



Report and recommendations of the Environmental Protection Authority



Browse Liquefied Natural Gas Precinct

Minister for State Development

Report 1444

July 2012

STATEMENT ON TIMELINES

Timelines for an assessment may vary according to the complexity of the project and are usually agreed with the proponent soon after the level of assessment is determined.

In this case, the Environmental Protection Authority met its agreed timeline objective of 10 weeks from the time the last information was provided by the proponent to the completion of the assessment and provision of a recommendation to the Minister.

A handwritten signature in blue ink, appearing to read 'P. Vogel', with a long horizontal line extending to the right.

Dr Paul Vogel
Chairman
16 July 2012

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Summary and recommendations

This report provides the Environmental Protection Authority's (EPA's) advice and recommendations to the Minister for Environment on the strategic proposal referred by the Minister for State Development to develop a liquefied natural gas (LNG) processing precinct at James Price Point, 60 kilometres (km) north of Broome (Figure 1).

It is the EPA's view that the proposed LNG precinct could be implemented at James Price Point such that the EPA's objectives could be met, provided that strict environmental management conditions and appropriate offsets, as recommended in this report, are applied.

The EPA has concluded through this assessment that the future proposals, identified in the Browse LNG Precinct proposal and designed to include one or more of the developments/activities listed in Column 1 of Table 1 of this report may be implemented, if they are subsequently declared to be derived proposals, in such a way as to meet the EPA's environmental objectives provided they are carried out consistent with the recommendations below.

Environmental assessment processes

This report is part of a continuing process of environmental evaluation of the proposal to process LNG from the Browse basin, off the Kimberley coast. These processes are briefly set out below.

Previous process

The Northern Development Taskforce (NDT) was set up in June 2007 by the Western Australian Government to provide a framework for development in the West Kimberley (EPA, 2008). The Taskforce conducted a site evaluation process leading to the identification of a preferred site for LNG production as set out below.

The plan for the Browse LNG Precinct was developed following earlier site selection studies carried out for the State by the NDT. The NDT examined over 40 sites along the Kimberley coast, culminating in further examination of 11 sites and a shortlist of four sites (NDT, 2008a, 2008b, 2008c). That site selection process also included examination of the feasibility of alternatives to the location of the precinct outside the Kimberley region, including sites in the Pilbara and in the Northern Territory (Gaffney Cline, 2008; GHD, 2009; Worley Parsons, 2008). Studies of those alternatives determined that only companies that could secure low priced infrastructure facilities such as pipelines and existing processing facilities could consider locating outside the Kimberley region (Gaffney Cline, 2008). The EPA accepts that the screening of alternatives via the NDT process and the above reports was an appropriate level of analysis to determine a short list of four sites.

In December 2008, the EPA provided advice on the four shortlisted sites under section 16(e) of the *Environmental Protection Act 1986* (EP Act) (EPA, 2008). The EPA concluded that two sites (North Head and Anjo Peninsula) were not suitable for large scale industrial development from an environmental point of view. The EPA further concluded that Gourdon Bay was the least

environmentally constrained of the four sites and that James Price Point was the least environmentally constrained of the two shortlisted sites on the Dampier Peninsula. Based on the available data at the time, the EPA was of the view that the environmental impacts and risks of locating a precinct in the James Price Point area were likely to be manageable.

In its 2008 report, the EPA strongly supported a strategic level review of potential LNG processing in the Kimberley. The EPA went on to say that it strongly supported focusing development at a single site so that environmental impacts could be contained and operational efficiencies maximised in ways that minimise environmental impacts.

In late 2008, the Premier announced that James Price Point was the State's preferred location for a Browse LNG Precinct. In its 2008 report, the EPA identified that formal environmental assessment of the preferred location was expected to be undertaken under the provisions of the EP Act.

In considering the array of sites evaluated, it has become evident to the EPA that any site on the coast is likely to raise issues associated with Traditional Ownership. In this regard, James Price Point is not likely to be unique.

Current process

By letter dated 25 March 2008, the Minister for State Development referred to the EPA under s38(3) of the EP Act a plan for a multi-user precinct to produce up to 50 million tonnes a year (Mtpa) of liquefied natural gas, including a port and ancillary infrastructure. The EPA determined that the referral should be assessed as a strategic proposal and this determination was advertised on 14 April 2008. The environmental impact assessment of the Browse LNG Precinct has been undertaken concurrently under both the EP Act and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Terms of reference for the assessment are set out in a Strategic Assessment Agreement between the Commonwealth and Western Australia.

In assessing a strategic proposal, the EPA should be able to reasonably conclude at an appropriately high level that future significant proposals could be implemented without significant deleterious impacts on the environment. Sufficient detail should be available to allow the EPA to conclude that:

1. The strategic proposal does not contain obvious fatal flaws.
2. Significant deleterious impacts at the population level on important components of the biota are not likely. This explicitly recognises that there may be deleterious impacts to individual organisms, but they should not be likely to have an impact on the long term viability of the population.
3. The strategic proposal contains sufficient information for the EPA to make reasonably informed decisions about points 1 and 2 above.
4. The strategic proposal specifies any work required in a derived proposal to provide additional, more detailed information about potential impacts to a level that allows for the development of environmental management programs and plans for their proper

management. The work required should be framed in the form of proposed draft conditions.

5. The work specified in proposed conditions set under point 4 above specifies to what end or for what purpose that work is to be performed.
6. Proposed conditions in point 4 above specify by whom the work should be done and by when.

Judgements about the likely environmental impact and acceptability or otherwise of a strategic proposal will incorporate the EPA's wisdom and experience of similar proposals that have been assessed at the project level.

The current assessment as a strategic proposal considers whether a 50 Mtpa LNG production precinct could be implemented at James Price Point. This assessment has involved the production of a Strategic Assessment Report (SAR) by the proponent, receipt of public submissions on that report, response to those submissions by the proponent, incorporation of more detailed environmental and precinct design information and an assessment of the strategic proposal by the EPA. This report contains the EPA's assessment and recommendations on the contemporary proposal, its residual impacts and their management.

Future process

The purpose of a strategic proposal is to consider the environmental impacts of a future proposal, or group of future proposals. A strategic proposal does not of itself lead to the implementation of an actual project.

It is thus expected that a future proponent would refer a proposal, previously identified in the strategic proposal, for the implementation of a project to the EPA and request that it be considered to be a 'derived proposal'. For the EPA to be able to determine that a future proposal is a derived proposal, the EPA must be satisfied that the future proposal was identified in the strategic proposal and that any decision or agreement provides that the future proposal may be implemented. The EPA may refuse to decide that a future proposal is a derived proposal if:

- the environmental issues raised by it were not adequately assessed during the assessment of the strategic proposal,
- there is significant new or additional information that justifies the re-assessment of the issues raised by the future proposal, or
- there has been a significant change in the relevant environmental factors since the strategic proposal was assessed.

If the EPA determines that a future proposal is a derived proposal, any relevant conditions applied when a decision was made about the strategic proposal then apply to the derived proposal. The EPA may also inquire into changing those conditions under s46 of the EP Act.

In this case, the strategic proposal relies heavily on a series of detailed plans for environmental management, to be produced and implemented by the future proponent of any derived proposal. The EPA recommends strongly that conditions be applied to ensure that there is proper consultation with stakeholders on the content of these plans prior to their submission for

approval under the provisions of the EP Act and has set out recommended conditions to that effect at the end of this report.

Further discussion about the relationship between strategic and derived proposals and the EPA's expectations of future derived proposals is provided as "other advice" in Section 5 of this report (EPA, 2012) and in the EPA's Environmental Assessment Bulletin Number 17 "Strategic and Derived Proposals", available at <http://www.epa.wa.gov.au/EPADocLib/32148%20EPA%20EPB%2017.pdf> .

This report

The Browse LNG Precinct was assessed as a strategic proposal as it identifies potential future proposals which if implemented, singly or in combination, are likely to have a significant impact on the environment. It is envisaged that future proposals identified in this report and proposed for the Precinct, including LNG processing plants, a port and supporting infrastructure may be progressively referred to the EPA in the future with requests that the EPA declare these future proposals to be derived proposals under s39B of the EP Act.

Section 44 of the EP Act, read with s40B, requires the EPA to report to the Minister for Environment on the outcome of its assessment of a strategic proposal. The report must set out:

- the key environmental factors identified in the course of the EPA's assessment of the strategic proposal; and
- the EPA's recommendations as to whether or not the future proposals identified in the strategic proposal may be implemented in the event that the future proposals are declared to be derived proposals, and, if the EPA recommends that implementation be allowed, the conditions and procedures to which implementation of the future proposals should be subject.

The EPA may include in the report any other advice and recommendations as it sees fit.

The EPA is also required to have regard for the principles set out in s4A of the EP Act in its assessment of the strategic proposal and report to the Minister for Environment.

Key environmental factors and principles

The EPA identified the following key environmental factors during its assessment of the strategic proposal:

- a) Marine fauna;
- b) Benthic habitats;
- c) Marine environmental quality;
- d) Terrestrial biota;
- e) Landscape processes;
- f) Surface and groundwater;

- g) Heritage;
- h) Air emissions; and
- i) Greenhouse gases.

There were a number of other factors which were identified as relevant, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation of the other relevant factors identified.

The following principles were considered by the EPA in relation to the strategic proposal:

- a) The precautionary principle;
- b) Intergenerational equity;
- c) Conservation of biological diversity and ecological integrity;
- d) Improved valuation, pricing and incentive mechanisms and;
- e) Waste minimisation.

Conclusions

The EPA has assessed the strategic proposal referred by the Minister for State Development to create the Browse LNG Precinct.

The EPA acknowledges that the creation of any industrial undertaking, particularly one of this magnitude, will involve environmental impacts. If there is to be an LNG processing precinct in the Kimberley, the EPA considered in its advice of December 2008 that, based on the available data, the environmental impacts and risks of locating a precinct in the James Price Point area were likely to be manageable (EPA, 2008). The current assessment considers the strategic proposal and the James Price Point location in more detail.

In considering a proposal such as this, it is always necessary to consider the least impact in one part of the environment against the least impact in another part. For example, in this case, impact to Monsoon Vine Thickets would be avoided if the plant were located north of James Price Point however such a location would likely require considerably more dredging, resulting in greater potential impacts on the marine environment. Both locations, and indeed probably any location on the coast, would still have some impact on Aboriginal heritage matters. These dilemmas are properly part of the EPA's environmental considerations of a proposal. Provided always that the EPA can be satisfied that resolution of dilemmas like these does not result in a significant residual impact overall, it is likely to find that a proposal could be implemented.



Figure 1. Indicative location of proposed Browse LNG Precinct.

For each of the key environmental factors listed above, the EPA has come to the conclusions summarised below.

Marine fauna

Whales, dolphins, dugong, turtles and fish are important inhabitants of the marine environment off James Price Point. Turbidity from dredging, loss of habitat, oil spills, industrial discharges, noise, light and vessel strikes have the potential to adversely affect these animals.

The EPA believes that the whale population requires careful protection, consistent with State and Federal laws. The Authority has carefully considered the potential impacts on Humpback whales (and other cetaceans) given their seasonal migration pattern and the importance of the Kimberley region for calving. The EPA notes that the main calving grounds for Humpback whales are between the Lacepede Islands and Camden Sound (about 60 km and 340 km north of James Price Point respectively). These whales migrate past James Price Point each year, with about 95% of them passing more than 8 km offshore, in Commonwealth waters.

The EPA notes that the population of Humpback whales has continued to increase exponentially since commercial whaling ceased off the west coast in the 1960s, despite the significant increases in shipping and offshore hydrocarbon production due to the advent of the iron ore and petroleum industries in Western Australia over the same period. The EPA also notes and welcomes the creation of the Camden Sound Marine Park by government.

The EPA notes that turtles utilise the area for feeding and, although there is some evidence of turtle nesting on mainland beaches, the predominant nesting habitats in the region occur at the Lacedede Islands, approximately 60 km north. The EPA believes that although there may be some loss of turtle foraging habitat and impacts on individuals as a result of the development and operation of the precinct, these impacts are unlikely to be significant at the population level provided the conditions in this report are implemented.

The EPA has concluded that while there may be some impacts to individuals, its objectives for the protection of whales and turtles at the population level are likely to be met provided the conditions in this report and the Commonwealth government guidelines are implemented.

The EPA notes that less studied marine fauna such as coastal dolphins, dugong and fish also utilise the area but, considering the current state of knowledge of critical habitats and likely ranges, has come to similar conclusions about these marine fauna in the proposal area in that it finds that, while impacts to individuals may occur, they are unlikely to be significant at the population level provided the strict conditions recommended in this report are implemented.

Benthic habitats

Dredging and construction have the potential to adversely affect the benthic (seabed) habitats that support algae, seagrass, scattered corals and filter feeders that are an important foundation of marine ecosystems in the precinct area. Patchy, ephemeral seagrass occurs in the James Price Point coastal

area, where it provides important seasonal food for dugong and turtles. Sandy, often bare, sediments are common in the area.

Strategic level information on benthic habitats and modelling of dredging impacts has been used to describe where impacts would be permanent, where they would be temporary and where the turbid dredge plume may be visible but not cause any measurable ecological impacts on benthic communities. These areas are termed the zones of High Impact, Moderate Impact and Influence respectively. It is acknowledged that there is uncertainty around these predictions. These uncertainties include the actual design of the marine infrastructure and how it will be constructed, the inter-annual variability in benthic habitats locally and more broadly, the sensitivity and resilience of the biota and the resultant extent of permanent and recoverable impacts that may arise. The EPA accepts that, while development would result in direct and indirect impact to benthic communities, on balance those impacts could be made acceptable. This conclusion is supported by the EPA's previous experience with other marine infrastructure proposals and the general resilience of the benthic communities in this part of the Kimberley to natural perturbations such as cyclones.

The EPA considers that proponents should be able to design and build the port such that the permanent impacts are minimised, can be significantly less than proposed, and should not be permitted to extend one kilometre from the boundary of the port area as originally set out in the SAR. The EPA has therefore recommended that all facilities should be located within the port (Area A in Figure 2) and channel (Area G) boundaries and all Zones of High Impact should be limited to within 500 m from the infrastructure itself. For pipelines between the Precinct and the offshore gas fields, the EPA has recommended that they be located within the northern and southern pipeline corridors (areas F and E) and accepted that the associated Zone of High Impact may be up to 500 m from any pipe, but the proponent must demonstrate the use of best practice techniques to minimise permanent impacts. In practice, depending on a suitability analysis of different pipelaying techniques, the EPA expects proponents to be able to reduce the actual extent of permanent impact to less than 50 m from any pipeline, based on experience with other projects.

The EPA has recommended that there should be no measurable effects on benthic communities outside a Zone of Moderate Impact bounded by a line extending two kilometres due south from Cape Boileau, then west to the limit of state jurisdiction at the State Waters boundary, and a line west from a point three kilometres south of Coulomb Point to the boundary of State Waters (Figure 23). The EPA considers it important that creek systems along the Dampier Peninsula are not adversely affected by the construction or operation of the proposal. The boundary outlined above would ensure that Barred Creek was outside the Zone of Moderate Impact.

The EPA concludes that the proposal could be implemented and managed in a way that is unlikely to compromise the ecological functioning of the marine environment locally and regionally, provided that cumulative impacts are strictly limited as set out above and the recommended conditions are applied.

Marine environmental quality

The EPA aims to ensure that emissions to the marine environment do not adversely affect designated environmental values such as ecosystem health, recreation, aesthetics, fishing, aquaculture including pearling, and cultural and spiritual values. The quality of the marine environment is maintained by ensuring that water, sediment and biota are free of harmful levels of contaminants and that physical factors remain at healthy levels. Contaminants can include metals such as copper, nutrients such as nitrogen, and organic compounds such as oil. Physical factors include water temperature, pH and salinity.

The EPA has considered this issue in the context of pressures arising from construction (e.g. dredging-generated turbidity) and those that might arise during day-to-day operation of the port and Precinct (e.g. waste discharges).

During construction, turbid plumes from dredging may extend as far as Gantheaume Point to the south or Emeriou Point to the north, with the probability of occurrence increasing closer to the site of dredging. Based on the most recent modelling, the proponent predicts that turbid plumes are likely to be present in Barred Creek, and to a lesser extent in Willie Creek, for considerable periods, but these plumes will not cause any measurable effects on biota or aquaculture such as pearl production. They could, however, affect recreation and aesthetics in the creeks and on the coast, including Cable Beach and Gantheaume Point from time to time. The EPA expects proponents to use contemporary best practice measures to avoid impacts on these environmental values and to manage any resultant or perceived impacts as far as practicable in close consultation with stakeholders.

During the operation of the port and Precinct, the EPA recommends that a moderate level of ecological protection should not extend beyond 250 m from all shipping berths, ship turning basins and the area enclosed by the Integrated Marine Facility (IMF) breakwaters and the coast. The cumulative effect of all port and Precinct related activities must be managed to ensure all environmental values are protected and a high level of ecological protection is maintained outside of this area. It is expected that all environmental values will be protected in all locations, including the mixing zones of industrial wastewater outfalls in the port area.

A small area associated with the discharge of treated sewage where levels of pathogens would make the water unsuitable for activities such as swimming or harvesting shellfish could be acceptable if no safe and practical alternatives can be found. All wastewater discharges must be located within a moderate level of ecological protection area and be located, designed and operated to ensure the mixing zones of the outfalls are small and, individually and in combination, are managed to achieve the relevant environmental quality objectives and levels of ecological protection for the waters around James Price Point.

The EPA notes the commitment of the proponent to require the preparation of a comprehensive oil spill response plan and to house sufficient response equipment on-site to deal with a Tier 2 oil spill and considers this to be necessary and appropriate.

Terrestrial biota

The vegetation of the precinct largely comprises Shrublands on Pindan sandplains over most of the inland area, with narrow belts of beach sand and dune communities to the west. Bands of evergreen and deciduous Monsoon Vine Thicket (MVT) vegetation lie behind the dunes, as does a single patch of drainage basin vegetation. These vegetation types are predicted to rely on intercepted surface runoff and groundwater. Coastal heath occurs atop the exposed coastal cliffs in the north-western part of the precinct.

MVT vegetation on the Dampier Peninsula is listed as a Vulnerable Threatened Ecological Community by the Western Australian Department of Environment and Conservation (DEC). The Type B form at James Price Point comprises a significant percentage of this type that remains on the Dampier Peninsula. MVTs are important as an ecological network and dry season refuge for flora and fauna species. They are also important to Traditional Owners as a significant source of customary foods and other resources. MVTs of the Dampier Peninsula are poorly represented in conservation reserves.

The EPA recommends that loss of MVT as a result of the proposal should be limited to 132 hectares (ha) due to both direct and indirect impacts. This means that no more than this amount should be lost due to both direct clearing and indirect impacts such as saline water intrusion, groundwater drawdown or the diversion of surface water. The EPA notes that, as a result of the assessment process, the proponent has proposed to avoid development in Area H on Figure 2 which will reduce impact on MVT in that area.

Five listed fauna species possibly occur in the precinct area. Of these, the Greater Bilby has been positively identified in the precinct buffer zone but is not restricted to the precinct area nor to the Kimberley region.

The EPA has recommended conditions to ensure all practical measures are taken to avoid impacts to listed species. The EPA also recommends that additional reserves for the secure conservation of MVT and Greater Bilby habitat should be created.

Landscape processes

Construction of marine and coastal infrastructure would affect coastal processes that lead to changes in sediment transport, erosion and accretion, with the potential to change the shape of beaches and the coast. Pindan soils disturbed during construction may erode when subject to heavy wet season rains.

While the risk of coastal erosion is mitigated by the presence of rocky beach platforms and headlands in some areas, other areas are susceptible to beach loss and backshore erosion that could lead to some loss of amenity, habitat disturbance and disruption or loss of heritage material some kilometres to the north and south of the Precinct.

The EPA considers that impacts to the natural and heritage values of the coast outside the direct footprint of the built infrastructure should be minimised and expects coastal management and terrestrial erosion management programs to be developed and implemented to minimise accretion and

erosion of beaches and coastal landforms outside the project area. It is expected that the management measures will include active sand by-pass or similar mitigation measures where necessary. The EPA also recommends that pipelines should only be installed by micro-tunnelling techniques to avoid impacts to coastal landforms and intertidal areas, unless it can be demonstrated that such techniques are not technically feasible and an alternative method is warranted.

Surface and groundwater

Surface and groundwater are important to the maintenance of terrestrial biota generally, and particularly to vegetation within the MVT and drainage basin communities that occur on, and immediately behind, the coastal dunes. Local communities also depend on groundwater for potable water supplies. There is limited information on groundwater available as the proponent has not been able to gain access to the site for on-ground studies.

The EPA recommends that groundwater abstraction should only be permitted if it can be demonstrated with a high degree of confidence that no more than a total of 132 ha of direct and indirect impacts to MVT vegetation would occur by any cause, including groundwater drawdown or disruption of surface flows. The EPA expects proponents to use contemporary best practice measures to minimise impacts on MVT and drainage basin vegetation communities.

The EPA notes the concern of local communities about the potential for groundwater abstraction to affect the water supplies on which they depend. The EPA understands that Traditional Owners have reached agreement with the State on circumstances under which the Native Title Party may direct that groundwater may not be drawn from the Broome Sandstone aquifer.

The EPA recommends that adequate additional surface and groundwater studies are undertaken by future proponents to demonstrate that any groundwater abstraction or surface water diversion would not cause unacceptable impacts on MVT and drainage basin vegetation communities.

The EPA is aware that the Department of Water (DoW) exercises regulatory control over the abstraction of groundwater and considers that these controls are adequate to prevent significant environmental impacts if water is abstracted from aquifers on the Dampier Peninsula. The EPA notes that licencing under Part V of the EP Act has the capacity to adequately manage activities that may cause spills that could affect surface or groundwaters.

Some Precinct designs include an option where significant elements of an IMF may be constructed by excavating into the existing shoreline. The issue of saltwater intrusion resulting from this construction method was not evaluated explicitly in the SAR but was considered during the assessment of the s43A application of 24 February 2012 (Appendix 8). Construction of an IMF in this way could result in saltwater extending to a distance of approximately 330 m inland from its current location under all tidal conditions. Consequent saltwater intrusion may have the potential to affect groundwater dependent vegetation. The EPA is aware of physical interventions and other techniques that may be used to avoid and manage this issue.

The EPA recommends that the cumulative effect of all activities associated with the construction and operation of the precinct, including the effects of any

saltwater intrusion, does not result in the loss of more than 132 ha of MVT communities.

Heritage

Where there is information before the EPA of Aboriginal people's cultural and social connection to components of the environment which are likely to be effected by a proposal, the EPA may identify the physical and biological elements of a place as a key environmental factor.

In these circumstances, the EPA receives and considers advice from heritage experts, traditional owners, the Department of Indigenous Affairs and the Aboriginal Cultural Material Committee as appropriate.

In its assessment of environmental factors based on Aboriginal heritage considerations in relation to the Browse LNG Precinct, the EPA:

1. reviewed the reports produced for and by the Kimberley Land Council and included in the SAR as appendices E-1 to E-7 that deal with matters of particular interest to Aboriginal people;
2. received advice from the Department of Indigenous Affairs that it was satisfied that the proponent had properly considered heritage values; and
3. is aware that the proponent has acknowledged and addressed Aboriginal heritage matters in agreements reached between Traditional Owners and the State, including the Browse LNG Precinct Project Agreement, concluded in June 2011. The EPA understands that these agreements give the Traditional Owners a degree of control over the development of the Browse LNG Precinct, including with respect to environmental issues of interest to them.

The EPA notes that Indigenous interests have been heard and considered in this assessment.

The EPA expects the proponent to demonstrate that the relevant Aboriginal heritage issues have been identified to the satisfaction of the Department of Indigenous Affairs and that the proponent has properly considered how to avoid or minimise any adverse impacts caused by implementation of the proposal on components of the environment that are of cultural or social significance to Aboriginal people.

Advice from the Department of Indigenous Affairs indicates that it is satisfied that the relevant Aboriginal heritage issues have been identified and the proponent has properly considered how to minimise any adverse impact.

To the extent that the EPA considers that impacts on the physical and biological environment have been adequately assessed and can be adequately constrained, managed or offset such that there are not likely to be significant residual impacts to those physical and biological attributes themselves at a regional level, the EPA concludes that, in its judgement, a significant impact on Aboriginal heritage matters is also not likely, although localised impacts would occur.

The EPA has also considered the heritage value of fossilised dinosaur tracksites that occur in Broome Sandstone in the region and required the

proponent to undertake further surveys in response to a highly credible but confidential submission. The EPA sees this outcome as a very good example of the assessment process in general, and the provision for confidential submissions, in particular, working as they should. The additional surveys were undertaken by international experts and peer reviewed by another independent expert. The surveys also benefited significantly from the input of Traditional Owners, local people and their independent expert advisors.

The expert's report found that significant fossils are located within the northern 750 m of the approximately 2700 m wide area proposed to connect the port with the terrestrial components of the proposal. They found that a further 150 m adjacent to and south of the area above contains potentially track-bearing material, although they did not find fossils in that section. One possible site was found on the southern edge of the southern pipeline corridor.

Based on the findings of the international expert's report, the EPA recommends that fossil dinosaur footprints should not be disturbed within the northern 900 m of that part of the proposed precinct that crosses the coast in the port area and at the southern edge of the southern pipeline crossing. The EPA also recommends that additional surveys occur in any area where Broome Sandstone exists at the surface that is planned to be disturbed for this proposal. If fossils are found, disturbance should be avoided wherever possible. Where disturbance cannot reasonably be avoided, appropriate recovery work to either salvage the fossils or properly document them prior to disturbance should be undertaken under the guidance of a suitably qualified expert and with the advice and participation of Traditional Owners.

Air emissions

Air emissions must be managed to ensure they do not pose a threat to human health or other biota. The key emissions requiring management in this case are benzene, toluene, ethylbenzene and xylene (collectively referred to as BTEX) and hydrogen sulphide.

BTEX chemicals are volatile organic compounds that act as precursors to photo-chemical smog. The main source of BTEX emissions would be the loading of ships with condensate, which is a light oil product produced along with the feed gas.

The EPA's overarching recommendation for air emissions is that they should be managed to best practice levels. The EPA recommends that volatile organic compounds should be controlled such that ambient *National Environment Protection Measure* standards are not exceeded beyond the seaward boundary of the port area and the outer boundary of the inner Precinct buffer zone as shown by the broken yellow line on Figure 2.

Hydrogen sulphide is released during LNG production and has a distinctive 'rotten egg' smell that affects amenity at low concentrations. The release rate depends on the amount in the feed gas and the effectiveness of control equipment. The proponent has modelled the release rates using conservative assumptions, with a high level of hydrogen sulphide in the feed gas and a low level of availability of the control equipment.

Under these conditions, hydrogen sulphide emissions are not predicted to represent a health risk but detectable odours could occur to the east and west of the Precinct. The EPA recommends that health standards are met at the outer boundary of the inner buffer zone (the broken yellow line on Figure 2). An amenity standard of 0.5 odour units (ou) should be met at the outer boundary of the outer buffer zone (the broken green line on Figure 2), at the seaward port boundaries and wherever public access is permitted otherwise.

Greenhouse gases

Greenhouse gas emissions from the proposal will depend on the annual rate of LNG production and the carbon dioxide content of the feed gas. Assuming the average carbon dioxide content of feed gas is 10%, the annual emission rate of carbon dioxide is 41 Mtpa at an LNG production rate of 50 Mtpa.

The EPA considers that future proponents should implement best practice in design and operation to minimise emissions of greenhouse gases, consistent with what is achievable under local climatic conditions. The EPA has recommended that an initial target is set of 0.26 tonnes of carbon dioxide equivalent emissions from energy generation per tonne of LNG produced and that this rate be improved over time. The EPA recommends that any future proponent offset remaining greenhouse gas emissions (particularly reservoir gas emissions) for the life of the project. If it is determined by the Minister for Environment that offsetting emissions is not complementary to Commonwealth legislation for greenhouse gas reduction, then this requirement should be removed.

Establishing a cooperative fire management strategy with Traditional Owners and other land managers across the Kimberley to limit late season fires would reduce greenhouse gas emissions from burning, help offset emissions from the proposal and provide conservation benefits and indigenous employment on-country. The EPA encourages the State and future proponents to support such an initiative.

Section 43A application

While a proposal is being assessed, s43A of the EP Act allows the EPA to consent to the proponent changing the proposal without a revised proposal being referred to the Authority if the Authority considers that the change is unlikely to significantly increase any impact that the proposal may have on the environment.

On 24 February 2012 the proponent provided a letter with attachments to the EPA headed 'Browse LNG Precinct – Project Description' (DSD, 2012a - Appendix 8 to this report) which outlined changes to the provisions for an IMF within Area A of the Precinct. This change outlined additional wharves, materials offloading facilities and tug pens designed to ensure that there would be sufficient capacity to service 50 Mtpa of LNG production.

On 17 May 2012 the proponent provided a final document entitled 'BLNG Precinct Section 43A Application – Change in Dredging Volumes' (DSD, 2012b – Appendix 10 to this report) that applied for a change in dredging volumes from a total of 21 million cubic metres of capital dredging in 12 months spread over 18 months to 34 million cubic metres over a continuous 21 month period.

Both these applications were considered during the assessment of the strategic proposal. The EPA considered that these changes were unlikely to significantly increase the impact that the proposal may have on the environment, provided the appropriate recommended conditions were applied, primarily because the predicted environmental impacts would be contained within the areas and extents previously predicted in the SAR.

Implementation

It is the EPA's view that the proposed LNG precinct could be implemented at James Price Point such that the EPA's objectives could be met, provided that strict environmental management conditions and appropriate offsets, as recommended in this report, are applied.

The EPA has concluded through this assessment that the future proposals, identified in the Browse LNG Precinct proposal and designed to include one or more of the developments/activities listed in Column 1 of Table 1 of this report may be implemented, if they are subsequently declared to be derived proposals, in such a way as to meet the EPA's environmental objectives provided they are carried out consistent with the recommendations below.

As this is an assessment of a strategic proposal, the EPA has identified key issues throughout the report, and in other advice given in Section 5 in particular, that future proposals would need to address in order to meet environmental objectives for the environmental factors the EPA has assessed. Attention to these issues would ensure that progressive implementation would be consistent with the description of the location, proposed environmental management and predicted environmental impacts set out in this proponent's strategic proposal (DSD, 2010a; DSD, 2011a), as modified by this assessment.

The EPA also draws particular attention to its recommendations in other advice given in Section 5 of this report. Careful consideration of these recommendations by the responsible government agencies and future proponents will provide opportunities to further minimise the overall environmental impacts of future proposals that fall within the ambit of this assessment of a strategic proposal.

Recommendations

The EPA submits the following recommendations to the Minister for Environment:

1. That the Minister notes that the strategic proposal being assessed identifies future proposals which will be designed to include one or more of the developments/activities listed in Table 1 of this report for the Browse LNG Precinct, including LNG processing plants, a port and supporting infrastructure;
2. That the Minister considers the report on the key environmental factors and principles as set out in Section 3;
3. That the Minister notes that the EPA has concluded that future proposals, identified in the Browse LNG Precinct proposal and designed to include one or more of the developments/activities listed in column 1 of Table 1 of

this report, may be implemented, if declared to be derived proposals, in such a way as to meet the EPA's environmental objectives provided;

- a. no future proposal designed to include one or more of the developments/activities listed in column 1 of Table 1 of this report, developed either singly or in combination with other proposals, exceeds the extent/limits of the developments/activities listed in column 2 of Table 1 of this report,
 - b. the proponent of any future proposal ensures that their proposal is implemented in accordance with the recommended conditions relevant to their future proposal as set out in Appendix 4 and summarised in Section 4,
 - c. future derived proposals have key attributes identified by the EPA in this report,
 - d. environmental issues raised by future proposals were adequately assessed when the strategic proposal was assessed,
 - e. there is no significant new or additional information that justifies the reassessment of the issues raised by the future proposal, and
 - f. there has not been a significant change in the relevant environmental factors raised by the future proposal since the strategic proposal was assessed.
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report; and
 5. That the Minister notes the EPA's 'other advice' presented in Section 5 in relation to the configuration of the Precinct and efficient use of its capacity, offsets for residual impacts, the relationship between this strategic proposal assessment and future derived proposals, operations of the port and recommendations for consideration during the DEC works approval and licencing process.

Conditions

Having considered the information provided in this report, the EPA has prepared a Statement regarding the implementation of future proposal(s) identified in the strategic proposal which specifies the conditions and procedures the EPA recommends should be applied, subject to any notice given under section 45A(3) of the EP Act and or any inquiry under section 46 or assessment under section 46B of the EP Act, to any future proposal, declared to be a derived proposal. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

- a. Condition 5 'Terrestrial Facilities and Disturbance Footprint Plan' to show the location and limits of disturbance from the proposal;
- b. Condition 6 'Terrestrial Baseline State Report, to define the location of important terrestrial elements of the environment including Monsoon Vine Thickets and threatened fauna like the Greater Bilby ;

- c. Condition 7 'Terrestrial Environment Protection Program' to ensure terrestrial facilities are sited, constructed and operated to avoid and minimise adverse impacts;
- d. Condition 8 'Terrestrial Environment Monitoring Program' to establish a program of ongoing monitoring to detect any material or serious environmental harm outside the disturbance footprint;
- e. Condition 9 'Marine Facilities and Impact Zones Plan' to define the location and configuration of all marine facilities and zones of High and Moderate Impact and Zones of Influence from the proposal in the marine environment;
- f. Condition 10 'Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program' to ensure that turbidity generating activities achieve environmental protection outcomes, are managed to defined targets and exercise all reasonable and practical means to reduce adverse effects on benthic habitats;
- g. Condition 11 'State of the Marine Environment Surveys' to survey the condition of the marine environment before, during and after marine works to determine baseline conditions, impacts and recovery;
- h. Condition 12 'Coastal Processes Monitoring and Management Program' to minimise and manage erosion, sediment transport and impacts on recreational beaches induced by the proposal;
- i. Condition 13 'Marine Environmental Quality and Marine Outfalls' to define the location of outfalls from onshore facilities, the quality of wastewater discharges and the environmental quality objectives to be met;
- j. Condition 14 'Pipeline Shore Crossing Management and Monitoring Program' to limit adverse impacts to the shoreline by restricting pipe placement to tunnelling methods rather than open trenching unless the proponent can demonstrate that tunnelling is technically infeasible and an alternative method is warranted;
- k. Condition 15 'Marine Fauna Interaction – Marine Pile-driving, Dredging and Marine Construction Vessels and Light Sources' to require dedicated marine fauna observers and trained crew members for dredging and piling operations, lodgement of cetacean records, limits on work vessel speeds, conditions for the commencement and suspension of piling operations and a Conservation Significant Marine Fauna Interaction Management Program and an Underwater Noise Monitoring and Review Program;
- l. Condition 16 'Marine Drilling and Blasting Activities' to require that these operations are managed to minimise adverse impacts to marine fauna;
- m. Condition 17 'Introduced Marine Pests' to prevent introductions and detect and control marine pests;
- n. Condition 18 'Surface and Groundwater Management and Monitoring' to ensure that groundwater abstraction and construction and operation

- of the proposal do not adversely affect groundwater dependent vegetation, including the Monsoon Vine Thicket and drainage basin vegetation communities;
- o. Condition 19 'Weeds' to prevent the introduction of new weeds and the spread of existing weeds in the vicinity of the proposal and to undertake weed control and rehabilitation, where necessary;
 - p. Condition 20 'Rehabilitation' to require progressive rehabilitation and the development of completion criteria for rehabilitation;
 - q. Condition 21 'Emissions to Air' to require best practice for minimising emissions of volatile organic compounds, hydrogen sulphide, oxides of nitrogen, criteria pollutants and to optimise the smokeless capacity of flares and minimise non-emergency flaring of gas;
 - r. Condition 22 'Greenhouse Gas Abatement' to require the development and implementation of an approved Greenhouse Gas Abatement Program and the offsetting of the emission of reservoir carbon dioxide to the atmosphere;
 - s. Condition 23 'Fossil Heritage Management' to ensure that fossilised dinosaur footprints in the vicinity of the precinct are not damaged by excluding proposal activities from certain areas and requiring proper survey and salvage where damage cannot reasonably be avoided ;
 - t. Condition 24 'Decommissioning' to set decommissioning criteria prior to closure;
 - u. Condition 25 'Residual Impacts and Risk Management Measures' to be implemented to address the residual environmental impacts and risks of the proposal to important environmental assets such as fossilised dinosaur footprints and Monsoon Vine Thickets;
 - v. Condition 26 'Preparation and Review of Plans and Programs' to ensure that environmental management plans referred to in the proponent's Strategic Assessment Report are prepared, that consultation on those plans occurs with relevant stakeholders and amended plans are implemented as amended;
 - w. Condition 27 'Staging and Timing for the Submission of Programs' to allow programs to be prepared in advance of components or stages of the facility;
 - x. Condition 28 'Minor or Preliminary Activities' to enable the CEO to allow minor or preliminary activity to occur prior to certain conditions being met; and
 - y. Condition 29 'Public Availability of Data, Plans, Programs and Surveys' to require all validated environmental data to be made publicly available, except where it can be demonstrated it is confidential commercially sensitive information or where publication would put important environmental assets such as dinosaur footprints or threatened species at risk.

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1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for Environment on the key environmental factors and principles identified as relevant during the EPA's assessment of the strategic proposal referred by the Minister for State Development. The strategic proposal is for the establishment of a liquefied natural gas processing precinct at James Price Point, 60 km north of Broome, referred to in this report as the Browse LNG Precinct, or Precinct.

In February 2008 the Minister for the Environment; Climate Change (now Minister for Environment) and the Minister for State Development signed a joint Agreement with the Commonwealth Minister for the Environment, Heritage and the Arts (now Minister for Sustainability, Environment, Water, Population and Communities) for the assessment of the Browse LNG Precinct. This Agreement committed both Governments to undertaking a concurrent, coordinated and collaborative environmental assessment of the Precinct. The parties to the Agreement collaborated in the development of site selection criteria and agreed that the selection of the Precinct would consider feasible alternatives to locations outside the Kimberley region.

This assessment report by the EPA contributes to the process of assessment required under the Agreement described above.

The Agreement also committed the parties to assess the National Heritage values of the west Kimberley region. That process culminated in the Federal Minister announcing that the west Kimberley had been added to the National Heritage List on 31 August 2011. National Heritage values become matters of national environmental significance under the Commonwealth Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and require assessment under that Act. At the same time, the Federal Minister noted that national heritage listing is about protecting outstanding heritage values by considering them in any development proposal under national environmental law and the listing itself does not prevent development (Burke, 2011).

The plan for the Browse LNG Precinct was developed following earlier site selection studies carried out for the State by the Northern Development Taskforce (NDT). The NDT examined over 40 sites along the Kimberley coast, culminating in a shortlist of four sites (NDT, 2008a, 2008b, 2008c). That site selection process also included examination of the feasibility of alternatives to the location of the Precinct outside the Kimberley region, including sites in the Pilbara and in the Northern Territory (Gaffney Cline, 2008; GHD, 2009; Worley Parsons, 2008). Studies of those alternatives determined that only companies that could secure low priced infrastructure facilities such as pipelines and existing processing facilities could consider locating outside the Kimberley region (Gaffney Cline, 2008).

The EPA does not have the expertise or mandate to comment on the technical or economic feasibility of LNG processing developments. For that reason, the EPA accepts at face value the analysis of feasibility of alternatives as outlined above and accepts the view that expending additional resources

on a detailed environmental analysis of a site is not justified if LNG development is not technically or economically feasible there. The EPA accepts that the screening of alternatives via the NDT process and the above reports was an appropriate and adequate level of analysis to determine a short list of four sites.

In December 2008, the EPA provided advice on the four shortlisted sites under s16(e) of the EP Act (EPA, 2008). The EPA concluded that two sites (North Head and Anjo Peninsula) were not suitable for large scale industrial development from an environmental point of view. The EPA further concluded that Gourdon Bay was the least environmentally constrained of the four sites and that James Price Point was the least environmentally constrained of the two shortlisted sites on the Dampier Peninsula. Based on the available data at the time, the EPA was of the view that the environmental impacts and risks of locating a precinct in the James Price Point were likely to be manageable.

In its 2008 report, the EPA strongly supported a strategic level review of potential LNG processing in the Kimberley. The EPA went on to say that it strongly supported focusing development at a single site so that environmental impacts could be contained and operational efficiencies maximised in ways that minimise environmental impacts.

Late in 2008, the Premier announced that James Price Point was the State's preferred location for a Browse LNG Precinct. In its 2008 report, the EPA identified that formal environmental assessment of the preferred location was expected to be undertaken under the provisions of the EP Act.

At the request of the proponent, the EPA agreed to assess the Browse LNG Precinct at James Price Point as a strategic proposal and this was advertised on 14 April 2008. The Browse LNG Precinct is subject to a joint assessment of a strategic proposal under both the EP Act and the EPBC Act. Terms of reference for the joint assessment are set out in a Strategic Assessment Agreement between the Commonwealth and Western Australia (see Appendix A-3 of the SAR).

This document provides the EPA's report and recommendations on its assessment of the Browse LNG Precinct.

Further details of the strategic proposal are presented in Section 2 of this report. Section 3 discusses the key environmental factors and principles for the strategic proposal. The conditions that the EPA recommends any future proposal declared to be a derived proposal should be subject to, if the Minister determines that the future proposals may be implemented, are set out in Section 4. Section 5 provides other advice by the EPA and Section 6 presents the EPA's recommendations.

Appendix 5 contains a summary of submissions and the proponent's response to submissions. It is included as a matter of information only and does not form part of the EPA's report and recommendations. Issues arising from this process, and which have been taken into account by the EPA, appear in the report itself.

2. The strategic proposal

On 22 December 2008, the Premier announced the selection of James Price Point as the site for an LNG precinct in the Kimberley. The Minister for State Development referred the proposal to the EPA. The EPA determined the proposal would be assessed as a strategic proposal and set a formal level of assessment. The EPA's assessment of the precinct at James Price Point, referred to as the Browse LNG Precinct, is the subject of this report.

The Browse LNG Precinct proposal comprises a plan to designate land for the future development of facilities, associated infrastructure and a port for the receipt and processing of feed gas and export of LNG and condensate (Figure 2). Future proposals to construct the facilities within the Browse LNG Precinct would be bought forward by 'project proponents'.

Assessment of a strategic proposal in this instance requires the EPA to carefully consider the environmental risks and impacts arising from the implementation of the developments and activities incorporated in the future proposals identified in the strategic proposal and provide advice to the Minister for Environment on whether or not the future proposals could be implemented and any environmental conditions that it considers should apply to the implementation of those future proposals. The Minister for Environment makes the decision about whether future proposals identified in the strategic proposal may proceed and, if so, under what conditions.

If the Minister for Environment decides that the future proposal(s), if declared to be a derived proposal, identified in the strategic proposal may proceed, the future proposal(s) to construct facilities within the Precinct would need to be referred to the EPA and the project proponent(s) may request that the future proposal(s) be declared a 'derived' proposal.

If the EPA declares that a referred future proposal is a derived proposal, no further formal environmental assessment of the derived proposal is required, although the EPA may inquire into whether the conditions need to be changed under s46 of the EP Act. In making such a decision, the EPA would consider a series of matters that are further set out in Section 5 'Other advice' of this report. Other development approval processes including planning approvals, works approvals, licences etc., would need to proceed in the normal way.

The proponent for the Browse LNG Precinct is the Minister for State Development. The Department of State Development (DSD) is managing the proposal on behalf of the State. Woodside Energy Limited (Woodside) is a potential foundation proponent for future proposals in the Precinct. Woodside is not a proponent for the current strategic proposal.

A Strategic Assessment Report (SAR) was prepared by DSD and released for public comment for 15 weeks. The public comment period closed on 28 March 2011.

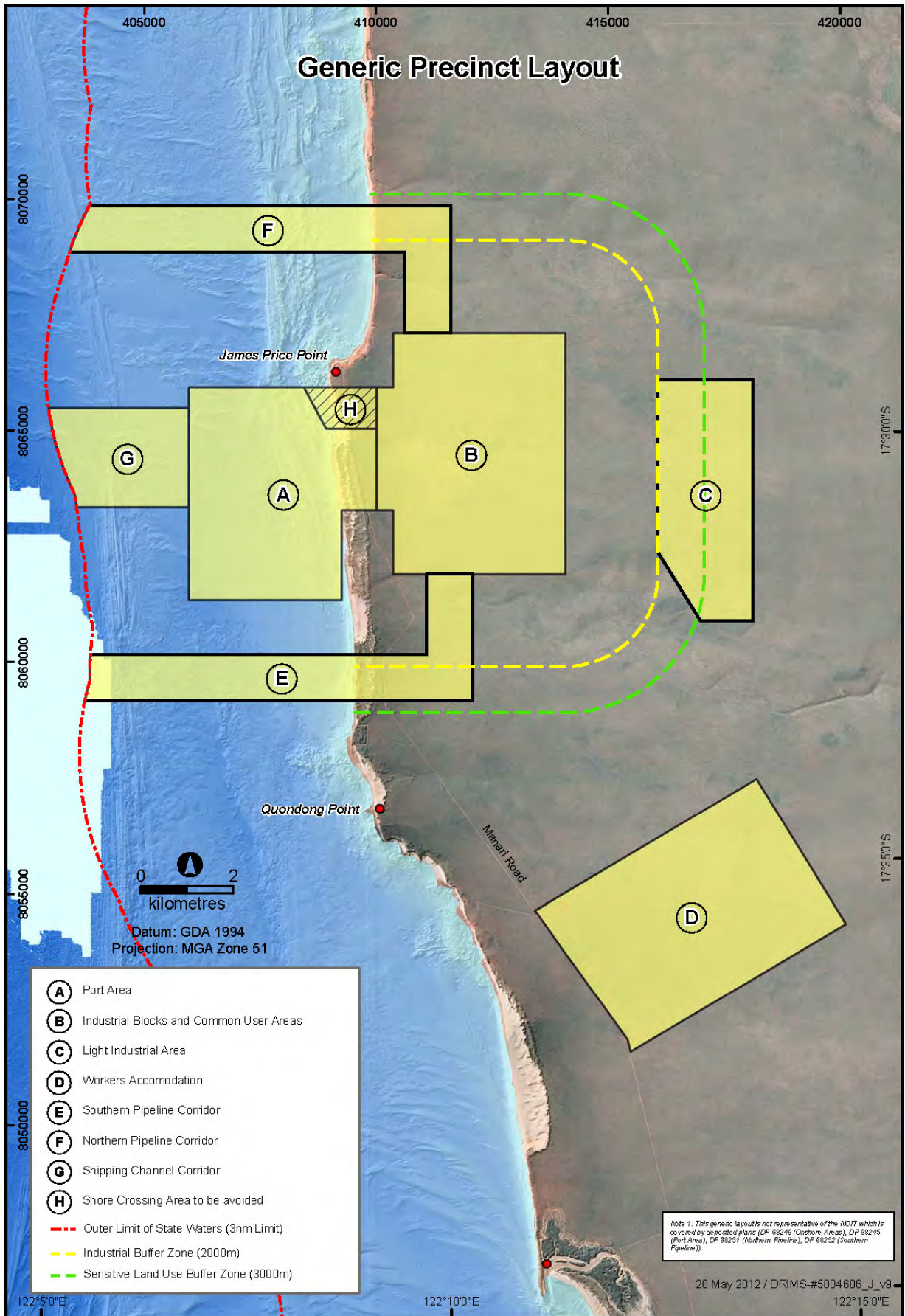


Figure 2. Browse LNG Precinct Proposal.

The developments/activities and a description of the limits/extent of those developments/activities of future proposals identified in the strategic proposal are summarised in Table 1. A description of the strategic proposal was provided in Section 5, Part 2 of the SAR prepared by the proponent (DSD, 2010a) and subsequently clarified with more detail as part of the proponent's response to submissions and refinement of the project location and design.

On 24 February 2012, the proponent provided a letter with attachments to the EPA headed 'Browse LNG Precinct – Project Description' (Appendix 8 to this report) which outlined changes to the provisions for an Integrated Marine Facility within Area A of the precinct. This change outlined additional wharves, materials offloading facilities and tug pens designed to ensure that there would be sufficient capacity to service 50 Mtpa of LNG production.

