansion potential up to 6,000 people should a parallel new-build LNG plant be required) • Permanent accommodation complex(es) to allow for: <ul style="list-style-type: none"> ▪ Operations personnel: a potential total maximum of around 1,000 personnel should on-site accommodation concept be selected for permanent workforce⁵

⁵ On-site accommodation requirements may vary depending on the accommodation strategies implemented for the Precinct. The number of personnel that commute is not certain and therefore the size of on-site accommodation for operations personnel has been provided as an indication as to the maximum number.

Component	Description
	<ul style="list-style-type: none"> ▪ Campaign maintenance personnel: a total of 800 personnel during major shutdowns for operating facilities • Power generation for supporting infrastructure elements • Service corridors for pipelines and powerlines • Access roads • Haul road from IMF • Warehouse(s) • Laydown areas • Administration & security building • Control, substation & field auxiliary buildings • Workshops • Waste management facilities • Laboratory • Visitor centre • Training centre
Effluent and discharge	<p>The proposed development will primarily generate the following liquid effluent streams, which will be primarily discharged to nearby marine waters as determined by modelling studies:</p> <ul style="list-style-type: none"> • sewage and grey water (will be treated prior to discharge) system • brine (from desalination) system • site drainage water system • process water system (will be treated prior to discharge) produced formation water system (will be treated prior to discharge) • cooling water system • rainwater run off system
Water supply	<p>During construction and operations, it is envisaged that water to the LNG facilities will be supplied either from groundwater, desalinated saline aquifer groundwater or desalinated sea water. Infrastructure for the provision of water will therefore include:</p> <ul style="list-style-type: none"> • Groundwater extraction system • Desalination system • Sea water intake
Service provider facilities	<p>During construction and operations, various third party suppliers of goods and services will be required for the LNG Precinct. These suppliers will require separate facilities to conduct their activities from, that do not interfere with the LNG facilities.</p>

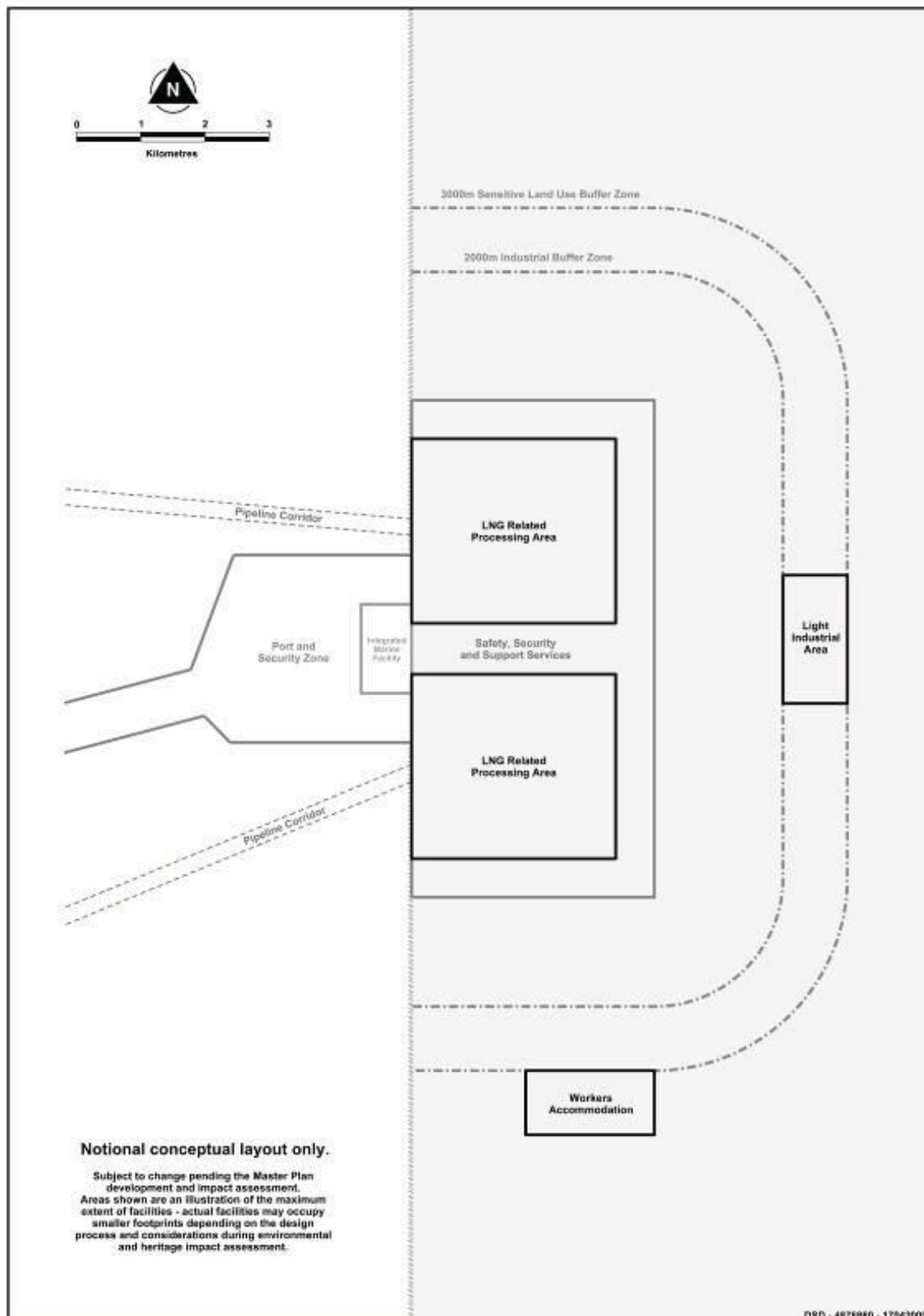


Figure 3.3 – Generic Layout of LNG Precinct

3.4 LNG Precinct Activities

The construction and operation of the facilities described above will require many and varied activities to be completed. An outline of the key construction and operational activities are outlined below.

3.4.1 Construction

Construction activities will start with the development of the pioneering camp and progress through earth works, port development, construction of processing facilities and through to commission of the processing facilities. The foundational development construction is likely to occur over 4-5 years, with additional construction periods of 3-5 years associated with each expansion or new facilities as they are required. **Table 3.4** outlines key construction activities anticipated to be required for development of the LNG Precinct.

Table 3.4 Key Construction Activities for the LNG Precinct

Activity	Description
Site preparation	
Road construction	Roads around and within the LNG Precinct will need to be constructed and upgraded to support the development.
Pioneer camp/facilities	One of the first activities will be to create the pioneer facility to accommodate the workforce that will construct the construction camp and other facilities that are required early.
Site clearing and levelling	The area of the LNG facility and other supporting facilities will be levelled and cleared. This will require bulk earth works to get level areas and may also require activities to improve the foundations for the LNG plant.
Storm water management	During construction storm water run off will require active management.
Sourcing of fill - aggregate, road base etc.	Aggregates, road bases, etc. will need to be sourced and excavated for use within the LNG Precinct.
Onshore construction	
Transport of materials - terrestrial	Various materials will need to be transported via road to the LNG Precinct. This will include aggregates, supplies and equipment.
Transport of materials - marine (including modules)	The majority of the LNG facilities will be imported in the form of large modules by sea direct to the site via the MOF.
Foundations construction	Foundations will typically be constructed with concrete and will potentially include the use of piles due to the properties of pindan soils. Ground improvement will be required in some instances to support the foundation system.
Tank construction	The various tanks will be constructed on site utilising concrete and metal construction techniques.
Plant construction (LNG and other)	The majority of the LNG facilities will arrive as large modules. These will be transported from the IMF to their final location where they will be welded into place and the various services connected.
Nearshore construction	
Dredging	Dredging of the navigation channel, berth pockets and turning basins will be required. The spoil may be disposed of either onshore (for use as fill in the LNG Precinct) or by disposal at sea (in accordance with regulations).
Export jetty	The export jetty will require piling (likely to be via drilling) and construction of the deck.

Activity	Description
Breakwater	A breakwater most likely using prefabricated concrete or rock may need to be constructed seaward of the berths. Final configuration will be a result of metocean and port studies.
Integrated marine facility	The integrated marine facility is likely to be constructed via the use of dredging, fill, rocks and pre-cast concrete. This will be one of the earliest focus areas for construction to enable the import of material for the LNG Precinct.
Pipelines (product, MEG, CO₂ etc)	
Installation of pipelines in state waters (3nm)	Pipelines will be laid via a pipelay vessel. Pipeline stabilisation is likely to require a combination of dredging, rock dumping and potentially stabilisation using pre-cast concrete plinths.
Shore crossings	The pipelines are likely to require a prepared area for the beach landing through to the LNG facility or onshore pipeline corridor depending on the finalised crossing location. The pipeline will be trenched and the crossing area rehabilitated following installation.
Installation of pipelines onshore	Onshore the pipelines will be buried in a pipeline corridor(s) through to the LNG facilities.
Supporting Infrastructure	
Construction Camp	The construction camp will require clearing, levelling, construction of supporting services and the various buildings required.
Service Provider Facilities	Clearing, levelling, fencing and construction of buildings, storage and hardstand areas as required by the various providers.
Lay down area	During construction cleared areas will be required for the temporary storage of various items of equipment prior to their installation.
Crushing and screening	Rock and aggregate obtained from onsite and offsite will need to be crushed and screened for use as aggregate and fill material. This will require a crushing and screening plant.
Fuel and chemical storage	During construction a fuel and chemical storage area will be required. Where practicable these facilities will be retained for operations.
Water supply	During construction a water supply will be required both for potable and construction water. Depending on the quality required there are several sources of potential water supply, in order of preference, including surface aquifers, the confined Wallal aquifer and desalination of ocean water if these are not viable. Where practicable these facilities will also be used for operations.
Waste water treatment	A waste water treatment plant and associated outfalls will need to be developed for both the LNG facilities within the LNG Precinct and the operations and construction camp.

3.4.2 Operations

Once operational, the facilities within the Precinct will be capable of processing 3.7-15 Mtpa in the first phase (with future expansion potentially up to 50 Mtpa) of LNG. Routine operations will be carried out by a permanent contingent of approximately 350 staff for the foundation development and will potentially increase to 1,000 for the ultimate Precinct capacity of 50 Mtpa LNG. They may be housed in the operations accommodation camp depending on the operational accommodation approach of the project proponents.

Personnel will be transported to and from site by air or land as appropriate.

The operation of the facility will result in both air and liquid emissions (see also **Section 4**). Atmospheric emission will primarily occur from flue gas emissions from gas turbines and will be dominated by CO₂.

Main liquid effluent streams would include produced formation water, desalination reject water, sewage and storm water drainage. Volumes of storm water drainage will depend on annual rainfall events and final surface area of the facilities.

The **Table 3.5** outlines the key operational activities anticipated for the development.

Table 3.5 Key Operational Activities for the LNG Precinct

Activity	Description
Site	
Site maintenance	Various site maintenance activities will be required on the site. These vary from day to day ongoing maintenance to major 'turn-around' maintenance on the LNG trains. The turn-around maintenance is a particularly intense period of activity where the train is shut down and key components of the train are overhauled and various consumables replaced. These activities can require approximately 800 additional individuals.
Stormwater management	The tropical environment of the Kimberly LNG facilities will require active management of storm water. The storm water will be managed to maximise on-site filtration and minimise erosion and run-off from the plant area. Stormwater will be controlled and sent to water treatment where required.
Fire management	A fire management strategy will need to be developed to protect the facilities within the LNG Precinct.
Processing	
Gas Processing	All activities associated with the processing of LNG (and potentially LPG, condensate) including dehydration, acid gas removal, refrigeration flaring etc.
Product Storage	Product storage (LNG, LPG and condensate) and related distribution systems.
Dredging	
Maintenance dredging	Maintenance dredging may be required depending on coastal sediment process in the area around the LNG Precinct.
Vessel operation	
Shipping movements	LNG carriers, condensate tankers and potentially LPG carriers will be transiting through the LNG Precinct port facilities. The number of shipping movements will be dependent on ship size and installed facilities, but can be anticipated to be in the order of 200-300 ships per annum per 10 Mtpa of LNG capacity.
Support vessels	Various support vessels and tugs will transit both to and within the port facilities that support the LNG Precinct. This is likely to include support vessels, supply boats and tugs.
Vessel maintenance, servicing, refuelling	Various bunkering, refuelling and maintenance activities will be undertaken within the integrated marine facility.
Supporting Infrastructure	
Waste Management	The LNG facilities will produce hazardous and non-hazardous wastes as part of ongoing operations. This waste will need to be recycled or disposed of at appropriate facilities.
Operations Camp	The operations camp facilities are likely to include recreation facilities such as pools, visual entertainment and outdoor recreation areas. The camp will also require a water supply, power supply, telecommunications and a water treatment system.

Activity	Description
Fuel and chemical storage	The LNG facilities and other supporting infrastructure will require fuel and chemical storage in appropriately bunded areas.
Water supply	A good quality water supply will be required for both potable and process requirements during operations. Depending on the quality required there are several sources of potential water supply, in order of preference, including surface aquifers, the confined Wallal aquifer and desalination of ocean water if these are not viable.
Waste water treatment	A waste water treatment plant will treat process, maintenance and potentially contaminated stormwater prior to discharge. Treatment methodologies have yet to be selected but may include areas of pondage.

3.4.3 Development Timeline

Indicative timeframes for the onshore activities for the LNG Precinct are largely dependent on the commencement of the first LNG project. It is unlikely that any pre-investment of facilities would be undertaken prior to an LNG operator selecting the LNG Precinct as the location for LNG processing. Table 3.6 shows the anticipated development schedule for the LNG Precinct and first LNG development.

Table 3.6 Anticipated Development Schedule for LNG Precinct and first LNG Project

Project Phases	Timeline
Phase I: Commencement of construction of pioneer facilities, infrastructure preparations	Notionally 2010/11 ¹
Phase II: Construction of LNG Precinct facilities for first proponent (Typical LNG project)	6-12 months after Phase I
Phase III: Operation (Typical LNG project)	4-5 years after commencement of Phase II
Phase IV: Decommissioning	~30-40+ years after commencement of Phase III

¹ Note: indicative timelines only. Actual timelines are dependant on considerations such as location of site selected (requirement for additional geotechnical or other early works and associated approvals), selection of the LNG Precinct for use by LNG Project Proponent(s) and initial project capacity selected (appraisal drilling still ongoing).

3.5 Category B: Indirect activities

Indirect activities and actions occurring as a result of the Precinct such as housing, offsite quarries, Government services and infrastructure etc. as well as separate projects such as modifications which may be required such as to the Broome Port, light industrial or commercial developments outside of those within the Precinct scope discussed above, modifications to the Broome airport, etc. are not covered within the assessment and approvals scope of the Strategic Assessment. As such, these will be subject to separate approvals process as required.

The development of management arrangements for the implementation of the LNG Precinct may require management or planning measures to be undertaken by the LNG Precinct proponent (or other Government entity) to ensure that impacts associated with the Precinct, and indirect activities, are managed appropriately. However, the consideration of these indirect activities in the Strategic Assessment is not intended to involve applying conditions or management arrangements directly on the proponents of the indirect activities as they are subject to separate approvals and regulatory requirements outside of the Strategic Assessment.

3.6 Category C: Related Projects

Related projects are those that are indirectly linked to the LNG Precinct but are proposed by entities separate to the Precinct Proponent (Department of State Development) and outside of the scope of the LNG Precinct Strategic Assessment. It is important for the Strategic Assessment to consider the potential impacts of these activities during the impact assessment and planning process, however they are not included in the approvals scope of the LNG Precinct Strategic Assessment.

The development of management arrangements for the implementation of the LNG Precinct may require management or planning measures to be undertaken by the LNG Precinct proponent (or other Government entity) to ensure that impacts associated with the Precinct, and related projects, are managed appropriately. However, the consideration of these related projects in the Strategic Assessment is not intended to involve applying conditions or management arrangements directly on the proponents of the related projects as they are subject to separate approvals and regulatory requirements outside of the Strategic Assessment.

Related projects whose activities and potential impacts that may need to be considered in the Strategic Assessment include:

- Upstream developments (including gas extraction and transport) of LNG project proponents who elect to utilise the LNG Precinct;
- Upstream exploration and appraisal activities within the Browse Basin and the activities required to support such operations;
- Upstream exploration and appraisal activities in the Canning Basin and other onshore hydrocarbon provinces within proximity to the LNG Precinct location; and
- Other independent projects related to resource development as appropriate and can be reasonably identified.

These projects will be considered from a planning perspective only and will be subject to separate approvals processes under the applicable legislation.

3.7 Study and Investigations Interest Areas

Based on the proposed components of the Browse LNG Precinct as outlined in **Sections 3.2 and 3.3**, the regional and site specific areas of interest for environmental and social studies and investigations have been determined for the James Price Point coastal area. These interest areas will be the focus for scoping the environmental and social studies and investigations to support the Strategic Assessment (SA) for the Kimberly LNG Precinct.

The study interest areas encompass the entire area requiring assessment (i.e. the actual development area and potential zones of direct and indirect impacts) including the selected location for the LNG facilities complex as well as for LNG Precinct associated infrastructure, such as:

- LNG jetty, berth & channel;
- Materials offloading;
- Pipelines to extent of State waters;
- Roads connecting Precinct to public road and within associated infrastructure components;
- Administrative buildings; and
- Permanent and construction workforce accommodation.

The regional area of interest extends from Port Smith, south of Broome, to the tip of the Dampier Peninsula to the North, and extends around 70 km offshore to include the migration route of humpback whales. Onshore it includes all areas to the North-West of the Great Northern Highway (**Map 1**).

The James Price Point coastal area is the preferred location for the Browse LNG Precinct and is the current region of interest for detailed studies and investigations. As the project is further defined, it is likely that the extent of this area will be refined.

Both the regional and James Price Point coastal areas are shown in **Figure 1.1** on the attached maps.

4 Emissions, Discharges and Wastes

The emissions, discharges and wastes associated with the construction and operation phases of the Browse LNG Precinct have been determined for the purpose of scoping for the Strategic Environmental Assessment. These have been described broadly based on the current concept however rates and total discharge amounts have not been considered as a part of this scoping process. These rates and amounts would be further defined during the strategic assessment.

A summary of the emissions wastes and discharges likely to be associated with the construction and operation of the Browse LNG Precinct is provided in **Table 4.1**.

Table 4.1 Key emissions, discharges and wastes

Atmospheric Emissions and Discharges	
	Greenhouse Gases (predominantly CO ₂)
	Combustion Products (NO _x , SO _x , CO)
	Dark Smoke
	Dust (as particulates)
	Odour
	Light (marine and terrestrial)
	Noise (marine and terrestrial)
Marine discharges and waste	
	Cooling water
	Hydrotest fluids
	Dredge spoil
	Deck drainage
	Anti-fouling
	Ballast
	Food scraps from vessel
	Waste water (including sewage, produced water etc.)
Terrestrial Discharges and Waste	
	Domestic waste from marine activities
	Domestic waste from terrestrial activities
	Green waste
	Hazardous waste from marine activities
	Hazardous waste from terrestrial activities

5 Description of Existing Environment

This section provides a description of the existing regional and local physical, biological and social environment of the proposed Browse LNG Precinct at the James Price Point coastal area. This information has been compiled based on desktop studies and the surveys and investigations undertaken to support the site selection process (NDT 2008d). New reports and information on the marine and terrestrial environments of the Kimberley coast, such as the DEC (2009) report, *A Synthesis of scientific knowledge to support conservation management in the Kimberley region of Western Australia*, are continuing to build on the existing information. Wherever possible, an attempt has been made to update this environment description to reflect the latest scientific information and reports. Prior to the SA being completed an additional review of the existing environment information will be undertaken to ensure the latest state-of-knowledge is incorporated.

5.1 Regional Environmental Context

The Kimberley extends northwards from the Great Sandy Desert to the rugged uplands, escarpments and coastal islands of the Kimberley Plateau and east to the Northern Territory border. It covers a land area of 424,500 square kilometres (km²), equivalent to 1.8 times the size of Victoria (DEC 2009).

The Dampier Peninsula is located within the geological area known as the Fitzroy Trough; a major subdivision of the Canning Sedimentary Basin (Damara 2008). This area is characterised by vast, gently undulating Pindan sandplains. The spectacular gorges, rivers and islands associated with the Kimberley region occur to the north within the Kimberley Plateau.

The Kimberley region has a tropical monsoonal climate, that is characterised by a hot and humid 'wet' season from November to March (summer) and a 'dry' season (winter) from April to October. Ninety percent of the Kimberley's rainfall occurs during the wet season, resulting in enormous volumes of water being discharged into the ocean from the region's main rivers. Upon the transition into winter, south-easterly winds bring dry continental air over the region, resulting in clear days and cool nights.

The Interim Biogeographic Regionalisation of Australia (IBRA) divides Australia into 85 bioregions based on major biological, geographic and geological attributes (Thackway & Cresswell 1995). James Price Point is located within the Dampierland Bioregion which covers approximately 83,700 km² and extends from south of Pardoo, north along Eighty Mile Beach to the north of Derby.

The Dampierland Bioregion comprises both the Fitzroy Trough and Pindanland subregions. The Dampier Peninsula is located within the Pindanland subregion. The Dampier Peninsula itself is characterised by vast, gently undulating Pindan sandplains which are known for their poor surface drainage, resulting in a tendency for sheet runoff and subsequent sheet erosion, particularly after heavy seasonal (summer) rainfall. The Peninsula is dominated by Pindan woodlands which are largely composed of Grey Box (*Eucalyptus tectifica*) and Blackwood (*Corymbia spp.*), resulting in an open canopy ranging in height from 8-12 m, which is supported by an Acacia dominated shrub layer. The Woodlands extend over almost the entire extent of the Dampier Peninsula, however additional vegetation communities are known to occur. These include both Monsoon (vine) thickets and Bunda Bundas communities, both of which are identified as Threatened Ecological Communities within WA.

Rare features of the Dampier Peninsula include the extensive mudflats of Roebuck Bay and Eighty Mile Beach where large numbers of migratory birds are known to congregate.

The bioregion has a number of species that occur nowhere else and is an important refuge for water and migratory birds (DEWHA 2008a). The terrestrial fauna habitats of the Dampier Peninsula are unique and varied across the region and provide habitat for a large number of State and Commonwealth listed fauna species. Fauna habitats are likely to fall into one of five categories, namely:

- Mangroves;
- Rainforest and Monsoon (vine) thickets;
- Savannah Woodland;
- Pindan Woodland; and

- Wetlands (including perennial and seasonally ephemeral).

Many Kimberley landscapes are now used for resource production with the pastoral industry in particular occupying extensive plains in the south and east Kimberley and most of the Kimberley Plateau (DEC 2009). It is worth noting that a number of threatening process, as identified by the WA DEC, are currently operating on the Dampier Peninsula. Altered fire regimes, weed invasion and grazing and trampling by introduced cattle have been identified by local Department of Environment and Conservation officers, as high priority threats operating within the Dampierland bioregion.

The Kimberley coastline consists of an assortment of habitats resulting from diverse localised environmental conditions. These include sandy beaches, cliffs and headlands, small inlets, mudflats and mangrove lined shores, as well as numerous offshore islands.

The marine environment provides habitats for a diversity of threatened and non-threatened marine fish, reptile and mammal species. Of particular note is the annual migration of Humpback Whales from feeding grounds in the Antarctic to calving grounds in Camden Sound to the north of the Dampier Peninsula. In addition a number of important marine turtle nesting beaches are known to occur along the Dampier Peninsula coastline and offshore islands while seagrass beds and coral reef communities are also known to occur within the region

5.2 Existing Marine Environment

5.2.1 Coastal Geomorphology

In a regional context, the Dampier Peninsula's northern and western coastal margins are predominantly of a low energy nature, receiving occasional storm surges from cyclonic weather events. The peninsula's west coast receives refracted westerly swells for the majority of the year, with the swells from the north and north-west affecting the western and northern facing shores during the summer period. Cyclones during summer often batter the region, bringing rough seas and swell and causing extensive coastal erosion and changes to coastal structures.

The coastal sediments of the Dampier Peninsula include quartz beach sands, shell ridges, mudflats and limestone platforms and dunal systems. White Holocene sand dunes run parallel to the coast often forming long, expansive systems. The sand dunes at Cable Beach are an example of these Holocene sand dunes. Older, less exposed dunes of Pleistocene origin also occur on the peninsula. These dunes are typically pink in colour and more stable. Examples of these can be seen fringing Roebuck Bay (Kenneally et al. 1996).

The prominent coastal geomorphology/habitat types evident at a large scale include riverine channels, small inlets/embayments, broad shallow embayments, rocky headlands/shores, sandy beaches, numerous offshore islands and extensive reef systems. The intertidal zone of this shoreline varies in width as a result of differing topography across the Peninsula. In general, the widest intertidal regions are apparent in bays, which typically empty at Lowest Astronomical Tide (LAT) to reveal reef platforms, quartz beach sands, shell ridges and mud flats which adjoin the bay's headlands and shores.

The James Price Point coastal area is characterised by narrow beaches with an intermittent rocky shoreline and platforms of lithified coastal sediments which adjoin stretches of low lying cliffs and sand dunes to the landward side. Four small headlands, less than 0.5 km outcrop from Coulomb Point to Quondong Point. Other outcrops occur as linear, shore-parallel rock platforms underlying sandy beaches. Storm surge associated with fluctuations in sea level, and extreme meteorological conditions interact with the geology to affect shoreline development and stability in nearby embayments. The upper sandy intertidal zone and dune systems comprise of white, Aeolian quartz and carbonate sands. Coastal dunes are located at Quondong Point, close to James Point and in the embayment immediately south of Coulomb Point. Storm surges, onshore winds associated with tropical cyclones and monsoonal activity contribute to the formation of these dune formations and composite storm bars. **Figure 5.1** provides a schematic representation of the biophysical habitat types found in the James Price Point coastal area.

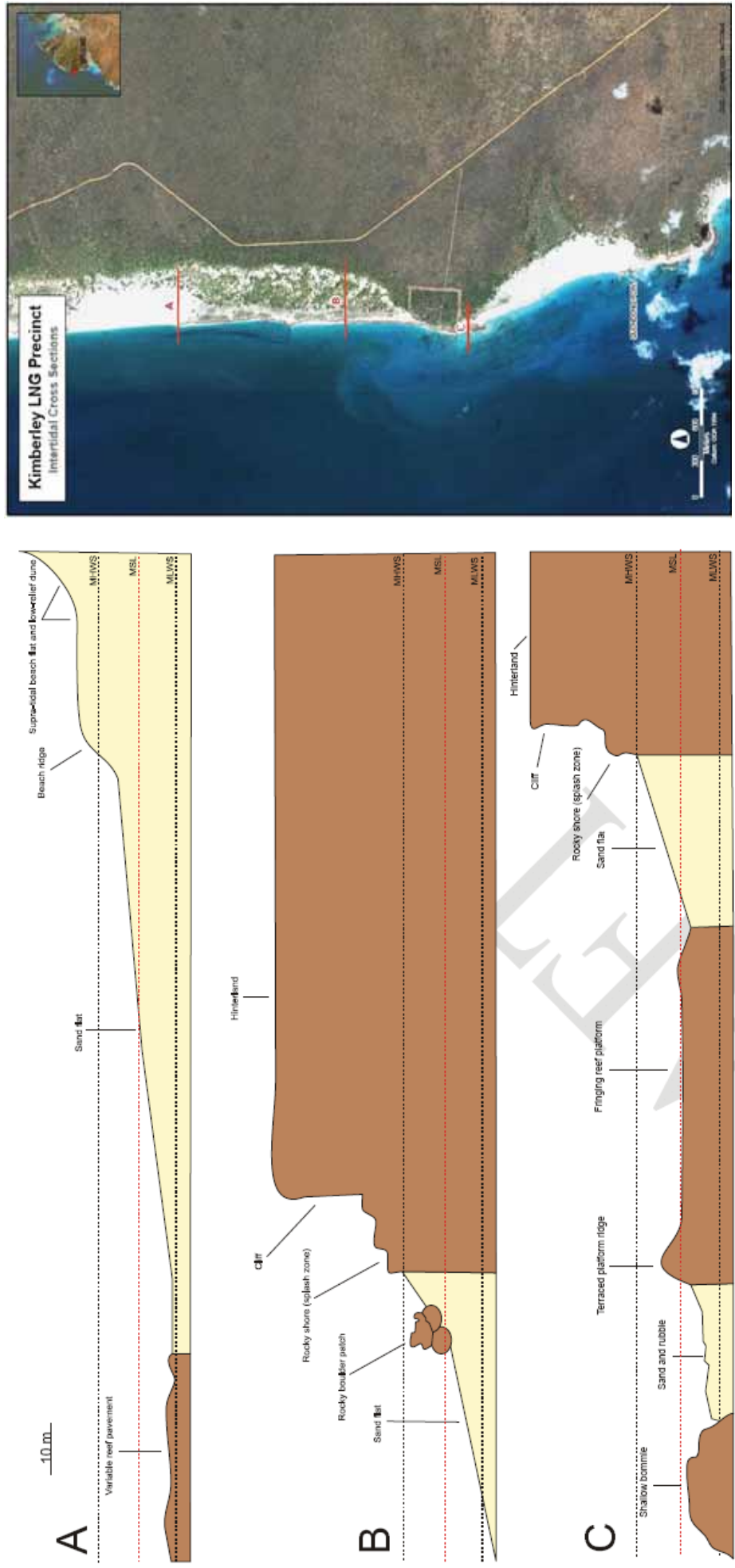


Figure 5.1 Variation in the biophysical habitats present throughout the intertidal zone within the James Price Point coastal area

NOTE: Profile drawings are schematic representations only

5.2.2 Subtidal Geomorphology and Bathymetry

Very wide intertidal sand flats are a feature of the open ocean shores of the Dampier Peninsula. During low spring tides these flats can be greater than a kilometre wide. Sediment composition on the flats ranges from fine, silty sand nearshore, to coarse, shelly rubble in areas of strong tidal flow. Few aquatic plants occur on these flats, however sparse occurrences of seagrasses do occur in shallow pools (CALM 1994). These intertidal flats are rich in invertebrates, with a high density and diversity of bivalve molluscs and other burrowing infauna. The outer edge of these flats support soft corals and sponges (CALM 1994).

The Lacepede Islands are low sandy cays approximately 50 km to the west of Beagle Bay and the only offshore islands along the Dampier Peninsula coast (CALM 1994). The continental shelf in the region has a regular slope with some deep tidal scour channels (CALM 1994). **Map 3** illustrates the nearshore bathymetry (m, MSL) of the Dampier Peninsula between Gourdon bay and Cape Leveque.

According to Fry *et al.* (2008) the area around Coulomb Point (approximately 15 km and 25 km north of James Price Point and Quondong Point respectively) consists primarily of fine sand substratum (70% sand coverage), with patches of sand and dunes observed in the shallower water (around 5m). Deeper water (> 5m) between Quondong Point and James Price Point is predominately flat sandy substrate and some silty-sand. From James Price Point north to Coulomb Point the seabed is comprised of mostly sand (55% coverage), but also extensive areas of sand dunes. Relatively large areas of low relief reef structure are present in this northern area. Fry *et al.* (2008) described one site in the northern area between James Price Point and Coulomb Point as having a significant coverage of high relief reef structure and rocky substratum. Restricted areas of low relief reef are present in shallow waters from Quondong Point to James Price Point. **Map 3** illustrates the nearshore bathymetry (m, MSL) between Quondong Point and James Price Point.

5.2.3 Oceanography

5.2.3.1 Meta-scale Oceanography

The oceanography and climate of the Kimberley region is heavily influenced by the Indonesian Throughflow (ITF). This comprises a complex system of currents, linking the Pacific and Indian Oceans via the Indonesian Archipelago. The strength of the ITF fluctuates seasonally, reaching a maximum during the south-east monsoon, and weakening during the north-west monsoon (Tomczak and Godfrey 1994).

These variations in oceanography resulting from seasonal monsoonal conditions and the long-term El Nino Southern Oscillation (ENSO) have implications for productivity in the Kimberly region. The upper euphotic zone in tropical waters is generally nutrient poor, with the majority of nutrients stored in the cooler, deeper waters. Upwellings provide an important mechanism for bringing these deeper, nutrient enriched waters to the surface where there is sufficient light for photosynthesis. This increase in nutrient load from deeper waters to the well-lit surface waters results in a proliferation in phytoplankton, thereby increasing productivity. Phytoplankton blooms are indicated by changes in density of chlorophyll, a pigment on the ocean's surface layers.

Other mechanisms affecting productivity include local wind mixing of the surface layer and vertical mixing of the water column. Phytoplankton blooms require a stable surface layer (Francis *et al.* 1998) and are therefore affected by seasonal changes in surface winds. The depth of the upper mixed layer also affects phytoplankton production. While a well-mixed water column results in increased nutrients into the surface layers, it also results in decreased light intensity and a decrease in phytoplankton production (Gargett 1997). Moore and Marra (2002) identified that phytoplankton blooms depend upon the availability of cold, nutrient enriched waters and mechanisms for mixing and uplifting these waters to the surface. Their observations in the Strait of Ombai (Indonesia) showed there was a correlation between phytoplankton blooms and monsoonal seasonality, with blooms peaking during the winter south-easterly monsoon when the thermocline is shallow (closer to the surface) and ceasing with the arrival of the north-west monsoon when the thermocline deepens. They also observed that ENSO events also influence bloom activity.

During El Nino events when the ITF is weaker, there is a rising of the thermocline into shallower water and an increase in upwelling strength leading to enhanced phytoplankton production. During La Nina events the ITF strengthens, thereby deepening the thermocline and reducing upwelling strength

(Susanto *et al.* 2001), thereby reducing phytoplankton production. This pattern has also been observed in the Kimberley area, where higher levels of sea surface chlorophyll were reported during the winter when the ITF is strong and sea surface temperatures are relatively low (Mustoe and Edmunds 2008).

Physical features also affect productivity as phytoplankton blooms are also often concentrated at water mass boundaries or fronts due to increased upwelling of nutrients (Franks 1992, Yoder *et al.* 1994). These fronts can occur as a result of physical forces such as strong tidal flow over steep or complex bathymetry, or interactions with topography (eg. islands or headlands) resulting in curvature of flow. This leads to strong vertical mixing bringing nutrients into the upper surface layers.

5.2.3.2 Coastal Mixing Processes

Key drivers for coastal processes in the region are tides and rainfall (Mustoe and Edmunds 2008), with these contributing to productivity through catchment runoff, sediment transportation and tidal mixing. Studies by Cresswell and Badcock (2000) indicate tidal mixing plays an important role in nutrient enrichment of nearshore waters, reef and islands through mixing of the thermocline. This process brings cooler nitrate rich waters to the surface where photosynthesis occurs, and therefore is likely to be an important mechanism for supporting the areas marine ecosystem.

The Kimberley region has one of the largest tidal ranges in the world with tidal ranges up to 10 m (Mustoe and Edmunds 2008) and associated strong tidal currents as large as 4 knots (Anon 1972). This strong tidal regime and high summer monsoonal rainfall, results in highly turbid coastal waters. This high turbidity is persistent throughout the year, but with the concentration of suspended sediments varying by an order of magnitude between spring and neap tides (Magvelashvili *et al.* 2006).

Sediments are transported by the currents in the coastal region forming subtidal habitats such as channels, harder sand banks and soft muddy deposits offshore to approximately 20 m depth. The currents also scour sediments from reef structures and supply food to filter-feeding fauna (Mustoe and Edmunds 2008).

At a local level, the James Price Point coastal area has a direct west facing aspect and is therefore relatively exposed. The general Metocean climate is characterised by a tidal range of approximately 7.3 m (Seafarer Tides 2008) and relatively strong coastal currents as a result of its high energy location.

5.2.4 Coastal Marine Habitats

5.2.4.1 Mangroves

The intertidal coastline of the Dampier Peninsula is characterised by prominent mangrove communities which generally fringe the head of bays, sheltered inlets and accreting estuary shorelines (Semeniuk 1980) **Map 4**. Mangroves, including associated flora and faunal communities are further described in **Section 5.1.5.5**.

5.2.4.2 Rocky Shore / Reef Platform and Pavement

The extent of Benthic Primary Producer (BPP) coral and macroalgae development within the intertidal platforms and rock shore varies between sites along the Dampier Peninsula. Areas where the reefs are terraced often include sheltered rock pools and gutters which may support more extensive coral and macroalgae development. In comparison, reefs which are more platformed are unlikely to support extensive coral growth due to frequent periods of desiccation.

The Flora (i.e. Mangroves, Seagrasses and Macroalgae) and Fauna (i.e. Invertebrate, Corals and Fish) species associated with Rocky Shore / Reef Platform and Pavement habitats are described in the following relevant sections.

5.2.4.3 Sandy Beach Flats

Sand flats are a common occurrence along the open coastal shores of the region, adjoining intermittent headlands and rocky shorelines and fringing the low-relief dune hinterland. The width of the intertidal zone on these sand flats vary along the regional coastline as a result of differing nearshore topography such as the presence of wind and wave-formed dune ridges or deep subtidal trenches. Waves at the beaches within the study region are generally weak or absent, resulting in the

sandy beach flats to be categorised as reflective beaches (McLachlan 1990). Within this environment, coarse sand is likely to be deposited high in the intertidal, resulting in a characteristic step (approximately 0.5 metres) along the shoreline where incoming waves clash with the backwash and with a platform of coarse sand above the intertidal slope (Honkoop *et al.* 2006). The intertidal beach flat is therefore defined as the area below this step and is characterised by a particle size gradient ranging from flat, fine sediments in the low intertidal to medium coarse sands in the upper reaches adjacent to the beach ridge.

Intertidal sand flats are predominantly unvegetated, low in gradient and consist of a range of sandy mud sediments. Carbonate concentrations are moderate (as a result of shelly material and rubble) and the concentration of organic material is variable, but may be high depending on the extent of fringing vegetation (e.g. mangroves) and fluvial run-off.

Important Benthic Primary Producers (BPP) such as sediment microalgae, seagrass and mangroves colonise the intertidal sandy flats at variable densities across the regional study area. Despite their minute size, sediment microalgae are ecologically important within the marine system, as they are a major source of food for benthic fauna and help stabilise the sediments. Despite the difficulty in determining the abundance and diversity of such small organisms, it can be assumed that they are present, and therefore contribute to production in all sandy intertidal environments described. More notable BPP such as macroalgae and seagrass may also be present within the sand flat zone.

The Flora (i.e. Mangroves, Seagrasses and Macroalgae) and Fauna (i.e. Invertebrate, Corals and Fish) species associated with sandy beach flat habitats are described in the following relevant sections.

5.2.5 Benthic Primary Producer Habitat

Benthic Primary Producer Habitat (BPPH) refers largely to marine plants such as seagrasses, macroalgae and mangroves, but also includes scleractinian coral species. BPPH plays a major role in marine ecosystem functioning including acting as a substrate and providing shelter and food for organisms, as well as providing physical stability of the coastline and seafloor (EPA 2004). The BPPH, based on current available information is mapped on **Map 4**, and described in sections below.

5.2.5.1 Sediment Microalgae

Sediment microalgae consist of microscopic diatoms that live in the sediment surface layers and are an important primary producer in the Kimberley region (Mustoe and Edmunds 2008). These microphytobenthos (MPB) are highly mobile and able to migrate between the surface, to utilise sunlight for photosynthesis, and deeper sediments, to acquire nutrients. As MPB are less affected by lower light levels of turbid waters than other primary producers, their presence in intertidal and subtidal sediments ensure these areas are rich benthic primary producer habitats (Mustoe and Edmunds 2008). MPB have rapid growth rates and are consumed largely by sediment infauna including nematodes, crustaceans, mollusc filter-feeders and worm deposit feeders. Suspension of MPB during tidal movements contributes to the production of plankton and benthic filter feeders in other areas (Mustoe and Edmunds 2008).

Sediment microalgae (along with macroalgae, **Section 5.2.5.4**) are expected to be the main benthic primary producers at the James Price Point coastal area due to the limited areas of seagrass and mangroves. Within the extensive sand flats, it is likely that a suite of sediment microalgae is present.

5.2.5.2 Plankton

See **Section 5.2.3.1**.

5.2.5.3 Seagrass

Areas of seagrass are often found in association with sand flats and are a known feeding ground for Dugong (*Dugong dugon*). Their occurrence is largely influenced by light availability (i.e. increasing turbidity) and the overall stability of the substratum. Currently, eleven seagrass species within seven genera have been recorded around the coastal margin of the Dampier Peninsula. The recorded genera include *Cymodocea*, *Halodule*, *Syringodium*, *Thalassodendron*, *Enhalus*, *Halophila* and *Thalassia* (Kenneally *et al.* 1996). While species occur in a wide range of sediments, *Halodule pinifolia* and *Halophila ovate* are usually found on finer sediments and only occur in intertidal or shallow subtidal areas (Kenneally *et al.* 1996). In mixed seagrass meadows where the substrate is fully exposed at low tide, *Halodule univervis* is the dominant species (Kenneally *et al.* 1996). Other

species, such as *Thalassodendron ciliatum*, are located in areas with strong currents, growing directly on reef or coarse shell grit (Kenneally *et al.* 1996).

Dugong activity in the vicinity of James Price Point suggested the presence of seagrass in that area, however this was not verified until recent benthic habitat surveys by DEC November 2007 and December 2008 and Fry *et al* June (2008). These surveys identified seasonally-abundant subtidal seagrass communities patchily distributed across large areas along the Dampier Peninsula from the lower intertidal and out to a depth of approximately 20 m. Subtidal seagrass patches and meadows appear to be well developed in areas where sediments were relatively fine and stable such as in inter-reefal areas and between/among patches of filter feeder communities. These subtidal meadows were first observed during surveys undertaken by DEC in November 2007. At this time, meadows were well developed and biomass was high. Repeat surveys of some locations where seagrass was found in November 2007 were undertaken in April 2008 but no seagrass was recorded. Seagrass had re-established in these areas by June 2008 and surveys by DEC in December 2008 found prolific seed production in *Halophila* sp, suggesting that recruitment from seed may be a very important process for sustaining these seagrass communities (Fry *et al*, 2008)

Numerous sessile taxa are likely to be associated with the seagrass communities found off the Dampier Peninsula. These include sessile benthic organisms and epiphytes such as sponges, gorgonians, hydroids and alcyonarians. In addition, vertebrate and invertebrate species are likely to utilise the seagrass habitats for shelter and food including fish, urchins and crinoids.

5.2.5.4 Macroalgae

Like seagrasses, macroalgae are dependent upon light as a source of energy and suitable sea temperatures and sea conditions. There is a paucity of knowledge regarding the tropical macroalgal flora of Western Australia (Huisman 2000).

Studies within the Kimberley region have reported the diversity and abundance of algal flora on intertidal platforms to be generally poor as a result of the extreme tidal exposure and scouring. Encrusting coralline algae is likely to be the most prominent algal type in these high energy areas due to its ability to withstand scouring. The relatively low abundance in nearshore sub-tidal areas is also likely to be attributed to the constant highly turbid waters that reduce light penetration and increase sedimentation. Of the species documented, *Sargassum* sp.(Phaeophyta), along with rhizobenthic algae such as *Halimeda*, *Avrainvillea* and *Udotea* (Chlorophyta) were most commonly found on sub-tidal reefs and within patches/pockets of sediment (Walker 1996).

Hard substrate (low/high relief reef structures and rocky substrate) suitable for macroalgal growth exist in patches between Quondong Point and Coulomb Point. At the northern end of Coulomb Point, there is a large patch of *Sargassum* algae (Fry *et al* 2008). Other brown algae are major contributors to the percentage biohabitat coverage along the shallow coastal area off Coulomb Point, corresponding to the presence of low relief reef structures.

Numerous invertebrates are likely to be found resident amongst the macro-algal communities including ascidians, sponges and crinoids. In addition, vertebrates such as fish are likely to utilise these macro-algal communities for food.

5.2.5.5 Mangroves

The numerous inlets, lagoons and embayments along the Kimberley coast support extensive mangrove communities (Pedretti & Paling 2001). The mangrove flora of the northern Kimberley region is diverse with 14 out of 17 species occurring in this area (Mustoe & Edmunds 2008). Typically however, the combination of low durations and frequencies of tidal inundation and low, highly seasonal fluvial influences produce conditions that are inhospitable for plants over large areas of the intertidal zone. Mangrove and associated flora of the intertidal zone is only possible in the wet tropics of Australia where fluvial inputs are large, reliable, and extend over most of the year. Much of the intertidal zone of the Kimberley coast, including the James Price Point coastal area, is inhospitable to colonisation by mangroves and other flora such as salt marsh species because the areas of the intertidal above mean high water mark are infrequently inundated and have little fluvial inputs from the hinterland. Mangroves areas on the Dampier Peninsula are shown in **Map 4**.

The fauna associated with mangals may be distinguished as either resident or temporary and span a wide range of groups such as invertebrates (e.g. Hanley, 1995b, c, in prep, Reid 1985, Wells and

Slack-Smith 1991), foraging turtles (Pendoley and Fitzpatrick 1999), mangrove birds (Johnstone 1990, Noske 1996), reptiles (Messel et al. 1977) and fish (Robertson and Duke 1987).