On 17 May 2012, the proponent provided a final document entitled 'BLNG Precinct Section 43A Application – Change in Dredging Volumes' (Appendix 10 to this report) that applied for a change in dredging volumes from a total of 21 million cubic metres of capital dredging in 12 months spread over 18 months to 34 million cubic metres over a continuous 21 month period.

While a proposal is being assessed, s43A of the EP Act allows the EPA to consent to the proponent changing the proposal without a revised proposal being referred to the Authority if the Authority considers that the change is unlikely to significantly increase any impact that the proposal may have on the environment. Both these applications were considered during the assessment of the strategic proposal. The assessed proposal is as set out in Table 1.

It should be noted that the SAR pays considerable attention to social issues that are not within the jurisdiction of the EPA. The EPA acknowledges that social factors are very important in this case and need to be included to satisfy the requirements of the Commonwealth Government's assessment process under the EPBC Act. The EPA accepts that it made sense to include that social material in the SAR along with the environmental material that the EPA requires.

The EPA will not, however, address social issues that are not within its jurisdiction. It is to be hoped that it is useful to stakeholders for all this material to be included in a single set of documents and that other Western Australian government agencies will act on those social issues that are within their respective jurisdictions.

Table 1. Description of developments/activities of future proposals and their maximum limits/extents.

	Developments/activities/change in land use	Description of limits/extent
1	Hydrocarbon processing area	<p>Maximum of two heavy industrial areas of up to approximately 500 ha each (in total up to 1000 ha) to be located within Area B identified in Figure 2 – Precinct Layout.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • Facilities for the conversion of natural gas to produce up to 50 Mtpa of LNG (plus associated LPG, condensate, other hydrocarbon products (excluding petrochemicals)), storage and export at variable rates, flare structures, other ancillary facilities and facilities for carbon dioxide export offsite. • Any relevant supporting infrastructure – including wastewater treatment facilities, water supplies, desalination water production facility (if required), electricity generation plants, concrete batching plants, rock screening and crushing facilities, relevant administration buildings and offices, internal access and haul roads. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
2	Common user area	<p>Up to approximately 980 ha for the common user area within Area B as identified in Figure 2 – Precinct Layout.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • Lay down areas and internal buffer areas between the industrial facilities. • Administration and plant buildings. • Internal access roads. • Wastewater pipes. • Temporary stockpiles. • Contractor offices. • Concrete batch plant. • Trucking, parking and assembly areas. • Flood management works. • Clearing for bush fire management.

	Developments/activities/change in land use	Description of limits/extent
		<ul style="list-style-type: none"> • Service utilities. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
3	Light industrial area (LIA)	<p>Up to approximately 200 ha within Area C as identified in Figure 2 – Precinct Layout.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • Developments and uses permitted in light industrial area include all those developments and uses permissible in the Industrial Zone referred to in the Shire of Broome Town Planning Scheme No. 4 (e.g. fuel and transport depot and warehouses), subject to any buffer zone restrictions, as identified in Figure 2 - Precinct Layout. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
4	Port area	<p>Up to approximately 1000 ha within Area A identified in Figure 2– Precinct Layout.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • Loading berths and load out infrastructure. • Multi-user shipping channel. • Desalination seawater intake and brine outlet. • Flood management works. • Tug pens. • Support vessel area. • Storage tanks (diesel, LNG, LPG, condensate). • Marine flares. • Pipelines. • Roads. • Lay down areas. • Piled jetties. • Turning basin(s). • Breakwater(s) (as required in final design). • Wastewater disposal pipelines and diffusers. • Capital and maintenance dredging.

	Developments/activities/change in land use	Description of limits/extent
		<ul style="list-style-type: none"> • Integrated Marine Facilities (IMF), including connecting causeway(s), support vessel harbours, marine support facilities, marine offloading facilities (MOF) and roll-on, roll-off facilities (RORO). • Breakwater(s)/seawall(s) (as required). • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11. • Total permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat directly related to permitted uses and developments, but not exceeding the areas of loss listed in item 12.
5	Shipping channel area	<p>Shipping channel within Area G (identified in Figure 2 – Precinct Layout) up to 550 m wide and extending from the limit of Port Area A to the limit of State Waters.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • Multi-user shipping channel.
6	Pipeline corridor areas	<p>Areas E and F identified in Figure 2 – Precinct Layout. Up to 250 ha of terrestrial habitat in aggregate may be utilised for pipelines and their operating/ service corridors.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • Construction of up to a maximum of 16 pipelines in total in Areas E and F for natural gas, mono-ethylene glycol, liquids, services and potentially carbon dioxide export. • Support facilities. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11. • Total permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat directly related to permitted uses and developments, but not exceeding the area of loss listed in item 12.
7	Accommodation area	<p>Up to approximately 200 ha within Area D identified on Figure 2 – Precinct Layout</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • Accommodation and associated support facilities.

	Developments/activities/change in land use	Description of limits/extent
		<ul style="list-style-type: none"> • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
8	Infrastructure and services corridors	<p>Up to a total of 297 ha located within 13 km from the boundary of Area B identified in Figure 2 - Precinct Layout.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • Borefield. • Electricity transmission services corridors. • Pipelines from borefield to Precinct . • Borefield access and service roads. • Manari Road diversion. • Service facilities. • Other access and management tracks. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
9	Industrial land use buffer zone	<p>Area extending 2000 m from the boundary of Area B identified in Figure 2 - Precinct Layout. The outer boundary of the industrial land use buffer zone is indicated by broken yellow line in Figure 2 - Precinct Layout.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • No permanent land uses or activities are permitted save for the infrastructure and service corridor developments and activities (see item 8).
10	Sensitive land use buffer zone	<p>Area between 2000 m and 3000 m from the boundary of Area B identified in Figure 2 - Precinct Layout. The outer boundary of the sensitive land use buffer zone is indicated by broken green line on Figure 2 - Precinct Layout.</p> <p><u>Permitted use and development:</u></p> <ul style="list-style-type: none"> • No sensitive land uses are permitted (e.g. accommodation). • Compatible light industry uses and development permissible.
11	Clearing of terrestrial native vegetation across all Areas shown in Figure 2 - Precinct Layout	<p>Total clearing of terrestrial native vegetation permissible for all future development, activities and changes of land uses is up to a maximum of 3037 ha in the areas and approximate amounts as</p>

	Developments/activities/change in land use	Description of limits/extent
		<p>specified below:</p> <ul style="list-style-type: none"> • Area A up to 110 ha, • Area B up to 1980 ha, • Area C up to 200 ha, • Area D up to 200 ha, • Areas E and F up to 250 ha in aggregate, • Within 13 km of the boundary of Area B up to 297 ha. <p>Within the total area of permissible clearing no more than a maximum of 132.4 ha of Monsoon Vine Thicket Threatened Ecological Community to be cleared either directly or indirectly (e.g. as a consequence of groundwater drawdown).</p>
12	Permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat	<p>Permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat directly related to permitted uses and developments in:</p> <ul style="list-style-type: none"> • Port Area A, • Marine portions of the Pipeline Corridor areas E and F, • Shipping Channel Area G, <p>in aggregate do not exceed 1138 ha.</p>
13	Construction and operation of hydrocarbon processing facilities for converting natural gas to LNG plus associated LPG and condensate (excluding petrochemicals).	<ul style="list-style-type: none"> • Located within Port Area A and/or heavy industrial areas located in Area B. • Up to a maximum combined operating capacity of 50 Mtpa of LNG. • LNG, condensate and LPG storage tanks commensurate with a 50 Mtpa LNG development. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
14	Construction and operation of supporting developments and activities.	<ul style="list-style-type: none"> • Located within Port Area A and/or heavy industrial area in Area B. • Discharge from wastewater treatment facilities and wastewater outfalls of up to a total of 30 GL per annum of produced water, condensed water, desalination brine, treated sewage and greywater. • First flush stormwater to be captured and treated and all captured water to be used on

	Developments/activities/change in land use	Description of limits/extent
		<p>site or discharged via marine outfall.</p> <ul style="list-style-type: none"> • Water supply by groundwater abstraction and/or desalination of up to a combined total of 8 GL per annum. <p>All supporting infrastructure necessary for LNG production developments/activities contained within Precinct boundaries A to F and the borefield within 13 km of the boundary of Area B, identified in Figure 2 - Precinct Layout.</p>
15	Construction and operation of a marine and terrestrial port and port infrastructure including.	<p>Up to 1000 ha within Port Area A (identified in Figure 2 - Precinct Layout) comprising;</p> <ul style="list-style-type: none"> • Up to 6 loading berths. • Up to 3 piled jetties extending up to 3 km west from the current location of the Lowest Astronomical Tide. • One multi-user shipping channel to limit of Area A as identified in Figure 2 – Precinct Layout. • Turning basins. • Breakwaters extending up to 3 km west from the current location of the Lowest Astronomical Tide. • Wastewater pipelines and diffusers with up to 30 GL per annum capacity. • Up to 34 million m³ of capital dredging plus periodic maintenance dredging – (more details see item 19 below).
16	Construction and operation of the multi-user shipping channel.	<p>Multi-user shipping channel in Area G identified in Figure 2- Precinct Layout.</p> <ul style="list-style-type: none"> • Up to 550 m wide and extending from the western limit of Port Area A to the limit of State Waters.
17	Construction and operation of the Integrated Marine Facilities (IMF).	<p>Contained within Area A identified in Figure 2 - Precinct Layout.</p> <ul style="list-style-type: none"> • Onshore excavation (if required) shall not extend more than 330 m east from current location of Highest Astronomical Tide. • Clearing of terrestrial native vegetation related to IMF is included in the 110 ha of permissible clearing in Area A at item 11 above. • Permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat directly

	Developments/activities/change in land use	Description of limits/extent
		related to IMF is included in the 1138 ha at item 12 above.
18	Construction and use of accommodation village.	<ul style="list-style-type: none"> • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11. • All access to and from accommodation village to be via Browse LNG Precinct Road (not part of this proposal).
19	Dredging and spoil disposal activities.	<ul style="list-style-type: none"> • Up to 34 million cubic metres of capital dredge material plus periodic maintenance dredging as required. • No dredge spoil disposal in State Waters.
20	Infrastructure and services corridor development activities.	<ul style="list-style-type: none"> • Groundwater production limited to up to 8 GL per annum. • Clearing up to 297 ha directly related to activities in this item within 13 km of the boundary of Area B indicated in Figure 2 – Precinct Layout.
21	Pipeline corridors for gas, mono-ethylene glycol, liquids, and potentially carbon dioxide export and communications.	<ul style="list-style-type: none"> • Within Areas E and F identified in Figure 2 – Precinct Layout. • Clearing of terrestrial native vegetation directly related to permitted uses and developments, but not exceeding the areas listed in item 11.

Since release of the proponent's Strategic Assessment Report (SAR) a number of elements of the strategic proposal have been more clearly specified by the proponent. These specifications are included in Table 1 above.

The potential impacts of the strategic proposal initially predicted by the proponent in the SAR (DSD, 2010a) and their proposed management are summarised in Tables 7-3 to 7-10 and Tables 8-4 to 8-11 in Part 1: Executive Summary of the SAR.

The EPA has noted that the proponent has made some refinements to the layout for the Browse LNG Precinct during the course of the assessment, at least partly in response to environmental issues raised during the assessment process, which have reduced the potential for environmental impacts in some cases. For example, the proponent has made a commitment to avoid shore crossing activity in the northern 900 m of the original port area to avoid fossilised dinosaur footprints in that zone. Since this change reduces the potential for environmental impacts, it can be accommodated by this assessment.

Other refinements involve reducing the envelope within which the Accommodation and Light Industrial Area (areas C and D on Figure 2) would be located. The EPA has been given the clear understanding by the proponent that these refinements involve reducing the area of the Precinct to new boundaries that are within the boundaries set out in the proposal in the SAR and as shown in Figure 2. As such, these refinements do not constitute a change to the proposal that can result in different or additional impacts and the EPA is satisfied that its assessment of the area set out in the original SAR will properly cover any refinement of the proposal that falls inside the boundaries for the Precinct shown in the SAR.

The EPA is also aware that refinements to the IMF have been made to ensure that sufficient capacity exists to accommodate 50 Mtpa of LNG production (Figure 3). This includes duplicating some key elements, like tug pens and Marine Offloading Facilities (MOF). In considering this change, the EPA was also alerted to alternative construction approaches for the IMF. Broadly, the options vary in the degree to which they are built out into the ocean or cut into the shoreline. Indicative drawings of a range of options are included in the SAR (see Figures 5-4 to 5-7 in Part 2 of the SAR, noting that the shoreline is not indicated on these drawings, and Figure 5-8 in Part 7 of the SAR).

While the SAR contemplated impacts on groundwater via saltwater intrusion and drawdown from construction and also from the physical presence of the precinct to some degree (see Part 4, pages 2-33 and 2-35), the proponent has acknowledged that saltwater intrusion resulting from the construction and operation of the IMF was not explicitly discussed in the SAR.

Refinements in the design of the port and IMF by the proponent to accommodate the full 50 Mtpa of proposed LNG production resulted in an increase in dredged volume from 21 to 34 million cubic metres of material. It was also determined that the duration of dredging associated with the foundation development would increase from 12 months in an 18 month period to dredging over 21 continuous months. The original model setup was significantly revised to re-assess the environmental consequences of these changes.

Newly available, improved bathymetric, geotechnical and metocean data were used to set up and calibrate the physical models which generate turbidity fields and revised environmental sensitivity criteria were used to predict the biological implications. The simulation also included a more realistic representation of the sequence of dredging operations. Although uncertainty remains, inclusion of these factors in combination has improved confidence about the likely extent, severity and duration of impacts. The result of this remodelling showed that the significant environmental impacts expected for the zones of High and Moderate Impact as a result of dredging fell within the envelope of predictions made for these zones earlier in the SAR.

The EPA has considered these changes in the context of s43A of the EP Act, which provides that the EPA may consent to the proponent changing the proposal without a revised proposal being referred if the EPA considers that the change is unlikely to significantly increase the impact that the proposal may have on the environment. In considering the significance of any different or potential increase in impact, the EPA has taken into account the likelihood

that impacts can be adequately managed. The EPA has consented to these changes on the basis that it considers that there is not likely to be a significant increase in environmental impact. This is discussed in relation to dredging in Section 3.2 of this report, and in relation to the IMF, in Section 3.4 of this report.

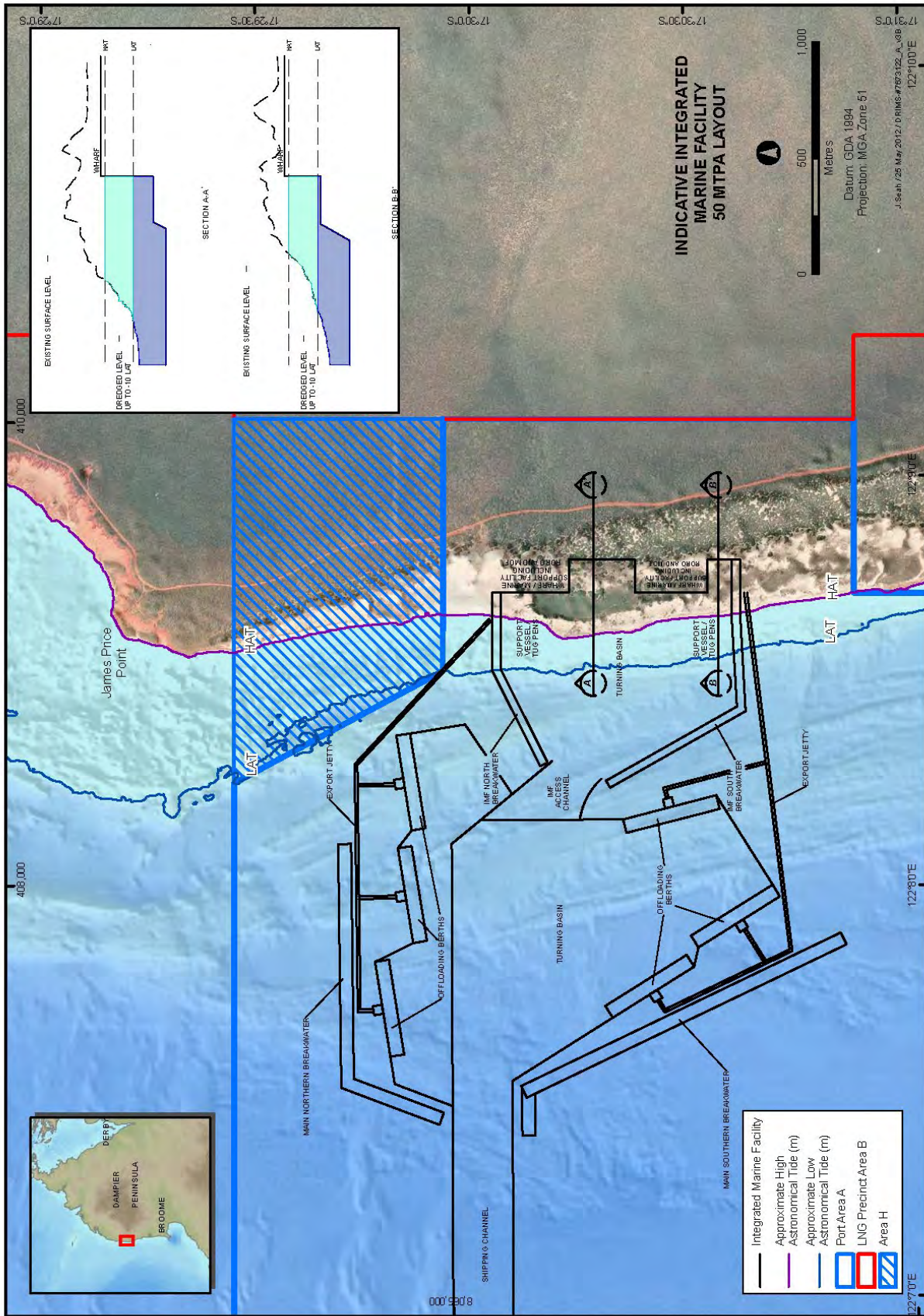


Figure 3. Indicative Integrated Marine Facility capable of handling 50 Mtpa of LNG.

3. Key environmental factors and principles

Section 44 of the EP Act read in conjunction with s40B requires the EPA to report to the Minister for Environment on the key environmental factors relevant to the strategic proposal and the conditions and procedures, if any, to which the proposal should be subject. In addition, the EPA may make recommendations as it sees fit.

The identification process for the key factors selected for detailed evaluation in this report is summarised in Appendix 3. The reader is referred to Appendix 3 for the evaluation of factors not discussed below. A number of these factors, such as visual amenity, pests and weeds are relevant to the strategic proposal, but the EPA is of the view that the information set out in Appendix 3 provides sufficient evaluation.

It is the EPA's opinion that the following key environmental factors for the strategic proposal required detailed evaluation in this report:

- a) Marine fauna;
- b) Benthic habitats;
- c) Marine environmental quality;
- d) Terrestrial biota;
- e) Landscape processes;
- f) Surface and groundwater;
- g) Heritage;
- h) Air emissions; and
- i) Greenhouse gases.

The above key factors were identified from the EPA's consideration and review of all environmental factors generated from the SAR and the submissions received, in conjunction with the proposal characteristics.

Details on the key environmental factors and their assessment are contained in Sections 3.1 - 3.9. The description of each factor shows why it is relevant to the strategic proposal and how it will be affected by it. The assessment of each factor is where the EPA decides whether or not a proposal meets the environmental objective set for that factor.

The following principles were considered by the EPA in relation to the strategic proposal:

- a) The precautionary principle;
- b) Intergenerational equity;
- c) Conservation of biological diversity and ecological integrity;
- d) Improved valuation, pricing and incentive mechanisms; and
- e) Waste minimisation.

The SAR contains commitments for the production of numerous plans and other obligations that the proponent of this strategic proposal intends would be prepared and met by the proponents of future proposals that may be considered to be derived proposals. Those commitments have been updated by additional undertakings in the proponent's response to submissions (DSD, 2011b). The SAR also outlines conditions that the proponent considers would be required to manage various aspects of proposals flowing from this strategic proposal.

The EPA expects that all such commitments and obligations contained in the SAR will be met to the extent that they do not result in a lower level of environmental protection than any environmental condition recommended by the EPA in this report or subsequently. In this assessment, the EPA accepts that many of the commitments and obligations set out in the SAR would be valuable to manage or mitigate environmental impacts. The EPA has, however, made additional recommendations for environmental conditions, as set out in Appendix 4, where it considers that a factor is so important that it warrants special attention via a Ministerial condition.

3.1 Marine fauna

Description

Construction of port facilities and the operation of LNG loading and shipping facilities have the potential to affect a number of important marine fauna groups. The main vertebrate groups considered here are cetaceans (whales and dolphins), dugong, reptiles (marine turtles, crocodiles and sea snakes or kraits) and fish.

Cetaceans

Studies have estimated the current overall Breeding Stock D Humpback whale population (formerly referred to as the Group IV population) passing the Shark Bay to Northwest Cape region on the northward migration each year at between 26,000 (C. Jenner, Centre for Whale Research, pers. comm.) and 34,000 (J. Bannister, formerly of the WA Museum, pers. comm.). These data are consistent with estimates provided by Hedley *et al* (in press).

Humpback whale numbers appear to have increased exponentially off the west coast at more than 10% per annum since hunting for them there ceased in 1963 (Bannister, 1964; Bannister *et al.*, 1991; Jenner and Jenner, 1994; Jenner and Jenner, 1996; Bannister and Hedley, 2001; Jenner *et al.*, 2001; Hedley *et al.*, in press; Kent *et al.*, in press) (Figures 4 and 5).

This rate of population growth has continued despite the increase in shipping and maritime infrastructure associated with the iron-ore and petroleum industries in Western Australia that has occurred over the same time period.

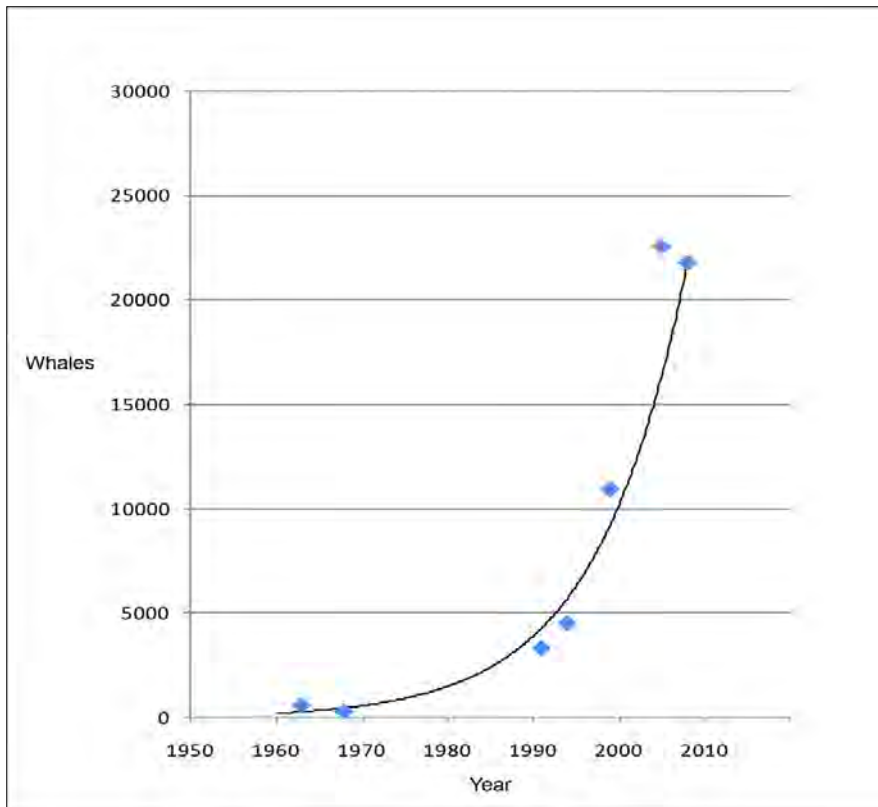


Figure 4. Annual population estimates of Humpback whales passing Shark Bay.

Confidence intervals in references. Sources: included in text.

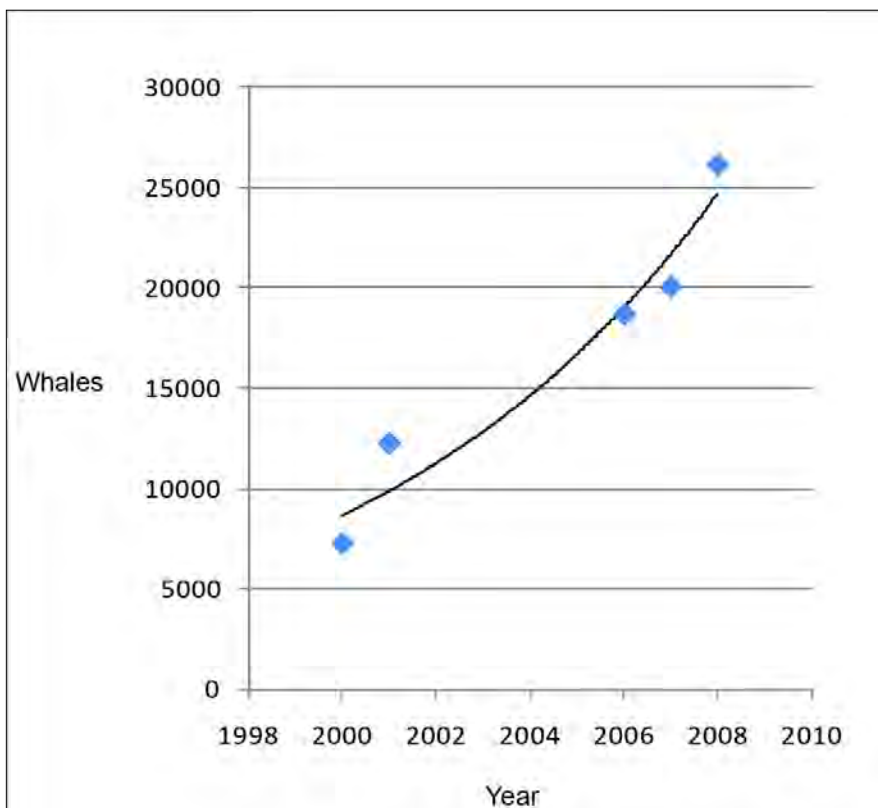


Figure 5. Annual population estimates of Humpback whales passing North-West Cape.

Confidence intervals in reference. Source: Kent *et al.*, in press.

The area between the Lacepede Islands (approximately 60 km north of James Price Point) and Camden Sound (approximately 340 km north of James Price Point) is recognised as an important calving and nursing area for Humpback whales in the Kimberley region. The recently announced Camden Sound Marine Park gives recognition to the importance of this area to whales, and other marine life.

The estimated number of Humpback whales travelling northward through a 90 km wide corridor stretching offshore from the coast around James Price Point during June to November in 2008 was 13,115, or 50% or more of the 2008 population estimate of Breeding Stock D (RPS, 2010a; Hedley *et al.*, in press). More than 95% of Humpbacks observed within the 90 km wide corridor were greater than 8 km from the coast (RPS, 2010a), with the mean distance being 27 km, and 24 km when calves were present. However, this leaves 5%, or an estimated 656 Humpback whales, that pass within 8 km of the proposed development on the northward leg of their migration. Projected forward to 2012 with a population growth rate of about 10% (e.g. Bannister and Hedley, 2001), the number of whales in this zone would approach 1000 out of a population of about 36,000.

Since some of the northward migrating whales are pregnant females that successfully give birth north of James Price Point, then perhaps about 10% more whales migrate south again each year, based on estimates of population growth rate by Bannister and Hedley (2001). For the purposes of considering impacts on whales, both the northward and southward migrations need to be considered, or roughly a doubling or more of the above estimate of the population migrating northward.

Community-based whale surveys confirm that Humpback whales are common off the Kimberley coast, including in the area between Broome and the Lacepede Islands (e.g. Kimberley Whale Watching, pers. comm.). These vessel and shore based surveys have observed whales and calves in these waters, which is consistent with the observations reported in other references above.

In summary, many Humpback whales pass by James Price Point. Most of them (>95%) pass more than 8 km offshore. The evidence suggests that Humpbacks generally migrate steadily past James Price Point, relying on places like Pender Bay (60 km north of James Price Point) to rest. Calving can occur along the coast, including off James Price Point, but is most common between Beagle Bay and Camden Sound to the north.

Underwater sound has the potential to interfere with communications between cetaceans, and disturb, injure or kill marine animals if sound pressure levels occur at extreme levels and in close proximity (Southall *et al.*, 2007). Modelling of underwater sound exposure contour levels was presented in the SAR (DSD, 2010a). The proponent subsequently advised that modelling had been in error and provided corrected data showing that the predicted zone of potential physical injury could extend 12 m from piling operations and the zone of potential behavioural disturbance could extend 4500 m from the same activity (see Appendix 9 to this report).

Small numbers of Killer whales were recorded in near-shore areas in the region but other whale species were not found during some near-shore surveys (RPS, 2010a). Southern Right, Minke and Pilot whales were recorded off the Dampier Peninsula in other surveys (Jenner and Jenner, 2009).

Bottlenose and Spinner dolphins were reported in the SAR (RPS, 2010d) as most commonly recorded along the Dampier Peninsula, including around the James Price Point coastal area. It is possible that at least some of the Spinner dolphins in this area are a diminutive form that would be a new record for the area (Allen *et al.* in press.). Indo-Pacific Humpback and Snubfin dolphins were reported by the proponent as being recorded in very low numbers in the vicinity of James Price Point, but the aerial surveys used are not considered best practice for locating and identifying these animals due to their cryptic nature and smaller size (Bedjer *et al.* in press). These dolphin species are reported to show moderate levels of site fidelity, making them potentially vulnerable to habitat degradation and loss given their coastal distribution (Parra *et al.*, 2006).

Indo-Pacific Humpback and Snubfin dolphins are understood to be most typically located in shallow, coastal-estuarine habitats where they are often seen foraging (Parra, 2006). Such habitats are typical of Carnot, Pender and Cygnet bays to the north-east or Roebuck Bay to the south. Allen *et al.* (in press) recorded Indo-Pacific Humpback and Snubfin dolphins off the Dampier Peninsula, with Snubfin most frequently found in Roebuck Bay. These authors also report a clear range extension for Snubfin dolphins to as far south as Exmouth Gulf and also note numerous sightings of Indo-Pacific Humpback dolphins in the western gulf of Shark Bay.

Off the Townsville coast, Snubfin dolphins preferred 1-2 m deep waters and Indo-Pacific Humpback dolphins 2-5 m deep waters. The bathymetry adjacent to the proposed precinct is such that the water is more than five metres deep within about 400 m of the coast and more than two metres deep within less than 100 m of the coast (DSD, 2010a). Indo-Pacific Humpback and Snubfin dolphins have been reported offshore from the Dampier Peninsula from Gantheaume Point to Quondong Point, just south of James Price Point (Allen *et al.* pers. comm.).

Dugong

Dugong were found over the width of the area surveyed by the proponent, generally out to the 20 m depth contour and occasionally beyond (RPS, 2010c). Dugong were distributed along the whole west coast of the Dampier Peninsula, from La Grange Bay in the south to Cape Leveque in the north. Dugong numbers were consistently high to the west and south-west of Carnot Bay, between the Lacepede Islands and in Roebuck Bay (RPS, 2010c).

The dugong population estimate in the late wet season (March) was found to be 930 individuals (SKM, 2009), and in the dry season estimates were about 1,800 for surveys in July and September (RPS, 2010c). The substantial difference in numbers between the wet and dry seasons was considered by the proponent to represent a large scale regional movement of dugong in the Kimberley, possibly in response to seasonal seagrass availability. Distribution data in the SAR (Figure 2.6-4) suggest that dugong move up and down the

coast seasonally, with a node of animals recorded offshore from James Price Point in July. Highest concentrations were recorded off Carnot Bay in September (DSD, 2010a).

Seagrass provides the primary food source for dugong and it is restricted to relatively shallow coastal waters where there is sufficient sunlight reaching the seabed to allow it to grow. Significant ephemeral seagrass meadows have been found off the Dampier Peninsula, including off James Price Point. These meadows are considered important to the dugong populations in the area, at least on a seasonal basis.

The impact of dredging on seagrass has been considered in Section 3.2 of this report. On the data available, the density of dugong over an area of about 9,500 km² stretching from Cape Leveque to La Grange Bay is thought to vary seasonally between about 0.1 to 0.19 animals per square kilometre. This is marginally less than the density of dugongs in Exmouth Gulf (0.24 animals per square kilometre) and considerably lower than the density in Shark Bay (0.64 animals per square kilometre) (RPS, 2010c).

These density estimates are derived by dividing the number of dugong recorded by the area surveyed, but do not consider the relative importance of various parts of the survey area. Arguably, the shallower areas that support seagrass food resources will be more valuable for the population as a whole than deeper areas that do not. It is reasonable to assume that the majority of the dugong's food resources are found out to about the 20 m depth contour. The area of habitat capable of supporting food resources, including bays and coastal waters between Cape Leveque and LaGrange Bay, is about 6000 km² (Figure 6).

Recalculated for this smaller area, the dugong density estimate increases to a maximum of 0.30 animals per square kilometre. In State Waters, the area where recoverable impacts from this proposal could occur stretches about 35 km from north to south and is of the order of 200 km² (see Section 3.2). Assuming an extreme worst case scenario where food resources along 35 km of coast out to the 20 m depth contour (~350 km²) were lost for five years, and where this area provided habitat supporting a density of 0.30 animals per square kilometre, then construction of the port and associated facilities could potentially impact foraging habitat for up to 105 of the estimated 930 to 1800 animals. This worst case scenario represents the potential displacement of approximately 6 - 11% of the population for up to five years.

The area of predicted permanent loss of seagrass is approximately 260 ha. This represents about 0.8% of the feeding habitat based on the assumptions set out above.

Dugong is regarded as a highly prized source of customary food for Traditional Owners. People continue to watch from the top of dunes or headlands for signs of dugong and launch boats (or rafts in the past) to pursue them (DSD, 2010a). It is not known how important this practice is at James Price Point compared with other locations on the Dampier Peninsula where there are more residents, but customary fishers include dugong in the list of species they catch at or near James Price Point (DSD, 2010a).

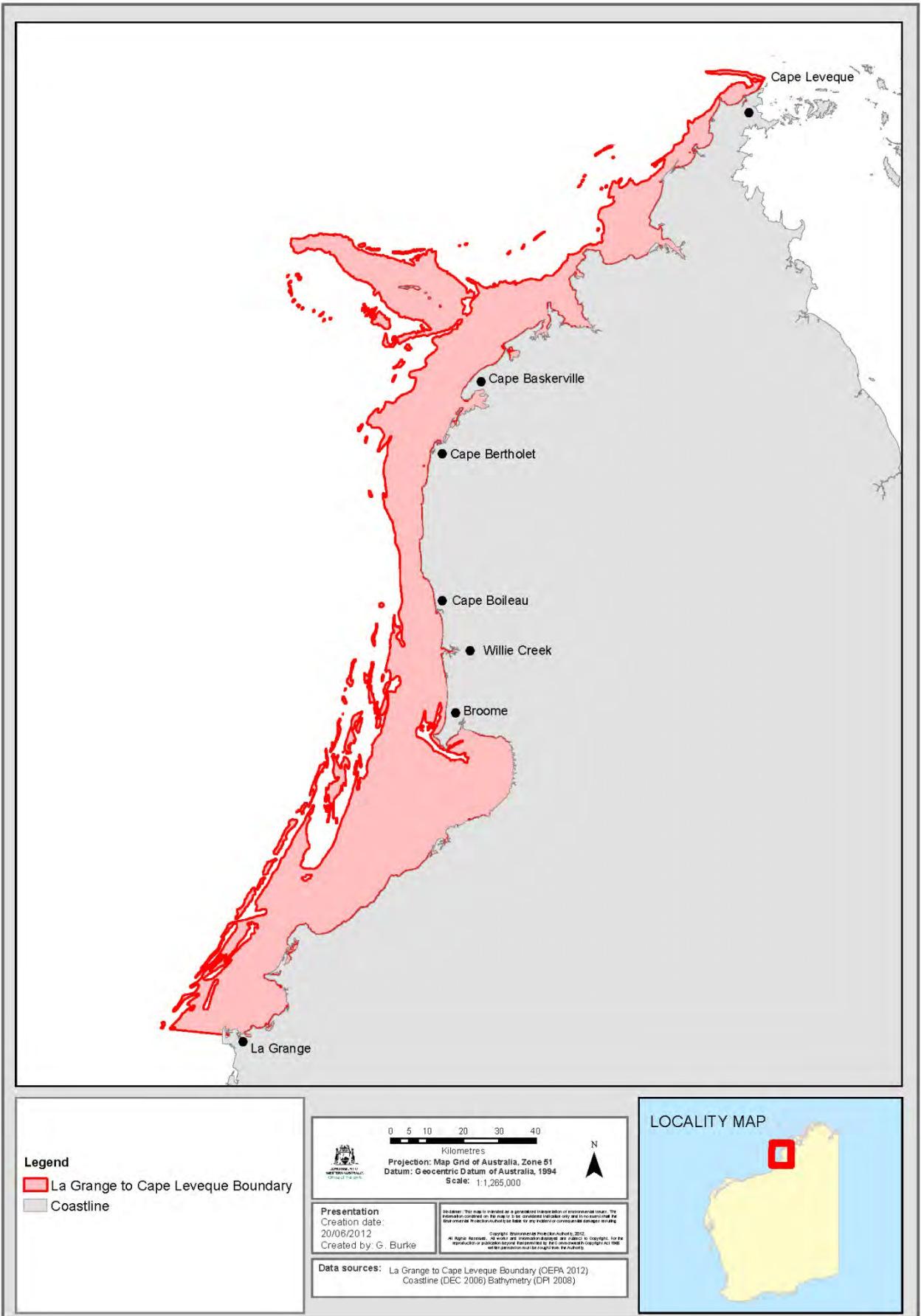


Figure 6. Area of habitat capable of supporting food resources for dugongs between Cape Leveque and La Grange Bay.

It is also important to note that the dugong in a particular area are especially important to custodians of that particular place. Hence, dugongs at James Price Point are more important to the local custodians than animals at another place because Traditional Owners have custodial responsibilities and rights to animals from their country around James Price Point that they may not have to animals in country for which other Traditional Owners have responsibility (Traditional Owner, pers. comm.).

Marine turtles

Significant Green and Flatback turtle nesting occurs on the Lacepede Islands, about 60 km north of James Price Point (EPA, 2010). Recorded turtle densities are greatest around the Lacepede Islands (SAR Part 3, Figure 2.7-3) but there is an increasing trend from Quondong Point northwards to beyond Coulomb Point. The DEC considers the Lacepede Islands to be regionally significant for the conservation of marine turtles in the lower Kimberley.

One confirmed nest was detected in beach surveys conducted north and south of James Price Point as part of studies for the SAR during 2009 – 10. Beaches in this area were identified by the proponent as generally less suitable for nesting as they are often swept by high tides. It should be noted, however, that any turtles in the area are regarded as important to the local Traditional Owners because those owners may not have traditional access to turtles in other places, on the lands of other traditional owners. Recent information from community surveys indicates that up to 14 turtle nests of Flatback, Hawksbill and possibly a Hawksbill/Olive Ridley hybrid were recorded in the vicinity of James Price Point in the 2011 – 12 nesting season (Lindsay *et al.*, 2012).

Despite limited nesting, turtles do utilise the waters off James Price Point. Turtles are considered by the proponent to be likely to be foraging or travelling through the area. Benthic organisms in this area, such as seagrass, sponges and sea whips, are likely to represent an important food source for these animals, which is consistent with benthic habitat data that shows an increasing density of benthic invertebrates northward from James Price Point (Fry *et al.*, 2008; Masini *et al.*, 2009). Studies commissioned by the proponent indicate that important turtle foraging habitat probably occurs off Carnot Bay (about 40 km north), at Cape Latreille (about 40 km south) and at other embayments further afield.

Green and Flatback turtles are also recorded in the SAR as species caught by customary fishers at or near James Price Point. Turtles, like dugong, continue to be highly prized customary food (DSD, 2010a) and the local custodianship issue is likely to be as relevant for turtles as it is for dugong.

Sea snakes

The SAR reports that sea snakes are abundant and widely distributed along the Dampier Peninsula and in the wider region. Locally, the majority of sightings were reported between the 10 and 50 m isobaths, with the highest densities reported in July and September about 30 km off Broome (DSD, 2010a).

Crocodiles

Crocodiles do not appear to inhabit the area around the proposed precinct in significant numbers.

Fish

As reported in the SAR, some 114 species of fishes, sharks and rays were identified from 154 sites surveyed from Coulomb Point (15 km north of James Price Point) to Cape Boileau (18 km south of James Price Point). The fish fauna was both diverse and abundant, although not as diverse as places far offshore like the Rowley Shoals (Allen, 1992). None of the species recorded was restricted to the James Price Point area but there were more small pelagic planktivores and large semi-demersal predators when compared with inshore waters of the Burrup Peninsula and other parts of the Kimberley bioregion (Cappo *et al.*, 2010a, 2010b).

State protected species including Great White and Whale sharks and Green and Dwarf sawfish may occur periodically off James Price Point in low numbers. Sawfish appear to prefer estuarine habitats but may transit the James Price Point area. Great White and Whale sharks are wide ranging and may transit the area.

This diversity and abundance of fish is understood to be important to Traditional Owners as a source of food and as the basis for recreational fishing activity for other residents of the region. Recreational fishing is more concentrated on areas of high and low relief reef, such as offshore from Quondong and Coulomb points, which support demersal species such as Emperor and Coral Trout, and pelagic species such as Mackerel and Trevally. Reports in the SAR indicate that two locations known as “The Puddle” and “The Peanut” (approximately 15 km and 22 km respectively offshore from James Price Point) are particularly favoured for boat-based catch and release fishing.

Many species of fish, including Queenfish, Red Snapper, Spangled Emperor, Stingray, Coral Trout, Mulloway, Mullet and Bream are recorded in the SAR as being caught by customary fishers at or near James Price Point (DSD, 2010a).

Invasive marine species

Introduced marine species can displace native marine species by the introduction of competition, pathogens or predators, which may reduce biodiversity, impact on ecosystem function and damage infrastructure or productive activities like fishing, pearling and aquaculture.

Goolarabooloo/Jabbir Jabbir and other Traditional Owners, in common with pearl farmers, commercial and recreational fishers, have indicated that they are worried that as yet unknown pest species and diseases could be introduced by increased shipping traffic and expressed their expectation that the highest possible levels of cleanliness and inspections would be required of vessels using the facility (DSD, 2010a). The Department of Fisheries advises that the Port of Broome has never been surveyed for introduced marine pest species and its current status is unknown.

The proponent has rated the risk of the introduction of invasive marine species as being low due to the low endemism, high biodiversity and competitive exclusion exhibited by existing biota.

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Environment and Conservation (DEC)

Points from the DEC submission relevant to this factor include:

- additional survey for dugong and cetaceans should be undertaken during and after construction;
- protection of local and regional turtle, dugong, Humpback whale and Indo-Pacific Humpback and Snubfin dolphin habitats;
- Broome Port Authority (BPA) should ensure all vessel operators avoid impacts to marine mammals consistent with the Wildlife Conservation (Closed season for Marine Mammals) Notice 1998;
- Broome Port Authority, Department of Transport and Australian Maritime Safety Authority should designate vessel corridors that avoid critical habitat for dugongs, marine turtles and cetaceans specially protected under the *Wildlife Conservation Act 1950*.
- verification of underwater acoustic models should be undertaken to determine specific marine fauna management zones;
- noise management procedures for pile driving and blasting need to be developed;
- no anchoring to occur in proximity to the Lacepede Islands or mainland turtle nesting beaches;
- best practice lighting be applied, including zero light horizon at all turtle nesting beaches; and
- dredges be fitted with tickler chains, no pumping occurs in transit, pumping to stop when drag head is more than 0.5 m from sea floor, overflow screens are fitted and all accessible machinery inspected after each dredge cycle.

Kimberley Land Council (KLC)

Points from the KLC submission relevant to this factor include:

- qualitative surveys for crustaceans need to be undertaken;
- dry season vessel based surveys are unlikely to be sufficient to establish a baseline for turtles in the areas given the importance of turtles to Traditional Owners;
- given the highly variable nature of seagrass caution needs to be applied when considering dugong survey results and drawing conclusions on the importance of the area to dugongs; and

- the SAR should provide a robust and detailed assessment on cumulative and additive impacts for fish, marine fauna and marine reptiles as this is a key concern for traditional owners.

West Australian Fishing Industry Council (WAFIC)

Points from the WAFIC submission relevant to this factor include:

- a detailed assessment has not been undertaken for fish;
- the impacts of seismic surveys on commercial fish populations and the need for further research;
- cumulative impacts of loss of coastline to collection activities of the specimen shell and marine aquarium commercial fishers business viability; and
- consideration of managed commercial fisheries needs to be expanded to include species of fish targeted by commercial fishermen in the Northern Demersal Scale Fishery.

Murdoch University Cetacean Research Unit (MUCRU)

Points from the MUCRU submission relevant to this factor include:

- the threat of coastal zone development to Snubfin and Indo-Pacific Humpback dolphins which are considered data deficient and nearly threatened;
- the ineffectiveness of aerial surveys to delineate between inshore delphinid species;
- impacts to acoustic communication between Humpback dolphins and their ability to maintain a cohesive group as a result of boat traffic and noise;
- behavioural disruptions to dolphins may lead to displacement from preferred habitat, reduced fitness and fecundity and therefore population declines;
- direct impacts to dugong as a result of loss of seagrass through dredging potentially resulting in death or emigration of dugong;
- the vulnerability of dugong to large and/or high speed vessels due to their delayed response to boats;
- changes in dugong density over time and satellite tracking suggest that dugong transit the James Price Point area;
- that 650 (5%) is not a low number of whales migrating near the coast;
- higher numbers of whales at Pender Bay may be due to this being a resting area;
- methodology for population estimates and density comparisons;

- previous Murdoch University surveys have noted multiple groups of Snubfin, Indo-Pacific Humpback and Indo-Pacific Bottlenose dolphins in the Canning Marine Bioregion; and
- stretches of open coastline (e.g. around James Price Point) are likely to represent avenues of connectivity between hotspots of delphinid activity.

Public submissions and conservation groups raised concerns regarding:

- the impacts of the proposal on marine megafauna;
- potential impacts as a result of increased vessel movements, noise and oil spills;
- inadequate assessment of cumulative impacts;
- the importance of the James Price Point area to whale and calf migration, and dolphins;
- scientific knowledge gaps in relation to turtles, Snubfin dolphins, dugong and whales;
- the lack of consideration of the importance of inter-nesting and post nesting habitat of turtles which will be at risk from shipping and onshore operations;
- impacts to turtles that use the area between Quondong Point and Flat Rocks for nesting as indicated by local knowledge;
- potential impacts to EPBC Act recovery plans for turtles and whales, and international conventions;
- the lack of understanding of the importance of sea grass at James Price Point;
- impacts to marine fauna, including whale calving habitat, as a result of shipping movement, vessel strikes and dredging;
- impacts of underwater noise and vibration as a result of pile driving, marine blasting, dredging dumping, seismic testing and drilling on marine fauna, which may impact in particular dugong, and communication between whale mothers and calves;
- cumulative impacts on whales including from developments at Wheatstone, Ashburton North, Anketell and Gorgon;
- lack of consideration of the highly productive pelagic zone located 15 nautical miles off the coast; and
- the need for further studies to determine whether the area is an important habitat and/or migration zone for the three endangered sawfish species found in the Kimberley.

Assessment

The EPA's environmental objective for this factor is to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

Potential threats to marine fauna include temporary or permanent displacement, collisions with vessels, behavioural disruption, or injury at close range from high impact noises like pile driving, and deleterious effects from oil or other spills.

Cetaceans

Whales are clearly an important and iconic group of animals that continue to require careful protection consistent with their protected status under both Federal and State laws. At the same time, it is noteworthy that the recovery in Humpback whale numbers from the 1960s to the present has coincided with the rapid development of the iron ore and petroleum industries in the north-west of Western Australia over the same time span.

Low levels of iron-ore shipments occurred from Koolan and Cockatoo islands in the Kimberley (about 220 km north-west of James Price Point) in the late 1940s and by 1963 a substantial operation was established there. Iron ore exports commenced from the Pilbara ports of Dampier and Port Hedland in 1966 and had expanded to 4657 vessel arrivals per annum at Dampier and 1303 at Port Hedland in 2009 – 2010 (Dampier Port Authority, 2010; Port Hedland Port Authority, 2010).

Oil shipments from Barrow Island commenced in 1967. By 2009 - 2010 a cumulative total of 251 million kilolitres of crude oil and 106 million kilolitres of condensate had been produced from Western Australian fields (Department of Mines and Petroleum, 2010).

Combined shipping arrivals in Dampier and Port Hedland have increased 43 fold from 138 in 1965 to 5960 in 2010 (Dampier Port Authority, 2010; Port Hedland Port Authority, 2010; Commonwealth Bureau of Census and Statistics, 1964-1992)¹. Figure 7 illustrates the rise in shipping from these ports. Most of the 357 million kilolitres of liquid hydrocarbons produced in Western Australia to 2009 – 2010 would have been shipped by sea over the same period (Department of Mines and Petroleum, 1997 – 2010). The pattern of hydrocarbon production is illustrated in Figure 8.

Over the same time frame, Humpback whale numbers have increased exponentially at a rate of around 10% per annum, from less than 600 in 1963 to an estimated 21,750 off Dirk Hartog Island in 2008 (Hedley, *et al.*, in press) and possibly as many as 34,000 now (Bannister, pers. comm.) (Figures 4 and 5). It appears that Humpback whales have been able to sustain a significant rate of population increase while migrating annually through offshore waters of Western Australia while there has been a significant increase in shipping associated with the growth of the iron-ore and petroleum industries over the same time span.

¹ Assuming one arrival is accompanied by one departure, this equates to about 12,000 shipping movements per annum today.

Considerable numbers of other associated shipping movements (e.g. supply vessels, seismic surveys, tugs and pilot boats) servicing the iron-ore and petroleum industries, and general shipping traffic associated with an increasing population serviced by increasing imports and exports, would have further increased the total shipping traffic and opportunities for whale/ship collisions. The potential for other negative impacts from oil spills, seismic and construction noise and the like have clearly also increased as oil and gas exploration and production and iron-ore exports have increased over the last 50 years.

Notwithstanding the increased shipping movements, the west-coast Humpback whale population has increased exponentially over the same period, indicating that the significant increases in shipping outlined above, together with the associated activities with the potential to disrupt whales, have not in fact done so at a population level. The proponent notes that five collisions between ships and all types of whales were recorded in Western Australian waters from 2006 to 2008 (DSD, 2011b; IWC, 2008).

While there may have been some impact on whale numbers due to shipping and oil spills off Western Australia over the last 50 years, it is difficult to conclude that it has been significant at the population level when the population has sustained an exponential growth rate of 10% or more.

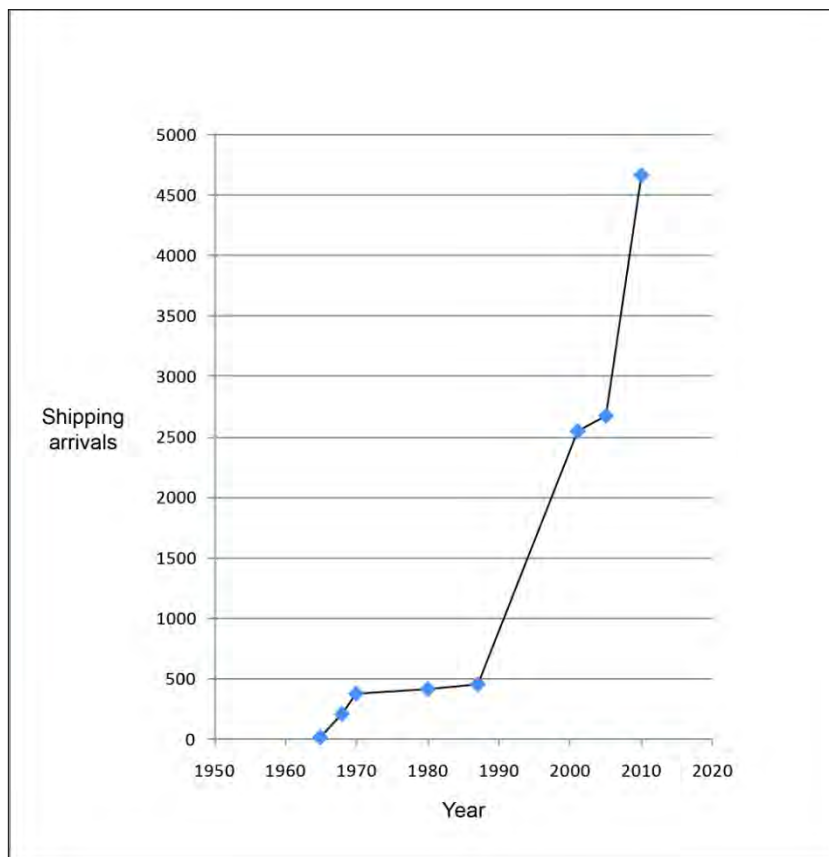


Figure 7. Annual shipping arrivals combined for Dampier and Port Hedland, Western Australia.

Sources: listed in text.

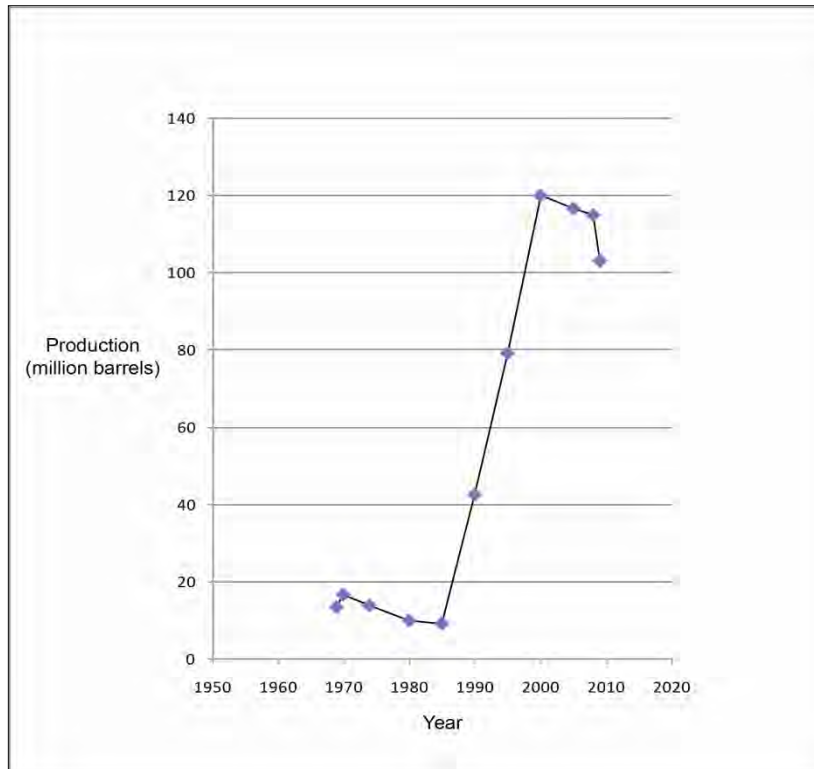


Figure 8. Annual production of oil and condensate combined for Western Australia.

Sources: listed in text.

The number of ships using the precinct would be up to 1300 a year at a production capacity of 50 Mtpa of LNG. This is similar to the current level of traffic at Port Hedland (although iron-ore carriers are typically larger than LNG tankers) and is of a similar order to the 1,836 ships that visited Fremantle in 2009 – 2010 (Fremantle Port Authority, 2010).

The EPA notes that large numbers of whales and calves pass the James Price Point area and, while most pass well offshore, 5% of them pass within 8 km of the coast. It is also possible that a number of calves are born nearby each year. The precinct is, however, located on a straight section of coast which may be less attractive as a resting area and is some 60 km from the main whale calving area delineated by Jenner *et al.* (2001) from Beagle Bay north to Camden Sound. James Price Point is roughly the same distance from the nearest likely resting areas at Pender, Carnot and Roebuck bays.

The EPA considers that the level of increase in shipping traffic and potential impacts from oil and other spills associated with an LNG processing precinct at James Price Point may have some deleterious effects on individual whales, and makes recommendations to help reduce the likelihood of these effects. The EPA considers, however, that the proposal is not likely, on the experience of the last 50 years of development off north-west Australia, to have a significant additional impact on Humpback whales at the population scale.

The EPA notes Figure 2.6-3 in Part 3 of the SAR which indicates that 95% of whales pass James Price Point more than 8 km offshore, largely in waters subject to the jurisdiction of the Commonwealth Government. Figure 2.6-3 in

Part 3 of the SAR also indicates that 60-70% of the population would be out of the zone of influence from any turbidity associated with construction of the state-based elements of the proposal. About 70% to 80% of whales travel beyond the zone of moderate impact that is predicted to extend about 12 km offshore from James Price Point as a result of dredging. The zone where noise impacts due to pile-driving and blasting could cause behavioural disturbance may extend as far as 7 km offshore and affect about 5% of migrating whales. This separation between the bulk of migrating whales and the port area would also mitigate significant impacts to most of the population from other lower-level construction noise, such as dredging and rock dumping.

Nonetheless, significant numbers of whale mothers and calves pass James Price Point, as evidenced by the data in the SAR and from shore-based observations by community members provided to the EPA via submissions. The EPA acknowledges the importance of these citizen observations and notes information provided to it showing evidence of propeller strike on individual cetaceans. While it is not possible to guarantee that there will be no impact to cetaceans as a result of implementation of this proposal, the EPA considers that impacts which may affect cetaceans at the population level are unlikely.

Communication via sound may, however, be particularly important to keep whale (and other cetacean) mothers and calves together, especially when they cannot see each other. Accordingly, the EPA recommends a Ministerial condition in Appendix 4 of this report that requires, among other things, that marine pile driving is suspended to reduce noise at night during the peak southern migration of mother and calf Humpback whale pods. The EPA notes that night-time pile driving is prohibited during the period from mid-August to mid-October for the Wheatstone LNG project near Onslow on the Pilbara coast. Prohibition of night-time pile driving and blasting from June to November is recommended in the present case to cover the longer period when mothers and calves are expected to be present off James Price Point.

Given the points set out above and that the exposed waters adjacent to James Price Point are unlikely to be as important for calving or resting as places like Camden Sound and Pender Bay, the EPA considers that its objectives for the protection of whales are likely to be met if the proposal were to be implemented with the application of the conditions recommended in Section 4. The EPA notes also that the Commonwealth requires that cetacean interaction guidelines consistent with the EPBC Act (Part 8) are followed and these guidelines serve to reduce the likelihood of adverse impacts of interactions with these animals (Commonwealth of Australia, 2005).

The EPA understands that the distribution and behaviour of other cetaceans such as dolphins are less well known in this area. Species such as the Snubfin and Indo-Pacific Humpback dolphin are uncommon, but have been recorded across the Kimberley and other tropical Australian locations in the Northern Territory and Queensland (Parra *et al.*, 2002). While these animals appear to rely principally on coastal-estuarine habitats, it is probable that they transit the James Price Point area close to shore based on records from the region (Allen *et al.*, in press).

The EPA notes that these two species appear to favour waters less than five metres deep and that waters this shallow are confined to a narrow strip, dependent on the state of the tide, off the proposed precinct. Thus the amount of preferred habitat for these species off James Price Point is considerably restricted, compared to other regional locations like Roebuck Bay. It is possible that some individual animals of these species will suffer deleterious impacts, but unlikely that development at James Price Point would interfere with important feeding habitat for significant numbers of these animals to the point where the level of threat to this species at the population level is likely to be raised significantly.

Accordingly the EPA considers that its objectives for the protection of these animals are likely to be met, noting also that the application of standard cetacean interaction guidelines consistent with Commonwealth requirements will also assist in protecting them. That said, the EPA also notes that the distributions of Snubfin and Indo-Pacific Humpback dolphins are not well known and further monitoring and research is warranted on these species to assist with their collective future management off the Dampier Peninsula.

Dugong

The EPA notes that significant numbers of dugong are found off the Dampier Peninsula, with numbers varying seasonally at densities that are similar to those recorded in Exmouth Gulf, and at densities that may range from a third to roughly half of the density recorded for these animals in Shark Bay when considered as a function of likely foraging habitat. The EPA understands that protection of seasonal sea-grass habitats is a key element in maintaining healthy dugong populations and notes that they appear to be commonly associated with the sheltered waters of Beagle Bay, off Carnot Bay and Roebuck Bay.

On the evidence available, dugong appear to occur off James Price Point on a seasonal basis. It has been recently suggested that there is a high degree of connectivity between dugong populations along the Dampier Peninsula, or they may represent a single population (Holley and Prince, 2008). These animals feed almost exclusively on seagrasses, which are prevalent in estuaries and embayments, but which do occur seasonally in significant quantities offshore along most of the Dampier Peninsula including the James Price Point area.

There is little known about the degree of inter-annual variability in seagrass distribution and biomass but considering all waters less than about 20 m deep as possible foraging habitat, it is possible that the proposal could cause the permanent loss of about 260 ha of habitat containing seagrass and cause the temporary loss of seagrass habitat that might at some time support 6-11% of the estimated dugong population along the Dampier Peninsula. The likely consequences would include consequent permanent or temporary displacement of dugong from the affected habitats, putting added pressure on the remaining resources that would be required to sustain the population as a whole.

The EPA notes the potential scale of impacts contemplated above but, based on experience with other large scale developments in the Pilbara, the

ephemeral nature of seagrass cover, the likely high resilience of these communities and their ability to recover from disturbance, the EPA expects that actual impacts will be of a significantly lesser extent and duration than the worst case outlined above.

Considering the available information, the EPA believes that it is unlikely that actual impacts to seasonal seagrass habitat off James Price Point will be so significant in extent and duration as to affect dugong at a level that would increase the level of threat to this species. Accordingly the EPA considers that its objectives for the protection of these animals are likely to be met given the conditions it has recommended and the application of standard cetacean interaction guidelines consistent with Commonwealth requirements that will also assist in protecting these animals.

Fish

It is most likely that the largest impacts on fish in terms of extent and duration will be associated with the first phase of construction and loss of habitat associated with the foundation project. The worst case scenario would result in impacts to habitat over an area of about 350 km² with about 200 km² of that in State Waters. This area extends along about 35 km of coastline and contains a variety of habitats ranging from bare sand through to diverse and structurally-complex reef systems. The degree of impact to fish will be related to the relative importance of these habitats to the various fish species in the area.

The EPA notes that listed sawfish appear to be most often associated with estuarine habitats and embayments, although it is considered likely that they may transit other coastal habitats like those off James Price Point. Listed Whale sharks are wide ranging oceanic animals that may transit waters offshore from the Dampier Peninsula but do not appear particularly dependent on this area for resources. Listed species such as sawfish and Whale sharks are thus not considered to be so dependent on the habitats off James Price Point that there are likely to be at significant risk of an increase in the level of threat to these species as a result of implementation of the proposal.

Areas of high habitat diversity occur offshore from Quondong Point and some of the area offshore and south of Coulomb Point. These areas support recreationally important species such as Coral Trout, Emperor and Blue-bone. These species all display a degree of habitat linkage and although it is not expected they would suffer injury or mortality, they may be displaced from these areas until the habitats recover from the effects of construction. However, for the reasons described previously, the EPA expects impacts to habitats will be managed to be substantially less in terms of extent and duration than the recommended permissible maximum.

Popular recreational fishing locations at the Peanut and the Puddle are in Commonwealth waters and outside the jurisdiction of the EPA.

The EPA considers that conditions for the management of dredging (see Section 3.2) and marine environmental quality (see Section 3.3) would protect fish habitat and the marine environment generally and are likely to adequately manage issues relevant to fishing and similar activities that rely on maintenance of the marine environment.

Marine turtles

The EPA notes that turtles feed offshore from James Price Point and the most likely cause and extent of impact will be due to temporary and permanent loss of benthic habitats, similar to that set out above for dugong. However the EPA notes that, in contrast to dugong, turtles are less habitat-constrained and more wide-ranging in both the areas they forage in and the food resources they consume. While some turtles may be killed by percussive effects from blasting or entrainment during dredging, experience from other dredging projects off Western Australia where turtles are prevalent indicates that the numbers affected are not likely to significantly increase the level of threat to these species.

The EPA also notes the records of up to 14 additional turtle nests based on observations by community members. While this is an increase over the single nest recorded in surveys conducted for the SAR, it is not a level of nesting effort that is comparable to the major turtle rookeries on the Lacepede Islands and at other locations in the Pilbara and Kimberley (EPA, 2010). Loss of these particular nests may well be important to traditional custodians of the area but is not expected to significantly increase the level of threat to turtle populations as a whole.

Conclusions

While the level of information considered here is commensurate with an assessment of a strategic proposal, the EPA notes that there is still more to be learned about whales, dolphins, dugong and turtles off the Kimberley coast. Improved knowledge about critical habitats for dugong, turtles and Snubfin and Indo-Pacific Humpback dolphins in the area will be important to the effective conservation and management of these animals if this proposal were to proceed. The EPA has therefore recommended the application of conditions to manage the residual risks to these species. The EPA also recommends that longer term research into the distribution and habitat preference and utilisation by these animals is undertaken to assist in their long term management and conservation should the Precinct be developed.

Given the widespread distribution of fish off the Dampier Peninsula, the absence of site specific forms and the absence of prominent reefs or other structures on which fish may be especially dependent (See also Section 3.3 below) the EPA concludes that some impacts on fish may occur but stocks are not likely to be significantly affected at the regional scale.

The EPA notes the importance of properly managing dredging operations to ensure that impacts to habitat important to dugong, whales, dolphins, fish and turtles is not so great as to have a significant impact at the population level. The EPA has made specific recommendations for dredging management in sections 3.2 and 3.3 of this report.

While the EPA considers that impacts to dugong, turtles and fish from this proposal are unlikely to have significant environmental impacts at a level that would increase the level of threat at a population level, it notes the special importance of these animals to the Traditional Owners of the proposal area. Although these animals occur throughout the Kimberley, Pilbara and

Gascoyne regions, the EPA is aware that a local reduction in abundance may be of particular importance to Traditional Owners. The EPA understands that Traditional Owners attach considerable importance to animals that are present in the local area, since those animals belong to country that is the responsibility of local Traditional Owners, whereas animals elsewhere may not be available to an outside group of Traditional Owners, since those animals are located on country owned by others.

The EPA understands that management of this 'local ownership' issue for Traditional Owners is designed to occur, at least in part, by arrangements secured through the Browse LNG Precinct Regional Benefits Agreement of June 2011 (Western Australian Government, 2011c). Noting that dugong and turtles may form part of the 'social surroundings' for Traditional Owners, the EPA recognises that there may be some impacts to individual animals but considers that those impacts are not likely to be so great as to significantly affect the social surroundings associated with these species.

The EPA considers that implementation of the recommended conditions would ensure that impacts to marine fauna were managed to the fullest extent possible. While it is unlikely that marine fauna species would be significantly threatened at the population level due to their occurrence elsewhere across the Kimberley and further afield, there may still be reductions in abundance and geographic distribution at the local scale from implementation of this proposal.

The EPA notes that the location of the proposal has been informed by a wide ranging site selection process undertaken by the NDT. That site selection process operated at the regional level to create a single hub, thus avoiding the potential for more widespread impacts in potentially more sensitive parts of the Kimberley. For example, the site selection process has avoided whale calving areas in Camden Sound and resting areas such as Pender Bay towards the northern end of the Dampier Peninsula.

While any location will have some impacts, the selection of a site such as James Price Point achieves separation from particularly environmentally sensitive areas such as turtle nesting areas on the Lacepede Islands and significant dugong foraging habitat on seagrass beds in Roebuck and Beagle bays. The EPA acknowledges that there will be impacts to some aspects of the environment at James Price Point but has made the judgement that they could be adequately managed based on the recommendations in this report.

Specific measures to improve the protection of marine fauna have been undertaken including the Government commitment to establish additional Kimberley marine conservation areas, such as in Camden Sound. This measure in particular will increase the protection of Humpback whales in an important calving and resting area.

To maximise the level of protection given to marine fauna including whales, dolphins, dugong and turtles, the EPA has concluded that offsets should be proposed as part of any future proposal to deal with residual impacts. The EPA recommends that proponents of future proposals should systematically address the knowledge gaps that exist about the distribution, migration and behaviour of marine fauna in the Kimberley region and put forward measures

to improve their conservation and management. With the conditions and offsets described above in place, the EPA's objective for this factor could be met.

The proponent has proposed that an Invasive Marine Species Management Program is prepared and implemented to apply to vessels, barges and other immersible equipment that enters and operates within the Precinct.

While the proponent may consider that the risk of the introduction of invasive marine species is low, it is recognised that the environmental values of the Kimberley marine ecosystem are of international importance and the introduction and establishment of invasive marine species could have significant negative consequences for a wide range of activities and environmental values. Furthermore, if established, a marine pest could be very difficult or potentially impossible to eradicate. The EPA recognises that this potential threat is of considerable concern to individuals or groups who made submissions to the EPA.

The EPA considers that this threat is potentially significant, but manageable and recommends a comprehensive set of conditions, based on advice from the Department of Fisheries, to protect against the introduction of invasive marine species during implementation of the proposal, which includes both construction and ongoing operations.

A recommended condition to address the threats associated with non-trading vessels (e.g. dredges), developed in consultation with the Department of Fisheries, is provided in Appendix 4.

The threats associated with trading vessels (e.g. LNG tankers) are proposed to be managed under arrangements administered by the Australian Quarantine and Inspection Service, which has set mandatory ballast water management requirements as well as guidelines for managing bio-fouling. The EPA considers that these arrangements should allow its objectives for this factor to be met.

Summary

The EPA considers the key environmental factor of marine fauna has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures and offset the residual impacts as recommended in this report. The relevant recommended conditions for this factor include:

- Condition 9 relating to a Marine Facilities and Impact Zones Plan;
- Condition 10 relating to a Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program;
- Condition 11 relating to State of the Marine Environment Surveys;
- Condition 13 relating to Marine Environmental Quality and Marine Outfalls,

- Condition 15 relating to Marine Fauna Interaction – Marine Pile Driving, Dredging and Marine Construction Vessels and Light Sources;
- Condition 16 relating to Marine Drilling and Blasting Activities;
- Condition 17 relating to Introduced Marine Pests; and
- Condition 24 relating to Decommissioning.

3.2 Benthic habitats

Description

Benthic habitats provide an important foundation for many ecosystem processes that underpin a healthy and productive marine environment. Dredging and construction of port facilities and the operation of LNG and shipping facilities have the potential to affect benthic habitats.

Overview

Benthic habitats and substrates along the Dampier Peninsula were first mapped during surveys undertaken for the NDT (Fry *et al.* 2008, DEC unpublished data 2008). The surveys focused on specific areas including Gourdon Bay south of Broome and locations along the Peninsula between Quondong Point in the south and Packer Island in the north. One of the four localities surveyed by Fry *et al.* (2008) was an area off James Price Point that extended alongshore from just south of Quondong Point to just north of Coulomb Point.

After James Price Point was selected as the proposed site for the LNG Precinct, further biological surveys of the marine area off the Point were undertaken by the proponent to refine the understanding of benthic habitats and their underlying substrate types. In addition to the biological surveys, high resolution bathymetric data were also generated for the seabed offshore from James Price Point from Laser Airborne Depth Sounder (LADS) surveys and these data are presented in Figure 3-2 in Part 7 of the SAR, reproduced as Figure 9.

A key purpose of these studies was to provide data that would be used to inform the benthic habitat modelling that was undertaken by the proponent to generate the benthic habitat distribution maps used to assess potential impacts (e.g. Figure 1-27 in Part 3 of the SAR, reproduced as Figure 10). These maps provided the basis for the predictions that have been made of the likely extent, severity and duration of impacts that might be associated with the construction and operation of the marine components of the LNG Precinct.

Descriptions of the key benthic habitats

There is a distinct difference between the marine habitats off the Dampier Peninsula and those that typify the Kimberley coastal waters north of King Sound (Masini *et al.*, 2009). This difference is reflected in Australia's integrated marine and coastal regionalisation (Commonwealth of Australia 2006). In broad terms, the benthic substrates and habitats off the Dampier Peninsula are typical of the Canning Bioregion (Commonwealth of Australia 2006, IMCRA V4.0).

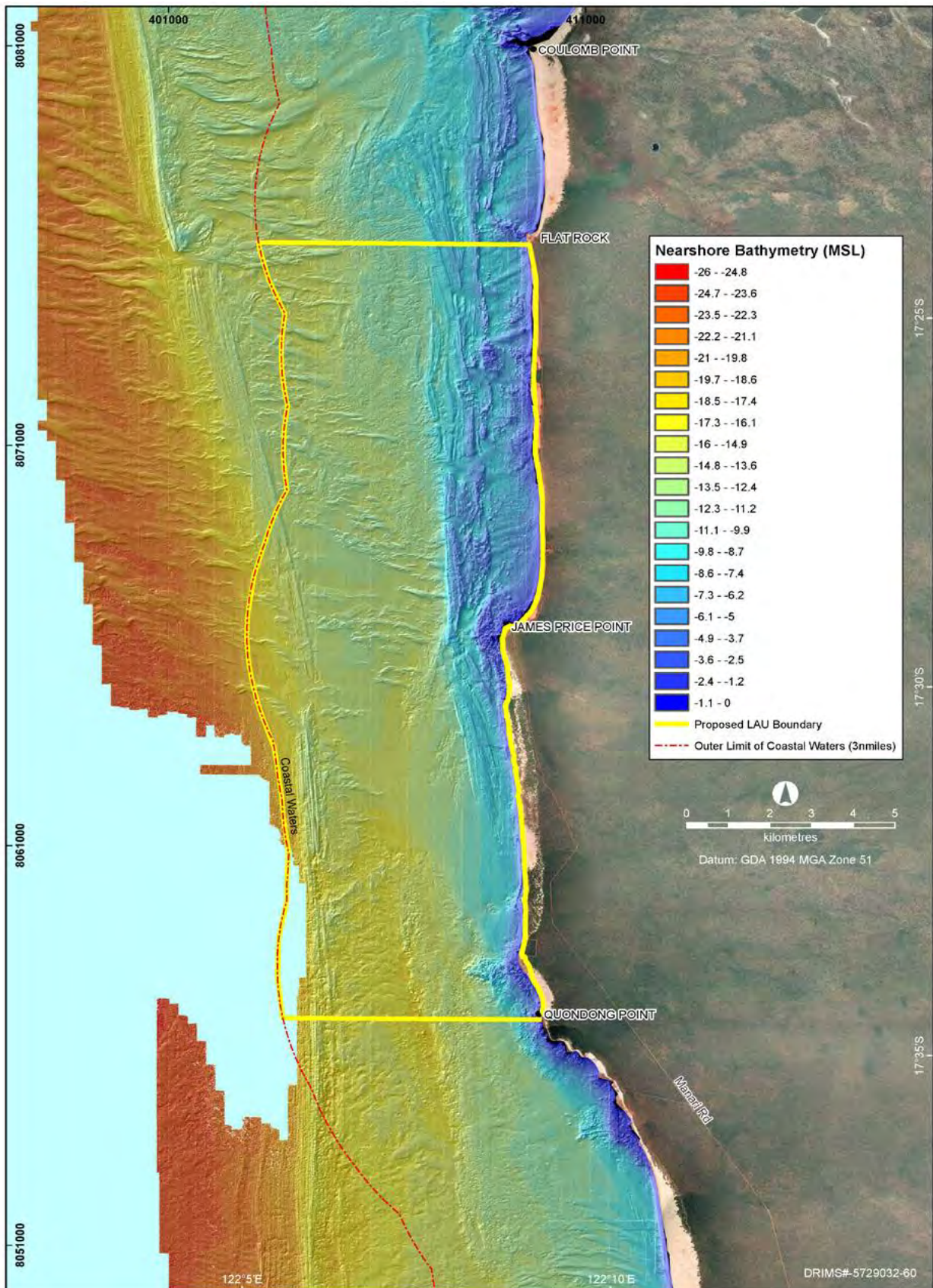


Figure 9. A map showing bathymetry offshore from the James Price Point coastal area and the proponent's proposed local assessment unit which was used as the basis for its benthic primary producer habitat loss calculations. Source; Figure 3-2 in Part 7 of the SAR.

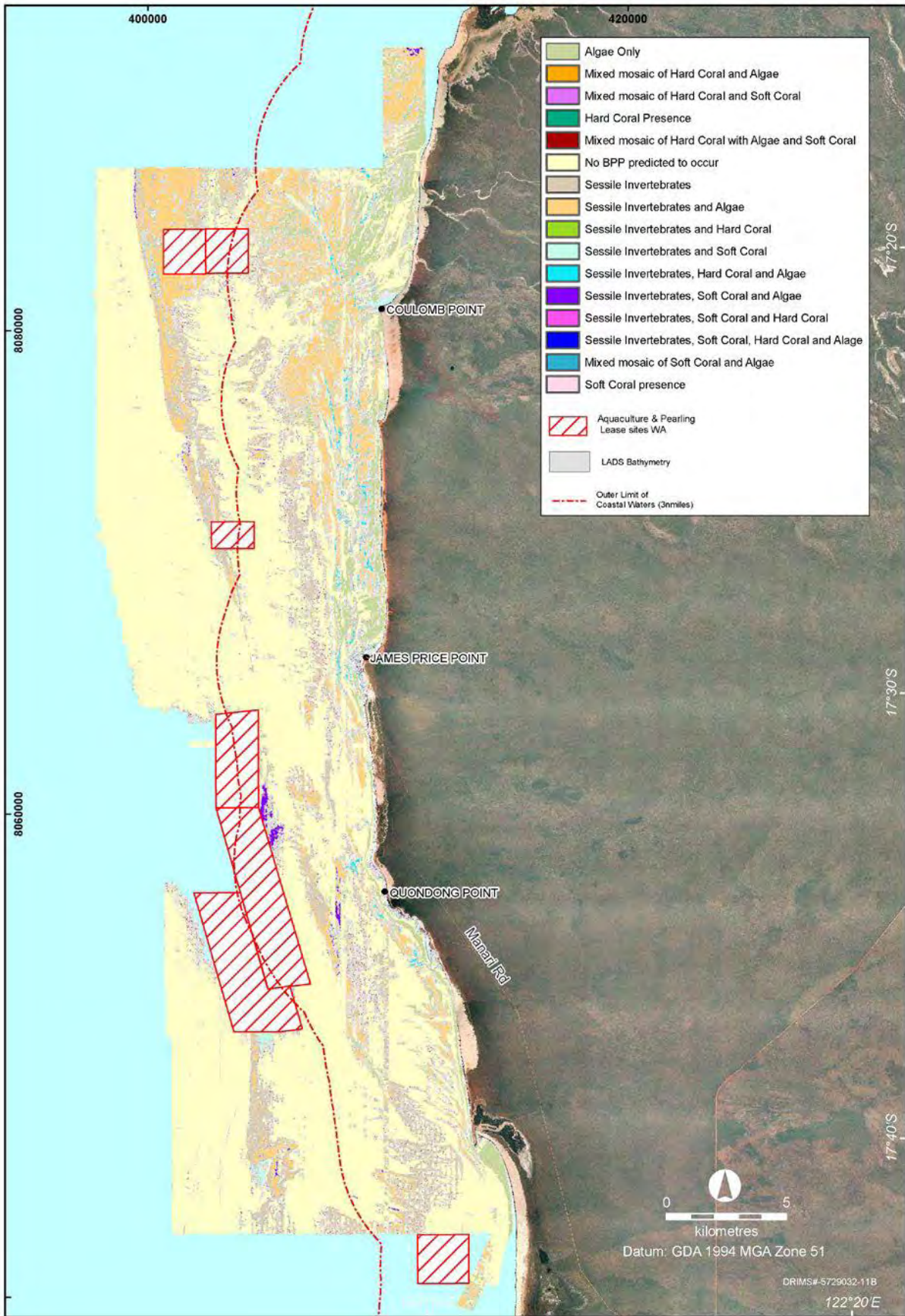


Figure 10. Derived benthic habitat map of the James Price Point coastal area. Source: Figure 1-27 in Part 3 of the SAR.

It is generally recognised that the marine communities off the Dampier Peninsula and the Kimberley more broadly are poorly described in terms of their biodiversity values, species composition and distribution, and the ecological roles they play. The proponent has used existing information and undertaken studies in an effort to understand the relative importance of the habitats off James Price Point and the ecological roles they are likely to perform at the local and regional (i.e. along the Dampier Peninsula) scales.

The benthic substrates offshore from the James Price Point coastal area are commonly sandy, with areas of low-relief reefs mainly in the intertidal and shallower subtidal zones (<10 m depth) off the Point proper. Rocky substrates also occur in places in the intertidal and subtidal zones of the mapped area to the north and south of James Price Point, including off Coulomb Point. Further offshore, unconsolidated sandy substrate occurs widely, with some relatively flat, hard substrate (primarily in the northern section of the mapped area) and low-relief reefs offshore that are oriented generally parallel with the coast.

In broad terms, the proponent found that about 25% of the marine habitat offshore from James Price Point is characterised by diverse communities of both benthic primary producers such as algae, seagrass and corals and filter feeders such as sponges, sea whips and soft corals. Hard substrates in the lower intertidal and shallower subtidal areas support macroalgae with some corals. The biological assemblages on hard substrates in deeper offshore areas are mainly characterised by filter feeding communities (e.g. sponges, soft corals) with scattered hard corals. Seagrasses were observed growing in the more stable sandy areas between reefs in the nearshore zone, and among the filter feeding communities to a depth of about 20 m in more offshore waters. Seagrasses are reported in the SAR as being most well developed in the northern portion of the mapped area off James Price Point.

Available evidence suggests that the majority of the seagrass species off James Price Point are ephemeral and patchily distributed over quite extensive areas. Observations to date indicate that the above-ground biomass of seagrass off the Dampier Peninsula peaks towards the end of the dry season before plants set seed and above-ground biomass declines dramatically at the start of the wet season (OEPA, unpublished data). The fate of rhizomes and roots that are buried in the sediments is unknown. The re-establishment of seagrass in the subsequent dry season is thought to occur from seed stock in sediments and potentially by vegetative regeneration from surviving viable plant tissues. The seagrass species present are known food resources for dugong and turtles. The communities they form are therefore considered to provide a significant, but somewhat seasonal, food resource across large areas off the Dampier Peninsula (SKM, 2010; Commonwealth of Australia, 2011).

Hard corals have scattered distributions off the James Price Point coastal area and generally occur at low densities according to the proponent. The surveys and mapping undertaken for the NDT (Fry *et al.*, 2008, DEC, unpublished data) supports the view that while corals are present off James Price Point, they are generally small, patchily distributed and do not form the same extensive coral reef habitats found elsewhere in the Kimberley bioregion.

Diverse assemblages of macroalgae (i.e. seaweeds) and benthic microalgae occur over large areas around James Price Point. The larger seaweeds, which tend to be associated with areas of rocky substrates, are likely to provide habitat and a food resource for biota including invertebrates, fish and turtles (DSD, 2010a) and thus form important foundations for food chains where they occur. Communities of benthic microalgae are observed on sandy seabed over widespread areas. Their ecological role is not clear but they are thought to play a role in supporting mobile invertebrates such as heart urchins (Keesing and Irvine, in press) and higher order consumers through grazing by micro-invertebrates and subsequent predation of these by larger organisms up the food chain and also for the general maintenance of healthy sediments.

In contrast to some other locations where benthic primary producers such as coral are visually dominant, filter feeders are the predominant structural component of habitats over considerable areas off James Price Point. Filter-feeding invertebrates such as sponges, soft corals, ascidians, gorgonians and sea whips were found to be a prominent component of the benthos around James Price Point (Fry *et al.*, 2008; DSD, 2010a). These organisms do not obtain the bulk of their energy requirements by photosynthesis, as benthic primary producers do, but sustain themselves primarily by filtering small organisms or organic particles from the water column. It is known that some species of sponge and soft coral, for instance, contain zooxanthellae (i.e. microscopic algae) that photosynthesise and transfer energy to their hosts in a symbiotic relationship similar to that which exists in most hard corals. In terms of diversity, survey data indicate that filter feeders are amongst the most abundant biota in the nearshore environment off James Prince Point, with the species diversity of sponges between Coulomb Point and Quondong Point estimated to be twice that determined from other survey sites along the Dampier Peninsula and Gourdon Bay (DSD, 2010b).

Filter feeders are likely to provide food and shelter for crustaceans, fish and turtles, and fulfill an important role near the base of the food chain. Erect forms of filter feeders retard water movement and reduce disturbance of unconsolidated sediments, and may create conditions favourable for the seasonally-abundant seagrass communities that are observed within filter feeder communities offshore.

The proponent used observational data from biological surveys as well as data describing the physical environment off the James Price Point coastal area to inform a habitat modelling exercise. This modelling was used to produce a derived benthic habitat distribution map that shows a combination of observations and model outputs (Figure 10). This map serves two key purposes for the assessment. Firstly, it provides the 'receptor field' data that is used to inform predictions of impacts to benthic habitats associated with the proposed dredging activities. Secondly, it forms the basis for the proponent's estimates of benthic primary producer habitat loss, which is effectively a subset of the predicted extent of impacts associated with dredging.

Key threats to benthic habitats

The key threats to benthic habitats are associated with direct disturbance due to the physical footprints of the marine infrastructure and the indirect effects of maritime construction activities. These activities impose pressures on the

habitat and on the organisms in it, from which they may or may not be able to recover. Of these pressures, the most significant are associated with the capital dredging and dredge material disposal (including any land reclamation) activities required to develop the shipping channel, turning basins, berth pockets for the export facilities, an IMF and trench excavation if required for installing gas pipelines.

It was originally anticipated that a total of 21 million cubic metres (Mm³) of capital dredging and dredge material disposal would be required to develop the Precinct's marine facilities. About 80% of the capital dredging was anticipated at the foundation stage, and it was expected this component would take about 18 months to complete (DSD, 2010a). The remaining approximately 20% of capital dredging would occur subsequently, during discrete periods associated with the implementation of future derived proposals. Smaller volumes of maintenance dredging would be expected over the life of the proposal to maintain operability of the port.

Since the SAR was produced, a number of studies have been undertaken which have significantly improved the level of understanding of the environment off James Price Point, including ocean conditions and the geotechnical characteristics of the seabed. This has led to modifications and improvements in the design of the port and IMF infrastructure which in turn has enabled the proponent to more accurately predict the extent of dredging required for the port turning basin, the approach channel and to provide a foundation for offshore breakwaters.

This led to the expected volume of dredging and spoil disposal being revised upwards to 34 Mm³. In addition, the proponent was able to better plan the dredging process, including identifying the types of dredges and their sequencing, scheduling and expected dredge production rates. Instead of requiring 12 months of dredging over 18 months, the proponent's new analysis showed that it would take 21 continuous months of operation to complete the 22.4 Mm³ of dredging needed to construct the marine facilities required to support a foundation 12 Mtpa LNG processing and export facility. It is now expected that about 70% of the total dredging (by volume) would occur at the foundation development stage.

Dredge material is proposed to be largely disposed of to the ocean offshore in Commonwealth Waters and, although disposal in State Waters is not contemplated in this proposal, it is possible that turbid plumes generated by ocean disposal may indirectly affect State Waters and also that some dredged material may be used as fill for constructing near-shore marine facilities. The proponent has advised that turbid plumes from ocean disposal have been included in the predictions of impacts in State Waters.

The offshore disposal of smaller volumes of dredge spoil resulting from maintenance dredging is also likely to be required during the life of the proposal. Ocean disposal of dredge material for both capital and maintenance dredging is generally subject to the provisions of the *Commonwealth Environment Protection (Sea Dumping) Act 1981*.

Dredging in general has the potential to cause both direct and indirect impacts to the marine environment. Disturbance of the seabed under the footprints of

the dredged areas is a direct impact, involving permanent removal of benthic communities and modification of their habitats. Similarly, dredge material disposal has the potential to bury benthic communities and permanently modify habitats at the disposal site and within an area immediately surrounding those sites. The direct impacts to benthic habitats associated with dredging are most often irreversible which, in the context of EPA assessments, means that the timeframe for recovery is expected to be greater than five years after the pressure associated with dredging has been removed.

Indirect effects of dredging are caused by sediments released to the water column through a combination of the mechanical interaction of dredging equipment with the seabed and release of sediment-laden water during the loading and unloading of vessels used to transport dredged material to the disposal site. In very simple terms, there are two main pathways of effects from this sediment that need to be considered:

- deposition of sediment particles on the seabed where they can smother or clog the feeding apparatus of benthic organisms that filter seawater as a means of acquiring their food (e.g. sponges); and/or
- transport of sediment particles in suspension as a turbid plume away from the dredge and spoil disposal sites under the action of water currents. This gives the water a cloudy appearance and reduces light available to benthic organisms that depend on photosynthesis for all or part of their energy requirements (e.g. corals, seagrasses).

Deposited sediments can be re-suspended through the action of waves and currents, where they contribute to turbidity plumes before being re-deposited, potentially multiple times, further down-current. The proposed dredging activities for the LNG Precinct will increase sediment deposition rates and water turbidity levels, which the proponent has predicted will impact benthic communities and cause visible plumes.

Other threats causing permanent alteration of benthic habitats include rock dumping (e.g. for breakwaters and pipeline stabilisation), placement of pylons (e.g. to support the product export jetty), positioning of jack-up platforms, and possibly sub-sea blasting. The presence of marine infrastructure would cause shading of the seabed in places and alter natural wave and current patterns potentially changing marine geomorphological processes (e.g. erosion and deposition). The potential effects of waste discharges on benthic habitats are considered separately in Section 3.3 of this report.

Policy setting

The EPA has developed Environmental Assessment Guidelines (EAGs) that are designed to impart consistency and clarity to its assessments of predicted impacts to benthic habitats from development activities.

With respect to proposed dredging and the presentation of predicted impacts to benthic communities associated with that activity, EAG No.7 (EPA, 2011) is relevant to this strategic proposal. EAG No.7 provides guidance for proponents on how they should describe and present the impacts to benthic habitats that are predicted to occur as a result of dredging proposals. As there

is often uncertainty associated with the predictions of dredging impacts, the EAG provides a framework for taking this predictive uncertainty into account during assessments, condition setting and operational management of dredging activities.

A fundamental part of EAG No.7 is a spatial zoning scheme that has been designed to impart clarity and consistency to the way predicted impacts of dredging activities on benthic habitats are presented. This spatial zoning scheme allows impacts to be presented in simple map forms that convey information about the anticipated extent, severity and duration of impacts. The zoning scheme comprises three zones, the Zone of High Impact (ZoHI), Zone of Moderate Impact (ZoMI) and Zone of Influence (Zol) which are summarised in Table 2 below.

Table 2. Description of the zones used to define the effects of dredging on marine benthic communities.

Zone of High Impact (ZoHI)	The area where impacts on benthic organisms are predicted to be <i>irreversible</i> , meaning that impacts in this zone render the habitat incapable of returning to a state resembling that prior to impact within five years or less. This zone is associated with the direct footprints of infrastructure and generally extends a short distance from those footprints.
Zone of Moderate Impact (ZoMI)	The area within which predicted impacts on benthic organisms are sub-lethal, and/or the impacts are recoverable within a period of five years following completion of the dredging activities. This zone abuts, and lies immediately outside of, the Zone of High Impact. The outer boundary of this zone is coincident with the inner boundary of the next zone, the Zone of Influence.
Zone of Influence (Zol)	The area within which changes in environmental quality (e.g. suspended sediment levels) associated with dredge plumes are predicted and anticipated during the dredging operations, but these changes would not result in a detectible impact on benthic biota. The outer boundary of the Zone of Influence encompasses all of the predicted maximum extents of dredge plumes and represents the point beyond which dredge-generated plumes should not be discernable from background conditions at any stage during the dredging campaign. While these areas can be very large, at any point in time dredge plumes are likely to be restricted to a relatively small portion of the Zone of Influence.

EAG No.7 also establishes clear guidance for proponents on the application of impact minimisation principles and best practice management of dredging operations and the design of environmental monitoring and management programs.

Proponents typically determine the boundaries of zones described in EAG No. 7 by interpreting outputs of numerical models that are applied to predict water quality implications of dredging against pressure thresholds for key sensitive biota (e.g. levels of sediment deposition or degrees of light reduction above which sensitive biota would be expected to experience either mortality or a lesser impact from which they could recover). The predicted zone boundaries are then superimposed over a benthic habitat map to provide

information regarding the location and extent of impacts to each habitat as well as an understanding of the severity and duration of impacts.

Taken together, this information about extent, severity and duration of impacts provides a basis for considering potential effects on overall ecological integrity, for determining whether those impacts are acceptable and, if so, for establishing a set of recommended conditions to manage those impacts.

Approach to impact prediction

Typically, there are five key steps involved in predicting the impacts of dredging on marine benthic communities:

1. Sediment source characterisation - Predict the amount of sediment that will be released during dredging.
2. Sediment transport and fate - Use source characterisation in a hydrodynamic model to predict sediment concentration and fate as it is carried away and dispersed by currents and deposited on the seabed.
3. Light attenuation - Determine the effect of sediment plumes on the amount of sunlight reaching the seafloor.
4. Biological thresholds - Set criteria that signify the thresholds of biological effect and impact using knowledge of sensitivity and tolerance to sediment and light reduction.
5. Impact prediction - Interrogate the model outputs and habitat maps using the biological criteria to determine the extent of the zones of impact and influence defined in Table 2.

The proponent has used this approach and applied a combination of hydrodynamic, sediment transport and water quality modelling to predict the potential extent and intensity of visible sediment plumes, and the extent and duration of resultant impacts to marine biota (DSD, 2010a). Predicted levels of dredge-generated turbidity and sediment deposition, and how these vary in space and time, were interrogated against various thresholds to predict the extent, severity and duration of impact on benthic communities that were either observed or predicted to occur based on habitat modelling.

These predictions of impacts on benthic communities were generally couched in terms of the spatial zoning scheme described in EAG No.7 (Table 2). Details of the numerical modelling and impact prediction associated with the dredging component of the strategic proposal as presented in the SAR are provided in Appendix C-13 of the SAR (DSD, 2010b). The proponent has set out an updated approach in the more recent documentation presenting the impact predictions associated with the most contemporary port design (DSD 2012b).

The proponent has indicated that, at the time the SAR was being prepared, some investigations to inform predictions of environmental impacts of dredging were well advanced (e.g. metocean studies, hydrodynamic and sediment transport modelling; benthic habitat mapping), while others were only at a preliminary stage (e.g. geotechnical surveys, port layout and engineering design, alternative dredge combinations). This introduced several sources of uncertainty to the assessment of a strategic proposal that would

not normally be the case in the environmental impact assessment of a more precisely defined project.

In order to account for key areas of uncertainty associated with the capital dredging elements of the strategic proposal, the proponent’s predictive work was underpinned by a number of assumptions, which it considered to be conservative. These assumptions are presented in Column 2 of Table 3. The proponent also considered that the application of several assumptions together was likely to have a compounding effect on the conservatism of predictions. The proponent explains this by indicating that the conservatism associated with one assumption (e.g. high volume of fines loss) is considered likely to enhance the conservative result produced by another assumption (e.g. low impact thresholds for biota). Conservatism in this sense means that it is very unlikely that actual impacts would be greater than the largest predicted using this conservative approach.

As described earlier, the more contemporary modelling undertaken since preparation of the SAR utilised new information that led to the revision of some of the original assumptions. The revised assumptions are set out in Column 3 of Table 3.

Table 3. Summary of assumptions and inputs associated with the process of predicting environmental impacts of dredging.

Note that references to section numbers in this table refer to sections of the SAR.

Source: Table 4.2 DSD,2012b

Inputs	Description – SAR	Description – Revised Assessment Approach
Fines Content	The highest fines content (29%) from the particle size distribution (PSD) samples taken during the preliminary geotechnical program has been used as the basis for modelling. It has been assumed that all material dredged will have a PSD where 29% of sediment has a particle size <63µm. It is likely that a range of sediment types will be encountered throughout the dredging program. This can only be confirmed through an expanded geotechnical program which is currently underway.	Recent PSDs show that the mean fines percentage is approximately 22% which is somewhat lower than the 29% assumed in the SAR. Further, the in situ density of dredged material for the SAR was very conservatively assigned as a uniform dry density of 2650 kg/m ³ , whereas the measured density has been confirmed to be typically below 2000 kg/m ³ . As a result, total spillage in terms of mass released into the water column per m ³ of excavated material reduces significantly for the revised assessment approach relative to the SAR.