5.2.6 Fauna

5.2.6.1 Corals

Coral reef ecosystems support a high diversity of marine flora and fauna (Allen and Steene 1994), and are afforded a high level of protection by the Commonwealth and Western Australian regulatory authorities. In comparison to other regions of Western Australia, such as Ningaloo Reef and the Dampier Archipelago, coral occurrences in the Kimberley have not been extensively studied (Blakeway and Radford 2005). The majority of collected information on corals from the Kimberley region relate to a limited number of studies of offshore coral islands. Studies of reefs within the Kimberley region undertaken by the Western Australian Museum (Marsh 1992) identified in excess of 170 species and 60 genera of scleractinian coral. The extent of coral development within the intertidal platforms will vary between sites along the Dampier Peninsula. Areas where the reefs are terraced often include sheltered rock pools and gutters which may support coral development. In comparison, reefs which are more platformed are unlikely to support extensive coral growth due to frequent periods of desiccation.

The intertidal zone of the James Price Point coastal area is dominated by flat, sandy areas with relatively sparse intermittent habitat of rocky substratum and reef platform which may be suitable for coral growth. Where patches of low relief reef exist, there are sparse to medium densities of soft corals (Fry *et al.* 2008). These are shown in **Map 4**.

5.2.6.2 Marine Invertebrates

A wide range of invertebrates are found in the intertidal zones of the Kimberley region, associated with mangrove communities (tidal creeks and embayments), rocky shore/reef platform and pavement and sandy beach flats. The diverse range of invertebrate epifauna present may include sponges, hydroids, anemones, polychaetes, bivalves, barnacles, bryozoans and ascidians.

Sponges, soft corals, and ascidians are often common elements of the sessile fauna and their diversity and abundance is dependent on suitable substrate and height on the shore, with the influence of the modifying factors that provide relief from exposure increasing both diversity and abundance higher on the shore. On many rocky shorelines, the underside of boulders often has an extremely rich fauna of sponges and ascidians which in turn provide habitat for a variety of polychaetes, crustaceans, echinoderms and molluscs.

The mixed sandy sediments of the beach and low intertidal sand flats is likely to be home to resident epibenthic, infaunal and meiofaunal invertebrates which inhabit this environment during all tidal states. It is reported that like most intertidal environments, there is a clear pattern of zonation of species based on a combined effect of several factors, including the physical environment, animal-sediment relations and species interactions (e.g. predation, competition). The abundance of these communities provide a rich, vital feeding ground for temporary fauna such as fish and crustaceans which invade the area at high tide, and birds invade the area at low tide. Crustaceans such as Decapod, Grapsid and Ocypode crabs forage and burrow in the upper intertidal sand flats, utilising this habitat during all tidal states. Hermit crabs are also likely to be abundant. Echinoids (sand dollars) and Holothuria (sea cucumbers) inhabit the soft sandy shores to feed on detritus particles between the sediments. In a sand dominated habitat, polychaetes are described to be one of the most diverse and abundant macroinvertebrate infauna, making a significant contribution to the overall faunal biomass of the habitat. Many of the polychaete species likely to be present are detritivores and include representatives of the families Orbiniidae, Spionidae, Capitellidae, Terebellidae, Ampharetidae, Cirratulidae, Amphinomidae, Nephtyidae, Maldanidae and Lumbrineridae.

Along the patches of low relief reef in the James Price Point coastal area, there are sparse to medium densities of sponges, gorgonians and whips. Sparse to medium density gardens of soft corals were also relatively common on this substratum type (Fry *et al.* 2008). The most abundant benthic invertebrates within the survey location between Quondong Point and Coulomb Point are heart urchins, crinoids and ascidians. Heart urchins and crinoids were found mostly on the sandy flats in the offshore areas, with densities of up to 30,000 and 33,000 animals per linear km, respectively. There were few other animals observed in any numbers, except for sea pens that occurred in the hundreds at a few sites off James Price Point (Fry *et al.* 2008).

5.2.6.3 Reptiles

The Kimberley region is host to a number of marine reptile species including marine turtles, crocodiles and sea snakes. Up to six species of marine turtle may occur in the Kimberley, all of which are on the list of threatened species under the *EPBC Act*. Both saltwater (*Crocodylus porosus*) and freshwater (*Crocodylus johnstoni*) crocodiles along with several species of sea snake, are also known from the Kimberley region and are listed Marine species under the *EPBC Act*.

The green turtle (*Chelonia mydas*) breeds in Western Australia during summer and is known to have major nesting rookeries on the Lacepede Islands, Browse Island, Barrow Island, Montebello Islands and North West Cape. A number of smaller nesting sites can also be found on the mainland between the Ningaloo and Kimberley coasts. The green turtle is still harvested by the indigenous people of the Dampier Peninsula, however, exact numbers taken are unknown (Limpus 2002). This species is declared Threatened under the Western Australian Wildlife Conservation Act 1950 and Vulnerable under the *EPBC Act*.

The flatback turtle (*Natator depressus*) is also recorded as nesting on the Lacepede Islands (Kenneally et al. 1996). Flatback turtles are known to feed throughout Australian continental shelf waters (Limpus 2004). This species is declared Threatened under the Western Australian Wildlife Conservation Act 1950 and Vulnerable under the *EPBC Act*.

Hawksbill turtles (*Eretmochelys imbricata*) in Western Australia range from North West Cape to the Dampier Archipelago (Moritz et al. 2002, Dutton et al. 2002), although individuals have been recorded from as far north as Scott Reef (M. Guinea pers. comm. 2009). The major rookeries for hawksbill turtles in Western Australia are in the Dampier Archipelago, the Montebello Islands and the Lowendal Islands (Limpus 2004). Hawksbill turtles nest all year round, but the peak nesting period is typically between July and September in northern Australia (Limpus 1992). The feeding areas of hawksbill turtles in Western Australia is largely unknown, however, it has been suggested that they commonly feed on the reefs adjacent to the mainland Kimberley coast (Prince, 1994). This species is declared Threatened under the *Western Australian Wildlife Conservation Act 1950* and Vulnerable under the *EPBC Act*.

Loggerhead turtle (*Caretta caretta*) rookeries in Western Australia generally occur between Shark Bay and Ningaloo (Dutton et al. 2002) although no mating or nesting has been recorded in the Kimberley region. This species is declared Threatened under the Western Australian Wildlife Conservation Act 1950 and Endangered under the *EPBC Act*.

Although listed as occurring within the nearshore environment, the leatherback turtle (*Dermochelys coriacea*) is considered unlikely to occur given that no confirmed breeding occurs in Western Australia and its populations within the Indo-Pacific region are in significant decline (Limpus 2004). This species is declared Threatened under the Western Australian Wildlife Conservation Act 1950 and Endangered under the *EPBC Act*.

Olive ridley turtles (*Lepidochelys olivacea*) are not known to nest in Western Australia, or further west than Darwin in the Northern Territory (DEWHA 2009). Records of this species come from a few individuals caught by fishers off the Kimberley-Pilbara coast (Robins et al. 2002). This species is declared Endangered under the *EPBC Act*.

Within the James Price Point coastal area, sandy beaches occur south of James Price Point. In these areas, significant stretches of loose, aeolian sands are present with little vegetative cover, provide possible substrata composition for turtle nesting. **Map 5** shows the location of sandy beaches in the James Price Point coastal area. While these areas are not specifically known for turtle nesting, any sandy shore could potentially be considered turtle nesting habitat.

While the saltwater crocodile (*Crocodylus porosus*) and freshwater crocodile (*Crocodylus johnstoni*) are known to occur within marine and estuarine waters of the Kimberley, fresh water habitats for the freshwater crocodile are unlikely to be present. Saltwater crocodiles may occur within the James Price Point coastal area. Habitats for a number of sea snake species are likely to be present within the James Price Point coastal area.

5.2.6.4 Marine Mammals

Few comprehensive investigations of cetaceans have been undertaken in the Kimberley region. An *EPBC Act* protected matters search of the area identified two Threatened species, the blue whale (*Balaenoptera musculus*) and humpback whale (*Megaptera novaeangliae*) and ten migratory species as likely to occur within the area (**Appendix B**).

To date, recorded sightings have included the Australian snubfin dolphin (*Orcaella heinsohni*), bottlenose dolphin (*Tursiops aduncus*), humpback whale and dugongs (*Dugong dugon*). The Indo-Pacific humpback dolphin (*Sousa chinensis*) also has the potential to occur in the wider Dampier Peninsula marine environment. The remaining listed species are generally found well offshore and are therefore unlikely to be encountered within near shore waters.

Humpback whales migrate annually from feeding grounds in the Antarctic to breeding grounds in Camden Sound in the Kimberley region of Western Australia (Jenner *et al.* 2001). Humpback whales use an extensive area of the Kimberley region via the migration corridor around Cape Leveque and to the west of the Lacepede Islands to the inshore waters between the Lacepede Islands and Camden Sound (**Map 4**). This inshore area between the Lacepede Islands and Camden Sound is a calving ground typically used between June and mid November with the highest number of cow-calf pairs being seen between mid-August and mid-September (Jenner *et al.* 2001). Preliminary data of aerial surveys conducted in July and August of 2008 confirmed the presence of the migration route, extending from south of Broome to north of the Dampier Peninsula and the consistent timing of migration, but indicates that the migration route may vary.

The Australian snubfin dolphin is known to occur close to rivers mouths in Australian waters (Parra *et al.* 2002). Their preference for near shore, estuarine waters is likely related to the productivity of these tropical coastal areas (Parra 2006). Known from Roebuck Bay, Brunswick Bay, the Troughton Passage and Cape Londonderry (Mustoe and Edmunds 2008), however, they may potentially occur along the entire length of the Kimberley coastline including in the general vicinity of James Price Point.

Indo-Pacific humpback dolphins exhibit a similar distribution pattern as the Australian snubfin dolphin, as most populations are associated with areas receiving freshwater inputs (Jefferson and Karczmarski 2001). Spinner dolphins (*Stenella longirostris*) are known to occur offshore in the Kimberley region, but unlikely to be found in the nearshore environment.

Dugongs are found in shallow, protected waters in tropical and sub-tropical regions. They are herbivores feeding solely on seagrass (as shown on **Map 4**). The known presence of seagrass beds within the James Price Point coastal area (DEC 2009), suggests that this area may represent feeding for the species. The dugong's reproductive cycle is sensitive to food availability, with breeding delayed if there is insufficient food. Little information is known on dugongs in the Kimberley region. Holley and Prince (2008) provide information on dugong observations in the Kimberley region based on an assessment survey conducted in 1984, a series of strip transect aerial surveys throughout 1985 and longitudinal dataset of incidental observations from 1996 to 2007 collected by the Australian Customs Service. Holley and Prince (2008) suggest that the Kimberley region represents the only remaining area within Australia that has a large population of dugongs with no quantitative estimates available and recommend that aerial surveys are undertaken.

5.2.6.5 Fish

The marine fish fauna in the coastal Kimberley region has been the focus of few ecological studies and species checklists (e.g. Allen 1992, 1996, Newman *et al.* 2003, Travers *et al.* 2006) and is considered to be low in diversity in comparison to fish species found well off the Kimberley coast such as the Rowley Shoals (Allen 1992). The inshore fish fauna of the Kimberley can be best described as belonging to the Indo-Australian subprovince of the Indo-West Pacific region and are primarily coastal fishes that are adapted to silty environments associated with large tidal fluctuations (Allen 1992). Newman *et al.* (2003) sampled nearshore, shallow waters on beaches and in mangroves and intertidal pools in three regions along the Pilbara and Kimberley (Port Smith) coasts during the wet and dry periods of two consecutive years (between December 2000 and November 2002) with fish catches from all habitat types collectively yielding 170 species representing 66 families. The species compositions of the fish assemblages were influenced not only by habitat type, but also by season and region and also apparently the extent of tidal action and thus turbidity (Newman *et al.* 2003). Nearshore shallow waters (< 2 m depth) act as a nursery area for some fish species in tropical waters (Blaber *et al.* 1995). The offshore survey component of Newman *et al.* (2003) sampling over reefs using fish traps and over soft substrates using an otter trawl net in both shallow (ca 15 m) and deeper inshore waters (ca 22 m) at seven regions along the Pilbara and Kimberley coasts, including Dampier Peninsula, yielded 132 fish species caught over reefs and 279 species over soft substrates. A 1991 (Allen 1992) survey of aquatic fauna of the Kimberley islands and reefs from King George River in the east to Lacepedes, West Island in the west recorded a total of 311 species of marine fishes and 13 freshwater species. Hutchins (1995) recorded 197 species of marine fish from nearshore shallow reefs in the Buccaneer Archipelago.

Three threatened fish species, whale shark (*Rhincodon typus*), freshwater sawfish (*Pristis microdon*) and green sawfish (*Pristis zijsron*) are listed as Vulnerable under the *EPBC Act* and have potential to occur within or migrate through the area. The whale shark may utilise the region for migration and foraging. The species occurs in both tropical and temperate waters, and is generally encountered in areas where the water surface temperature is between 21 and 25°C with upwellings of colder (17°C or less) water, and a salinity range of 34 to 34.5 ppt (Colman 1997). While important information has been collected on whale sharks at Ningaloo Reef, there still remains a general lack of knowledge on many aspects of whale shark biology, including definitive migration patterns.

No site specific fish fauna surveys are available for the James Price Point coastal area, so assumptions of species present are based on nearby or regional surveys and are also directly related to the physical environmental characteristics. Sandy beach flats which are relatively exposed compared to other locations are the predominate feature and as such the fish fauna is expected to be temporarily present during the high tides to feed on invertebrates. Other fish species may be associated with the intermittent rocky shoreline and reef platforms.

5.2.6.6 Seabirds

The seabirds of the Kimberley region include the suite of shorebirds, waders and near shore species, such as plovers and sandpipers, gulls and cormorants, and the pelagic offshore feeding species such as shearwaters, noddies and tropicbirds. For shorebirds and waders, the RAMSAR wetlands located adjacent to Roebuck Bay, east of Broome, is an important stopover site for at least twenty species, with more than 300,000 waders using the site each year. Each year shorebirds numbers begin to increase in Roebuck Bay during August and continue to rise until November. In March, numbers decrease as adult birds return to the Northern Hemisphere. The Roebuck Bay RAMSAR wetlands which support internationally significant species are thought to be the fourth most important site for waders in Australia in terms of absolute numbers. Roebuck Bay is located approximately 60 kilometres south of the James Price Point coastal area.

For the nearshore and offshore marine environment of the Kimberley, a total of 43 species occur in the region (Schodde and Tideman 1986). Conservation issues for these seabirds in the region relate to the use of nearshore and offshore feeding grounds by both resident and migratory species and the use of Kimberley islands and coastal environment as breeding and roosting areas.

With a mix of different seabird species in the region, food resources are partitioned on the basis of prey species and prey size for birds that may be nearshore or offshore feeders. Feeding by offshore pelagic species can be more opportunistic as birds take advantage of localised upwellings and the patterns of abundance of pelagic seabirds north-west of Australia tend to reflect the known patterns of nutrient enrichment and marine productivity (Dunlop *et al.* 1988).

The major seabird breeding islands off the Kimberley coast are Lacepede and Adele Islands (**Map 4**). These islands are important breeding grounds for colonies of Brown Booby (*Sula leucogaster*), Lesser Frigatebird (*Fregata ariel*), Caspian Tern (*Sterna caspia*), Common Noddy (*Anous stolidus*), and pelican (*Pelecanus conspicillatus*). Adele Island is a small 200 Ha islet approximately 100km north of Cape Leveque. It has an important closed lagoon that is used by migratory waders such as Red-necked Stints. Adele Island is an important breeding island for Masked Booby (*S. dactylatra*), Brown Booby's, Lesser Frigatebirds with records of breeding by Red-footed Booby (*S. sula*) and Great Frigatebird (*F. minor*).

The presence of specific seabird roosting or nesting habitat within the James Price Point coastal area is considered unlikely. This is based the limited availability of intertidal sand and mudflats and wetland habitats, however surveys would aim to clarify habitat availability and importance.

5.2.6.7 North-west Marine Region

The Commonwealth Government is in the process of Marine Bioregional Planning for Australia's Commonwealth waters under the *EPBC Act*. The initiative will see Marine Bioregional Plans, including a system of new Marine Protected Areas (MPAs), established in five marine regions (i.e. South-east, South-west, North-west, North and East Marine Regions). These new bioregional plans will also provide the platform for developing a National Representative System of Marine Protected Areas (NRSMPA) in Commonwealth waters around Australia. Importantly, the Marine Bioregional Planning process will help ensure that migratory species that pass through the region to important breeding or feeding sites are considered in the planning process. Examples of these species include humpback

whales that use the Kimberley to breed and calve, and migratory shorebirds and waders that use the RAMSAR wetlands of the Kimberley coast as a stopover point.

DEWHA released its North-west Bioregional Profile in 2008, as the starting point for developing a Marine Bioregional Plan for the Region, anticipated to be released in 2010.

Key ecological features in the North-west Marine Region (DEWHA 2008) have been identified by DEWHA on the basis of advice from scientists about the ecological processes and characteristics of the Region. The Commonwealth waters adjacent to Quondong Point was identified as one of 14 key ecological features of the North-west Marine Region, reflecting existing scientific knowledge suggesting that this is an area of enhanced biological productivity.

Waters surrounding Quondong Point are assessed by DEWHA to be an area of enhanced localised biological productivity, which supports large numbers of baitfish that in turn attract aggregations of seabirds and other marine life including turtles, dugongs and possibly sawfish. This area reflects the important linkages between biophysical and ecological processes occurring in both State and Commonwealth waters.

Humpback whales, as well as other cetaceans have been recorded in the waters around Quondong Point (DEWHA, 2008). Flatback turtles, which are known to nest at Barrow Island, have also been reported in waters here (DEWHA, 2008). The processes that give rise to these aggregations are not yet fully understood but may be associated with a unique combination of bathymetry and oceanography.

The physical and biological processes that result in enhanced biological productivity in this area are not well understood but may be associated with a unique combination of bathymetry and oceanography (DEWHA, 2008). It is concluded that further information, including those proposed as part of the LNG Precinct Strategic Assessment, will provide additional valuable information to better characterise the existing marine values of the area.

5.2.6.8 Commonwealth Protected Marine Fauna

A point search of the EPBC Act protected matters search tool was undertaken within 120 km north, 84 km east, 140 km south and 145 km west of the James Price Point coastal area on 20 April 2009 (**Appendix B**). The search identified 10 Threatened species (as listed below) as species or species habitat likely to occur within the area:

- Blue Whale (*Balaenoptera musculus*) – Endangered, Migratory
- Humpback Whale (*Megaptera novaeangliae*) – Vulnerable, Migratory
- Loggerhead Turtle (*Caretta caretta*) – Endangered, Migratory
- Green Turtle (*Chelonia mydas*) – Vulnerable, Migratory
- Leatherback Turtle (*Dermochelys coriacea*) – Endangered, Migratory
- Hawksbill Turtle (*Eretmochelys imbricate*) – Vulnerable, Migratory
- Flatback Turtle (*Natador depressus*) – Vulnerable, Migratory
- Freshwater Sawfish (*Pristis microdon*) – Vulnerable
- Green Sawfish (*Pristis zijsron*) – Vulnerable
- Whale Shark (*Rhincodon typus*) – Vulnerable, Migratory

The EPBC Act protected matters search also identified 52 wetland and marine migratory species (**Appendix B**) that may potentially occur within the area.

5.2.6.9 State Protected Marine Fauna

A search was undertaken on the 27 August 2008 of the Western Australia's Department of Environment and Conservation (DEC) Threatened Fauna database, *Wildlife Conservation (Specially Protected Fauna) Notice 2008 (2)*, which includes species which are declared under the *Wildlife Conservation Act 1950* (WA) as 'Fauna that is rare or likely to become extinct (Schedule 1)', 'Birds protected under an international agreement (Schedule 3)', and „Other specially protected fauna

(Schedule 4)'. A total of six marine species although not protected, are listed as Priority species by DEC.

Schedule 1 - Fauna that is rare or is likely to become extinct

- Humpback Whale (*Megaptera novaeangliae*)
- Blue Whale (*Balaenoptera musculus*)
- Masked Booby (eastern Indian Ocean) (*Sula dactylatra bedouti*)
- Green Turtle (*Chelonia mydas*)
- Leatherback Turtle (*Dermochelys coriacea*)
- Loggerhead Turtle (*Caretta caretta*)
- Hawksbill Turtle (*Eretmochelys imbricate*)
- Flatback Turtle (*Natador depressus*)
- Green Sawfish (*Pristis zijsron*)

Schedule 4 – Other specially protected fauna

- Dugong (*Dugong dugon*)
- Saltwater Crocodile (*Crocodylus porosus*)

Priority 1 & 2 – Fauna with few, poorly know populations

- Dwarf Sawfish (*Pristis clavata*)
- Northern River Shark (*Glyphis sp. C*)

Priority 3 – Fauna with several, poorly know populations

- Freshwater Sawfish (*Pristis microdon*)

Priority 4 – Fauna in need of monitoring

- Australian Snubfin Dolphin (*Orcaella heinsohni*)
- Indo-Pacific Humpback Dolphin (*Sousa chinensis*)
- Spinner Dolphin (*Stenella longirostris*)

5.3 Existing Terrestrial Environment

5.3.1 Geology

The Dampier Peninsula is located within the geological area known as the Fitzroy Trough; a major subdivision of the Canning Sedimentary Basin.

The Jarlemai sandstone is the oldest geological formation on the peninsula and is known to contain a large number of fossilised marine shells and dates from the Upper Jurassic to Early Cretaceous (150-120mya). The Broome sandstone overlays the Jarlemai formation. This early cretaceous formation is composed of cross-bedded sandstone, comprising quartz sand with a cemented matrix, and small conglomerates of marine origin.

5.3.2 Soils and Landforms

In addition to the pindan soils, which are the dominant soil type, the sandplains are also characterised by yellow sandy earths and yellow deep sands (Tille 2006). A general grading towards yellowish-grey sandplains typically occurs towards the northern tip of the peninsula, due to an increase in rainfall (Kenneally *et al.* 1996).

The region has a variety of different coastal landforms, including tidal mangrove mudflats, sandy beaches, sandplains with some dune systems and rocky outcrops. The Dampier Peninsula's sandplains are widespread, with the associated dune systems ranging in elevation from 10 – 150m AHD (Tille 2006). These sandplains are characterised by poorly organised drainage and occasional shallow, broad valley floors (Tille 2006).

At James Price Point six metre high soft Pindan Cliffs form the boundary of the shoreline along parts of this coast (Damara 2008). The landforms near James Price Point are a very simple environment of very gentle sloping surfaces with few incised drainage lines.

5.3.3 Groundwater Resources and Hydrogeology

Regionally, the main aquifer in use on the Dampier Peninsula is the freshwater bearing Broome Sandstone. The aquifer comprises fine to coarse grained largely unconsolidated quartzose sandstone, with minor beds of grey siltstone, thin coral seams and minor beds of gravel and pebbles. The aquifer has been recorded to a maximum thickness of 283 m and is underlain by an aquiclude comprised of Jarlemai Siltstone, thereby isolating the aquifer from the Alexander Formation and Wallal sandstone aquifers deeper below the surface.

The Broome Sandstone Aquifer is unconfined and recharged principally from rainfall infiltration and leakage from coastal dunes to the north of Broome (Laws 1991), although local recharge is likely to occur throughout the peninsula associated with a range of topographical features. These features include the Pindan Sands, Eolian Sandstones and Mellingo Sandstones.

The groundwater within the Broome Sandstone Aquifer is fresh (<250 mg/L TDS) for over 80% of the area of the aquifer. Salinities in excess of 30 000mg/L TSD can be reached adjacent to the Roebuck Plains (south-east of Broome) (Laws 1991).

5.3.4 Vegetation

5.3.4.1 Vegetation Communities

Vegetation surveys conducted in 2008 at James Price Point for the site selection process identified a total of 5 vegetation communities (**Map 4**). These were:

- Coastal Communities;
- Monsoon (Vine) Thicket;
- Coastal Heath;
- Pindan Woodland; and
- Ephemeral Wetlands.

The vegetation communities identified at Coulomb-Quondong Point (including James Price Point) by ENV (2008) are described at Table 5.1 below. Pindan woodland is the dominant vegetation type with coastal communities and monsoon (vine) thickets occupying a thin strip along the coastal boundary.

Table 5.1 Vegetation Community Descriptions

Vegetation Community Type	Description
Coastal Communities	Sparsely vegetated mobile foredunes usually feature <i>Spinifex longifolius</i> , along with the sedges <i>Fimbristylis cymosa</i> and <i>F. sericea</i> . Beach creepers include <i>Ipomoea pes-caprae</i> and <i>Canavalia rosea</i> . At Quondong and Coulomb Point stabilised dunes are dominated by scattered <i>Crotalaria cunninghamii</i> .
Monsoon Vine thickets	These discontinuous belts of vine thickets are found behind coastal dunes north of Broome, and are particularly well-developed at James Price Point. Vine thickets contain many fleshy-fruited plants, providing an important food resource for wildlife such as agile wallabies, bats, bower-birds and fruit-doves. They are also an important traditional resource for Aboriginal people. Northward through Quondong to James Price Point, there is a significant belt of vine thickets notable for the evergreen trees <i>Terminalia petiolaris</i> , <i>Diospyros humilis</i> , <i>Mimusops elengi</i> , <i>Celtis australiensis</i> , <i>Melaleuca dealbata</i> and, more rarely, the conservation Priority 4 species <i>Pittosporum moluccanum</i> at James Price Point.
Coastal Heath	These heathlands occur as linear bands, typically on exposed coastal cliffs (eg Emeriau Point, Flat Rock to James Price Point and Gourdon Bay), and are dominated by low, wind-pruned shrubs such as <i>Acacia monticola</i> and <i>A. tumida</i> .
Pindan Woodland	This community of the Dampier Peninsula dominates inland sandplains, developed over red and yellow soils with an annual rainfall over 500mm. Tree cover is relatively dense with an upper layer of eucalypts (<i>E. miniata</i> , <i>E. tectifica</i>), bloodwoods (<i>Corymbia dampieri</i>) and/or ghost gums (<i>Corymbia bella</i> , <i>C. flavescens</i>). A variably dense understorey of wattles includes <i>Acacia eriopoda</i> , <i>A. tumida</i> , <i>A. monticola</i> , <i>A. platycarpa</i> and <i>A. colei</i> . Grass species are similar to those in the pindan shrubland but also include annual <i>Sorghum</i> , <i>Heteropogon</i> and <i>Cymbopogon</i> . Many areas surveyed had been severely impacted by repeated fires.
Ephemeral Waters	These represent a mosaic of communities subject to ephemeral freshwater flooding and/or ponding. At Coloumb Point, north of James Price Point, drainage lines drainage lines are dominated by <i>Melaleuca alsophila</i> , <i>Pandanus spiralis</i> and <i>Eucalyptus camaldulensis</i> .

5.3.4.2 Threatened Ecological Communities

No Threatened Ecological Communities (TECs), as pursuant to the EPBC Act, are present on the Dampier Peninsula. However, under Western Australian listings, two TECs (listed as „vulnerable’) are identified as occurring within the region. These are noted as:

Community Type #67: Monsoon (vine) thickets– Vulnerable

These communities occur as semi-deciduous vine thicket communities on landward slopes of coastal sand dunes. The thickets tend to be patchily distributed, dense areas of remnant rainforest vegetation with the extent of their cover largely dependent on increasing adjacent sand dune size. Vine thickets are known to occur in the James Price Point coastal area. In this location, one community has been mapped as a continuous band, with its northern most boundary within 200m of the point (ENV 2008a). Another smaller vine thicket community is mapped approximately 3km north of James Price Point.

Community Type #85: Bunda Bunda – Vulnerable

There are two Bunda Bunda communities occurring as organic mound springs on the tidal mudflats of Carnot Bay, approximately 50km north of James Price Point. These mounds, up to 3m in height, have a peaty composition and comprise accumulated leaf litter which supports a dense closed canopy rainforest and tall shrubland.

5.3.4.3 Flora

A total of 717 species of vascular plants have been recorded on the Dampier Peninsula representing 122 families and 361 genera (Kenneally et al 1996). The most widely represented families include Poaceae, Papilionaceae, Cyperaceae, Euphorbiaceae, Mytaceae, Mimosaceae, Convolvulaceae and Malvaceae. Of these, 68 introduced species have been recorded, with the majority located on the northern tip of the peninsula (north of Beagle Bay) (Kenneally et al 1996).

A search conducted for conservation significant flora resulted in no species of Commonwealth significance being identified, however one species, *Keraudrenia exastis* was noted as Declared Rare under the Wildlife Conservation Act 1950. In a recent survey of the James Price Point coastal area only one priority species was recorded. This was *Pittosporum moluccanum* – Priority 4, located 2.5 km south of James Price Point.

In addition, a further 16 priority listed species were noted as potentially/previously been recorded on the western margin of the Dampier Peninsula (**Map 4**). These were:

Priority 1

- *Glycine pindanica* – a perennial Pindan herb, only known from occurrences on the western Dampier Peninsula.
- *Ipomoea* sp. A Kimberley Flora (L.J. Penn 84) – a creeping or twining perennial herb only known from a small area north of Broome.
- *Nicotiana heterantha* – a low, spreading herb, forming rosette colonies. Recorded from a number of coastal areas near Broome.
- *Tephrosia andrewii* – a tall shrub with a preference for Pindan soils. Known from a number of coastal localities south of Broome.
- *Tetragonia coronata* – an annual herb which prefers calcrete outcrops.
- *Aphyllodium parvifolium* – a trailing shrub to 30 cm tall, preferring Pindan soils.
- *Trachymene oleracea* subsp. *sedimenta* – an annual herb to 60 cm tall, preferring limestone and sandstone substrates.
- *Goodenia byrnesii* – a herb, found growing on the edge of watercourses.
- *Cullen candidum* – a shrub to 3 m. Has been recorded at the northern tip of the Dampier Peninsula.

Priority 2

- *Gomphrena pusilla* – a slender annual herb found in beach sand.
- *Nymphoides beaglenensis* – an aquatic annual herb, occurring at the edges of permanent waterholes or seasonally inundated claypans and depressions.
- *Pterocaulon* sp. A Kimberley Flora (B.J. Carter 599) – a compact shrub, occupying sand flats and Pindan sandplain.
- *Gomphrena cucullata* – a herb to 25 cm, found on sandy loams and clayey Dampierland sands.
- *Blumea pungens* – a perennial herb to 1.5 m, occurring on hills and plateaus.
- *Alysicarpus suffruticosus* – an erect shrub to 30 cm, occurring on Dampierland sandy clays.

Priority 3

- *Fuirena incrassata* – a sedge-like annual herb, preferring sand or a sandy clay substrate.
- *Keraudrenia katatona* – an erect shrub to 1 m. Found on Pindan desert dunes.
- *Phyllanthus aridus* – branched shrub to 25 cm, requiring a gravel or sandy substrate. Recorded from coastal areas of the Dampier Peninsula.

- *Stylidium costulatum* – a tufted annual herb occupying creeks or seasonally wet coastal areas of the Dampier Peninsula.
- *Triodia acutispicula* – a tussock-forming perennial of sandy soils, often associated with river banks, Pindan plains and rocky outcrops.
- *Aphyllodium glossocarpum* – shrub to 1.2 m, found on Pindan sands north of Broome.
- *Fimbristylis sieberiana* – a tufted, perennial grass-like herb.
- *Goodenia sepalosa* var. *glandulosa* – a prostrate to sprawling herb, inhabiting red sands and loams of the Dampierland.
- *Pityrodia oblique* – occurs on sandstone or quartzite rocky faces in mountain ranges. No known occurrences on the Dampier Peninsula.
- *Acacia glaucochaesia* – occurs on loams and clays of floodplains.

Priority 4

- *Pittosporum moluccanum* – a small tree to 6 m, occurring on sand dunes north of Broome.

Weeds

Weed species invasion has been identified by the WA DEC as a threat to biodiversity conservation on the Dampier Peninsula. Seventeen weed species were recorded on the Dampier Peninsula within the by ENV (2008) with Twelve weed species recorded within the Coulomb-Quondong (Including James Price Point) area. Three of these weed species, *Aerva javanica*, *Cenchrus ciliaris*, and *Passiflora foetida* var. *hispida*, have a high weed rating under the Environmental Weed Strategy for WA. Although not recorded within Coulomb-Quondong Point, *Sida cordifolia* is a Declared plant for all of Western Australia north of the Tropic of Capricorn under the *Agriculture and Related Resources Protection Act 1976*.

5.3.5 Fauna

The fauna of the Dampier Peninsula is not well known with very few comprehensive fauna surveys of the area having been carried out. In recent surveys conducted by ENV (2008a), two hundred and seventy-two fauna species were recorded. These consisted of seven amphibian species, 56 reptile species, 178 bird species and 31 mammal species. Of the 272 species recorded and believed to occur, 93 are protected under the Commonwealth *EPBC Act*, the State *Wildlife Conservation Act* and/or are listed as Priority species by the Department of Environment and Conservation. Eighty one species listed as Migratory or Marine under the EPBC Act were recorded or are known to occur in the survey areas. These include four reptiles – six Sea Turtle species, the Saltwater Crocodile (*Crocodylus porosus*), and 77 bird species recognised under international treaties such as CAMBA, JAMBA and ROKAMBA.

Fauna habitats are likely to fall into one of five categories, namely:

- 1) Mangroves;
- 2) Rainforest patches and Monsoon (vine) thickets;
- 3) Savannah Woodland;
- 4) Pindan; and
- 5) Wetlands (including perennial and seasonally ephemeral).

ENV (2008) recorded the following conservation significant fauna species within the survey areas (Table 5.2), it should be noted that these do not include listed migratory or marine species. The little Northwestern Mastiff Bat (*Mormopterus loriae cobourgiana*) was recorded within Coulomb Quondong (incl James Price Point) and it is likely that habitats for additional conservation significant fauna species would occur.

Table 5.2 - Conservation Significant Fauna Species Records

Common Name	Scientific Name	Conservation Significance	Recorded			
			Perp Head/ North Head	Packer Island	Coulomb - Quondong (incl James Price Point)	Gourdon Bay
Bilby	<i>Macrotis lagotis</i>	Vulnerable(EPBC) Schedule 1 (WC)				Lo
Little Northwestern Mastiff Bat	<i>Mormopterus loriae cobourgiana</i>	Priority 1 (DEC)		X	X	X
Lakeland Downs Mouse	<i>Leggadina lakedownensis</i>	Priority 4 (DEC)				X
Saltwater Crocodile	<i>Crocodylus porosus</i>	Schedule 4 (WC)	X			
Dampierland Burrowing Snake	<i>Simoselaps minimus</i>	Priority 2 (DEC)		X		
	<i>Lerista separanda</i>	Priority 2 (DEC)		X		X
Peregrine Falcon	<i>Falco peregrinus</i>	Schedule 4 (WC)				X
Eastern Curlew	<i>Numenius madagascariensis</i>	Priority 4 (DEC)	X			
Bush Stone-curlew	<i>Burhinus grallarius</i>	Priority 4 (DEC)	X	X		X
Australian Bustard	<i>Ardeotis australis</i>	Priority 4 (DEC)		Lo		X
Pictorella Mannikin	<i>Heteromunia pectoralis</i>	Priority 4 (DEC)				Lo
Gouldian Finch	<i>Erythrura gouldiae</i>	Endangered (EPBC) Schedule 1 (WC)		Lo		

Lo – Observation by local resident or traditional owner

5.3.5.1 Commonwealth Terrestrial Protected Fauna

A point search of the EPBC Act protected matters search tool was undertaken within 120 km north, 84 km east, 140 km south and 145 km west of the James Price Point coastal area on 20 April 2009 (**Appendix B**). The search identified eight Threatened species (as listed below) as species or species habitat likely to occur within the area:

- Red goshawk (*Erythrotriorchis radiatus*) – Vulnerable
- Gouldian finch (*Erythrura gouldiae*) – Endangered, Migratory
- Australian painted snipe (*Rostratula australis*) - Vulnerable
- Masked owl (*northern*) (*Tyto novaehollandiae kimberli*) - Vulnerable
- Mulgara (*Dasyurus cristicauda*) – Vulnerable
- Greater bilby (*Macrotis lagotis*) – Vulnerable
- Airlie Island ctenotus (*Ctenotus angusticeps*) – Vulnerable

- Great desert skink (*Egernia kintorei*) - Vulnerable

The EPBC Act protected matters search also identified four migratory terrestrial species (Appendix B) that may potentially occur within the area.

5.3.5.2 State Protected Fauna

Under the Western Australia Wildlife Protection Act 1950, a number of State protected fauna are given protection and are listed in the Wildlife Conservation (Specially Protected Fauna) Notice 2005. In consultation with the DEC, a desktop analysis of protected fauna was undertaken for the western Dampier Peninsula from Cape Leveque to Quondong Point. In addition to the Red Goshawk, Gouldian Finch and Bilby (listed as Schedule 1 – rare). The following threatened terrestrial species were also noted:

- Golden Bandicoot (*Isoodon auratus auratus*) – Schedule 1 (rare) (Also Listed as Vulnerable under the *EPBC Act*);
- Peregrine Falcon (*Falco peregrinus*) – Schedule 4

In addition to the species listed above, a number of priority listed fauna species were noted including:

- Little North-western Mastiff Bat (*Mormopterus loriae cobourgiana*) – Priority 1
- Snake species (*Simoselaps minimus*) – Priority 2
- Skink species (*Lerista separanda*) – Priority 2
- Bush Stonecurlew (*Burhinus grallarius*) – Priority 4

5.3.5.3 Subterranean Fauna

The WA DEC (2003) defines subterranean fauna as comprising both stygofauna and troglafauna. Stygofauna are aquatic subterranean animals, found in a variety of groundwater systems, while troglafauna occur in air chambers in underground caves or other smaller voids.

Studies of subterranean fauna in the Kimberley are largely limited to those in the eastern extent of the region, with no known surveys having occurred on the Dampier Peninsula. It is believed, however, that the occurrence of mound springs on the Peninsula may increase the probability of stygofauna occurring. There is currently little information on the availability of stygofauna and troglafauna habitats within the James Price Point coastal area and this would be clarified as initial geological and hydrological investigations are undertaken.

In accordance with EPA Guidance Statement No. 54 an assessment of the likely impacts of the proposal on stygofauna and troglafauna would be required if habitats are likely to be significantly impacted by lowering of the water table, changing water quality (including increasing salinity or nutrient levels) or destroying or damaging caves.

5.3.5.4 Short Range Endemics

Comprehensive reviews of different faunal groups often reveal the presence of short range endemic species (SRE's). Among the terrestrial fauna there are numerous regions that possess short-range endemics. Mountainous terrains and freshwater habitats often harbour short-range endemics, but the widespread aridification and forest contraction that has occurred since the Miocene has resulted in the fragmentation of populations and the evolution of many new species (DEC 2004).

Harvey (2002) considered that although there were occasional short-range endemics among the vertebrates and insects, there were much higher numbers among the molluscs, earthworms, some spider groups (especially the mygalomorphs), millipedes, and some groups of crustaceans (DEC, 2004).

SRE fauna are defined as arthropods that display restricted geographic distributions that may be disjunct and highly localised (nominally defined as < 10km² Land clearing in Harvey, 2002). SRE species such as land snails, earthworms and spiders are known to occur in vine thicket communities

in the Kimberley, and are likely to occur within vine thicket communities within the James Price Point coastal area (**Map 4**).

5.3.6 Threatening Processes

A threatening process in natural ecosystems is a process that detrimentally affects the conservation of native species or ecological communities (Lindenmayer & Burgman 2005). The identification and listing of a key threatening process is the first step to addressing the impact of a particular threat under Commonwealth law.

Currently there are 17 Key Threatening Processes listed under the EPBC Act. It should be noted that the Commonwealth list is not definitive and that local threats identified by state conservation agencies must be understood. Of the 17 listed Commonwealth threats and those identified as high priority by local Department of Environment and Conservation officers, the following have been identified as the high priority threats operating within the Dampierland bioregion:

- **Altered fire regimes:** Changes in the temporal and spatial scale of fire in the Dampierland bioregion may affect the conservation of terrestrial biodiversity through degradation of fire sensitive habitat, such as vine thickets, and the development of large areas of similar aged post-fire vegetation. The outcome of this process is a loss of habitat diversity. Inappropriate fire regime is considered a major biophysical threat against broad biodiversity conservation values of landscape, the protected area system, ecosystem and species-scale biodiversity assets.
- **Weed invasion:** Weeds are considered a major threat to the conservation of biodiversity assets on the Dampier Peninsula. The impact of invasive weeds on the condition of the Dampier Peninsula vegetation is not well quantified. Anecdotal information suggests that areas that are affected by networks of tracks in the southern part of the peninsula experience greater weed impacts than remote locations.
- **Grazing and trampling by introduced cattle:** In many parts of the Kimberley this is seen as a major threatening process affecting biodiversity assets. Recent unpublished reviews undertaken by DEC in suggest this may be of less concern on the Dampier Peninsula.

5.4 Existing Social Environment

The Kimberley region of Western Australia is large, environmentally varied and culturally diverse. According to the Kimberley Development Commission, the region covers an area of over 420,00 sq kilometres and has a relatively small population (approx 30,000), with a high percentage of Indigenous persons compared to other regions in Western Australia. The tourism, fishing, pearling and aquaculture industries are also recognised to form a critical part of the Kimberley economy and reflect the unique history, culture and lifestyle of the region.

5.4.1 Population

5.4.1.1 General population

The Kimberley Development Commission identified the estimated resident population of the Kimberley in 2007 as 34,270 (KDC 2008a). This represented 6 per cent of regional Western Australia's population and 1.6 per cent of the state as a whole. Over the past decade the population has been expanding rapidly and is, in fact, the second fastest growing region in the state (KDC 2008b).

The Shire of Broome is the Kimberley's largest population centre and 44.5 per cent of the Region's entire population in 2007; followed next by Shire of Wyndham- East Kimberley with 21.8 per cent (KDC 2008b).

Population estimates for the Dampier Peninsula predict that there is somewhere between 1100 and 1600 people living in this area. The residents of the Dampier Peninsula remains concentrated around the former Aboriginal missions of Lombadina and Beagle Bay, as well as Ardyaloon (One Arm Point) and Djarindjin (DPI 2008b). In addition approximately 74 discrete Indigenous communities are scattered across the Peninsula (DPI 2008b).

5.4.1.2 Indigenous Population

The Kimberley has a significant Indigenous population. The 2006 census recorded that 47.7 per cent of the population identified themselves as Indigenous compared with 3.5 per cent across Western Australia as a whole (KDC 2008b).

Over 95% of the residents on the Dampier Peninsula are Aboriginal (Dampier Peninsula Steering Committee 2005). A significant proportion of this fairly stable population live in small coastal communities, in remote camps and on outstations, some communities containing as few as 2 inhabitants. Some of these are identified in **Map 2**.

5.4.2 Employment

5.4.2.1 Regional Employment

Major occupations for residents in the Kimberley, and the Shire of Broome, are provided in **Table 5.1**. Results from the 2006 Census identified the dominant employment areas in the region to comprised of labourers (21%), professionals (15.6%), technicians and trade workers (13.5%) and managers (11.9%) (ABS 2008).

Table 5.3: Occupations of the Residents of the Kimberley Region (statistical division) and the Shire of Broome (local government area)

Occupation Generic Category	Shire of Broome % employed persons aged over 15 years (number)	Kimberley % employed persons aged over 15 years (number)
Professionals	17.0% (1013)	15.6% (2005)
Technician and Trade Workers	16.3% (934)	13.5% (1728)
Labourers	14.3% (850)	21.0% (2700)
Managers	13.0% (775)	11.9% (1526)
Clerical & Administrative workers	12.7% (755)	11.1% (1429)
Community & Personal Service Workers	11.8% (705)	11.5% (1474)
Sales Workers	7.7% (457)	6.0% (769)
Machinery Operators & Drivers	4.8% (288)	5.9% (756)

Source: ABS 2006 Census Data

Local government, administration, school education and accommodation were the most common industries for employment across the Kimberley, though no particular industry stood significantly above the rest (ABS 2008). Similarly no particular industry dominates the employment of residents of the Shire of Broome, the main areas identified by the 2006 Census were accommodation which accounts for 6.6% of employed people aged 15 years and over (394 individuals) and 6.2% (372) School Education (ABS 2008).

The labour force (total persons employed and unemployed aged 15 and above) of the Kimberley region in the March 2008 quarter is estimated to be 18,072 people (DLGRD 2008).

Unemployment levels in the Kimberley have historically been higher when compared with other regions of Western Australia. In March 2008 the unemployment rate for the Kimberley was 5.0 percent, compared with 3.0 percent for the state, and the 3.5 per cent rate for regional Western Australia (DLGRD 2008). The unemployment rate has been increasing steadily over the past year, in opposition to Western Australia's average unemployment rate which has, as a consequence of the tight labour market bought on by the economic boom, remained low and steady since March 2007 (Nicolaou 2008). **Figure 5.1** below compares the unemployment rate in the Kimberley with the

unemployment rates across regional Western Australia and the state as a whole from September 2005 to March 2008 (KDC 2006).