Inputs	Description – SAR	Description – Revised Assessment Approach
Modelled Fines Loss	<p>The water quality and sediment transport modelling base case assumed uniform losses equating to 70% of in situ fines, which is the sum of 50% of in situ fines lost to the water column upon initial dredging plus a further 20% of in situ fines lost upon dumping. This equates to a total of 1.45 million cubic metres of fines being lost over a 12 month period. The assumed 50% loss of fines in initial dredging as cited above is considered very conservative; based on previous project experience which suggests losses in the range of 10% to 35% are more likely, depending on the dredge and sediment types involved.</p>	<p>Under the revised assessment approach, spill rates are assigned as a percentage of the given dredger's production rate, largely based on DHI's extensive spill monitoring database. However, the effective spill rate by mass into the water column is also a function of the fines content, the density of the material being moved, and the history of that material (specifically, whether a portion of the fines have already washed out in previous steps of the handling process). Once the progressive reduction of fines content is incorporated into this bookkeeping, the net spillage tends to be about 55% of the total volume of the fines present in virgin seabed material excavated, which is somewhat lower than the net 70% of fines assumed in the SAR. This is also a contributing factor to the lower total mass of spilled fines for the revised assessment approach.</p>
Metocean Conditions	<p>Metocean data selected to drive the hydrodynamic model (May 2008 to April 2009) is considered to represent an abnormally windy year, with three Tropical Cyclones (Billy, Dominic, and Freddy) and one significant tropical low affecting the region between December 2008 and February 2009. Cyclones are common in the region; however, the pattern experienced in 2008/2009 resulted in persistent abnormally high wind speeds along the Dampier Peninsula. For example, the wind speed exceeded 50% of the time between 2004 and 2008 was 3-4m/s and in 2008/2009 it was 12.5m/s. This is likely to have significantly enhanced the spreading characteristics of the plume.</p>	<p>For the revised assessment approach, candidate simulation periods were screened based upon hindcast wave statistics, wind statistics from Broome Airport, and in terms of the number and intensity of tropical cyclones passing within 500 km of the site, in order to confirm that the chosen simulation period is not an outlier. Based upon this analysis, the period of May 2007 – Jan 2009 was chosen as being adequately representative for the simulation of 21-month long revised dredging program. Further comparison (post submission of the SAR) of modelled and measured currents demonstrated that the hydrodynamic model captures the character and directionality of northward-directed tidal residual currents north of James Price Point. However, it matches somewhat less well, the weaker southward residual flow. Tests showed that the introduction of a forcing function from the north, equivalent to an artificial wind component of 5 m/s, onto the existing MesoLAPS wind fields does a reasonably good job of compensating for the apparent model bias in residual flows, showing a near-universal</p>

Inputs	Description – SAR	Description – Revised Assessment Approach
		improvement against the available current meter locations once this adjustment is implemented. This wind adjustment has been applied for the Revised Assessment Approach.
Discharge Frequency and Rate	<p>The water quality and sediment transport modelling uses a fixed continuous point source discharge over a 12 month period. Sediment losses associated with dredging programs are typically pulsed as a result of regular pauses between loading and dumping. In addition, delays associated with weather, breakdowns, maintenance, and sourcing dredging equipment frequently result in a staggered dredging program.</p> <p>Pulsing of sediment losses allows periodic dissipation of the plume, which therefore provides periods of relief/recovery for biota.</p> <p>The SAR did not incorporate weather downtime.</p>	<p>The modelling conducted for the revised assessment approach includes one cyclone season in which work continues unabated. Operations during the summer are complicated not only due to cyclone passages, which carry risks of attendant downtime as well as limited evacuation options for equipment from a remote worksite, but also due to seasonally elevated wave-induced downtime under non-cyclonic conditions.</p> <p>Weather induced downtime has been applied in the revised assessment approach in terms of a simple on/off threshold for each vessel, triggered by a hindcast significant wave height just offshore of the work area.</p>
Zone of Moderate Impact Thresholds	<p>The Zones of Moderate Impact (temporary loss) depicted in Section 6 of the SAR are considered conservative as they represent a range of conditions under which biota are likely to experience a range of physiological effects, ranging from no effect, through sub-lethal stress, to mortality. The thresholds used to define the outer boundary of these zones have been set at conservative levels based on available literature and previous project experience. The severity of the effect can generally be expected to increase with proximity/exposure to the sediment source. Therefore the likely effect in the area between the point source discharge and the boundary of the zones of moderate impact should not be considered uniform. It should instead be considered as a gradient ranging from no effect at the periphery, through sub lethal stress, to potential mortality closest to the source. For example, the coral zone of moderate impact threshold is set at a level which literature suggests is a likely transition point between no effect and sub-lethal effect. At</p>	<p>Revised impact thresholds by MScience (2012), for zone of moderate impact were developed for:</p> <ul style="list-style-type: none"> mixed benthos: a patchwork of various benthos including sponges, hard corals, soft corals, a variety of other sessile fauna, macroalgae and occasional sparse seagrass, generally with an average cover of 1-10% biota, or 40-70% cover if turf algae are included; seagrass beds: areas of sandy bottom with 2% to 20% cover of <i>Halophila</i> sp. with few other biota; <p>The revised thresholds for the zone of moderate impact were revised based on:</p> <ul style="list-style-type: none"> A review of recent literature on the effects of turbidity and sedimentation on hard corals, soft corals, sponges and seagrasses, and thresholds used in recent dredging projects; Experience drawn from monitoring around dredging programs off Western Australia's Pilbara Region; Surveys of the hard coral, soft coral, sponge and seagrass fauna of James Price Point; Laboratory-based experiments on the effects of sedimentation on

Inputs	Description – SAR	Description – Revised Assessment Approach
	this stage of assessment, with the data available, it is not possible to subdivide the zones of moderate impact.	corals and sponges, and light reduction for seagrasses, using species relevant to those identified to occur at James Price Point; Analysis of the baseline water quality recorded off James Price Point from November 2010 to June 2011; Integration of the above to develop thresholds at intensities and durations relevant to the physiological mechanisms of mortality and stress affected by the impacting processes.

Considered in the context of the key steps in the modelling process, the approaches used and any main differences between the modelling presented in the SAR and in the more contemporary modelling can be summarised as follows:

- Sediment source characterisation: In the SAR, the dredging was represented by a single, stationary, point source of sediment release and assumptions about the geology of the site. The more recent modelling represented individual dredges and their movements, revised estimates of fines production from new geotechnical information and knowledge of the production characteristics of the individual pieces of dredging equipment.
- Sediment transport and fate: Key outputs of sediment transport and water quality models are sediment deposition rates and total suspended solid concentrations. The revised modelling used the results of further measurements and analysis of currents and waves and a more finely resolved modelling grid than in the SAR. It also considered the effect of a net southward current drift that is apparent in some current metre records and a drogue deployment. The proponent argues that the revised model better represents the hydrodynamics of the region than that used in the SAR.
- Light attenuation: Total suspended solids (TSS) concentration affects water cloudiness or turbidity, which in turn affects the amount of light reaching the seabed. Light attenuation coefficient is a measure of how easily the water column can be penetrated by light. The proponent developed relationships for converting total suspended sediment concentrations generated by the sediment transport model into light attenuation coefficients, which in turn allowed predictions of the amount of light reaching the seabed to be made at each time step of the model, which could then be interrogated against the relevant biological thresholds. The same relationships were used in both sets of modelling.
- Biological thresholds: In the SAR the proponent defined the pressure thresholds by applying professional judgement based on reviews of

available information from other projects, published literature and information about the extent, distribution and biology of the various benthic habitats observed offshore from the James Price Point coastal area. A number of different tolerance criteria for sediment deposition and light were established to signify the zones of High Impact, Moderate Impact and Influence (DSD, 2010a, see Tables 2.4-1 and 2.4-2 in Part 3 of the SAR). Consistent with EAG 7, the proponent defined recovery within five years as a temporary impact and used this to define the Zone of Moderate Impact. Similarly, areas where substrate is physically removed or recovery is not expected to occur within five years were defined as Zones of High Impact (see Table 2).

A detailed description of the proponent's justification and rationale for the development of the original threshold values used is provided in Appendix C-13 of the SAR. The criteria for the Zones of Moderate and High Impact were subsequently refined by the proponent to take account of new information and used in the impact predictions for the more contemporary port design. The derivation and rationale for the more recent criteria are presented in MScience (2012).

The criteria defining the outer boundaries of the Zone of Influence were based on the proponent's assessment of the concentration of suspended solids above background that would be discernable by a casual observer. The same criteria were used for both sets of modelling.

- Impact prediction: In the SAR and the more recent impact modelling, the outputs of sediment transport and water quality modelling were interrogated against the biological thresholds to predict the outer boundaries for the Zone of High Impact, Zone of Moderate Impact and Zone of Influence. The SAR presented a wide range of possible outcomes that reflected the conservative nature of the assumptions used and the degree of confidence that could be placed on the predictions at that time. The revised model outputs have been rationalised so that a single output is produced while still providing predictions that account for the remaining uncertainty that exists around the likelihood and importance of a southward flowing residual current that may be present.

The two sets of criteria used in the modelling are set out for comparison in Table 4 below:

Table 4. Impact thresholds applied for the impact assessment presented in the SAR and 43A Dredging Application.

Category	Receptor	SAR	S43A Application
		Threshold	Revised Threshold
Zone of Influence (ZOI)		TSS from dredging alone > 5mg/L for 5% of the modelled period	
Zone of Moderate Impact (ZOMI) [‡]	Coral ¹	Median sedimentation over four weeks >30mg/cm ² /d above background daily	Mean Sedimentation > 84mg/cm ² /d over a rolling 84 day period for entire year in water depth < 14m
	Coral - chronic	Any 56 days in a 64 day period where mean daily PAR ≤ 25% relative to natural levels	
	Seagrass - acute	Mean daily SI ² <1% for three days	Mean daily TSS>([234/z]*f-3.4) for 30 days in any 36 day period between April and November in water depth <25m
	Seagrass - chronic	Mean daily SI ² <12% for 15 days	
Zone of High Impact (ZOHI)	Water Quality	Any 84 day rolling period when the sum of gross sedimentation > 7056mg/m ² + Direct Dredging Footprint + 1000m	Direct Dredging Footprint + 1000m

Notes

Z=depth in metres

"<" means "less than"; ">" means "greater than"

f = seasonal correction factor

PAR = Photosynthetically Active Radiation

[‡] occurs where any threshold is exceeded

¹. Corals are recognised as one of the most sensitive marine receptors for anomalous increases in sedimentation and turbidity (Brown *et al.*, 1990 in DSD 2012b), therefore, in lieu of a categorical level of sedimentation at which seagrass mortality is known to occur, the coral ZOHI sedimentation threshold has been adopted for seagrass to account for potential impact from chronic fines sedimentation.

². SI Sub-surface irradiance

Source DSD 2012b

Predicted impacts and effects

The Zone of High Impact in the SAR for seagrass/ macroalgae and for hard coral/ filter feeders was predicted to be confined to the area of the port and extend 1000 m radially from port infrastructure or the port precinct boundary (Figures 11 and 12). Predicted Zones of High Impact for the whole port Precinct development scenario and two different indicative port designs are shown in Figures 11 and 12. The figures show that by varying the design of a fully-developed port, the area and outer boundary of the Zone of High Impact varies accordingly.

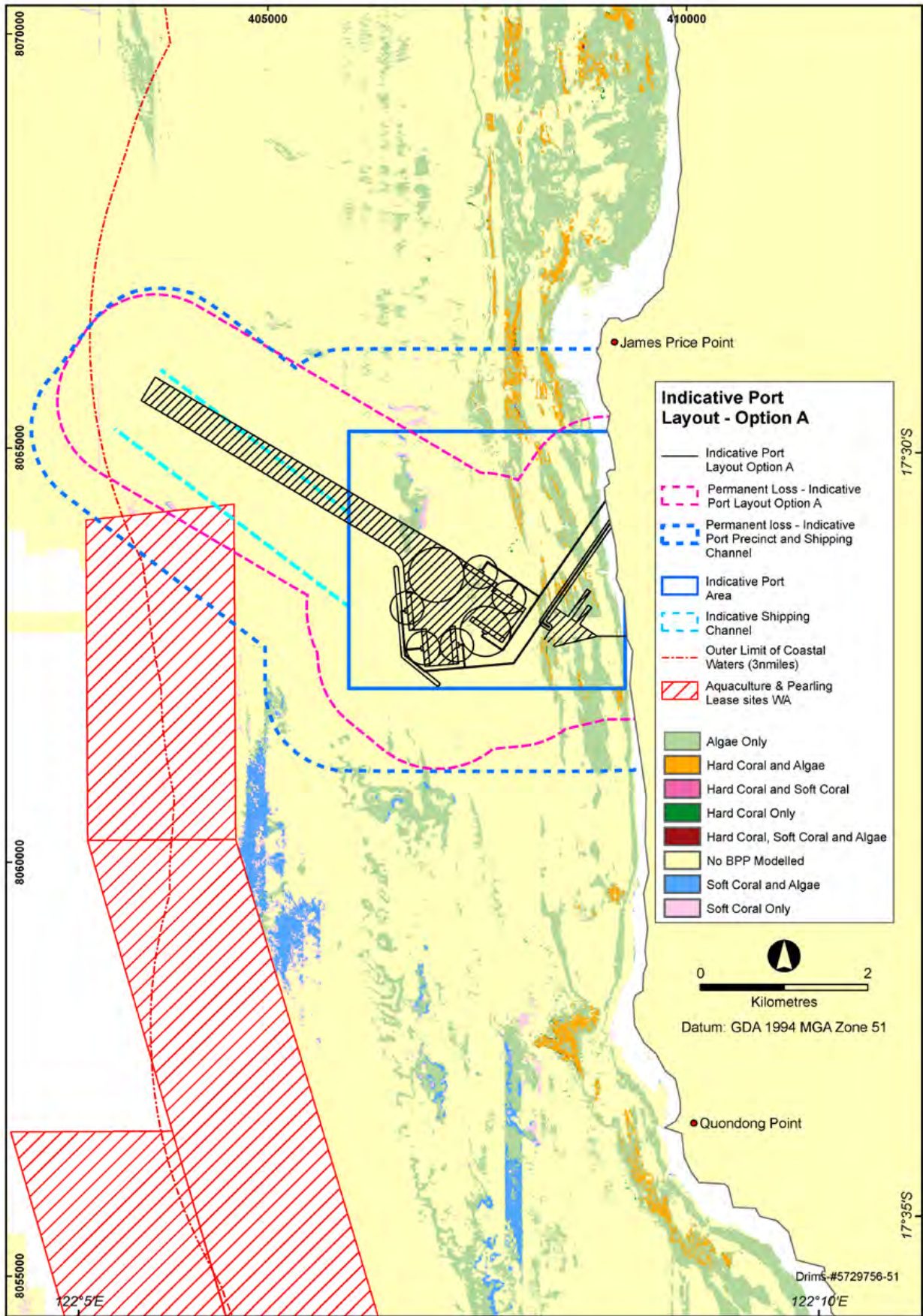


Figure 11. Predicted Zone of High Impact (i.e. permanent loss) for port layout option A and for the broader port area.

Source: Figure 2.4-2 in Part 3 of the SAR

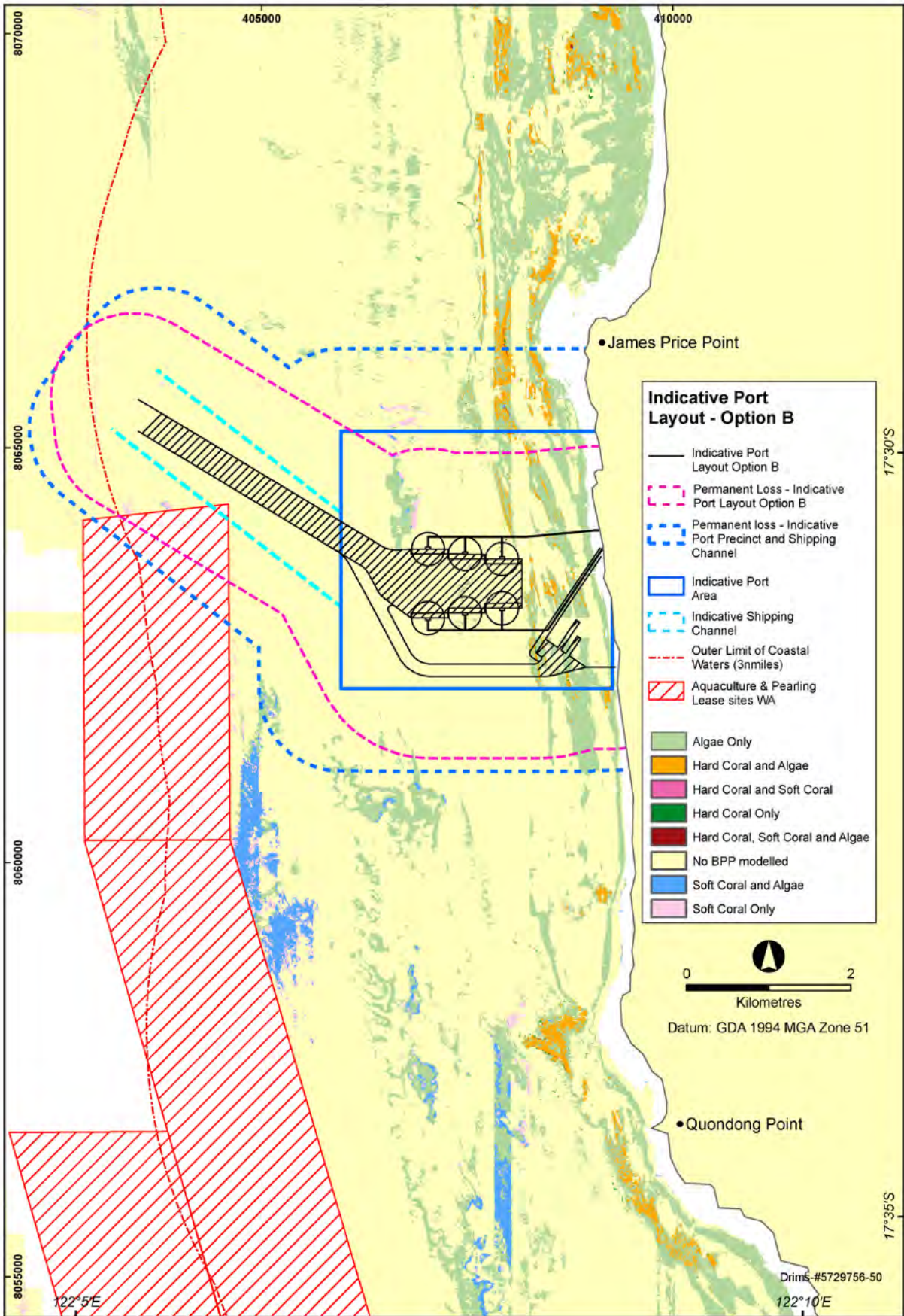


Figure 12. Predicted Zone of High Impact (i.e. permanent loss) for port layout option B and for the broader port area.

Source: Figure 2.4-3 in Part 3 of the SAR.

Predicted zones of High and Moderate Impact generated using the different pressure thresholds used in the SAR are shown in Figure 13. In the SAR, the proponent tested the sensitivity of predictions based on an initial relationship between total suspended solids and light attenuation coefficient by varying a key constant in that relationship. The effects of using the alternative conversion relationship are shown in Figure 14.

Figures 13 and 14 show that the predicted extent of the Zone of Moderate Impact depends on the type of receptor (e.g. coral or seagrass), and the consequent assumptions about the critical level of light reduction (due to suspended sediment in the water column) that will lead to an impact on that receptor. Figure 14 indicates that the modelled Zone of Moderate Impact is substantially smaller if the alternative relationship is used for converting modelled total suspended solids concentrations into a light attenuation coefficient. Although the effect of applying this alternative relationship was not tested for the revised modelling, it may be reasonable to assume that if it was applied, the size of the resultant Zone of Moderate Impact may reduce by similar proportions to those in Figure 14.

The Zone of Moderate Impact for seagrass/macroalgae was predicted to extend from about Coulomb Point to about 5 km south of Quondong Point (about 35 km) and up to about 15 km offshore when the criterion of the mean daily photosynthetically active radiation (PAR) value $< 1\%$ of normal for three consecutive days (brown dashed line in Figure 13) is used. The Zone of Moderate Impact was predicted to extend from offshore Carnot Bay to south of Cape Boileau (about 70 km) in a 20 km wide band using the criterion of mean daily PAR $< 12\%$ of normal for 15 consecutive days (black dashed line in Figure 13).

The Zone of Moderate Impact for hard coral/ filter feeders was predicted to extend from north of Cape Baskerville to south of Willie Creek (about 90-100 km) in a band about 20 km wide if the criterion of $< 25\%$ of natural PAR levels for any 56 days in a 64 day period is used (blue dashed line in Figure 13). The composite Zone of Moderate Impact generated for the most contemporary port design using updated assumptions and modelling extends from just south of Coulomb Point to just south of Cape Boileau, but excluding Barred Creek (area bounded by dashed red line in Figure 15). This includes the possibility of a net southerly current in the area.

The proponent anticipates that light conditions within the predicted Zone of Moderate Impact would return to those typical of the normal range once dredging finishes, allowing re-colonisation and recovery of benthic communities to occur within a period of five years.

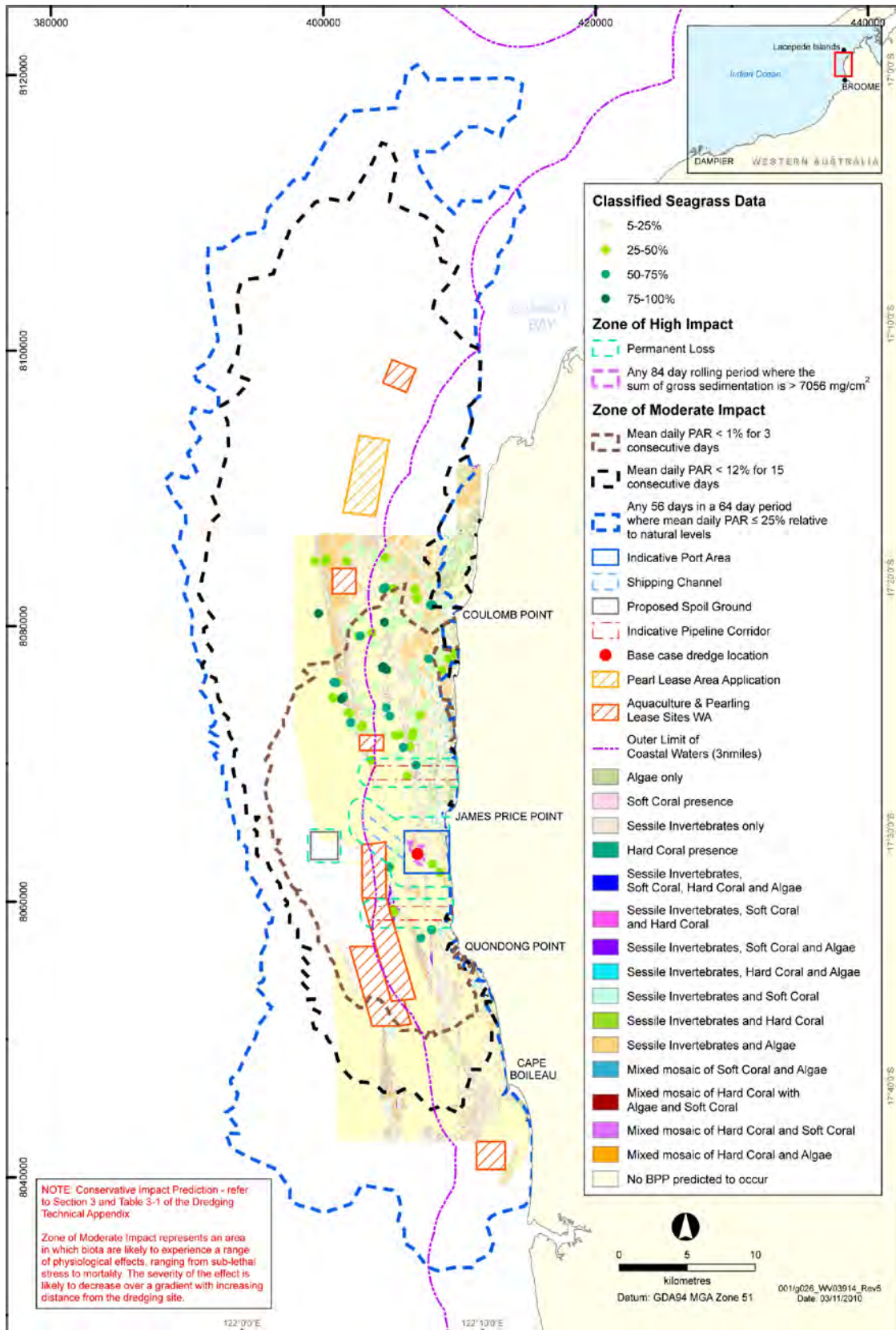


Figure 13. Cumulative predicted impacts to BPP and non-BPP shown as Zone of High Impact and Zone of Moderate Impact generated using initial relationship for converting modelled total suspended solids concentrations into light attenuation coefficient.
Source: Figure 2.4-5 in Part 3 of the SAR.

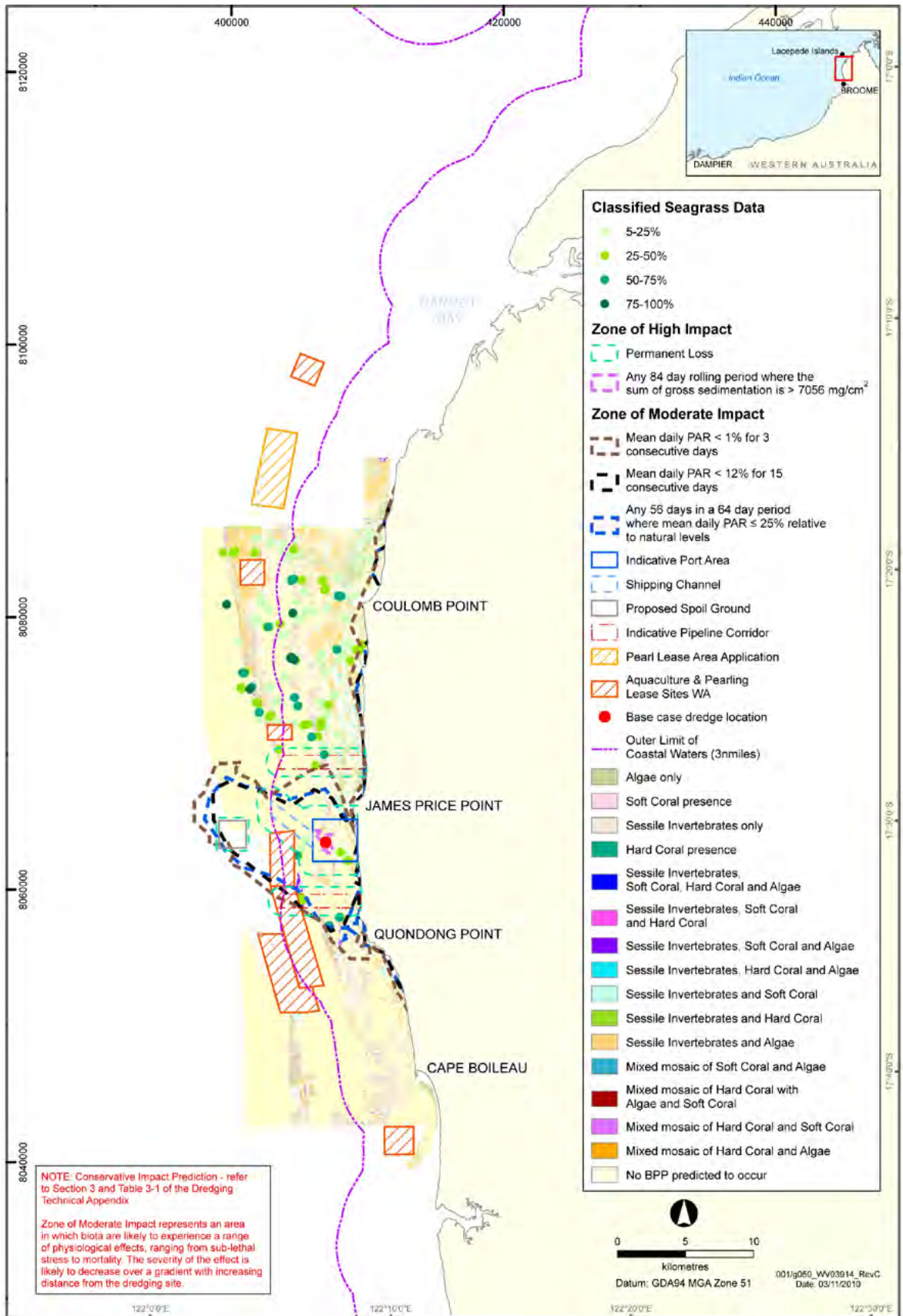


Figure 14. Cumulative predicted impacts to BPP and non-BPP shown as a Zone of High Impact and Zone of Moderate Impact generated using an alternative relationship for converting total suspended solids concentrations into a light attenuation coefficient.
Source: Figure 2.4-6 in Part 3 of the SAR.

The Zone of Influence was predicted using the same criteria in both the original and revised modelling in that it was deemed to be present wherever the TSS concentration was predicted to be 5 mg/L or more for 5% or more of the duration of the dredging campaign. The differences between the predictions in the SAR and the more recent predictions are therefore based on the different model setup, updated assumptions and calibration, the different port designs and the consideration of residual currents.

The Zones of Influence predicted in the SAR and for the revised modelling are shown in Figure 16. The Zone of Influence predicted in the SAR is represented by the dashed black line in Figure 16 and extends from north of Cape Baskerville to Gantheaume Bay; a distance of more than 100 km. The Zone of Influence predicted from the revised modelling is shown for a 'normal' current and an 'imposed' current that is considered by the proponent to approximate the effect of a southward residual current. Under normal conditions the revised modelling shows the predicted Zone of Influence extending as far north as Beagle Bay. If a southerly drift is factored in then the Zone of Influence extends past Gantheaume Point and ends south of Broome.

The contemporary view of the proponent is that the Zone of Influence is therefore most likely to be contained within these scenarios combined (the solid black line in Figure 16). This combined zone extends further north and further south than that depicted in the SAR.

As an indication of what the plumes might look like at any point in time the proponent presented 'snapshots' showing turbidity contours under a range of tidal conditions based on modelling undertaken for the SAR. The Zone of Influence in the summer snapshot extends from Quondong Point in the south to near Coulomb Point in the north (a distance of about 25 km), and to approximately 14 km seaward of James Price Point which is beyond the limit of State waters (DSD, 2010a). During this summer spring tidal period, more intense plumes with sediment concentrations reaching 50 mg/L or more above background were predicted in an area radiating out between 3 to 5 km from the dredging location (Figure 17).

During winter ('dry' season) neap tides, when weather conditions in general tend to be calmest and currents are weakest, sediment was poorly dispersed and concentrated near the dredge site with predicted levels exceeding 750 mg/L immediately adjacent to the dredging location. The lesser extent of plumes and the plume-concentrating effect of weak currents during a winter neap tide cycle are shown in Figure 18.

The proponent has provided further analysis of the probability or frequency that the plume might be evident during the dredging program for the revised modelling. Figure 19 shows the percentage of the time that the plume was predicted to be present under southerly drift conditions. This diagram shows a visible plume that tends to hug the coast and is present at the mouth of Willie Creek for up to 90% of the dredging campaign. The plume is seen to enter the creek and be present there up to 80% of the time. Barred Creek is located closer to the dredging activities, just behind Cape Boileau, and although not resolved in the simulation it can be inferred that plumes would be present at the mouth of the creek for practically the entire duration of the 21-month dredging campaign.

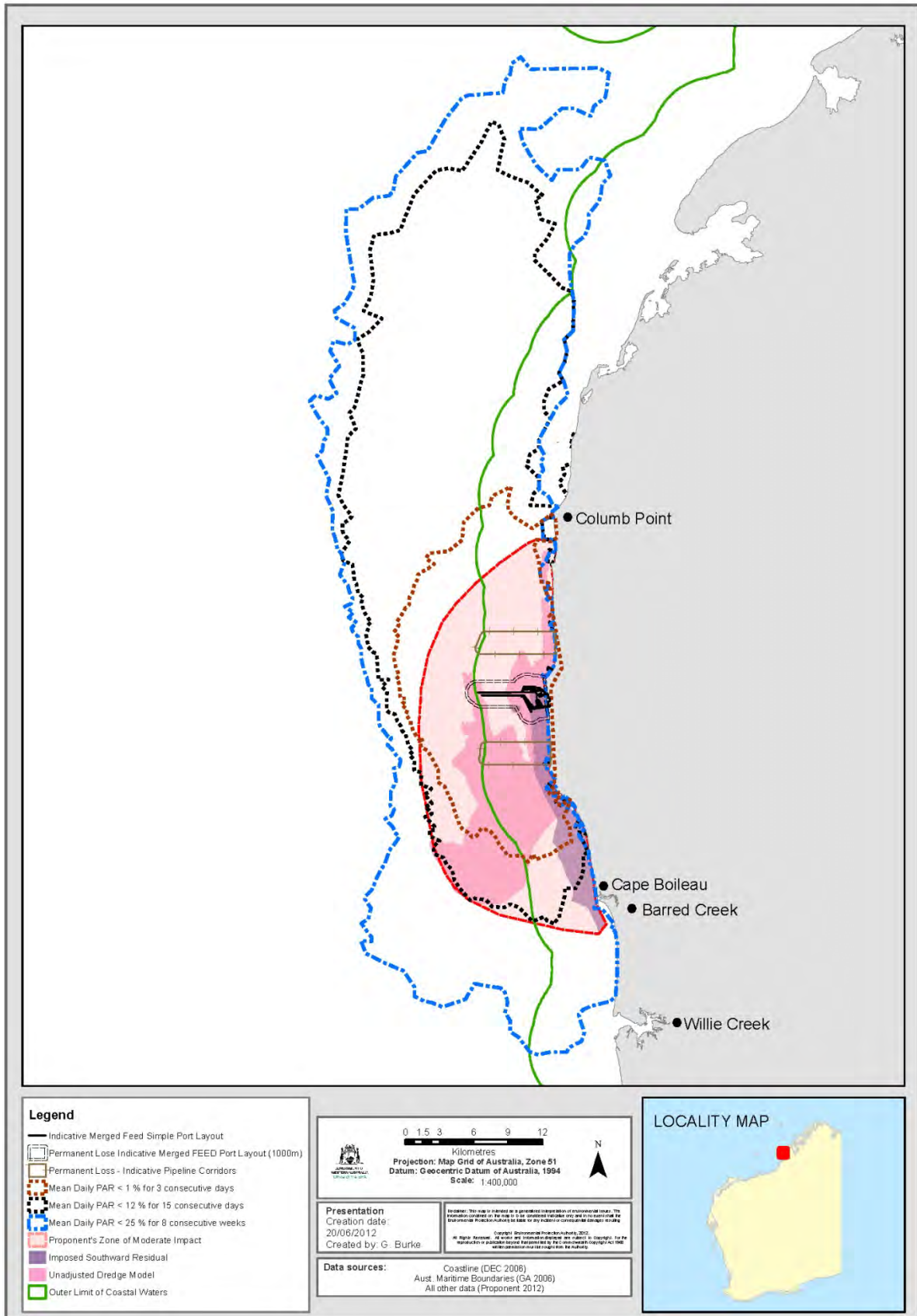


Figure 15. Combined Zone of Moderate Impact (ZOMI) for Phase 1 unadjusted model and imposed southward residual current. Predicted infill of ZOMI with overlay of three predicted ZOMI areas as presented in the SAR.

Data Source Figure 4.5 DSD2012b.

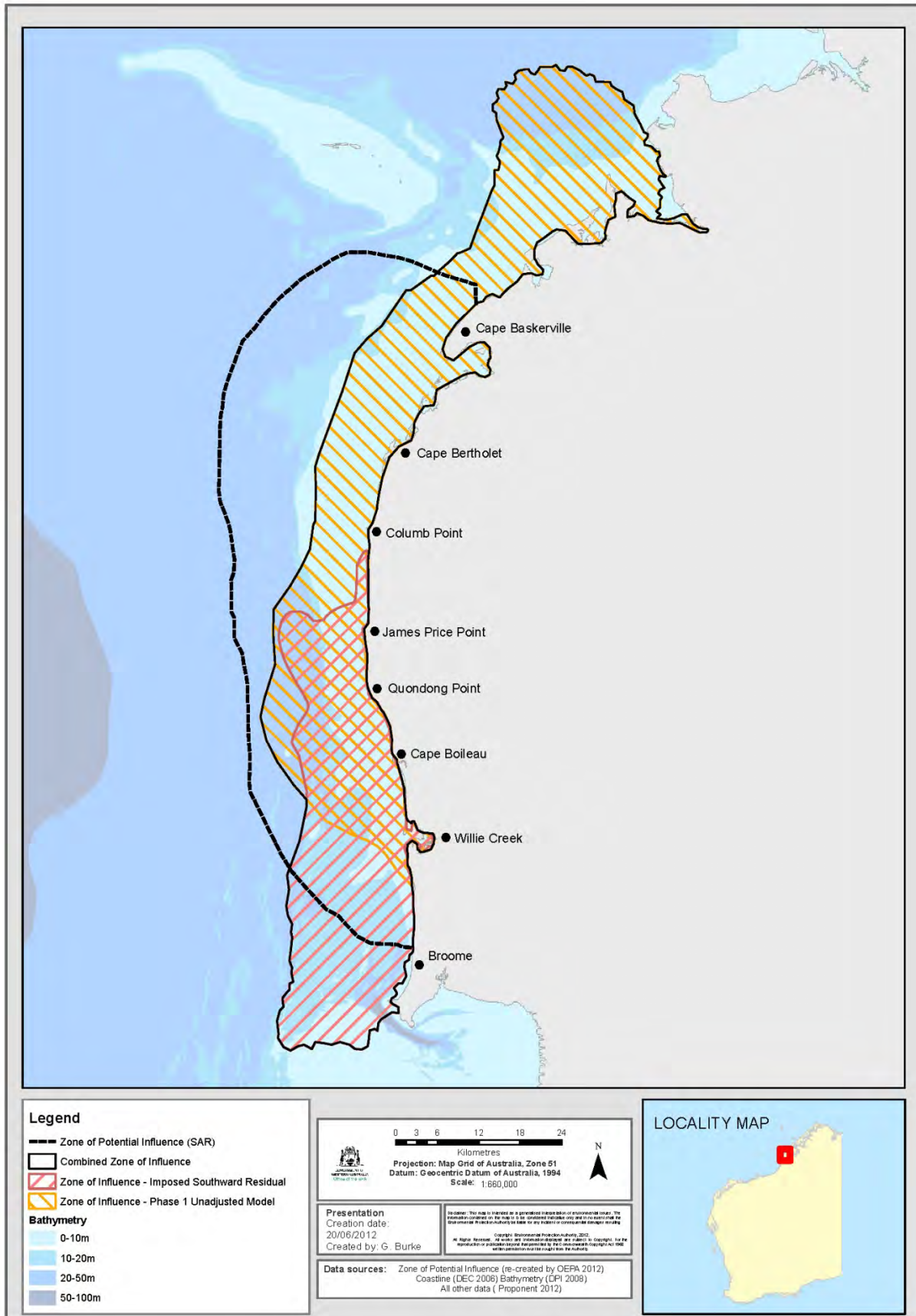


Figure 16. Zone of Influence (ZOI) for Phase 1 unadjusted model and southward residual. Dashed black line shows the predicted ZOI area as presented in the SAR.

Data Source Figure 4.7 DSD2012b.

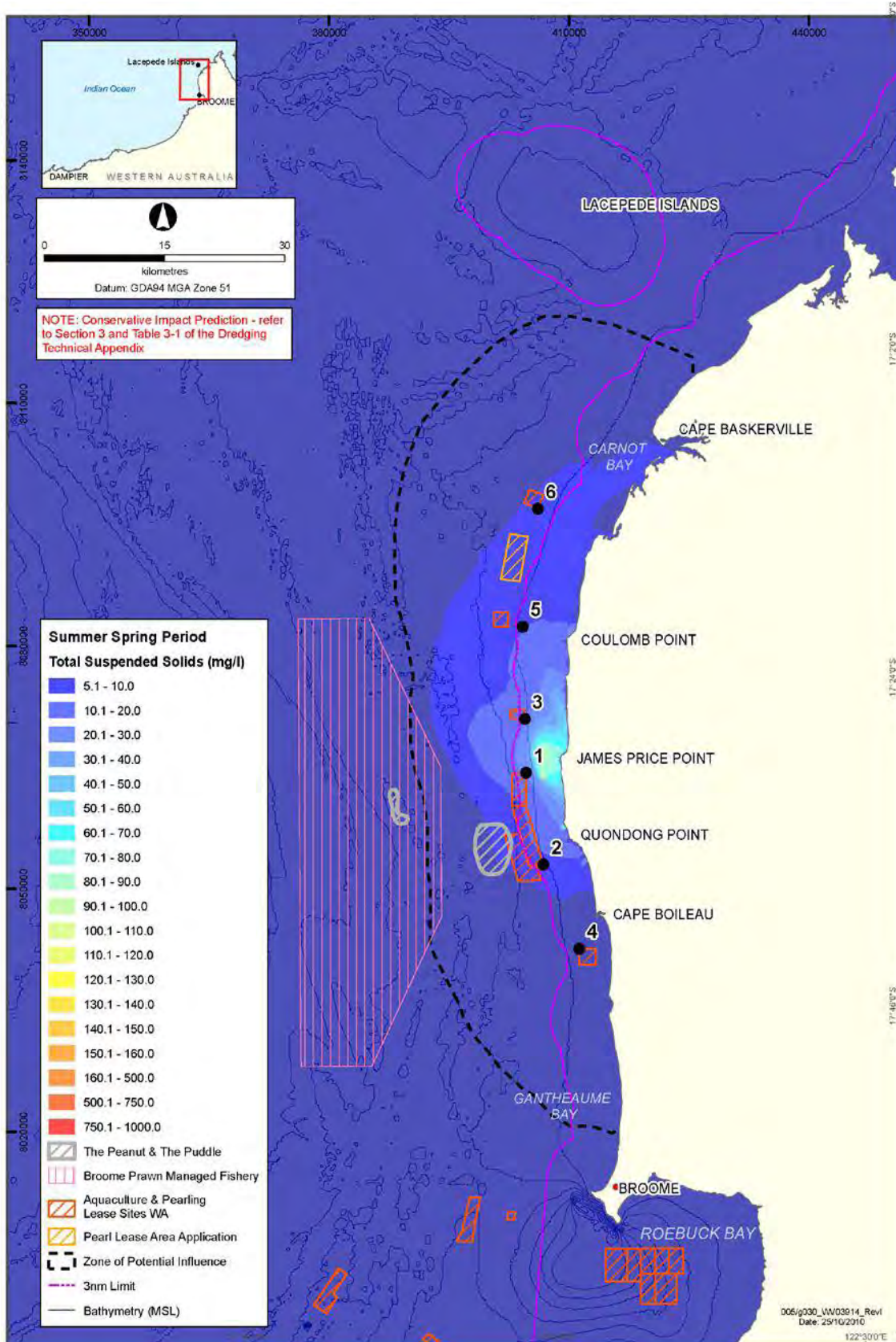


Figure 17. A water quality model ‘snapshot’ (i.e. a particular point in time) showing the contribution of suspended solids (i.e. above background) during summer spring tide conditions. The black dashed line represents the outer boundary of the predicted Zone of Influence over the entire dredging campaign. Source: 2.3-2 in Part 3 of the SAR.

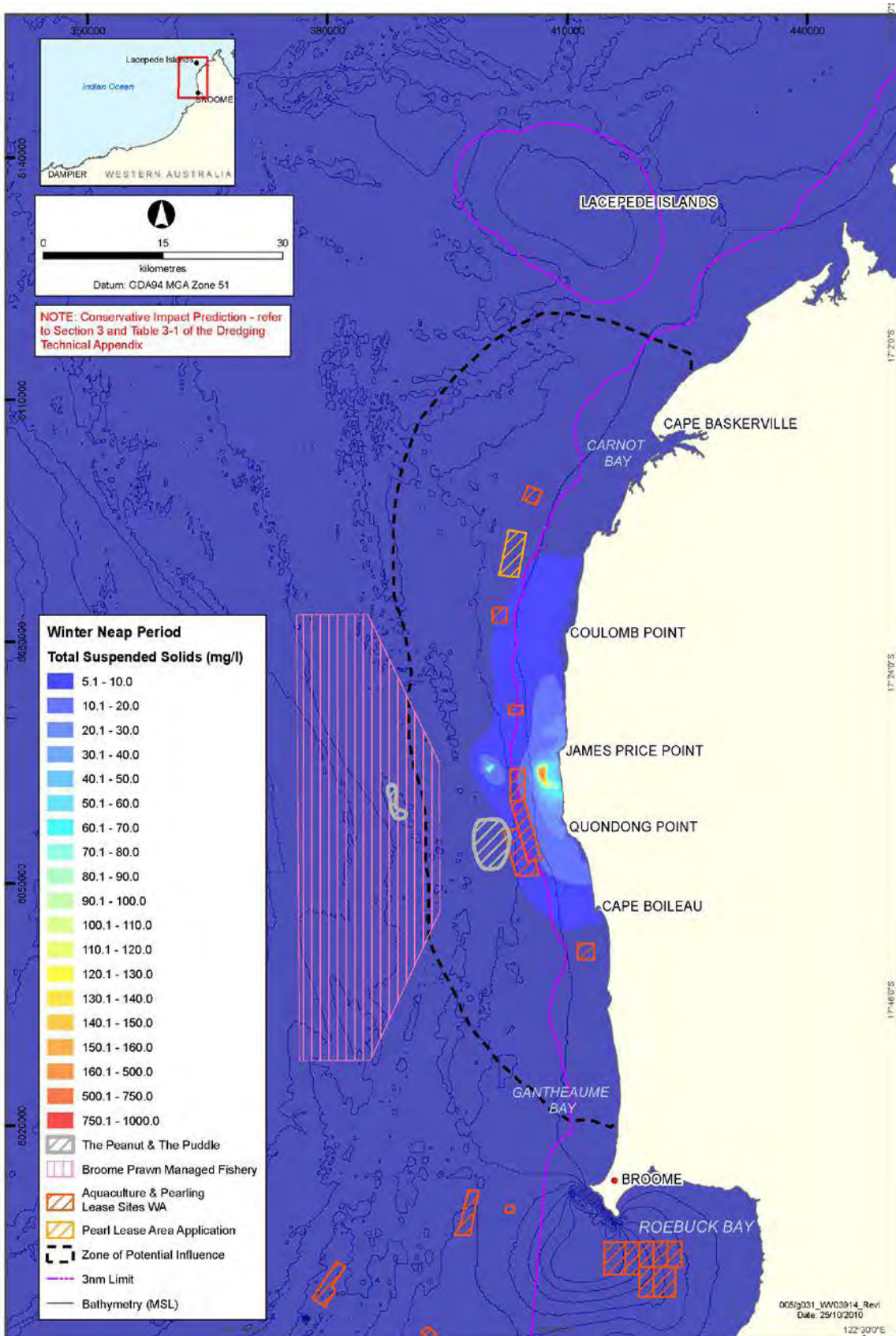


Figure 18. A water quality model ‘snapshot’ (i.e. a particular point in time) showing the contribution of suspended solids (i.e. above background) during winter neap tide conditions. The black dashed line represents the outer boundary of the predicted Zone of Influence over the entire dredging campaign. Source: 2.3-5 in Part 3 of the SAR.