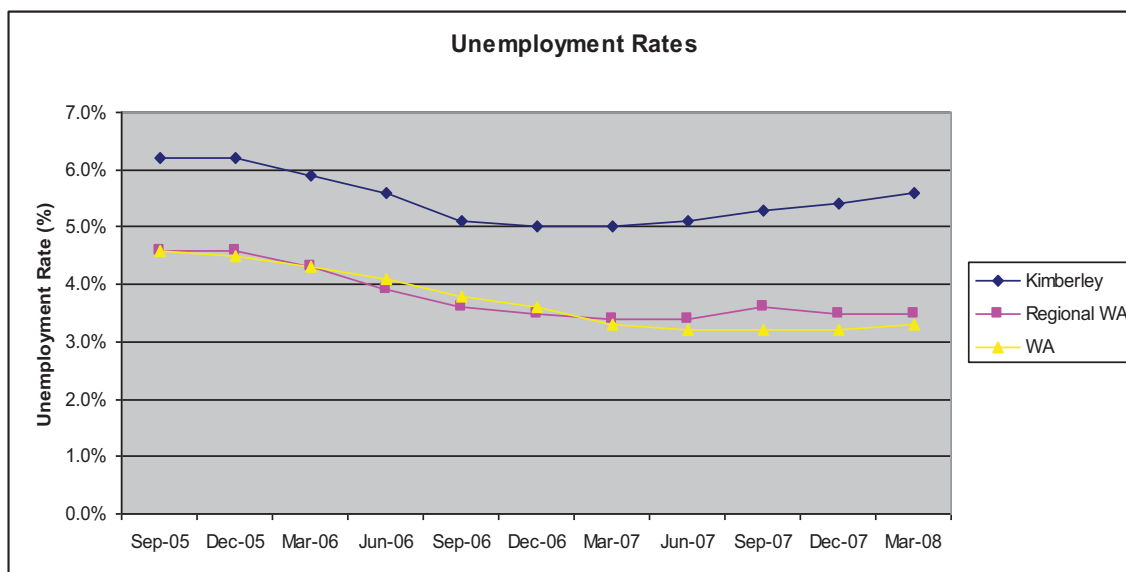


Figure 5.2: Quarterly unemployment rate comparison between the Kimberley, regional WA and WA

Source: DLRGD 2008

The Department of Education, Employment and Workplace Relations Small Area Labour Markets March 2008 report identifies that almost half of the of the Kimberley labour force is in the Shire of Broome, for the March Quarter 2008 this was 8348 people (DEEWR 2008).

The unemployment rates in the Shire of Broome followed a similar pattern to the Kimberley region as a whole, increasing from 4.5% in March 2007 to 4.9% for the 2008 March quarter (DEEWR 2008). The following table (**Table 5.4**) summarises the March 2008 quarter labour force and unemployment rates across the Kimberley by local government area.

Table 5.4: Labour force and unemployment rates in the Kimberley

Area	Labour Force (total number)	Unemployed (total number)	Unemployment Rate (%)
Shire of Broome	8348	406	4.9%
Shire of Derby-West Kimberley	4097	224	5.5%
Shire of Halls Creek	1677	205	12.2%
Shire of Wyndham-East Kimberley	4218	226	5.4%

Source DEEWR (2008)

5.4.2.2 Indigenous Employment

The labour force status of Indigenous people in the Kimberley is substantially different to that of non-Indigenous persons (ABS 2008).

Employment opportunities for Indigenous residents of the Kimberley tend to be around aquaculture, supported by the Kimberley Aquaculture Aboriginal Corporation (KAAC), fishing and tourism ventures. Indigenous owned and operated tourism businesses include eco-adventure businesses, cultural tours, commercial accommodation and service facilities (KDC 2006).

The pastoral industry is another significant sector of employment for Indigenous people in the Kimberley, 30% of all pastoral establishments are being operated by Indigenous people (KDC 2006). The pastoral industry provides career and training opportunities for remote Indigenous communities.

In particular a large number of Indigenous people participate in Community Development Employment Projects (CDEP), funded by the Commonwealth government. These aim to provide remote Indigenous communities with employment skills and development opportunities in order to become employed in mainstream work (KDC 2006).

5.4.3 Cost of Living

According to the 2007 Regional Prices Index, on average, prices in the Kimberley are 16.9 per cent more expensive than those in Perth (KDC 2008a). The Kimberley Development Commission publishes a table that identifies the % greater a product is when purchased in areas (Broome, Derby and Kununurra were the collection points) of the Kimberley than when purchased in Perth, the **Table 5.5** below demonstrates this comparison (KDC 2008a).

Table 5.5 Regional Price Index 2007: Locality Comparison

% Greater than Perth			
	Broome	Derby	Kimberley
Food	9.5	15.4	10.8
Clothing	1.9	15.9	5.2
Housing	31.8	4.9	27.1
Transportation	1.1	1.5	1.2
Health & Personal Care	1.8	5.2	2.5
Recreation & Education	43.5	47.4	44.3

Source: KDC 2008a

5.4.3.1 Housing

Western Australia has recently experienced a severe rise in the cost of housing. In line with these state wide increases housing and accommodation facilities in the Kimberley are experiencing increasing levels of strain (KDC 2008a). Demand pressures are resulting in significant challenges in accommodation availability and affordability, with a general upward trend in construction costs, established housing purchase prices and rental costs (KDC 2006).

The Regional Prices Index indicates the cost of housing across the Kimberley, particularly in Broome, is significantly higher than in the metropolitan area (KDC 2008a). The Department of Local Government and Regional Development identified the Kimberley as having housing costs at 127.1 per cent of Perth (DLGRD 2007), with home ownership being 10.7 per cent more expensive and renting 62.5 per cent higher than Perth (DLGRD 2007). Broome was identified as having housing costs at 131.8 per cent of the metropolitan costs (DLGRD 2007).

The tenure type of dwellings in the Shire of Broome area between 1996- 2006 is summarized in **Table 5.6**, with statistics revealing that the number of dwellings being purchased and fully owned increased significantly over this period (ABS 2008).

In parallel with these increases, the median price of houses in Broome almost doubled from \$359,000 in 2004 to \$685,000 in 2007 (KDC 2008a).

Table 5.6 Tenure Type by Dwelling Structure for each Kimberley LGA between 1996 to 2006

Tenure Type	Broome LGA		
	1996	2001	2006
Fully owned	1,404	1,901	1,997
Being purchased	474	823	987
Rented	1,841	2,479	2,322
Other tenure type	81	209	78
Tenure type not stated	509	544	1,188
Total	4,309	5,956	6,572

Source: Australian Bureau of Statistics 2008

Public housing availability is also under enormous strain, with in excess of 860 people on the Kimberley Region Waiting List in late 2007. The majority of applicants during this period comprised Indigenous people; a demographic constituting 70% of the region's tenants (Gibson 2007).

5.4.4 Industry

The major industries across the Kimberley are identified as minerals and petroleum, retail trade, tourism, construction, pearling and pastoral activities (KDC 2006). In Broome industry is more focused around tourism, pearling, fishing, aquaculture, pastoral and horticulture activities. Similarly the Dampier Peninsula contains horticultural, pastoral, aquaculture and eco-tourism activities (DPI 2008a). Key industry areas are discussed in the sections below.

5.4.4.1 Mining

The mining activities in the Kimberley are diverse and include diamonds, iron-ore, nickel, crude oil and rock (KDC 2006). Mining is by far the largest revenue earner in the region (Rangelands NRM Coordinating Group 2004). In 2004/2005 \$660.6 million represented the value of the mining activities in the Kimberley (KDC 2006). However, it is important to note that a significant portion of this revenue is attributable to Argyle Diamond Mine (\$430.1 million), and the Savannah nickel project (\$122.5 million) which are located in Wyndam-East Kimberley and Halls Creek local government areas respectively (KDC 2006).

No major mining projects occur within the Shire of Broome, however over the last two decades some mineral exploration has occurred. In the main the Broome townsite is being utilized to support the mining industry, with the port serving as a supply base and the town having an increasing flow of fly-in and fly-out traffic (WAPC 2004).

On the Dampier Peninsula there are mineral sands resources at Coulomb Point and James Price Point, however, development of these resources has been limited due to access difficulties (WAPC 2004). It has been suggested that the kinds of minerals present in these sands makes this resource of negligible commercial interest (DPI 2008b). Materials utilized for building such as rock, clay, gravel and limestone are found on the Mt Yowlaenga and Yeeda Stations, and silicified Melligo Sandstone is quarried in this area (DPI 2008b).

There are a number of mineral exploration licenses in place across the Peninsula (DPI 2008b). The location and type of these can be seen in **Maps 2 and 3**.

5.4.4.2 Agriculture

Agricultural ventures cover almost half of the Kimberley's land mass, that is 23 million hectares (KDC 2006). However the value of this industry to the economy has experienced dramatic fluctuations, rising from \$71.6 million in 1994-1995 to \$126.8 million in 2000, and falling again to \$95.9 million in 2003-2004 (KDC 2006).

Agriculture in the Kimberley is largely dominated by horticulture and the pastoral industry (KDC 2008a). Horticulture centres around the Ord River Irrigation area, 14,000 hectares of developed land around Kununurra in the north east (KDC 2008a). In addition, there is a small horticultural industry operating near Broome and Derby, producing products such as mangoes, melons, bananas and pasture seeds (KDC 2006).

On the Dampier Peninsula there are small horticultural and agroforestry businesses. In close proximity to Beagle Bay is a small orchard and vegetable garden, which this has now become part of a TAFE training program (DPI 2008b). In addition, plantations of Indian sandalwood, teak, Indian rosewood and African mahogany have been proposed in, and around the Beagle Bay reserve. As yet none of these plantations have been progressed beyond the trial stage (DPI 2008b). In the same area a crop of the billygoat plum (also called *Gubinge* (Bardi) and *Kabinyn* (Nyul Nyul)) is currently in the development stage and a cooperative of seven landholders has been established in an effort to develop this industry further. The plums are currently sold as a health food supplement to the North American market. Recently the Department of Agriculture estimated that 100 tonnes of fruit could be picked from existing native trees on the Peninsula if the right measures are put in place (DPI 2008b).

In addition to the horticulture trade the pastoral industry is a long established industry in the Kimberley region; in 2004/2005 the Department of Agriculture estimated there were 100 pastoral stations (KDC

2006). In this period approximately 30 per cent of the state's beef cattle, 600,000 animals, were in the Kimberley herd and the value of cattle disposals was up to \$70 million (KDC 2006).

Historically, the Dampier Peninsula has similarly been utilised for pastoral activities. The first pastoral leases, which covered much of the Peninsula, were taken up in 1890. Today only three pastoral leases operate in the south portion of the Peninsula at more than 50 km to the west and south-west of James Price Point; Yeeda, Mt Jowalaenga and Country Downs, these cover an area of approximately 420,000 hectares (DPI 2008a). These are shown on **Maps 2 and 3**.

Indigenous Agriculture

The James Price Point coastal area has Indigenous food products ("bush products") that are harvested for use by local Indigenous people. The main species targeted for "bush tucker" commercial sales is the Gubinge (*Terminalia ferdinandiana* (Excell)), or bush plum. A number of families from the Traditional Owner claimant group in the James Price Point area participate in commercial harvesting as part of the Kullari Australia Co-operative.

T. ferdinandiana flowers at the end of the dry season (September–November) and fruits from the middle of the wet season (January–June) to the early part of the dry season, depending on location. It is harvested by members of Kullari Australia from coastal woodlands and vine thickets. The harvest stretches along a 350 km coastal band starting at One Arm Point in the North to Bidyadanga in the south. (Kullari 2009)

5.4.4.3 Commercial Fishing

The fishing industry in the Kimberley is diverse, and includes significant catches of wild stocks (KDC 2008a). The primary focus is on finfish, particularly emperors, snappers and cods (KDC 2006), and prawns (Department of Fisheries 2008). In the 2004/2005 season catches of finfish and prawns contributed 98 per cent of the economic value of the Kimberley fishing industry. Across the board it was estimated that there was a catch of 2426 tonnes with a value of \$13.5 million (KDC 2006).

The Kimberley has a number of limited-entry trawl fisheries for prawns. Across the Kimberley the prawn fisheries tend to be dominated by banana, tiger and endeavour prawns. In the Broome region the focus is on western king and coral prawns (KDC 2006).

Other significant fish species include Spanish mackerel, barramundi, threadfin salmon and shark (KDC 2006), and mud crabs.

A number of Western Australian State managed and Commonwealth managed fisheries operate in the coastal inshore waters of the Kimberley (Department of Fisheries 2008). Commonwealth fisheries are those within the 200 nautical mile Australian Fishing Zone (AFZ) managed by Australian Fisheries Management Authority (AFMA) and are, on the high seas, and, in some cases, by agreement with the States and Territory, to the low water mark. State fisheries are managed by the Western Australian Department of Fisheries either with specific management plans, management through regulations or a variety of subsidiary legislations under the *Fish Resources Management Act 1994*. These Commonwealth and State fisheries occur extensively throughout Kimberley waters, some in the vicinity of James Price Point as shown on the **Map 1**. The full list is provided below:

Commercial Fisheries in State Waters:

- Broome Prawn Managed Fishery (western king prawns and coral prawns)
- Kimberley Gillnet and Barramundi Managed Fishery (barramundi, giant threadfin salmon and clue threadfin salmon)
- Northern Demersal Scalefish Managed Fishery (tropical snapper, emperors and groupers)
- Mackerel Managed Fishery
- Northern Shark Fishery
- Pearl Oyster Managed Fishery (wild stock fishery for pearl oysters)
- Marine Aquarium
- Beche-de-mer Fishery (sea cucumbers or trepang).

Commercial Fisheries in Commonwealth Managed Waters:

- Southern Bluefin Tuna Fishery
- Western Skipjack Tuna Fishery
- Western Tuna and Billfish Fishery

5.4.4.4 Aquaculture

Aquaculture is emerging as an increasingly important industry for the Kimberley. Cultured pearling is the most predominant, and well established, section of this industry. Since the 1880s the pearling industry has played a significant role in the Kimberley and the Shire of Broome's economy (KDC 2006). In 2006/2007 pearling was valued at \$92.5 million (KDC 2008a).

With Broome originally established as a pearling port (Broome Visitors Centre 2008) it continues to be inextricably linked with the pearling industry. Today, not only is pearling a significant contributor to the economy but the history of pearling, pearls and the pearling farms serve as a major tourist attraction (Broome Advertiser 2006).

Pearling has been carried out on the coast of the Dampier Peninsula since the industry's establishment and remains a significant sector today (DPI 2008b). There are major operations at Cygnet Bay, Beagle Bay and Deepwater Point, the locations of which are identified in **Map 1**.

The Department of Fisheries has identified significant potential for diversifying aquaculture on the Dampier Peninsula. Although there are various limitations, such as infrastructure availability and access to sites during the wet season (Department of Fisheries, cited in DPI 2008b), there are however a number of trials underway, including a trochus hatchery and research facility at Ardyaloon (DPI 2008b).

5.4.4.5 Tourism

Tourism is a significant contributor to the Kimberley region's economy. The Kimberley Development Commission identifies significant draw cards as "major populations centres and natural attractions such as the Buccaneer Archipelago, Cable Beach, Cape Leveque, Geikie Gorge National Park, Lake Argyle, Manning Gorge, Mitchell Falls, Purnululu (Bungle Bungle) National Park, Windjana Gorge National Park, and the Wolfe Creek meteor crater" (KDC 2006, page 5).

It is estimated by Tourism Western Australia that averaged across 2005, 2006 and 2007 the value of tourism in the Kimberley annually was \$257 million (KDC 2008a). During this period there were 346,600 overnight visitors to the region per year, staying a total of 2,808,300 nights (KDC 2008a). A large portion of these are domestic tourists, it is estimated that 86 per cent of visitors over the 2005-2007 period came from Western Australia or interstate (Tourism Western Australia 2008).

July to December is the peak period for tourism; 40 per cent of domestic visitors travelled to the Kimberley from July through to September, and a further 26 per cent visit from October to December. International visitors tour throughout this period (KDC 2006).

In Broome tourism is considered the major industry, with tourists travelling to this area since the 1970s. Broome has its own attractions, such as Cable Beach and world famous pearl jewellery, but also tends to provide a base for the exploration of the wider Kimberley area (Rangelands NRM Coordinating Group 2004).

In 2007, approximately 30,000 people visited the Dampier Peninsula. Even so, these numbers are impeded by the primitive nature of the Cape Leveque Road, the Department of Planning and Infrastructure has predicted that sealing this road „would lead to an increase in the number of tourists visiting the area' (DPI 2008a).

5.4.5 Community Infrastructure

5.4.5.1 Water Supply

Broome's water supply is obtained from bores screened in the unconfined Broome Sandstone aquifer north east of the town. The aquifer provides a large resource of high quality water. With proper management, it is expected that it will support Broome's continued strong population growth.

The aquifer is recharged directly from rainfall. This makes it vulnerable to contamination from inappropriate land uses (Water and Rivers Commission, 2001).

On the Dampier Peninsula, water is sourced from the Broome Aquifer. Bores are installed and fitted with small treatment systems by contracted parties to support the remote communities.

Broome water supplies are controlled by the Water Corporation (KDC 2006). The supply of water in remote areas is often also provided by the Water Corporation, but is supplemented by the Remote Areas Essential Services Program (RAESP) which services a number of aboriginal communities (KDC 2008).

5.4.5.2 Power

Energy is supplied to the Kimberley's urban centres by Horizon Power, in all except Kununurra and Wyndham, where hydro-electric power is utilized and diesel oil generators are used (KDC 2006).

In 2004 the State Government started a project to update existing power stations in Broome, Derby, Fitzroy Crossing, Halls Creek and Camballin-Looma in an attempt to ensure the growing energy needs of the Region are met (KDC 2006). The new 76 MW Broome Power station became operational at the beginning of 2008.

Power supply to remote areas in the Kimberley is provided by the State Government Aboriginal Community Remote Area Power Supply (RAPPS) program, which provides rebates for renewable power systems in off-grid areas (KDC 2008).

On the Dampier Peninsula Horizon power recently established 50kW diesel power stations at Ardyaloon, Beagle Bay and Lombadina/Djarindjin (DPI 2008b). These power stations have been designed to allow for expansion by adding additional modules where required (DPI 2008b). Individual outstations tend to have individual power generators, but can also apply to Horizon Power to be integrated into the grid serviced by these stations (DPI 2008b).

5.4.5.3 Waste Management

The Shire of Broome manages a waste management facility, located 9km from the town of Broome on the Broome Highway. Through contracted service providers, the Shire provides weekly household refuse collection services and also provides a comprehensive recycling service.

There are no centralised or shared waste collection or management on the Dampier Peninsula. Instead each main community, and many outstations, have their own tips (DPI 2008b).

5.4.5.4 Telecommunications

Telecommunications within the Kimberley region are varied, including television, phone linkages, radio and internet facilities, however the scattered nature of the small towns of the Kimberley makes communication infrastructure a major challenge (KDC 2006).

The urban centres have access to various television and radio stations, ABC and SBS national television, WIN and GWN commercial television, ABC Regional Radio, ABC Radio National, commercial WAFM and North West Radio. In addition GTV 35, a community TV station, is in operation in Broome (KDC 2006). There are a couple of community radio stations, such as Goolarri radio and Imparja, which are available in some remote communities (KDC 2006).

The Broadcasting for Remote Aboriginal Communities Scheme (BRACS), introduced in 1987, provides for the re-transmission of television or radio services, including local Indigenous content, within many Indigenous communities (KDC 2006).

Major towns, and several mining operations, have access to digital mobile phone services. In remote communities there is a growing Community Phones Program which allows incoming calls, outgoing calls can be made by utilising a Country Calling Card (KDC 2006)

The Higher Bandwidth Incentive Scheme (HiBIS) allows people to access broadband technology in regional and remote areas at a comparable cost to metropolitan areas and a growing number of communities have access to Integrated Services Digital Network (ISDN) The ISDN network enables local call access to the Internet (KDC 2006).

5.4.5.5 Transport

The wide distribution of the communities across the Kimberley makes a comprehensive transport system critical for community and business survival (KDC 2006). The transport network in this area is made up of sea, air and road infrastructure, with a particularly heavy reliance on road transport (KDC 2006).

Land Transport

There are approximately 7800 kilometres of roads servicing the Kimberley region (KDC 2006), including local unsealed and sealed roads, main roads as well as national and state highways. However, consistent access and use of these roads is limited due to heavy rains isolating sections of the road network. **Map 3** shows the major access roads across the Kimberley and the Dampier Peninsula (KDC 2006).

The Great Northern Highway provides a sealed link across the Region, linking the North West Coastal Highway in the Pilbara region, to the Northern Territory in the north-east (KDC 2006). It provides a major transportation route from Broome to Derby, Fitzroy Crossing, Halls Creek and north to Kununurra and Wyndham. Beyond the Highway the unsealed Gibb River Road, linking Derby and Kununurra, also provides an important transport route, while numerous unpaved dirt roads service the smaller remote areas in the West Kimberley.

Road access to the Peninsula is generally via the Broome-Cape Leveque Road. This 220km road is sealed on the northern half but remains unsealed from just south of Manari Road for 90km down to just south of Beagle Bay (DPI 2008b). This means that the road is trafficable during the dry season but can be treacherous, particularly the unsealed section, during the wet season (DPI 2008b). From 2000 to 2005 there were 50 reported accidents, including 2 fatalities, on this road (DPI 2008b). The Shire of Broome is responsible for the maintenance of this road and receives however Main Roads has predicted it would cost \$40million to seal the south section (DPI 2008b). Traffic has increased significantly on this road over the last 15 years, which may be attributable to an increase in tourist establishments and day visitors (DPI 2008b).

Other tracks and roads branch off Broome-Cape Leveque Road to main communities, outstations, pearling operations, areas of cultural importance, recreational sites and fishing spots (DPI 2008b). Of these, Manari Road, Pender Bay Road and Kinney Road are dedicated roads vested in the Shire of Broome.

Manari Road is a corrugated, unsealed road that stretches 55km north to Manari, terminating at the southern boundary of Coulomb Point Nature Reserve. A track, which is only accessible during dry season, extends from the end of this road through to Beagle Bay (DPI 2008b).

The Nillibubacca Track joins the Great Northern Highway, near the Shire of Derby-West Kimberley border, and the Broome-Cape Leveque Road running through Yeeda Station and Beagle Bay Reserve. It is used as a shortcut from Derby but is also becoming increasingly popular with tourists (DPI 2008b). It provides better access than Broome-Cape Leveque Road but does tend to be impassable during the wet season (DPI 2008b).

Sea Transport

Transport via sea was historically the major mode of transport for the Kimberley, via Broome, Derby and Wyndham ports. These ports continue to function as major trade links, operating as gateways for imports and exports in the Kimberley region (KDC 2006). The Port of Broome is widely operated as trading facility, with cattle, mining and agricultural commodities exported, and general cargo and fuel imported. Tourism vessels, navy, fishing and pearling vessels also frequently use the Port of Broome. Due to its 2006 upgrades, the Port of Broome can accommodate vessels of 50,000 tonnes, which provide the cruise ships with a stopover point to the region.

Near the main communities on the Dampier Peninsula there are several places where boats can be launched off the beach. In addition the pearling operations in this area have private boat launching facilities (DPI 2008b).

Air Transport

There are major airports at Broome, Derby and Kununurra. The Broome Airport is an international airport that has regular services to Australian capital cities (KDC 2008b). Through the 2007/2008 financial year the Broome airport handled more than 380,000 passengers (Broome International Airport 2008).

Air travel to the Dampier Peninsula is for tourism, emergency services, medical services, pearl farming and industry exploration. There are a number of light aircraft air strips located near the main communities, these are shown on **Map 1**. **Table 5.7** below provides a summary of the length and standard of each of these airstrip (DPI 2008b).

Table 5.7: General-purpose Landing Strips on the Dampier Peninsula

Landing Strip	Length	Standard	Current Status
Ardyaloon	1190m	Unsealed, emergency flares	Maintenance required
Cape Leveque	1200m	Unsealed	Fully operational
Djarindjin/Lombadina	1290m	Sealed, lights	Fully operational
Beagle Bay	1000m	Unsealed, portable lamps	Maintenance required

Source: DPI 2008b

5.4.6 Community Services

5.4.6.1 Health

A number of medical facilities are located throughout the Kimberley, including hospitals, small community clinics and the Royal Flying Doctor Service (KDC 2006). Major hospitals are located in Kununurra, Fitzroy Crossing, Halls Creek, Wyndham and Broome. The number of public hospital beds as at December 2007 was 135, accounting for approximately 4.1 beds per 1000 people. During this time, the maximum number of licensed private hospital beds was 10 (DLGRD 2008).

Specialist services in the region include mental health and rehabilitation services, a renal dialysis facility and aged care facility. In Broome there is a satellite dialysis facility, managed by the Broome Regional Aboriginal Medical Service, that enables up to 40 patients per week to receive treatment. Mental health and drug and alcohol services are provided by the North West Mental Health Service and Kimberley Community Drug Service Team (KDC 2008a).

In more isolated areas of the Kimberley, community and public health services are available, specifically operating as the Kimberley Remote Area Health Services (RAHS) and are sited in the Dampier Peninsula. Nursing and health points which report to the Kimberley RAHS include:

- Lombadina RAHS; and
- One Arm Point Community RAHS (Department of Health 2008).

While there are currently three small clinics on the Dampier Peninsula, WA country health are currently consider establishing a „super-clinic‘, a better resourced single service in Djarindjin (DPI 2008b).

The Royal Flying Doctor Service, which is based in Derby, supports the region by conducting routine clinical and medical consultations and providing a 24 hour on call aero-medical service (KDC 2006).

Many Indigenous communities in the Kimberley have limited access to adequate health services due to their remoteness. Various factors have led to poor health status and higher than average morbidity and mortality rates for remote indigenous population (Taylor 2008).

Taylor (2008) noted chronic diseases including cardiovascular, cancer, chronic pulmonary and diabetes as the dominant causes of morbidity and mortality rates for Indigenous Australians in the West Kimberley region (**Table 5.8**). His investigations identified diabetes and related renal diseases as having the largest difference in mortality and morbidity rates between non-indigenous and Indigenous people in the West Kimberley.

Table 5.8 Indigenous Mortality Rates in the Broome and Derby-West Kimberley Shires for Selected Major Health Conditions, 1994 – 2003

Cause of Death	Broome		Derby-West Kimberley	
	Number	ASR	Number	ASR
Circulatory disease	49	321.2	116	568.4
Respiratory disease	13	63.1	31	136.5
Diabetes and Renal	12	73.6	30	148.6
Injury and Poisoning	32	87.3	65	160.6

Source: Taylor 2008

5.4.6.2 Education

5.4.6.2.1 Pre-School and Child Care

There are eight schools within the Shire of Broome that offer kindergarten and primary school education. The schools are:

- Broome Primary School
- Cable Beach Primary School
- Djarindjin Lombadina Catholic School
- La Grange Remote Community School
- One Arm Point Remote Community School
- Roebuck Primary School
- Sacred Heart School
- St Mary's College

There are six childcare facilities in the Broome Shire, two of which offer out-of-school care.

5.4.6.2.2 Primary and Secondary Education

Schools in the Kimberley are operated by both government and non-government authorities, providing education for primary to secondary students. Government schools in the Kimberley are serviced by the Kimberley District Education Office. Facilities under the jurisdiction of the office include:

- 24 government schools;
- A senior high school, located in Broome;

- The largest district high school in Kununurra;
- 4 district high schools;
- primary schools, located in Broome;
- 13 remote community schools;
- The Kimberley Camp School; and
- The Kimberley School of the Air. (Kimberley District Education Office 2008).

The Catholic Education Office of Western Australia provides education to secondary level at St Mary's College in Broome, with primary school education programs to Year 7 offered in Derby, Red Hill, Gibb River, Wyndham and Kununurra (KDC 2008b).

5.4.6.2.3 Post-secondary Education

Post-secondary educational facilities in the Kimberley include the Kimberley College of TAFE, located in Broome, Derby, Fitzroy Crossing, Halls Head, Kununurra and Wyndham. In addition the University of Notre Dame and Edith Cowan University are both located in Broome (KDC 2008b).

5.4.6.2.4 Education in Broome

Statistics from the 2006 Australian Bureau of Statistics (ABS) suggest that the proportion of Broome residents of high school age is comparatively smaller than the proportion of younger children (0-9 years) and young adults (20-29 years). This observation is evident in the Age and Sex profile for the Shire of Broome, provided below.

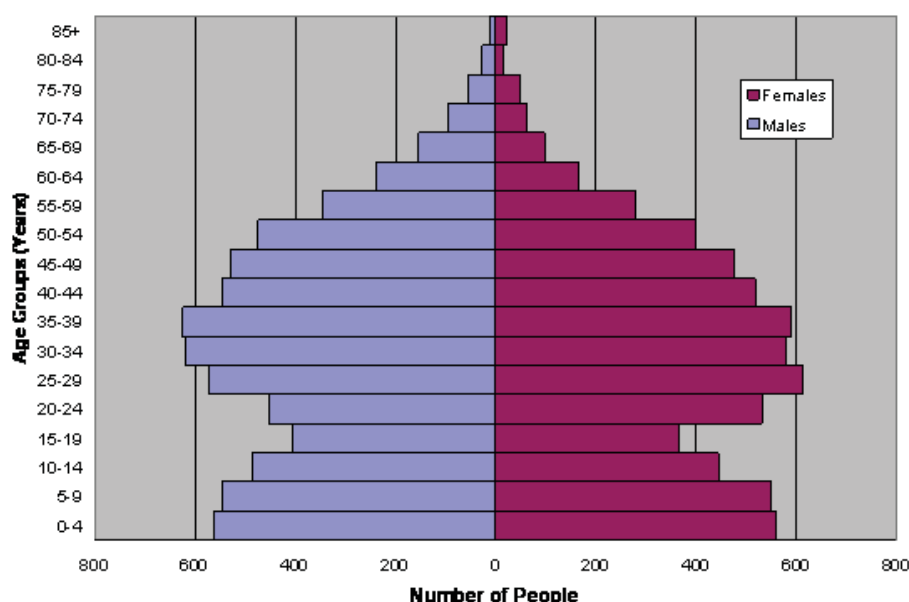


Figure 5.3: Shire of Broome Age and Sex Pyramid

The Kimberley Development Commission (2009) notes that many students from the Kimberley elect to complete their study in Perth or other regional centres, and are assisted by the Student Assisted Travel Scheme operated by the State Government (KDC 2009).

5.4.6.2.5 Indigenous Training

According to the Western Australian State Training Profile 2009-2011, low literacy skills are reflected in the low demand for higher level qualifications at the Kimberley TAFE. However, demand is increasing in the areas of child care and business skills for the aquaculture industry.

The Western Australian State Training Profile 2009-2011 also highlights that the newly funded mobile training unit to be based in Halls Creek may assist with meeting training needs in remote areas (State Training Board and Department of Education & Training, 2009). Infrastructure to support flexible delivery is being rolled out; however there are difficulties associated with accessing suitable accommodation for staff in remote communities. Indigenous students often do not attend classes due to various reasons including participation in cultural events.

The Kimberley TAFE uses short courses to encourage Indigenous students to move into longer training programs, however there is a need for continual support and literacy and numeracy

assistance. The region has demonstrated some progress, with more Indigenous students completing Years 11 and 12, which could subsequently result in increased engagement with the Vocational Education and Training Sector.

Edith Cowan University has a School of Indigenous Studies in Broome and its Indigenous University Orientation Course is designed for indigenous students who wish to gain access to tertiary studies (KDC 2009). The University of Notre Dame in Broome also offers certificates and diplomas in the Aboriginal Studies and a Masters program in Aboriginal Education.

5.4.6.2.6 Indigenous Education

Taylor (2006) identified that in 2006 almost half of the enrolments in schools in the Shire of Broome were Indigenous students, with schools on the Dampier Peninsula, such as One Arm Point Remote Community School and Djarindjin Lombadina Catholic School have almost exclusively Indigenous attendees (Taylor 2006).

While enrolment rates for Indigenous children have risen significantly, to be similar to those of non-Indigenous children, there is a significant difference in rates of attendance. Many Indigenous students enrolled in school in the Kimberley do not attend school regularly, and as such do not progress in line with expected achievement through the grade levels (Taylor 2006). This leads to a large portion of Aboriginal students not completing the milestones of year 10 and year 12 (Taylor 2006).

According to the 2006 ABS Census, the percentage of non-Indigenous Kimberley residents (aged 15 years and over) who have completed Year 12 (46.4%) is on par with Western Australia as a whole (41.4%). A considerably smaller proportion of Indigenous Kimberley residents (15.1 %) have attained this level of education. However, this figure does represent an increase since the 2001 census, which indicated only 12.4% of Indigenous residents (aged 15 years and over) had completed Year 12.

5.4.7 Land Tenure

Throughout the Kimberley region, the majority of land is held under pastoral lease (KDC 2008a). Approximately 224,000km (over 50 per cent of the region) has been classified primarily for grazing stock (KDC 2008a), with the remaining portion of the Kimberley being Crown Land, Aboriginal reserve, conservation estate or freehold land in the major urban areas (KDC 2008b).

On the Dampier Peninsula, land tenure is a complex mix of:

- Aboriginal Reserves (vested in the Aboriginal Lands Trust)
- Aboriginal Land Trust leases to Aboriginal corporations
- Aboriginal corporations sub-leases issued to families for the establishment of outstations
- State Land Service leases to Aboriginal corporations and other entities such as pearling companies
- Pastoral leases
- Limited freehold land (primarily owned by the Catholic Church, Cygney Bay Pearls and Kooljaman Resort).
- Conservation estates (includes Coulomb Point, Swan Island and Lacepede Islands)
- Public purpose reserves (for example Cape Leveque Lighthouse and Bungarragut Pool on the Fraser River)
- Unallocated Crown Land

These are shown on the **Maps 1 and 2**.

Across the Dampier Peninsula there are also areas of 'permissive occupancy', areas where family groups reside for considerable periods of time with permission but without formal tenure (DPI 2008b).

According to the Department of Indigenous Affairs (2008), there are approximately 65 Aboriginal communities and homeland settlements, or outstations, throughout the Dampier Peninsula region. These Aboriginal communities cover several groups and are located on different land tenure arrangements. For example, Beagle Bay is known to be on Nyul Nyul Aboriginal land and the community is part of the Beagle Bay Aboriginal Reserve which is administered by the Aboriginal Lands Trust (ALT) of Western Australia.

Over half of the Dampier Peninsula area is administratively known as Aboriginal land and this includes the Beagle Bay and One Arm Point Aboriginal Reserves, the Coulomb Point Nature Reserve and the Carnot Bay Reserve. The Beagle Bay Aboriginal Reserve, for example, spans the northern region of peninsula and covers an area of land spanning from Carnot Bay north to Pender Bay on the west coast and travelling across the peninsula to and area south of Goodenough Bay on the east coast.

Informally, land on the Dampier Peninsula is largely used by Indigenous people who live on and access the land for purposes such as hunting, fishing, and the operation of small concentrated eco-tourism activities (DPI 2008a). The Peninsula is also networked with a number of four wheel drive access tracks, making it a popular destination for self sufficient tourists. In particular, the area surrounding Quondong Point is a major focal point for camping and recreational activities on the peninsula, with fishing a common occurrence along the sandy beaches.

5.4.8 Terrestrial Conservation Areas

The Class A Coulomb Point Nature Reserve is the only gazetted conservation area on the Peninsula, occupying 28,676 ha. The roughly rectangular shaped reserve is situated on the western coastal margin of the peninsula between Cape Bertholet and Coulomb Point and lies approximately 80 km north of Broome as shown on the **Map 1**.

A proposed “Reserve for Conservation and Aboriginal Heritage” occurs to the south and east of the Coulomb Point Nature Reserve as outlined in the then Department of Land Administration’s (now Department of Land Information) Waterbank Structure Plan (DOLA 2000). Discussion is still ongoing between the Kimberley Land Council and State government to secure tenure arrangements for this area.

Located to the south of Broome, Roebuck Bay is a listed RAMSAR wetland of international significance, as shown on **Map 1**. Roebuck Bay is located approximately 60 km to the south of the James Price Point coastal area and is considered to provide important habitat for migratory bird species. Eighty Mile Beach, at approximately 180km south of James Price Point is also listed as RAMSAR wetland.

5.4.9 Native Title

The *Native Title Act 1993* (Cth) (NTA) provides a legal process to formally recognise that some Indigenous people continue to hold rights in relation to land and waters in Australia. Native title can be proven to exist where Indigenous people can demonstrate they have maintained a connection to land and waters since sovereignty and where this has not been affected by acts of government.

There are currently 22 claims in the Kimberley region, 19 of which are represented by the Kimberley Land Council (KLC). To date, 11 of the 21 native title determinations that have occurred in WA are in relation to approximately 45% of the Kimberley (ref: Office of Native Title website). The claims in relation to Broome and the Dampier Peninsula include Rubibi (determined), Goolarabooloo Jabirr-Jabirr, Djaberra Djaberra and Bardi Jawi (determined, subject to appeal in the Full Federal Court).

The KLC is the recognized native title representative body, pursuant to the NTA and as a result receives funding from the Commonwealth Government to assist in performing its functions under the NTA.

The KLC was formed in 1978 and was one of the first Aboriginal land rights organizations in Western Australia. This was at the time of the high profile Noonkanbah dispute which resulted in Aboriginal people blockading the drilling of an Aboriginal heritage site by an oil company. The KLC is responsible for advocating, protecting, enhancing and gaining formal status for the customs, laws and traditions of Kimberley traditional owners (NNTT 2008).

Under the NTA, the rights and interests of registered native title claim groups/determined native title holders must be taken into account when new developments are proposed. The rights available to groups range from a right to negotiate to a right to be notified depending on the type of development proposed. However, native title claim groups/determined native title holders do not have the right to veto new developments (NNTT 2008).

The James Price Point coastal area is situated within the Goolarabooloo Jabirr-Jabirr registered native title claim. The claim currently encompasses a portion of the Dampier Peninsula (approximately north from Pender Bay) and adjacent marine areas as shown on the **Map 2**.

5.4.10 Heritage

5.4.10.1 Natural Heritage

The Commonwealth Register of the National Estate, which lists places of natural, Indigenous and historic heritage throughout Australia, identifies several places of environmental significance located on the Dampier Peninsula. The details are listed in the **Table 5.9** below:

Table 5.9: Natural Places of Significance on the Commonwealth Register of the National Estate

Name	Legal Status	Significance
Coulomb Point Reserve	Registered	Breeding area for endangered species such as the Bilby (<i>Macrotis lagotis</i>), Nailed Hair Wallaby (<i>Onychogalea unguifera</i>) and the Golden Bandicoot (<i>Isodon auratus auratus</i>).
Point Coulomb Area	Indicative	Biodiversity and aesthetic values
Swan Island	Registered	Inshore bird breeding ground, particularly the lesser frigate bird.
Lacepede Islands Middle and West	Registered	Important breeding ground for sea birds and turtles.

Source: Australian Heritage Database (AHC 2008)

In February 2008 the Australian and Western Australian governments agreed that the Kimberley's national and international heritage values should be examined as part of the Kimberley strategic assessment. To implement this aspect of the agreement a National Heritage assessment of the west Kimberley region, by the Australian Heritage Council commenced in June 2008. The Council is due to provide its assessment by June 2010. A Kimberley World Heritage nomination may follow the National Heritage process, if agreed to by the Australian and Western Australian governments

5.4.10.2 Palaeontology

Areas along the Kimberley coast including south of Broome at Gantheaume Point (Broome Visitors Centre 2008) and coastal areas north along the Dampier Peninsula are known to have 120 million year old dinosaur footprints. These can be seen at low tide and are a major tourist attraction of the area. There are anecdotal reports that similar footprints may be found on the intertidal platform in the James Price Point coastal area, however the exact location of these is not publicly available.

5.4.10.3 Aboriginal Heritage

The north west of Western Australia has been identified as a likely point through which Aboriginal people first entered Australia (DIA 2008). This 45,000 year history of Aboriginal settlement, and the broad distribution of Aboriginal groups across the Kimberley, ensures that there are many sites in the region that are culturally significant and contribute to state heritage (DIA 2008).

The Dampier Peninsula is rich in Aboriginal history and culture, with a large number of significant Aboriginal sites. Historically, Aboriginal people predominately utilised the Peninsula's coastal margin and subsequently many sites of Indigenous cultural significance are situated along the coast, in and around the dunes, near natural water sources and wetlands, and in close proximity to significant flora and fauna habitats (Kenneally et al 1996). These areas have long supported the physical and cultural needs of the Indigenous people (DPI 2008a) and traditional activities, many which have left physical indicators of Aboriginal history and culture, for example shell middens.

The Department of Indigenous Affairs maintains a list of heritage sites that have been identified through a variety of survey activities. A search of this Aboriginal Heritage Inquiry System of the James Price Point coastal area determined a number of listed sites, as presented in **Table 5.10** and shown on **Map 2**. A high proportion of these sites were composed of artefact and midden scatters (Aboriginal Heritage Enquiry System 2009).

Table 5.10 Registered Aboriginal Heritage Sites located in the James Price Point coastal area

DIA Site ID	Name	Site Type
12426	Murtjul Creek	Mythological
12684	Inballal Karnbor	Mythological, Ceremonial
12902	Kundandu	Mythological, Artefacts / Scatter, Midden / Scatter
12903	Murrjal	Mythological, Artefacts / Scatter, Midden / Scatter
13076	Walmadan (James Price Point)	Skeletal Material / Burial, Fish Trap, Artefacts / Scatter, Midden / Scatter
12941	Bindingankuny 1	Artefacts / Scatter , Midden / Scatter
12942	Bindingankuny 2	Artefacts / Scatter, Midden / Scatter
12943	Bindingankuny 3	Artefacts / Scatter, Midden / Scatter
12944	Kurakaramunjuno 1	Artefacts / Scatter, Midden / Scatter
12945	Kurakaramunjuno 2	Artefacts / Scatter, Midden / Scatter
12946	Kurakaramunjuno 3	Artefacts / Scatter, Midden / Scatter
12947	Kurakaramunjuno 4	Artefacts / Scatter, Midden / Scatter
12424	Kulmugarigun Claypan	Mythological
12425	Pidingkangkun	-
12427	Pidirakundjanu Creek	-
12842	Inbalmarra	Ceremonial, Mythological Quarry, Artefacts/Scatter, Midden/Scatter
12950	Kulmukarakun Juno 1	Artefacts/Scatter, Midden/Scatter
12899	Kulmukarakun Juno 2	Artefacts/Scatter, Midden/Scatter
12900	Ngarrimarran Juno Quarry	Quarry, Artefacts/Scatter
12901	Murrdudun	Mythological, Artefacts/Scatter, Midden/Scatter
12948	Flat Rock 1	Artefacts/Scatter, Midden/Scatter
12949	Flat Rock 2	Artefacts/Scatter, Midden/Scatter
13504	Kardilakan – Jajal	Ceremonial, Mythological, Fish trap, Artefacts/Scatter, Midden/Scatter
14271	Minarringy	Mythological, Skeletal Material/Burial, Artefacts/Scatter, Midden/Scatter

It should be noted however, that the sites register is by no means a comprehensive record of all possible Aboriginal heritage sites. Further studies are proposed as part of the Strategic assessment process.

The Heritage Council of WA has established heritage trails which traverse places of environmental, indigenous and cultural heritage (Heritage Council 2008). There are 5 heritage trails in the Kimberley with 3 of these located on the West Kimberley coastline around Broome, Derby and the Dampier Peninsula. In particular the Lurujarri Heritage Trail follows a traditional Aboriginal song cycle, running from Coulomb Point through James Price Point down the coast of the Dampier Peninsula to Yinara.

The Commonwealth Register of the National Estate lists Karrakatta Bay Fish Traps, 35 km east of Lombadina Mission on King Sound as an Indicative Place (Source: Australian Heritage Database 2009).

5.4.10.4 Colonial Heritage

Colonial legacy is evident throughout parts of the Kimberley particularly in Broome, Derby and across the Dampier Peninsula. The register of Heritage Places Western Australia identifies five sites on the Dampier Peninsula (Heritage Council 2008). The location of these sites is detailed in **Table 5.11**.

Table 5.11 Heritage Places on the Dampier Peninsula as Noted Under the register of Heritage Places WA

HCWA Place No.	Name	Location	Description
690	Lombardina Mission	Lombardina	Comprises a church, convent and cemetery dated to 1913
3630	Beagle Bay Mission Church	Beagle Bay	A church built of rendered clay brick. Constructed between 1915 to 1918.
7198	Cape Leveque Lighthouse	Cape Leveque	Lighthouse constructed from prefabricated cast iron. Built from 1909 to 1911.
7199	Relay Station	Cape Leveque	Telecommunications relay station constructed in 1970.
16872	Pender Ruins	Pender Bay	The remains of a police station which operated from 1911 to 1916.

5.4.10.4.1 Shipwrecks

A search of the National Shipwrecks Database identified a number of wrecks which are scattered along the coastal margin of the Dampier Peninsula. Wrecks in the vicinity of the James Price Point coastal area includes the Shamrock (Shipwreck ID 3866), a lugger which was shipwrecked at Cape Bertholet in 1901.

There are 64 vessels reported lost between Broome and the mainland coast directly south of Carnot Bay (Cape Bertholet) and another nine lost somewhere off the north west coastal pearling grounds. The majority comprise pearling vessels (luggers, ketches) dating from the 1860's onwards. While none off these sites have been physically located, unidentified wrecks were reported at James Price Point and further south at Barred Creek in 1982 by Scott Sledge. Many of the 64 reported lost vessels were lost in the periodic cyclones which proved devastating to fleets working the pearling grounds. If given enough warning that a cyclone was in the offing, most ship masters would have made a run for the mainland to seek shelter in many of the creeks and discrete anchorages along the Dampier Peninsula. As such, while we can anticipate that some shipwrecks may occur in deep water, it is highly probable that many sites will be found in shallow water coastal contexts. Similarly, the inshore waters north of Broome extending through to the Lacepedes have historically known pearling beds, some of which are still in use today. (Souter 2009).

5.4.11 Visual Amenity

The James Price Point coastal area is assessed as “suitable with reservations” from a visual landscape significance perspective, having landscape quality that is moderate inland to high on the coast, with moderate levels of public concern based on visual values, and low to moderate visual absorption capability (NDT 2008c).

5.4.12 Leisure

The Kimberley region of Western Australia supports leisure activities including fishing, camping etc. The recreational uses reflect the unique environment, remoteness, wilderness, culture and lifestyle of the region.

5.4.12.1 Sports and Recreation

Informally, land on the Dampier Peninsula is used for camping, day trips etc.. The Peninsula is also networked with a number of four wheel drive access tracks, making it a popular destination for self sufficient tourists. James Price Point coastal area is a popular recreational area with the local population accessed for camping and fishing.

5.4.12.2 Recreational Fishing

In Western Australia, recreational fishing is managed within four broad biological regions – the West Coast, Gascoyne, South Coast and Pilbara/Kimberley. Each region has particular fishing rules to suit the regional ecology, mix of species and fishing pressure. The Pilbara/Kimberley region of WA runs from the Ashburton River, south of Onslow to the WA/NT Border (all land and water north of 21° 46' south latitude and east of 114° 50' east longitude).

Total recreational fishing activity in the Pilbara and Kimberley is estimated at 70,000 anglers and one million fishing days a year (Department of Fisheries 2008). Recreational fishing continues to experience significant growth and is concentrated around key population centres (e.g. Broome), with a peak in activity during the winter months (dry season) when the local population increases by considerable numbers of tourists that travel to or through the area.

Due to the high tidal range, much of the recreational angling activity is boat based, with shore fishing limited to periods of flood tides and high water. Shore based fisher activity may be concentrated around mangrove areas and creeks for species such as mud crabs, barramundi etc. The total catch of all species taken by recreational fishers in the region is about 300 tonnes per year (Department of Fisheries, Recreational Fishing guide, Pilbara/Kimberley region 2008). Key species caught include: trevally, Spanish mackerel, blue-lined emperor, tuskfish, threadfin salmon, mangrove jack, barramundi and mud crabs (Newman *et al* 2004).

6 Impact Summary

The purpose of this section is to show how potential impacts of the proposed Browse LNG Precinct were identified and ranked, which lead to the development of the studies and investigations program and impact assessment approach as discussed in **Sections 7, 8, 9 and 10**.

6.1 Risk Assessment Process

A risk-based approach was used to identify the potential impacts. This approach incorporated a number of steps as outlined in the sections below.

6.1.1 Identify the Proposed Activities

The activities associated with the Browse LNG Precinct are based on the components outlined in **Section 3 (Tables 3.4 and 3.5)**. These activities, as listed in **Appendix C**, are based on the Precinct Master Plan and were determined in consultation with future Project Proponents.

6.1.2 Identify the Environmental Aspects

Associated with each of the activities are a number of environmental aspects (or stressors). These are components of an activity which have a potential to impact on the environment (either biological, social or both). To link impacts to particular activities, the matrix in **Appendix C** shows the activities proposed for the Browse LNG Precinct, and the aspects associated with these activities. In this matrix it was indicated whether the aspects potentially interact with the marine or terrestrial environment (or both), as shown by the colour coding. This step was undertaken by environmental and engineering specialists.

6.1.3 Identify the Environmental Factors Potentially at Risk from the Identified Aspects

Environmental factors can be considered the components of the biological and social environment which need to be protected. The list of environmental and social factors is outlined in **Appendix D**.

Identifying which of these factors are at risk of impact from the aspects is a step undertaken in consultation with environmental specialists, regulators and other stakeholders. This information is presented in the Impact Summary Tables (**Appendix G and H**), sorted by the aspects (stressors) affecting the marine, terrestrial and social environments. The terrestrial and social environments were split and the risk assessment done separately given that environmental and social impact studies and assessments are likely to be conducted separately by different groups of specialists.

6.1.4 Identify the Impacts

The potential impacts were considered for each of the environmental factors against each aspect. For the purpose of scoping, the potential impacts were described from a list of standard terminology. These are outlined in the Impact Summary Tables (**Appendix G and H**).

6.1.5 Calculate the Inherent Risk

Risk can be defined as the product of the potential consequence of an event and the likelihood (or probability) of that consequence occurring.

Knowledge of the likelihood of an impact and the assessment of the environmental consequences of that impact are used to characterise the level of environmental risk on an environmental factor associated with particular aspects. The likelihood and the environmental consequence categories are defined by a set of qualitative category descriptions shown in the risk matrix (**Appendix F**).

The calculated risks are presented in the Impact Summary Table in **Appendix G & H**.

The risk assessment methodology used for scoping of the Strategic Assessment is consistent with standard risk management process and practice as outlined in the Australian risk management standards (AS/NZS 4360).

6.1.6 Describe the rationale for assigning the level of risk

The rationale is the basis on which the level of risk has been determined.

Section 5 outlines the existing marine, terrestrial and social environment on the James Price Point coastal area and wider region. This data is based on desktop studies and some field studies including those undertaken by the state to support the site selection process. This information along with an understanding of the proposed activities has been used as the rationale for the initial risk assessment, conducted as a part of the scoping process.

The Impact Summary Table (**Appendix G&H**) provides a brief summary on the rationale for a level of risk. For further information, the existing environment descriptions in Section 5 should be referred to.

6.1.7 Identify the additional information required for assessment

The rationale may be based on some assumptions about presence and distribution of species, the potential for interaction etc. This is generally based on existing literature, experience and consultation with specialists. Studies and investigations would be undertaken during the SEA process to clarify the extent of actual impacts that have been identified during the risk assessment process.. These studies and investigations are discussed further in **Section 7, 8 and 9**.

6.2 Risk Based Scoping Results and Approach

The scoping risk ranking matrix includes risk ranking criteria (Low – Severe). Where the risk is less than low (i.e. no consequences expected), a rating of “Very Low Risk” is applied.

This process is consistent with a move toward a risk-based approach to inform key stages of the EIA process that is being adopted by the WA EPA, as signalled in the recent EPA Bulletin: *Review of the Environmental Impact Assessment Process in Western Australia* (EPA 2009).

The table below explains the treatment of the various potential impacts in the Strategic Assessment.

Severe Risk:	Detailed investigations and detailed evaluation in the Strategic Assessment. Approach to impact assessment provided in this document (Section 9).
High Risk:	Detailed investigations and detailed evaluation in the Strategic Assessment. Approach to impact assessment provided in this document (Section 9).
Medium Risk:	Evaluation of potential for impact to be covered in the Strategic Assessment. Approach to be aligned with the impact assessment approach outlined in Section 9.1.
Low Risk:	Brief discussion in the Strategic Assessment. To be addressed in relevant management plans, works approvals or licences for the Project. Further investigations may be undertaken and reported in the SEA if confidence level is low.
<Low Risk	Very brief notation in the Strategic Assessment. To be addressed in subsequent Environmental Management Plans, works approvals or licenses for the Project if required.

7 Baseline Physical Studies and Investigations Program

Chapters 7 and 8 summarise the baseline studies programs that are required to collect the baseline information for each of the environmental factors that were considered during the risk assessment process as previously detailed at **Section 6.1.3**. The environmental factors considered during the risk assessment have been logically consolidated under the baseline study headings within this Chapter and are hereafter assessed as such.

This chapter provides the studies proposed to gather the baseline information for physical marine and terrestrial factors such as marine water quality and soils and geomorphology. This chapter does not provide a proposed methodology as these physical studies will be used to support the assessment of each identified environmental and social aspects that are discussed at **Chapter 10**.

7.1 Marine Water Quality

At present there is little water quality data for the marine waters surrounding the proposed Precinct location. However, given the absence of surrounding development and pollution sources it is likely that marine waters surrounding the proposed location(s) are largely free of anthropogenic pollution sources.

The Kimberley region has one of the largest tidal ranges in the world with tidal ranges up to 10 m (Mustoe and Edmunds 2008) and associated strong tidal currents as large as 4 knots (Anon 1972). This strong tidal regime and high summer monsoonal rainfall, results in highly turbid coastal waters. This high turbidity is persistent throughout the year, but with the concentration of suspended sediments varying by an order of magnitude between spring and neap tides (Magvelashvili *et al.* 2006).

It is considered likely that elevated turbidity is experienced in the marine waters of the James Price Point coastal area, consistent with other regional conditions. However, it is recognised that there are some uncertainties regarding this assumption which will be clarified by the proposed studies and investigations.

7.1.1 Baseline Study Objective

The baseline study objectives are as follows:

- Quantify the baseline status of nutrients, pigments, suspended solids, hydrocarbons and metals in the marine waters at the James Price Point coastal area;
- Understand existing natural turbidity levels in waters off the James Price Point coastal area;
- Determine the temporal variability of key physico-chemical parameters, including water temperature, salinity, PAR, chlorophyll and turbidity;
- Provide physical and chemical water quality data to underpin and validate hydrodynamic models;
- Provide baseline data for impact assessment and spatial establishment of zones of potential impact and ecological protection

7.1.2 Study approach

The following study approach is proposed to meet the baseline study objective:

- Literature review of existing information and data;
- Field Sampling (DFS11);
- Laboratory analyses of water samples; and,
- Collection and analysis of remote sensing data.

The following studies are proposed, the specific objective of each study is also provided.

Table 7-1 Proposed Marine Water Quality Studies

Study Reference	Objective
DFS11 - Nearshore Marine Water Quality Study	<p>Collect baseline water quality data for the nearshore marine waters of the James Price Point coastal area. Data to be used as input to the prediction and assessment of potential impacts associated with dredging or other physical disturbances during construction or operation of proposed facilities. Data will be collected for water quality indicators including turbidity, suspended sedimentation concentrations, light attenuation and sediment deposition rates. In addition, possible contaminants such as heavy metals, hydrocarbons and other contaminants relevant to prediction and management of the impacts of construction (e.g. dredging and spoil disposal, breakwater construction) and operational activities (e.g. waste discharges) will be collected.</p> <p>Use a combination of remote sensing (if appropriate) and field survey techniques to understand turbidity at a range of spatial scales in the waters off James Price Point coastal area.</p>

7.2 Seabed Features

The James Price Point coastal area is characterised by narrow beaches with an intermittent rocky shoreline and platforms of lithified coastal sediments. Low lying cliffs and sand dunes are present along the coastline while headlands also occur.

7.2.1 Baseline Study Objective

The baseline study objectives are as follows;

- Characterise the physical properties (e.g. depth, relief, rugosity, stability) of the seabed;
- Determine potentially significant or sensitive areas of the seabed, or areas that may support sensitive benthic communities, including areas of hard substrate or variable bathymetry;
- Map the morphology of the seabed within infrastructure areas;
- Provide physical data for impact assessment and for assimilation into hydrodynamic models.

7.2.2 Proposed Study approach

The following study approach is proposed to meet the baseline study objective:

- Literature review of existing information and data;
- Review of historical bathymetric data;
- Geophysical survey and mapping of the seabed;
- Remote sensing (Laser Airborne Depth Surveys (LADS)).
- Deploy metocean data collection buoys.

The following studies are proposed, the specific objective of each study is also provided.

Table 7-2 Proposed Seabed Studies

Study Reference	Objective
DIS9 - Geotechnical Study (PSD)	Understand underlying geological conditions, including marine geotechnical conditions.
DFS5 - Remote Sensing – Terrestrial and Marine	<p>Identify terrestrial and marine habitat types at a range of spatial scales (local to regional)</p> <p>Correlate physical and biological parameters with threatened species distributions.</p>

7.3 Marine Sediment Quality

There is currently no detailed information on marine sediment quality for the James Price Point coastal area. Based on existing information the upper sandy intertidal zone and dune systems of James Price Point comprise white, Aeolian quartz and carbonate sands.

Sediments are considered a sink for marine contaminants and a baseline study of natural contaminant concentrations in sediments will be undertaken. Due to the remoteness of the development area, baseline water and sediment contaminant concentrations are expected to be low.

7.3.1 Baseline Study Objective

The baseline study objectives are as follows;

- Characterise the existing nature of Sediments within the James Price Point coastal area;
- Quantify the baseline status of nutrients, hydrocarbons and metals in marine sediments at the James Price Point coastal area;
- Understand the baseline distribution and particle size of marine sediments;
- Understand the depth and thickness of sediments; and
- Provide physical data for impact assessment and for assimilation into hydrodynamic models.

7.3.2 Proposed Study approach

The following study approach is proposed to meet the baseline study objective;

- Literature review of existing information and data;
- Geophysical and geotechnical surveys; and
- Laboratory analysis of sediment samples;

The following studies are proposed, the specific objective of each study is also provided.

Table 7-3 Proposed Marine Sediment Quality Studies

Study Reference	Objective
DIS9 - Geotechnical Study	To understand pipeline shore approach routing and thickness of seabed cover and depth to rockhead level. Understand underlying geological conditions.
DFS12 - Marine Sediment Quality - physical / chemical properties	Collect baseline marine sediment quality data for the James Price Point coastal area for input into impact assessments and modelling studies. Data will be collected for sediment quality indicators including physical characteristics, such as particle size distributions, as well as heavy metals, hydrocarbons and other contaminants relevant to prediction and management of the impacts of construction (e.g. dredging and spoil disposal, breakwater construction) and operational activities (e.g. waste discharges).

7.4 Tidal Regimes, Currents and Hydrodynamics

Key drivers for coastal processes in the region are tides and rainfall (Mustoe and Edmunds 2008), with these contributing to productivity through catchment runoff, sediment transportation and tidal mixing. Studies by Cresswell and Badcock (2000) indicate tidal mixing plays an important role in nutrient enrichment of nearshore waters, reef and islands through mixing of the thermocline). This strong tidal regime and high summer monsoonal rainfall, generally results in highly turbid coastal waters. Sediments are transported by the currents in the coastal region forming subtidal habitats such as channels, harder sand banks and soft muddy deposits offshore to approximately 20m depth

7.4.1 Baseline Study Objective

The baseline study objectives are as follows:

- Understand baseline marine hydrodynamic conditions at the James Price Point coastal area for input into nearshore facility sighting, impact studies and modelling;
- Determine baseline sedimentation rates within the James Price Point coastal area;
- Identify any significant considerations for Precinct layout and design.

7.4.2 Proposed Study approach

The following study approach would be used to meet the baseline study objective;

- A desktop study would be completed to review existing information on nearshore hydrodynamic and oceanographic conditions at the James Price Point coastal area and broader Kimberley coastline;
- Deploy metocean data collection buoys.

The following studies are proposed, the specific objective of each study is also provided.

Table 7-4 Proposed Tidal Regime, Currents and Hydrodynamic Studies

Study Reference	Objective
DIS4 - Metocean Study (Engineering and Environmental)	Deploy and maintain metocean data collection instruments (current meters, and wave rider buoys etc) to obtain specific metocean data off the James Price Point coastal area, and other reference sites as appropriate, to assist design of jetty and product export facilities, and provide input data for the implementation of hydrodynamic, sediment transport, dredging and coastal process models, which will in turn be used to inform environmental impact prediction studies.
DIS7 - Coastal processes – Sediment Transport Study	Understand existing sediment movement patterns and the key physical drivers of those patterns. Implement appropriate and validated modelling, which makes use of the understanding above to predict the potential impacts of proposed marine infrastructure on the current natural coastal processes. This will also be used to help design minimum impact structures.

7.5 Air Quality and Noise

There is little existing air quality data for the Dampier Peninsula or James Price Point coastal area. There is currently no industrial development on the Dampier Peninsula while no large urban areas are located near the James Price Point coastal area.. As a result it is likely that the existing air quality is largely free of anthropogenic pollution sources however, it is likely that dust and smoke from fires on the Dampier Peninsula would affect air quality at the James Price Point coastal area. Ambient noise levels are generally expected to be low.

To understand and quantify the potential for impacts, baseline air quality and noise studies will be undertaken which will include provision for the identification of sensitive receptors and the potential impacts to these areas.

7.5.1 Baseline Study Objective

The baseline study objectives are as follows;

- Determine baseline atmospheric conditions and air quality in the James Price Point coastal area;
- Determine baseline ambient noise levels at the James Price Point coastal area;
- Determine baseline meteorological conditions for input into modelling and impact studies;
- Identify any significant considerations for Precinct layout and design.

7.5.2 Proposed Study Approach

The following study approach is proposed to meet the baseline study objective;

- A desktop study would be completed to review existing information air quality conditions at the James Price Point coastal area;
- Baseline air quality conditions and meteorological information would be collected for the James Price Point coastal area;
- Ambient noise levels would be collected for the LNG Precinct development zone, including nearest identified sensitive receptors.

The following studies are proposed, the specific objective of each study is also provided.

Table 7-5 Proposed Air Quality Studies

Study Reference	Objective
DFS7 - Ambient Meteorological and Air Quality Monitoring Station	Obtain baseline air quality and meteorological data of the James Price Point area. Provide inputs into airshed, hydrological and climate modelling and environmental assessment.
DIS26 – Terrestrial Baseline Noise Study	Characterise existing ambient noise levels at terrestrial areas within and surrounding the LNG Precinct development zone, including nearest identified sensitive receptors. Understand impact of noise and vibration on important receptors.

7.6 Soils and Geomorphology

The Dampier Peninsula is characterised by vast, gently undulating Pindan sandplains which dominate the areas around the James Price Point (NDT 2008). This soil is of mixed alluvial and Aeolian (wind blown) origin and comprises deep homogenous profiles of coherent red loamy material, which is nutrient poor and includes iron oxides (Kenneally *et al* 1996). Pindan soils form widespread undulating plains and have poor surface drainage, resulting in a tendency for sheet runoff and subsequent sheet erosion.

The James Price Point coastal area is characterised by narrow beaches with an intermittent rocky shoreline and platforms of lithified coastal sediments which adjoin stretches of low lying cliffs and sand dunes to the landward side. Four small headlands, less than 0.5 km outcrop from Coulomb Point to Quondong Point. Other outcrops occur as linear, shore-parallel rock platforms underlying sandy beaches. Storm surge associated with fluctuations in sea level, and extreme meteorological conditions interact with the geology to affect shoreline development and stability in nearby embayments.

7.6.1 Baseline Study Objective

The baseline study objectives are as follows:

- Identify and describe the soils, topography, geology and geomorphology of the proposed Precinct Development area;
- Identify any significant considerations for Precinct sighting, layout and design.

7.6.2 Proposed Study approach

The following study approach is proposed to meet the baseline study objective:

- A desktop study would be completed to review existing information on soil sand geomorphology relating to the James Price Point coastal area;

- A soils and geotechnical survey will be completed to understand underlying geological conditions for input into plant design and layout.

The following studies are proposed, the specific objective of each study is also provided.

Table 7-6 Proposed Soils and Geomorphology Studies

Study Reference	Objective
DIS19 - Soils and Geotechnical investigation	Understand existing soil and geological conditions for input into site layout, design and impact assessment.

7.7 Surface and Groundwater

Due to the extensive Pindan sandplain soils, few drainage features, low elevation and heavy seasonal (summer) rainfall patterns, surface water flows on the Dampier Peninsula are largely dominated by sheet flooding (overland flow) (Kenneally *et al.* 1996).

The James Price point site does not occur within the catchment of any major river systems and while it is possible that the development may occur adjacent to minor creeks or ephemeral drainage lines, it is expected that the LNG Precinct would be sited so as to avoid sensitive riparian or coastal drainage lines and/or areas prone to flooding.

Regionally, the main aquifer in use on the Dampier Peninsula is the freshwater bearing Broome Sandstone. The Broome Sandstone Aquifer is unconfined and recharged principally from rainfall infiltration and leakage from coastal dunes to the north of Broome (Laws 1991).

The quality of groundwater within the Broome Sandstone Aquifer is fresh (<250 mg/L TDS) over 80% of the area of the aquifer. Salinities in excess of 30 000 mg/L TSD can be reached adjacent to the Roebuck Plains (south-east of Broome) (Laws 1991). The aquifer's main usage is for Broome's domestic water supply. The nature of hydrological regime in the vicinity of Broome does not provide a strong indication as to the groundwater conditions and interactions at the James Price Point coastal area.

While no specific investigations have been undertaken, local hydrological characteristics for the James Price Point coastal area are likely to be similar to adjacent areas of the Dampier Peninsula.

7.7.1 Baseline Study Objective

The baseline study objectives are as follows:

- Identify the extent and quality of existing surface and groundwater associated with the Precinct development area;
- Understand surface and groundwater movement and drainage patterns within the Precinct development area and broader James Price Point coastal area.
- Identify any significant considerations for Precinct sighting, layout and design.

7.7.2 Proposed Study approach

The following study approach is proposed to meet the baseline study objective:

- A desktop study would be completed to review surface and groundwater information for the James Price Point coastal area;
- Desktop and field study information would be used to map the site elevation and topography and drainage conditions;
- A Desktop study of groundwater conditions within the site and broader James Price Point coastal area would be completed; and
- A hydrological assessment and modelling study would be completed to understand natural surface and groundwater flow conditions.

The following studies are proposed, the specific objective of each study is also provided.

Table 7-7 Proposed Surface and Groundwater Studies

Study Reference	Objective
DIS17 - Desktop Assessment of Groundwater Conditions and Stygofauna Habitat Assessment	Assess extent of, and hydrological conditions, of groundwater systems and assess habitat potential for stygofauna.
DIS18 - Hydrological and Hydrogeological Assessment and Modelling	Obtain an understanding of surface and ground water flows and interactions with nearby water systems Identify any significant issues for consideration in the facility design/ layout and in the environmental approval documentation.

8 Baseline Biological Studies and Investigations Program

The following baseline biological studies programs are proposed to gather additional information regarding the terrestrial and marine biological factors identified during the risk assessment and would be used as the basis of the subsequent assessment for each environmental aspect. As noted at **Chapter 7**, the factors have been logically grouped according to ecological requirements.

Scoping documents have traditionally provided a list of objectives for each of the baseline biological factors and in some instances will provide a detailed scope of studies for a specific biological factor. The approach taken for the preparation of this Scope for the Strategic Assessment has been to outline the baseline study objectives for each baseline biological factor and instead, provide a methodology to describe the process by which the stated objective would be achieved. This enables the baseline study process to be understood and agreed and study scopes would be drafted to achieve the baseline study objectives.

The existing background information, baseline study objective and proposed study approach is provided for each biological factor. A proposed list of studies and the individual study objective is also provided.

8.1 Benthic Communities

Benthic communities, including primary producers within the James Price Point coastal area include corals, invertebrates, seagrasses, mangroves, sediment macroalgae, microphytobenthos and macroalgal communities. A detailed description of benthic primary producers is provided in Section 5.

Recent mapping commissioned by the NDT and undertaken by the CSIRO and Aims (Fry *et al*, 2008) identifies seagrass beds and other benthic habitats at the Northern part of the James Price Point coastal area. This study and mapping indicates that seagrass beds along the west Kimberley coast and James Price Point coastal area appear seasonally depending on climatic and oceanic conditions. Seagrass beds are known to provide important fish habitats and provide feeding habitat for dugongs and benthic primary producer studies would concentrate on further understanding the distribution, abundance and importance of these habitats within the James Price Point coastal area.

8.1.1 Baseline Study Objective

The baseline study objectives are as follows:

- Map, identify and describe benthic communities at the James Price Point coastal area;
- Describe the physical structure of seagrass and macroalgal communities and the subtidal features that support them.
- Identify areas of conservation significance and or regional uniqueness and assess the environmental sensitivities of these assemblages.
- Provide baseline information for impact assessment and for the spatial establishment of zones of potential impact and ecological protection

8.1.2 Proposed Study approach and Outcome

The following study approach is proposed to meet the baseline study objectives;

- A desktop study would be completed to review existing benthic habitat (survey and mapping data collected along the Dampier Peninsula coastline, and specifically within the James Price Point coastal area by the EPA and SKM (2008), and also including latest NDT study jointly undertaken by CSIRO and AIMS (Fry *et al*, 2008). The review would also concentrate on identifying if additional habitats are likely to occur within the area and their likely importance;
- Remote sensing would be used to collect bathymetric measurements of the James Price Point coastal area to classify additional potential habitat areas;
- Results of field studies such as the baseline marine biodiversity survey would provide additional information regarding the presence, extent and distribution of benthic habitats within the James Price Point coastal area.

The following studies are proposed, the specific objective of each study is also provided.

Table 8-1 Proposed Benthic Habitat Surveys/Studies

Study Reference	Objective
DFS14 Nearshore Benthic Habitat Assessment & Mapping	<p>Assess and map benthic (intertidal and subtidal) communities (e.g. benthic invertebrate communities, seagrasses, algae and coral) including benthic primary producer habitat offshore of the James Price Point coastal area. This information will provide a basis for predicting environmental impacts of proposed marine development activities and to address the requirements of EPA Guidance Statement 29 and other formal guidance.</p> <p>LADs survey to be undertaken, and data interrogated based on information available at the time of assessment to determine and map the distribution and extent of the different habitat and substrate types within the area of interest.</p>
DFS10 - Flora and fauna of the Intertidal zone	<p>Understand the distribution and abundance of intertidal flora (eg. macroalgae, seagrass) within the James Price Point coastal area to meet the requirements of EPA Guidance Statement 29.</p> <p>Understand the distribution and abundance of invertebrate fauna within the intertidal zone of the James Price Point coastal area.</p> <p>Detect the presence of IMS.</p> <p>Use these data to feed into habitat mapping study (DSF14)</p>
DFS15 - Nearshore Marine Biodiversity	<p>Marine biodiversity assessment of the James Price Point coastal area. Surveys will be undertaken to record species distribution and abundance. Taxa will include important invertebrate groups and EPBC-listed fishes.</p>
DFS16 - Nearshore Pipeline Corridor Assessment	<p>Assess and map the different benthic communities, including benthic primary producer habitat along and adjacent to (i.e. within the predicted zone of effect) the proposed pipeline corridor to inform impact prediction and meet the requirements of EPA Guidance Statement 29.</p> <p>Surveys will be undertaken to record species distribution and abundance to inform marine biodiversity assessment within the nearshore pipeline corridor. Taxa will include important invertebrate groups and EPBC-listed fishes.</p>
DIS12 – Desktop study for species presence and habitat preferences	<p>Determine likely marine species presence within the James Price Point coastal area based on existing reports and studies with emphasis on identifying State and Commonwealth listed species and/or their habitats/utilisation and/or dependence.</p>

The studies would be used to develop a habitat map of the James Price Point Coastal area, identifying the extent of habitats and important habitat areas. This mapping would be used to guide Precinct design and would form the basis of the required impact studies.

8.2 Fish

No site specific fish fauna surveys are available for the James Price Point coastal area so assumptions of species present are based on nearby or regional surveys and are also directly related to the physical environmental characteristics. Sandy beach flats which are relatively exposed compared to other locations are the predominate feature and as such the fish fauna is expected to be temporarily present during the high tides to feed on invertebrates. Other fish species may be associated with the intermittent rocky shoreline and reef platforms.

Three threatened fish species, the whale shark (*Rhincodon typus*), freshwater sawfish (*Pristis microdon*) and green sawfish (*Pristis zijsron*) are listed as Vulnerable under the EPBC Act and have potential to occur within or migrate through waters off the Dampier Peninsula and James Price point coastal area.

8.2.1 Baseline Study Objective

The baseline study objectives are as follows

- Describe the shallow water fish communities at the James Price Point coastal area;
- Qualitatively determine the likely marine fish communities within the James Price Point coastal area through known habitat associations and preferences;
- Consider the marine biological value of Quondong Point (as described at Chapter 5) and quantify its local importance as an area of enhanced biological productivity;
- Assess the likely habitat potential of the James Price Point coastal area for conservation significant fish species;
- Provide baseline information for impact assessment and for the spatial establishment of zones of potential impact and ecological protection.

8.2.2 Proposed Study Approach and Outcome

The following study approach would be used to meet the baseline study objective:

- A desktop study of available literature and publicly available databases would be completed to further understand the likely species composition of the James Price Point coastal area and habitat availability;
- Field surveys (DFS15) would be undertaken to record fish species, where possible, and further understand likely habitat availability within the James Price Point coastal area;
- The results of benthic habitat surveys, as outlined above would also be used to understand habitat availability.

The studies would be used to develop a habitat map of the James Price Point Coastal area, identifying the extent of habitats and important habitat areas. This mapping would be used to guide Precinct design and would form the basis of the impact assessments relating to each of the environmental aspects (**Chapter 9**).

The following studies are proposed, the specific objective of each study is also provided.

Table 8-2 Proposed Fish-Related Studies

Study Reference	Objective
DFS15 - Nearshore Marine Biodiversity	Marine biodiversity assessment of the James Price Point coastal area. Surveys will be undertaken to record species distribution and abundance. Taxa will include important invertebrate groups and EPBC-listed fishes.
DIS12 – Desktop study for species presence and habitat preferences	Determine likely marine species presence within the James Price Point coastal area based on existing reports and studies with emphasis on identifying State and Commonwealth listed species and/or their habitats.

8.3 Marine Mammals

Twelve species of marine mammals are listed by DEWHA as occurring within the Kimberly region. Several of these species including the Dugong (*Dugong dugon*), Snub-fin Dolphin (*Orcaella heinsohni*) and the Humpback Whale (*Megaptera novaeangliae*) are protected under the *EPBC Act*.

The inshore waters of the northern Kimberly coast Between the Lacepede Islands and Camden Sound are known to be a Humpback Whale calving ground with much of the population migrating there from the Antarctic Ocean Between June and Mid-November. In addition to this, seagrass beds representing habitat for the dugong occur in many parts of the Dampier Peninsula coastline. It is also expected that habitat is likely to occur for additional whales and megafauna known to occur in the area.

8.3.1 Baseline Study Objective

The baseline study objectives are as follows:

- Determine the diversity and distribution of cetaceans and other marine mammals within the James Price Point coastal area;
- Determine seasonal distribution and abundance of cetaceans and other marine mammals within the James Price Point coastal area;
- Determine the distribution and abundance of humpback whales across the migration corridor adjacent to the James Price Point coastal area;
- Understand if critical habitats for the Humpback whale, such as calving or resting areas, occur within the James Price Point coastal area;
- Identify critical dugong habitats such as seagrass beds within the James Price Point coastal area that may be potentially impacted by the proposed Precinct.

8.3.2 Proposed Study Approach and Outcome

The following study approach is proposed to meet the baseline study objective:

Whales

- A desktop study would be completed to compile existing information on Humpback Whale migration patterns and habitat usage along the west Kimberley coastline;
- Noise loggers will be used to determine the start and end of Humpback Whale migration season (as well as to detect other cetaceans);
- Using aerial surveys determine the distribution and abundance of humpback whales (and other cetaceans) across the migration corridor adjacent to the James Price Point Coastal Area (every 3 weeks starting Aug 1st, Aug 22nd, Sept 12th, Oct 3rd);
- Using photo-ID methodology determine residence time of humpback whales during the period of peak southern migration (Aug-Sept) in the James Price Point Region (2-3x10 day trips)

Dugong

- A desktop study would be completed to compile existing information on Dugong movement patterns and habitat usage along the west Kimberley coastline;
- Using aerial surveys determine the distribution and abundance of dugongs within the James Price Point coastal area, three surveys are proposed to during 2009;
- The aerial surveys would be used to create a distribution and abundance map for the James Price Point coastal area. This would be overlaid onto the seagrass habitat mapping (see 8.3) to determine the presence and locations off feeding grounds.

The following studies are proposed, the specific objective of each study is also provided.

Table 8-3 Proposed Marine Mammal Studies

Study Reference	Objective
DIS12 – Desktop study for species presence and habitat preferences	Determine likely marine species presence within the James Price Point coastal area based on existing reports and studies with emphasis on identifying State and Commonwealth listed species and/or their habitats.
DFS17 – Aerial Megafauna Surveys	Determine the seasonal distribution and abundance of marine mammals along the west Kimberley coast.
DFS18 – Humpback Whale Tagging	Quantify the behaviour and residence time of a small number of Humpback Whales in the Dampier Peninsula region.
DFS19 – Cetacean Noise Loggers	Understand the seasonality and occurrence of different cetacean species in the James Price Point coastal area.

DFS20 – Vessel Megafauna Surveys	Quantify the behaviour and residence time of Humpback Whales along the Dampier Peninsula and how this varies over the migration season.
DFS21 – Aerial Megafauna Surveys (Dugong)	Determine the seasonal distribution and abundance of Dugongs along the West Kimberley coast and understand the temporal and spatial availability of feeding habitat in the James Price Point coastal area.
DFS22 – Dugong Tagging Program	Quantify the behaviour and preferred habitat of a small number of Dugongs in the Dampier Peninsula region.

The studies would be used to develop a marine mammal habitat map of the James Price Point Coastal area, identifying the extent of habitats and important habitat areas. This mapping would be used to guide Precinct design and would form the basis of the required impact studies.

8.4 Marine Reptiles

The Kimberley region is host to a number of marine reptile species including marine turtles, salt and freshwater crocodiles and sea snakes. An *EPBC Act* database search identified five marine turtle species as having previously been recorded within the area (Appendix B), although potentially six species occur as outlined in Section 5.2.6.3..

Turtle nesting and breeding in the Kimberley region peaks in winter, with nesting largely occurring around Cape Dormett and presumably western Arnhem Land in the Northern Territory (Limpus 2002). Known nesting locations within the west Kimberley include Eighty Mile Beach, islands within King Sound, the Lacepede and the Slate Islands (within Camden Sound) (DEC 2008).

Within the James Price Point, the major likely turtle nesting areas occur approximately 2.5 km to the north and 1 km south of the James Price Point Coastal Area. In these areas, significant stretches of loose, aeolian sands are present with little vegetative cover, providing the ideal substrata composition for turtle nesting (SKM, 2008).

8.4.1 Baseline Study Objective

The objectives of marine reptile surveys are to:

- Identify critical marine turtle habitats (aggregation, feeding and nesting areas) in the vicinity of the James Price Point coastal area and broader region;
- Quantify the usage of beaches within the James Price Point coastal area by marine turtles;
- Identify areas of conservation significance in relation to turtle habitat in proximity to the James Price Point coastal area,
- Qualitatively assess the community composition of sea snakes in the James Price Point coastal area.
- Identify important sea snake habitat areas, should they occur.

8.4.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- A literature review would be completed to understand the likely presence and habitat usage of the James Price Point coastal area by marine turtles and sea snakes and the location of important habitats along the west Kimberley coast;
- Turtle field surveys would be conducted to determine if marine turtles are nesting at beaches within the James Price Point coastal area and if so determine species presence and abundance;
- Vessel based surveys would also be conducted to identify turtle species within the James Price Point coastal area, opportunistic surveys of sea snakes would also be completed;

The following studies are proposed, the specific objective of each study is also provided.

Table 8-4 Proposed Marine Reptile Studies

Study Reference	Objective
DIS12 – Desktop study for species presence and habitat preferences	Determine likely marine species presence within the James Price Point coastal area based on existing reports and studies with emphasis on identifying State and Commonwealth listed species and/or their habitats.
DIS12 – Desktop study for species presence and habitat preferences	Determine likely marine species presence within the James Price Point coastal area based on existing reports and studies with emphasis on identifying State and Commonwealth listed species and/or their habitats.
DFS2 – Wet and Dry Season Fauna Survey	Understand if beaches within the James Price Point coastal area are being utilised for nesting by marine turtles and if so quantify nesting and identify marine turtle species involved, where possible. Surveys would be conducted as part of the broader wet and dry season fauna surveys.
DFS9 – Turtle Field Surveys	Quantify the distribution and importance of turtle nesting beaches and other critical habitats (eg seagrasses) within the James Price Point coastal area and the broader region. Understand the seasonality of turtle nesting behaviour and determine the presence of important habitats within the James Price Point coastal area

The studies would be used to develop a habitat map of the James Price Point Coastal area, identifying the extent of habitats and important habitat areas. This mapping would be used to guide Precinct design and would form the basis of the required impact studies.

8.5 Terrestrial Flora and Species of Ethno-biological Significance

A total of 717 species of vascular plants have been recorded on the Dampier Peninsula representing 122 families and 361 genera (Kenneally et al 1996). Recent dry season flora surveys instigated by the NDT identified 422 taxa of which 17 were introduced weed species (ENV 2008). No State or Commonwealth Declared Rare flora species have been recorded at the surveyed sites. A number of Priority species were identified in the vicinity of Gourdon Bay, James Price Point and North Head (ENV 2008).

ENV (2008) recorded a total of ten vegetation communities from surveys conducted at Gourdon Bay, James Price Point and North Head. No Threatened Ecological Communities (TECs), pursuant to the EPBC Act, are present on the Dampier Peninsula. However, under Western Australian listings, two TECs (listed as „vulnerable’) are identified by the Species and Communities Branch (within the Nature Conservation Division of DEC) as occurring within the region. The TEC listed as monsoon (vine) thickets are known to be present within the James Price Point coastal area and has been mapped as a continuous band, with its northern most boundary within 200 m of the point (ENV 2008a). Another smaller vine thicket occurs approximately 3 km north of James Price Point.

The James Price Point coastal area has Indigenous food products ("bush products") that are harvested for use by local Indigenous people. The main species targeted for "bush tucker" commercial sales is the Gubinge (*Terminalia ferdinandiana* (Excell)), or bush plum. A number of families from the Traditional Owner claimant group in the James Price Point area participate in commercial harvesting as part of the Kullaria Australia Co-operative. Given the known indigenous heritage values of the site and surrounding areas it is likely that additional species and habitats are present within the James Price Point coastal area.

8.5.1 Baseline Study Objective

The objectives of the terrestrial flora and ethno-biological surveys are to:

- Derive a taxonomic floral inventory for the James Price Point coastal area;
- Identify and map the location of introduced species;
- Map the terrestrial vegetation communities on the James Price Point coastal area;

- Identify and map Declared Rare Flora (DRF), priority flora and flora and threatened ecological communities within the James Price Point coastal area;
- Identify and map species of ethno-biological significance;
- Identify important sea snake habitat areas, should they occur; and
- Assess the conservation significance of flora and vegetation in areas proposed to be cleared in terms of listed status and representation in other areas of the Kimberley coast.

8.5.2 Proposed Study Approach and Outcome

The proposed study approach to address terrestrial flora is summarised below:

- A desktop study would be completed to compile existing information and vegetation mapping for the James Price Point coastal area surrounding Kimberley region;
- Field studies would be completed to identify and map the presence of flora species and vegetation communities within the James Price Point coastal area;
- Remote sensing would be used to map terrestrial vegetation types at a broader scale to further identify the distribution of those vegetation types mapped within the James Price Point coastal area.

The following terrestrial flora studies are proposed as summarised in the table below. The specific objective of each study is also provided.

Table 8-5 Proposed Flora Studies

Study Reference	Objective
DFS1 – Wet and dry season flora and vegetation surveys	<p>Meet the requirements of the EPA's Guidance Statement 51 'Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia',</p> <ul style="list-style-type: none"> • Undertake surveys to record and map the presence of flora species and vegetation associations; • Identify the presence of any significant flora species (Priority or Declared Rare), significant vegetation associations (Threatened Ecological Communities or locally significant associations) and introduced weed species; • Describe the condition of flora and vegetation associations with particular reference to any historical disturbance; • Describe the conservation significance of flora and vegetation identified within the sites in a local and regional context; • identify any significant flora and vegetation aspects for consideration in the facility design/ layout and in the environmental approval documentation.
DFS3 – Ethno-biological Surveys	<p>Undertake assessments of indigenous significance of flora / fauna, and describe the significance of species and habitats within the James Price Point coastal area.</p>
DFS5 – Remote Sensing (Terrestrial and Marine)	<p>Identify terrestrial and marine habitat types at a range of spatial scales (local to regional)</p> <p>Correlate physical and biological parameters with species distributions.</p>

The studies would be used to develop a habitat map of the James Price Point Coastal area, identifying the extent of habitats and important habitat areas. This mapping would be used to guide Precinct design and would form the basis of the required impact studies.

8.6 Terrestrial Fauna

Existing information on the likely presence of threatened and non-threatened fauna species and their habitats has been provided at Section 5.3.5 above. A single fauna survey was undertaken within the Coloumb-Quondong Point area (which includes the James Price Point coastal area) by ENV 2008. The little little Northwestern Mastiff Bat (*Mormopterus loriae cobourgiana*) is listed as a Priority 1 species under the WA WC Act and was recorded by ENV (2008) within the Coloumb-Quondong Point area (incorporating the James Price Point coastal area). Based on the results of database searches and survey results from elsewhere on the Dampier Peninsula it is considered likely that additional conservation significant species, or their habitats would occur within the James Price Point coastal area.

8.6.1 Baseline Study Objective

The objectives of the terrestrial fauna surveys are to:

- Determine the diversity and distribution of terrestrial fauna within the James Price Point coastal area;
- Determine the presence of introduced species;
- Determine the presence of listed threatened fauna or potential Short Range Endemic (SRE) fauna;
- Investigate the presence of subterranean fauna, or their habitats, on the James Price Point coastal area;
- Quantify the use of the James Price Point and surrounding areas by migratory shorebirds and seabirds particularly those protected by JAMBA / CAMBA / ROKAMBA Agreements or protected under other Commonwealth or State Legislation; and
- Compare the faunal habitats and fauna of the proposed Precinct location with those in the surrounding James Price Point coastal area.

Surveys will be conducted in accordance with the principles of EPA Guidance Statement No. 56 (Environmental Protection Authority 2004b).

8.6.2 Proposed Study Approach and Outcome

The proposed study approach for terrestrial fauna is summarised below:

- A desktop study would be completed to compile existing information on the species presence and habitat availability within the James Price Point coastal area surrounding Kimberley region;
- Field studies would be completed to identify fauna species and habitats within the James Price Point coastal area;
- Remote sensing would be used to map terrestrial vegetation type and fauna habitats at a broader scale to further identify the distribution of those vegetation types mapped within the James Price Point coastal area.

The following studies are proposed, the specific objective of each study is also provided

Table 8-6 Proposed Fauna Studies

Study Reference	Objective
DFS2 – Wet and dry season fauna survey	<p>Meet the requirements of the EPA's Guidance Statement 56 „Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia’;</p> <ul style="list-style-type: none"> • Meet the requirements of the EPA's Guidance Statement 56 „Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia’, and Guidance Statement No. 54 'Consideration of Subterranean Fauna in Groundwater and in Caves during Environmental Impact Assessment in Western Australia'. • Identify and map fauna habitats occurring within the James Price Point coastal area; • Undertake targeted surveys for significant species (including land snails and other shortrange endemics) within the James Price Point coastal area to record the presence of any species; • Identify the presence of any significant fauna species (Schedule 1, vulnerable, threatened or endangered, CAMBA, JAMBA, ROKAMBA); <p>Describe the condition of fauna habitats with particular reference to any historical disturbance;</p> <ul style="list-style-type: none"> • Describe the conservation significance of fauna habitats and fauna species identified within the James Price Point coastal area in a local and regional context; and • identify any significant fauna aspects for consideration in facility design layout and in the environmental approval documentation.
DFS3 – Ethno-biological Surveys	Undertake assessments of indigenous significance of flora / fauna, and describe the significance of species and habitats within the James Price Point coastal area.
DFS4 – Remote Sensing (Terrestrial and Marine)	<p>Identify terrestrial and marine habitat types at a range of spatial scales (local to regional)</p> <p>Correlate physical and biological parameters with threatened species distributions</p>
DFS8 – Migratory Bird Surveys	<p>Understand the distribution and abundance of migratory bird species within the James Price Point coastal area.</p> <p>Determine the habitat usage and importance of the site for migratory bird species; particularly those protected under international agreements (ie CAMBA, JAMBA, ROKAMBA) and the EPBC Act.</p>
DFS4 - Stygofauna and GDE Study	<p>Assess the habitat potential and presence of stygofauna and groundwater dependant ecosystems within the James Price Point coastal area.</p> <p>Meet the requirements of EPA Guidance Statement No. 54 'Consideration of Subterranean Fauna in Groundwater and in Caves during Environmental Impact Assessment in Western Australia'.</p>

The studies would be used to develop a habitat map of the James Price Point Coastal area, identifying the extent of habitats and important habitat areas. This mapping would be used to guide Precinct design and would form the basis of the impact assessment studies.

9 Baseline Social Studies and Investigations Program

The risk assessment process identified a number of potential risks to the social factors including heritage values and other land uses (fishing, tourism etc).