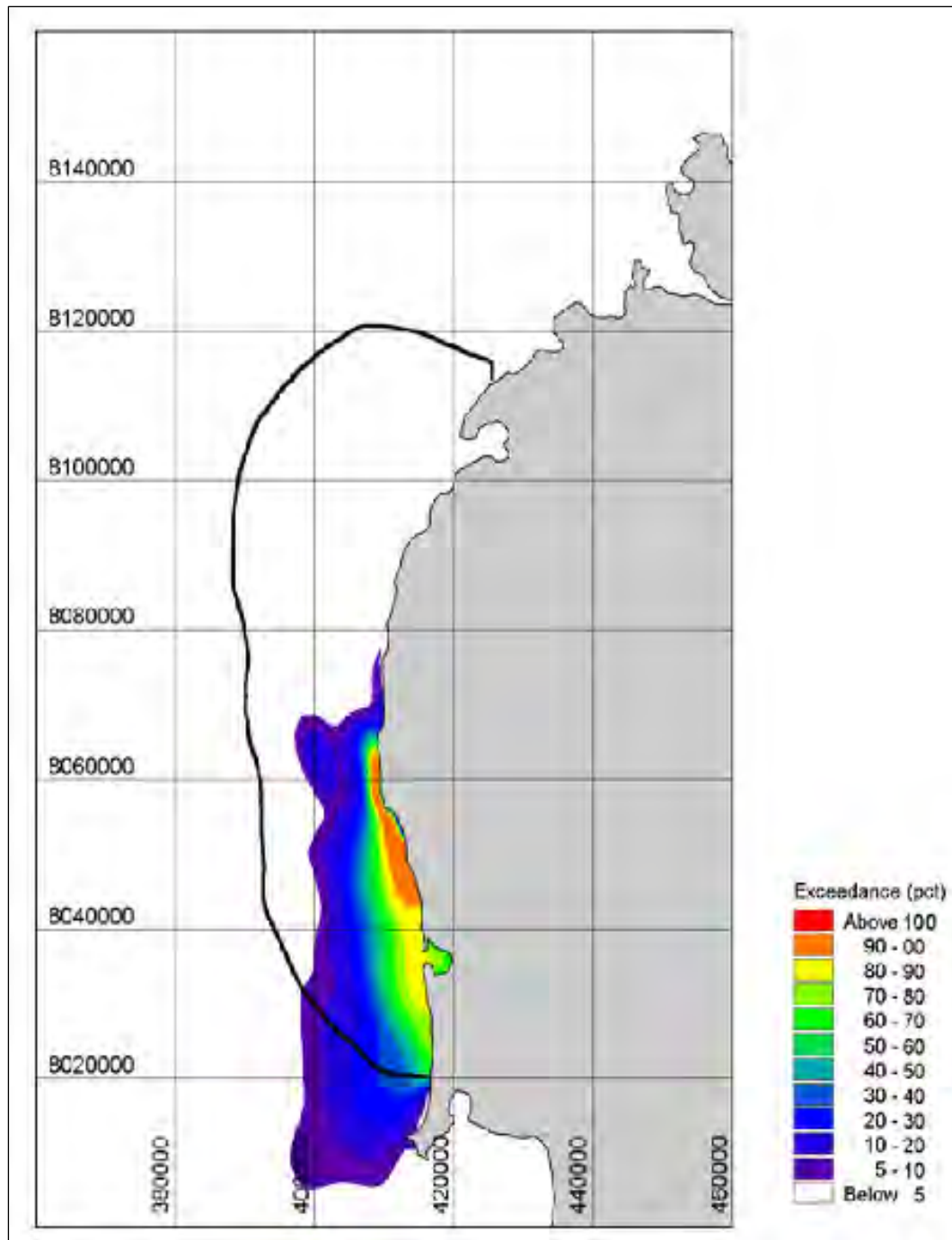


Figure 19. Zone of influence (ZOI) shown as percentage exceedance of threshold, with imposed southward residual current.

Source DSD, 2012b.

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Environment and Conservation (DEC)

Points from the DEC submission relevant to this factor include:

- the potential for loss of benthic primary producer habitat (BPPH) to directly and indirectly impact marine fauna.

Kimberley Land Council (KLC)

Points from the KLC submission relevant to this factor include:

- specific management measures are required in terms of BPPH loss so Traditional Owners can gain an understanding of impacts and the ability to manage these impacts.
- more detailed dredge spoil modelling is required for derived proposals;
- the Dredge Spoil Disposal Management Plan (DSDMP) will be critical in providing specific details on how impacts from dredging will be reduced and managed and will need to be reviewed and endorsed by the Traditional Owners;
- it is unclear if or what opportunity there is for Traditional Owner review and consultation on the suitability of spoil grounds; and
- further specific details are required on the predicted impacts to coastal habitats as a result of changes to sediment transport.

Woodside Energy Limited (Woodside)

Points from the Woodside submission relevant to this factor of the assessment include:

- the EPA should give greater consideration to the site selection process as opposed to cumulative loss calculations of BPPH in the Local Assessment Unit;
- considers the use of EAG 3 in the determination of offsets to be inconsistent with the proposal to develop a multi-user LNG precinct; and
- due to the strategic nature of the proposal the predictions of the range of impacts are conservative (e.g. dredge modelling) and concern that this may result in undue stakeholder concern, management measures not commensurate with the actual likely scale of impact and offsets being specified in proportion to conservative impacts and not the actual environmental outcomes.

Public submissions and conservation groups raised concerns about:

- increased turbidity as a result of dredging reducing light availability and smothering benthic communities, in particular sea grass;
- benthic surveys being undertaken over one season and therefore not allowing for seasonality;
- impacts to fauna as a result of loss of BPPH;
- the extent of the zones of High and Moderate Impacts;
- information gaps in seagrasses and corals; and
- the predicted loss of BPPH as a result of dredging will exceed the EPA's guidelines in EAG 3.

In common with other fisheries interests, customary fishers were concerned that there would be considerable repetitive dredging required, and that this would cause excessive silting of a wide area because of the currents and high tidal range (DSD, 2010a).

Assessment

The EPA's environmental objectives for this factor are to maintain ecological integrity, and protect the biodiversity and environmental values of WA's marine environment.

The EPA has considered information presented in the SAR, public submissions and the proponent's responses to submissions. It has also considered the revised impact predictions contained in an application under section 43A of the EP Act to change the proposed volume of material and the duration of dredging (DSD, 2012b), as well as other advice it has received, and made the following assessment.

Assessment of the scope of work

The hydrodynamic model applied to inform sediment transport and water quality modelling is a two dimensional model, and although the validity of this approach has been tested against outputs of a three dimensional model, key components of the overall modelling approach presented in the SAR were un-calibrated or calibrated based on limited data (BMT WBM, 2010). While this level of input is commensurate with a strategic level assessment, it needs to be kept in mind during the following analysis.

It is noted that the predictions of indirect impacts of dredging contained in the SAR are based on outputs from the sediment transport and water quality model that uses a stationary 12-month continuous sediment source located roughly in the centre of the indicative port design. The EPA acknowledges that, in the absence of both a detailed port design at this strategic stage of assessment and data with which to develop a detailed dredge log for modelling purposes, it was necessary for the proponent to underpin its impact prediction process with a range of general assumptions. The simplicity of some assumptions and the uncertainty that these assumptions expose in the impact prediction process have been taken into account for this assessment.

For example, while there had been some testing to examine the sensitivity of water quality predictions to changes in the release characteristics of dredge-related sediment in the model, the limitations of the approach for allowing a rigorous appraisal of the likely effectiveness of a particular dredge management option has apparently influenced the proponent to present worst-case predictions, which in some cases the EPA considers are highly conservative and unlikely scenarios that do not warrant further detailed consideration.

Notwithstanding the above, the EPA recognises that modelling undertaken since production of the SAR (in DSD, 2012b) benefitted from improved bathymetric, geotechnical and metocean data including a higher resolution modelling grid and better representation of wave-induced resuspension and improved calibration of the hydrodynamic model. The simulation also included a more realistic representation of how the dredging might be undertaken. The modelling included partitioning the work area and representing dredge movements, cycling times and production/spill rates for each piece of equipment in the different geotechnical settings within the Precinct's port area. The outputs of the hydrodynamic and sediment transport models were interrogated against a revised set of environmental impact thresholds. The development of the revised impact thresholds was informed by further habitat surveys, analysis and research, and as such they are considered more relevant to the marine benthic communities off the Dampier Peninsula coast than those used in the SAR. More detail about these changes can be found in Table 3 and Appendix 10.

The proponent recognises that uncertainty remains, but argues that incorporation of a better understanding of the proposal design and the environmental setting have, in combination, improved confidence about the likely extent, severity and duration of impacts. The result of this remodelling showed that the significant environmental impacts expected for the zones of High and Moderate Impact as a result of dredging fell within the envelope of predictions made for these zones in the SAR (Figure 15).

The EPA has been presented with a summary of the recent modelling and approaches used, including a comparison of net residual currents associated with an imposed northerly wind (see Appendix 10), but does not have access to the detailed technical reports supporting this modelling. As such the EPA has not been able to independently verify the proponent's assertions with respect to the modelling. Nonetheless, the EPA accepts the proponent's assertion that greater confidence can be placed on the contemporary modelling than that presented in the SAR based on improvements in the data available, refined assumptions and direct questioning of those involved in the modelling work.

Assessment of proponent's description of benthic habitats

High-resolution LADS-derived bathymetric data collected by the proponent has provided a fundamental data set to assist in understanding the extent and distribution of benthic habitats off the James Price Point coastal area.

The proponent has been fortunate to have access to a significant contemporary data set for the benthic substrates and habitats (Fry *et al.*,

2008) in areas off James Price Point to inform both additional dedicated surveys to fill gaps and to calibrate and validate its predictive modelling of habitat distributions. It is noted that the proponent had difficulty accessing pearl leases to acquire benthic habitat data within those lease areas within State Waters that are within the indicative southern pipeline corridor and the predicted zones of High and Moderate Impact associated with dredging.

The proponent used the available data sets and habitat modelling techniques to produce full coverage benthic habitat distribution maps for a large area of interest (approximately 500 km²; DSD, 2011a). The EPA recognises that developing the full-coverage maps of benthic habitat distribution over this large area is a considerable undertaking. It also recognises that, unlike areas in WA's south which are characterised by clearer water that enable proponents to capture high quality water-penetrating aerial photographs which provide a basis for deriving actual full coverage benthic habitat maps, technical challenges and water clarity conditions off the James Price Point area have necessitated that the proponent apply a predictive modelling approach to derive habitat distributions.

The resultant predictions are presented in Part 3 of the SAR as a series of 'derived' benthic habitat maps for macroalgae, hard corals, sessile invertebrates and for all habitats combined. A map showing both point data for seagrass presence and cover, and derived distributions for combined benthic habitats is shown in Figure 20 (also shown as Figure 3-1 of Part 7 of the SAR; DSD 2011a).

The data and habitat modelling outputs underpinning the maps shown in the SAR, including the one presented as Figure 20 below, form the basis for the proponent's calculation of benthic primary producer habitat loss and other estimates of the areas of habitat predicted to be indirectly impacted by dredging activities (i.e. the areas of habitat within predicted Zones of High Impact and Zones of Moderate Impact). The EPA notes that the predicted habitat distributions for areas within the pearl leases are not presented in these figures and have not been used in the calculations of habitat loss. Although the benthic habitat maps such as that shown in Figure 20 are generated using a predictive model, the proponent has indicated that a high degree of confidence can be placed in the information conveyed by these habitat maps. The proponent has undertaken further surveys since the SAR was prepared, which provide further validation and insight into the degree of inter-annual variability and seasonality of the key benthic communities such as the ephemeral seagrass and the longer lived and more stable filter feeding communities.

The EPA has assessed benthic habitat loss and formulated judgments regarding the environmental acceptability of predicted impacts using these modelled habitat distributions recognising that, as with any prediction, there is a degree of uncertainty associated with the benthic habitat maps which needs to be taken into account.

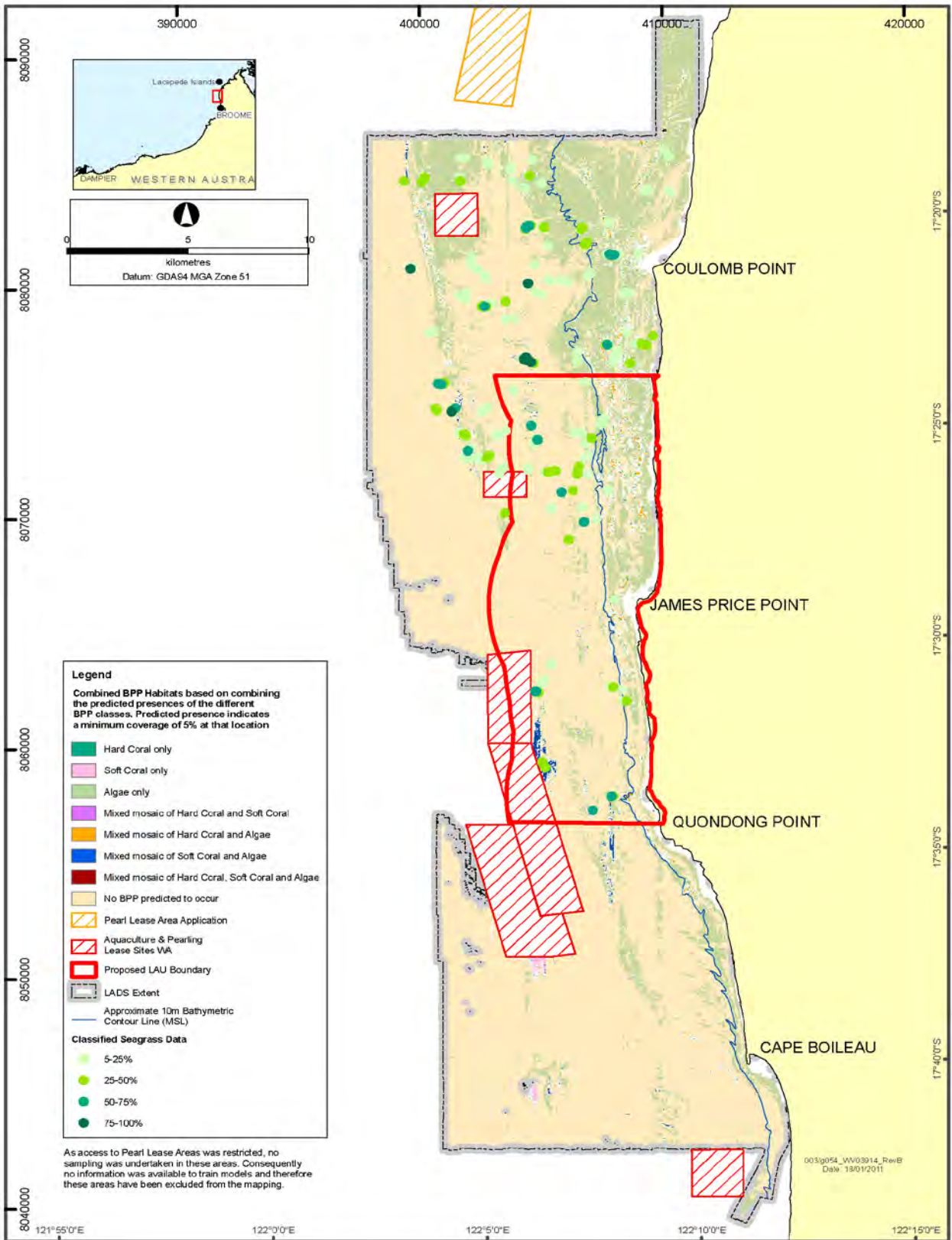


Figure 20. A map showing derived distributions of combined benthic habitats offshore from the James Price Point coastal area.

Source: Figure 3-1 in Part 7 of the SAR.

In view of the issues discussed above, the EPA urges proponents of future proposals to carefully consider the information conveyed by these maps and the associated assumptions and limitations when considering issues such as habitat loss assessments, siting of infrastructure, monitoring and reference sites for benthic monitoring and reactive monitoring of construction activities, and strategies to be employed for comparing the baseline condition of benthic habitats with those conditions following completion of construction activities.

Assessment of the proponent's consideration of threats

The proponent has considered key threats to benthic habitats to the extent it has been possible to identify them at the strategic level. With an understanding of these threats and the attendant pressures they generate, the proponent has endeavoured to provide predictions of their potential impacts on benthic habitats.

The proponent's predictions of direct and indirect impacts on benthic habitat associated with marine construction activities and the presence of infrastructure are considered to warrant detailed assessment. Threats to benthic habitats from ongoing operations and maintenance of the port (e.g. maintenance dredging) also require particular attention.

Assessment of predicted impacts on benthic habitat

The benthic habitats off James Price Point comprise both light-dependent BPPH (e.g. coral, seagrass, macroalgal habitats) and other non-BPPH (e.g. benthic invertebrate habitats). The proponent has applied various methods to predict the extent, severity and duration of impacts to these benthic habitats. The predictions of permanent loss have been presented and evaluated in the context of EAG No.3 (EPA, 2009). The proponent has also generated predictions of the potential indirect and recoverable effects of dredging activities on all the different mapped benthic habitats and presented those predictions in the context of EAG No.7. There is no published guidance for assessing the potential ecological implications of temporary reductions or losses of benthic habitats other than those that contain primary producers. Accordingly, the EPA has applied professional judgement to formulate its view of environmental acceptability of these impacts, considering previous experience and the professional technical and scientific advice it has received.

In order to generate predictions of impacts associated with marine infrastructure and dredging activities associated with this strategic proposal, it has been necessary for the proponent to make a number of assumptions. For example, because at the early stage of the assessment of the strategic proposal there were significant uncertainties regarding the detail of actual proposals to be developed within the Precinct, the proponent based predictions of direct impacts of marine infrastructure on an indicative port infrastructure layout (Figure 2-2 in Part 7 of the SAR, DSD, 2011a) and indirect impacts were predicted using modelling, which in turn was underpinned by a variety of general assumptions (DSD, 2010a). The indicative port layout may be considered realistic in the sense that it included each of the major elements that could be foreseen at this stage as being parts of a fully developed port facility. The proponent considered that assumptions

associated with predictive modelling incorporate an appropriate degree of conservatism (DSD, 2010a).

The more recent impact modelling is for a more mature port design (DSD 2012b) and considered by the proponent as likely to be more realistic than that presented in the SAR. The more contemporary design includes more detail on the core elements comprising the IMF and refinements to the orientation of the channel and offshore breakwaters. The proponent states that the computational mesh used is more finely resolved and the model better calibrated to measured ocean conditions and geotechnical conditions than for the SAR predictions. It also considers the consequence of a net southward flowing current on the likely extent of predicted impacts and influences. These differences are set out in Table 3.

Although all impact predictions are considered in this assessment, the revised impact predictions based on the most contemporary port design have been used as the primary basis on which the EPA has assessed the likely impacts of the proposal on the environmental values of the west coast of the Dampier Peninsula.

Assessment of predicted impacts from dredging

The proponent has couched predictions of environmental impacts associated with the dredging components of the strategic proposal in the context of guidance in the EPA's draft EAG No.7, which was the published version of that document at the time the SAR was prepared. The fundamental elements of the spatial zonation scheme were not modified significantly between the draft and final versions of the guidance. The EPA has considered the environmental acceptability of predicted impacts of dredging associated with the strategic proposal in the context of the draft guidance and it has used the final EAG No.7 as a basis for recommended conditions.

The draft guidance sets out a common framework for proponents to use when describing the extent, severity and duration of impacts to benthic communities. The overall footprint of the proposal is the Zone of Influence where plumes may be visible at some stage during the dredging program. Moving closer to the dredging source the frequency and intensity of plumes will get to the point where biological effects may be observed. This point marks the outer boundary of the Zone of Moderate Impact. Although impacts may be detectable inside the boundary of this zone, they must be recoverable. In this context recoverable is defined as being able to recover within five years from cessation of the pressure that caused the loss in the first instance. Moving closer to the source, where turbidity levels are higher and more persistent, a point is reached where the impacts to the environment are so great that it is unlikely that anything will re-establish within five years. This point marks the outer boundary of the Zone of High Impact. These zones are described in Table 2 and form the basis of the assessment below.

Assessment of the predicted Zone of Influence

Turbidity plumes generated by dredging and spoil disposal are predicted to be relatively discrete, forming a band of turbid water extending down-current and reducing in intensity with distance from source, with patterns that vary seasonally. Based on the modelling of the dispersion of fine sediment

particles (<63 microns in size), and conservative assumptions in the SAR about the amount of fines produced, the proponent predicted that visible plumes may occur from north of Cape Baskerville to Gantheaume Bay at some time during the course of dredging; a north-south distance of more than 100 km (see the dashed black line in Figure 16). These predictions were based on an analysis of where in the model the predicted turbidity would be greater than 5 mg/l above background for greater than 5% of the duration of dredging.

The more recent predictions of the likely Zone of Influence consider the consequences of the increased dredging volumes and duration using the same criteria as used in the SAR (i.e. >5 mg/L for >5% of the time). Contemporary geotechnical data is used to determine the likely particle size distribution and percentage losses and better simulate the dynamics of these particles and their transport and fate over time. The more recent predictive work considers the implications of two hydrodynamic regimes. The first is the 'normal' situation and the other considers the implications of a net southerly flowing current in the area.

Under normal conditions the revised modelling shows the predicted Zone of Influence extending further north than originally predicted and potentially extending as far north as Beagle Bay (Figure 16); a north-south distance of about 120 km. If a southerly drift is factored in then the plume is smaller (a north-south distance of about 70 km), but extends further southward than shown in the SAR, past Gantheaume Point and ending south of Broome (Figure 16). Under this scenario the plume would be visible off Cable Beach between 5% and 30% of the time during the 21-month dredging campaign, noting that it is most likely during stormy, wet season conditions when background levels of turbidity are naturally elevated.

A continuous plume is not expected to occur over the entire area of this predicted Zone of Influence at any single point in time during the proposed dredging program(s). Rather, the Zone of Influence represents the area within which a visible plume may be expected to occur at some time under the assumptions used in the modelling. For the purposes of this assessment, the EPA has considered the combined Zone of Influence from the two scenarios, which extends about 140 km in a north-south direction and is shown as the solid black line in Figure 16, to be the potential worse case Zone of Influence associated with this proposal. It is also important to note that the Zone of Influence is not expected to sustain any ecological impacts.

In general, the presence of a visible plume becomes more common the closer one is to the dredging area. Figure 19 shows the percentage of the time that the plume was predicted to be present under southerly drift conditions. This diagram shows a visible plume that tends to hug the coast and is present at the mouth of Willie Creek for up to 90% of the dredging campaign. The plume is seen to enter the creek and be present there up to 80% of the time. Barred Creek is located closer to the dredging activities and the proponent expects that sediment plumes would be present at the mouth of the creek (and presumably within the creek) for practically the entire duration of the 21 month dredging campaign.

The predicted concentrations of turbidity at the entrance to each creek system are shown in Figure 21 as concentrations above background. Based on the modelling presented, if the plume is not influenced by a net southerly drift then it is likely that the plume will be visible in the creek systems to the north of James Price Point, including those around Carnot Bay and through to Beagle Bay. The proponent has not provided any further detail on the intensity and frequency of occurrence of visible plumes other than that they are not predicted to cause any measurable ecological effects as they are modelled to be within the Zone of Influence only.

Beyond the outer boundary of the predicted Zone of Moderate Impact (discussed below), these plumes are not expected to result in detectable effects on benthic habitats or associated biota. As such, and even though the plumes are likely to be present for the majority of the time in these creek systems, the proponent concludes that they are not of sufficient severity or duration to cause measurable impacts on the ecology of these creek systems. Hence they are depicted as being outside the Zone of Moderate Impact. Figure 22 shows this in some detail for Barred Creek. These creeks support mangroves and two species of seagrass have been reported from rocky terraces on the banks of Barred Creek (Prince, 1986; Walker and Prince, 1987). However, there is no published information on the subtidal habitats within these creeks and the impact assessment and conclusion of the proponent is based largely on an assumption that the creeks have variable and sometimes high levels of turbidity naturally, which in turn is based on studies of other mangrove creek systems from interstate or overseas.

From a simple evaluation of aerial images it is evident that these 'creeks' are primarily tidal inlets rather than the more turbid estuarine systems which are typically found to the north and east of the Dampier Peninsula. They lack large catchments with significant rivers and the white sandy beaches and relatively clear water indicate that they may not be highly turbid. As such, the proponent's argument that the creeks are unlikely to suffer any impact due to prolonged periods of elevated turbidity does not appear to have strong support given the limited evidence presented.

It is evident that these creeks, and the other creek systems on the Dampier Peninsula, are poorly studied and their ecological roles and functions, and their sensitivities to prolonged periods of elevated turbidity, are not well understood.

Given the paucity of information, the EPA finds it difficult to appraise the relative importance of these creek systems to the functioning of the marine ecosystem off the Dampier Peninsula as a whole, and to evaluate the likelihood and consequence of any effects that dredging may have. These creeks may support conservation significant fauna such as sawfish but there is no compelling evidence to indicate their importance or otherwise. Based on the precautionary principle and given the small number of similar creek systems on the Peninsula, the EPA considers it important that they are protected from the possible effects of the construction and operation of the proposal. The EPA concludes that any ecological impact on these creek systems would be unacceptable. Therefore future proponents will need to demonstrate a better understanding of the ecology of the creeks and provide

a monitoring and management plan that ensures that the creeks will be properly protected. The EPA has recommended conditions to give effect to this advice (see below under Zone of Moderate Impact) should a decision be taken that the strategic proposal may be implemented.

The EPA does not believe it is necessary or appropriate to recommend conditions that specify the outer limit of the Zone of Influence. This is consistent with previous recommendations by the EPA in similar circumstances (e.g. EPA, 2011b). It also recognises the difficulty in monitoring, measuring and responding to any 'excursions' of visible plumes outside the predicted Zone of Influence, in a timely manner. The EPA notes that management will mainly occur closer to the site of dredging and focus on ensuring all permanent and all reversible biological impacts are fully contained within the Zones of High and Moderate Impacts respectively. Monitoring and management within the Zone of Influence will focus on the area adjacent to the Zone of Moderate Impact to prevent any detectable biological effects from occurring.

Assessment of the Zone of Moderate Impact

For biota, the predicted impacts of dredging include loss of substrate, smothering, and turbidity induced light reduction leading to reduced photosynthesis by benthic primary producers.

Areas are defined as being part of the Zone of Moderate Impact when impacts are temporary and losses are predicted to fully recover in less than five years (Table 2). Loss and recovery is dependent on the type of receptor (e.g. seagrass, coral, filter feeders) and the type and duration of impact (e.g. smothering versus light reduction to varying degrees for varying lengths of time).

The proponent has relied on interpretation of sediment transport and water quality model outputs and modelled habitat distributions to predict the potential extent of the Zones of Moderate Impact for different classes of benthic habitat and for all benthic habitats combined.

The extents of the Zones of Moderate Impact depicted in the SAR vary considerably depending on the habitat type and the pressure threshold value applied. The proponent showed that predictions of the likely location of zone boundaries are highly sensitive to relatively modest changes to the way that model outputs are interpreted. This degree of uncertainty is well illustrated by the marked reduction in the extent of the Zone of Moderate Impact which results from a change made to one constant in the equation used to convert TSS concentrations output from the water quality model to light attenuation coefficients used to determine benthic light fields (see Figures 13 and 14).

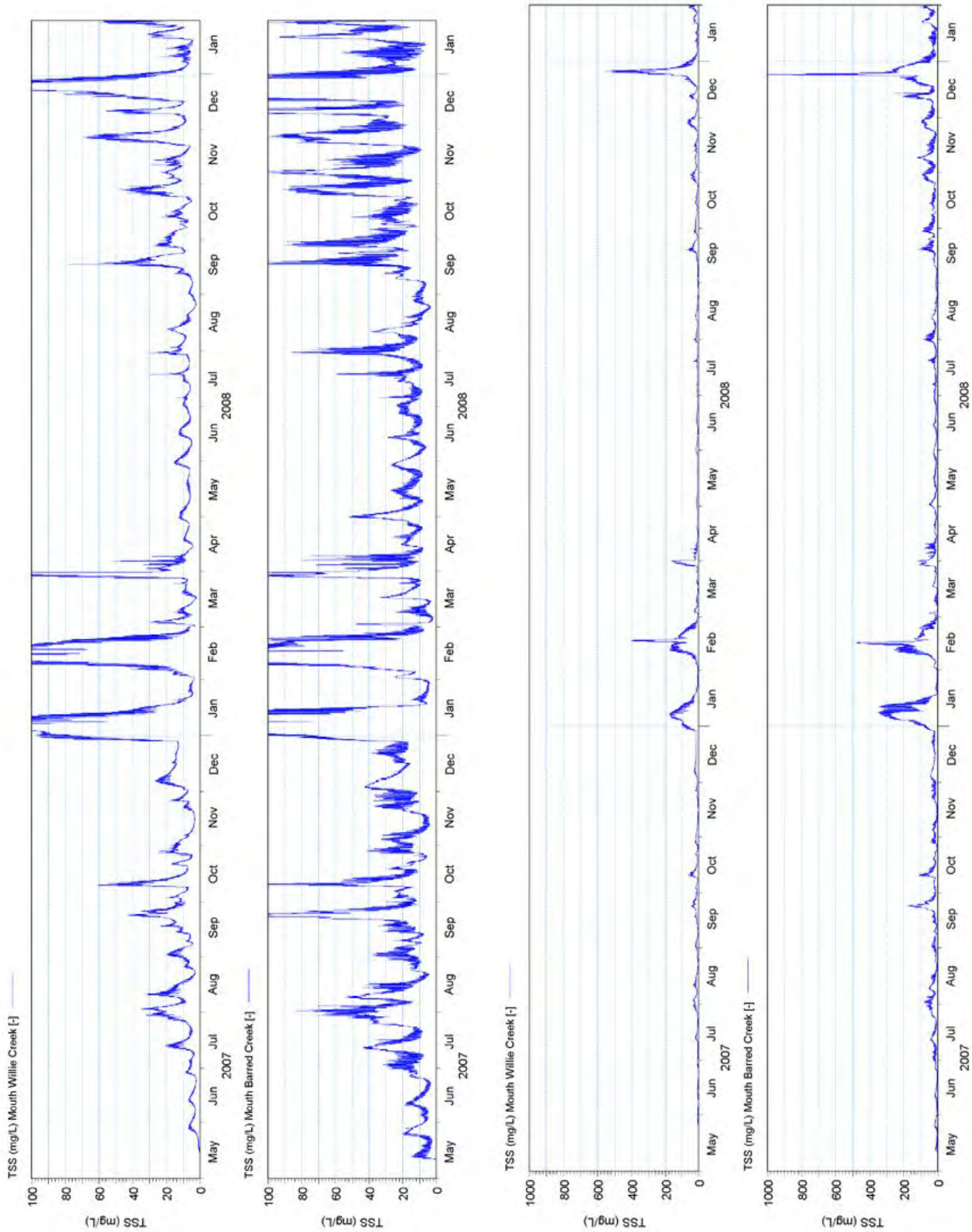


Figure 21. A snapshot of the expected TSS at the mouth of Willie Creek and Barred Creek over a full dredging simulation year.

Source Figure 4.13 DSD, 2012b.

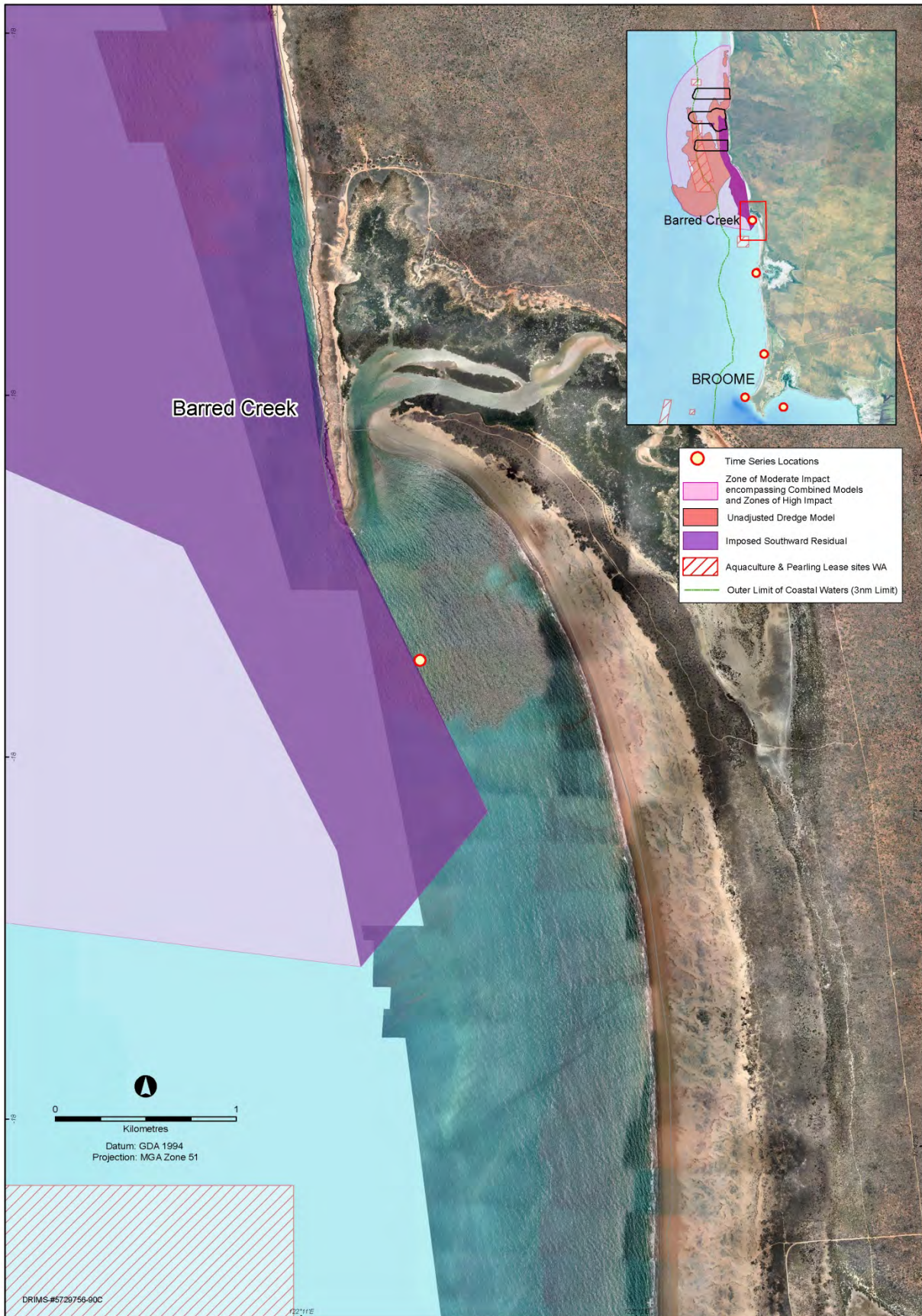


Figure 22. Extent of the predicted Zone of Moderate Impact in relation to Barred Creek. Source Figure 4.6 DSD, 2012b.

Regardless of the extent of the predicted Zone of Moderate Impact, the proponent's prediction is that benthic habitats which might be impacted within that zone are expected to recover within a period of five years following removal of the pressure source, which in this case is principally dredging. The EPA notes that if this outcome is achieved, there would still be a degree of loss to the ecosystem over considerable areas for a period of up to five years. The EPA also notes that the impacts of sequential developments in the same locality may lead to temporary losses that, in a cumulative sense, could be longer than five years in total. For some parts of the system this potential loss needs to be carefully considered to evaluate its significance, though there is a degree of uncertainty associated with predicting any likely consequence.

By way of example, seagrasses are known to be seasonally abundant offshore from James Price Point and the species present are a known food resource for dugong and turtle species. It is possible that the Zone of Moderate Impact area could provide feeding habitat for up to about 105 dugong (see Section 3.1). One view is that a five-year temporary loss of seasonally abundant seagrass communities from the vicinity of James Price Point would tend to cause a temporary shift in where dugong and other seagrass-consuming species would forage for food. Whether this would occur and, if so, what the implications might be for the regional food resources and dugong stock are not fully understood. What is known is that dugong do occur in the area coincident with the Zones of Moderate Impact, and they utilise the seagrasses that occur there. It is also known that dugong are distributed more widely along the Dampier Peninsula, and significant numbers occur elsewhere in the Kimberley and in other tropical coastal waters of Western Australia.

The areas encompassed by the predicted Zones of Moderate Impact are large at the regional scale and, as noted elsewhere in this report, there are uncertainties associated with the actual distributions of benthic habitats, their potential to recover from disturbance and the ecological implications of any habitat reduction or losses that may occur.

Given the wide distribution of similar habitats in the Kimberley and the relative mobility of the associated megafauna such as dugong and turtles, the EPA accepts that while development of the Precinct's port would result in direct and indirect impacts to benthic communities and their associated fauna, on balance those impacts could be made acceptable. In view of the issues above, it is recommended that, to minimise the risk to ecological integrity associated with those impacts, conditions should be applied to strictly limit the spatial extent of the Zone of Moderate Impact and the Zone of High Impact and to establish clear environmental protection outcomes that must be achieved.

With respect to the Zone of Moderate Impact, the EPA only has the jurisdiction to assess the component that is in State Waters. In Section 2.4 of Part 3 of the SAR, the proponent presents a number of predicted Zones of Moderate Impact for a range of benthic community types that differ significantly in extent (see Figure 15). The largest predicted Zone of Moderate Impact extends from near Willie Creek in the south to north of Cape Baskerville, a distance of approximately 90 km. The EPA notes the conservative nature of the predictions, including the lack of specific mitigation

measures factored into those predictions, and has also taken into account its previous experience from other dredging projects of this scale undertaken in recent times in Western Australia. The EPA notes that the proponent has also presented scenarios where the Zone of Moderate Impact is significantly smaller than that described above.

The most recent modelling used better defined pressure fields and revised criteria to determine the extent of predicted Zones of Moderate Impact associated with port construction under both normal conditions and conditions with a net southerly current. The outputs of the two scenarios are presented in Figure 15 along with predictions from the SAR described earlier. Under normal conditions the zone extends along about 25 km of coastline and offshore to the south-west and beyond the limits of State Waters. Under an imposed southward residual current the zone primarily extends southward from the port in a band staying within 3 km from shore and ending south of Cape Boileau. In both cases the Zones of Moderate Impact do not include predictions of impact associated with laying gas pipelines. Notably, the outputs of the simulation include impacts associated with the channel dredging but there are significant areas of the channel in both scenarios that are not depicted as being impacted by dredging-generated turbidity.

To account for impacts associated with pipe laying, and the residual uncertainties associated with prediction of dredging impacts more broadly, the proponent prepared a composite Zone of Moderate Impact by overlaying the recent model outputs and applying professional judgment. This area is shown by the red dotted line in Figure 15. It extends from just south of Coulomb Point and maintains contact with the coast to Cape Boileau where it remains offshore before terminating. This places Barred Creek outside the Zone of Moderate Impact as described previously when considering the Zone of Influence. Figure 22 shows this in more detail.

The EPA notes the residual uncertainty associated with predicting impacts of dredging generally and particularly where infrastructure designs are still being developed and recognises that there are gaps in knowledge about environmental sensitivities. The EPA accepts that some of these knowledge gaps are considerable, and will take dedicated time and effort to address, but it also notes that the Precinct will likely be built in a staged approach potentially extending over decades. As such, the EPA expects proponents of future proposals to take account of the knowledge gaps identified here and to undertake and support studies to continually improve the ability to predict, mitigate and manage the impacts of dredging and infrastructure construction on the tropical marine communities off the Dampier Peninsula.

After considering all the information at hand, the EPA believes that the Zone of Moderate Impact resulting from a well planned and managed dredging program for this project should be able to be contained within an area from approximately Cape Boileau in the south to approximately Coulomb Point in the north. These northern and southern limits approximate the most contemporary impact scenario presented by the proponent and are shown in Figure 15. In reaching this view the EPA notes that no detectable biological effects would be allowed outside of the Zone of Moderate Impact (i.e. within the Zone of Influence which includes Barred Creek) and, as such, expects

future proponents to actively manage their activities so that any biological effects would be attenuated down to zero within the Zone of Moderate Impact.

Accordingly, the EPA recommends that there should be no measureable effects on benthic communities outside a Zone of Moderate Impact bounded by a line extending 2 km due south from Cape Boileau, then west to the limit of state jurisdiction at the State Waters boundary, and a line due west from a point 3 km south of Coulomb Point to the boundary of State Waters (Figure 23).

Assessment of the Zones of High Impact

The proponent has applied numerical modelling and a measure of professional judgment to predict Zones of High Impact for the port area and for the pipeline corridors. As described previously, impacts to benthic communities in this zone are permanent, and the EPA gives particular regard to the assessment of these impacts.

The Zone of High Impact for the port area is described in the SAR as any area where the substrate is removed by dredging and for one kilometre around dredged areas and other near-shore marine infrastructure (jetties, MOF, tug harbour etc). The proponent has assumed that losses in this area are permanent and no recovery or re-colonisation would occur. Based on the most recent modelling since publication of the SAR, the proponent concluded that the Zone of High Impact could be contained well within the 1000 m band set out in the SAR and has provided an assessment of the losses that would occur if the band was reduced to a more realistic 500 m (DSD 2012b).

The proponent has estimated the cumulative permanent loss of different types of BPPH present in the James Price Point area based on predictions of impacts associated with dredging for indicative full development port infrastructure scenarios. These predictions are based on a combination of numerical modelling and professional judgement based on experience gained from other dredging campaigns.

EAG No.3 provides guidance for applying a set of overarching environmental protection principles and a risk-based spatial assessment framework for evaluating cumulative irreversible loss of BPPH associated with past and present development activities within defined local assessment units (LAU). This area is essentially a greenfield site that is not known to have experienced any loss of benthic habitat due to human activities to date. As such, the habitat loss assessment is based solely on the predicted impacts of the proposed 50 Mtpa LNG production and export facility now under assessment here.

The proponent proposed a LAU in the SAR, which is shown in Figure 9. The proposed LAU is centred approximately on James Price Point and extends roughly 10 km north and south from this point along the coast. This places the northern and southern boundaries of the local assessment unit around Flat Rock and Quondong Point respectively. This unit extends seaward from the shore out to the limit of State coastal waters and covers a total area of approximately 120 km².

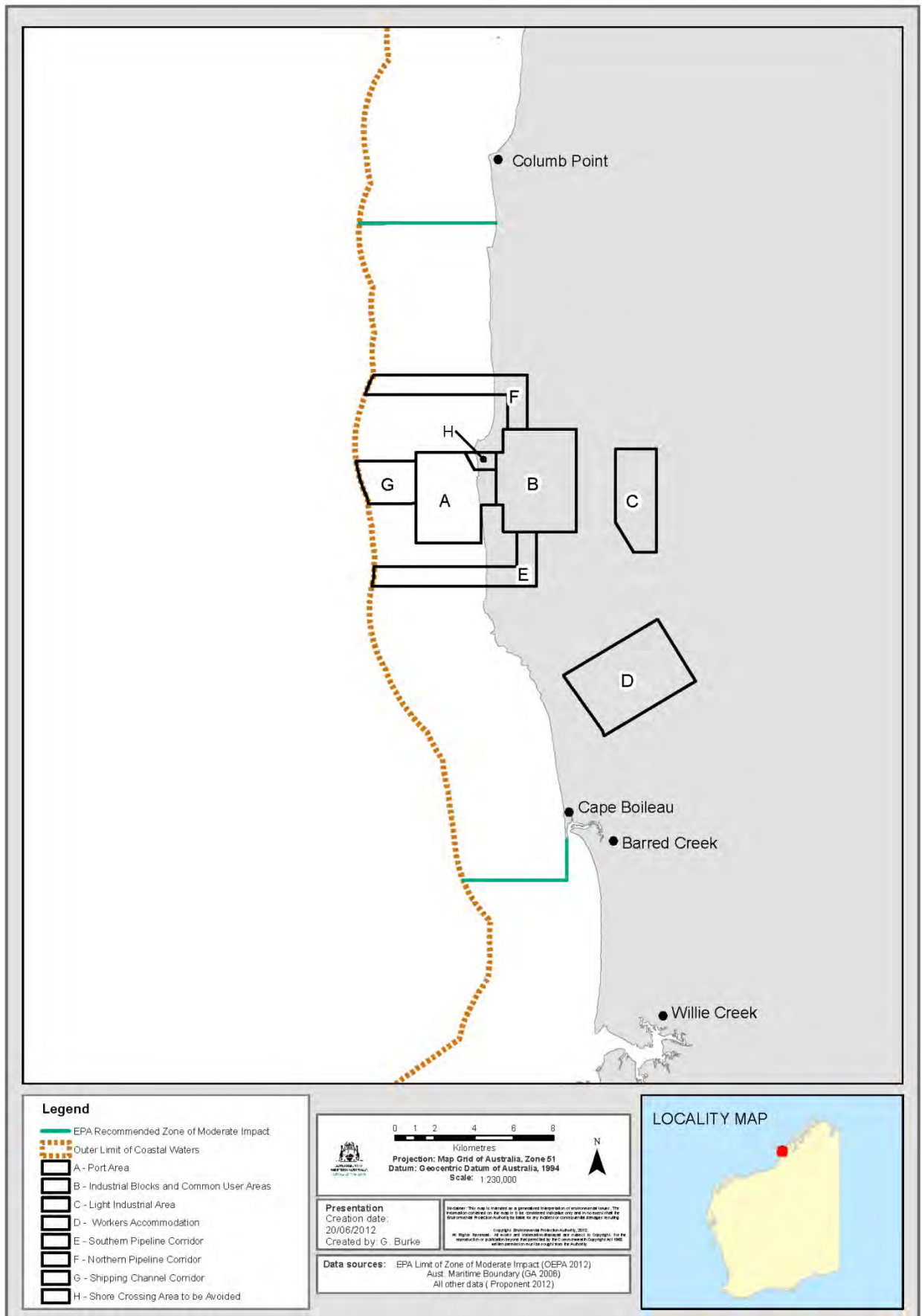


Figure 23. Zone of Moderate Impact recommended by the EPA.

EAG No.3 recommends that LAUs should normally be approximately 50 km² and notes that larger or smaller units can be considered if they are well justified. While the LAU proposed in the SAR (~120 km²) is considerably larger than 50 km² the EPA notes that the proponent has presented information in Section 3.3.3 of Part 7 of the SAR, including bathymetry, substrate descriptions, habitat distribution and hydrodynamic data, descriptions of coastline orientation and interpretation of scientific literature, to justify the size of the proposed LAU.

While the EPA would generally expect to see loss assessments based on smaller LAUs, it acknowledges that this is not an exact process but rather one that relies on professional judgment. In view of this, and considering the general lack of obvious environmental features that would serve as discrete cut off points for defining unit boundaries, it is reasonable in this case to consider the predicted cumulative irreversible loss of BPPH within the LAU proposed in the SAR.

Table 5 shows the different categories of marine ecological protection and associated cumulative loss guidelines that are described in EAG No.3. Estimates of habitat loss expressed as a percentage of the area of each BPPH type originally present within the LAU are compared against the relevant cumulative loss guidelines. This comparison is used as an initial basis for gauging risk to overall ecological integrity within the LAU that may be associated with loss of BPPH. Predicted losses that are less than the guideline value are considered *a priori* to pose a limited risk to ecological integrity and could be assessed principally on the basis of the estimated extent of habitat loss. However, as the cumulative extent of habitat loss approaches and exceeds the guideline value, the EPA expects proponents to accompany their loss calculations with a technically-substantiated assessment of potential risk to ecological integrity that would result should the proposed losses be allowed to occur.

Table 5. Cumulative loss guidelines for benthic primary producer habitat within defined local assessment units for six categories of marine ecological protection.

Category	Description	Cumulative loss guideline
A	Extremely special areas	0%
B	High protection areas other than above	1%
C	Other designated areas	2%
D	Non-designated area	5%
E	Development areas	10%
F	Areas where cumulative loss guidelines have been significantly exceeded	No net damage/loss

Source: EPA, 2009.

The proponent designates its proposed LAU as Category E with a cumulative loss guideline of 10% in recognition of the decision by Government to proceed with a strategic environmental assessment of a multi-user LNG processing precinct in the vicinity of James Price Point. The EPA has undertaken its assessment in the context of Category E.