The following baseline social studies programs are proposed to gather additional information regarding the key social factors identified during the risk assessment to be relevant to the LNG Precinct, and would be used to inform the subsequent assessment for each environmental aspect.

The existing background information, baseline study objective and proposed study approach is provided for each social factor. A proposed list of studies and the individual study objective is also provided.

A detailed process for the assessment of some socio-economic impacts has not yet been fully completed and is envisaged to form a part of the Social Impact Assessment (SIA). Other programs being undertaken in parallel with the Strategic Assessment, including the Indigenous Heritage Assessment and Land Use Agreements, will also interface with and inform the scope of social studies outlined in this chapter.

To ensure an integrated approach, this process will be undertaken in a similar manner to the SEA and as such meet the requirements for the Strategic Agreement and Terms of Reference (Strategic Agreement 2008).

9.1 Population

The Shire of Broome is the Kimberley's largest population centre and 44.5 per cent of the Region's entire population in 2007. Over 95% of the residents on the Dampier Peninsula are Aboriginal.

The residents of the Dampier Peninsula remain concentrated around the former Aboriginal missions of Lombadina and Beagle Bay, as well as Ardyaloon (One Arm Point) and Djarindjin (DPI 2008b). In addition approximately 74 discrete Indigenous communities are scattered across the Peninsula (DPI 2008b).

9.1.1 Baseline Study Objective

The objective of baseline studies for population, as a social factor, is to:

- Provide an overview of indigenous and non-indigenous demographics, population trends, health status and that will provide understanding of social baseline conditions

9.1.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Review of existing information
- Consultation with Traditional Owners and other key stakeholders
- Compilation and interpretation of data regarding local demographics, population trends, livelihoods, and health status.

The following studies are proposed, the specific objective of each study is also provided.

Table 9-1 Proposed Population Studies

Study Reference	Objective
SIA4 - Indigenous Socio-cultural and economic profiling Study	Provide an overview of indigenous demographics, population trends, livelihoods, health status, access to services and infrastructure that will provide understanding of socio-economic baseline conditions
SIA6 - Socio-cultural and economic profiling Study	Provide an overview of demographics, population trends, health status and that will provide understanding of social baseline conditions

An overview of socio-cultural profile is required to inform Strategic Assessment, to understand the existing socio-economic setting of the area within and surrounding the LNG Precinct.

There is a likely interaction with outputs from the SIA to characterize existing socio-economic and economic profile, from a combination of baseline social studies and ongoing stakeholder engagement for the Browse Project.

Outcomes of baseline socio-cultural and economic profiling are required to inform impact assessments of a range of aspects, e.g. potential effects of traffic on traditional marine uses, or constraints on access to recreational areas.

9.2 Employment

Latest census results identified the dominant employment areas in the region to comprised labourers, professionals, technicians and trade workers, and managers (s. 5.4.2.1). Local government, administration, school education and accommodation are the most common industries for employment across the Kimberley,

Employment opportunities for Indigenous residents of the Kimberley tend to be around aquaculture, supported by the Kimberley Aquaculture Aboriginal Corporation (KAAC), fishing and tourism ventures. Indigenous owned and operated tourism businesses include eco-adventure businesses, cultural tours, commercial accommodation and service facilities (KDC 2006).

Unemployment levels in the Kimberley have historically been higher when compared with other regions of Western Australia.

9.2.1 Baseline Study Objective

The objective of baseline studies for employment, as a social factor, is to:

- Undertake an analysis of the workforce including assessing of local skills, project worker requirements (skilled and unskilled), training needs, recruitment, and management.

9.2.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Review of existing information
- Consultation with key stakeholders, including Department of Training, local TAFEs, Shire of Broome, etc
- Characterisation of predicted workforce skills anticipated to be required for the LNG Precinct and support industries
- Assessment of potential effects on workforce skills in a local and regional context, and recommendation of strategic measures for forward planning, including opportunities for indigenous employment.

The following studies are proposed, the specific objective of each study is also provided.

Table 9-2 Proposed Employment Studies

Study Reference	Objective
SIA9 - Workforce / Employment Impact Assessment Study	Analysis of the workforce including assessing of local skills, project worker requirements (skilled and unskilled), training needs, recruitment, and management.

An analysis of workforce skills and requirements is necessary to inform both the SA report and SIA, as part of the forward planning, recruitment and training needs for the LNG Precinct.

9.3 *Housing / Cost of Living*

In line with State wide increases, housing and accommodation facilities in the Kimberley are experiencing increasing levels of strain (s. 5.4.3.1). Demand pressures are resulting in significant challenges in accommodation availability and affordability, with a general upward trend in construction costs, established housing purchase prices and rental costs (KDC 2006). The Regional Prices Index indicates the cost of housing across the Kimberley, particularly in Broome, is significantly higher than in the metropolitan area.

9.3.1 **Baseline Study Objective**

The objective of baseline studies for housing / cost of living, as a social factor, is to:

- Undertake an analysis of the current housing situation (temporary and permanent), the annual fluctuations and the predicted requirements during the lifetime of the LNG Precinct, to determine potential effects on regional housing and cost of living.

9.3.2 **Proposed Study Approach and Outcome**

The proposed study approach is outlined below:

- Review of existing information, including current housing market trends in the Broome region
- Consultation with key stakeholders, including Department of Housing and Department of Planning, real estate industry, Shire of Broome, etc
- Characterisation of predicted housing demands anticipated to be required for the LNG Precinct and support services
- Assessment of potential effects on housing in a local and regional context, and recommendation of strategic measures for forward planning

The following studies are proposed, the specific objective of each study is also provided

Table 9-3 Proposed Housing / Cost of Living Studies

Study Reference	Objective
SIA8 - Housing Impact Assessment Study	Undertake an analysis of the current housing situation (temporary and permanent), the annual fluctuations and the predicted requirements during the lifetime of the LNG Precinct, to determine potential effects on regional housing and cost of living.

A summary of existing housing infrastructure is required to inform the Strategic Assessment, as the basis to determine predicted demands on available infrastructure, support services and subsequent cost-of-living indices, as a result of catering for accommodation of LNG Precinct workforces and their families, and support industries (both construction and operations phases).

9.4 *Industry*

The major industries across the Kimberley are identified as minerals and petroleum, retail trade, tourism, construction, pearling and pastoral activities (s.5.4.4). In Broome industry is more focused around tourism, pearling, fishing, aquaculture, pastoral and horticulture activities. Similarly the Dampier Peninsula contains horticultural, pastoral, aquaculture and eco-tourism activities.

A number of WA State managed and Commonwealth managed fisheries operate in the coastal inshore areas of the Kimberley. In a regional context, major aquaculture / pearling operations occur at Cygnet Bay, Beagle Bay and Deepwater Point (s. 5.3.4.4). A few pearling leases are offshore James Price Point, although well removed from the LNG Precinct area.

The Precinct development zone of the James Price Point area is not for agricultural use. On the Dampier Peninsula there are small horticultural and agroforestry businesses (s. 5.3.4.2). The Gubinge is grown and harvested by local traditional owners on the Dampier Peninsula, representing a traditional agricultural practice. The nearest pastoral leases are more than 50km to the west and south-west of James Price Point.

9.4.1 Baseline Study Objective

The objectives of baseline studies for industry, as a social factor, are to:

- Obtain an overview of current local occupations and livelihoods including fishing (commercial), pearling and aquaculture, to determine potential effects arising from the LNG Precinct.
- Understand existing tourism uses and trends at a local and regional context, to determine potential effects arising from the LNG Precinct.

9.4.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Review of existing information
- Consultation with key local industry stakeholders, including fishing and pearling industry associations and operators, agricultural industry users, Fisheries WA, etc to characterise existing usage and any planned developments
- Consultation with tourism industry associations and operators, etc to characterise existing usage (both land- and marine-based tourism) and any planned developments
- Information will form basis of an assessment of the potential effects arising from the LNG Precinct on commercial fisheries, pearling and aquaculture and tourism.

The following studies are proposed, the specific objective of each study is also provided.

Table 9-4 Proposed Industry Studies

Study Reference	Objective
SIA11 - Fisheries, Pearling and Aquaculture Impact Assessment	Overview of current local occupations and livelihoods including fishing (commercial), pearling and aquaculture, to determine potential effects arising from the LNG Precinct.
SIA12 - Tourism Impact Assessment	Provide an overview of existing tourism activities and trends at a local and regional context, to inform an assessment of potential effects anticipated to arise from the LNG Precinct and supporting infrastructure.

An overview of current local occupations and livelihoods, including tourism uses, is required to inform Strategic Assessment, to understand existing socio-economic setting of the area within and surrounding the LNG Precinct.

There is likely interaction with outputs from the SIA to characterize existing livelihoods, from a combination of baseline social studies and ongoing stakeholder engagement for the Browse Project.

9.5 Community Infrastructure and Services

An overview of current community infrastructure and services in the Kimberley region is provided in Section 5.4.5. The wide distribution of the communities across the Kimberley makes a comprehensive transport system critical for community and business survival (KDC 2006). The transport network in this area is made up of sea, air and road infrastructure, with a particularly heavy reliance on road transport.

Many Indigenous communities in the Kimberley have limited access to adequate health services due to their remoteness.

9.5.1 Baseline Study Objective

The objectives of baseline studies for community infrastructure and services, as a social factor, are to:

- Characterise available local and regional community infrastructure and services as relevant to the LNG Precinct - including key social factors:
 - Education
 - Health facilities
 - Emergency services (police and fire services)
 - Water supply
 - Power supply
 - Waste management and sanitation services
 - Telecommunications
- Characterise the transportation requirements (including air, land and sea) for the LNG Precinct, to assess the potential impacts on existing transportation networks and infrastructure.

9.5.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Review of existing information
- Consultation with key stakeholders, including Main Roads, Shire of Broome, etc
- Compilation and interpretation of data regarding existing capacity of education and health, emergency services, utilities, waste management, telecommunications and sanitation services
- Characterisation of predicted transportation requirements anticipated to be required for the LNG Precinct and support industries
- Assessment of potential effects on transportation networks and capacity in a local and regional context, and recommendation of strategic measures for forward planning
- Information will form basis of an assessment of the capacity of existing/planned infrastructure and services to accommodate the LNG Precinct

The following studies are proposed, the specific objective of each study is also provided.

Table 9-5 Proposed Community Infrastructure Studies

Study Reference	Objective
SIA7 - Community Infrastructure and Services Capacity Study	Characterise available local and regional community infrastructure and services as relevant to the LNG Precinct - including key social factors: <ul style="list-style-type: none"> - Education - Health facilities - Emergency services (police and fire services) - Water supply - Power supply - Waste management and sanitation services - Telecommunications
SIA10 - Transportation Impact Assessment Study (interfaces with: <ul style="list-style-type: none"> - DIS29 – Desktop Review of Existing Marine Traffic; and - DIS30 - Marine Traffic Impact Assessment) 	Characterise the transportation requirements (including air, land and sea) for the LNG Precinct, to assess the potential impacts on existing transportation networks and infrastructure.

An overview of available infrastructure is required to inform Strategic Assessment, to understand existing socio-economic setting of the area within and surrounding the LNG Precinct.

Results of SIA baseline assessment will inform Strategic Assessment conclusions regarding broader regional infrastructure requirements and demands as it relates to the LNG Precinct development, flow-on community infrastructure needs for temporary and permanent workforce, and integration of LNG Precinct with local community services in line with social investment strategies.

SIA outcomes will also inform LNG Precinct master planning and engineering interfaces, to ensure facilities for education, health and emergency services, waste management, etc are adequately resourced to support a multi-user LNG Precinct, and identify upgrades / capacity building where necessary.

Projected transportation requirements are also linked to anticipated effects on land-based (road transport) routes and access rights, marine-based routes (vessel movements) and air-based travel, with potential for physical, biological or social impacts. For example, land-based transport – interface with potential for weed incursions, noise and amenity from trucking activities, direct and indirect impacts from construction of new access roads; marine-based transport – interface with potential physical effects on marine fauna, risk of collisions and/or spills, introduction of IMS; underwater acoustic effects on marine mammals, etc.

9.6 Land Tenure

Throughout the Kimberley region, the majority of land is held under pastoral lease (KDC 2008a). Approximately 224,000km (over 50 per cent of the region) has been classified primarily for grazing stock, with the remaining portion of the Kimberley being Crown Land, Aboriginal reserve, conservation estate or freehold land in the major urban areas.

On the Dampier Peninsula, land tenure is a complex mix of:

- Aboriginal Reserves (vested in the Aboriginal Lands Trust)
- Aboriginal Land Trust leases to Aboriginal corporations
- Aboriginal corporations sub-leases issued to families for the establishment of outstations
- State Land Service leases to Aboriginal corporations and other entities such as pearling companies
- Pastoral leases
- Limited freehold land (primarily owned by the Catholic Church, Cygney Bay Pearls and Kooljaman Resort).
- Conservation estates (includes Coulomb Point, Swan Island and Lacepede Islands)
- Public purpose reserves (for example Cape Leveque Lighthouse and Bungarragut Pool on the Fraser River)
- Unallocated Crown Land (see also s.5.4.7).

The James Price Point coastal area is situated within the Goolarabooloo Jabirr-Jabirr registered native title claim. The claim currently encompasses a portion of the Dampier Peninsula (approximately north from Pender Bay) and adjacent marine areas.

9.6.1 Baseline Study Objective

The objective of baseline studies for land tenure, as a social factor, is to:

- Provide an understanding of indigenous land ownership, rights and agreements within and surrounding the area of the LNG Precinct, including key social factors:
 - Land Tenure including Native Title
 - Informal Land Use
 - Terrestrial Conservation Areas
 - Marine Conservation Areas

9.6.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Review of existing information, including tenure maps
- Baseline ethnographic studies with Traditional Owners
- Consultation with Traditional Owners and other key stakeholders, including planning agencies, DOLA, DEC and Shire of Broome, etc
- Interface with process and outcomes of the Indigenous Land Use Agreement (ILUA) for the LNG Precinct to address Native Title.
- Interface with Precinct master planning design, risk studies and definition of appropriate buffer zones for public safety risk.

The following studies are proposed, the specific objective of each study is also provided.

Table 9-6 Proposed Land Tenure Studies

Study Reference	Objective
SIA5 - Land use, tenure and access Study	Provide an understanding of indigenous land ownership, rights and agreements within and surrounding the area of the LNG Precinct, including key social factors: <ul style="list-style-type: none"> - Land Tenure including Native Title - Informal Land Use - Terrestrial Conservation Areas - Marine Conservation Areas
SIA16 - Safety and Security Impact Assessment Study	Assessment of the potential security and safety issues associated with the development of an LNG facility of this nature. Issues will include potential for off-site safety risk, increased smuggling of humans, drugs etc.

An overview of indigenous land ownership, rights and agreements is required to inform Strategic Assessment, and to satisfy requirements of the Cwth-WA ToR Agreement. The SA report will also need to demonstrate that the Precinct proponent has consulted with relevant indigenous groups, to obtain a holistic understanding of indigenous land ownership as it relates to the LNG Precinct.

There is likely interaction with outputs from the SIA to characterize indigenous land ownership from a combination of baseline ethnographic studies, the Indigenous Land Use Agreement and ongoing stakeholder engagement for the Browse Project. The results of baseline ecological studies will also inform the regional database of knowledge on terrestrial and marine conservation areas in a regional context.

Results of SIA baseline assessment will also interface with LNG Precinct master planning design, risk studies and engineering with regard to appropriate buffer zones and exclusion areas to maintain safe distances and comply with safety provisions. Refer also *EPA Guidance Statement No. 2 Guidance for Risk Assessment and Management* (EPA 2000d) and *EPA Guidance Statement No. 3: Separation distances between industrial and sensitive land uses* (EPA 2005b).

9.7 Cultural Heritage

The Dampier Peninsula is rich in Aboriginal history and culture, with a large number of significant Aboriginal sites. A search of the DIA Aboriginal Heritage Inquiry System of the James Price Point coastal area determined a number of listed sites in the general area. A high proportion of these sites are understood to be composed of artefact and midden scatters (s.5.4.10.3). The Lurujarri Heritage Trail follows a traditional Aboriginal song cycle, running from Coulomb Point down the coast of the Dampier Peninsula to Yinara.

9.7.1 Baseline Study Objective

The objectives of baseline studies for cultural heritage, as a social factor, are to:

- Obtain an understanding of indigenous cultural heritage issues within the area of interest.
- Obtain an understanding of indigenous archaeological artefacts etc existing within the project scope area.
- Provide an understanding of indigenous relationship, value and connection with local flora and fauna.

9.7.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Review existing information
- Consultation with Traditional Owners and other key stakeholders, including DIA
- Aboriginal Heritage studies (Ethnographic survey and Archaeological survey) of the LNG Precinct area
- Baseline ethnobiological survey with TOs, including review of outcomes from marine/terrestrial flora and fauna surveys
- Interface with process and outcomes of the Kimberley National Heritage Assessment

The following studies are proposed, the specific objective of each study is also provided.

Table 9-7 Proposed Cultural Heritage Studies

Study Reference	Objective
SIA1 - Cultural heritage Study	Obtain an understanding of indigenous cultural heritage issues within the area of interest.
SIA2 - Archaeological field survey	Obtain an understanding of indigenous archaeological artefacts etc existing within the project scope area.
SIA3 - Ethnobiological field survey (interfaces with Study DFS3)	Provide an understanding of indigenous relationship, value and connection with local flora and fauna.

Characterisation of cultural heritage values of the local (James Price Point) and broader regional area is required to inform the Strategic Assessment.

The SA report needs to demonstrate that the requirements under the *EPBC Act* and *EP Act* are addressed (as defined in Cwth-WA ToR Agreement), and that Precinct proponent has consulted with relevant indigenous groups – in line with *EPA Guidance for the Assessment of Environmental Factors No. 41 (Assessment of Aboriginal Heritage)* (EPA 2004d).

The Aboriginal Cultural Material Committee (ACMC) provides advice to the Minister for Indigenous Affairs on the management of sites in significance of the development process.

9.8 Environmental and Colonial Heritage

The Commonwealth Register of the National Estate, which lists places of natural, Indigenous and historic heritage throughout Australia, identifies several places of environmental significance located on the Dampier Peninsula. These include Coulomb Point Reserve (Registered), Point Coulomb Area (Indicative), Swan Island (Registered) and Lacepede Islands Middle and West (Registered) (s. 5.4.10.1)

Colonial legacy is evident throughout parts of the Kimberley particularly in Broome, Derby and across the Dampier Peninsula. A search of the National Shipwrecks Database identified a number of wrecks which are scattered along the coastal margin of the Dampier Peninsula. There are also vessels reported lost between Broome and the mainland coast directly south of Carnot Bay (Cape Bertholet). The majority comprise pearling vessels (luggers, ketches) dating from the 1860's onwards, which were lost in the periodic cyclones which proved devastating to fleets working the pearling grounds.

9.8.1 Baseline Study Objective

The objective of baseline studies for Environmental and Colonial heritage, as a social factor, is to:

- Obtain an understanding of Environmental and Colonial heritage issues within the area of interest.

9.8.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Review of existing information and databases, at a State and Commonwealth level
- Consultation with key stakeholders, including WA Museum
- Assessment of potential effects of the LNG Precinct on known listed heritage places, both terrestrial and maritime,
- Interface with process and outcomes of the Kimberley National Heritage Assessment.

The following studies are proposed, the specific objective of each study is also provided.

Table 9-8 Proposed Environmental and Colonial Heritage Studies

Study Reference	Objective
SIA15 - Colonial and Environmental Heritage Study	A complete list detailing all listed heritage places and all registered commonwealth and state places as well as maritime heritage (ship wrecks, WWII artefacts etc).

The characterisation of existing heritage values of the local (James Price Point) and broader regional area is required to inform the SA report.

The SA report needs to demonstrate that the requirements under the *EPBC Act* and *EP Act* are addressed (as defined in Cwth-WA ToR Agreement). This includes consideration of listed heritage places, and registered Commonwealth and State places protected under *EPBC Act* and *EP Act*.

This data will also likely inform the Heritage Assessment of the National Heritage values in accordance with the requirements set out in the *EPBC Act* and as part of the strategic assessment of broader land use development within the Kimberley Region, committed by the Commonwealth and State Governments in 2008.

9.9 Visual Amenity

The James Price Point coastal area was assessed by the NDT as “suitable with reservations” from a visual landscape significance perspective (s.5.4.11). It is recognised that visual amenity is a subjective determination based on personal values and appreciation of the surrounding area.

9.9.1 Baseline Study Objective

The objective of baseline studies for visual amenity, as a social factor, is to:

- Understand the existing landscape character, value and sensitivity of the study area, and both the visual and cognitive relationship with surrounding communities, to provide a basis of assessing potential impacts from the presence of the LNG Precinct.

9.9.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Consultation with local stakeholders to identify current landscape values and character, and nearest receptors of public amenity and use
- Assessment of potential effects of the LNG Precinct (e.g. through photomontages, 3D visual representation from a range of perspectives)

The following studies are proposed, the specific objective of each study is also provided.

Table 9-9 Proposed Visual Amenity Studies

Study Reference	Objective
SIA13 - Landscape and Visual Amenity Impact Assessment	Understand the existing landscape character, value and sensitivity of the study area, and both the visual and cognitive relationship with surrounding communities, to provide a basis of assessing potential impacts from the presence of the LNG Precinct.

This study will interface with SIA studies as relevant to potential landscape and visual effects anticipated to arise from the LNG Precinct.

SIA baseline assessment will inform the identification of social receptors, and the subsequent assessment of predicted visual impacts. The results of this assessment be presented in the SA report, as the basis to enable regulatory and community stakeholders to assess the acceptability of visual amenity impacts in the context of surrounding values and meeting EPA objectives.

9.10 Leisure

The Kimberley region of Western Australia supports leisure activities including fishing, camping etc. The recreational uses reflect the unique environment, remoteness, wilderness, culture and lifestyle of the region.

Informally, land on the Dampier Peninsula is used for camping, day trips etc. The Peninsula is also networked with a number of four wheel drive access tracks, making it a popular destination for self sufficient tourists. James Price Point coastal area is a popular recreational area with the local population accessed for camping and fishing.

9.10.1 Baseline Study Objective

The objective of baseline studies for leisure, as a social factor, is to:

- Overview of the primary recreational activities such as fishing, sports, camping, 4WDing, and associated values, linkages and networks.

- Understand the potential impacts on existing recreational and lifestyle values surrounding the study area.

9.10.2 Proposed Study Approach and Outcome

The proposed study approach is outlined below:

- Review of available information
- Consultation with local stakeholders to identify current recreational values of the local area, and nearest receptors of public amenity and use
- Assessment of potential social effects of the LNG Precinct on current / planned recreational uses, taking into account outcomes of Impact Assessment studies for noise, light, landscape and visual amenity, etc

The following studies are proposed, the specific objective of each study is also provided

Table 9-10 Proposed Leisure Studies

Study Reference	Objective
SIA14 - Recreation and Lifestyle Study	<p>Overview of the primary recreational activities such as fishing, sports, camping, 4WDing, and associated values, linkages and networks.</p> <p>Understand the potential impacts on existing recreational and lifestyle values surrounding the study area.</p>

This study will interface with SIA studies to characterise existing recreation and lifestyle activities within and surrounding the LNG Precinct project area.

Precinct requirements for buffer/exclusion zones have potential to affect recreational amenity values of transient and/ or permanent community stakeholders. The SA report will need to demonstrate that these values have been taken into account in the Strategic Assessment.

This will interface with SA studies as relevant to potential direct/indirect effects anticipated to arise from amenity impacts (e.g. noise, light emissions, visual amenity) from the LNG Precinct.

10 Assessment of Identified Environmental Aspects

This section outlines the proposed approach for assessing the potential impact of each environmental aspect (as defined at **Chapter 6.1.2**) on the key environmental and social factors identified from the risk assessment process. Key environmental and social factors are defined as those that were identified as having a high or medium risk rating. The approach for assessing each environmental aspect is described as follows.

Under each environmental aspect heading, the activities that were identified as being associated with the aspect are summarised. The purpose of each of these chapters is to outline how the potential impacts of each environmental aspect on the key environmental and social factors would be investigated and assessed and in turn, how the specified assessment objective would be achieved.

A table is provided for each environmental aspect listing the environmental and social factors identified through the risk assessment process. For each environmental aspect the assessment objective and impact assessment approach has been designed to concentrate on understanding the potential impacts on the key environmental and social factors (high or medium inherent risk rating however, those factors identified as low risk would also be considered within the assessment. Along with the inherent risk rating, each table also lists the related impact studies. The complete studies list and objectives of each study is provided as **Appendix I**.

The assessment objectives for each environmental and social factor are then outlined. This generally follows a process of characterising the existing risk, estimating the likely exposure as a result of LNG Precinct construction and operation, determining the potential for impacts to occur and finally, determining the significance of impacts, should they occur. For all assessments there will be an iterative process to assess potential alternatives in order to minimise the risk and level of impact to acceptable levels.

The impact assessment methodology is then outlined. **Table 10.1** below provides an example of this table and a brief explanation of each assessment stage.

It should be noted that the following impact assessment studies in this Chapter have been defined on the basis of currently available information at the time of preparing this scoping document. Framework methodologies to assess all key aspects have been determined, recognising, however, the limitation that is the Precinct master plan is yet to be finalised, and limited conceptual engineering information is available to inform the Strategic Assessment studies at the time of writing. It is anticipated that, as additional details on the Precinct design and engineering data are provided, combined with further characterisation of the surrounding physical, biological and social environment through baseline studies (Sections 7 and 8), the inherent risk ranking for resultant aspects and impacts will likely evolve. As such this is a dynamic and evolving process to ensure that latest available information is incorporated into the Strategic Assessment process.

Assessment methodologies for some aspects ranked as low and medium are still to be subject to method scoping, with prioritisation on key aspects that may result in impacts of potential high significance. Further collaboration is also necessary to define acceptable environmental thresholds and targets that will inform the impact assessment for some aspects. More detailed methodologies will be defined, in conjunction with regulatory stakeholders, as studies move forward under the frameworks outlined in this document.

Table 10-1 Example Assessment Methodology

Assessment Stage	Method
(1) Baseline (See relevant baseline sections)	<i>The outputs of the baseline studies in relation to each of the identified key environmental and social factors would be used as the basis for predicting the likely impacts of the environmental aspect being considered.</i>
(2) Evaluate Receptor Sensitivity	<p><i>An understanding of the sensitivity of each key environmental and social aspect to the environmental aspect is required to evaluate the likely behavioural or physiological response.</i></p> <p><i>This will be conducted to ensure the range of potential exposure levels are considered in determining receptor sensitivity.</i></p>
(3) Characterise Existing Exposure Regime	<i>An understanding of the existing exposure regime of each key environmental and social aspect is required to understand the existing conditions and the extent of exposure currently being experienced by the key environmental factors</i>
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	<p><i>This is required to determine the extent or zones of potential impact for the relevant environmental and social aspect. In some instances this may include modelling and the generation of contour maps to predict the extent of likely exposure of impact.</i></p> <p><i>This assessment would be based on inclusion of management measures that are in line with reasonable industry practice.</i></p>
(5a) Predict Potential Effects	<p><i>Step 4 would then be combined with the baseline ecological and social information (1) and receptor sensitivity (2) to predict potential effects as a result of the relevant environmental factor.</i></p> <p><i>This assessment would be based on inclusion of management measures that are in line with reasonable industry practice.</i></p>
(5b) Identify Potential Alternatives (if Risk High)	<p><i>This stage applies for all assessments. If the scale of the impacts result in a high residual risk of impacts on key environmental and social factors then alternative mitigation and management measures will be identified as alternatives. Assessment of the resultant potential effects would then be evaluated (i.e. steps 4 and 5 in the impact assessment approach).</i></p> <p><i>Consideration of alternatives and implementation of additional mitigation and/or management measures will not be based solely on potential environmental and/or consequences. Selection of additional measures will be based on trade-off and evaluation of whether the additional implications for the activity (cost, time, safety, operability, impacts from other environmental aspects, etc) justify the associated reduction in environmental risk.</i></p>

10.1 Marine and Terrestrial Noise and Vibration

Noise and vibration generating activities would occur throughout construction and operation of the Precinct. Noise and vibration generating activities have been listed at Appendix A and based on similar projects it is likely that key noise and vibration generating activities would include marine dredging, marine blasting, nearshore construction activities such as jetty construction and site excavation activities. Precinct operations and vessel movements are likely to be an ongoing source of emissions.

10.1.1 Summary of Key Environmental and Social Factors

The key environmental and social factors identified as having the potential to be impacted by terrestrial noise and vibration are listed in Table 10.2 below.

Table 10-2 Environmental and Social Factors - Noise and Vibration

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Marine Mammals – Disturbance to conservation significant fauna individuals	High	DIS1 – Baseline Marine Noise Study DIS2 – Desktop Study for Noise and Vibration Impacts; DIS3 – Marine Noise Impact Assessment
Terrestrial Fauna – Disturbance of conservation significant fauna individuals	Medium	DIS2 - Desktop Study for Noise and Vibration Impacts; DIS27 – Terrestrial Noise Impact Assessment
Reptiles - Disturbance of conservation significant fauna individuals	Medium	DIS2 - Desktop Study for Noise and Vibration Impacts; DIS3 - Marine Noise Impact Assessment
Birds (including sea and migratory) – Disturbance of conservation significant fauna individuals	Medium	DIS2 - Desktop Study for Noise and Vibration Impacts; DIS27 - Terrestrial Noise Impact Assessment; DIS3 - Marine Noise Impact Assessment
Subterranean SRE – Disturbance of fauna individuals	Low	DIS2 – Desktop Study for Noise and Vibration Impacts; DIS27 - Terrestrial Noise Impact Assessment;
Fish - Disturbance of fauna individuals	Low	DIS2 – Desktop Study for Noise and Vibration Impacts; DIS3 – Marine Noise Impact Assessment
Coral – Physical damage/ disturbance to coral reefs	Low	As above
Invertebrates – Disturbance of fauna individuals	Low	As above
SOCIAL FACTORS		
Tourism – Disturbance to existing and future activities	Medium	SIA12 – Tourism Impact Assessment
Sports and Recreation – Noise impacts	Medium	SIA14 – Recreation and Lifestyle Study

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Aboriginal Heritage – Disturbance to heritage sites, Noise Impacts	Medium	SIA1 – Cultural Heritage Study; SIA2 – Archaeological Field Survey; SIA3 – Ethnobiological Field Survey;
Aquaculture – Disturbance to existing and future activities	Low	SIA11 - Fisheries, Pearling, and Aquaculture Impact Assessment
Commercial Fishing – disturbance of fauna individuals	Low	SIA11 - Fisheries, Pearling, and Aquaculture Impact Assessment
Colonial Heritage – Disturbance to heritage sites	Low	SIA15 – Colonial and Environmental Heritage Study
Recreational fishing – Disturbance to existing and future activities	Low	SIA14 - Recreation and lifestyle study

10.1.2 Objective of Assessment

The objectives of the Noise and Vibration Study are to:

- Characterise existing terrestrial and underwater noise (physical, biological and anthropogenic) inside and outside the “footprint” or “zone of influence” of the proposed development;
- Estimate terrestrial and underwater noise emissions and predict their zone of influence associated with the proposed development (during construction and operational phases);
- Determine the potential physical and/or behavioural effects on key environmental and social factors due to estimated noise emissions associated with the proposed development (construction and operational phases);
- Assess the potential effects on key species at an individual and population levels to noise emission associated with the proposed development;
- Assess the potential affects on tourism and other relevant social factors as a result of noise emissions associated with the proposed development; and
- Develop mitigation and management measures to manage terrestrial and underwater noise ALARP and consistent with the requirements of EPA Guidance for the Assessment of Environmental Factors No. 8 - Environmental Noise.

10.1.3 Impact Assessment Approach

Environment

Noise and vibration was identified as a presenting a high potential risk to marine mammals and a medium risk to sea and migratory birds and marine reptiles. This was based on the known presence of conservation significant species and the potential for noise and vibration to disturb these factors. Accordingly, the impact assessment would concentrate on determining the likelihood, extent and potential consequences of impacts.

The assessment would also consider potential impacts to fish, coral, invertebrates and refuge value for terrestrial biota.

Social

Noise and vibration was identified as presenting a medium risk to tourism, sport and recreation and Aboriginal heritage. This was based on the potential for recreational users such as campers and fishes to be impacted by noise emissions while Aboriginal visitors to the nearby songline may also be affected by noise emissions.

The assessment would also consider potential impacts on commercial and recreational fishing, aquaculture and colonial heritage.

In undertaking the assessment, the noise study will take into account EPA guidelines as defined in EPA Guidance for the Assessment of Environmental Factors No. 8 - Environmental Noise (EPA 2007).

Table 10.3 outlines the proposed methodology to quantify and assess the likely impacts of noise and vibration on the key environmental and social factors.

Table 10-3 Noise and Vibration Assessment Approach

Assessment Stage	Method
(1) Baseline (See Section 5)	<p>Environment - Outputs from the desktop and field studies related to the key environmental factors at Table 9.2 (marine mammals, marine reptiles and birds) will be used to predict the presence, behaviour and residence time of these factors within the James Price Point coastal area and Kimberley region where appropriate.</p> <p>Social - For the identified social factors at Table 10.2 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage areas within the James Price Point coastal area.</p>
(2) Evaluate Receptor Sensitivity	<p>Environment - Conduct desktop study to evaluate potential behavioural and physiological effect(s) of the key environmental factors when exposed to anthropogenic noise.</p> <p>Social – a desktop study would be conducted to understand social acceptability of noise impacts based on known examples of developments located in proximity to recreational and heritage values.</p>
(3) Characterise Existing Exposure Regime	Conduct field study (noise loggers) to determine existing background underwater and terrestrial noise (i.e. pre-development) within the James Price Point coastal area. This data would also be used to model sound propagation and attenuation in the area.
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	Conduct desktop study to estimate sound exposure levels for equipment and activities expected to be used during construction and operational phases (i.e. piling, marine blasting, dredging/shipping and plant operation). These estimates, background noise data and sound propagation/ attenuation modelling would be used to model peak and normal/operational noise emissions and develop noise contour maps for each major activity.
(5) Predict Potential Effects	<p>Modelling would be combined with the identified exposure limits to establish noise contours. This would be overlaid with habitat mapping and recreational and heritage use areas and the results of baseline studies to establish zones of potential impact.</p> <p>Impact Assessment undertaken based around the likelihood that terrestrial and underwater noise emissions would effect critical habitats, or the extent to which it is predicted to alter movement or other behavioural/physiological patterns of fauna behaviour</p> <p>For social aspects the impact assessment would be based around the potential for noise emissions to affect the recreational and heritage values of the area, including consideration of the amenity value of the James Price Point coastal area for recreational and indigenous users..</p>

10.1.4 Impact Assessment Outcome

The results of the noise and vibration impact assessment will provide the following outcomes:

- An understanding of the baseline terrestrial and underwater noise levels for the James Price Point coastal area;
- Mapping of predicted terrestrial and underwater noise emissions as a result of Precinct construction and operational activities;
- Assessment of likely impacts of underwater noise on key environmental factors based on baseline ecological and social information and predicted noise and vibration levels.

- Definition of appropriate mitigations and/or offsets if required.

10.2 Sediment Deposition and Turbidity

Sediment generating activities primarily associated with marine based construction works and include dredging, breakwater constructions, site preparation, pipeline installation and nearshore construction works. It is likely that the main source of impact would occur during construction and dredging while ongoing impacts may occur as a result of maintenance dredging (if required) and propeller wash.

10.2.1 Summary of Key Environmental and Social Factors

The Key environmental and social factors identified as having the potential to be impacted by sediment deposition and turbidity are listed at Table 10.4 below.

Table 10-4 Environmental Factors – Sediment Deposition and Turbidity

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Marine Waters – Decline in water quality	High	DIS5 – Modelling of Pressures Associated with Sediment and Turbidity Generating Activities; DIS8 – Sedimentation Study DIS10 – Particle Generation Study DIS18 – Hydrological and Hydrogeological Assessment and Modelling; DFS13 – Spoil Ground Investigation; DIS6 – Dredge Alternative Study
Coral – disturbance to coral reefs	Medium	DIS5 – Modelling of Pressures Associated with Sediment and Turbidity Generating Activities; DIS8 – Sedimentation Study DIS10 – Particle Generation Study DIS18 – Hydrological and Hydrogeological Assessment and Modelling DFS13 – Spoil Ground Investigation; DIS6 – Dredge Alternative Study
Reptiles – Disturbance to conservation significant fauna individuals	Medium	As above
–Marine mammals – Disturbance to conservation significant fauna individuals	Medium	As above
Invertebrates – Disturbance of fauna habitat	Medium	As above
Seagrass – Loss of habitat	Medium	As above
Macroalgal Communities – Disturbance of fauna habitat	Medium	As above
Mangroves – Loss of habitat	Low	As above

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Fish – Disturbance of conservation significant fauna individuals	Low	As above
Intertidal Marine Sediments – Loss of habitat	Low	As above
Physical – Alteration of flow regimes	Low	As above
SOCIAL FACTORS		
Commercial Fishing - Disturbance to existing and future activities	Medium	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Aquaculture - Disturbance to existing and future activities	Medium	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Tourism - Disturbance to existing and future activities	Medium	SIA12 – Tourism Impact Assessment
Visual Amenity – Change to visual amenity	Medium	SIA13 – Landscape and Visual Amenity Impact Assessment
Palaeontology (Archaeological Heritage) – Disturbance to heritage sites	Medium	SIA2 – Archaeological Field Survey
Colonial Heritage – Disturbance to heritage sites	Medium	SIA15 – Colonial and Environmental Heritage Study
Environmental Heritage – Disturbance to heritage sites	Medium	SIA15 – Colonial and Environmental Heritage Study
Sport and recreation – Disturbance to existing and future activities	Medium	SIA15 – Recreation and Lifestyle Study
Recreational Fishing – Disturbance to existing and future activities	Medium	SIA15 – Recreation and Lifestyle Study

10.2.2 Objective of Assessment

The objectives of the sediment deposition and turbidity study are to:

- Determine the existing physico-chemical characteristics and the deposition rates of naturally-occurring sediments within the James Price point coastal area considering tidal regimes (e.g. spring-neap, ebb-flood) and seasonal cycles (e.g. wet-dry).
- Characterise the natural turbidity regime and other relevant water quality indicators within the area of interest considering tidal regimes (e.g. spring-neap, ebb-flood) and seasonal cycles (e.g. wet-dry).
- Identify and compile the data and other model inputs, including measurements and assumptions, which will be used to establish boundary conditions and drive hydrodynamic models required for dredge plume and sediment deposition modelling.
- Parameterise drivers of the hydrodynamic model using measured data where available, including particle size distributions and density of cut and unconsolidated material, rate of discharge, depth, dredge characteristics and modes of operation, etc.

- Using an appropriate 3D hydrodynamic model which is validated and calibrated using data relevant to the area(s) of interest, predict the dispersion and fate of sediments liberated (including deposition and resuspension rates of liberated particles) during activities such as dredging, dredge spoil disposal and breakwater construction and determine the impacts of different types and modes of operation of potential construction vessels and design options on the model outputs and „test’ the likely effectiveness of management options.
- Provide model output data in the form required to support the assessment of potential impacts arising from sediment / turbidity generating activities on the identified key environmental factors and establish spatially defined zones of impact, effect and influence.

10.2.3 Impact Assessment Approach

Environment

Sediment deposition and turbidity was identified as a high risk to marine water quality and a medium risk to benthic communities including benthic primary producers, marine mammals and reptiles. This is largely based on the known presence of seagrass beds within the James Price Point coastal area and known habitat importance of these areas. In addition marine waters are likely to provide foraging habitats for marine reptiles and fish species and habitat for other benthic communities. Natural turbidity of the waters is expected to be high however, this will be further investigated during field studies, and sedimentation is considered to have the potential to smother benthic habitats and result in reduced water quality. Accordingly, the impact assessment approach would concentrate on determining the likelihood, extent and severity/persistence of potential impacts occurring to these key environmental factors. The assessment will also consider potential impacts to fish, intertidal marine sediments and flow regimes.

Social

The risk assessment identified sediment deposition and turbidity as being of medium risk to the relevant social factors (as listed at Table 10.4 above), This reflects the potential for impacts on social aspects such as commercial and recreational fishing, aquaculture and tourism to occur as a result of reduced water and habitat quality.

In undertaking the assessment, the study will take into account EPA guidelines as defined in EPA Guidance Statement No. 29 - Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment (EPA 2004).

The following methodology is proposed to identify and assess the potential impact of sedimentation on key environmental and social factors.

Table 10-5 Assessment Approach – Sediment Deposition and Turbidity

Assessment Stage	Method
(1) Baseline (See Section 5)	<p>Environment - Outputs from desktop and previous field studies related to benthic communities and marine fauna are used to identify habitat areas (benthic communities) and substrate types within the James Price Point coastal area and Kimberley region to develop benthic habitat/substrate maps to support impact prediction and management, and to identify knowledge gaps.</p> <p>Previously collected data to be reanalysed to consolidate current understanding of the seasonal and inter-annual variability of benthic communities and patterns of utilisation of the area by fauna, the critical lifecycle processes and identify knowledge gaps.</p> <p>Revision of benthic habitat maps will be undertaken as appropriate, in order to produce high quality, spatially accurate and comprehensive maps of substrate/habitat type and benthic communities covering the likely zones of Impact and Effect, and representative areas within the Zone of Influence and identify suitable reference areas for each of the various habitat types that will not be influenced by the development.</p> <p>Subject to the outcomes of the baseline surveys, knowledge gaps may be identified that warrant further investigation for the project moving forward, and may form the basis of commitments for monitoring programs prior to, during and after</p>

	<p>construction.</p> <p>Social - For the identified social factors at Table 10.4 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage areas within the James Price Point coastal area.</p>
(2) Evaluate Receptor Sensitivity	<p>Environment - Conduct desktop studies to evaluate potential biological and physiological response(s) of benthic communities, including primary producers and filter feeders, and marine mammals to mobilised sediments and turbidity associated with activities such as dredging. Study required to show demonstrable understanding of the tolerance thresholds and pressure/response relationships, particularly for benthic communities, to the intensity, frequency and duration of exposures that might be experienced during the development program. These relationships will be used to establish tolerance/sensitivity criteria for key components of the ecosystem that will in turn be used to interrogate the predicted pressure fields of sediment deposition and turbidity to establish and spatially-define zones of impact, effect and influence.</p> <p>This will be scoped to ensure the range of potential exposure levels are considered, within the realm of what is natural and what is imposed, in determining receptor sensitivity.</p> <p>Desktop studies may show that future targeted research is warranted to further refine pressure/response relationships. Subject to the outcomes of the baseline surveys, knowledge gaps may be identified that may form the basis of commitments for monitoring programs prior to, during and after construction.</p> <p>Social - a desktop study would be conducted to understand the likely impacts of sediment deposition and turbidity on the identified social factors.</p>
(3) Characterise Existing Exposure Regime	<p>Studies to be undertaken to understand the existing sediment movement patterns and turbidity regimes in the area of interest (including the likely zone of influence). These studies will include acquisition of data on the baseline rates of sediment deposition and resuspension and turbidity under a variety of physical conditions (e.g. tides, winds and swell), particle size distributions and other physico-chemical characteristics of the sediments to provide a baseline for modelling studies and to evaluate any changes that may result from the proposed activities</p>
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	<p>Models will be developed and subsequently implemented to predict the intensity, frequency and duration of sediment/turbidity pressures imposed on the environment by realistic scenarios for dredging and spoil disposal and other sediment/turbidity generating activities. These models will be based on known and predicted (i.e. modelled) hydrodynamic conditions and sediment characteristics including particle sizes and distributions that are expected to result from dredging and other sediment/turbidity generating activities. Studies will be implemented as necessary to gather the required modeling inputs and to validate assumptions made within the model. Sediment modeling will report additional loads of suspended and deposited material resulting from the proposed activities, as well as resuspended materials, and these loads will be reported in the context of existing levels including natural variation and at spatial and temporal scales that are appropriate for informing predictions of impacts on benthic communities and dependent fauna. Model outputs would apply across the model domain and include;</p> <ul style="list-style-type: none"> • Time series concentrations of suspended sediments, and sediment deposition and re-suspension rates; • Contours of suspended sediment concentrations and deposited sediment thickness, and predictions of persistence; • Predicted stability (and instability) of deposited sediments, including dumped spoil material. <p>Time series concentrations and contours for exposure (suspended or deposited) will be produced in forms that are compatible with the criteria used to establish the zones of impact, effect and influence.</p> <p>Assessment will benefit from predictions of a range of scenarios and dredge types/options etc (including offshore/onshore disposal options) with the most probable case being carried forward as the basis for environmental impact assessment as described in 9.2.5.</p>

(5) Predict Potential Effects	<p>The modelled contours of pressure established in stages 3&4 would be combined with the habitat mapping and understanding of receptor sensitivity (stage 1&2) to determine severity of impact and the potential and timeframes for recovery (to be defined spatially and temporally).</p> <p>Prediction of ecological effects undertaken for other scenarios and dredge types/options will be an iterative process to minimise impacts while considering issues of technical feasibility, safety and cost.</p>
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10.2.4 Impact Assessment Outcomes

The results of the impact assessment will provide the following outcomes:

- Characterisation and distributions of the benthic communities and substratum within the James Price Point Coastal area covering the likely zones of Impact and Effect, and representative areas within the Zone of Influence, including information on the seasonality and critical environmental windows for those benthic communities and marine fauna that utilise the area.
- Characterisation of the existing turbidity, sediment transport and deposition regimes within the James Price Point coastal area and potentially a wider area, subject to definition of realistic zone of influence associated with turbidity/sedimentation and representative model domains;
- Model outputs including time series concentrations of suspended sediments, contours of the rate and load of deposited sediments and their thickness and predicted stability of dredged material.
- A quantitative assessment of predicted impacts of turbidity and sediment deposition on adjacent and nearby receptors (i.e. benthic communities and other sensitive receptors, see receptors identified in 10.2.3) expressed in map form;
- Definition of appropriate mitigations and/or offsets if required.