In the SAR the proponent calculated potential losses of BPPH associated with four indicative infrastructure scenarios and various combinations of these that might be anticipated at full development of the precinct. The four fundamental infrastructure scenarios are described in Section 3.4 of Part 7 of the SAR and are briefly summarised below.

Scenario 1 in Table 6 includes an *indicative* port layout where port infrastructure occupies only a part of the entire port area and a shipping channel corridor. The 'whole' port development scenario (Scenario 2) assumes that port infrastructure would occupy and cause irreversible losses of BPPH over the entire port area and shipping channel corridor. Scenarios 3 and 4 assume development of the entire area of the southern or northern pipeline corridor respectively.

The proponent calculated losses of BPPH based on direct footprints and a predicted surrounding Zone of High Impact. A Zone of High Impact extending 1000 m radially around the port development scenarios was applied for the calculations, while the boundaries of Zones of High Impact associated with the pipeline scenarios extended 500 m radially around each of the corridors.

The calculated losses for the four fundamental infrastructure scenarios and four combinations of these are presented as areas and percentages in Tables 6 and 7 respectively.

According to the SAR, 72% of the LAU contains no BPPH, although other filter feeding benthos types which are not primary producers are widespread. A relatively low 0.2% of the area within the LAU comprises hard coral patches. Seagrass cover is represented in these figures as observations of predicted percent cover rather than real distribution (see Figure 3-1, Part 7 of the SAR).

In relation to the port infrastructure development scenarios (Scenarios 1 and 2), the EPA notes that a number of indicative layouts depicting a fully developed port precinct (i.e. a port with capacity to export up to 50 Mtpa of LNG with associated port infrastructure) are presented in the SAR (e.g. Scenario 1) and that each of these indicative layouts occupies only a portion of the entire port area. It follows then, that an indicative port layout that occupies only part of the port area, regardless of its exact final design, must result in a lesser extent of BPPH loss compared with Scenario 2 (which involves BPPH loss over the entire port area, including throughout the entire Zone of High Impact that extends 1000 m radially from the port area boundary). This is shown clearly in the proponent's BPPH loss calculations.

In order to reach a view on the environmental acceptability of BPPH losses, the EPA has firstly considered the overall environmental acceptability of the scenarios in terms of their implications for BPPH and ecological integrity.

Table 6. Benthic Primary Producer Habitat (BPPH) extent and loss estimates in hectares.

Source: Table 3-1 in Part 7 of the SAR.

BPPH Category	LAU (ha)	Indicative port development scenario (1) (ha)	Whole port development area scenario (2) (ha)	Southern pipeline corridor (3) (ha)	Northern pipeline corridor (4) (ha)	Component/Scenario Totals (ha)			
						1+3	2+3	1+3+4	2+3+4
Total BPPH	3314.3	321.1	525.1	262.1	350.2	583.2	787.2	933.4	1137.4
Intertidal mosaic of coral, algae and filter feeders	372.10	34.44	68.51	8.21	14.57	42.65	76.72	57.22	91.28
Hard coral only	6.76	0.46	0.72	0.12	1.08	0.58	0.84	1.65	1.91
Soft coral only	115.03	5.53	19.19	13.78	0.83	19.30	32.97	20.13	33.80
Macroalgae only	1707.18	164.46	251.98	86.90	261.21	251.36	338.88	512.57	600.09
Seagrass only	514.29	96.69	138.72	78.18	33.99	174.87	216.89	208.86	250.88
Mixed mosaic of hard coral and algae	269.80	15.56	36.01	2.36	33.21	17.92	38.37	51.14	71.59
Mixed mosaic of soft coral and algae	127.0	1.0	2.12	29.46	0.15	30.46	31.59	30.61	31.73
Mixed mosaic of hard coral and soft coral	0.18	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01
Mixed mosaic of hard coral, soft coral and algae	2.76	0.00	0.19	0.02	0.20	0.02	0.21	0.22	0.40
Mixed mosaic of Seagrass and Algae	143.02	2.12	5.87	6.14	4.54	8.26	12.01	12.80	16.55
Mixed mosaic of Seagrass and Hard Coral	1.76	0.07	0.08	0.00	0.37	0.08	0.09	0.44	0.45
Mixed mosaic of Seagrass and Soft Coral	14.23	0.72	1.40	8.74	0.04	9.46	10.14	9.50	10.18
Mixed mosaic of Seagrass, Hard Coral and Algae	5.19	0.02	0.03	0.00	0.01	0.02	0.03	0.03	0.03
Mixed mosaic of Seagrass, Soft Coral and Algae	34.89	0.02	0.24	28.21	0.00	28.23	28.45	28.23	28.45

Table 7. Cumulative Percentage Loss of benthic primary producer habitats within the proponent’s local assessment unit.

Source: Table 3-2 in Part 7 of the SAR.

BPPH Category	Indicative port development scenario (1) (%)	Whole port development area scenario (2) (%)	Southern pipeline corridor (3) (%)	Northern pipeline corridor (4) (%)	Component/Scenario Totals (%)			
					1+3	2+3	1+3+4	2+3+4
Combined BPPH	9.7	15.8	7.9	10.6	17.6	23.8	28.2	34.3
Intertidal mosaic of coral, algae and filter feeders	9.3	18.4	2.2	3.9	11.5	20.6	15.4	24.5
Hard coral only	6.8	10.7	1.7	15.9	8.5	12.4	24.5	28.3
Soft coral only	4.8	16.7	12.0	0.7	16.8	28.7	17.5	29.4
Macroalgae only	9.6	14.8	5.1	15.3	14.7	19.9	30.0	35.2
Seagrass only	18.8	27.0	15.2	6.6	34.0	42.2	40.6	48.8
Mixed mosaic of hard coral and algae	5.8	13.3	0.9	12.3	6.6	14.2	19.0	26.5
Mixed mosaic of soft coral and algae	0.8	1.7	23.2	0.1	24.0	24.9	24.1	25.0
Mixed mosaic of hard coral and soft coral	0	2.0	0	6.0	0	2.0	6.0	8.0
Mixed mosaic of hard coral, soft coral and algae	0	6.8	0.7	7.2	0.7	7.4	7.8	14.6
Mixed mosaic of Seagrass and Algae	1.5	4.1	4.3	3.2	5.8	8.4	9.0	11.6
Mixed mosaic of Seagrass and Hard Coral	4.1	4.7	0.2	20.9	4.3	4.9	25.2	25.8
Mixed mosaic of Seagrass and Soft Coral	5.1	9.8	61.4	0.3	66.5	71.3	66.8	71.5
Mixed mosaic of Seagrass, Hard Coral and Algae	0.4	0.5	0	0.1	0.4	0.5	0.6	0.6
Mixed mosaic of Seagrass, Soft Coral and Algae	0.1	0.7	80.9	0	80.9	81.6	80.9	81.6

While the SAR includes calculations of impact to BPPH associated with both an indicative port layout (Scenario 1) and development over the entire port area (Scenario 2), the proponent clearly indicates that Scenario 2 represents a 'worst case' on the basis that, in reality, the area occupied by marine infrastructure is likely to only encompass a subset of the broader port area (Section 2.4.3.1 Part 3 of the SAR). In view of the information presented in Parts 3 and 7 of the SAR, which indicates it is not intended that port facilities would occupy the entire port area, and the relatively large extent of predicted loss of BPPH associated with Scenario 2 alone (16% of all BPPH combined) and in combination with pipelines (34% of all BPPH combined), the EPA is of the view that Scenario 2 is improbable but, if realised, could result in environmentally unacceptable impacts.

On balance, the EPA concludes that impacts to the extent contemplated by Scenario 2 are unwarranted and not environmentally acceptable and should not be considered further.

The impacts associated with the most contemporary port design were also assessed and compared against the equivalent scenario in the SAR (that is combined scenarios 1,3 and 4). This was done assuming a 1000 m wide band of high impact and a smaller 500 m wide band. The comparison shows that with a 1000 m wide band the impacts are about 10% greater than predicted in the SAR when BPPH is considered in total (Table 8). With a 500 m wide band the total area of BPPH loss is reduced by about 42 ha or 5%. This is primarily due to a 38 ha (about 22%) reduction in the predicted impact on the seagrass habitat category and a 29 ha (about 6%) reduction in the predicted impact on the macroalgal habitat category.

Considering BPPH losses in terms of combined BPPH, which are shown in the top row of Table 8, the percentage loss estimate for each of the impact scenarios exceeds the 10% cumulative loss guideline. The SAR impact scenario would result in 28% of the existing BPPH being lost. The losses associated with the more contemporary design with the 1000 m wide high impact zone band were 3% greater (31%) whereas with a 500 m wide band the losses were marginally less (27%). When the losses are considered for each key component of the contemporary design with the 500 m wide band and restricted to just the habitat that contains seagrass, the cumulative losses for the port area (14%) and the southern pipeline corridor (17%) are individually greater than the cumulative loss guidelines for the LAU as a whole (Table 9). In the southern pipeline corridor almost half of the total BPPH lost contains seagrass as a component. In absolute terms these losses amount to 100 ha and 121 ha for the port and the southern pipeline corridor respectively.

The distributions of habitats that are predicted to support seagrass, both solely and in combination with other benthic biota, are presented in Figure 24. This figure also shows predicted distributions for the pearl leases that do not form part of the loss calculations. Although the EPA accepts the proponent's view that these distributions have relatively low reliability (and hence were not included in the SAR), the figure suggests that there is substantial habitat that has the potential to support seagrass but which has been previously classified as not containing benthic primary producers such as seagrass. Seen in context, the main area of seagrass loss towards the seaward end of the

southern pipeline corridor is not an isolated patch, but part of a habitat band that extends further to the south. Similarly, the section of dense seagrass near the seaward end of the channel is part of a habitat band that extends and narrows to the north. The EPA's spatial analysis of the data in Figure 24 revealed approximately equal amounts of potential seagrass habitat to the north (2,220 ha) and south (2,120 ha) of a centreline drawn through the port area.

It is also noted that when losses of benthic habitats are considered at the level of individual mapped BPPH classes, most losses significantly exceed the 10% cumulative loss guideline. For two of the mosaic habitat classes it is predicted that 50% or more of the existing extent of those habitats would be permanently lost. Some of the high levels of predicted loss are in part a function of the high degree of habitat discrimination in the mapping process that in turn can result in small and/or discrete areas of impacted habitat representing a high proportion of the total amount of that habitat within the LAU. Notwithstanding this, the EPA is concerned by the levels of predicted irreversible loss of BPPH associated with the marine infrastructure development scenarios and considers that, if the proposal is to be made environmentally acceptable, conditions should be applied to place strict limits and controls on the allowable extent of irreversible loss of benthic habitats associated with port infrastructure development and pipeline installation within the identified corridors.

Furthermore, based on previous experience, the EPA notes that with diligent implementation of the recommendations around the Zones of High Impact associated with port facilities development and pipeline installation, the extent of potential BPPH loss could be substantially reduced compared to the estimates discussed above, which are based on much larger Zones of High Impact.

The EPA is aware of the challenges faced by the proponent due to the current level of uncertainty associated with an exact layout of proposed port facilities and has recommended conditions that, in the EPA's view, take design uncertainties into account, while importantly encouraging proponents of future proposals to implement contemporary best practice and impact minimisation principles.

Based on previous experience with other marine proposals, and the generally held view that the benthic habitats in this part of the Kimberley exhibit a degree of resilience to natural perturbations such as cyclones, the EPA considers that proponents should be able to design the port infrastructure, and plan and execute their dredging programs such that the Zone of High Impact is minimised and would not extend as far as 1000 m from infrastructure or dredged areas. The EPA expects that the development of marine facilities should be able to be managed such that the associated Zone of High Impact is constrained to within 500 m of dredged areas and other marine infrastructure.

Table 8. Comparison of loss of BPPH for indicative scenario in the SAR and indicative scenarios (1000m ZOHI and 500m ZOHI) in the 43A Application – Change in Dredging Volume.

BPPH Category	Total area of BPPH in LAU (ha)	Loss of BPPH within LAU (ha)			Loss of BPPH within LAU (%)		
		Scenario 1+3+4 Indicative port development scenario (1), Southern Pipeline corridor (3), Northern Pipeline corridor (4) (Source Pt 7 SAR, 2011)	1000m ZOHI from Infrastructure Revised Channel Alignment and Increased Dredging Volumes (Source DSD, 2012b)	500m ZOHI from Infrastructure Revised Channel Alignment and Increased Dredging Volumes (Source DSD, 2012b)	Scenario 1+3+4 Indicative port development scenario (1), Southern Pipeline corridor (3), Northern Pipeline corridor (4)	1000m ZOHI from Infrastructure Revised Channel Alignment and Increased Dredging Volumes	500m ZOHI from Infrastructure Revised Channel Alignment and Increased Dredging Volumes
Total BPPH	3314	933	1026	891	28	31	27
Intertidal mosaic of coral, algae and filter feeders	372	57	95	63	15	26	17
Macroalgae only	1707	512	528	484	30	31	28
Hard coral only	7	2	2	2	29	29	29
Soft coral only	115	20	33	23	18	29	20
Seagrass only	514	209	210	171	41	41	33
Mixed mosaic of hard coral and algae	270	51	72	62	19	27	23
Mixed mosaic of soft coral and algae	127	31	31	31	24	24	24
Mixed mosaic of seagrass and algae	143	13	16	15	9	11	10
Mixed mosaic of seagrass and hard coral	2	0	1	1	0	50	50
Mixed mosaic of seagrass and soft coral	14	10	11	10	71	79	71
Mixed mosaic of hard coral, soft coral and algae	3	0	1	1	0	33	33
Mixed mosaic of seagrass, hard coral and algae	5	0	0	0	0	0	0
Mixed mosaic of seagrass, soft coral and algae	35	28	28	28	80	80	80

Note - The calculations do not take into account potential BPPH within the pearl leases, as access was restricted during surveys of the area. (DSD, 2011)
 - Cells shaded green show cumulative loss less than EAG3 guideline level, while cells shaded orange indicate exceedance of the guideline threshold.

Table 9. Comparison of loss of habitats containing seagrass for indicative scenario in the SAR and indicative scenarios (1000m ZOHI and 500m ZOHI) in the 43A Application – Change in Dredging Volume.

BPPH Category	Total area of BPPH in LAU (ha)	Loss of BPPH within LAU (ha)						Loss of BPPH within LAU (%)				
		Indicative port development scenario (1), (Source Pt 7 SAR, 2011)	Contemporary indicative port development scenario -500m buffer**	Northern pipeline corridor	Southern pipeline corridor	Total SAR Development Scenario **	Total 43A Development Scenario	Indicative port development scenario (1),	Northern pipeline corridor	Southern pipeline corridor	Total SAR development scenario	Total 43A Development Scenari
Total BPPH	3314	321	279	350	262	933	891	10	11	8	28	27
Seagrass only	514	97	59	34	78	209	171	19	7	15	41	33
Mixed Mosaics containing Seagrass	199	3	5	5	43	51	53	2	3	22	26	27
Total BPPH containing seagrass	713	100	64	39	121	260	224	14	5	17	36	31
Proportion of seagrass:non-seagrass habitat (%)	22	31	24	11	46	28	25					

* Total SAR Development Scenario data derived from Indicative port development scenario (1), Northern pipeline corridor & Southern pipeline corridor (Source Pt 7 SAR, 2011)

** Total 43A Development Scenario data derived from Contemporary Indicative port development scenario (1), Northern pipeline corridor & Southern pipeline corridor from 43A Application (DSD,2012)

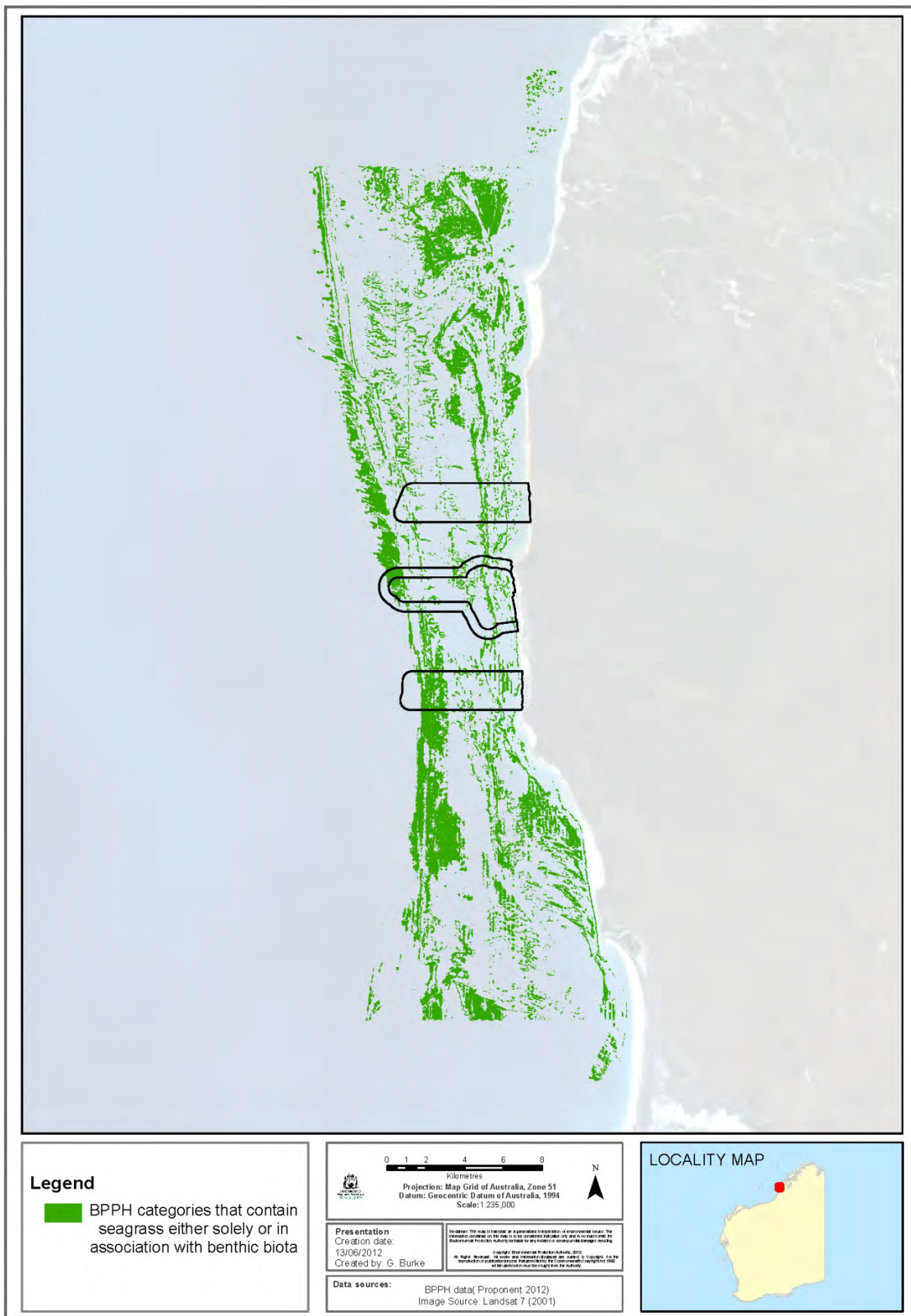


Figure 24. Distributions of habitats that are predicted to support seagrass, both solely and in combination with other benthic biota.

Therefore the EPA recommends that port and channel infrastructure components conform to a Marine Facilities and Impact Zones Plan which requires that all infrastructure components are wholly contained within Port Area A, the channel is contained within Area G and that permanent impacts are contained within 500 m of the marine facilities (including dredged channels) defined by that plan.

With respect to the pipeline corridors, the EPA recognises that maintaining a degree of flexibility with respect to the exact mode of placement of feed gas pipelines is desirable at this stage of planning. The EPA notes that the predictions of a 500 m wide zone of high impact around each pipeline have been based on the assumption that the most invasive construction technique (open cut trenching followed by backfill) would be used for the entire pipeline corridor out to the three nautical mile limit of State waters. However, by using micro-tunnelling for shore crossings and less invasive subsea pipelay techniques wherever practicable, the EPA would expect proponents to significantly reduce the area of habitat that would need to be permanently altered simply for laying and stabilising a single pipeline. It would not be unreasonable to expect the permanent impact zone for each pipeline to be reduced to a width of approximately 50 m or less. The EPA notes that the pipeline corridor in proponent documentation for the upstream feed gas supply to this proposal refers to a disturbed corridor of up to 25 m wide through Commonwealth waters (Woodside, 2011).

It is considered that retaining both pipeline corridors in areas E and F would be acceptable provided that conditions are applied to limit the Zones of High Impact associated with pipeline installation activities.

Noting that the proposal area is considered to be in an environment that is relatively resilient to physical perturbations such as cyclones and where benthic organisms are expected to substantially recover from disturbance impacts within five years, the EPA considers that it should be possible to plan and execute pipeline installation activities such that pipeline infrastructure at full capacity and the associated Zone of High Impact would not extend far outside the corridor, if at all. It also acknowledges the residual uncertainty associated with the technical feasibility of various low impact pipe laying options.

On balance, and considering the environmental implications of the worst case trenching scenario, the EPA accepts that permanent impacts may be up to 500 m outside the pipeline corridors shown as areas E and F in Figure 2. To avoid unnecessarily affecting any more of the corridors than is reasonably necessary, the EPA expects pipelines to be grouped as close together as good safety and environmental practice requirements would allow. It also expects proponents to use best endeavours to employ best practice techniques to avoid and minimise impacts as far as practicable.

Accordingly, the EPA recommends that the installation of pipeline infrastructure should be managed such that all infrastructure is contained within the pipeline corridors shown as areas E and F in Figure 2 and the associated Zone of High Impact is confined to within 500 m of the centreline of any pipeline. In making this recommendation the EPA expects proponents to note that if they seek to use less than best practice they will need to provide strong evidence in support of their application demonstrating that they have

used best endeavours to minimise impacts and that it is not technically feasible to use low impact pipelaying techniques.

In considering the environmental acceptability of the impacts of constructing the marine infrastructure component of the precinct as a whole, the EPA acknowledges that the proponent has taken steps to avoid or minimise impacts to benthic habitat through the NDT site selection process. The benthic surveys undertaken in the James Price Point area and the wider region to support that site selection process have provided context for this assessment and contributed to improved understanding of Kimberley marine habitats more broadly. The NDT process resulted in the selection of a site at James Price Point that does not contain unique or rare marine benthic communities or significant coral reefs or mangrove communities.

The EPA notes that the benthic communities off James Price Point that will be impacted by this proposal are of value and support a diversity of wide ranging biota including dugong, turtles and fish. The EPA has concluded that some residual impacts and risks to benthic habitat and the organisms that utilise it will remain, even given the management measures proposed in the SAR.

On the most contemporary information, it is conservatively estimated that some 27% of the total BPPH and some 31% of the BPPH containing seagrass within the LAU could be permanently lost if the Precinct was developed. There remains uncertainty regarding the extent of impact given that the actual extent and severity of impact and risk are linked to the configuration, orientation and methods of construction of future infrastructure proposals, all of which are yet to be finally determined. The EPA also considers that the impacts should be able to be reasonably further constrained such that these conservatively high loss scenarios do not need to eventuate.

The EPA has therefore recommended that proponents of derived proposals should carefully refine the design and approach to dredging and infrastructure placement and the management of installations to ensure that the extent of impact to BPPH can be considerably lower than predicted. The EPA also recommends that future proponents put forward offset measures to address these impacts and risks, such as research to improve the understanding, mapping and management of benthic habitats and creek systems in the region and understanding how to better predict and manage dredging related impacts to the marine environment.

The EPA concludes that the proposal could be implemented and managed in a way that is unlikely to compromise the ecological integrity of the marine environment locally and regionally. The EPA therefore finds that its objectives for this factor at this location could be met subject to appropriate design and proactive management to control and strictly limit impacts to benthic communities from marine construction and ongoing operational activities and the application of appropriate offsets. To this end, the EPA recommends the conditions listed in Appendix 4 to this report be applied to adequately manage the impacts of dredging and other forms of marine disturbance.

Summary

The EPA considers the key environmental factor of benthic habitats has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures and offset the residual impacts as recommended in this report. The relevant recommended conditions for this factor include:

- Condition 9 relating to Marine Facilities and Impact Zones Plan;
- Condition 10 relating to Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program;
- Condition 11 relating to State of the Marine Environment Surveys;
- Condition 12 relating to Coastal Processes;
- Condition 14 relating to Pipeline Shore Crossing Management and Monitoring Program; and
- Condition 24 relating to Decommissioning.

3.3 Marine environmental quality

Description

Marine environmental quality is a generic term to encompass the quality of water, sediment and biota. Quality, in this sense, refers to the levels of potential contaminants such as metals (e.g. copper, zinc, mercury), bio-stimulants such as nutrients (e.g. nitrate, phosphate) and also physical factors such as temperature, salinity and turbidity. The natural or background levels of these various parameters can vary significantly between locations and between sites within a particular location. They can also be affected by human activities such as dredging, wastewater discharges and accidental leaks and spills. Quality is determined through measurement and subsequent analyses and interpretation of the data collected against relevant guidelines and standards.

There have been few surveys of environmental quality in the Kimberley, with most having been undertaken in association with the NDT process (e.g. Daly *et al.*, 2012). The proponent collected environmental quality information through a combination of long term instrument deployment and periodic surveys. The purpose of these data collection programs was two-fold. Firstly, to characterise the baseline levels of a number of key substances that may be influenced by activities associated with the construction and operation of the LNG Precinct, and secondly, to use this information to predict the potential environmental consequences of various waste discharges and activities and determine the level of management required to ensure the environment is adequately protected.

Key findings from background studies by the proponent include:

- the water clarity off James Price Point is generally very high, and levels of turbidity (which affect water clarity) vary depending on season, tides and weather conditions,
- the intensity of sunlight (as photosynthetically active radiation (PAR)) at the seabed, which is required to sustain benthic primary producers, varies up to 200-fold between peak and low turbidity events,
- naturally elevated turbidity is largely restricted to the bottom layer of the water column,
- the median TSS level was lowest in the winter dry season (2.3 mg/l) and highest in the summer wet season (7.5 mg/l), and
- the 95th percentile TSS level (typical highest values) ranged between 9.8 mg/l in the winter dry season and 34.3 mg/l in the summer wet season.

The tides off the Dampier Peninsula are semi-diurnal which means there are two full tidal cycles each day. During spring tidal periods, which occur each fortnight, the difference in water level between high and low water can exceed nine metres. In contrast, the difference in water level during neap tidal periods (occurring on the alternative fortnightly cycle) can be less than one metre. The SAR notes that incoming and outgoing tides during spring tidal periods can generate strong currents and increase levels of turbidity compared with neap periods. Cyclones are infrequent, but extreme, events that can generate very high turbidity over relatively short periods.

These observations suggest that local organisms are adapted to periodically elevated levels of turbidity occurring on a cyclical (tidal) basis, and to short duration, infrequent but potentially extreme turbidity events.

Surveys undertaken by the proponent also established baseline conditions for a number of other water and sediment quality parameters (Gardline Marine Sciences, 2009). Nutrient levels are reported in Table 1-8 of Part 3 of the SAR and background metal values are reported in Table 1-10 of Part 3 of the SAR. The proponent discussed these results in the SAR and suggested that ammonia-N levels in samples may have been influenced by mineralisation of organic nitrogen. The proponent also noted that a number of samples for trace metals appear to have been contaminated during transit to the laboratory or analysis, and that in addition, laboratory reporting limits for some parameters were above the relevant ANZECC & ARMCANZ (2000) guideline trigger value.

Marine discharges

Routine discharges from the Precinct would include cooling water, hydrotest water, process water, brine from desalination, produced formation water, stormwater, greywater and treated sewage (DSD, 2010a). These waste streams would be controlled within the Precinct facilities and are proposed to be discharged into the nearshore marine environment via ocean outfall(s). The proponent has not determined the exact locations of the associated outfalls, however, they are expected to fall within the current Browse LNG port area.

Routine stormwater runoff in both construction and operations phases would occur during and subsequent to large rainfall events. The first flush of a runoff event removes contaminants from surfaces (particularly impervious surfaces) and the proponent proposes to utilise treatment technologies to reduce the concentration and loads of contaminants such as hydrocarbons and metals in these discharges. Routine stormwater runoff from the process areas has been estimated at 8 gigalitres per year (GL/year) for a 50 Mtpa plant.

First flush water would be collected and sent to the wastewater management system prior to discharge. Post 'first flush' stormwater is expected to be low in contaminants and to be discharged direct to sea via ocean outfalls. Therefore the proponent does not anticipate that stormwater runoff will result in a reduction in water quality outside the mixing zone.

Many of the construction-related discharges are similar to the operational phase discharges, but volumes may differ. For example, discharges of treated sewage, which is linked to the size of the workforce, will be greater during construction phases than during routine operations. Discharges from dredging equipment or dewatering of dredge spoil utilised for land-based construction are examples of phase specific discharges that may or may not occur. Similarly, the discharge of produced formation water will only occur during the operations phase. There may also be differences in terms of the location and mode of discharge during construction and operational phases. For instance, temporary outfalls may be required to be used for stormwater or treated sewage before the permanent infrastructure has been installed and commissioned. The type of discharge and the phase of the project where it might occur is summarised in Table 10.

In addition to the planned routine discharges during construction and operation, there is the potential for non-routine discharges of hydrocarbons or chemicals (e.g. LNG, LPG, condensate, bunker fuel, lubricants, diesel or monoethylene glycol) to be released into the marine environment. These can range in scale from minor leaks and small accidents associated with pipelines and storage facilities through to large scale spills arising from catastrophic failures or maritime collisions.

Dredging and rock dumping will generate turbidity, but dredging and dredge spoil disposal associated with construction of the marine facilities would be the largest sources of turbidity plumes associated with this proposal. These plumes will be carried by currents and the proponent predicts that visible plumes in the Zone of Influence could extend as far north as Beagle Bay and as far south as Broome. The Zone of Influence of these plumes is described in more detail in Section 3.2. While plumes in the Zone of Influence are not predicted to have an ecological impact, they can affect amenity uses of the environment. These uses include recreational activities such as sightseeing and swimming, as well as commercial uses that rely on good water quality such as tourism and pearl farming.

Table 10. Marine discharges from construction and operations of the Browse LNG Precinct.

Activity source	Phase of Project		Discharge scenario	
	Construction	Operations	Routine discharges	Non-routine discharges
BLNG Precinct marine discharges (onshore and marine facilities)				
Treated sewage and grey water	+	+	+	
Brine from desalination		+	+	
Produced water and process water		+	+	
Stormwater	+	+	+	
Hydrotest fluids	+		+	
Hydrate inhibitors (MEG)		+		+
LNG storage		+		+
Fuel and chemical storage	+	+		+
Vessel marine discharges				
Deck drainage	+	+	+	
Sewage and greywater	+	+	+	

Source: Table 2.3-1 in Part 3 of the SAR.

Turbidity associated with marine Infrastructure construction

The proponent predicts that plumes in the Zone of Influence will be visible off Cable Beach for between 5% and 30% of the 21 month dredging campaign and offshore from Gantheaume Point for between 10% and 20% of the dredging period. It is possible that visible plumes might enter Roebuck Bay and affect amenity there. Although the plumes may affect visual amenity, the proponent predicts that the plumes will not cause any ecological effects and will be at their greatest intensities during summer storms.

The most recent modelling undertaken by the proponent shows that plumes will be present at the mouths of Willie Creek and Barred Creek for the majority of the 21 month dredging period (DSD, 2012b). The implications of any turbidity plumes on the creek systems were not explicitly considered in the SAR but were discussed in the more recent documentation. During the dry season when background levels of turbidity range from 2 to 3 mg/L, average turbidity levels at Willie and Barred creeks are predicted to be 10.4 mg/L and 21.8 mg/L respectively (DSD, 2012b).

The proponent notes the commercial pearl farm/tourism activities in Willie Creek, but considers that the elevated turbidity generated by dredging will not adversely affect the growth of the pearl oysters that are grown there. Similarly, the proponent is not anticipating any effects on mariculture activities further north in Beagle Bay.

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Environment and Conservation (DEC)

Points from the DEC submission relevant to this factor of the assessment include:

- water quality monitoring not having been undertaken over a full 12 months; and
- insufficient information on wastewater discharge to assess the impacts.

Kimberley Land Council (KLC)

Points from the KLC submission relevant to this factor of the assessment include:

- oil spill sensitivity maps, supported by field surveys to ground truth sensitive habitats, should be required as part of the Oil Spill Response prior to construction;
- Traditional Owners should be given an opportunity to review and approve the key Oil Spill Contingency Plan prior to these being approved by Government;
- binding commitments are required to ensure that the responsible organisations, such as the Broome Port Authority, have the skills and resources to provide effective oil spill preparedness and response for such a large hydrocarbon processing development;
- few details are provided on the locations of outfalls and the treatment options for discharges that will be adopted. These are required for a full understanding of the likely impacts and assessment of mitigation measures proposed;
- the Marine Wastewater Discharge Management Plan will be critical in providing specific details on treatment standards, outfall location and mitigation measures and will need to be reviewed and endorsed by the Traditional Owners;
- future proponents should be required to demonstrate that they will meet ANZECC & ARM CANZ 2000 (where applicable) as a minimum and that other best practice initiatives will be adopted; and
- best practice should be applied in regard to wastewater treatment options and outfall design.

Western Australian Fishing Industry Council (WAFIC)

Points from the WAFIC submission relevant to this factor of the assessment include:

- salt water intake and brine discharge associated with a potential desalination plant;
- support the preparation of a BLNG Precinct Environmental Management Plan (EMP) for the port area and recommend that the Department of Fisheries be included in the formal consultation;
- the use of dispersants in responding to an oil spill will have adverse impacts on fish and marine life, and impacts to the commercial fishing industry;
- the commercial fishing, pearling and aquaculture industries should be consulted in the development of spill contingency planning; and
- spill contingency planning should include the commitment to compensate businesses that suffer loss as a result of a spill.

Public submissions and conservation groups raised concerns regarding:

- potential impacts of wastewater discharge from operations on marine fauna;
- impacts as a result of cumulative marine discharges over the life of the project have not been adequately considered;
- that the proposal relies on compliance with International Maritime Organisation MARPOL 73/78 Annex IV to address vessel discharges, however this allows for discharge of untreated discharge of greywater from galleys;
- inadequate consideration of potential impacts of desalination;
- the risk of oil spill to the Kimberley coastal environment and marine fauna;
- the adequacy and robustness of hydrocarbon spill modelling;
- the preparedness of the proponent to both prevent and manage a major oil spill; and
- a detailed oil spill management plan not being made available for public scrutiny.

Assessment

The EPA's environmental objective for this factor is to ensure that emissions do not adversely affect the designated environmental values of the marine environment of the James Price Point area, including the ecological values of ecosystem health and the social values of recreation and aesthetics, fishing and aquaculture, cultural and spiritual, and industrial water supply, by meeting spatially-defined environmental quality objectives.

The potential impact on marine environmental quality needs to be considered for a number of discharges and disturbance activities. These include the discharge of:

- turbid water and suspended sediment from dredging,
- desalination brine,
- treated wastewater (including treated sewage),
- process water (including produced water, process water, hydro-test water and cooling water if required),
- stormwater runoff, and
- accidental spills of hydrocarbons or chemicals.

Each of these activities has the potential to affect a range of values including ecosystem health (i.e. the health of marine organisms) and social values that encompass peoples' uses of the marine environment (e.g. for mariculture or recreation) and organisms within that environment (e.g. seafood quality).

For the purposes of this assessment, the activities listed above have been placed into three broad categories: dredging-related activities; planned and controlled wastewater discharges; and accidental releases. These categories of activity are discussed in individual sections below.

Proponent's assessment of marine environmental quality

The proponent characterised the concentrations and seasonality of total suspended solids (TSS) in the waters off James Price Point. The characterisation of this key water quality parameter is generally consistent with surveys reported in Daly *et al.* (2012).

The proponent also attempted to establish baseline conditions for a number of other water and sediment quality parameters such as nutrients and heavy metals. These data are at odds with the results of other surveys undertaken in the same area that reported significantly lower levels of most of the parameters measured. In the case of nutrients, the levels reported in the SAR for nitrogen components were significantly greater than in other surveys and, in the case of ammonia, were up to 100 times higher than reported in Daly *et al.* (2012). Similarly, the reported background levels of metals in water were higher than expected for a number of parameters. The reported levels of copper and zinc, for example, were between ten and one hundred times greater than reported by McAlpine *et al.* (2012). The results reported in the SAR are not consistent with other studies and are considered to be indicative of problematic sampling or analytical practices as noted by the proponent rather than likely actual background values.

Based on these observations, the EPA assigns a low level of confidence to the background water quality data for nutrients and heavy metals presented in the SAR and expects proponents of future derived proposals to undertake new surveys, with appropriate quality assurance procedures, to better characterise the ambient environment and to design and operate their waste discharges to minimise impact on environmental quality. In the interim, the EPA will base its assessment of this factor on the background conditions reported by Daly *et al.* (2012) and McAlpine *et al.* (2012).

Influence of dredging related activities

Suction dredging affects environmental quality by generating turbidity at the suction head, by the action of propellers and thrusters, through turbid water overflow from hopper barges as they fill, during ocean disposal of dredged material or via the discharge of decant water when dredged material is used for land reclamation. Sediments suspended in the water column make the water turbid (cloudy), changing its appearance and reducing its clarity. Turbidity effects can extend widely and to significant distances depending on factors including sediment properties, weather, sea state and wind and tidal induced currents.

The proponent expects that turbid plumes generated by dredging activities would be visible at TSS concentrations as low as 2 mg/L above background if background waters are very clear, and at about 10 mg/L above background if background levels are about 5 mg/L. Background levels of suspended sediments in waters near the seabed in the precinct area range from a median of 10-15 mg/L in summer (wet season) to a 2-3 mg/L median in winter (dry season) and surface levels are expected to be lower than these values (DSD, 2010a). The proponent considers 5 mg/L of sediment to be a critical threshold for visual amenity, although advice in ANZECC & ARMCANZ (2000) suggests that smaller percentage elevations above background may be visible, particularly during the dry season when background levels are low.

Simulation modelling was used to predict the intensity and extent of plumes that might be generated through dredging activities. The results indicate that a plume comprising up to 50 mg/L of sediment above background could extend 3 to 5 km from the dredge. Applying the relative visibility criteria outlined above, such a plume would be expected to be highly visible and likely to affect amenity values to the extent that people are likely to be deterred from swimming, boating and fishing in the area.

Modelling in the SAR predicts that a plume of sediment 10 mg/L above background extending approximately from Quondong Point to Coulomb Point would occur under certain conditions during a 12-in-18 month dredging period. A plume of this intensity would be expected to be readily visible and affect visual amenity values when it is present.

A visible plume (5 mg/L above background according to the proponent's modelling) may occur at some time (> 5% of the time) during the duration of dredging within an area bounded by Gantheaume Point/Roebuck Bay in the south to Beagle Bay in the north. This does not mean that all of this area is likely to be subject to a plume at any one time, but that conservative modelling indicates that a visible plume could appear anywhere within this area at some time during the dredging period. The intensity and persistence of elevated turbidity will tend to increase with increasing proximity to the source.

The effects of these plumes on amenity values will depend on when and where they occur, their intensity and their frequency of occurrence. If they occur off Cable Beach or Gantheaume Point in winter, when water clarity is high, they are likely to be detectable by tourists along the beachfront and readily noticed from Gantheaume Point. If they occur in summer, when water clarity is poorer and winds are onshore, they are less likely to be noticed, except perhaps by experienced observers. The presence of the plumes will

elevate turbidity in Willie Creek and Barred Creek, and they are likely to be very noticeable if they reach the concentrations predicted by the proponent. In all cases the plumes would be most prominent when viewed from the air.

Influence of planned and controlled wastewater discharges

The precise locations of outfalls for planned liquid discharges to the marine environment have not been determined but it is intended that they are located within the main basin of the port operations area. The proponent expects that discharge into an environment that is well-mixed and highly flushed by twice-daily tidal changes of up to nine metres in height will promote rapid mixing and accelerate dilution of the discharge constituents.

The proponent expects that any contaminants in the discharge will not be detectable above background levels except within the immediate mixing zone, although it is noted that hyper-saline brine from desalination may form a layer of higher salinity water on the seabed that may move offshore to deeper water under gravity (DSD, 2010a). Discharge of mixed liquid containing trace amounts of potentially toxic biocides, hydrocarbons or oxygen scavenging chemicals is proposed via an outfall diffuser into a mixing zone located within the port area. The proponent anticipates that wastewater streams will achieve a level of 95% species protection outside the Precinct's port area, according to the definitions in the ANZECC & ARMCANZ 2000 Guidelines and sets 99% species protection as a target for the same area (DSD, 2010a).

Modelling of marine wastewater discharges by the proponent indicates that under most circumstances wastewater would be diluted 10 times within one metre of the discharge point, and 100 times dilution would be achieved within less than 10 m during strong currents and within less than 30 m during weak currents (DSD, 2011a). The quality of wastewater, discharge rate and actual diffuser design and location will influence the final size of the active mixing zone but the proponent considers that dilutions in excess of 100 times should be readily achievable within a maximum sized active mixing zone of 300 m and that dilutions of 300 to greater than 1,000 times can be expected within a few kilometres of the outfall (DSD, 2011a).

The proposal states that precinct users will be required to demonstrate that routine wastewater discharges achieve the relevant ANZECC & ARMCANZ water quality guidelines at the boundary of an agreed mixing zone and undertake regular eco-toxicology testing and improvements to target a 99% species level of protection beyond the port area.

Influence of accidental and uncontrolled discharges

The most likely source of non-routine discharges is considered to be hydrocarbon spills. The proponent acknowledges that the potential impacts of a hydrocarbon spill are a significant concern to local community members, and that these concerns were heightened by the Montara spill off the Kimberley coast in 2009 (DSD, 2010a).

Given the low viscosity nature of the Browse condensate, containment at sea is regarded as unlikely but evaporation is expected to assist with dissipation of a slick (DSD, 2010a). A diesel fuel spill is expected to behave similarly. Although these light-weight hydrocarbons are less persistent than heavier oils, they are generally more toxic.

The proponent considers that a major spill is extremely unlikely but the consequence may be severe (DSD, 2010a). Apart from impacts to significant environmental features, such as the Lacepede Islands and Roebuck Bay, impacts could accrue to the people of the Dampier Peninsula/West Kimberley who are customary users of fish, commercial fishermen, pearling or other aquaculture operators, and swimmers and tourism operators who rely on Cable Beach and other coastal sites remaining unpolluted.

The proponent's modelling indicates that spills could reach sensitive environments such as the Lacepede Islands within seven days, Willie Creek Pearl Farm in five days, Cable Beach in six days and Roebuck Bay in 10 days with probabilities ranging from the equivalent of once-in-2,000 to once-in-10,000 years (DSD, 2011a). The modelling also finds that strong tidal flows could move spills quickly over two to 10 kilometres. This would require the capability to rapidly respond to spills of all sizes. Adequate response equipment would need to be maintained on-site to enable the immediate response required.

A significant LNG spill would result in spontaneous and explosive boiling of the LNG, with little impact on water quality according to the proponent, and the resulting gas discharging to the atmosphere.

Management of spills would depend on an emergency response plan designed around the provision of oil spill response equipment onsite by the Port Authority, as required under the State Emergency Management Plan for Marine Oil Pollution.

Assessment of dredging related activities

The EPA considers that visual amenity impacts at the level set out above are largely unavoidable if the proposal proceeds, but there is scope to plan and manage activities to control and reduce turbidity. The EPA acknowledges the potential impacts on aesthetics and related social values of the environment and is of the view that it would be possible to design and execute a dredging and construction program to prevent any significant loss of amenity in the vicinity of Cable Beach and Gantheaume Point. The EPA notes that it is unlikely the proponent would be able to undertake the proposed dredging without causing some elevated turbidity in Willie and Barred creeks and the creeks further north along the Dampier Peninsula. However, the EPA expects the proponent to actively manage the dredging to prevent any ecological impacts on these creeks and to work with stakeholders as needed to minimise any amenity impacts that elevated turbidity may have on their activities.

The EPA makes recommendations below about the management of dredging effects on biota and considers that those recommendations probably represent the full extent of what is practical in terms of management actions to limit the extent and intensity of dredge plumes generally, which in turn reduces their negative effects on amenity and other social values.

Assessment of planned and controlled wastewater discharges

The EPA considers that the policies and principles that were applied to establish environmental values, environmental quality objectives and levels of ecological protection for State waters off the Pilbara coast (DOE, 2006) should also apply to the waters associated with this proposal.

The EPA is not confident that the nutrient and metal values for marine waters reported in the SAR form a satisfactory basis for properly characterising the background environment and designing and operating wastewater discharges to avoid and minimise environmental impacts. Based on this the EPA expects proponents of future derived proposals to undertake new surveys, with appropriate quality assurance procedures, to better characterise the ambient environment and to design and operate their waste discharges to minimise their environmental footprints. In the interim, the EPA has based its assessment of this factor on the background conditions reported by Daly *et al.* (2012) and McAlpine *et al.* (2012).

With regard to marine discharges, the EPA notes that the proponent has committed to meeting a 95% species protection level outside the port area, with a target of 99% species protection (DSD, 2010a). Considering that the port area in this strategic proposal is approximately 3 km by 4.5 km, the EPA does not consider that this is an adequate measure to ensure that discharges are controlled as well as they can be.

The EPA recommends that a moderate ecological protection area should apply to the port and be defined as the area contained within 250 m of all shipping berths and ship turning basin(s), and the area enclosed by Marine Offloading Facility breakwaters and the coast. The EPA recommends that a high level of ecological protection should apply to all other areas, including the shipping channel and the balance of the designated port area under the control of the Port Authority.

Environmental quality guidelines for a moderate level of ecological protection should be based on achieving a 90% level of species protection for toxicants, and between the 5th percentile and 95th percentile of un-impacted background conditions for other physical and chemical stressors (ANZECC & ARMCANZ, 2000; EPA, 2005a). For a high level of ecological protection a 99% level of species protection is to be achieved for toxicants and for other physical and chemical stressors. The median concentration should be between the 20th and 80th percentiles of un-impacted background.

The EPA recommends that all discharges to the marine environment are actively managed and will only occur via an effective, purpose built diffuser system. Accordingly, the EPA considers that a low level of ecological protection could be considered appropriate to accommodate an outfall and that its extent should be based on the 'zone of initial dilution' around the outfall diffuser where active mixing is achieved by momentum in the wastewater stream and does not rely on passive mixing by dispersion or currents and other natural factors.

For marine wastewater discharges the proponent's modelling shows that 100 dilutions can be achieved within 10 to 30 m of a typical outfall in the zone of initial dilution, and the proponent concludes that dilutions in excess of 100

times should readily be achievable within an area extending to a maximum of 300 m from the diffuser.

The EPA considers that a low ecological protection zone of 300 m radius is excessive. Since the proponent's modelling suggests that 100 dilutions can be achieved within a mixing zone of 30 m radius around an outfall, and that the resultant concentrations were based on higher than expected background conditions derived from faulty background water quality figures (i.e. requires more dilutions to achieve a certain concentration than if background concentrations are lower), a more tightly defined low ecological protection zone is reasonably achievable. Furthermore, to minimise potential impacts on the quality of the surrounding marine environment, the EPA expects wastewater discharge outlets to be located so that any associated low ecological protection zone(s) are entirely contained within the moderate ecological protection area for the operational portion of the port.

The EPA expects proponents of future proposals to develop safe and environmentally sound alternatives to ocean disposal of domestic wastewater but acknowledges that there may be circumstances where treated domestic sewage may be disposed of to the ocean. The mixing zone of any treated sewage outlet is the only location where the values for recreation and aesthetics and harvesting of molluscs would not be protected. Apart from these zones, the EPA expects that all port waters, including all the low ecological protection areas, are managed so that all social values are protected to a standard where the water would be safe to swim in and the seafood would be safe to eat.

In conclusion, the EPA recommends that any low ecological protection zones should be as small as possible and based on the 'initial (active) mixing zone' for well-designed diffusers and using best practice control and treatment measures. The EPA expects the outfall of any wastewater discharge to be sited, designed and operated so that:-

- the low ecological protection zones are minimized, do not exceed a radius of 70 m from the diffuser, and do not rely on far-field mixing to achieve the required level of ecological protection at their boundary singly and in combination with other outfalls;
- the low ecological protection zone for an outfall is located entirely within the moderate ecological protection area for the port; and
- the relevant level of ecological protection is achieved within each of the ecological protection zones associated with the precinct.