10.3 Marine Discharges – Including Non-routine events

Marine discharges consist of routine controlled discharges from LNG Precinct facilities and unplanned events such as spills of hydrocarbons or chemicals.

Routine discharges may consist of cooling water, desalination brine, residual stormwater, grey water, and treated sewage, while non-routine events may occur in the hypothetical scenario of accidental release. Changes in the chemical properties of the receiving waters from these discharges may affect the ecological function of the receiving environment through physiological or toxicological impacts and hence impact on sensitive receptors in the area.

10.3.1 Summary of Key Environmental and Social Factors

The Key environmental factors identified as having the potential to be impacted by marine discharges, including non-routine events are listed at Table 10.6 below.

Table 10-6 Environmental Factors - Marine Discharges

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Reptiles – Disturbance to conservation significant fauna individuals	Medium	DIS13 – Non-routine Discharge Modelling DIS32 – Marine Discharge Modelling DIS24 – Desktop Spill Risk Assessment; DIS18- Hydrological and Hydrogeological Assessment and Modelling
Marine Mammals – Disturbance to conservation significant individuals	Medium	As above

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Birds (Incl sea and migratory) – Disturbance to conservation significant fauna individuals	Medium	As above
Fish – Disturbance of Conservation fauna individuals	Medium	As above
Marine Waters (and sediment) – Surface water contamination	Medium	As above
Invertebrates (ex corals) – Disturbance to fauna habitat	Medium	As above
Seagrass – Disturbance of fauna habitat	Medium	As above
Microphytobenthos – Disturbance of fauna habitat	Medium	As above
Plankton – Surface water Contamination	Medium	As above
Macroalgal Communities	Medium	As above
Interidal Marine Sediments	Medium	As above
Mangroves – Disturbance of fauna habitat	Low	As above
Coral – Physical damage/disturbance to coral reefs	Low	As above
SOCIAL FACTORS		
Commercial Fishing – Disturbance to existing and future activities	Medium	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Aquaculture – Disturbance to existing and future activities	Medium	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Tourism – Disturbance to existing and future activities	Medium	SIA12 – Tourism Impact Assessment
Visual Amenity – Disturbance to existing and future activities	Medium	SIA13 – Landscape and Visual Amenity Assessment
Palaeontology (Archaeological Heritage) – Disturbance to heritage sites	Medium	SIA2 – Archaeological Field Survey
Environmental Heritage – Disturbance to heritage sites	Medium	SIA15 – Colonial and Environmental Heritage Study
Sport and recreation – Disturbance to existing and future activities	Medium	SIA14 – Recreation and Lifestyle Study
Recreational Fishing – Disturbance to existing and future activities	Medium	SIA14 – Recreation and Lifestyle Study

10.3.2 Objective of Assessment

The objectives of the marine discharge studies including non-routine discharge are to:

- Identify and characterise routine and non-routine discharge sources for the purpose of understanding likely risks and potential impacts;
- Provide a quantification of the likely trajectories, fates and consequences of production discharges and potential accidental spills that have been identified;

- Predict the hydrodynamic circulation over the James Price Point coastal area using a validated three-dimensional hydrodynamic model and its influence on the dispersion and fate of discharges effluents;
- Assess the likelihood and potential impacts of marine discharges and non-routine discharges on relevant environment (including EQOs and levels of ecological protection) and social factors during construction and operations.

10.3.3 Impact Assessment Approach

Environment

Marine discharges were identified as a medium risk to a number of environmental factors, as listed at Table 10.6 above. This was based largely on the potentially consequences of ongoing marine discharges and a non-routine discharge, should one occur, and it is likely that a separate risk assessment would be conducted to further understand the likelihood of such an event occurring. The impact assessment would concentrate on quantifying the extent of potential impacts occurring to the identified key environmental factors.

The assessment would also consider potential impacts on those factors identified as low risk.

Social

Marine discharges were identified as a medium risk to the social factors identified at Table 10.6 above. This is primarily related to the potential for ongoing and non-routine discharges to reduce water quality and habitat quality and the subsequent impacts on commercial fishing and other social uses of the area that may potentially occur. The social impact assessment would concentrate on firstly identifying current site usage and the importance of the coastal environments of the James Price Point coastal area and assessing the extent and nature of impacts.

In undertaking the assessment, the study will take into account relevant EPA guidelines and National Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000) and the WA State Water Quality Management Strategy (WA Government 2004).

The following methodology is proposed to identify and assess the potential impact of sedimentation on key environmental and social factors.

Table 10-7 Assessment Approach – Marine Discharges

Assessment Stage	Method
(1) Baseline (See Section 5)	<p>Environment - Outputs from the desktop and field studies related to the key environmental factors will be used to identify habitat areas and predict the existing ecological requirements and conditions within the James Price Point coastal area and Kimberley region where appropriate.</p> <p>Social - For the identified social factors at Table 10.6 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage areas within the James Price Point coastal area.</p>
(2) Evaluate Receptor Sensitivity	<p>Environment - Conduct desktop study to evaluate the toxicity of the marine discharge sources to key environmental factors and compare with ANZECC and ARMCANZ guidelines.</p> <p>Social - a desktop study would be conducted to understand the likely impacts of sediment deposition and turbidity on the identified social factors.</p>
(3) Characterise Existing Exposure Regime	Conduct desktop study to profile the nature, scale and extent of existing activities which may represent a potential non-routine discharge source
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	<p>Models would be developed based on known hydrodynamic conditions and discharge type and source;</p> <p>Model outputs would include;</p> <ul style="list-style-type: none"> • Time series concentrations of discharge types; • Contours of discharge concentrations;

(5) Predict Potential Effects	The completed models would then be combined with the baseline ecological mapping and social information for each key factor and known thresholds to characterise zones of potential impacts and to begin to assess the extent of likely impacts toxicity of key Precinct products would be compared with ANZECC / ARMCANZ guidelines. At this point alternative discharge locations or concentrations would be investigated to further understand the extent of likely impacts and to avoid impact where possible
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10.3.4 Impact Assessment Outcomes

The results of the impact assessment will provide the following outcomes:

- Contours for exposure to single or 'mixed effluent' from release location (concentration and dosage)
- Probability of exposure, potential exposure concentrations, cumulative doses at a Precinct level;
- Comparison with ecological protection levels;
- Definition of appropriate mitigations and/or offsets if required.

10.4 Terrestrial Wastes and Discharges – Including Non-routine events

Terrestrial wastes and discharges would typically consist of non-hazardous and hazardous wastes from onshore and offshore activities and would include domestic wastes and scrap material, chemicals, catalysts and green wastes.

While there are no major waterways within the James Price Point coastal area waste materials may have the potential to contaminate soils and groundwater, increase fire risk or attract vermin.

10.4.1 Summary of Key Environmental and Social Factors

The Key environmental and social factors identified as having the potential to be impacted by terrestrial wastes and discharges, including non-routine events are listed at Table 10.8 below.

Table 10-8 Environmental Factors - Marine Discharges

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Watercourses (rivers, creeks and wetlands)	Medium	DIS24 – Spill Risk assessment DIS18 – Hydrological and Hydrogeological Assessment and Modelling; DIS28 – Waste Assessment
Subterranean Fauna – Contamination of subterranean habitats	Medium	As above
Groundwater – Groundwater contamination	Medium	As above
Soils – Soil contamination	Medium	As above
Refuge Value for terrestrial Biota – Disturbance of fauna habitat.	Low	As above

Environmental Factor	Inherent Risk Rating	Related Impact Studies
SOCIAL FACTORS		
Waste Management – Disturbance to existing and future activities	Medium	DIS28 – Waste Assessment
Agriculture – Disturbance to existing and future activities	Medium	SIA4 – Indigenous Socio-cultural and Economic Profiling Study; SIA3 - Ethnobiological Field Survey; SIA1 – Cultural Heritage Study
Tourism – Disturbance to existing and future activities	Low	SIA12 – Tourism Impact Assessment
Visual Amenity – Change to visual amenity	Low	SIA13 – Landscape and Visual Amenity Impact Assessment
Palaeontology (Archaeological Heritage) – Disturbance to heritage sites	Low	SIA2 – Archaeological Field Survey
Environmental Heritage – Disturbance to heritage sites	Low	SIA15 – Colonial and Environmental Heritage Study
Aboriginal Heritage – Disturbance to heritage sites	Low	SIA1 – Cultural Heritage Study; SIA2 – Archaeological Field Survey; SIA3 – Ethnobiological Field Survey;
Sports and recreation – Disturbance to existing and future activities	Low	SIA14 – Recreation and Lifestyle Study
Recreational Fishing	Low	SIA14 – Recreation and Lifestyle Study

10.4.2 Objective of Assessment

The objectives of the terrestrial waste and discharge studies including non-routine discharge are to:

- Identify and characterise waste and routine and non-routine discharge sources for the purpose of understanding likely risks and potential impacts;
- Provide a quantification of the likely trajectories, fates and consequences of production discharges and potential accidental spills that have been identified;
- Predict the hydrodynamic circulation of groundwater flows within the James Price Point coastal area using a validated three-dimensional hydrodynamic model;
- Assess the likelihood and potential impacts of discharges and non-routine discharges on sensitive terrestrial and social receptors during construction and operations.

10.4.3 Impact Assessment Approach

Terrestrial wastes and discharges were identified as a medium risk to a number of environmental and social factors, as listed at Table 10.8 above. This was based largely on the potentially for onsite wastes to contaminate local watercourses, soil and groundwater. It is likely that a separate risk assessment would be conducted to understand the likelihood and potential consequences of a non-routine event. The impact assessment would concentrate on quantifying the extent of potential impacts occurring to the identified key environmental and social factors.

The assessment would also consider potential impacts on those factors identified as low risk.

In undertaking the assessment, the study will take into account relevant EPA guidelines and National Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000) and the WA State Water Quality Management Strategy (WA Government 2004).

The following methodology is proposed to identify and assess the potential impact of terrestrial wastes and discharges on key environmental factors.

Table 10-9 Assessment Approach – Terrestrial Wastes and Discharges

Assessment Stage	Method
(1) Baseline (See Section 5)	Environment - Outputs from the desktop and field studies related to the key environmental factors will be used to identify habitat areas and predict the existing ecological requirements and conditions within the James Price Point coastal area and Kimberley region where appropriate.
	Social - For the identified social factors at Table 10.8 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage areas within the James Price Point coastal area.
(2) Evaluate Receptor Sensitivity	Environment - Conduct desktop study to evaluate the toxicity of waste and discharge sources to key environmental factors and compare with ANZECC and ARMCANZ guidelines.
	Social - a desktop study would be conducted to understand the likely impacts of terrestrial wastes on the identified social factors.
(3) Characterise Existing Exposure Regime	Conduct desktop study to profile the nature, scale and extent of existing activities which may represent a potential discharge source
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	Models would be developed based on known hydrodynamic conditions and waste and discharge type and source;
	Model outputs would include; <ul style="list-style-type: none"> • Time series concentrations of discharge types; • Contours of discharge concentrations;
(5) Predict Potential Effects	The completed models would then be combined with the baseline ecological mapping and social information for each key factor and known thresholds to characterise zones of potential impacts and to begin to assess the extent of likely impacts, toxicity of key discharges would be compared with ANZECC and ARMCANZ guidelines. At this point alternative discharge locations or concentrations would be investigated to further understand the extent of likely impacts and to avoid impact where possible;

10.4.4 Impact Assessment Outcomes

The results of the impact assessment will provide the following outcomes:

- Contours for exposure to single or 'mixed effluent' from release location (concentration and dosage)
- Probability of exposure, potential exposure concentrations, cumulative doses at a Precinct level;
- Comparison with ecological protection levels;
- Definition of appropriate mitigations and/or offsets if required.

10.5 Terrestrial Site Disturbance and Excavation

Terrestrial site disturbance and excavation activities will occur during site preparation and would include site excavation, filling and compaction works. These activities are likely to alter the local landscape within the LNG Precinct itself and have the potential to impact environmental and social factors, as identified in Table 10.10 below.

10.5.1 Summary of Key Environmental and Social Factors

The key environmental and social factors identified as having the potential to be impacted by site disturbance and excavation are listed at Table 10.10 below.

Table 10-10 Environmental Factors - Site Disturbance and Excavation

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Geomorphology	High	DIS19 – Soils and Geotechnical Investigation
Groundwater	High	DIS18 – Hydrological and hydrogeological Assessment and Modelling DIS17 – Desktop Assessment of Groundwater Resources and Stygofauna Habitat Assessment
Soils	Medium	DIS19 – Soils and Geotechnical Investigation
Surface SRE	Medium	DFS2 – Fauna Study (wet and dry)
Subterranean SRE	Medium	DIS17 – Desktop Assessment of Groundwater Resources and Stygofauna Habitat Assessment
Terrestrial Conservation Areas	Low	SIA15 – Colonial and Environmental Heritage Study
Watercourses Rivers Creeks and Wetlands	Low	DIS18 – Hydrological and hydrogeological Assessment and Modelling
SOCIAL FACTORS		
Tourism – Disturbance to existing and future activities	High	SIA12 – Tourism Impact Assessment
Visual Amenity – Change to visual amenity	High	SIA13 – Landscape and Visual Amenity Impact Assessment
Recreational Fishing – Disturbance to existing and future activities	High	SIA14- Recreation and Lifestyle Study
Palaeontology – (Archaeological Heritage)	Medium	SIA2 – Archaeological Field Study
Aboriginal Heritage – Disturbance to heritage sites	Medium	SIA1 – Cultural Heritage Study; SIA2 – Archaeological Field Survey; SIA3 – Ethnobiological Field Survey;
Cultural Heritage – Disturbance to heritage sites	Medium	SIA3 – Ethnobiological Field Survey; SIA1 – Cultural Heritage Study;

Environmental Factor	Inherent Risk Rating	Related Impact Studies
		SIA2 – Archaeological Field Study
Environmental Heritage – Disturbance to Heritage Sites	Medium	SIA15 – Colonial and Environmental Heritage Study
Sport and recreation – Disturbance to existing and future activities	Low	SIA14 – Recreational and Lifestyle Study
Mining – Disturbance to existing and future activities	Low	N/A
Agriculture – Disturbance to existing and future activities	Low	SIA4 – Indigenous Socio-cultural and Economic Profiling Study; SIA3 - Ethnobiological Field Survey; SIA1 – Cultural Heritage Study
Terrestrial Conservation Areas – Disturbance to heritage sites	Low	SIA5 – landuse, Tenure and Access Study.

10.5.2 Objective of Assessment

The objectives of the impact study to assess likely impacts as a result of site disturbance and excavation are:

- Understand the fate and nature of existing hydrological and hydro-geological conditions within the James Price Point coastal area;
- Determine the likely presence of acid sulphate soils;
- Meet the requirements of EPA Guidance Statement No. 54 'Consideration of Subterranean Fauna in Groundwater and in Caves during Environmental Impact Assessment in Western Australia
- Understand nature of existing geological and geomorphological conditions;
- Understand the consequences of a change in soil properties and compaction as a result of site preparation on geomorphology and hydrological conditions;
- Determine the area of habitat for key environmental factors that is likely to be removed as a result of site construction activities; and
- Consider the importance of the habitats proposed to be removed and determine the likely significance of habitat removal on the key environmental factors.

10.5.3 Impact Assessment Approach

Environment

Site disturbance and excavation was identified as a high risk to coastal geomorphology and groundwater. This primarily relates to the site preparation works that would occur including large scale excavation works, site compaction and potential changes to groundwater flows and quality. The remaining environmental factors were identified as a medium or low risk (Table 10.10).

Social

Site disturbance and excavation was identified as a high risk to tourism, visual amenity and recreational fishing due to changes to the local landscape that would occur. Aboriginal, environmental and cultural heritage were all identified as medium risks as site excavation activities would aim to avoid areas of significance wherever possible. The remaining social factors were identified as low risk (Table 10.10).

The following methodology is proposed to identify and assess the potential impact of site disturbance and excavation on key environmental and social factors;

Table 10-11 Assessment Approach Site Disturbance and Excavation

Assessment Stage	Method
(1) Baseline (See Section 5)	<p>Environment - Outputs from the desktop and baseline studies related to the key environmental factors will be used to establish existing baseline and geotechnical and hydrological conditions within the James Price Point coastal area and Kimberley region where appropriate.</p> <p>Social - For the identified social factors at Table 10.10 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage areas within the James Price Point coastal area.</p>
(2) Evaluate Receptor Sensitivity	Site disturbance and excavation represents a direct impact to habitat and social factors in the immediate disturbance area.
(3) Characterise Existing Exposure Regime	Site disturbance and excavation is not currently occurring within the James Price Point coastal area.
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	<p>The baseline ecological mapping and social usage patterns and locations of important heritage areas for each key factor (stage 1) would be considered in relation to proposed onshore construction and site preparation works to identify areas of potential impact, consideration of alternative layouts etc. will be undertaken as a means to minimise impacts to important habitats or social values, where possible.</p> <p>Hydrological and hydrogeological assessment and modelling would be undertaken to understand surface and groundwater flows in order that the interactions/implications of site disturbance can be best understood.</p>
(5) Predict Potential Effects	Once proposed construction locations are confirmed and areas of impact identified, an assessment would be completed to quantify the extent impacts on each environmental and social factor that is likely to be affected and assess the likely significance of this impact in relation to the James Price Point coastal area and the broader west Kimberley coast.

10.5.4 Impact Assessment Outcomes

The results of the impact assessment will provide the following outcomes:

- An understanding of the existing environmental and social factors within the James Price point coastal area that may be affected by site disturbance and excavation activities;
- Understanding of existing hydrological and geological conditions within the James Price Point coastal area and likely impacts and key environmental factors;
- Quantification of the likely impacts of site excavation and preparation activities on key environmental and social factors;
- Quantification of the area of habitat for key environmental factors that is likely to be removed, in order to determine a level of significance at a local and regional context; and

10.6 Marine Site Disturbance and Excavation

A number of activities associated with the construction of an LNG Precinct will require marine site disturbance and excavation to occur. This includes nearshore excavation works, pipelaying and dredging activities. This environmental aspect deals only with the physical disturbance of marine sediments and subsequent direct habitat disturbance. Impacts associated with related impacts such as sediment deposition and turbidity or noise and vibration are considered under the separate environmental aspect headings.

10.6.1 Summary of Key Environmental and Social Factors

The key environmental and social factors identified as having the potential to be impacted by site disturbance and excavation are listed at Table 10.12 below.

Table 10-12 Environmental Factors - Site Disturbance and Excavation

Environmental Factor	Inherent Risk Rating	Related Studies
Marine mammals	Medium	DIS9 - Geotechnical Study (PSD) Baseline Studies as described at Chapter 8
Seagrass	Medium	As above
Reptiles	Medium	As above
Coral	Low	As above
Mangroves	Low	As above
Macroalgal Communities	Low	As above
Invertebrates	Low	As above
Fish	Low	As above
SOCIAL FACTORS		
Aboriginal Heritage – Disturbance to heritage sites	High	SIA1 – Cultural Heritage Study; SIA2 – Archaeological Field Survey; SIA3 – Ethnobiological Field Survey;
Palaeontology (Archaeological Heritage) – Disturbance to heritage sites	High	SIA2 – Archaeological Field Survey;
Commercial Fishing – Disturbance to existing and future activities	Low	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Aquaculture – Disturbance to existing and future activities	Low	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Tourism – Disturbance to existing and future activities	Low	SIA12 – Tourism Impact Assessment
Visual Amenity – Change to visual amenity	Low	SIA13 – Landscape and Visual Amenity Impact Assessment
Environmental Heritage – Disturbance to heritage sites	Low	SIA15 – Colonial and Environmental Heritage study
Sports and Recreation – Disturbance to existing and future activities	Low	SIA14 – Recreation and Lifestyle Study
Recreational Fishing – Disturbance to existing and future activities	Low	SIA14 – Recreation and Lifestyle Study

10.6.2 Objective of Assessment

The objectives of the impact study to assess likely impacts as a result of site disturbance and excavation are:

- Understand nature of existing geological and geomorphological conditions;
- Determine the area of habitat for key environmental factors that is likely to be removed as a result of marine site disturbance and construction activities;
- Understand existing social values and usage patterns (refer to Guidance Statement 29) within the James Price Point coastal area; and
- Consider the importance of the habitats and areas proposed to be disturbed and determine the likely consequence and significance of impacts on the key environmental and social factors.

10.6.3 Impact Assessment Approach

Environment

Marine site disturbance and excavation was identified as a medium risk to marine mammals, seagrass and reptiles. This primarily relates to the potential for marine excavation activities to disturb habitats and affect foraging behaviour. The remaining environmental factors were identified as a low risk (Table 10.12).

Social

Aboriginal and archaeological heritage were identified as being of high risk to marine site disturbance and excavation activities given the potential for sites to be disturbed as a result of excavation activities. The remaining social factors were identified as low risk given the likelihood of limited visual impacts occurring relatively small area of potential impacts.

The following methodology is proposed to identify and assess the potential impact of site disturbance and excavation on key environmental factors;

Table 10-13 Assessment Approach Site Disturbance and Excavation

Assessment Stage	Method
(1) Baseline (See Section 5)	Environment - Outputs from the desktop and baseline studies related to the key environmental factors will be used to establish the existing baseline conditions within the James Price Point coastal area and Kimberley region where appropriate. Social – For the identified social factors at Table 10.12 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage areas within the James Price Point coastal area.
(2) Evaluate Receptor Sensitivity	Site disturbance and excavation causes a direct impact/change to the habitat within the immediate disturbance area and potential for subsequent impacts to marine fauna.
(3) Characterise Existing Exposure Regime	Site disturbance and excavation is not currently occurring within the James Price Point coastal area.
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	The baseline ecological mapping for each key factor (stage 1) would be placed over the proposed construction locations including nearshore pipelines, shipping channels and nearshore infrastructure to identify areas of potential impact, consideration of alternative layouts etc. will be undertaken as a means to minimise impacts to important habitats, where possible;
(5) Predict Potential Effects	Once proposed construction locations are confirmed and areas of impact identified, an assessment would be completed to quantify the extent of habitat for each environmental factor that is likely to be removed and assess the likely significance of this impact in relation to the James Price Point coastal area and the broader west Kimberley coast. Loss of BPPH will be accounted for along with other predicted loss/ serious damage and then assessed in the context of guidance in GS. No 29.

10.6.4 Impact Assessment Outcomes

The results of the impact assessment will provide the following outcomes:

- An understanding of the existing marine environmental and social factors within the James Price point coastal area that may be affected by site disturbance and excavation activities;
- Quantification of the likely impacts of site excavation and preparation activities on key environmental and social factors;
- Quantification of the area of habitat for key environmental factors that is likely to be removed, and an assessment of the ecological consequences in order to determine a level of significance at a local and regional context; and,
- Definition of appropriate mitigations and/or offsets if required.

10.7 Invasive Marine Species

Invasive marine species (IMS) have the potential to be introduced to the James Price Point coastal area a result of increased vessel activity during Precinct construction and operation..

Invasive marine species (IMS) are species that have been introduced to an area outside of their normal range and have survived, become established and become a threat to ecological and/or other values. The two primary mechanisms for the inadvertent introduction and spread of invasive marine species are via ballast water discharge or vessel biofouling. Vessels and barges can inadvertently transfer IMS if not appropriately managed. IMS have the potential to impact directly on benthic communities, coral and fish via competition for habitat and food resources. Indirect impacts may occur to commercial and recreational fishers, tourism operators and the development itself.

10.7.1 Summary of Key Environmental and Social Factors

The Key environmental and social factors identified as having the potential to be impacted by IMS are listed at Table 10.14 below.

Table 10-14 Environmental Factors – Invasive Marine Species

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Coral – Biological	High	DFS23 – Invasive Marine Species Survey and Assessment
Invertebrates - Biological	High	DFS23 – Invasive Marine Species Survey and Assessment
Fish - Biological	High	DFS23 – Invasive Marine Species Survey and Assessment
Seagrass - Biological	High	DFS23 – Invasive Marine Species Survey and Assessment
Ecosystem Integrity - Biological	High	DFS23 – Invasive Marine Species Survey and Assessment
Macroalgal Communities - Biological	High	DFS23 – Invasive Marine Species Survey and Assessment
SOCIAL FACTORS		
Aquaculture – Disturbance to existing and future activities	High	SIA11- Fisheries, Pearling and Aquaculture Impact Assessment
Commercial Fishing – Disturbance to existing and future activities	Medium	SIA11- Fisheries, Pearling and Aquaculture Impact Assessment

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Recreational Fishing – Disturbance to existing and future activities	Medium	SIA14 – Recreation and Lifestyle Study
Environmental Heritage – Disturbance to heritage sites	Low	SIA15 - Colonial and Environmental Heritage Study

10.7.2 Objective of Assessment

The objectives of an assessment of the likely impact of IMS marine environments are to:

- Establish a baseline of marine species presence, including invasive marine species, at the James Price Point coastal area using the results of the baseline biological studies;
- Identify IMS species of risk to the James Price Point coastal area based on existing biological conditions and IMS species known from Australia and elsewhere; and
- Establish a framework for the assessment and management of quarantine risks to the James Price Point coastal area associated with the construction and operation of the proposed Precinct.

10.7.3 Impact Assessment Approach

IMS were identified as a high risk to benthic primary producers and fish, and ecosystem integrity this primarily relates to the potential for introduced species to compete with benthic communities and fish for habitat and food resources.

IMS were identified as a high risk to aquaculture and a medium risk to commercial and recreational fishing. This primarily relates to the potential biological impact of IMS on the marine environment and subsequent impacts on these activities.

The impact assessment would concentrate on quantifying the extent of potential impacts occurring to the identified key environmental and social factors (high and medium risk).

The following methodology is proposed to identify and assess the potential impact of IMS on key environmental factors.

Table 10-15 Assessment Approach - Invasive Marine Species

Assessment Stage	Method
(1) Baseline (See Section 5)	<p>Environment - Outputs from the desktop and field studies related to the key environmental factors will be used to record the presence, distribution and habitat types for marine species within the James Price Point coastal area and record the presence of IMS, should they occur.</p> <p>Social – For the identified social factors at Table 10.14 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage and social areas within the James Price Point coastal area.</p>
(2) Evaluate Receptor Sensitivity	<p>A list of identified and potentially occurring pest species would be created. This would include;</p> <ul style="list-style-type: none"> • list of potential IMS for Scott Reef and near shore areas; • identifying incursions of IMS that are already reported from elsewhere in Australia; • Detect IMS not previously recorded from Australia but known to be pests elsewhere. <p>A desktop study would then be conducted to evaluate potential ecological and physiological response(s) of the key environmental factors to introduced pests.</p>
(3) Characterise Existing Exposure Regime	Based on the results of the baseline ecological studies existing disturbances and impacts as a result of introduced pests would be identified. This would include a review of current and past transmission pathways and identification

Assessment Stage	Method
(4) Establish Monitoring and Management Frameworks	At this point a robust monitoring and management frameworks would be established based on an IMS risk assessment and the results of baseline biological field surveys.

10.7.4 Impact Assessment Outcomes

The results of the IMS impact assessment will provide the following outcomes:

- Knowledge of baseline IMS within the James Price Point coastal area and risks with respect to non-indigenous and invasive marine species
- An understanding of the baseline status of introduced pests in the James Price Point area, including an IMS list for James Price Point and near shore areas;
- Validation of introduced pest transmission pathway management; and
- Basis for the development of a long term IMS monitoring strategy for the LNG Precinct.

10.8 Terrestrial Introduced Pests

Weed species are already known to occur on the Dampier Peninsula and James Price Point coastal area (Scoping Report Sect. 5.3.4.3) and have the potential to outcompete native flora species. It is considered likely that introduced fauna species currently inhabit the Dampier Peninsula and James Price Point coastal area. There is the potential for the introduction of new pests to the James Price Point coastal area as a result of Precinct construction and operation however there is also the potential for improved management of natural resources to occur.

10.8.1 Summary of Key Environmental and Social Factors

The Key environmental factors identified as having the potential to be impacted by introduced pests are listed at Table 10.16 below.

Table 10-16 Environmental Factors – Terrestrial Introduced Pests

Environmental Factor	Inherent Risk Rating	Related Studies
Terrestrial Flora– Disturbance to conservation significant vegetation communities	Medium	DFS1 [*] - Wet and Dry Season Flora and Vegetation Surveys DFS2 – Wet and Dry Season Fauna Surveys
Terrestrial Fauna- Disturbance to fauna populations	Low	As above
Refuge Value for Terrestrial Biota – Introduction and/or spread of weeds	Low	As above
Ecosystem Integrity – Introduction and/or spread of weeds	Low	As above
SOCIAL FACTORS		
Agriculture – Disturbance to existing and future activities	Medium	SIA1 – Cultural Heritage Study; SIA3 – Ethnobiological Field Survey
Tourism – Disturbance to existing and future activities	Medium	SIA12 – Tourism Impact Assessment

Environmental Factor	Inherent Risk Rating	Related Studies
Visual Amenity – Change to visual amenity	Medium	SIA13 – Landscape and Visual Amenity Impact Assessment
Sport and recreation – Disturbance to existing and future activities	Medium	SIA14 – Recreation and Lifestyle Study

10.8.2 Objective of Assessment

The objectives of an assessment of the likely impact of introduced pests on terrestrial environments are to:

- Establish a baseline of terrestrial weed and introduced fauna species presence at the James Price Point coastal area using the results of the baseline biological studies; and
- Establish a framework for the assessment and management of quarantine risks to the James Price Point coastal area associated with the construction and operation of the proposed Precinct.

10.8.3 Impact Assessment Approach

Introduced pests were identified as a medium risk to terrestrial flora given the known presence of Monsoon Vine Thicket TEC within the James Price Point coastal area and the potential for additional weed invasion to impact the quality of these areas. The remaining factors were assigned a low risk given that introduced flora and fauna species are likely to be already established within the James Price Point coastal area and it is likely that improved vegetation and land management would occur in vegetated areas surrounding the Precinct during construction and operation of the Precinct.

In relation to the relevant social factors identified at Table 10.16 introduced plants and fauna species were considered to represent a medium risk. This was primarily based on the potential for introduced pests to impact existing site uses and future activities.

The impact assessment would concentrate on quantifying the extent of potential impacts occurring to the identified key environmental factors (high and medium risk).

The following methodology is proposed to identify and assess the potential impact of introduced pests on key environmental and social factors.

Table 10-17 Assessment Approach – Terrestrial Introduced Pests

Assessment Stage	Method
(1) Baseline (See Section 5)	Environment - Field studies would be used to record the presence and distribution of introduced flora and fauna species within the James Price Point coastal area. Social - For the identified social factors at Table 10.16 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage values within the James Price Point coastal area.
(2) Evaluate Receptor Sensitivity	A list of identified and potentially occurring weed and introduced fauna species would be generated A desktop study would then be conducted to evaluate potential ecological and physiological response(s) of the key environmental factors to introduced flora and fauna species
(3) Characterise Existing Exposure Regime	Based on the results of the baseline ecological studies a desktop study would be completed to profile existing disturbances and threats posed by introduced flora and fauna species within the James Price Point coastal area.
(4) Establish Monitoring and Management Frameworks	At this point robust monitoring and management frameworks would be established based on the results of baseline biological field surveys and the existing exposure regime.

10.8.4 Impact Assessment Outcomes

The results of the terrestrial introduced pest impact assessment will provide the following outcomes:

- Knowledge of baseline presence and distribution of introduced flora and fauna species within the James Price Point coastal area;
- Identification and management of potential transmission pathways; and
- Basis for development of a long term introduced flora and fauna species monitoring strategy for the LNG Precinct.

10.9 Light Emissions

Light emissions occur from temporary infrastructure during construction of the LNG Precinct. During operations, the operational facilities and associated loading infrastructure require lighting to maintain industrial safety standards. Depending on the distance to sensitive receptors light can potentially impact on nesting behaviour of turtles and influence turtle hatchling orientation. Lighting can also act as a repulsion/attraction source for fauna.

10.9.1 Summary of Key Environmental and Social Factors

The key environmental factors identified as having the potential to be impacted by light emissions are listed at Table 10.18 below.

Table 10-18 Environmental Factors - Light Emissions

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Marine Reptiles– Disturbance of Conservation Significant Fauna Individuals	Medium	DIS14 – Baseline Light Study; DIS15 - Desktop Study for Lighting Impacts; DIS16 – Light Dispersion Modelling
Birds– Sea and Migratory	Medium	As above
Marine Mammals – Disturbance to conservation significant individuals	Low	As above
Fish – Disturbance to conservation significant individuals	Low	As above
Coral – Physical damage/disturbance to coral reefs	Low	As above
SOCIAL FACTORS		
Commercial Fishing – Disturbance to existing and future activities	Medium	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Aquaculture – Disturbance to existing and future activities	Medium	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Tourism – Disturbance to existing and future activities	Medium	SIA12 – Tourism Impact Assessment
Visual Amenity – Change to visual amenity	Medium	SIA13 – Landscape and Visual Amenity Impact Assessment
Sport and recreation – Disturbance to existing and future activities	Medium	SIA14 – Recreation and Lifestyle Study

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Recreational Fishing – Disturbance to existing and future activities	Medium	SIA14 – Recreation and Lifestyle Study

10.9.2 Objective of Assessment

The objectives of an assessment of the likely impact of light emissions on surrounding environmental and social factors are to:

- Determine the existing light levels of the onshore and nearshore study area and identify nearby land uses and sensitive receptors.
- Assess the likely impact on key environmental and social factors by modelling light levels that could affect receptors / factors of concern.
- Assess light manipulation techniques should significant levels of light pollution remain following mitigation, to reduce identified risks and impacts to acceptable levels.

10.9.3 Impact Assessment Approach

Light emissions were identified as a medium risk to marine reptiles and sea and migratory bird species. This is largely based on the potential for light to affect nesting activity and success however current information suggests that important nesting areas for sea and migratory bird species and marine reptiles is unlikely to occur within the James Price Point coastal area. The remaining social factors were identified as medium risk, largely as a result of likely impacts to visual amenity. The impact assessment approach would concentrate on determining the likelihood and extent of potential impacts occurring to these key environmental and social factors.

The following methodology is proposed to identify and assess the potential impact of light emissions on key environmental and social factors:

Table 10-19 Assessment Approach – Light Emissions

Assessment Stage	Method
(1) Baseline (See Section 5)	<p>Outputs from the desktop and field studies related to the above environmental factors will be used to identify habitat areas and usage patterns within the James Price Point coastal area and Kimberley region where appropriate.</p> <p>In relation to social factors the desktop and field studies would concentrate on identifying important heritage sites and community and commercial land uses within the James Price Point coastal area.</p>
(2) Evaluate Receptor Sensitivity	<p>Conduct desktop study to evaluate potential impacts on key environmental factors (both ecological and social) to light emissions.</p> <p>Temporal nature of responses will be considered in the study (eg. turtle nesting or peak recreational periods).</p> <p>This will be scoped to ensure the range of potential exposure levels are considered in determining receptor sensitivity.</p>
(3) Characterise Existing Exposure Regime	Review to be undertaken to determine the baseline light exposure levels.
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	<p>Likely construction and operational light sources would be identified and predicted for both the onshore and nearshore facilities,</p> <p>A light dispersion model would be developed, based on baseline and expected light intensity and dispersion.</p>
(5) Predict Potential Effects	The results of the modelling (light dispersion) would be overlain with sensitive receptors to identify zones of potential impact. If significant issues are identified, it will be considered in the facility design as an iterative process to minimise impacts, while considering issues of technical feasibility, safety and cost.

10.9.4 Impact Assessment Outcomes

The results of the light impact assessment will provide the following outcomes:

- An understanding of the existing level of illumination in the James Price Point area;
- Characterisation of predicted light emission levels for the LNG Precinct.
- Information to provide an informed assessment of potential light emissions on sensitive receptors; and
- Where required, develop strategies to reduce light spill for the LNG Precinct to acceptable levels where practicable.

10.10 Vessel Movements

A range of vessel movements will be necessary during development and operation of the LNG Precinct. During construction, marine vessels will be required to undertake preparatory nearshore works, dredging, berth construction, pipe laying, material/equipment offloading and supporting activities. During operations, LNG carriers will regularly export LNG product from loading facilities for shipping to international markets.

10.10.1 Summary of Key Environmental and Social Factors

The Key environmental and social factors identified as having the potential to be impacted by vessel movements are listed at Table 10.20 below.

Table 10-20 Environmental Factors and Social Factors- Vessel Movements

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Marine Reptiles– Disturbance of Conservation Significant Fauna Individuals	Medium	DIS29 – Desktop review of Existing Marine Traffic DIS30 – Marine Traffic Impact Assessment
Marine Mammals – Disturbance to conservation significant individuals	Medium	As above.
Marine Water and Sediment Quality	Low	DIS13 – Non-routine Discharge Modelling
SOCIAL FACTORS		
Commercial Fishing – Disturbance to existing and future activities	High	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Aquaculture - Disturbance to existing and future activities	High	SIA11 – Fisheries, Pearling and Aquaculture Impact Assessment
Tourism - Disturbance to existing and future activities	High	SIA12 – Tourism Impact Assessment
Transport - Disturbance to existing and future activities	High	SIA10 – Transportation Impact Assessment Study
Visual Amenity – Changes to visual amenity	High	SIA13 – Landscape and Visual Amenity Impact Assessment
Sport and recreation - Disturbance to existing and future activities	High	SIA14 – Recreation and Lifestyle Study

Recreational Fishing - Disturbance to existing and future activities	High	SIA14 – Recreation and Lifestyle Study
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10.10.2 Objective of Assessment

The objectives of an assessment of the likely impact of vessel movements on the key environmental and social factors are to:

- Determine the likely behavioural response of marine reptiles and marine mammals to increased vessel movements within the James Price Point coastal area;
- Understand existing social usage patterns within the James Price Point coastal area and potential impacts of vessel movements on these;
- Determine the potential for vessel movements to alter marine mammal and marine reptile usage patterns within the James Price Point coastal area.
- Determine the risk of cetacean – vessel interactions and the likely consequences.

10.10.3 Impact Assessment Approach

Vessel movements were identified as a high risk to the social factors identified at Table 10.20 above. This primarily relates to known uses of the coastal environment of the James Price Point coastal area and potential impacts on these.

Vessel movements were identified as a medium risk to marine reptiles and marine mammals. This is largely based on the potential for vessel movements to disturb these key environmental factors.

The following methodology is proposed to identify and assess the potential impact of vessel movements on slow-moving marine mammals and marine reptiles and the identified social factors.

Table 10-21 Assessment Approach - Vessel Movements

Assessment Stage	Method
(1) Baseline (See Section 5)	Environment - Outputs from the desktop and field studies related to marine reptiles (turtles specifically) and marine mammals (humpback whales, dugongs and dolphins) will be used to illustrate the presence, behaviour and residence time of marine megafauna within the James Price Point coastal area and Kimberley region where appropriate. Social – Baseline social studies would be used to understand recreational and commercial usage patterns of the James Price Point coastal area
(2) Evaluate Receptor Sensitivity	A desktop study would be conducted to evaluate inherent behavioural and physiological response(s) of marine megafauna when exposed to interaction with stationary and mobile vessels. Temporary nature of responses will be considered in the study.
(3) Characterise Existing Exposure Regime	Conduct desktop study to profile the nature, scale and extent of existing activities, including tourist operations, marine support, aquaculture and local shipping along the Dampier Peninsula and illustrate the likely regional context for these operations where they are coincident with marine megafauna presence..
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	For both marine and social factors a marine traffic profile will be created for the development including a breakdown by the general magnitude of vessel size, frequency, mode of operation and potential spatial distribution..
(5) Predict Potential Effects	Predicted vessel profiles will be combined with the marine megafauna presence patterns and sensitivity to undertake a risk-based assessment of potential for effecting marine megafauna use of James Price Point area and the migratory population. A conceptual model will be used to underpin the risk assessment. For the social factors the vessel profile will be combined with known commercial and recreational areas to identify potential impacts and conflicts with existing marine activities within the James Price Point coastal area.

10.10.4 Impact Assessment Outcomes

The results of the assessment will provide the following outcomes:

- An understanding of the existing marine vessel traffic in the James Price Point area and Dampier Peninsula;
- Characterisation of predicted marine traffic profile anticipated to be required as part of the LNG Precinct development;
- A risk-based assessment of the predicted impacts of marine traffic on marine megafauna to quantify risk of cetacean – vessel interactions and the likely consequences; and
- Definition of appropriate mitigations and/or offsets if required.

10.11 Vegetation and Habitat Clearing

Vegetation and habitat clearing would primarily occur as a result of onshore construction activities for Precinct construction and associated activities. Initial site clearing and grading activities will result in some direct loss of vegetation and associated habitat in the development footprint. Indirect impacts may occur from habitat loss affecting distribution and behaviour of associated fauna.

10.11.1 Summary of Key Environmental and Social Factors

The key environmental and social factors identified as having the potential to be impacted by vegetation and habitat clearing are listed in Table 10.22 below.

Table 10-22 Environmental Factors - Vegetation and Habitat Clearing

Environmental Factor	Inherent Risk Rating	Relevant Impact Studies
Declared rare and Protected Fauna – Loss of habitat	High	.DFS2 – Wet and Dry Season Fauna Surveys
Species of Ethno-biological Significance	High	DFS3 – Ethnobiological Surveys
TECs – Loss of flora species and vegetation communities	High	DFS1 – Wet and Dry Season Flora and Vegetation Surveys
Refuge Value for Terrestrial Biota – Loss of habitat	High	DFS1 – Wet and Dry Season Flora and Vegetation Surveys; DFS2 – Wet and Dry Season Fauna Surveys
Birds (incl sea and Migratory) – Loss of habitat	Medium	DFS2 – Wet and Dry Season Fauna Surveys; DFS8 – Migratory Bird Survey
SRE – Disturbance of fauna habitat	Medium	DFS1 – Wet and Dry Season Flora and Vegetation Surveys; DFS2 – Wet and Dry Season Fauna Surveys
Subterranean SRE – Disturbance of fauna habitat	Medium	DFS4 – Stygofauna and GDE Study
Declared Rare Flora – Loss of habitat	Medium	DFS1 – Wet and Dry Season Flora and Vegetation Surveys

Environmental Factor	Inherent Risk Rating	Relevant Impact Studies
Terrestrial Conservation Reserves – Disturbance of heritage sites	Low	N/A
SOCIAL FACTORS		
Visual Amenity – Change to visual amenity	High	SIA13 – Landscape and Visual Impact Assessment
Terrestrial Conservation Areas – Disturbance to heritage sites	Medium	SIA5 – Landuse, Tenure and Access Study
Tourism – Disturbance to existing and future activities	Medium	SIA12 – Tourism Impact Assessment
Environmental Heritage – Disturbance to heritage sites	Medium	SIA15 – Colonial and Environmental
Agriculture – Disturbance to existing and future activities	Low	SIA1 – Cultural Heritage Study; SIA3 – Ethnobiological Field Survey
Mining – Disturbance to existing and future activities	Low	N/A
Sport and recreation – Disturbance to existing and future activities	Low	SIA14 – Recreation and Lifestyle Study

10.11.2 Objective of Assessment

The objectives of the study to assess likely impacts as a result of vegetation and habitat clearing are:

- Determine the species distribution and habitat importance of the James Price Point coastal area for those key environmental factors identified above;
- Understand existing social values and usage patterns within the James Price Point coastal area;
- Map the presence and distribution of conservation significant flora and fauna species and vegetation communities within the James Price Point coastal area
- Determine the area of habitat for key environmental factors that is likely to be removed as a result of clearing activities;
- Meet the requirements of relevant EPA guidance Statements; and
- Consider the importance of the habitats proposed to be removed on a local and regional scale and determine the likely significance of habitat removal on the key environmental factors.

10.11.3 Impact Assessment Approach

Environment

Vegetation and Habitat Clearing were identified as a being a high risk to terrestrial flora (including TECs) and fauna and species of ethnobiological significance within the James Price Point coastal area. This is largely based on the known presence of listed threatened fauna and vegetation communities and the potential for vegetation clearing to impact these environmental factors. Important indigenous food products are also known to occur within the James Price Point coastal area and are harvested by local indigenous groups.

The following methodology is proposed to identify and assess the potential impact of vegetation and habitat clearing on terrestrial flora (including TECs) and fauna.

In undertaking the assessment, the study will take into account EPA guidelines, as defined in:

- EPA Guidance Statement No. 51 (Terrestrial Flora Surveys for Environmental Impact Assessment in Western Australia) (EPA 2004b)
- EPA Guidance Statement No. 56 (Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia) (EPA 2004c)
- EPA Position Statement No. 2 (Environmental Protection of Native Vegetation in Western Australia) (EPA 2000a)
- EPA Position Statement No. 3 (Terrestrial Biological Surveys as an Element of Biodiversity Protection) (EPA 2002).

Social

Vegetation and habitat clearing was identified as a high risk to visual amenity and tourism, given the visual impact of vegetation removal within the James Price Point coastal area. The remaining social factors were identified as medium and low risk.

Table 10-23 Assessment Approach - Vegetation and Habitat Clearing

Assessment Stage	Method
(1) Baseline (See Section 5)	<p>Environment - Outputs from the baseline flora and fauna studies would be used to identify and map the presence and distribution of flora and fauna species and habitat distribution within the James Price Point coastal area.</p> <p>This would also map important habitat areas for TECs, Groundwater Dependant Ecosystems (including stygofauna) and specific flora or fauna species locations and habitats.</p> <p>Social - For the identified social factors at Table 10.22 outputs from desktop studies at Chapter 11 would be used to determine current usage patterns and locations of important heritage values within the James Price Point coastal area.</p>
(2) Evaluate Receptor Sensitivity	N/A
(3) Characterise Existing Exposure Regime	Conduct desktop study to profile existing disturbance and threats within the Kimberley region such as weed invasion, land clearing, inappropriate fire regimes or feral species.
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	The extent of proposed clearing as a result of Precinct construction and associated key construction activities would be confirmed and mapped at the James Price Point coastal area. Estimates of the total hectares removed and area of each habitat or vegetation type would be determined.
(5) Predict Potential Effects	<p>In relation to the listed factors, the area of each vegetation and/or habitat type would be mapped and used to quantify the total area of each vegetation and/or habitat type being removed from within the James Price Point coastal area.</p> <p>The significance of potential impacts would be predicted based on the area of habitat proposed to be removed in relation to the James Price Point coastal area and biological requirements of the species or communities under consideration. If required, impacts would be considered in relation to the availability of habitats known to occur elsewhere on the Dampier Peninsula</p>

10.11.4 Impact Assessment Outcomes

The results of the assessment will provide the following outcomes:

- An understanding of the existing presence and distribution of vegetation, protected flora and fauna, species of ethno-biological significance and TECs in the local area;

- Mapping of the vegetation types and flora and fauna habitats in the area to enable an informed assessment of the distribution and significance of species and communities in a local and regional context;
- An assessment of the predicted loss of vegetation and habitat types anticipated to be removed as a result of clearing activities for LNG Precinct. The significance of impacts would be considered in relation to the local and regional context; and
- Definition of appropriate mitigations and/or offsets if required

10.12 Atmospheric Emissions

Atmospheric emissions will occur during all phases of the development from the LNG Precinct and supporting infrastructure. Emissions have the potential to impact air quality in the immediate vicinity of the facilities and contribute to global emissions.

Emissions during construction are likely to be predominantly particulates from fugitive dust, during initial site clearing, movement of materials and personnel. The nature of dust emissions depend on the disturbance activities, vehicle movements, ground moisture and meteorological conditions at the time. Construction machinery and vehicles will also lead to release of products of combustion, in particular oxides of nitrogen (NO_x), sulphur dioxide (SO₂) and carbon monoxide (CO).

Primary emissions during operation of a typical LNG facility will be products of combustion from compressors, power generation, flaring and fugitive emissions. Atmospheric emissions will include NO_x, SO₂, volatile organic compounds (VOCs) and the greenhouse gases; carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O).

10.12.1 Summary of Key Environmental and Social Factors

The key environmental factors identified as having the potential to be impacted by atmospheric emissions are listed at Table 10.24 below.

Table 10-24 Environmental and Social Factors – Atmospheric Emissions

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Air Quality – Decrease in air quality, resulting in health or amenity impacts	Medium	DIS25 – Air Emissions Assessment and Modelling; DIS31 – Greenhouse Gas Assessment
Air Quality – Contribution to climate change	High	As above
Visual amenity – Local amenity impacts from atmospheric emissions	Medium	As above
Terrestrial Flora – Potential deposition impacts from atmospheric emissions	Medium	As above
SOCIAL FACTORS		
Air Quality – Contribution to climate change	High	DIS25 – Air Emissions Assessment and Modelling;
Health – Decrease in air quality resulting in health or amenity impacts	Medium	DIS25 – Air Emissions Assessment and Modelling;
Tourism – Disturbance to existing and future activities	Medium	SIA12 – Tourism Impact Assessment
Visual Amenity- Local amenity impacts from atmospheric emissions	Medium	SIA13 – Landscape and Visual Amenity Impact Assessment
Palaeontology (Archaeological Heritage) – Disturbance to heritage	Medium	SIA1 – Cultural Heritage Study

sites		SIA2 – Archaeological Field Survey
Agriculture – Potential deposition impacts from atmospheric emissions	Low	SIA1 – Cultural Heritage Study SIA3 – Ethnobiological Field Survey
Sport and recreation – Disturbance of existing and future activities	Low	SIA14 – Recreation and Lifestyle Study

10.12.2 Objective of Assessment

The objectives of the air quality impact study to assess likely impacts as a result of atmospheric emissions are summarised as follows:

- Characterise baseline atmospheric conditions and air quality in the James Price Point project area and other areas potentially impacted by the Browse LNG Precinct development;
- Identify and model atmospheric discharges of potential concern anticipated to arise from the Precinct, in line with accepted industry methodologies;
- Comparison of modelled results against State, National and International standards and guidelines, to assess the potential risk of atmospheric emissions on off-site factors of relevance to the James Price Point area.

The following objectives apply to the assessment of greenhouse gas emissions;

- Identify and characterise the greenhouse gases that are relevant to the LNG Precinct, consistent with State, National and International standards, guidelines and methodologies;
- Undertake an evaluation of proposed emissions in the context of State, national and international estimates and prediction of climate change scenarios;
- Assess the potential impacts anticipated to arise from LNG Precinct activities, as a basis to inform a future GHG management strategy.

10.12.3 Impact Assessment Approach

Atmospheric emissions were identified as a being a medium risk to existing air quality conditions and terrestrial flora within the James Price Point coastal area. Greenhouse gas emissions were identified as a high risk in relation to the Precincts potential contribution to climate change. This is largely based on the current absence of pollutant generating activities within the area and potential for emissions within the Precinct to reduce local air quality and contribute to climate change.

The following methodology (Table 10-25) is proposed to identify and assess the potential impact of the proposed LNG Precinct on local / regional air quality.

In undertaking the assessment, the study will take into account EPA guidelines, as defined in:

- EPA Guidance Statement No. 18 (Prevention of Air Quality Impacts from Land Development Sites) (EPA 2000b)
- EPA Guidance Statement No. 15 (Emissions of Oxides of Nitrogen from Gas Turbines) (EPA 2000c)
- EPA Interim Guidance Statement No. 47 - Odour as a Relevant Environmental Factor (EPA 2005a)
- EPA Guidance Statement No. 53 - Implementing best practice in proposals submitted to the environmental impact assessment process (EPA 2003), and
- WA DEC Air Quality and Air Pollution Modelling Guidance Notes.

Table 10-25 Assessment Approach – Local / Regional Air Quality

Assessment Stage	Method
(1) Baseline (See Section 5)	<p>Environment - Desktop review of available ambient air quality and meteorological conditions for the James Price Point area, including available information from the Bureau of Meteorology and the DEC.</p> <p>Available results from ambient meteorological and air quality monitoring will also be used to inform the assessment of baseline air quality in the James Price Point area.</p> <p>Social - For the identified social factors at Table 10.24 outputs from desktop studies at Chapter 10 would be used to determine current usage patterns and locations of important heritage values within the James Price Point coastal area.</p>
(2) Evaluate Receptor Sensitivity	Identify key environmental sensitivities (e.g. vegetation/ listed flora species) and social receptors (i.e. aboriginal communities) within the vicinity of the onshore Browse LNG Precinct area.
(3) Characterise Existing Exposure Regime	<p>It is considered unlikely that air quality within the James Price Point coastal area is currently affected by pollution generating activities.</p> <p>The James Price Point coastal area currently has high air quality conditions with the exception of some smoke as a result of bushfire and dust. There is potential for dust emissions during clearing and site excavations to reduce current air quality conditions.</p>
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	<p>Development of an emissions inventory for expected emissions for the LNG Precinct, based on typical emission profiles from an LNG plant.</p> <p>Sources and levels of emissions for NO_x, SO_x, H₂S, BTEX, particulates, smoke and dust will be determined</p> <p>An air emissions study, supported by dispersion modelling, will be undertaken. Modelling will be consistent with the DEC's Air Quality Modelling Guidance Notes issued by the Western Australian Department of Environment and Conservation (DoE 2006). Atmospheric modelling will address key pollutants including NO₂, ozone (O₃), particulates (PM₁₀), SO₂ and air toxics including BTEX.</p> <p>Modelling will be used to assess that the environmental objectives for air quality (atmospheric emissions) are achievable. Nitrogen deposition modelling will also be undertaken and compared to trigger levels of concern for native vegetation.</p> <p>The model type, scenarios and assumptions will be discussed and agreed with the DEC Air Quality Branch prior to the commencement of model runs.</p>
(5) Predict Potential Effects	Assessment of air quality impacts anticipated from the onshore LNG Precinct, including comparison of ground level concentrations at sensitive receptors, against ambient standards of the air quality National Environment Protection Measures (NEPM) and all relevant state air management policies, legislation and guidelines.

The following methodology is proposed to identify and assess the potential impact of the proposed LNG Precinct on global air quality.

Table 10-26 Assessment Approach – Greenhouse Gas Emissions

Assessment Stage	Method
(1) Baseline (See Section 5)	Review of existing sources of GHG emissions in a local and regional context. Review of current Policies and measures for addressing climate change in the State, National and International arena.
(2) Evaluate Receptor Sensitivity	Receptors are considered global, considering the international nature of climate change.
(3) Characterise Existing Exposure Regime	Characterise existing exposure, through review of published inventories at the State (WA) and Australian level (Australia National Greenhouse Accounts).
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	Development of an emissions inventory for expected GHG emissions for the LNG Precinct, based on typical emission profiles from an LNG plant, in accordance with current Department of Climate Change Factors and Methodologies. Benchmarking of lifecycle GHG emissions for a typical LNG plant against other comparable projects and processes. Undertake an evaluation of proposed emissions in the context of State, national and international estimates and prediction of climate change scenarios. Identification of best practicable measures to define commitments for Proponents to minimise, monitor and report GHG emissions over the project life.
(5) Predict Potential Effects	Place the proposed LNG Precinct in the national and global context (including benefits of meeting energy demands and offsetting GHG emissions from other fossil fuels or other offshore projects).

10.12.4 Impact Assessment Outcomes

The results of the local/regional air quality impact assessment will provide the following outcomes:

- An understanding of the existing ambient air quality and meteorological conditions in the local area;
- An emissions inventory for the proposed LNG Precinct, based on current available engineering estimates at the time of assessment;
- Assessment of emissions anticipated to arise from the proposed LNG Precinct, in a local, regional and international context. The modelled outcomes will provide overlays of predicted concentrations of key pollutants to enable comparison of ground level concentrations at sensitive receptors, against ambient standards (NEPM) and all relevant state air management policies, legislation and guidelines.
- Definition of appropriate mitigations and/or offsets if required.

The results of the GHG impact assessment will provide the following outcomes:

- An emissions inventory for the proposed LNG Precinct, based on current available engineering estimates at the time of assessment;
- Assessment of emissions anticipated to arise from the proposed LNG Precinct, in a local, regional and international context; and
- Definition of appropriate mitigations and/or offsets if required.

10.13 Altered Fire Regimes

Although fire is known to be a natural environmental factor in many Western Australian ecosystems, evidence indicates that there has been a significant increase in the extent, intensity and frequency of fire over the past 30 years in the Kimberley. It is reported that most fires in the Kimberley region are lit by people, accidentally, maliciously or deliberately for a range of purposes, with a smaller proportion caused by lightning (EPA, May 2006).

It is believed that the current fire regime is substantially different from traditional Aboriginal practice of fine mosaic burning and has led to biodiversity loss with some plants, particularly fire-sensitive ones, unable to recover. From a social perspective, there are economic impacts if ineffective fire management as well as destroying agricultural potential of lands. Poor fire management and altered fire regime also has the potential to impact on visual amenity, recreational land uses and tourism (EPA, May 2006). An altered fire regime is a significant issue with potential to impact on biodiversity and a range of environmental and other social factors

10.13.1 Summary of Key Environmental and Social Factors

The key environmental and social factors identified as having the potential to be impacted by altered fire regimes are listed in Table 9.27 below.

Table 10-27 Environmental and Social Factors – Altered Fire Regime

Environmental Factor	Inherent Risk Rating	Related Studies
Refuge Value for Terrestrial Biota – Loss of habitat	Medium	.DFS1 – Wet and Dry Season Flora and Vegetation Surveys; DFS2- Wet and Dry Season Fauna Surveys
Declared Rare and Protected Fauna – disturbance of conservation significant fauna individuals	Medium	DFS2- Wet and Dry Season Fauna Surveys
Surface SRE – Disturbance to conservation significant fauna individuals	Medium	DFS4 – Stygofauna and GDE Study
TECs – Loss of flora species and vegetation communities	Medium	DFS1 – Wet and Dry Season Flora and Vegetation Surveys;
Species of Ethno-biological Significance – Loss of species and vegetation communities	Medium	DFS3 – Species of Ethno-biological Significance
Soils - Erosion	Medium	DIS19 – Soils and Geotechnical Investigation
Air Quality – Decrease in air quality	Medium	DFS7 – Ambient Meteorological and Air Quality Monitoring
Ecosystem Integrity – Alteration of vegetation community composition	Medium	DFS1 – Wet and Dry Season Flora and Vegetation Surveys; DFS2- Wet and Dry Season Fauna Surveys
SOCIAL FACTORS		
Visual Amenity – Change to visual amenity	Medium	TBD – Refer to Section 10.2
Tourism – Disturbance to existing and future activities	Medium	TBD – Refer to Section 10.2

Environmental Factor	Inherent Risk Rating	Related Studies
Environmental Heritage – Disturbance to heritage sites	Medium	TBD – Refer to Section 10.2
Aboriginal Heritage – Disturbance to heritage sites	Medium	SIA1 – Cultural Heritage Study; SIA2 – Archaeological Field Survey; SIA3 – Ethnobiological Field Survey;
Colonial Heritage – Disturbance to heritage sites	Medium	TBD – Refer to Section 10.2
Sport and recreation – Disturbance to existing and future activities	Medium	TBD – Refer to Section 10.2

10.13.2 Objective of Assessment

The objectives of the impact study to assess likely impacts as a result of altered fire regimes are:

- Determine the species distribution and habitat importance of the James Price Point coastal area for those key environmental and social factors identified above;
- Map the presence and distribution of conservation significant flora and fauna species and vegetation communities within the James Price Point coastal area
- Determine the potential impacts on factors identified above which result from fire;
- Understand the current fire regime and pressures placed on the environment; and
- Assess whether the current fire regime is likely to be altered a result of the development (either increased or decreased incidence of fire).

10.13.3 Impact Assessment Approach

Altered fire regimes were assigned a medium risk for each of the environmental and social factors identified at Table 9.27 above. Altered fire regimes are already known to impacting the natural and social values of the Dampier Peninsula and it is possible that altered fire regimes may currently be an issue within the James Price Point coastal area. While it is possible that the presence of an LNG Precinct may result in changes to existing fire regime such as the introduction of ignition sources it is considered that the development has potential to create opportunities to improve fire management planning maintenance of a more sustainable fire regime on the Dampier Peninsula.

Table 10-28 Assessment Approach - Altered Fire Regimes

Assessment Stage	Method
(1) Baseline (See Section 5)	Outputs from the baseline flora and fauna studies would be used to identify and map the presence and distribution of flora and fauna species and habitat distribution within the James Price Point coastal area. This would also map important habitat areas for TECs, and specific flora or fauna species locations and habitats. Soil characteristics and air quality will also be determined as a baseline to support the assessment.
(2) Evaluate Receptor Sensitivity	Understand the impacts of fire and the interrelation with the biodiversity, environmental and social factors for the region.
(3) Characterise Existing Exposure Regime	Conduct desktop study to profile current fire regime for the region and associated impacts.
(4) Identify Potential Exposure Levels from Base Case	Understand whether there is potential for increase in fire incidence due to introduction of new ignition sources or decrease a result of fire management around the Precinct in order to predict change to current regime.

Assessment Stage (& Alternatives if Required)	Method
(5) Predict Potential Effects	The significance of potential impacts would be predicted based on the area of sensitive receptors (factors) and the likely changes to the fire regime due to development of the Precinct.

10.13.4 Impact Assessment Outcomes

The results of the assessment will provide the following outcomes:

- An understanding of the existing presence and distribution of vegetation, protected flora and fauna and TECs in the local area;
- Mapping of the vegetation types and flora and fauna habitats in the area to enable an informed assessment of the distribution and significance of species and communities in a local and regional context;
- An understanding of the impacts of fires and the current fire regime for the area
- An understanding of how the development of the Precinct will impact on the current fire regime and an assessment of the positive or negative impacts of this change; and
- Definition of appropriate mitigations and/or offsets if required.

10.14 Physical Presence

In addition to each of the individual environmental aspects considered within this chapter there are likely to be ongoing social and environmental impacts associated with the physical presence of nearshore and landbased facilities. While many of these impacts would be considered within other environment and social impact studies the purpose of an assessment of the impacts of physical presence is to further consider likely permanent impacts.

10.14.1 Summary of Key Environmental and Social Factors

The key environmental and social factors identified as having the potential to be impacted by altered fire regimes are listed in Table 10.29 below.

Table 10-29 Environmental and Social Factors – Physical Presence

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Tidal Regimes, Currents and Hydrodynamics – Alteration of flow regimes	Medium	DIS18 - Hydrological and hydrogeological Assessment and Modelling; DIS7 – Coastal Processes and Sediment Transport Study
Refuge Value for Terrestrial Biota – Habitat fragmentation	Medium	.DFS1 – Wet and Dry Season Flora and Vegetation Surveys; DFS2- Wet and Dry Season Fauna Surveys
Birds (including sea and migratory) – Injury or death of conservation significant fauna	Low	DFS8 – Migratory Bird Survey
SOCIAL FACTORS		
Visual Amenity – Change to visual amenity	Severe	SIA13 – Landscape and Visual Amenity Impact Assessment

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Tourism – Disturbance to existing and future activities	Medium	SIA12 – Tourism Impact Assessment
Environmental Heritage – Disturbance to heritage sites	Medium	SIA15 – Colonial and Environmental Heritage Study
Aboriginal Heritage – Disturbance to heritage sites	Medium	SIA1 – Cultural Heritage Study; SIA2 – Archaeological Field Survey; SIA3 – Ethnobiological Field Survey;
Sport and recreation – Disturbance to existing and future activities	Medium	SIA14 – Recreation and Lifestyle Study

10.14.2 Objective of Assessment

The objectives of the impact study to assess likely impacts as a result of physical presence are:

- Understand the local context of the James Price Point coastal area for the key environment and social factors;
- Develop an understanding of natural processes and conditions, such as tidal regimes, currents and hydrodynamics, and how permanent land based and marine structures may impact these; and
- Assess the likely permanent impacts on environment and social factors as a result of the physical presence of the LNG Precinct infrastructure

10.14.3 Impact Assessment Approach

Physical presence was identified as a severe risk to the visual amenity of the James Price Point coastal area and a medium risk to the remaining environment and social factors. At present there is no large scale development at the James Price Point coastal area and the presence of an LNG Precinct is likely to result in ongoing impacts to the identified factors.

Table 10-30 Assessment Approach – Physical Presence

Assessment Stage	Method
(1) Baseline (See Section 5)	Outputs from the desktop and field studies related to the key environmental factors will be used to identify habitat areas and predict the existing ecological requirements and conditions within the James Price Point coastal area and Kimberley region where appropriate. The nature of existing tidal regimes, currents and hydrodynamics would also be investigated. In relation to key social factors, baseline studies, would aim to understand the location of important heritage sites and usage patterns within the James Price Point coastal area.
(2) Evaluate Receptor Sensitivity	Conduct a desktop study to identify potential impacts of an LNG Precinct in relation to the key environmental and social factors. This would concentrate on identifying potential visual impacts and impacts on tidal regimes, currents and hydro-dynamics, anticipated to arise from longer-term presence of infrastructure.
(3) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	An assessment of identified likely impacts will be conducted for each of the key environmental and social factors identified above. This will give particular consideration to the permanent nature of the Precinct. Overlay the permanent infrastructure footprint with the coastal morphology and terrestrial environmental conditions, in order to identify the area of direct infrastructure footprint on the marine/terrestrial environment and social receptors..

Assessment Stage	Method
(4) Predict Potential Effects	The significance of potential impacts will be predicted based on the importance of the James Price Point coastal area for each of the key environmental and social factors of relevance to physical presence.

10.14.4 Impact Assessment Outcomes

The results of the assessment will provide the following outcomes:

- An understanding of the existing presence and distribution of environment factors and social importance and usage patterns of the James Price Point coastal area;
- An understanding of natural processes, conditions and social importance of the James Price Point coastal area and the likely impact as a result of the physical presence of the LNG Precinct infrastructure;
- Definition of appropriate mitigations and/or offsets if required.

10.15 Groundwater Abstraction

At present there is little information regarding ground water conditions at the James Price Point coastal area with assumptions taken from existing knowledge of the nearby Broome aquifer (Section 7.7). During construction and operations, it is envisaged that water to the LNG facilities will be supplied either from groundwater, desalinated saline aquifer groundwater or desalinated sea water. Groundwater abstraction may have the potential to impact subterranean fauna habitats or the local hydrological regime

10.15.1 Summary of Key Environmental and Social Factors

The key environmental and social factors identified as having the potential to be impacted by altered groundwater abstraction are listed in Table 10.31 below.

Table 10-31 Environmental and Social Factors – Altered Fire Regime

Environmental Factor	Inherent Risk Rating	Related Impact Studies
Subterranean fauna - Disturbance of fauna habitat	Medium	DIS18 - Hydrological and hydrogeological Assessment and Modelling; DFS4 – Stygofauna and GDE Study
Watercourses (rivers, wetlands and creeks) - Disturbance and/or modification of natural drainage systems	Medium	DFS1 – Wet and Dry Season Flora and Vegetation Surveys; DFS2- Wet and Dry Season Fauna Surveys DIS18 - Hydrological and hydrogeological Assessment and Modelling DFS4 – Stygofauna and GDE Study
Groundwater - Disturbance and/or modification of natural drainage systems; changes to water quality	Medium	DFS8 – Migratory Bird Survey DIS18 - Hydrological and hydrogeological Assessment and Modelling DFS4 – Stygofauna and GDE Study
Refuge value for terrestrial biota - Decline in health of groundwater dependent vegetation (where groundwater drawdown occurs)	Medium	DIS18 - Hydrological and hydrogeological Assessment and Modelling DFS4 – Stygofauna and GDE Study

Environmental Factor	Inherent Risk Rating	Related Impact Studies
SOCIAL FACTORS		
Water Supply – Disturbance to existing and future activities	Medium	SIA7 – Community Infrastructure Services and Capacity Study DIS18 - Hydrological and hydrogeological Assessment and Modelling

10.15.2 Objective of Assessment

The objectives of the impact study to assess likely impacts as a result of groundwater abstraction are:

- Determine the current status of existing hydrological and hydrogeological conditions within the James Price Point coastal area;
- Understand the nature of existing sources and uses of groundwater in the area;
- Characterise the water demand requirements for the LNG Precinct, using projected abstraction rates;
- Assess the potential consequences and direct/indirect impacts of a potential change in groundwater levels on environmental and social factors.

10.15.3 Impact Assessment Approach

Groundwater abstraction was identified as medium risk to the key environmental factors due primarily to the potential impacts on fauna habitats and hydrological conditions within the James Price Point coastal area as a result of groundwater drawdown. Water supply was identified as a medium risk to local water supply and it is anticipated that any groundwater abstraction would occur in accordance with agreements with relevant government agencies.

Table 10-32 Assessment Approach – Groundwater Abstraction

Assessment Stage	Method
(1) Baseline (See Section 5)	Baseline ecological studies will identify and map the presence of flora species and habitat distribution within the James Price Point coastal area, which will inform an understanding of groundwater dependent ecosystems as they relate to underlying hydrogeological conditions. This stage will also include a review of subterranean habitat relevant to groundwater dependent fauna (stygo fauna).
(2) Evaluate Receptor Sensitivity	N/A
(3) Characterise Existing Exposure Regime	Conduct desktop study to profile existing groundwater and surface water sources, flows and uses within the James Price Point coastal area. The soils and investigation programme will also be used to inform the nature and extent of existing hydrogeological conditions in the area.
(4) Identify Potential Exposure Levels from Base Case (& Alternatives if Required)	The extent of proposed groundwater abstraction as a result of Precinct construction and operation activities will be confirmed, reflecting best available engineering estimates. A quantitative assessment of potential groundwater drawdown effects from abstraction will be undertaken
(5) Predict Potential Effects	The outcomes of the baseline and modelling studies will inform the prediction of potential changes to local groundwater levels arising from abstraction, on groundwater-dependent vegetation and associated fauna habitat. The total volume of groundwater proposed to be extracted as a water source for the Precinct will be compared against total groundwater flows and recharge rates in the James Price Point coastal area and Dampier Peninsula (based on available published information), to determine the significance of the proposed abstraction

Assessment Stage	Method
	<p>rates in a local and regional context.</p> <p>The impact assessment will predict potential impacts on specific groundwater-dependent flora and fauna and vegetation communities, such as those listed under State or Commonwealth legislation.</p>

10.15.4 Impact Assessment Outcomes

The results of the assessment will provide the following outcomes:

- An understanding of the existing presence and distribution of groundwater-dependent vegetation, and associated fauna habitat, in the local area;
- An understanding of the existing hydrological and hydrogeological conditions in the area;
- An assessment of the predicted effects of groundwater abstraction on identified environmental and social factors, for significance in a local and regional context; and
- Definition of appropriate mitigations and/or offsets if required.

10.16 Assessment Approach for Social Aspects

To aid in the scoping process for undertaking a Social Impact Assessment (SIA), an initial risk assessment was conducted to identify the social factors (receptors) potentially impacted by the aspects associated with the development. Social factors potentially impacted by the environmental aspects outlined in the risk summary spreadsheet (**Appendix H**) are discussed and the method for further assessment proposed in the relevant sections of **Section 10**.

In addition to these, in order to complete a robust SIA which considers all aspects associated with the development there are other aspects which can be considered to be „social’ in nature associated with the establishment of the LNG Precinct which have both a potential for impacts but also an opportunity for benefits. These include:

- Local population increases (temporary and permanent workforce)
- Use of infrastructure and services
- Access/Land use restrictions
- Increased demand on existing labour force

An initial risk assessment of these aspects was undertaken to support the scoping of related social studies and investigations. This is outlined in the Impact Risk Summary (**Appendix H**), and is addressed by factor in **Section 11**.

The integration of social impact assessment with the assessment of impacts to the natural environment is focussed on the impacts of Category A activities (as defined in **Section 3.1**) and a zone of impact around the Precinct. Consideration of the other related activities (i.e. Category B and C) as well as impacts of all categories of activities on a wider area of impact will be made through the broader work program for the Strategic Assessment. Other programs being undertaken in parallel with the Strategic Assessment, including the Indigenous Heritage Assessment and Land Use Agreements, Tourism Impact Assessment and Fisheries Impact Assessment which will also interface with and inform the scope of social studies outlined in this document.

These programs aim to address some of the broader aspects and factors in addition to those discussed above. Other social aspects with the potential for impacts and/or opportunities include, however are not limited to:

- Change in Native Title and land ownership
- Change in land management (land use planning)
- Conservation and heritage protection
- Cultural Heritage Protection
- Employment opportunities
- Introduction in economic opportunities
- Development of additional infrastructure for wider use

The broader social impact assessment of these aspects is being considered in terms of the factors potentially affected which extend to:

- Indigenous community
- Cultural heritage
- Community harmony
- Sense of place

- Ethnological significant sites
- Indigenous benefits
- Community health
- Health infrastructure
- Education

The baseline studies outlined in **Section 9**, as well as outcomes of the assessment of environmental aspects on social factors will support the broader social impact assessment proposed.

11 Summary of Impacts by Factor

Chapter 10 previously listed each environmental and social factor according to the environmental aspect identified as posing a potential risk. The purpose of this chapter is to provide an overarching summary of the identified environmental and social aspects and inherent risks to each environmental and social factor. This allows the potential impacts to each factor to be more clearly identified and the context of assessing the overall impact of the proposed LNG Precinct to be identified and understood. This would further assist in the final scoping of the required baseline and impact studies.

Under each environmental factor heading, potential impacts are summarized and the inherent risk rating from the risk assessment is also provided. A summary of impacts based on existing information and the risk assessment is also provided.

11.1 Summary of Risk Ratings by Key Environmental and Social Factors

Table 11.1: Summary of Environmental Factors, Aspects, and Impact Rationale

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/Rationale
Marine Reptiles	Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Medium	3) In a regional context, the Lacepede Islands are known to be an important nesting and inter-nesting habitat for green turtles (Scoping Report Sect. 5.2.6.3). Conservation significant turtle species are known to occur within the James Price Point coastal area, however current information suggests that potential nesting areas are likely to be located further to the south of the James Price Point coastal area (Scoping Report Sect. 5.2.6.3), this is to be confirmed through further investigations.
					4) The JPP coastal area is not known to be a high use zone for turtle nesting however, noise and vibration generating activities such as marine blasting, dredging and nearshore construction may have the potential to impact marine reptile foraging behaviour
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	3) As above 4) Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event.
	Light Emissions	10.9	Precinct operation, supporting infrastructure.	Medium	3) As above. 4) The JPP coastal area is not known to be a high use zone for turtle nesting. As a result it is considered that light emissions may have the potential to result in minor short term impacts on marine reptiles.
	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	3) As above. 4) Marine waters of the Kimberley coast are known to have highly turbid waters (Scoping Report Sect 5.2.3.2) and it is considered likely that this would also be the case at the James Price Point coastal area. There are some uncertainties regarding this claim (of natural high turbidity) which are to be investigated in field studies. Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term.

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Benthic Primary Producers	Site Disturbance and Excavation	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Medium	<p>3) As above.</p> <p>4) It is considered unlikely that nearshore excavations would disturb important nesting areas.</p>
	Vessel Movements	10.10	Product transport, Precinct construction and support.	Medium	<p>In a regional context, the Lacepede Islands are known to be an important nesting and inter-nesting habitat for green turtles (Scoping Report Sect. 5.2.6.3). Conservation significant turtle species are known to occur within the James Price Point coastal area, however current information suggests that potential nesting areas are likely to be located further to the south of the James Price Point coastal area (Scoping Report Sect. 5.2.6.3), this is to be confirmed through further investigations.</p> <p>Constant vessel movements may have the potential to disturb feeding and movement patterns however ship strike is considered unlikely given likely speed limits that would be implemented and slow speed of larger tankers.</p>
	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction.	Medium	<p>Seagrass beds are known to occur in the James Price Point coastal area and provide feeding habitat for Dugongs and habitat for other marine fauna (Scoping Report Sect 5.2.6.4 & 5.2.5.3). Marine waters of the Kimberley coast are known to have highly turbid waters (Scoping Report Sect 5.2.3.2) and it is considered likely that this would also be the case at the James Price Point coastal area. There are some uncertainties regarding this claim (of natural high turbidity) which are to be investigated in field studies.</p> <p>Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term.</p>
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	<p>Seagrass beds are known to occur in the James Price Point coastal area and provide feeding habitat for Dugongs and habitat for other marine fauna (Scoping Report Sect 5.2.6.4 & 5.2.5.3).</p> <p>Should a non-routine event occur it is considered that it may impact seagrass habitats and dependant marine fauna species. Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event</p>
	Site Disturbance	10.6	Marine dredging and drilling, nearshore construction and	Medium	Seagrass beds are known to occur in the James Price Point coastal area and provide feeding habitat for Dugongs and habitat for other marine fauna (Scoping Report Sect 5.2.6.4 & 5.2.5.3). Site disturbance as a result of dredging, pipeline installation and

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	and Excavation		pipeline installation.		nearshore construction works may result in the removal of dugong foraging habitat. It is considered that this would result in moderate impacts, should seagrass beds be disturbed.
	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	Medium	The marine environment of the James Price Point coastal area is relatively undisturbed and it is considered unlikely that invasive marine species currently exist there. Ballast water discharge and contaminated ships and equipment may have the potential to introduce IMS during construction and operation. Should IMS be introduced they have the potential to outcompete and displace native fauna which may in turn affect the local marine ecosystem whilst also impacting local pearling and aquaculture industries.
	Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	Current information suggests that potential habitat for coral communities within the James Price Point coastal area is relatively sparse (Scoping Report Sect. 5.2.6.1). Noise and vibration generating activities during construction and operation are considered unlikely to impact coral communities.
	Light Emissions	10.9	Precinct operation, nearshore construction, vessel operation	Low	Current information indicates that potential habitat for coral communities within the James Price Point coastal area is relatively sparse (Scoping Report Sect. 5.2.6.1). It is likely that coral communities would be avoided where possible. Potential effects of light on coral spawning have been considered, however it is determined unlikely that coral would be adversely impacted as a result of light emissions during construction and operation.
Fish	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	High	The marine environment of the James Price Point coastal area is relatively undisturbed and it is considered unlikely that invasive marine species currently exist there. Ballast water discharge and contaminated ships and equipment may have the potential to introduce IMS during construction and operation. Should IMS be introduced they have the potential to outcompete and displace native fauna which may in turn affect the local marine ecosystem whilst also impacting local pearling and aquaculture industries.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	Conservation significant fish species are known to occur off the coast of the Dampier Peninsula. No site specific fish fauna surveys are available for the James Price Point coastal area, so assumptions of species present are based on nearby or regional surveys and are also directly related to the physical environmental characteristics. At James Price Point important fish habitats such as mangroves and estuaries are mostly absent. Sandy beach flats which are relatively exposed compared to other locations are the predominate feature and as such fish fauna is expected to be temporarily present during the high tides to feed on invertebrates (ESD Sect. 5.2.6.5).

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					Should a non-routine event occur it is considered that it may impact marine water and habitat quality for fish species. Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event
	Site Disturbance and Excavation	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	3) Rationale as above. 4) Nearshore activities such as dredging, pipeline installation works and nearshore construction may result in localised impacts to some habitats however the area of potential impact is likely to be relatively small.
	Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	3) Rationale as above. 4) It is considered likely that noise impacts would be transient and temporary during construction.
	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction.	Low	3) Rationale as above 4) Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term.
	Light Emissions	10.9	Precinct operation, nearshore construction, vessel operation	Low	3) Rationale as above. 4) Light has the potential to attract fish species or alter cycles however it is unlikely that light emissions would impact important habitats, particularly for conservation significant species.
Marine Mammals	Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	High	3) Conservation significant marine mammals species (Whales and Dugong) are known to occur in the James Price Point coastal area while a significant portion of the humpback whale population migrates past this area. (Scoping Report Sect 5.2.6.4). 4) Noise and vibration generating activities such as marine blasting, dredging and nearshore construction may have the potential to impact marine mammal behavior.
	Marine Discharges – including non-	10.3	Nearshore construction activities, Precinct operation, product storage and	Medium	3) Rationale as above. 4) Should a non-routine event occur it is considered that it may impact marine water

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	routine events		distribution. Vessel movements.		and habitat quality for marine mammal species. Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event.
	Site Disturbance and Excavation	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Medium	3) Rationale as above. 4) Site disturbance as a result of dredging, pipeline installation and nearshore construction works may result in the removal of dugong foraging habitat. It is considered that this would result in moderate impacts, should seagrasses be disturbed as a result of marine excavation activities.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction.	Medium	3) Rationale as above. 4) Marine waters of the Kimberley coast are known to have highly turbid waters (Scoping Report Sect 5.2.3.2) and it is considered likely that this would also be the case at the James Price Point coastal area. There are some uncertainties re this claim (of natural high turbidity) which are to be investigated in field studies. Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term
	Light Emissions	10.9	Precinct operation, nearshore construction, vessel operation.	Medium	3) Rationale as above. 4) While conservation significant species are known to occur it is considered unlikely that light emissions would disrupt feeding or movement patterns.
	Vessel Movements	10.10	Product transport, Precinct construction and support.	Medium	3) Rationale as above. 4) Constant vessel movements may have the potential to disturb feeding and movement patterns while ship strike is considered unlikely given that larger tankers would move at slow speeds when approaching and existing the Precinct and likely speed limits for smaller vessels.

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Marine Water Quality	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction.	High	Conservation significant fish, marine mammal and reptile species are known to occur within the James Price Point coastal area. While the surrounding waters are generally free of pollutants, marine waters of the Kimberley coast are known to have highly turbid waters (Scoping Report Sect 5.2.3.2) and it is considered likely that this would also be the case at the James Price Point coastal area. There are some uncertainties re this claim (of natural high turbidity) which are to be investigated in field studies.
					Increased sedimentation as a result of dredging and nearshore construction may have the potential to impact habitat quality and it is considered likely that impacts would be localised and medium term.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	Marine waters of the James Price Point coastal area provide habitat for a variety of marine species and communities whilst also supporting indigenous and recreational activity. Commercial fisheries also occur nearby along with pearling leases. Should a non-routine event occur it is considered that it may impact marine water quality. Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event.
Marine Sediment Quality	Vessel Movements	10.10	Product transport, Precinct construction and support.	Low	While marine waters are already known to be highly turbid and subject to tidal flushing, constant vessel movements have the potential to stir-up bottom sediments which may affect water quality however this is unlikely to result in long or medium term impacts
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A number of activities associated with the development have the potential to result in a non-routine discharge event and may have the potential to contaminate marine sediments and reduce habitat quality for dependant species. Management and control measures would be implemented as part of Precinct design and operation which are likely to reduce the likelihood, and impact of a non-routine event.
	Sediment Deposition and Turbidity	10.2	Marine dredging and drilling and nearshore construction.	Low	Disturbance of marine sediments and subsequent habitats will occur as a result of dredging and trenching activities. Impacts as a result of sediment deposition may also occur however, there are naturally high turbidity levels and sediment flushing due to the high tidal flux.

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Terrestrial Flora incl TEC's	Vegetation and Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	High	No state or commonwealth declared rare flora species have been recorded within the James Price Point coastal area however, <i>Pittosporum moluccanum</i> is listed as a priority 4 species and was recorded 2.5 km south of James Price Point (Scoping Report Sect 5.3.4.3). Additional surveys will be conducted to confirm the presence or absence of declared flora species and the impact of habitat removal would be considered in relation to habitat availability within the James Price Point coastal area and broader Dampier Peninsula. Monsoon Vine Thicket TEC is known to occur along the James Price Point coastal area (Scoping Report Sect 5.3.4.2). The extent and condition of this community will be confirmed and it is likely that removal of this community would be avoided where possible. Should vine thicket be removed as a result of Precinct construction the likely impact would be considered in relation to the communities extent within the James Price Point coastal area and broader Dampier Peninsula.
	Groundwater Abstraction	10.15	Support construction and operation	Medium	There is some potential for ongoing abstraction to affect surrounding groundwater dependant vegetation types however, the existing groundwater and hydrological conditions and presence of dependant vegetation communities is unknown.
	Introduced Pests	10.8	Precinct Construction	Medium	Weed species are already known to occur on the Dampier Peninsula and James Price Point coastal area (Scoping Report Sect. 5.3.4.3) and have the potential to outcompete native flora species. There is the potential for the introduction of new pests to the James Price Point coastal area as a result of Precinct construction and operation however there is also the potential for improved management of natural resources to occur.
	Altered fire regime	10.13	Precinct operation and supporting infrastructure	Medium	TECs including vine thickets are at risk of impact from an altered fire regime. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley.
	Vegetation and Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	H	Culturally significant flora and fauna species are likely to occur within the James Price Point coastal area. For example indigenous food products ("bush products") that are harvested for use by local Indigenous people (Scoping Report Sect 5.4.2). Vegetation removal as a result of onshore construction has the potential to result in the removal of habitats which support culturally significant flora and fauna species. The significance of this habitat removal will be considered in relation to habitat availability within the James
Species of Ethno-biological Significance					

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Altered Fire Regimes	10.13	Precinct Operation and Supporting Infrastructure		Price Point coastal area and broader Dampier Peninsula. Potential for loss of species of ethno-biological significance including the Gubinge which is known to be present in vine thickets and throughout the Dampier Peninsula. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley.
Terrestrial Fauna and Declared rare and Protected Fauna	Vegetation and habitat clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	High	Based on database search results conservation significant fauna species are known to occur within the area (Scoping Report Sect. 5.3.5.1) and the James Price Point coastal area may provide habitat for some of these species. Vegetation and habitat clearing associated with onshore and nearshore construction activity is likely to result in the removal of habitat for both conservation significant and more common fauna species. The significance of this habitat removal would be considered in relation to habitat availability within the James Price Point coastal area and the broader Dampier Peninsula.
	Introduced Pests	10.8	Precinct Construction and operation	Low	It is considered likely that introduced fauna species currently inhabit the Dampier Peninsula and James Price Point coastal area and are likely to be competing with native species. There is the potential for the introduction of new pests to the James Price Point coastal area as a result of Precinct construction and operation however there is also the potential for improved management of natural resources to occur.
	Light Emissions	10.9	Precinct operation, supporting infrastructure.	Medium	Conservation significant species (for example birds) may occur within the James Price Point coastal area. While it is anticipated that increased lighting will be required for the Precinct, it is likely that they would be restricted to an area surrounding the Precinct facilities.
	Groundwater Abstraction	10.15	Support construction and operation	Medium	Groundwater abstraction is likely to occur to supply water during construction and operation. There is some potential for ongoing abstraction to result in groundwater drawdown and salt intrusion which would affect subterranean fauna habitats.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	At present there is little information on the groundwater conditions at the James Price Point coastal area. Should subterranean fauna habitats be identified there is the potential for them to be impacted as a result of a non-routine discharge or leak.