The EPA has accordingly recommended a condition to ensure that a Marine Environmental Quality management program is developed and implemented, with requirements that the program:

- identify the environmental values to be protected,
- spatially define the environmental quality objectives and levels of ecological protection to be achieved,
- establish environmental quality criteria for each relevant objective and level of protection,

- describe the data evaluation procedures that will identify where and when environmental quality objectives have not been met; and
- include contingency management strategies in the event that the objectives are not met.

The program is to implement the smallest practical low ecological protection zones, together with best practice treatment technologies and management principles.

Assessment of accidental and un-controlled discharges

The EPA accepts that significant hydrocarbon spills are likely to be infrequent, but still possible and potentially serious. A relatively light condensate, as opposed to heavy oil, will be produced and exported and if this is accidentally released it will be difficult to contain. The EPA notes that the proposal is not located within or immediately adjacent to a particularly sensitive or vulnerable habitat, but such habitats (e.g. mangrove lined embayments) exist both to the north and south. The EPA also notes that a spill could adversely affect some biota and other non-biological values such as fossilised dinosaur footprints near the proposal location. The EPA considers that, with appropriate preventative measures and sufficient oil spill response capability maintained on-site, the likelihood of significant impacts from spills is sufficiently low to conclude that its objectives for this factor are likely to be met.

The EPA considers it essential that any derived proposal is accompanied by a Marine Oil Pollution Response Plan containing detailed oil spill scenario and trajectory modelling and the provision of sufficient immediately available response equipment and trained personnel on-site to allow for a prompt and effective response if an oil spill occurs. The EPA particularly notes the important role that the responsible Port Authority will have to play in regard to maintaining an adequate Tier 2 oil spill response capability and appropriately trained personnel.

The EPA notes the commitment of the proponent to house sufficient response equipment to initiate and maintain an adequate level of response to a Tier 2 incident (10 to 1000 tonnes) and to prepare a comprehensive response plan. The EPA considers that there is adequate legislation under the relevant Petroleum acts and under Department of Transport requirements to ensure this plan is produced and the proponent's commitments are upheld. As such, the EPA does not consider it necessary to recommend a specific condition about spill response under the EP Act.

Summary

The EPA considers the key environmental factor of marine environmental quality has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures as recommended in this report. The relevant recommended condition for this factor includes:

- Condition 13 relating to Marine Environmental Quality and Marine Outfalls.

3.4 Terrestrial biota

Description

The Browse LNG Precinct is located in the Dampierland bioregion, within the Pindanland subregion. The vegetation largely comprises shrubland on Pindan sandplains over most of the area, with narrow belts of beach and dune communities to the west. Bands of evergreen and deciduous Monsoon Vine Thicket (MVT) vegetation that rely on intercepted surface runoff and groundwater lie behind the dunes, as does a zone of drainage basin vegetation. Coastal heath occurs in the north-western part of the precinct.

The Precinct area is predominantly uncleared, with the vegetation generally in good to very good condition. A number of weed species are common along roads and other disturbance areas.

Flora and vegetation

The Precinct area supports four vegetation communities of conservation significance as described in Table 11.

Drainage basin vegetation and coastal communities, including MVT which is listed as a threatened ecological community (TEC) at State level, were considered to be important in the SAR based on their restricted distribution, the effect of direct clearing and the likelihood of additional impacts through fragmentation, weed invasion, changed fire regimes, alteration of ecosystem processes maintained by frugivorous (fruit eating) fauna and changes to hydrological and hydro-geological regimes (DSD, 2010a). The total area of MVT on the Dampier Peninsula has been estimated to have declined by about 40% since European settlement (DEC, 2009).

The DEC has advised that MVT on the Dampier Peninsula has been classified into four distinct sub-types based on plant species composition (Black *et al.*, 2010). The whole extent of MVT in the proposal area (508 ha) is designated Type B. The context for the loss of MVT vegetation at James Price Point is described in Table 12 below.

The MVT around James Price Point is of very high conservation significance and forms a significant percentage of a distinct vegetation community that differs from other Kimberley rainforest assemblages. A significant proportion (~25%) of the plant species known from the Dampier Peninsula MVTs are believed to be mostly or wholly confined to these habitats. MVTs are also important to Traditional Owners as a significant source of customary foods and other resources. The MVTs of the Dampier Peninsula, which occur near their southern limit in Western Australia, are poorly represented in conservation reserves.

Table 11. Vegetation communities of conservation significance in the Precinct area.

Vegetation community	Conservation significance	DEC listing	Significant flora	Area in James Price Point area (ha)	Area to be cleared (ha)	Percentage in James Price Point area to be cleared	Extent on Dampier Peninsula (ha)	Percentage on Peninsula to be cleared
Monsoon Vine Thickets	High regional significance	TEC – listed as vulnerable	<i>Pittosporum moluccanum</i> – Priority 4	572 ¹	132.4	23.2	1,479 ¹	9.0 ¹
			<i>Eriachne semiciliata</i> – Priority 3	(508) ²		(26.1)	(2685 ²)	(4.9) ²
Drainage basin vegetation	High local significance	Not listed, considered to be at risk	<i>Lophostemon grandiflorus</i> subsp. <i>grandiflorus</i> – nominated as Priority 3	395	0	0	1018	0
Coastal heaths	Moderate regional significance	PEC – corresponds with dwarf pindan heath of the Broome coast (Priority 1)	<i>Eriachne semiciliata</i> – Priority 3	114	8.9	7.8	705	1.3
Coastal communities	Moderate regional significance	Not listed	<i>Gomphrena pusilla</i> – Priority 2	583	34.5	5.9	3712	0.9

Sources. ¹ SAR Tables 2.4-2 and 2.4-5 DSD, 2010a; ² DEC based on Black *et al.*, 2010.

No Endangered or Vulnerable flora species under the EPBC Act or Threatened Flora under the *Wildlife Conservation Act 1950* (WC Act) were recorded from a number of surveys commissioned for the SAR. The EPA notes that MVT on the Coastal Sand Dunes of the Dampier Peninsula has been nominated and is being considered for listing as a threatened ecological community under the EPBC Act. Priority flora species recorded in the precinct include *Pittosporum moluccanum* (Priority 4), *Gomphrena pusilla* (Priority 2), *Eriachne semiciliata* (Priority 3). *Lophostemon grandiflorus* subsp. *grandiflorus* (nominated as Priority 3) is considered by the proponent as likely to occur in the drainage basin community.

The LNG Precinct footprint also supports four undescribed plant taxa, one species of restricted distribution and numerous poorly collected taxa. One suspected new species of fungus was also described.

Some 22 weed species, including nine high priority environmental weeds, have been reported by the proponent. One species is a Declared Plant (*Sida acuta*) listed under the *Agriculture and Related Resources Protection Act, 1976*.

Table 12. Extent of Monsoon Vine Thicket types on the Dampier Peninsular and proposed direct loss at James Price Point.

	All types	Type B
On Dampier Peninsula	2,685ha	814ha
At James Price Point	508ha	508ha
% in James Price Point area	18.9%	62.4%
Area to be cleared (max)	132.4ha	132.4ha
% MVT loss by direct clearing	4.9%	16.3%

Source: Area figures provided by DEC based on vine thicket classification by Black *et al.* 2010.

Fauna

Five listed fauna species were noted as possibly occurring in the precinct area but were not recorded in surveys commissioned for the SAR. They include:-

- Australian Painted Snipe (*Rostratula australis*) - Vulnerable, Migratory (EPBC Act);
- Greater Bilby (*Macrotis lagotis*) - Vulnerable (EPBC Act), Schedule 1 (WC Act);
- Golden Bandicoot (*Isodoodon auratus*) - Vulnerable (EPBC Act), Schedule 1 (WC Act);
- Masked Owl (northern) (*Tyto novaehollandiae kimberli*) - Vulnerable (EPBC Act); and
- Golden-backed Tree-rat (*Mesembriomys macrurus*) Priority 4 (WC Act).

Fauna species of conservation significance confirmed in the Precinct area by surveys commissioned for the SAR include the Little Northwestern Mastiff Bat (DEC Priority 1), Dampierland Burrowing Snake (DEC Priority 2), Bush Stone Curlew (DEC Priority 4), the skink *Lerista separanda* (DEC Priority 4), Rainbow

Bee-eater (Cwlth Migratory), White-bellied Sea Eagle (Cwlth Migratory), Chestnut-backed Button-quail (DEC Priority 4), Eastern Curlew (DEC Priority 4), and Peregrine Falcon (WC Act Schedule 4) (DSD, 2010a).

Potential short range endemic (SRE) invertebrate taxa including land snails, mygalomorph spiders, scorpions, millipedes and pseudoscorpions have been collected from the area. The risk of significant stygofauna or troglifauna values being present was considered by the proponent to be low (DSD, 2010a).

The potential presence of the Greater Bilby was listed as 'possible' in the SAR based on the presence of suitable habitat and records of diggings in the precinct area but was not confirmed. As noted above, this species is listed as Vulnerable under the EPBC Act and on Schedule 1 of the WC Act. Reports of the Greater Bilby have recently been made from the region. A report provided to the EPA includes images of burrows and animals captured by motion-sensing cameras (Lindsay, 2011). Field inspection by staff from the Office of the EPA has confirmed the existence of burrows in the north-eastern part of the precinct buffer zone and advice from DEC and OEPA specialists has confirmed that there appears to be a basis for considering that a breeding population is either resident or transient in the vicinity.

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Environment and Conservation (DEC)

Points from the DEC submission relevant to this factor of the assessment include:

- the limited level of detail provided to adequately assess the impacts, particularly for threatened, restricted or endemic flora species and communities potentially warranting additional protection; specific design or management provisions;
- surveys be undertaken prior to ground disturbing activity, in particular to identify *Pittosporum molluccanum*, bats, Greater Bilbies, subterranean fauna and SREs;
- DEC is consulted prior to any attempt to relocate fauna;
- area of MVT at JPP at 508 ha is the largest remnant on the Dampier Peninsula (the next largest is 162 ha) and is the most significant occurrence of the Type B form of the TEC. The next largest Type B remnant is 17 ha;
- the direct loss of 132.4 ha of MVT TEC, leaving some 376 ha;
- majority of the remaining extent of the TEC at JPP is downstream of the Precinct and may be at risk from changes to ground or surface water;
- potential for significant indirect impacts to MVT as a result of alteration of hydrology; co-dependence with other flora and fauna; fragmentation and loss of ecological connectivity; and edge effects;

- the JPP patch of MVT has been identified by the Broome Botanical Society as one of six priority patches for conservation and protection;
- disturbance to MVT due to pipeline installation may be reduced by tunnelling rather than open trenching;
- extent of MVT loss may be sufficiently significant to require mitigation of residual impacts; and
- DEC supports avoidance and minimisation of impacts and consideration of offsets for any residual impacts.

Department of Water (DoW)

Points from the DoW submission relevant to this factor of the assessment include:

- cap the loss of MVT vegetation;
- require the proponent of this strategic proposal and future proponent(s) of derived proposals to complete environmental management plans for the management of MVT vegetation; and
- future proponents submit detailed water-related information as part of a derived proposal application.

Kimberley Land Council (KLC)

Points from the KLC submission relevant to this factor of the assessment include:

- insufficient detail is provided on the presence of groundwater dependant ecosystems;
- the risk of impacts to vegetation communities from groundwater abstraction needs to be assessed in more detail;
- firmer commitments are required regarding the protection of the MVT given their ecological value;
- loss of MVT will have an impact on Traditional Owners ability to harvest Gubinge. Demonstrate losses to vine thickets and other vegetation have been minimised by optimizing the plant layout; and
- no discussion is provided on the impacts of increased vehicle traffic on the road to and from Broome, which is highly likely to significantly increase fauna deaths.

Public submissions and conservation groups raised concerns regarding:

- the need for a comprehensive scientific study to understand the ecology and groundwater dependency of MVT prior to any clearing and to inform management;
- the hydrological impact of ground and surface water requirements and quality on vegetation;
- the importance of MVT as a corridor for fauna movement along the Dampier Peninsula;
- the importance of the MVT at James Price Point being a priority patch in terms of its conservation significance;
- potential introduction of weeds;
- impacts to species of ethno-biological significance including concern that focus on species of ethno-biological significance has been limited to *Terminalia ferdinandiana* (Gubinge) because of its known commercial value, however there could be other species equally of value which have not yet been identified;
- concern regarding indirect impacts to vegetation as a result of changes to fog, dew and air circulation which may be of importance;
- previous EPA decisions (Bulletin 434) have rejected mining exploration in the MVT;
- potential impacts to fauna and their habitat, including threatened and protected species, in particular Greater Bilbies, Gouldian Finch, and bats;
- potential impacts to SREs, in particular the *Simoselaps minimus* (Dampierland Burrowing Snake) and *Lerista apoda* which have only been recorded in the Monsoon Vine Thicket on the Dampier peninsula;
- the need for further investigation of the role of frugivorous birds and bats on the Dampier Peninsula;
- impacts to migratory birds of the East Asian Australasian Flyway, and their habitat as a result of the proposal; and
- the importance of migratory shorebirds as recognised under JAMBA, CAMBA, ROKAMBA, the Bonn Convention, EPBC Act and the *Wildlife Conservation Act 1950*.

Assessment

The EPA's environmental objective for this factor is to maintain the abundance, diversity, geographic distribution and productivity of flora and fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

Flora

Within the LNG Precinct, the MVT and the drainage basin community are locally and regionally significant vegetation communities providing food resources for specialised fauna, dry season refuges for others and support endemic species. The EPA notes that it has previously recommended that MVT vegetation should

be protected from significant impacts (EPA, 1990; 1991). By protecting these communities, priority flora (*Pittosporum moluccanum* – Priority 4, *Eriachne semiciliata* – Priority 3 and *Lophostemon grandiflorus* subsp. *grandiflorus* – nominated as Priority 3) would also be protected. Fauna species such as the Little Northwestern Mastiff Bat (WC Act Priority 1), which normally roosts among mangroves but may roost in vine thickets, and other species such as frugivores (fruit eaters) and potential SREs, such as land snails, could also be protected by retention of suitable vine thicket habitat. The proposal will have direct and indirect impacts on the MVT, which the EPA regards as a critical environmental asset.

The EPA notes that the major part of the Precinct has been set back a kilometre or more from the coast to limit direct clearing in the MVT vegetation unit. The DEC has advised that it would be desirable to consider the possibility of a further setback of the Precinct to the east to further buffer remnant vine thicket vegetation and to reduce the north-south extent of the port shore crossing area to reduce direct loss of vine thickets.

The proposal involves direct clearing of up to a maximum of 132.4 ha of MVT for the shore crossing, to link the precinct to the port, and for the southern feed gas pipeline. The likelihood of additional, indirect impacts on the MVT due to proposal-induced changes in surface and groundwater quantity and quality is not currently known but some impact is possible over the medium to long term given the scale of the development and the reliance of the MVT on surface and groundwater flows (see also Section 3.6 below for a discussion of the surface and groundwater flows). The EPA notes the proposed precinct avoids direct clearing in the drainage basin community.

The EPA notes that this proposal would affect one of the largest areas of MVT on the Dampier Peninsula and result in the loss of between 4.9% and 9% (Table 11) of the remaining MVT on the Peninsula, depending on whether the DEC or the DSD interpretation of the amount remaining is used. The area of vine thicket at James Price Point at 508 ha is the largest remnant on the Dampier Peninsula (the next largest is 162 ha). The whole 508 ha is Type B MVT. The next largest Type B remnant is 17 ha. Up to 16% (Table 12) of the total Type B MVT would be lost. The EPA considers that this loss is regionally significant.

The EPA regards Threatened Ecological Communities (TECs) as critical assets of the natural environment that require protection wherever possible. The EPA notes that 132.4 ha of MVT is proposed to be permanently lost due to direct clearing for the Precinct (Table 2.4-5 DSD, 2010a) and that the proponent proposes a condition (Tables 2.4-7 and 2.4-8 DSD, 2010a) that the cumulative loss of MVT community shall not exceed this figure.

Given the currently limited information on the extent of possible disruptions to surface and groundwater flows from the proposal, and the dependence of the MVT on those flows, the EPA considers that it is unlikely to be possible to accurately estimate the total area of MVT likely to be lost as a result of this proposal. If MVT vegetation is dependent on groundwater and disruptions to groundwater levels as a result of abstraction or construction cannot be completely avoided, additional impact on this TEC may occur. As a precautionary assumption, therefore, the EPA considered the potential for

impacts on the whole MVT that is on and adjacent to the Precinct as the basis for the assessment of this factor.

On that basis, the worst-case loss of MVT as a result of this proposal can be considered at one level in the context of the total area of up to 2,685 ha of the MVT known to exist on the Dampier Peninsula. The EPA notes, however, that all patches of MVT are not identical in composition and structure and that four types of MVT are recognised on the Peninsula. The EPA is also aware that the 508 ha of MVT at James Price Point is the largest remaining patch on the Dampier Peninsula and comprises 62% of Type B MVT on the Peninsula. The EPA notes that the direct loss of up to 132.4 ha of MVT would comprise 23% of the 508 ha at James Price Point and 16% of Type B on the Peninsula as a whole. If the proposal were to be approved at this location, these losses would be significant in the regional context.

The EPA is also aware that Priority flora, but no Threatened (declared rare) flora species, have been recorded from the MVT at James Price Point. The EPA understands that the Priority flora species *Pittosporum moluccanum* (P4) in the James Price Point area may be one of only two collections on the mainland of Western Australia; the other being from south of Coulomb Point. Other populations occur in Western Australia on Berthier Island and the Maret Islands off the Kimberley coast. The species is common in the Northern Territory and occurs in Indonesia, the Philippines, Malaysia and Taiwan (Black *et al.*, 2010). Further survey is recommended to confirm the existence of this species within the MVTs on the Dampier Peninsula.

Noting that the Dampier Peninsula represents the only known habitat for the Type B MVT community, the EPA considers that it is important to strictly limit impacts on MVT at James Price Point wherever possible.

The EPA recommends therefore that every effort should be made at the detailed design stage to avoid both direct and indirect impacts on MVT and the drainage basin community. To that end, the EPA recommends that loss of MVT as a result of this proposal should be limited to 132 ha in total, including both direct and indirect impacts, such as groundwater drawdown, saltwater intrusion or the diversion of surface water. The proponent and all future proponents should take all practical steps to locate infrastructure in a way that absolutely limits the direct clearing of MVT vegetation and avoids indirect impacts by every means possible. This also means that the first Precinct operator should not clear any more than absolutely necessary to ensure there is still space available for future proponents. The operators should also consider the long term maintenance, management or remediation of any cut into the coast for the IMF, including once the Precinct is decommissioned.

The Department of State Development should be aware of the need for an equitable allocation of capacity within the Precinct. For example, if the first operator removes too much of the limited area of MVT that is permitted to be cleared, then there may not be capacity for subsequent operators within this assessment of a strategic proposal. To this end, the EPA has recommended conditions that require the Browse LNG Precinct Control Group to endorse plans prior to their submission, showing the layout of terrestrial and marine facilities, to indicate that they satisfy the State's needs with respect to efficient use of the available land and adequate sharing of infrastructure.

Actions to ensure clearing is minimised should include the use of tunnelling techniques to install pipelines, to avoid the need for trenching operations that would require direct clearing of vegetation and which may exacerbate groundwater drawdown or interrupt surface water flows. Trenching should be avoided unless the proponent can demonstrate that, having exhausted all other practicable means, an alternative method is warranted.

The EPA has recommended conditions to this end in Appendix 4 of this report. Indirect impacts due to groundwater drawdown, saltwater intrusion or any other cause are to be controlled by whatever means necessary to ensure the area of indirect impact plus the area of direct impact from clearing does not exceed 132 ha. At the time derived proposals are considered the EPA expects the proponent to demonstrate that the area to be cleared has been limited to the fullest extent possible and has a management process to strictly control clearing by its operators or contractors.

The EPA notes also that solutions to limit direct and indirect impacts at the design stage are more likely to be sustainable in the long term than solutions that rely on engineering measures, particularly where those measures may require ongoing maintenance. This is particularly relevant to the decommissioning stage. A designed solution is less likely to require maintenance once the proposal is decommissioned than a solution that relies on engineering measures such as impermeable barriers or active water management.

The EPA notes in this regard that the site layout could avoid the widest point of the MVT by moving a few kilometres south, but understands that Aboriginal heritage sites are located in that general area. The EPA notes therefore that it may be possible to further optimise environmental and heritage outcomes in detail, prior to final design, in consultation with the Traditional Owners. The EPA has also recommended contracting the proposed port shore crossing area by about 900 m from the north, which could further limit impacts to the MVT. The EPA notes that the proponent has committed to avoid development in Area H on Figure 2 which would help protect MVT in that area.

Given the vulnerability of MVTs and other restricted coastal communities to fragmentation, potential hydrological impacts and impacts to ecosystem function due to loss of frugivores that help maintain plant species composition, the EPA recommends that careful consideration be given to further consolidating the Precinct layout prior to the detailed design stage.

Amalgamating the southern gas pipeline route with the southern edge of the Precinct would avoid additional fragmentation of remaining vegetation between the precinct and the pipe route and reduce edge effects, which increase the likelihood of weed invasion and other fragmentation effects. Similarly, consolidation of the northern and southern gas pipeline routes into a single corridor would further reduce fragmentation effects. Amalgamating the northern and southern gas pipeline routes could also avoid creating an isolated vegetation remnant around James Price Point itself if the southern route was selected. Amalgamation in the south is also likely to simplify management of future access to James Price Point by Traditional Owners and the public.

Given the generous allowance for development of facilities within the Precinct, there is also potential to further reduce impacts on MVT through locating the western boundary of the Precinct further east, providing for a greater buffer of native vegetation between development areas and the MVT.

The EPA notes that only the Coulomb Point Nature Reserve (28,676 ha) has so far been designated as a secure nature reserve on the Peninsula and that this reserve does not contain any MVTs. The Dampier Peninsula, including the James Price Point - Coulomb Point area, is the subject of previous recommendations for the establishment of conservation reserves (EPA, 1980; Burbidge *et al.*, 1991) but these recommendations have not yet been implemented.

The EPA recommends, in the Other Advice section of this report, that if this proposal were to be approved by Government, additional reserves for the secure conservation of the distinctive and important values of the Dampier Peninsula, including threatened ecological communities such as the MVT, should be created to include habitats within the West Kimberley region with similar characteristics to the habitats to be cleared around James Price Point.

Fire management, investigations into ecosystem and hydrological processes, weed and feral animal control, surveys and monitoring, and management planning are other essential areas where offsets for residual impacts to the MVTs could provide for improved protection of remaining areas via environmental conditions applicable to the Precinct and subsequent derived proposals.

The EPA is aware that refinements to the IMF have been made to ensure that sufficient capacity exists to accommodate 50 Mtpa of LNG production (Figure 3) including options where the IMF is cut into the shoreline (Figure 25).

While the SAR contemplated impacts from saltwater intrusion and groundwater drawdown from construction, saltwater intrusion resulting from the construction and operation of the IMF was not explicitly discussed.

The EPA recognises that the elements of the Precinct cannot be constructed without some environmental impact. Given that this is an assessment of a strategic proposal, the EPA has considered whether an IMF can be constructed in such a way that does not result in residual environmental impacts that the EPA considers are significant and which minimises impacts to the environment generally and the MVT in particular. The EPA considers that this approach is appropriate regardless of whether the IMF design extends further out to sea or into the land. On that basis the EPA considers that the s43A application in regard to the IMF is unlikely to significantly increase any impact on the environment. To achieve this outcome, the EPA has taken the approach of recommending an absolute limit on the level of direct and indirect impacts that may be permitted to the MVT vegetation and that all necessary design and engineering steps are taken to minimise impacts and prevent that limit being exceeded.

The EPA recognises that there is a degree of uncertainty as to existing groundwater levels due to the proponent's inability to obtain permission to access the site and the relationship of the MVT with groundwater levels. There is also uncertainty about the effects that construction of an IMF and other

infrastructure will have on surface water flows and the location of the saltwater interface with the groundwater.

The EPA therefore recommends that all direct impacts by clearing and any indirect impacts due to groundwater drawdown, diversion of surface flows, saltwater intrusion or any other indirect impact on the MVT be confined to the proposal footprint as set out in Figure 2 and limited to 132 ha. The EPA further recommends that the proponent take all necessary design and engineering steps in construction and operation to ensure this limit is not exceeded for the life of the Precinct and that the long term maintenance, management and remediation of any proposed cut into the coast is properly considered to avoid significant environmental impacts.

The EPA notes that the proposal involves the clearing of up to 3037 ha of native vegetation. Much of this is Pindan shrubland, most of which is in good condition. The EPA notes, however, that Pindan shrubland is extensively represented across the Dampier Peninsula and concludes that the level of clearing of this vegetation unit is not so extensive as to represent a significant impact in the regional context.

Fauna

The EPA considers that significant impacts that may increase the level of threat to listed species should be avoided. The EPA notes that none of the listed fauna species likely to occur in the Precinct is confined to the Precinct area nor are any of the other fauna considered to be of conservation significance likely to be restricted to the Precinct. Shells of an unidentified *Rhagada* sp. were collected but no live specimens were located. Whether these belong to an extinct population or a more widespread species cannot be determined at present. Further survey prior to construction would assist in determining this issue. Appropriate management action should then be taken by future proponents based on these further surveys.

While considered Threatened and ranked Vulnerable, the listed Greater Bilby is not restricted to the Precinct area nor to the Kimberley region. The SAR reports that *“It is believed that individuals of the Greater Bilby are regularly spotted by locals in the Gourdon Bay area, south of Broome, while there is a population known to exist in the Beagle Bay area, to the north of the James Price Point coastal area”* (DSD, 2010a). Other records for Western Australia since 1990 include specimens from south of Broome, the Pilbara, and the Great Sandy Desert. A report (Lindsay, 2011) notes the presence of a breeding colony of Greater Bilbies to the north-east of the Precinct.

Advice from the DEC states that available information on the diet and habitat requirements of the Greater Bilby (locally and in other areas of Australia) and local soils, vegetation and landforms, indicates that the extent of available habitat on the peninsula is likely to be considerable and extend well beyond the immediate vicinity of the proposed LNG Precinct. The DEC’s advice concludes that the area of Greater Bilby habitat directly impacted in the Precinct area is likely to be of relatively small scale in relation to the overall extent of areas capable of supporting Greater Bilby habitat on the peninsula.

A licence issued under the provisions of the WC Act is required to ‘take’ listed species, but does not apply to the disturbance of a species’ habitat. While up to

3037 ha of terrestrial habitat could be cleared, this is in the context of the wider Dampier Peninsula which covers about four million hectares. Habitats such as the MVT are clearly restricted in distribution and require careful attention to limit losses. Other habitats such as the Pindan shrubland have a wide distribution on the Peninsula, hence fauna like the Greater Bilby which occurs in this habitat are unlikely to be subject to a significantly increased level of threat provided appropriate management of fires, feral animals and other threats to this species occurs.

The EPA notes a recent peer review of available data on the Greater Bilby by Dr Rick Southgate (Appendix 7) which concluded that they are unlikely to be restricted to the proposal area but that actions should be taken to manage threats to them. Dr Southgate highlights the relevance of the Dampier Peninsula to this threatened species. The EPA notes, however, that only the Coulomb Point Nature Reserve has so far been designated as a secure nature reserve on the Peninsula. The EPA recommends, in the Other Advice section of this report, that if this proposal were to be approved by Government, additional reserves for the secure conservation of the Greater Bilby, and potentially other listed terrestrial fauna, should be created on habitats within the West Kimberley region with similar characteristics to the habitats to be cleared at James Price Point.

It is also appropriate that all practical measures are taken to avoid impacts to listed species. The EPA has therefore recommended conditions to ensure that additional surveys for listed species are undertaken before clearing occurs so that detailed site design can avoid unnecessary impacts wherever possible. These surveys should extend to all areas requiring clearing as a consequence of the development of the precinct, including access roads, borrow pits, pipelines, water supply points etc., and should include sufficient of the surroundings to provide an appropriate regional context for effective management. These additional surveys should extend far enough off site to enable management of the Precinct to be framed in an appropriate regional context. This would also further regional knowledge on the distribution of listed species that may occur in habitats the same as those on the Precinct site, assisting future management of the Precinct and its surroundings.

The EPA acknowledges that the proponent has endeavoured to avoid or minimise impacts on terrestrial biota. Although the selected site will have some impacts on MVT vegetation and more widely on Pindan vegetation, there is an opportunity to enhance the protection of important vegetation communities across the Dampier Peninsula through management and mitigation measures. The EPA also acknowledges that the Government has committed to undertaking further measures to mitigate impacts to surrounding habitats of threatened species by establishing additional Kimberley conservation reserves.

If the EPA's recommendations above are adopted in full, the EPA has concluded that some residual impacts and risks to terrestrial biodiversity will remain, including to the MVT threatened ecological community. The EPA has therefore recommended that proponents of derived proposals should put forward offset measures to address these impacts and risks, including contributing to conservation initiatives.

The EPA concludes that its objectives for this factor can be met, provided the recommendations above are put in place.

Summary

The EPA considers the key environmental factor of terrestrial biota has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures and offset the residual impacts as recommended in this report. The relevant recommended conditions for this factor include:

- Condition 5 relating to a Terrestrial Facilities and Disturbance Footprint Plan;
- Condition 6 relating to a Terrestrial Baseline State Report;
- Condition 7 relating to a Terrestrial Environment Protection Program; and
- Condition 8 relating to a Terrestrial Environment Monitoring Program.

3.5 Landscape processes

Description

Coastal processes

Construction of a port, channel, breakwaters, jetties and other marine infrastructure would affect coastal processes that lead to changes in sediment transport, erosion and deposition.

Modelling commissioned by the proponent was used to predict what changes were likely with an indicative port and marine infrastructure layout capable of accommodating 50 Mtpa of LNG production (DSD, 2011a). The indicative port layout that was modelled and the effects predicted are shown in Figure 25, reproduced from Figure 5-8 in Part 7 of the SAR. This possible port layout includes an option where the IMF is cut into the existing shoreline. The proponent notes that aerial photography from 1949 to 2007 indicates that the shoreline has been generally stable over that period (DSD, 2011a).

Key findings from this modelling were:

- The volume of sediment in the active coastal zone is relatively limited.
- Coastal geomorphology is strongly controlled by the geology of inter-tidal rock platforms, headlands, cliffs and rocky outcrops.
- Cyclonic activity dominates the movement of sediment.
- Ambient sediment transport is generally northwards at an estimated maximum rate of 20,000 m³ per annum.
- Cyclonic sediment transport is highly variable but generally southward at an average maximum rate of 40,000 m³ per annum.
- The balance of ambient and cyclonic effects is an average maximum net rate of sediment transport southward at 20,000 m³ per annum.

The potential impacts of these effects, as predicted by the modelling would be:

- Shoreline accretion adjacent to the northern and southern breakwaters.
- Localised infill of the shipping channel, which may necessitate periodic maintenance dredging.
- Increased erosion potential approximately 2-3 km north and south of the harbour.
- Increased potential for reduced sediment on the beach and increased backshore erosion in the above locations, noting that pindan soils to the north are regarded as 'somewhat resistant' to erosion and rocky backshore cliffs to the south would resist erosion.
- Without mitigation, the zone of increased erosion potential would migrate south gradually, potentially leading to additional impacts.

Unmitigated coastal erosion is predicted to result in some loss of beach sediments, resulting in some decrease in recreational value. Unmanaged migration of the erosion front to the south could lead to erosion of beaches not backed by rocky cliffs, about 3 km south of the indicative port location. A deflation basin with limited vegetation cover in this area may contain Aboriginal heritage artifacts, which could be lost if erosion is not managed.

Further unchecked potential erosion could eventually affect beaches in the Quondong Point area, about 7.5 km to the south (DSD, 2011a). Coastal erosion could result in further dinosaur footprints (see Section 3.7 of this report) becoming exposed. Accelerated coastal erosion would subsequently lead to movement and deposition of the eroded material. Deposition of this material may cover up currently exposed dinosaur footprints.

Terrestrial erosion

Pindan soils underlying the precinct may be subject to erosion when disturbed and subjected to heavy rains that are typical of wet season conditions on the Dampier Peninsula. Pindan cliffs up to about 20 m high occur in the vicinity of the northern pipeline crossing. According to the SAR, pindan material is *"sensitive to water; the clays weaken when wetted and the weakly cemented sands lose cohesion, disaggregating into a mix of loose sands and clay slurry."*

Sand plain soils overlaying the pindan are also subject to erosion. As set out in the SAR, these soils *"can be expected to have highly variable degrees of compaction and resulting soil strength and may be susceptible to erosion."*

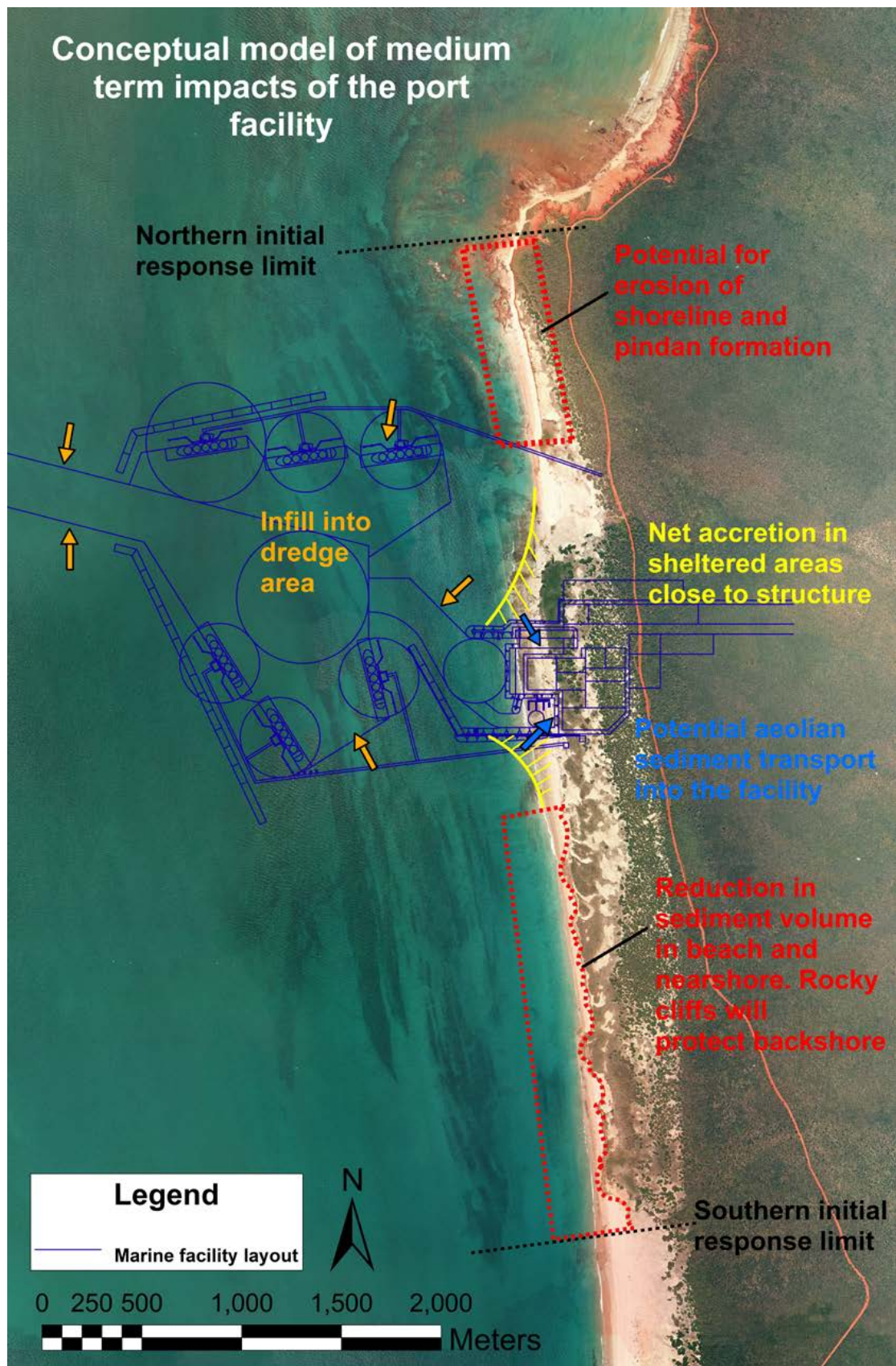


Figure 25. Possible marine facility layout and conceptual model for medium term impact of the port facility on coastal processes.

Source: Figure 5-8 in Part 7 of the SAR.

Site disturbance and excavation have the potential to cause increased surface runoff and erosion as a result of the disturbance of large volumes of pindan soils and other material. From 5 to 20 m of pindan soil may need to be removed and stockpiled for use elsewhere (DSD, 2011a), resulting in potential erosion hazards on the stockpile in particular but also from the resultant exposed site. If soil removal is necessary over the area occupied by two or more LNG plants, plus supporting infrastructure, potentially hundreds of hectares may need to be disturbed to a depth of 5 to 20 m, potentially requiring tens of millions of cubic metres of erodible soil and hundreds of hectares of open ground to be managed over a number of wet seasons. Site disturbance will also be required for roads, pipeline corridors, foundations and other earthworks.

Eroded material has the potential to smother terrestrial vegetation, fill drainage channels, increase turbidity in runoff waters and the sea and smother near-coastal marine environments.

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Environment and Conservation (DEC)

Points from the DEC submission relevant to this factor of the assessment include:

- the potential for direct and indirect impacts on flora, fauna and vegetation communities as a result of sand dune crossings, disturbance of acid sulfate soils and alteration of hydrology;
- the potential for adverse impacts if the groundwater table is intersected during construction and earthworks;
- the lack of information regarding the potential direct and indirect impacts associated with excavation, fill stabilisation and armoring requirements for marine and terrestrial structures, the source of fill and associated quarrying, in addition to appropriate disposal of excavated material;
- conditions should be applied to ensure appropriate investigations, monitoring and management during construction and earthworks; and
- conditions are applied requiring assessment and management of potential impacts of sand dune crossings including investigation and management of acid sulfate soils, alteration of hydrology including saltwater interface; appropriate reconstruction measures and risk management.

Department of Transport (DoT)

Points from the DoT submission relevant to this factor of the assessment include:

- the SEA appears to have identified the majority of key environmentally related coastal engineering issues;
- the potential impacts of climate change do not appear to have been considered. Of particular relevance to this proposal is the potential for changes in cyclone intensity and sea level rise;
- it appears very likely over time sediment will accumulate on the northern and southern side of the facility, resulting in subsequent erosion of areas further away. This can usually be managed by undertaking sand bypassing or back passing;
- the evaluation of the extent of impacts (erosion and deposition) is greatly dependent on the underlying geomorphology assessment. A full analysis of the offshore geomorphology is considered essential to understanding the availability of sediment and how it is transported within this natural system;
- it is difficult to interpret the sediment transport modelling as the limitations of the sediment transport models (LITPACK and Mike 21 ST) are not clearly stated;
- over a 20 year period it is considered likely that the morphology of the shoreline (orientation, profile shape) and grain size will change, in particular in the immediate vicinity of proposed facility. This will in turn change the sediment transport rates and should be taken into consideration;
- the sediment transport estimates would benefit from more extensive offshore sediment sampling;
- the proposed development may redefine the boundary and position of the sediment cells;
- the geomorphology assessment should be reviewed by:
 - review of the existing Laser Airborne Depth Sounder (LADS) offshore bathymetry;
 - review of the existing benthic habitat mapping;
 - more extensive offshore sediment sampling and composition analysis similar to that undertaken for onshore sediments; and
 - collection of offshore geotechnical data (e.g. seismic data) to determine the thickness of sediments overlying the rock platforms.
- the proponent should be required to contribute to scientific research. For example, further research is needed to understand the mechanisms by which sediment is resuspended to allow modelling of 'natural' or background turbidity;

- over estimation of the potential impacts can have the flow on effect of placing monitoring sites in ineffective locations or result in ineffective selection of management options. This is particularly relevant to:
 - estimation of reductions in water quality resulting from turbidity generated by dredging and associated activities; and
 - estimation of the long-term sediment transport rates.
- initial modelling results and predictions of impacts should be validated following the commencement of construction;
- management plans when developed should seek to undertake proactive management; and
- a number of similar projects have required subsequent changes to early stage designs to replace piled structures with causeways. Some broader consideration should be given to the potential for changes to the trestle structure following the full geotechnical investigation.

Kimberley Land Council (KLC)

Points from the KLC submission relevant to this factor of the assessment include:

- further details are required on the phasing of the pipeline infrastructure and corridors so that Traditional Owners can gain a better understanding of the potential impacts and timing of these impacts;
- the SAR refers to the need for the most invasive near shore pipeline construction; evidence should be provided as to why a less invasive construction technique is not viable;
- a future Coastal Process Management Program will be critical in providing specific details on how impacts from dredging will be reduced and managed and will need to be reviewed and endorsed by the Traditional Owners; and
- the SAR does not address potential impact on amenity value should impacts on coastal processes occur as predicted.

Public submissions and conservation groups raised concerns regarding:

- negative impacts on coastal and marine environments as a result of the proposal;
- impacts on littoral drift with effects to sea grass beds, natural creeks, mangroves and other habitats that may be adversely affected by sand movements; and
- the impact of the development on Cable Beach.

Assessment

The EPA's environmental objective for this factor is to maintain the integrity, ecological functions and environmental values of the soil and landforms.

Coastal processes

Unchecked coastal erosion is clearly not acceptable to the EPA. While the risk of coastal erosion is mitigated by the presence of rocky beach platforms and headlands in many areas, other parts of the project area are susceptible to beach loss and backshore erosion that could lead to some loss of amenity, habitat disturbance and disruption or loss of heritage material.

There is uncertainty around the final design of the port and the IMF and how the coastal processes will interact with them but, because of the scale of the infrastructure and the dynamic nature of the coast, these impacts may occur up to several kilometres from the port itself. There is also a degree of uncertainty around the offshore sediment movement and the processes that control it. The EPA considers that given this uncertainty it is not possible to confidently assess the predictions made by the proponent regarding coastal impacts and management at present.

Accordingly, the EPA recommends that a Coastal Processes Monitoring and Management program is developed, as set out in Appendix 4. The aim of this program should be to ensure that no significant net erosion attributable to the port or other coastal or marine infrastructure occurs. The EPA recommends that regular monitoring is undertaken and management such as sand bypassing is implemented to appropriately redistribute accumulated sand from either side of the port.

Terrestrial erosion

The proposal is somewhat unusual in a construction sense in Western Australia in that potentially tens of millions of cubic metres of erodible soils will need to be handled in an environment subject to intense wet season rainfall. While similar sized earthmoving projects have occurred previously in Western Australia, in the main they have been located in semi-arid to arid environments.

Erosion of cleared areas or soil stockpiles that leads to significant impacts on the surrounding terrain or in the sea would be unacceptable. Given the significant amount of erodible pindan and sand plain soils likely to be disturbed and stockpiled, the EPA recommends that a construction environmental management program is developed and implemented.

The EPA particularly notes the pindan cliffs at the northern pipeline crossing. It has noted in Section 3.4 that amalgamating this crossing with the southern pipeline crossing would limit the impacts of the proposal. In any event, pipelines should only be installed by directional drilling or other micro-tunnelling techniques that do not involve open trenching unless the proponent can demonstrate that an alternative method is warranted.

Summary

The EPA considers the key environmental factor of landscape processes has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the

proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures as recommended in this report. The relevant recommended conditions for this factor include:

- Condition 10 relating to Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program;
- Condition 11 relating to State of the Marine Environment Surveys;
- Condition 12 relating to Coastal Processes; and
- Condition 14 relating to Pipeline Shore Crossing Management and Monitoring Program.

3.6 Surface and groundwater

Description

Surface and groundwaters are important to the maintenance of potable water supplies and terrestrial biota. In the James Price Point area they are thought to be particularly important to vegetation within the MVT and drainage basin communities that occur on, and immediately inland of, the coastal dunes.

There is limited information on groundwater presented in the SAR as no dedicated studies had been undertaken at the time the SAR was released because access had not been gained for the drilling of test bores. A further desktop study of available data on groundwater was provided by the proponent as part of the response to public submissions on the SAR. That study is called the Groundwater Dependent Ecosystem Review and has been included in full as Annexure 5 with the proponent's response to submissions that is reproduced in full in Appendix 5 to this report.

Key aspects of surface and groundwaters in the James Price Point area are:-

- One sub-catchment, with a channel flowing from east to west through the centre of the Precinct, discharges seasonal runoff east of the coastal dunes, in the MVT.
- Another sub-catchment, with a channel roughly along the southern boundary of the precinct, also discharges seasonally east of the coastal dunes, again in an area of MVT.
- Shallow, possibly perched, groundwater aquifers in quaternary sands are likely directly beneath western parts of the Precinct.
- These shallow aquifers are likely to receive inflows, at least in part, from the Precinct area.
- The MVT appears to be maintained by both surface and groundwater inflow (Froend, quoted in DSD, 2010a; Annexure 5 to DSD, 2011b).
- Four aquifers may be used for water supplies or otherwise affected by the proposal. These are the quaternary superficial, Broome sandstone, Wallal and Grant group aquifers. From 2 to 8 GL/y of water will be required respectively for a 12 to 50 Mtpa LNG facility.

- Desalination of saline aquifers or seawater is an alternative for water supply if adequate supplies of suitable quality cannot be obtained from aquifers.

Surface and groundwater flows that originate, at least in part, from the Precinct site are thus likely to be important to the maintenance of the MVT that occurs within and south of the Precinct and to the drainage basin vegetation community. The SAR notes that the sensitivity of the groundwater regime of the superficial and Broome sandstone aquifers is unknown, but is likely to be high (DSD, 2010a).

Uncontrolled abstraction and unplanned discharges of wastes could adversely affect surface and groundwater. As well as reducing the groundwater level, excessive abstraction could cause the saltwater interface to move inland and adversely affect groundwater dependent ecosystems. Groundwater is a critical source of supply for communities and other users on the Dampier Peninsula. The Broome Water Reserve extends to within 15 km of the Precinct and the nearest communities that rely on groundwater supplies are about 35 km south and 75 km north-east at Coconut Wells and Beagle Bay respectively. Other users are likely to include Willie Creek Pearl Farm and Country Downs station (about 28 km south and 40 km north-east respectively). These locations are considered by the proponent to be up-gradient or cross gradient from the Precinct and thus not at risk from an unplanned spill (DSD, 2010a).

Disruption of perched aquifers in the coastal dunes by excavation for pipelines and other infrastructure associated with shore crossings is a potential threat to MVT vegetation that may depend on those aquifers. Coastal excavations to below sea level for marine facilities may reduce groundwater levels and create seawater inflows under adjacent lands.

The likelihood of acid sulfate soils being present in the Precinct is considered to be low (DSD, 2010a).

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Environment and Conservation (DEC)

Points from the DEC submission relevant to this factor of the assessment include:

- potential hydrological impacts as a result of physical presence of the proposal, sand dune crossings and water abstraction could result in potential impacts to groundwater dependant ecosystems, riparian vegetation and species which utilise this habitat;
- conditions requiring hydrological investigations to determine impacts of the proposal should be used to inform monitoring management, design, construction and operation of the precinct;

- conditions should require consultation with the DEC regarding the assessment of impacts of groundwater abstraction on conservation values; and
- conditions be included to address potential impacts of a desalination plant should that option be pursued.