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Noise and Vibration	10.1	Precinct operation and gas processing.	Medium	<p>The James Price Point coastal area is known to provide habitat for conservation significant fauna species. Noise and vibration as a result of onshore construction and plant operation has the potential to disturb fauna nesting and foraging habitats. It is likely that this would represent a minor disruption to a portion of the population.</p> <p>While it is possible that conservation significant sea and migratory bird species may periodically occur within the James Price Point coastal area current information suggests that the presence of specific seabird roosting or nesting habitat within the James Price Point coastal area is considered unlikely (Scoping Report Sect 5.2.6.6). While important migratory bird habitats are not expected to be present it is likely that it could be used for occasional foraging by conservation significant species (ie JAMBA, CAMBA). Noise and vibration generating activities may have the potential to disrupt foraging activity.</p>
	Site Disturbance and Excavation	10.5	Marine dredging and drilling, nearshore construction and pipeline installation.	Medium	<p>There is little existing information on the presence and abundance of subterranean SRE's within the James Price Point coastal area and site excavation activities have the potential to remove some potential habitat areas, should they occur.</p> <p>Short Range Endemic (SRE) species such as land snails, earthworms and spiders occur in vine thicket communities in the Kimberley, including those mapped within the James Price Point coastal area (Scoping Report Sect. 5.3.5.4). Should vine thicket communities occur within the proposed development area it is possible that areas of habitat would be removed.</p>
	Physical Presence	10.14	Plant operation and supporting infrastructure	Low	<p>It is possible that conservation significant sea and migratory bird species may periodically occur within the James Price Point coastal area. Current information indicates that the presence of specific seabird roosting or nesting habitat within the James Price Point coastal area is considered unlikely (Scoping Report Sect 5.2.6.6). There is some evidence that birds could potentially be impacted by gas flares and potential impacts on migrating birds will be considered</p>
	Vehicle Movements	9.0	Supporting infrastructure and Precinct operation	Low	<p>Conservation significant fauna species are known to occur within the James Price Point coastal area and there is the potential for death and injury as a result of increased vehicle activity.</p>
	Altered fire regime	10.13	Precinct operation and supporting infrastructure	Medium	<p>The simplification of the vegetation due to a lack of fine scale fire-induced mosaics can have consequences for small fauna with limited home ranges. Changes fire regimes are among the threatening processes which have the potential to impact on species (EPA May 2006).</p>

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					<i>The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley.</i>
Soils and Geomorphology	Runoff	10.4	Construction activities, site clearing, stormwater management	Medium	Site clearing and excavation is would disturb soils and alter landforms. There is the potential for increased runoff and erosion to occur, particularly considering the high erosion potential of pindan soils and high volume rainfall events however this is likely to result in only minor and temporary impacts.
	Site Disturbance and Excavation	10.5	Precinct construction and supporting infrastructure.	High	It is considered unlikely that ASS occur within the James Price Point coastal area however, this will be further considered during preliminary geotechnical investigations. There is some potential for increased soil salinity as a result of site preparation activities and dust suppression. While the James Price Point coastal area is relatively flat site contouring will be required and it is likely that coastal geomorphology will be altered as a result of nearshore construction and site preparation works.
	Waste Disposal	10.4	Result of construction and operation activities	Low	Waste disposal would occur throughout the construction and operation of an LNG facility within the James Price Point coastal area. It is considered unlikely that soil contamination would occur should appropriate waste management and disposal occur.
	Altered Fire Regimes	10.13	Precinct operation and supporting infrastructure	Medium	Frequent fires can result in further land degradation when exposed soils erode and litter layers are lost. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley
	Site Disturbance and Excavation	10.5	Precinct construction and supporting infrastructure.	High	At present there is little information on the groundwater conditions at the James Price Point coastal area. There is the potential for saltwater intrusion to occur as a result of excavation activities and the composition of soil used in site preparation, likely impacts will be further considered once groundwater conditions are further understood.
Surface and Groundwater					Existing information suggests that there are no major water courses within the James Price Point coastal area. There are some minor water courses to the North and south

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					however these are unlikely to be directly disturbed.
	Terrestrial Wastes and Discharges	10.4	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	High	Major waterways do not appear to be present within the James Price Point coastal area. Site drainage would be collected in storage ponds however there is the potential for site drainage including hydrocarbons and chemicals to enter local drainage systems (including groundwater) particularly under extreme rainfall events.
	Groundwater Abstraction	10.15	Support construction and operation	Medium	Groundwater abstraction is likely to occur to supply water during construction and operation. There is some potential for ongoing abstraction to affect surrounding watercourses and creeks however the existing groundwater and hydrological conditions are unknown.
	Waste Disposal	10.4	Result of construction and operation activities	Low	Waste disposal would occur throughout the construction and operation of an LNG facility within the James Price Point coastal area. While the extent of groundwater systems is to be determined it is considered unlikely that contamination would occur should appropriate waste management and disposal occur.
	Runoff	10.4	Construction activities, site clearing, stormwater management	Low	Water courses to not appear to be present within the James Price Point coastal area and erosion that may occur as a result of increased runoff is considered to represent a minor short-term impact.
Air Quality	Dust Emissions	10.9	Terrestrial site clearing and excavation activities as well as vehicle movements.	Medium	The James Price Point coastal area currently has high air quality conditions with the exception of some smoke as a result of bushfire and dust. There is potential for dust emissions during clearing and site excavations to reduce current air quality conditions.
	Greenhouse Gas Emissions	10.9	All aspects but primarily gas processing.	High	Operation of facilities within the LNG Precinct would result in the release of greenhouse gases, however its contribution to climate change is currently unknown (therefore likelihood and consequence ranking not currently defined). This aspect is conservatively ranked as high taking into account and recognising the global nature of the issue of climate change.
	Altered fire regime	10.9	Precinct operation and supporting infrastructure	Medium	Atmospheric emissions from bush fires contribute particulates as well as greenhouse gas. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley.

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Tidal Regimes, Currents and Hydrodynamics	Physical Presence	10.14	Nearshore jetty, pipelines and marine infrastructure	Medium	Nearshore facilities such as jettys and a vessel harbour have the potential to impact local scale marine hydrodynamic conditions. This may result in residual impacts on benthic habitats and seagrasses.
Ecosystem Integrity	Altered Fire regime	10.13	Precinct operation and supporting infrastructure	Medium	Altered fire regime has potential to lead to biodiversity loss with some plants, particularly fire-sensitive ones, unable to recover. At this stage it has not been possible to totally quantify those losses. Further land degradation caused when exposed soils erode, litter layers are lost, shrubs disappear and a homogenous landscape is produced. The presence of LNG Precinct may result in changes to existing fire regime with the introduction of ignition sources, however the development has potential to create opportunities to improve fire management planning to establish and maintain are more sustainable fire regime in the Kimberley.
	Introduced Pests	10.8	Precinct construction and operation	Low	Weed species are already known to occur on the Dampier Peninsula and James Price Point coastal area (Scoping Report Sect. 5.3.4.3) and have the potential to outcompete native flora species. It is considered likely that introduced fauna species currently inhabit the Dampier Peninsula and James Price Point coastal area. There is the potential for the introduction of new pests to the James Price Point coastal area as a result of Precinct construction and operation however there is also the potential for improved management of natural resources to occur.
	Invasive marine species	10.7	Precinct construction and operation	High	The marine environment of the James Price Point coastal area is relatively undisturbed and it is considered unlikely that invasive marine species currently exist there. Ballast water discharge and contaminated ships and equipment may have the potential to introduce IMS during construction and operation. Should IMS be introduced they have the potential to outcompete and displace native fauna which may in turn affect the local marine ecosystem whilst also impacting local pearling and aquaculture industries.

Table 11.2: Summary of Social Factors, Aspects and Impact Rationale

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Palaeontology	Atmospheric emissions	10.12	Terrestrial site clearing and construction activities as well as vehicle movements. Gas processing, operation of machinery	Medium	<i>There is potential for local deposition effects of atmospheric emissions on heritage sites. Current information indicates that areas of known aboriginal heritage value in the JPP area are composed of artefact and midden scatters (Scoping Report s. 5.3.10.3). No petroglyphs (rock art) that may be susceptible to erosion from atmospheric deposition are known to occur in the area.</i>
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	<i>Marine noise and vibration that may potentially arise from the Precinct construction and operation is considered highly unlikely to result in significant impacts on marine archaeological heritage values.</i>
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	<i>In a regional context, areas along the Kimberley coast are known to have dinosaur footprints (Scoping Report s.5.3.10.2). The presence or absence of similar palaeontological evidence on the intertidal platform in the JPP coastal area is not currently known. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.</i>
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	<i>In a regional context, areas along the Kimberley coast are known to have dinosaur footprints (Scoping Report s.5.3.10.2). The presence or absence of similar palaeontological evidence on the intertidal platform in the JPP coastal area is not currently known. The short term nature of potential impacts arising from sedimentation and turbidity, and the natural high turbidity in coastal waters, indicates that adverse impacts are unlikely. However potential impacts from higher sedimentation warrant further consideration.</i>
	Site disturbance/excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	High	<i>Seabed disturbance associated with the installation of marine infrastructure could have localised impacts on archaeological heritage. In a regional context, areas along the Kimberley coast are known to have dinosaur footprints (Scoping Report s.5.3.10.2). The presence or absence of similar palaeontological evidence on the intertidal platform in the JPP coastal area is not currently known. The potential effect on areas of heritage value warrants further consideration.</i>
	Site Disturbance/Exc	10.5	Product transport, Precinct	Medium	<i>Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless present a risk of disturbance to areas of</i>

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Environmental Heritage	aviation - terrestrial		construction and support.		archaeological heritage value. Heritage studies will be completed in collaboration with traditional owners, to ensure disturbance to areas of archaeological significance are to be avoided where practicable.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Terrestrial discharges are considered unlikely to impact on heritage sites as the selection and layout of the development area gives consideration to the location of these.
	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could impact sensitive sites. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local environmental heritage values warrants further investigation.
	IMS	10.7	Vessel movements and nearshore construction works	Low	Increased shipping and vessel movements increases potential for invasive marine species posing threat to conservation areas. However, the LNG Precinct area is located outside the boundaries of reserves, therefore potential impacts on areas of environmental heritage value are assessed to be highly unlikely.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event is considered to have low probability of occurrence. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Physical Presence - Marine	10.14	Nearshore jetty, pipelines and marine infrastructure, site works and clearing	Medium	Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities will cause changes to landscape in vicinity of the development. However, the LNG Precinct area is located outside the boundaries of reserves, therefore potential impacts on areas of environmental heritage value are assessed to be unlikely.
	Physical Presence - terrestrial	10.14	Clearing, site works, roads, plant, buildings	Medium	The physical presence of the LNG Precinct facilities and in the increased traffic and number of people in the area has potential to impact environmental heritage values in the local area. Site disturbance will be limited to the development area and footprint will be minimised. Disturbance to areas of conservation significance are to be avoided where practicable.
	Sediment Deposition and	10.2	Marine dredging and drilling	Medium	Sedimentation/deposition that may potentially arise from the Precinct construction and operation is considered unlikely to result in significant impacts on environmental

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	turbidity		and nearshore construction.		heritage values. The short term nature of potential impacts arising from sedimentation and turbidity, and the natural high turbidity in coastal waters, indicates that adverse impacts are unlikely. However potential impacts from higher sedimentation warrant further consideration.
	Site disturbance/excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure is considered unlikely to impact on areas of environmental heritage. The LNG Precinct area is located outside the boundaries of reserves, therefore resultant impact on areas of environmental heritage value are assessed to be low.
	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Medium	Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless present a risk of disturbance to areas of environmental heritage value. Disturbance to areas of conservation significance are to be avoided where practicable.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Terrestrial discharges are considered unlikely to impact on heritage sites as the selection and layout of the development area gives consideration to the location of these.
	Vegetation/Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Medium	Clearing of areas of conservation significance are to be avoided, and the footprint of infrastructure will be optimised to minimise disturbance where practicable..
Aboriginal Heritage	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could impact sensitive sites. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local aboriginal heritage values warrants further investigation.
	Physical Presence - marine	10.14	Nearshore jetty, pipelines and marine infrastructure	Medium	Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities will cause changes to landscape in vicinity of the development. Further aboriginal heritage and ethnographic studies are required.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of Traditional Owners/site custodians to visit and maintain Aboriginal sites and undertake cultural practices.

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Physical Presence - terrestrial	10.14	Clearing, site works, roads, plant, buildings	Medium	<i>The physical presence of the LNG Precinct facilities and in the increased traffic and number of people has the potential to impact Aboriginal heritage sites in the local area. Land disturbance will be limited to the development area and the footprint will be minimised. Disturbance to areas of Aboriginal heritage significance are to be avoided where practicable, as agreed with Traditional Owners during the design/layout process.</i>
	Site Disturbance/Excavation - terrestrial	10.5	Marine dredging and drilling, nearshore construction and pipeline installation.	Medium	<i>Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless present a risk of disturbance to areas of indigenous heritage value. Heritage studies will be completed in collaboration with traditional owners, to ensure disturbance to areas of aboriginal significance are to be avoided where practicable.</i>
	Site disturbance/excavation – marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	High	<i>Seabed disturbance associated with the installation of marine infrastructure could have localised impacts on Aboriginal heritage. Many sites of indigenous cultural significance are located along the coast. A high proportion of sites in the JPP coastal area listed on the DIA database are composed of artefact and midden scatters (Scoping Report s.5.3.10.3). The final site for the Precinct will be agreed with the traditional owners to ensure areas of highest indigenous heritage value are avoided. Further aboriginal heritage and ethnographic studies are required.</i>
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	<i>A non-routine event is considered to have low probability of occurrence. Terrestrial discharges are considered unlikely to impact on heritage sites as the selection and layout of the development area gives consideration to the location of these.</i>
	Vehicle Movements	9.0	Construction, operation of facilities	Medium	<i>Increased traffic and roads may lead to greater access to areas of heritage significance and risk to disturbance of sites.</i>
Colonial Heritage	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	<i>The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could impact sensitive sites. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local colonial heritage values warrants further investigation.</i>
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	<i>Marine noise and vibration that may potentially arise from the Precinct construction and operation is considered highly unlikely to result in significant impacts on colonial heritage values.</i>

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Medium	Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless present a risk of disturbance to areas of colonial heritage value. Disturbance to areas of heritage significance are to be avoided where practicable.
Visual Amenity	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could have local visual impacts (e.g. changes in smoke haze events and geographical extent of burn zones). It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local visual amenity warrants further investigation.
	Atmospheric emissions	10.12	Terrestrial site clearing and exaction activities as well as vehicle movements. Gas processing, operation of machinery	Medium	There is potential for visible emissions to arise from the construction and operation of the LNG Precinct facilities, which could impact visual amenity value of the local area.
	Introduced Pests - terrestrial	10.8	Site clearing, increased traffic, use of fill	Medium	Introduced species (weeds, pests etc) have potential to change the nature of the landscape which could consequently impact local amenity values.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	High	Light associated with marine facilities has the potential to impact visual amenity of area in the vicinity of the development. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area, however the geographical extent of potential light effects on amenity values warrants further investigation.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event has potential to adversely affect the local amenity values of the surrounding area. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Physical Presence - marine	10.14	Nearshore jetty, pipelines and marine infrastructure	High	Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities has potential to change local landscape values and therefore affect visual amenity along the coastal area.
	Physical Presence -	10.14	Clearing, site works, roads,	Severe	The physical presence of the LNG Precinct facilities will change visual amenity of the development area and surrounds. The extent of potential impact on visual amenity

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	terrestrial		plant, buildings		values of the local area will depend on the physical infrastructure characteristics, topography and proximity of social receptors, however a change in current visual amenity is inevitable. This aspect warrants further investigation.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	Activities that may lead to local sedimentation/deposition effects could potentially affect amenity of the local coastal area. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area. Potential impacts to visual amenity in a local context warrants further investigation.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure is anticipated to have limited impact to visual amenity and tourism in the local area.
	Site Disturbance/ Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	High	Site disturbance will be limited to the development area and footprint will be minimised. Clearing / excavation works will nonetheless result in a change to the visual amenity of area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area. However potential visual amenity impacts warrant further investigation.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release. Terrestrial discharges are unlikely to cause visual impacts or alter condition, therefore no significant impact on visual amenity is anticipated.
	Vegetation/ Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	High	Clearing will be limited to the development area and footprint will be minimised. The clearing of vegetation will nonetheless result in a change to the visual amenity of area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area. However potential visual amenity impacts warrant further investigation.
	Vehicle Movements	9.0	Construction, operation of facilities	High	Increased traffic will likely result in a change of visual amenity. Existing unpaved roads/tracks may require upgrading and/or expansion to accommodate LNG Precinct-related traffic. Potential traffic impacts on visual amenity in a local context warrants further investigation.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Vessel movements	10.9	Product transport, Precinct construction and support.	High	Introduction of large vessels to the region has potential to impact visual amenity in the vicinity of the Precinct development and associated vessel transit routes, and warrants further investigation.
Mining	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Low	The Precinct development zone of the James Price Point area is not likely to be required for mining activities. Therefore the risk of site clearing/excavation activities associated with the LNG Precinct on existing or future mining activities is assessed to be low.
	Use of infrastructure and services	9.0	Precinct construction and operation	Medium	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, will increase pressure on the airport, airline services and accommodation services which will cause negative impacts for the mining tourism sector.
	Restricted Areas	9.0	Precinct construction and operation	Medium	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of mining companies looking to explore for and/or develop mineral deposits. Whilst the general area may be prospective for mineral sands and construction materials, there is not a significant level of interest in the area at present in terms of title applications.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like mining, to compete for labour.
	Vegetation/Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Low	The Precinct development zone of the James Price Point area is not likely to be required for mining activities. Therefore the risk of vegetation clearance associated with the LNG Precinct on existing or future mining activities is assessed to be low.
Agriculture	Atmospheric emissions	10.12	Terrestrial site clearing and excavation activities as well as vehicle movements. Gas processing, operation of machinery	Low	There is potential for local deposition effects of atmospheric emissions on vegetation. However this is considered to represent a low risk to agricultural activities which are well removed from the Precinct development area.
	Introduced Pests -	10.8	Site clearing, increased traffic, use of fill	Medium	Introduced species (weeds, pests etc) have potential to be introduced to the area from the import and transport of materials, equipment and personnel, and expansion/upgrade of road access. Should pest species be established in the area,

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	terrestrial				there is potential for indirect secondary impacts on other land uses in the local area. The James Price Point coastal area is some distance from major pastoral leases in the southern portion of the Dampier Peninsula, however potential pest effects on local traditional agricultural practices warrants further investigation.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the activities of Aboriginal people associated with the harvest of wild gubinge (bush plumb) in the vine thicket areas.
	Runoff	10.4	Construction activities , site clearing, stormwater management	Medium	Runoff from LNG Precinct development has potential to impact on groundwater resources if incorrectly managed. Runoff will be diverted and controlled so as to ensure low risk to groundwater resources, thereby minimising the risk of secondary impacts on agricultural activities in the region.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like pastoralism/agriculture, to compete for labour.
	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Low	The Precinct development zone of the James Price Point area is not for agricultural use. On the Dampier Peninsula there are small horticultural and agroforestry businesses (Scoping Report s. 5.3.4.2). The Gubinge is grown and harvested by local traditional owners on the Dampier Peninsula, representing a traditional agricultural practice. The nearest pastoral leases are more than 50km to the west and south-west of JPP, therefore the risk of LNG Precinct affecting these agricultural areas is assessed to be low.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Medium	A non-routine event is considered to have low probability of occurrence. Terrestrial discharges have the potential to impact on groundwater resources, with consequent effects on other agricultural land users. The James Price Point coastal area is remote from major pastoral leases in the southern portion of the Dampier Peninsula, however potential effects on local traditional agricultural practices warrants further investigation.
	Vegetation/Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Low	The Precinct development zone of the James Price Point area is not for agricultural use. On the Dampier Peninsula there are small horticultural and agroforestry businesses (Scoping Report s. 5.3.4.2). The Gubinge is grown and harvested by local traditional owners on the Dampier Peninsula, representing a traditional agricultural practice. The nearest pastoral leases are more than 50km to the west and south-west of JPP, therefore the risk of LNG Precinct affecting these agricultural areas is assessed to be low.

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					low.
Commercial Fishing	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	Medium	Increased shipping and vessel movements increases the potential for invasive marine species to be introduced in the local area. Should introduced species establish in the area, there is potential to impact on commercial fishing activities in the area. Strict IMS inspection and management protocols are anticipated to minimise risk of introduction, however the risk of introduced pests on these activities warrants further investigation.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	Medium	Light associated with marine facilities has potential to disturb fishing operations. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from other users of the broader coastal area. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area. However potential impact from light on commercial fisheries warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase pressure on the port, and other services which may cause negative impacts for the commercial fishing sector.
	Commercial Fishing	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the activities of commercial fishers in and around James Price Point.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like commercial fishing, to compete for labour.
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	A number of WA State managed and Commonwealth managed fisheries operate in the coastal inshore areas of the Kimberley (Scoping Report s.5.3.4.3). These fisheries cover a broad geographic area and are not limited to the James Price Point coastal area. Noise impacts associated with the LNG Precinct are expected to occur primarily during construction and installation phases. Taking into account the short-term and temporary nature of nearshore noise-generating activities, it is not anticipated to result in significant disturbance to commercial fishing operations in the region.
	Marine Discharges – including non-	10.3	Nearshore construction activities, Precinct operation, product storage and	Medium	A non-routine event is considered to have low probability of occurrence. Commercial fisheries cover a broad geographic area along the Kimberley coast and are not limited to the James Price Point coastal area. Should a non-routine event occur it is considered

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	routine events		distribution. Vessel movements.		that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	Dredging during construction and ongoing maintenance may potentially increase sedimentation and may have the potential to disturb commercial fishing activities. The marine waters of the Kimberley region are known to have high natural turbidity throughout year due to high tidal flux. Taking into account the short term nature of potential impacts, the natural high turbidity and low density of commercial fishing operations in the area, significant impacts are not anticipated.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure could lead to localised impacts on habitat. Disturbance will be limited to the minimum necessary for the development, and anticipated to represent a small proportion of the total fish habitat along the coastal zone. Short-term activities are considered unlikely to affect commercial fishing operations.
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb commercial fishing activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on commercial fishing operators, warrants further investigation.
	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	High	Increased shipping and vessel movements increases the potential for invasive marine species to be introduced in the local area. Should introduced species establish in the area, there is potential to impact on aquaculture (including pearling) activities in the area. Strict IMS inspection and management protocols are anticipated to minimise risk of introduction, however the risk of introduced pests on these activities warrants further investigation.
Aquaculture and Pearling	Light emissions – marine	10.9	Precinct operation, nearshore construction, vessel operation	Medium	Light associated with marine facilities has potential to disturb aquaculture (including pearling) operations. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area. However potential impact from light on aquaculture farms in the local JPP coastal area warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase pressure on the port, and other services which may cause negative impacts for the agriculture sector.
	Use of infrastructure	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	and services		operation		pressure on the port, and other services which may cause negative impacts for the aquaculture (including pearling) industry.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like aquaculture (pearling), to compete for labour.
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	In a regional context, major aquaculture / pearling operations occur at Cygnet Bay, Beagle Bay and Deepwater Point (Scoping Report s. 5.3.4.4). A few pearling leases are offshore James Price Point, although well removed from the LNG Precinct area. Noise impacts associated with the LNG Precinct are expected to occur primarily during construction and installation phases. The nearshore infrastructure is anticipated to be located away from active aquaculture operations. Taking into account the short-term and temporary nature of noise-generating activities, it is not anticipated to result in significant disturbance to aquaculture (pearling) operations in the region. This risk ranking will be reviewed in the event that marine blasting is a requirement for the construction phase.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event is considered to have low probability of occurrence. A few pearling leases are offshore James Price Point, although removed offshore from the LNG Precinct area. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	In a regional context, major aquaculture / pearling operations occur at Cygnet Bay, Beagle Bay and Deepwater Point (Scoping Report s. 5.3.4.4). A few pearling leases are offshore James Price Point, although well removed from the LNG Precinct area. It is possible that trenching and/or dredging activities for the nearshore infrastructure may contribute to short-term increases in turbidity, however it is understood that naturally high turbid water conditions do occur already. The potential for sedimentation/turbid plumes arising from the LNG Precinct development zone to affect nearby aquaculture (pearling) sites warrants further investigation.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure could lead to localised impacts on habitat. Disturbance will be limited to the minimum necessary for the development, and anticipated to represent a small proportion of the total fish habitat along the coastal zone. Short-term activities are considered unlikely to affect aquaculture (including pearling) operations.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb aquaculture (including pearling) activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on commercial fishing operators, warrants further investigation.
Tourism	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could have impacts on local tourism activities. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local tourism warrants further investigation.
	Atmospheric emissions	10.12	Terrestrial site clearing and exaction activities as well as vehicle movements. Gas processing, operation of machinery	Medium	There is potential for visible emissions to arise from the construction and operation of the LNG Precinct facilities, which could impact amenity to tourism. Flare tip design and controls are anticipated to make this scenario unlikely to result in adverse impacts.
	Use of Infrastructure and Services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, will increase pressure on the airport, airline services and accommodation services which will cause negative impacts for the tourism sector, particularly during peak season.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of tourists in and around James Price Point.
	Increased demand for labour	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like tourism, to compete for labour.
	Introduced Pests - terrestrial	10.8	Site clearing, increased traffic, use of fill	Medium	Introduced species (weeds, pests etc) have potential to change the nature of the landscape which could consequently impact tourism values.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	High	Light associated with marine facilities has the potential to impact visual amenity of area in the vicinity of the development, which could affect tourism. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area, however the geographical extent of potential light effects on amenity values warrants

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
					further investigation.
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	High	<i>In the vicinity of the site, marine noise and vibration could potentially affect amenity of the local area with follow-on effects on local tourism uses. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from tourism and other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area.</i>
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	<i>A non-routine event is considered to have low probability of occurrence. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from tourism and other users of the broader coastal area. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.</i>
	Physical Presence - marine	10.14	Nearshore jetty, pipelines and marine infrastructure	High	<i>Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities has potential to change local landscape values and possibly interact with activities.</i>
	Physical Presence - terrestrial	10.14	Clearing, site works, roads, plant, buildings	Medium	<i>The development area not likely to be available for other land uses. The physical presence of the LNG Precinct facilities will affect amenity of the local area with follow-on effects on local tourism uses. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from tourism and other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area.</i>
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	<i>Activities that may lead to local sedimentation/deposition effects could potentially affect amenity of the local coastal area with follow-on effects on local tourism uses. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from tourism and other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area. The short term nature of the impacts and the natural high turbidity indicate minor consequence of effects, however potential impact to visual amenity warrants further investigation.</i>
	Site disturbance/excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	<i>Seabed disturbance associated with the installation of marine infrastructure is anticipated to have limited impact to visual amenity and tourism in the local area.</i>

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	High	Clearing will be limited to the development area and footprint will be minimised. The clearing of vegetation will nonetheless result in a change to the visual amenity of area, thereby altering the tourism potential of the local area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area. However potential impacts on existing and/or future tourism warrants further investigation.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	The construction and operation of facilities within the LNG Precinct will result in the generation of a range of solid, liquid and semi-liquid wastes requiring handling, storage and disposal. Waste re-use and recycling opportunities will be explored to minimise total volumes requiring disposal. Waste disposal will be at approved facilities however the temporary storage may result in localised visual impacts, which may have flow-on effects on local tourism values. The potential impact is considered minimal.
	Vegetation/Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	High	Clearing will be limited to the development area and footprint will be minimised. The clearing of vegetation will nonetheless result in a change to the visual amenity of area, thereby altering the tourism potential of the local area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area. However potential impacts on existing and/or future tourism warrants further investigation.
	Vehicle Movements	9.0	Construction, operation of facilities	High	Increased traffic on the Dampier Peninsula may disturb existing tourist traffic. It is anticipated that tourist traffic will be regulated to maintain safety buffer zones and ensure public health and safety risks are minimised. Potential traffic impacts to tourism in a local context warrants further investigation.
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb tourism activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on tourism operators, warrants further investigation.
	Altered Fire Regime	10.13	Precinct operation and supporting infrastructure	Medium	The presence of the LNG Precinct may result in a change in the existing fire regime of the local area on the Dampier Peninsula. Introduction of ignition sources and fire management may alter incidence of fire which could have impacts on local sports and recreation activities. It is possible that a positive impact may be derived should the introduction of a controlled fire regime lead to lower frequency and severity of bushfires. The potential impact of an altered fire regime on local recreation activities warrants further investigation.
	Atmospheric	10.12	Terrestrial site clearing and excavation activities as well as	Low	There is potential for exposure from emissions (e.g. dust) to recreational users of the area. It is anticipated that an appropriate buffer zone will be defined to maintain suitable

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	emissions		vehicle movements. Gas processing, operation of machinery		separation distance from the LNG Precinct from other users of the broader coastal area, therefore a low risk of impact to recreational users.
	Introduced Pests - terrestrial	10.8	Site clearing, increased traffic, use of fill	Medium	Introduced species (weeds, pests etc) have potential to be introduced to the area from the import and transport of materials, equipment and personnel, and expansion/upgrade of road access. Should pest species be established in the area, there is potential for indirect secondary impacts on other land uses in the local area. Potential pest effects on local recreational activities warrants further investigation.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	Medium	Light associated with marine facilities has the potential to impact visual amenity of area in the vicinity of the development. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area. However potential impact from light on recreational users along the coastal area warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	Low	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is highly unlikely to cause negative impacts on sport and recreation activities.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of people undertaking sport and recreation activities in the James Price Point area.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event is considered to have low probability of occurrence. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.
	Physical Presence - marine	10.14	Nearshore jetty, pipelines and marine infrastructure	High	Exclusion zones, introduction of large vessels to region, increased marine traffic and installation of marine facilities has potential to change local landscape values and possibly interact with activities.
	Local population increases (temp or permanent)	9.0	Precinct construction and operation	High	Due to an increase in population associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, should direct and indirectly employed workers chose to reside in Broome, there will be additional demand for/competing use of sporting and recreation activities/facilities.
	Physical Presence -	10.14	Clearing, site works, roads, plant, buildings	Medium	The development area is not likely to be available for other land uses and some limited access restricted areas will cause disturbance to existing recreational activities in the immediate development area. It is anticipated that an appropriate buffer zone will be

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	terrestrial				defined to maintain suitable separation distance from the LNG Precinct from recreational and other users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area.
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	Activities that may lead to local sedimentation/deposition effects could potentially affect amenity of the local coastal area. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from recreational users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area. Potential impacts to recreational amenity and uses in a local context warrants further investigation.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure is anticipated to have limited impact to sports and recreational uses in the local area.
	Site Disturbance/ Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Low	Clearing will be limited to the development area. However the development of the LNG Precinct will preclude the use of the immediate area for camping and other recreational activities. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from recreational users of the broader coastal area.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Should it occur, terrestrial discharge is unlikely to impact areas outside of the development area of the LNG Precinct. Therefore potential impact on sports/recreation values is assessed to be low.
	Vegetation/ Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Low	Clearing will be limited to the development area. However the development of the LNG Precinct will preclude the use of the immediate area for camping and other recreational activities. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from recreational users of the broader coastal area.
	Vehicle Movements	9.0	Construction, operation of facilities	High	Increased traffic on the Dampier Peninsula may disturb existing recreational users. It is anticipated that recreational traffic will be regulated to maintain safety buffer zones and ensure public health and safety risks are minimised. Potential traffic impacts on sports / recreational uses in a local context warrants further investigation.

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on sport/recreation values, warrants further investigation.
Recreational Fishing	Invasive Marine Species	10.7	Vessel movements and nearshore construction works	Medium	Increased shipping and vessel movements increases potential for invasive marine species. Should introduced species establish in the area, there is potential to impact on recreational fishing activities in the area. Strict IMS inspection and management protocols are anticipated to minimise risk of introduction, however the risk of introduced pests on these activities warrants further investigation.
	Light emissions - marine	10.9	Precinct operation, nearshore construction, vessel operation	Medium	Light associated with marine facilities has the potential to impact visual amenity of area in the vicinity of the development. Resultant impacts are anticipated to be limited to the coastal zone in close proximity to the Precinct area. However potential impact from light on recreational fishing activities along the coastal area warrants further investigation.
	Restricted areas	9.0	Precinct construction and operation	High	Marine and terrestrial restricted areas associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct may constrain the access of recreational fishers n and around James Price Point.
	Marine Noise and Vibration	10.1	Include marine drilling and geotechnical studies, dredging, nearshore construction, and vessel movements	Low	Marine construction activities such as piling and dredging may have the potential to affect fish species. However it is unlikely that such impacts would affect recreational fishing off the James Price Point coastal area. Areas of recreational fishing cover a broad geographic area and are not limited to the James Price Point coastal area. Noise impacts associated with the LNG Precinct are expected to occur primarily during construction and installation phases. Taking into account the short-term and temporary nature of nearshore noise-generating activities, it is not anticipated to result in significant disturbance to recreational fishing activities in the region.
	Use of infrastructure and services	9.0	Precinct construction and operation	Medium	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase pressure on the port, and other services which may cause negative impacts for recreational fishing.
	Marine Discharges – including non-routine events	10.3	Nearshore construction activities, Precinct operation, product storage and distribution. Vessel movements.	Medium	A non-routine event is considered to have low probability of occurrence. Should a non-routine event occur it is considered that it may have a temporary and localised impact, however this is dependent on the nature and fate of any release and warrants further consideration.

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Sediment Deposition and turbidity	10.2	Marine dredging and drilling and nearshore construction	Medium	Activities that may lead to local sedimentation/deposition effects could potentially affect amenity of the local coastal area. It is anticipated that an appropriate buffer zone will be defined to maintain suitable separation distance from the LNG Precinct from recreational users of the broader coastal area. Resultant impacts are anticipated to be minor and limited to the coastal zone in close proximity to the Precinct area. Potential impacts to recreational amenity and uses in a local context warrants further investigation.
	Site disturbance/ excavation - marine	10.6	Marine dredging and drilling, nearshore construction and pipeline installation.	Low	Seabed disturbance associated with the installation of marine infrastructure is anticipated to have limited impact to sports and recreational uses in the local area.
	Site Disturbance/ Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	High	Site disturbance to some areas of the shoreline will impact recreational fishing activities within the development area. Resultant impacts are anticipated to be limited to the coastal zone comprising the Precinct development area.
	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Low	A non-routine event is considered to have low probability of occurrence. Should it occur, terrestrial discharge is unlikely to impact areas outside of the development area of the LNG Precinct. Therefore potential impact on sports/recreation values is assessed to be low.
	Vessel movements	10.7	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb recreational fishing activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on recreational fishing activities, warrants further investigation.
	Groundwater Abstraction	10.15	Support construction and operation	High	Water abstraction may be required to supply water to facilities within the LNG Precinct. Water abstraction will be in accordance with allocation plans, as agreed with relevant Government agencies. It is possible that water abstraction may affect water supply and availability for other users in the local area, and warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to increase demand for potable water and put additional pressure on ground water resources in the region.

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Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Waste management	Terrestrial Wastes and Discharges	10.4	Precinct operation, product storage and distribution	Medium	The construction and operation of facilities within the LNG Precinct will result in the generation of a range of solid, liquid and semi-liquid wastes requiring handling, storage and disposal. Waste re-use and recycling opportunities will be explored to minimise total volumes requiring disposal. Waste management infrastructure required to support the Precinct may have impacts on other land uses.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to increase demand for waste management services and facilities and put additional pressure on associated infrastructure in the region.
Transport	Vehicle movements	9.0	Construction, operation of facilities	High	Increased traffic anticipated to arise from the LNG Precinct construction and operation will likely disturb existing traffic in the local area, between Broome and the development zone. Potential traffic impacts on existing road traffic in a local context warrants further investigation.
	Use of infrastructure and services	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to result in increased vehicle, marine and air traffic which will put additional pressure on associated infrastructure in the region.
	Vessel movements	10.10	Product transport, Precinct construction and support.	High	Exclusion areas to be established as part of the LNG Precinct, and the introduction of large vessels (LNG carriers, etc) to the region, has potential to disturb maritime transport activities in the vicinity of the development. The nature of exclusion zones, and the resultant effect on maritime transport, warrants further investigation.
Land tenure	Physical Presence - terrestrial	10.14	Clearing, site works, roads, plant, buildings	Medium	The development area is not likely to be available for other land uses. James Price Point is currently unallocated Crown land which has a native title claim over it by the Goolarabooloo Jabirr Jabirr Native Title Claimants. The final site allocation includes a Land Use Agreement to ensure land tenure issues are fully addressed.
Terrestrial Conservation Areas	Site Disturbance/Excavation - terrestrial	10.5	Product transport, Precinct construction and support.	Medium	The LNG Precinct area is located outside the boundaries of reserves, therefore potential impacts on areas of environmental heritage value are assessed to be unlikely. Clearing of areas of conservation significance to be avoided where practicable.

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Vegetation/ Habitat Clearing	10.11	Precinct preparation and excavation and supporting infrastructure.	Medium	<i>The LNG Precinct area is located outside the boundaries of reserves, Therefore potential impacts on areas of environmental heritage value are assessed to be unlikely. Clearing of areas of conservation significance to be avoided where practicable.</i>
Local population increases (temporary/permanent)	General Population	9.0	Precinct construction and operation	High	<i>The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in an increase in the general population of the region due to people being attracted by significant direct and indirect opportunities associated with the developments and lead to increased demand for goods and services in the region.</i>
	Indigenous Population	9.0	Precinct construction and operation	High	<i>The construction and operation of multiple LNG projects within the Browse LNG Precinct may result in an increase in the Indigenous population of the region due to people being attracted by significant direct and indirect opportunities associated with the developments and lead to increased demand for goods and services in the region.</i>
	Local Employment	9.0	Precinct construction and operation	High	<i>The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries to compete for labour.</i>
	Indigenous Employment	9.0	Precinct construction and operation	High	<i>The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries to compete for labour.</i>
	Cost of Living	9.0	Precinct construction and operation	High	<i>Due to an increase in population associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct and the demand from the projects themselves, upward pressure may be exerted on the regional cost of living due to competing demand for supply constrained goods and services.</i>
	Housing Prices	9.0	Precinct construction and operation	High	<i>Due to an increase in population associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, should direct and indirectly employed workers chose to reside in Broome, there will be upward pressure exerted on housing prices.</i>
	Regional Prices Index	9.0	Precinct construction and operation	High	<i>Due to an increase in population associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct and the demand from the projects themselves, upward pressure may be exerted on the regional prices index due to competing demand for supply constrained goods and services.</i>

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
Use of infrastructure and services	Local Employment	9.0	Precinct construction and operation	High	Additional use of local infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the infrastructure and services sectors in the region and lead to wage increases in order for other industries to compete for labour.
	Indigenous Employment	9.0	Precinct construction and operation	High	Additional use of local infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the infrastructure and services sectors in the region and lead to wage increases in order for other industries to compete for labour.
	Housing Prices	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase the population in Broome and cause upward pressure on housing prices.
	Regional Prices Index	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase the demand for supply constrained goods and services in Broome and cause upward pressure on the cost of living/regional prices index.
	Power	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to increase demand for power and put additional pressure on power supply and infrastructure in the region.
	Telecommunications	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to increase demand for telecommunications services and put additional pressure on associated infrastructure in the region.
	Health	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to result in increased demand for health services which will put additional pressure on associated infrastructure in the region.
	Education	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, is quite likely to result in increased demand for education services which will put additional pressure on associated infrastructure in the region.

Browse LNG Precinct – Scope of the Strategic Assessment

Environmental Factor	Aspect with potential to cause impact	Chapter	Relevant Activities	Inherent Risk Rating	Impact Summary/rationale
	Local Employment	9.0	Precinct construction and operation	High	Additional use of local infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the infrastructure and services sectors in the region and lead to wage increases in order for other industries to compete for labour.
	Indigenous Employment	9.0	Precinct construction and operation	High	Additional use of local infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the infrastructure and services sectors in the region and lead to wage increases in order for other industries to compete for labour.
	Housing Prices	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase the population in Broome and cause upward pressure on housing prices.
	Regional Prices Index	9.0	Precinct construction and operation	High	Additional use of infrastructure and services associated with the construction and operation of multiple LNG projects within the Browse LNG Precinct, may increase the demand for supply constrained goods and services in Broome and cause upward pressure on the cost of living/regional prices index.
Increase demand for labour	Health	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like the health sector, to compete for labour.
	Education	9.0	Precinct construction and operation	High	The construction and operation of multiple LNG projects within the Browse LNG Precinct is likely to result in increased competition for labour in the region and lead to wage increases in order for other industries, like the education sector, to compete for labour.

12 Engineering Inputs

Specific engineering inputs such as development footprint, emissions and discharges etc are required to scope the related studies and investigations to support the Strategic Assessment report and subsequent formal environmental approvals processes that apply to the Browse LNG Precinct.

As the scope of the studies and investigations are developed, the requirements and due date of key engineering inputs to inform the studies and investigations will be identified.

Engineering inputs will be obtained via the Master Plan, more detailed input will come from Project Proponents and rely on close working arrangements with Industry to ensure the assessment is applicable to the range of activities proposed to be undertaken within the Precinct. The role of Precinct Proponents will be to define the detailed parameters around components outlined in **Section 3**.

An integral component of the Strategic Assessment process will be to ensure interfaces are maintained between the environmental and engineering studies. The outcomes of the SA studies will feed back into the Precinct planning and design process, as an iterative mechanism to ensure optimal and balanced outcomes for the LNG Precinct.

13 Stakeholder Consultation

Stakeholder consultation is an integral component of the environmental assessment and approvals process.

In accordance with the industry guidelines for community involvement (DoE 2003), throughout the assessment process, the aims of stakeholder consultation include:

- Inform stakeholders of the proposed project;
- Maximise the level of accurate and accessible information about the project to affected communities;
- Provide adequate time for stakeholders to consider and engage in meaningful dialogue on the project;
- Identify and attempt to resolve potential issues early in the planning process;
- Record stakeholder concerns and ensure response is provided to address concerns; and
- Obtain mutually acceptable outcomes on the project.

A comprehensive consultation program was undertaken throughout the Site Selection Process (NDT 200d). A consultation program will continue throughout the assessment process as a two-way flow of communication between government as the Precinct Proponent, industry Proponents and stakeholders. This will assist in identifying significant environmental and social issues and will enable an open, transparent and comprehensive exchange of information and views.

The consultation program will meet the aims as discussed above ensuring that people are being kept informed of development plans and decisions and enable them to contribute input.

13.1 *Indigenous Consultation*

Indigenous consultation has been facilitated through the Kimberley Land Council (KLC) under a comprehensive funding agreement with the State Government. Formal consultation processes have been undertaken with all Kimberley coastal Traditional Owner groups and in all major communities. Aboriginal people who are not Traditional Owners for this region have been engaged in consultations with the KLC and directly with the NDT, DSD and other State agencies. The KLC has contracted external consultants who have provided independent analysis and advice on the environment, heritage, social impacts and LNG production operations.

The KLC is facilitating a comprehensive Aboriginal impact assessment and the State is establishing Indigenous focus groups covering health, education, recreation, employment and housing. This will form part of the Social Impact Assessment (SIA) that will support the Strategic Assessment.

Communication and information strategies are in place to ensure the preparation of culturally appropriate information materials and their dissemination through Aboriginal community, organisational and family networks.

13.2 *Key stakeholders*

The stakeholder consultation program will involve engagement with a range of stakeholders, including indigenous and non-indigenous organizations, and will include the following main groups:

- Members of the public;
- Conservation groups;
- Non-government organizations;
- Tourism Operators;
- Aquaculture Industry (including Pearling);
- Broome Community;
- Education/Academic Institutions;
- State, Commonwealth and Local Government Departments;
- Project Proponents and other industry groups; and
- Traditional Aboriginal owners and other indigenous groups.

A preliminary list of stakeholders has been prepared (**Appendix K**). This list includes (but is not limited to) people and organizations who are likely to have an interest in the Browse LNG Precinct or who may be affected by the proposal.

13.3 Consultation Program

Stakeholder consultation will be a continuing activity for the Browse LNG Precinct.

The consultation program will be framed around key milestones for the assessment, and be provided by various means including briefings, community meetings, published material, web sites and other communication methods appropriate to the target audience. The **Table 13.1** below outlines the consultation program.

Table 13.1 Key Milestones for Consultation

Milestone	Date	Objectives	Audience	Methods
Scoping Document for Strategic Assessment	March – May 09	Inform and seek input from key stakeholders of assessment process and the studies and investigations proposed to support the Strategic Assessment.	<ul style="list-style-type: none"> • State/Cwth Govt • Traditional Owners • NGOs • Industry • General Public 	Meetings/presentation Website Document distribution
Studies and investigations updates	March - Dec 2009	Update key stakeholders of the intent, progress and findings of studies and investigations. Discuss key issues and proposed/potential management strategies,	<ul style="list-style-type: none"> • State/Cwth Govt • Traditional Owners • NGOs • General Public 	Meetings/presentation
Draft SA Report	Dec 2009	Inform and seek input from key stakeholders of the outcomes of the assessment process, including likely impacts and proposed mitigations.	<ul style="list-style-type: none"> • State/Cwth Govt • Traditional Owners • NGOs • Industry • General Public 	Meetings/presentation Website Document distribution
EPA Assessment Report/ DEWHA Assessment Report	2010	Inform key stakeholders of outcomes of assessment and conditions.	<ul style="list-style-type: none"> • State/Cwth Govt • Traditional Owners • NGOs • Industry • General Public 	Website Document distribution Public notice (newspapers)

14 Peer Review Process

Given the significant environment and the scale and complexity of the proposal, there is required a high level of confidence of the technical work underpinning the Strategic Assessment. As such there is an intention to undertake ongoing reviews of the strategic assessment process and of all deliverables and outputs. Arrangements for Peer review, including the establishment of a Peer Review Panel consisting of members from government and non-government sectors are to be advised.

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16 Abbreviations & Acronyms

AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
ALT	Aboriginal Lands Trust
ASR	Age-standardised Mortality Rate
BPP	Benthic Primary Producer
BPPH	Benthic Primary Producer Habitat
BRACS	Broadcasting for Remote Aboriginal Communities Scheme
CAMBA	China-Australia Migratory Bird Agreement
DEC	Department of Environment and Conservation
DEWHA	Commonwealth Department of Environment, Water, Heritage and Arts
DIA	Department of Indigenous Affairs
DSD	Department of State Development
ENSO	El Niño Southern Oscillation effect
EPA	Environmental Protection Authority
EPBC	Environment Protection and Biodiversity Conservation Act 1999
EP Act	Environment Protection Act
ERMP	Environment Review and Management Program
GDE	Groundwater Dependant Ecosystems
HiBIS	Higher Bandwidth Incentive Scheme
ILUA	Indigenous Land Use Agreement
IMF	Integrated Marine Facilities
ISDN	Integrated Services Digital Network
ITF	Indonesian Throughflow
JAMBA	Japan-Australia Migratory Bird Agreement
JPP	James Price Point
KDC	Kimberley Development Commission
KLC	Kimberley Land Council
LADS	Laser Airborne Depth Sounder
LAT	Lowest Astronomical Tide
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MEG	Mono-ethylene glycol
MOF	Material Offloading Facility
MPB	Microphytobenthos
Mtpa	million tonnes per annum
NDT	Northern Development Taskforce
NGO	Non-Government Organisation
RAESP	Remote Areas Essential Services Program
RAHS	Remote Area Health Services
RAPS	Remote Area Power Supply
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SA	Strategic Assessment
SEA	Strategic Environmental Assessment
SEC	South Equatorial Current
SRE	Short Range Endemic
TEC	Threatened Ecological Communities
TO	Traditional Owners
ToR	Terms of Reference

Measurements

cm	centimetre
GL	giga litres
GW	giga watts
ha	hectares
MW	mega watts
km	kilometre
m ³	cubic metres
mg/L	micro grams per litre of total dissolved solids
mm	millimetres