Department of Water (DoW):

Points from the DoW submission relevant to this factor of the assessment include:

- identification of sustainable water supplies for the construction and operation phases of the project is a significant issue;
- the groundwater management plan must include an options analysis of all potential water supplies which may include groundwater from the deeper Wallal and Grant aquifers, water reuse recycling and desalination of sea water;
- groundwater related issues, other than impacts on MVTs, (i.e. abstraction impacts on inland migration and upconing of the saltwater interface) could be dealt with through the submission of detailed hydrological information with derived proposal applications and via the licensing process under the *Rights in Water and Irrigation Act 1914* (RIWI Act).
- the main surface water issues associated with the precinct will be managed through the requirement to develop an ecological surface water requirements management plan and construction environmental management plan (CEMP);
- the CEMP should identify techniques for water reuse and recycling, including stormwater capture and reuse, in order to reduce reliance on groundwater;
- the scope of the CEMP should be broadened or a separate operational management plan be developed to assist with best practice management of water related issues associated with the ongoing management of the Precinct – in particular stormwater management which would not be covered in the operating strategy for the groundwater licence under the RIWI Act; and
- the Better Urban Water Management Framework (WAPC, 2008) is applicable to surface water management, and ensures the total water cycle is considered at each stage of the planning process.

Kimberley Land Council (KLC):

Points from the KLC submission relevant to this factor of the assessment include:

- sensitivity of surface water hydrology to the Precinct is unknown;
- it is unclear when this information gap will be filled and how the results will be used to inform the current assessment process;
- further work is required to characterise existing groundwater conditions;
- adoption of water use efficiency methods should be a priority; and
- insufficient detail is provided on the presence of groundwater dependant ecosystems.

Public submissions and conservation groups raised concerns regarding:

- the timing of the development of an ecological surface water requirements plan;
- the frequency of heavy rainfall events increasing the likelihood of unplanned discharge events being transported to the marine environment or drainage basins;
- the potential for acidification of lakes and streams;
- the amount of water required by the Precinct;
- potential impacts to groundwater;
- the lack of knowledge regarding the aquifers, regional systems, sensitivities and usage;
- the inadequacy of investigations undertaken for the proposal;
- potential impacts to the Broome town water supply and other groundwater users if aquifer recharge is reduced;
- the ability to predict long term impacts even where information is known;
- the potential for contamination of groundwater;
- the potential for saltwater intrusion;
- the need for monitoring to ensure no unacceptable impacts occur; and
- potential impacts of desalination, particularly on the marine environment, and lack of information regarding this option.

Assessment

The EPA's environmental objective for this factor is to maintain the quality and quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

Water for groundwater dependent vegetation

Reduction of surface and groundwater inflows on which the MVT and the drainage basin vegetation community appear to depend, is likely to deleteriously affect the long-term maintenance of those two communities. Groundwater abstraction also has the potential to affect these important plant communities

Sealing the ground surface, or otherwise re-routing or disrupting flows from the Precinct area, would be likely to have negative impacts on any part of these vegetation units located down-flow that remain after construction. Unplanned discharges or waste spills from the precinct that may be carried down flow in surface or groundwater may also threaten these vegetation units.

As recommended in Section 3.4, the EPA considers that the direct and indirect loss of MVT should be strictly limited. The proponent should take all practicable steps to locate and operate infrastructure in a way that avoids impacts on surface and groundwater quality and flows generally and particularly on waters that are likely to support groundwater dependent vegetation communities in the James Price Point area. The EPA recommends that groundwater abstraction should only be permitted if it can be demonstrated with a high degree of confidence that no more than a total of 132 ha of direct and indirect impacts would accrue to MVT communities by any cause including changes in water quality, groundwater drawdown or disruption of surface flows. The EPA thus recommends the imposition of conditions as set out in Appendix 4 to manage disruptions to surface and groundwater flows through preparation of environmental management plans and submission of further detailed information as part of derived proposal applications.

Local potable water supplies

The EPA notes that the proponent has identified four potential aquifers for various aspects of water supply, together with desalination of deep groundwater or seawater if required. The EPA notes that there is presently limited information available about the aquifers. The EPA also notes that groundwater abstraction is licenced and regulated by the DoW under the *Rights in Water and Irrigation Act 1914* (RIWI Act).

The EPA notes the concern of local communities about the potential for groundwater abstraction to affect the water supplies on which they depend. The EPA understands that Traditional Owners have reached agreement with the State on circumstances under which the Native Title Party may direct the Foundation Proponent not to draw groundwater from the Broome Sandstone aquifer (Browse LNG Precinct Project Agreement, June 2011, Schedule 8, Section 8).

Given the range of water sources to choose from, advice from the DoW that adequate quantities of water should be available from an appropriate combination of those sources (confirmed through future detailed hydrogeological investigations), the agreement reached with the Native Title Party providing that it may direct that the Broome aquifer not be used by the Foundation Proponent,

and the regulatory role of the DoW, the EPA considers that this factor could be managed to meet the EPA's objectives.

Noting the limited amount of information currently available about aquifers, the EPA recommends that sufficient information about environmental impacts, sustainable yields, abstraction rates, maintenance of water quality, the design of the production borefield and monitoring bore networks and the groundwater monitoring program is required, before licensing under the RIWI Act occurs, to ensure that the EPA's objectives for this factor are met. This information should also include consideration of the potential impacts of saltwater intrusion caused by groundwater abstraction. Provided the additional information referred to above was available at the time future proposals were brought forward, the EPA considers that the regulatory controls exercised by the DoW under the RIWI Act are adequate to ensure that proper controls are exercised to prevent significant environmental impacts if water is abstracted from aquifers on the Dampier Peninsula.

The EPA recommends that adequate additional groundwater studies be undertaken by future proponents to demonstrate that any proposed groundwater abstraction would not cause unacceptable impacts on water quality or the viability of MVT or drainage basin vegetation communities. If it cannot be demonstrated that groundwater abstraction for water supplies would not unacceptably affect MVT vegetation, then the EPA recommends that alternative water supply options be secured for both construction and operation of the Precinct. The EPA has recommended a condition in Appendix 4 to manage this issue.

The EPA recommends that construction activities for pipeline shore crossings and other infrastructure should not have significant adverse impacts on groundwater dependent biota beyond a total of 132 ha of direct and indirect impacts on MVT vegetation at James Price Point. Appropriate additional groundwater studies and management plans will be required when derived proposals are submitted to ensure this outcome can be met.

The EPA recommends that pipeline shore crossings should only be installed by directional drilling or micro-tunnelling, not open trenching, unless the proponent can demonstrate that such techniques are not technically feasible and an alternative method is warranted. Similarly, the EPA recommends that future proponents must demonstrate that any other excavation, including for shore based infrastructure, can be undertaken without unacceptable impacts on the MVT vegetation.

The EPA notes that licencing under Part V of the EP Act has the capacity to adequately manage materials that may be the subject of unplanned spills that could affect surface and groundwater and considers that this licencing process is adequate to manage this aspect of the proposal. The EPA has a strong expectation that protection of groundwater and surface water from unplanned spills and contamination should be managed by the DEC under Part V of the EP Act.

Saltwater intrusion

More recent Precinct designs include an option where significant elements of the IMF are excavated from the existing coastline resulting in an inland harbor where saltwater may extend to a distance of approximately 330 m inland from its current location under all tidal conditions. The presence of saltwater 330 m inland has potential to allow saltwater to intrude further into the aquifer than it does currently. The EPA is aware of physical interventions and other techniques to avoid and manage this issue and recommends that they be applied to detailed designs for derived proposals.

Summary

The EPA considers the key environmental factor of surface and groundwater has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures as recommended in this report. The relevant recommended conditions for this factor include:

- Condition 18 relating to Surface and Groundwater Management and Monitoring;
- Condition 20 relating to Rehabilitation; and
- Condition 24 relating to Decommissioning.

3.7 Heritage

Description

Heritage matters have been extensively addressed in the agreement reached between Traditional Owners and the State under the terms of the Browse LNG Precinct Project Agreement concluded in June 2011 and available at www.dsd.wa.gov.au/documents/Project_Agreement_web.pdf.

This assessment by the EPA is not intended to overlap with that process. The EPA is, however, aware that matters of Aboriginal Heritage and social surroundings are of particular concern in relation to this proposal. In this regard, the EPA is mindful of the series of reports produced by and for the KLC that were attached to the SAR as appendices E-1 to E-7 about which more is said under the heading 'Assessment' below.

An aspect of natural and cultural heritage that has been assessed in some detail in this report is the factor of fossilised impressions of dinosaur footprints in Broome Sandstone that outcrops in the inter-tidal zone at various locations on the Dampier Peninsula.

A limited amount of published work indicates that dinosaur footprints occur in Broome Sandstone at Gantheaume Point near Broome (Glauert, 1952), and elsewhere along the Dampier Peninsula (Long, 1998, 2002; Thulborn *et al.*, 1994; Thulborn, 2012) without specifying exactly where the material was

located. A recent publication illustrates the impact of dinosaurs on the form of present day rock surfaces in the area (Thulborn, 2012).

Two studies were commissioned by the proponent (see DSD, 2010a Appendices F1 and F2). The conclusions reached in those studies were that no significant specimens were found in the areas surveyed at that time around James Price Point.

Following a highly credible but confidential submission on the strategic proposal, the EPA decided that additional survey work was required to determine whether important palaeontological resources existed within the proposal footprint or in surrounding areas. Additional work was undertaken by independent specialist palaeontologists Mr Rich McCrae, Curator of the Peace Region Palaeontology Research Centre, British Columbia in Canada and Dr Martin Lockley, Professor of Geology at the University of Colorado, Denver, USA. Their studies were facilitated by traditional owners and assisted by other local people and Dr Steve Salisbury of the University of Queensland. The studies were funded by the proponent and undertaken consistent with a scope of work set out by the EPA and subject to expert peer review. The report by McCrae and Lockley and the peer review by Professor James Farlow of Indiana-Purdue University, USA are attached to this EPA report in Appendix 6.

McCrae *et al.* (2011) found that there were palaeontological resources around James Price Point itself and extending south for some 750 m into the port crossing of the proposal area. They found that the general area of James Price Point itself (which is outside the Precinct) extending south and about 750 m into the port area (area A on Figure 2) of the Precinct “*exhibits a relatively high density of vertebrate ichnotaxa² (theropod, sauropod, ornithopod and thyreophoran) as well as some of the more impressive and scientifically significant larger-scale track surfaces.*” They did not find any dinosaur track sites in the balance of the port area to the south, although two locations were noted as ‘pseudo-fossils’.

One possible ‘trample’ site was found within the southern pipeline corridor with additional material found outside, near the southern edge of this corridor. No material was found in the northern pipeline corridor.

McCrae *et al.* concluded that the northern 750 m of the originally proposed port crossing area contains a significant number of track sites from a diverse range of ichnofauna. While they did not find any tracks in the port area south of this point, interpretation of aerial imagery indicated to them that potentially track-bearing exposed outcrop extends another 150 m to the south. They concluded that the northern 900 m of the port area has a high potential for fossil tracks and recommended any negative impact on fossils should be avoided there.

Based on limited published work (Thulborn *et al.*, 1995; Thulborn, 2012; Long, 1998; 2002) and additional survey by McCrae *et al.* (2011) outside the proposal area, it is evident that there are also a number of other locations where important dinosaur footprints and other fossil material occur in Broome Sandstone on the Dampier Peninsula. While the Broome Sandstone is indicated (McCrae *et al.*, 2011) to extend from the Cape Leveque area to the southern end of Eighty Mile Beach (over 600 km of coast), and up to 100 km inland

² In this context, ichnotaxa refers to fossil footprint types.

(Gorter, *et al.*, 1979), surface outcrops are restricted to local, coastal exposures, mainly around the Dampier Peninsula, and on a few local hill or creek bed exposures inland.

McCrae *et al.* (2011) considered the significance of the tracks in the entire Broome area and concluded that they constitute “a very significant local [palaeontological] resource’ that is of ‘great local significance”. They consider the regional context in terms of Australia as a whole and conclude that the Broome area tracks “assume considerable regional significance because they are the only dinosaur tracks known from Western Australia” and “almost all the information derived from the Broome tracks is additional to anything previously documented from the region”. In this context the region is again defined as Australia as a whole.

In the international context, McCrae *et al.* (2011) conclude that the association of sauropod, ornithopod and ankylosaur tracks is “unique on a global scale making the Broome Sandstone ichnofauna globally significant”. They find that the Broome tracksites “compare quite favourably with other track site regions in the southern hemisphere including eastern Australia, Africa...and South America...” Table 13 below is reproduced from the McCrae *et al.* (2011) report. It indicates that the four different track types currently known from the Broome area compares with between two and six types known from a range of other locations, noting that western European and North American sites have been documented more extensively and in more detail. Further as yet anecdotal reports indicate that there may be additional ichnotaxa in the same area.

Professor James Farlow of Indiana-Purdue University, USA conducted a peer review of the expert’s report. He was impressed by the quality of the work undertaken, found the report provides ample information for evaluation and finds the report’s recommendations appropriate and judicious. A copy of Professor Farlow’s review is attached in Appendix 6.

Following the experts’ report, the proponent wrote to the EPA and observed that “...the [McCrae *et al.*] report shows that there are important track sites within the indicative port crossing area. Further analysis of our design requirements indicates that it is possible to avoid potential direct impacts to these tracks by avoiding construction in the northern part of this area.”

The proponent also responded (Appendix 6) with undertakings in regard to the palaeontological material in the proposal area, by making commitments as follows:

- Avoidance of impacts to the possible trample area near the southern pipeline crossing;
- Development of a Palaeontological Resources Management Plan to manage all aspects of long term management;
- Requirement for proponents of derived proposals to support additional study and documentation at James Price Point to monitor indirect impacts and build on knowledge and management measures; and
- Development of an offset fund acknowledging uncertainty from potential indirect impacts due to changes in coastal processes. This fund would support long term research to further improve knowledge, and

investigations and the development of business plans on the potential for developing ecotourism or other opportunities.

Table 13. Comparison of important Lower Cretaceous track site regions of global significance.

TRACKSITE REGIONS OF GLOBAL SIGNIFICANCE	WELL-DOCUMENTED TRACK TYPES [with approximate diversity]	HISTORICAL SIGNIFICANCE (number of type specimens)
Broome: Western Australia*	TP – S – TH – O – x – x – x – x [4]	Reported 1950s (1 type)
South America	TP – S – TH – O – B – P – x – x [6]	Reported mid 1900s (? types)
China	TP – S – x – O – B – P – x – x [5]	Reported 1940s (+5 types)
South Korea	TP – S – x – O – B – P – x – mo [6]	Reported 1980s (+5 types)
USA: Texas *	TP – S – x – x – x – x – x – x [2]	Reported 1930s (1 type)
USA: Colorado*	TP – x – TH – O – B – P – C – x [6]	Reported 1930s (4 types)
Western Canada	TP – S – TH – O – B – x – x [5]	Reported 1980s (4 types)
Western Europe	TP – S – TH – O – x – P – x – mo [6]	Reported in 1800s (+5 types)

Eight general track type categories include theropod (TP), sauropod (S), thyreophoran (TH), ornithopod (O), bird (B), pterosaur (P), crocodile (C) and miscellaneous other (mo). Asterisk *refers to tracksite regions associated with a single formation.

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Indigenous Affairs (DIA)

Points from the DIA submission relevant to this factor of the assessment include:

- inconsistent references are made with regard to the number of registered sites within the project area;
- the document should state that ethnographic surveys of the areas will take place where required and section 18 processes under the *Aboriginal Heritage Act 1972* (AHA) will be complied with;
- it is pleased with the proponents heritage consideration of the project; and

- the risk rating of additional ‘stressors’ that are likely to Impact on Cultural Values (Including Aboriginal Heritage) Part 5 pg 3-51 are not consistent with the findings on cultural values and should be adjusted accordingly.

The DIA subsequently provided advice that it was satisfied that the proponent had followed the necessary requirements for Aboriginal heritage and noted that the s18 process under the AHA existed to deal with the disturbance of registered sites.

Public submissions and conservation groups raised concerns relevant to this factor of the assessment regarding:

- impacts to the cultural heritage of the Goolarabaloo-Jabirr Jabirr people;
- impacts to the Lurujarri Heritage Trail and reconciliation values;
- disturbance of burial grounds within the proposed port area;
- impacts to the song cycle, the significance of which has been accepted in western law;
- loss of access to the area for customary fishers;
- impacts to species of ethno-biologically important species in the Monsoon Vine Thicket;
- impacts to dinosaur tracks which are reasonably abundant at James Price Point, in all states of preservation, and are of considerable scientific interest and importance; and
- adequacy of the surveys undertaken for dinosaur tracks in terms of length, extent and expertise.

Assessment

The EPA’s environmental objective for this factor is to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations, including knowledge of the past, and comply with relevant heritage legislation.

Aboriginal heritage

With regard to Aboriginal cultural heritage and social surroundings the EPA is informed by its Guidance Statement 41 “Assessment of Aboriginal Heritage” (EPA, 2004). The EPA gives consideration to Aboriginal heritage matters to the extent that they may be affected by the impacts of the proposal on the physical or biological surroundings. The EPA expects the proponent to demonstrate that the relevant Aboriginal heritage issues have been identified to the satisfaction of the DIA and that the proponent has properly considered how to minimise any adverse impact by the proposal on heritage values. In the EPA context, this means impacts on the physical or biological surroundings.

Advice from the DIA indicates that it is satisfied that the relevant Aboriginal heritage issues have been identified and the proponent has properly considered how to minimise any adverse impact.

The EPA is aware of the reports produced for and by the KLC and included with the SAR as appendices E-1 to E-7 that deal with matters of particular interest to Aboriginal people. Appendix E-2 deals with the issue of Indigenous consultation. Key finding 2 in the Executive Summary of that report notes that:

“The location of a site for the LNG Precinct has been accompanied by Indigenous consultation processes, largely funded by the Government of Western Australia, that have been extensive and sustained, to a degree that is possibly unprecedented in relation to a major resource development in Australia. Kimberley Aboriginal people have been centrally involved in many facets of the LNG Precinct site selection process.”

Key finding 4 in Appendix E-2 to the SAR notes that:

“The Traditional Owners of James Price Point did give their consent to the Heads of Agreement for the establishment of an LNG Precinct. Their consent was informed by detailed information and advice in relation to legal and other options open to them, and in relation to agreement terms offered to them by the State and Woodside in negotiations.” This point notes further, however, that consent did not conform fully with the principle of Indigenous free, prior and informed consent for a number of reasons.

Key finding 5 in the same report notes that:

“Traditional Owners have been closely involved in the selection of a specific site for the LNG Precinct at James Price Point during 2009-2010, with the current preferred site resulting from a consideration of heritage and environmental impacts as well as engineering and economic considerations. They will continue to be closely involved, under the terms of a Heritage Protection Agreement concluded in November 2010, in decisions about the location of specific components of the LNG Precinct within the site.”

On this basis the EPA notes that Indigenous interests have been heard and considered in the context of the proposal under assessment.

Appendix E-3 of the SAR comprises an Aboriginal Social Impact Assessment, again prepared for and by the KLC. In the environmental realm which falls within the EPA’s purview, the EPA notes that concerns focus in particular on the risk of damage to land and sea country and marine resources that are closely aligned with the same issues that the EPA has identified among the list of key factors identified in this report. The EPA notes further that Appendix E-3 of the SAR makes some 75 recommendations that the report’s authors consider must be put in place if impacts of concern to Indigenous people *“are to be avoided, minimised and compensated for”*.

Appendix E-4 of the SAR, again prepared for and by the KLC, *“recommends appropriate safeguard and mitigation measures that are designed to make these impacts less than significant”* and concludes that *“impacts on environmental values are not likely to be significant if the Plan includes the recommended safeguard and mitigation measures identified in Section 6 of this Report”*. These measures include, among others, adherence to the terms of a Heritage Protection Agreement, Indigenous Land Use Agreement or other agreements with Traditional Owners.

In this regard the EPA notes that a number of formal Agreements between Traditional Owners and the State of Western Australia have been concluded. These Agreements include:

- Browse LNG Precinct Project Agreement, June 2011, – see http://www.dsd.wa.gov.au/documents/Project_Agreement_web.pdf;
- Browse LNG Precinct Regional Benefits Agreement, June 2011 – see http://www.dsd.wa.gov.au/documents/Regional_Benefits_Agreement_web.pdf;
- Browse (Land) Agreement, June 2011 – see http://www.dsd.wa.gov.au/documents/Land_Agreement_web.pdf.

The EPA notes the capacity of the *Aboriginal Heritage Act 1972* and the instruments discussed in the points above to deal with Aboriginal heritage matters related to this proposal, including existing sites and sites that may be registered in future.

Through this report, the EPA has carefully considered potential impacts on the physical and biological environment that may affect heritage matters to the extent that they are within the EPA's purview. With this in mind, the EPA considers that satisfactory management of the key environmental factors identified in this report is likely to adequately manage those physical and biological factors that are related to matters of social surroundings involved with Aboriginal heritage.

To the extent that the EPA considers that impacts on the physical and biological environment have been adequately assessed and can be adequately constrained, managed or offset such that there are not likely to be significant residual impacts to those physical and biological attributes themselves at a regional level, the EPA concludes that, in its judgement, a significant impact on Aboriginal heritage matters is also not likely, although localised impacts will occur.

In coming to this conclusion, the EPA is aware that local impacts are important to those Traditional Owners with responsibility for the particular heritage values that exist there. Recognising that there are likely to be local level impacts to heritage values at any location in the Kimberley, the EPA notes that the various Agreements between Traditional Owners and the State of Western Australia have been put in place to help mitigate those issues.

Dinosaur tracksites

Recent work indicates that tracksites occur at least between Roebuck Bay and James Price Point and are both more significant and more abundant than was previously appreciated. The EPA notes that significant palaeontological resources are located within the northern 750 m of the approximately 2700 m wide area that connects the proposed port area with the terrestrial components of the proposal as set out in the SAR. The EPA agrees with the findings of McCrae *et al.* (2011) recommending that any negative impact on fossils should be avoided there, and notes that the proponent has stated that it is possible to avoid potential direct impacts to these tracks by avoiding construction in the

northern part of the port crossing area. The proponent has also committed to avoid impacts to a possible 'trample' area on the southern edge of the southern pipeline corridor.

McCrae *et al.* (2011) suggest that general steps for mitigation of impact to footprints should include professional documentation, recovery of original specimens and recovery of high quality moulds. The EPA supports these suggestions but recommends that avoidance of impacts is strongly preferred and mitigation should be a secondary adjunct to avoidance. Any recovery action should be conducted with the advice and participation of Traditional Owners.

The EPA notes further that two 'pseudo fossils', but no confirmed fossils of dinosaur footprints, were recorded during the McCrae *et al.* (2011) study in the balance of the southern part of the port crossing area. The EPA considers that further careful examination of the two 'pseudo fossils' within the port crossing area is warranted if the proposal were to proceed. Depending on the findings, appropriate documentation and recovery works as suggested above should be undertaken if fossils are found in the balance of the port crossing area.

The EPA notes also that further exposures of fossil dinosaur tracks have been previously reported elsewhere on the Dampier Peninsula and confirmed by the latest studies. Additional exposure of dinosaur tracks may occur due to coastal erosion occurring either naturally, as a result of cyclones for example, or occasioned by changes in coastal processes associated with the proposal. The EPA is also aware that the Broome Sandstone hosting these tracks extends from Cape Leveque to the southern end of Eighty Mile Beach but is only exposed as local outcrops, mainly along the coast of the Dampier Peninsula and on a few hills and creeks inland. Tracks may thus be uncovered by excavations on land as a result of earthworks associated with this proposal. While it is possible that additional exposures of dinosaur tracks may be found elsewhere in future, the Dampier Peninsula coastline appears to be the most important known area of exposure of these important palaeontological resources.

The EPA notes that the Dampier Peninsula coastline has largely been included in a recent Commonwealth heritage listing, in recognition of the presence of these palaeontological resources and that they deserve careful consideration to ensure an appropriate level of protection is afforded to them.

For these reasons, the EPA recommends that fossil dinosaur footprints should not be disturbed within the northern 900 m of that part of the proposed Precinct that crosses the coast in the port area and at the southern edge of the southern pipeline crossing. To this end the EPA has recommended a Ministerial condition that defines the terrestrial disturbance footprint so as to avoid these areas where fossil dinosaur footprints are known to exist.

While current knowledge indicates that footprints are not currently exposed in other parts of the Precinct that cross the coast, the EPA recommends that additional survey occurs in any area where Broome Sandstone exists at the surface that is planned to be disturbed for the purposes of this proposal. If fossils are found, disturbance should be avoided wherever possible. Where disturbance cannot reasonably be avoided, appropriate recovery work to either remove and properly curate the fossils or properly document them prior to disturbance should be undertaken under the guidance of a suitably qualified

expert palaeontologist and with the advice and participation of Traditional Owners.

The EPA further recommends that additional survey and proper documentation, and curation where appropriate, of fossil dinosaur footprints elsewhere on the Dampier Peninsula should be undertaken as an offset for disturbance in the Precinct that cannot be avoided. This survey work should serve to put the palaeontological resources around James Price Point into a wider context by extending knowledge of other locations on the Peninsula where fossils occur in the Broome Sandstone.

The EPA acknowledges that the proponent has made a commitment to avoid impacts to known dinosaur tracksites within the Precinct area. The Proponent has also committed to developing a Paleontological Resources Management Plan that recognises the significance of the dinosaur footprints and outlines mitigation options, including an offset fund, to address risks from altered coastal processes and to support additional studies and monitoring to enable adaptive management.

Although considerable effort has been made to mitigate the potential impacts to dinosaur footprints, the EPA considers that some residual risk remains that there may be impact to as yet undetected dinosaur footprints. The EPA has therefore recommended that future proponents should put forward measures to address these risks, including further survey and documentation and curation of prints that may be disturbed. Future proponents should also support further research to improve the knowledge and understanding of paleontological resources to aid their management on the Dampier Peninsula.

With the above measures in place the EPA considers that its environmental objective for this factor can be met.

Summary

The EPA considers the key environmental factor of heritage has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures and offset the residual impacts as recommended in this report. The relevant recommended conditions for this factor include:

- Condition 12 relating to Coastal Processes;
- Condition 14 relating to Pipeline Shore Crossing Management and Monitoring Program;
- Condition 20 relating to Rehabilitation;
- Condition 23 relating to Fossil Heritage Management; and
- Condition 24 relating to Decommissioning.

3.8 Air emissions

Description

Emissions to the air may affect human health and other biota. Proper assessment and management of emissions is therefore required to ensure that unacceptable impacts will not occur as a result of this proposal.

Ambient air quality

Background pollutants in the region are predominantly associated with bush fires since there are few existing industrial facilities. Smoke from fires can generate PM_{2.5} and PM₁₀ levels likely to be above the National Environment Protection Measure (NEPM) standards for ambient air quality (DSD, 2010a). Dust storms could also potentially lead to exceedances of the NEPM standards for particulates.

Ground level concentrations of ozone from fires can reach levels at or just below the 4-hour NEPM standard (DSD, 2010a). Maximum concentrations of nitrogen dioxide from fires can reach about two thirds of the NEPM standard, while ambient concentrations of other pollutants such as carbon monoxide and benzene, toluene, ethylbenzene and xylenes (BTEX) are reported to be well below relevant criteria (DSD, 2010a).

Modelled emissions

Emissions from the proposed precinct have been modelled based on 50 Mtpa of LNG production, using assumptions that the proponent regards as conservative. These emission levels were modelled assuming available emissions control technology with conservative assumptions about the amount of hydrogen sulphide in the feed gas (assumed high) and the operational availability (assumed low) of the control equipment (DSD, 2010a).

Emissions are predicted to be as set out in Table 2.8-9 in Part 4 of the SAR. The proponent concludes that these data indicate that benzene, hydrogen sulphide, and to a lesser extent toluene, are the pollutants modelled to have predicted emission levels closest to or above assessment criteria.

BTEX

Benzene, toluene, ethylbenzene and xylenes are volatile organic compounds which act as precursors to photo-chemical smog. Based on the assumptions used in the proponent's analysis, the maximum concentrations of benzene, including ship-loading, could be 5.5 µg/m³ (10% above the European standard), at the south-western edge of the 3000 m buffer zone planned for the precinct (Figure 2.8-17 in Part 4 of the SAR, reproduced here as Figure 26). Levels would be higher inside the precinct and greater than 100 µg/m³ around the ship. In some places outside the port area, levels over the ocean could exceed 25 µg/m³.

An analysis that excludes ship loading (Figure 2.8-20 in Part 4 of the SAR, reproduced here as Figure 27) indicates that the modelled exceedances decrease. The NSW short term guideline level (99.9th percentile 1-hour average benzene concentration of 29 µg/m³) is exceeded over a reduced area to the east of the precinct when Figures 2.8-15 and 2.8-18 in Part 4 of the SAR are compared. The proponent states that the annual average concentrations are

much lower than the health impact criteria at all locations when ship-loading emissions are excluded (Figure 27). This is interpreted to show that ship loading is the most significant source of BTEX emissions.

The proponent's analysis predicts that elevated benzene and toluene levels are largely associated with ships loading condensate (a light oil) and the proponent acknowledges that additional volatile emissions control options may be required, depending on further analysis of derived proposals. While this analysis indicates that ship-loading is the most significant source of these emissions, they may also be emitted within the processing plant.

Hydrogen sulphide

Hydrogen sulphide emissions (see Table 2.8-9 and Figures 2.8-21 and 2.8-22 in Part 4 of the SAR) could still reach levels that result in detectable odours to the east and west of the precinct for between 10 and 100 hours per year (Figure 28), even with less hydrogen sulphide in the feed gas and with better availability of the thermal combustion unit (TCU) control equipment than was assumed in the conservative case considered in the SAR.

Criteria pollutants and particulates

Other potential pollutants (carbon monoxide, nitrogen dioxide, sulphur dioxide) and particulates (PM₁₀ and PM_{2.5}) are all predicted to remain below levels of concern.

Noise and light emissions

Noise emissions are controlled by the Environmental Protection (Noise) Regulations 1997 (Noise Regulations). The proposal is located well away from residences and noise emissions will not affect sensitive receptors as defined under those regulations.

Light emissions are not subject to specific regulations but EPA Guideline Number 5 (EPA, 2010) provides guidance on how to manage light emissions so that effects on turtles and other sensitive biota are minimised.

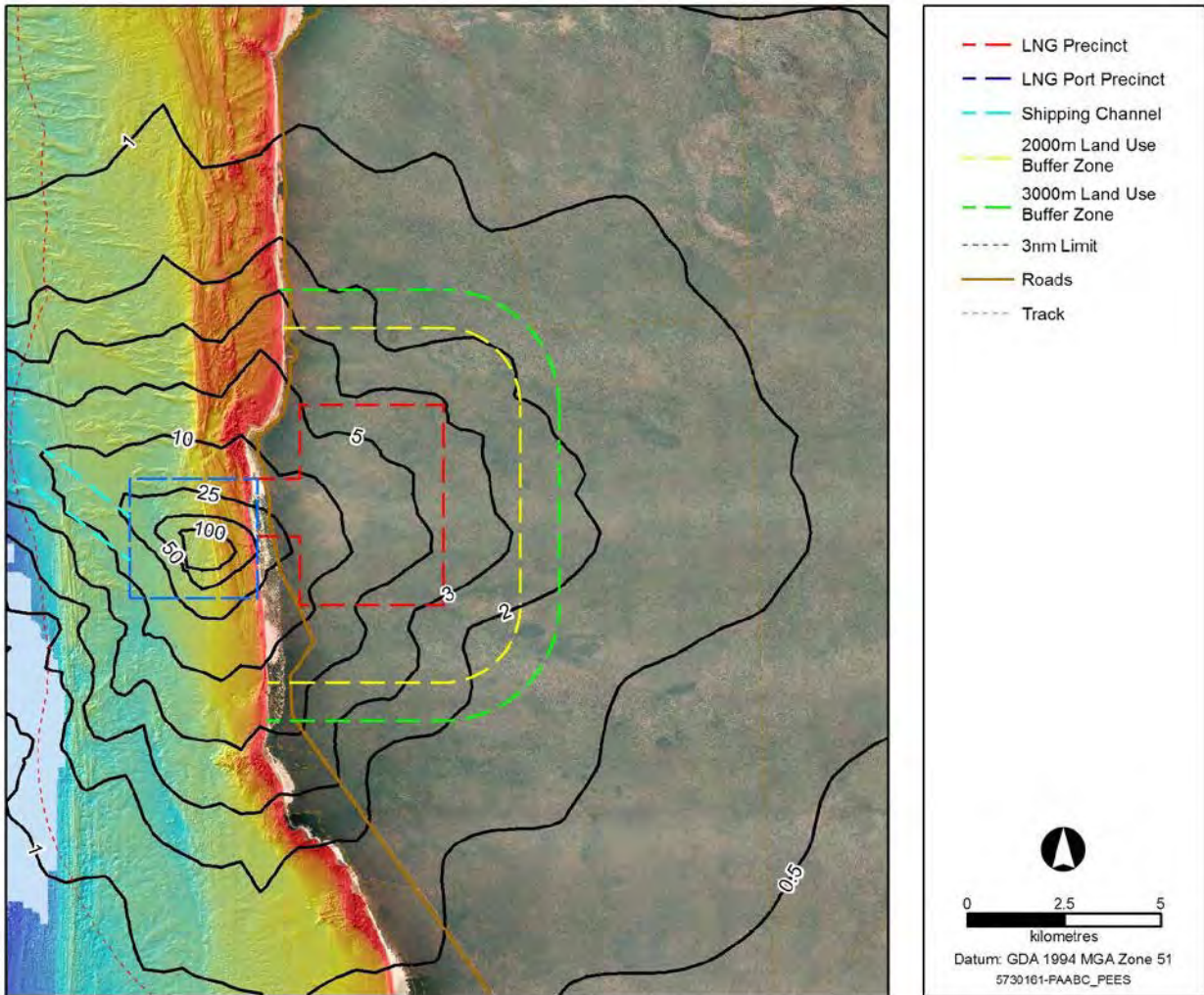


Figure 26. Predicted annual average benzene concentrations ($\mu\text{g}/\text{m}^3$) for a 50 Mtpa large industrial gas turbine Precinct excluding existing sources.
 Source: Figure 2.8-17 in Part 4 of the SAR.

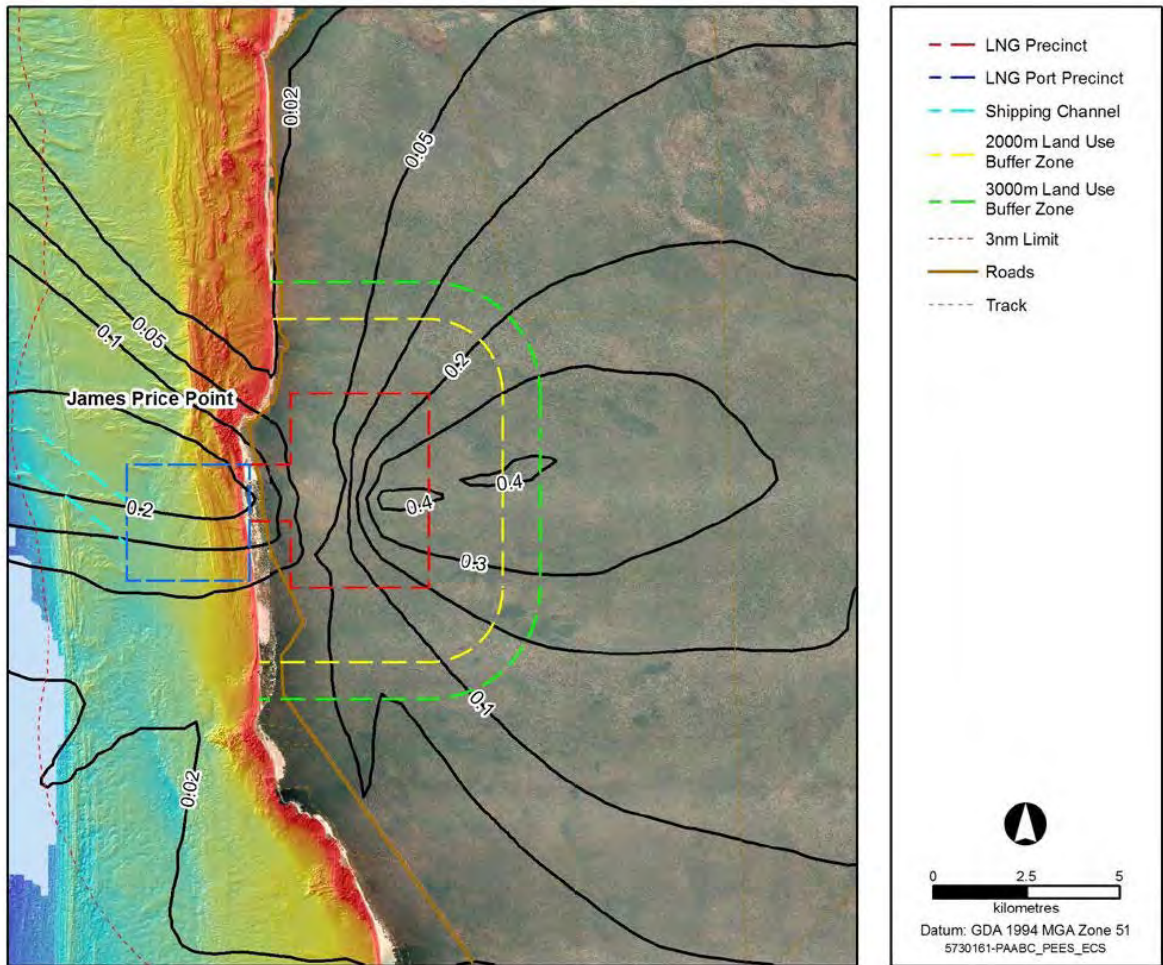


Figure 27. Predicted annual average benzene concentrations ($\mu\text{g}/\text{m}^3$) for a 50 Mtpa large industrial gas turbine Precinct excluding existing sources and condensate ship loading.
 Source: Figure 2.8-20 in Part 4 of the SAR.

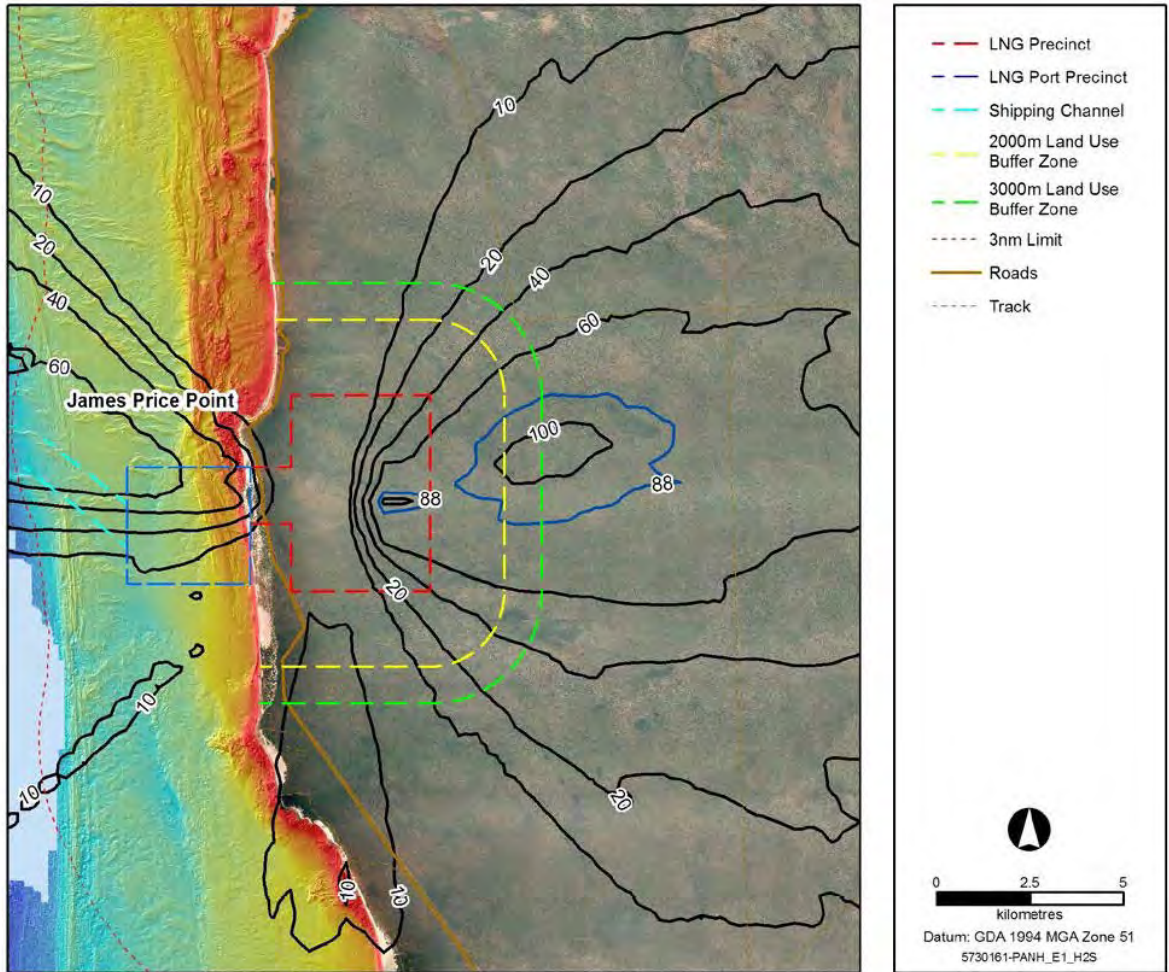


Figure 28. Predicted annual number of hours in which an exceedance of a 1-second hydrogen sulphide concentration of $4.8 \mu\text{g}/\text{m}^3$ occurs for a large industrial gas turbine 50 Mtpa Precinct (thermal control unit offline probability 10% with hydrogen sulphide concentration in the feed gas of 13 ppm).
 Source: Figure 2.8-22 in Part 4 of the SAR.

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Environment and Conservation (DEC)

Points from the DEC submission relevant to this factor of the assessment include:

- that the SAR contained inadequate information regarding the potential air emissions to assess the likely impacts from a regulatory point of view or to determine which activities would require licensing under Part V of the EP Act;
- H₂S odours will exceed the NSW odour criteria and would need to verify the emission rates in a detailed study of individual plants and that the current modelled data should be re-analysed using criteria consistent with WA practice; and
- BTEX emissions require verification, ambient monitoring should be undertaken to ensure levels are below acceptable criteria, and if not further emission reduction controls need to be considered.

Kimberley Land Council (KLC)

Points from the KLC submission relevant to this factor of the assessment include:

- there is no reference to standards (or limits to emissions) for the measures, proposed conditions and derived proposal requirements in relation to air quality;
- minimum limits should be set for each key atmospheric emission (including odour) as part of the current process; and
- proponents should be required to demonstrate best practice initiatives have been adopted to improve on the minimum standards specified.

Public submissions and conservation groups raised concerns regarding:

- the adequacy and rigour of air emission studies and air quality modelling;
- the ability to assess and predict impacts in the absence of background data;
- modelling does not account for daily wind or seasonal wind variation, or heavy sea mist and their role in particle deposition and photochemical smog;
- emissions from construction activities have not been predicted;
- impacts on communities and ecosystems as a result of cumulative emissions over the life of the project have not been adequately considered;

- emissions include toxic and noxious gases including known carcinogens, in particular benzene and toluene and VOCs;
- benzene emissions will exceed NSW guidelines and European standards;
- how mercury will be handled;
- what contingencies would occur and how the community will be advised should conditions give rise to adverse air quality or amenity issues beyond the precinct boundary;
- a safe buffer distance for casual users of the area;
- recreational activities will be affected by H₂S ('rotten egg gas');
- the impacts of air emission on water quality;
- the impact of light emissions on turtles and migratory birds;
- impacts of LNG processing chemicals to both humans and wildlife; and
- winds will carry emissions over Derby, Broome to Beagle Bay, and Indigenous communities at certain times of year.

Assessment

The EPA's environmental objective for air quality is to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses, by meeting statutory requirements and acceptable standards.

The EPA's environmental objective for light emissions is to avoid or manage potential impacts from light overspill and comply with acceptable standards. In relation to noise, the EPA's objective is to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring noise levels meet statutory requirements and acceptable standards.

The EPA expects that proponents will ensure that emissions including dust, noise and light from all sources during construction and operation of the proposal are managed in accordance with relevant regulations, standards and guidelines. Any conditions applied to an approval under Part V of the EP Act should take this advice into account.

Exceedance of NEPM levels for volatile organic compounds (VOCs) such as benzene and toluene is not acceptable to the EPA because there is a significant population within 50-60 km and environments containing important biota occur adjacent to the proposal. The EPA considers that additional controls should be applied if required to ensure that the conservative conditions assumed in the modelling do not arise. Firstly, if further analysis shows that feed gas can consistently be supplied with hydrogen sulphide significantly below the 13 ppm level assumed in the modelling, then exceedances may not arise, even if the conservative case of two thermal combustion units (TCUs) being offline continuously does apply. If additional standby TCUs were designed into the Precinct, the probability of two TCUs being offline at one time could be significantly reduced.

The EPA also understands that presently about 70% of condensate tankers have equipment fitted to capture and return VOC vapours to the plant (Woodside, pers. comm.). Without this equipment, VOCs could not be controlled when those ships are being loaded. Ships loading condensate should therefore be fitted with this equipment.

The EPA notes that air emissions are managed by licence issued under Part V of the EP Act. The EPA considers that the licencing process is capable of managing air quality such that the EPA's objectives can be met and provides the following recommendations to be taken into account during the licencing process.

The EPA's overarching recommendation is that emissions should be managed to best practice levels. The EPA recommends that VOC levels for the Browse LNG Precinct should be controlled such that ambient National Environment Protection Measure (NEPM) standards are not exceeded beyond the seaward boundary of the port area and the outer boundary of the inner Precinct buffer zone as shown by the broken yellow line on Figure 2. The EPA further recommends that VOC levels should not exceed health standards for annual average and peak levels wherever the public is to be permitted access, including at James Price Point itself if it remains open to the public. Management options, to be considered by proponents of derived proposals, include restricted public access on condensate ship-loading days or at other times when VOC levels are predicted to be high and closed systems as are required in the United States of America. Conditions as set out in Appendix 4 are recommended to ensure that VOCs are adequately controlled.

Hydrogen sulphide emissions are not predicted to represent a health risk, however detectable hydrogen sulphide odours are not desirable in an environment that is within 50-60 km of a significant population centre with a tourism industry largely based on natural values. While a modelling approach is appropriate for this assessment of a strategic proposal, dispersion modelling has significant limitations when applied to determining separation distances or placing limits on odour emissions when emissions are intermittent in nature.

The EPA notes that the SAR states that hydrogen sulphide emissions were modelled conservatively. It should thus be feasible to manage emissions to lower levels than those predicted by the conservative modelling in the SAR. The EPA also notes that measured hydrogen sulphide levels from the gas field drilling program range from 4 to 7 ppm, which is considerably less than the 13 to 20.5 ppm assumed by the modelling in the SAR. This provides a degree of confidence that modelling was in fact conservative.

The EPA notes the proponent's view in the SAR that if hydrogen sulphide levels are controlled so that the Queensland standard of 2.5 odour units (ou) is met at the outer boundary of the inner buffer zone, then significant amenity impacts from sulphur dioxide odours (rotten egg smell) are unlikely. The EPA notes the proponent's response to submissions (DSD, 2011b) which states that detectable odours may be about the level that residents sometimes experience in suburbs of Perth from groundwater bores.

Although there are no residences within about 30 km of the Precinct, workers accommodation is planned to be located about 5 to 6 km away, campers and

day-use visitors regularly use the Quondong Point area 3 km away from the inner buffer zone and cruise ships pass offshore. Adequate management of potential amenity impacts from odours is therefore considered necessary. The EPA recommends that health standards should be met at the outer boundary of the inner buffer zone (the broken yellow line on Figure 2). Amenity standards should be met at the outer boundary of the outer buffer zone (the broken green line on Figure 2) generally and where public access is permitted otherwise.

If the proposal were to proceed, the EPA strongly recommends that other measures be used to manage future proposals in parallel with modelling, such as greater redundancy in emissions control capacity, best practice and robust odour management plans.

The EPA recommends that the odour criteria generally used in WA be applied rather than the Queensland EPP (Air) hydrogen sulphide criterion. This is due to the larger than normal uncertainties associated with modelling maximum hourly averaged concentrations as required by the Queensland EPP criterion, and also to maintain consistency with the approach previously used to model odours in WA.

Literature specifying methodology consistent with Australian Standard 4323.3 reported ranges from 0.4 ppb to 1.0 ppb for the detection threshold for hydrogen sulphide. As an odorant, hydrogen sulphide ranks very highly on the annoyance potential scale and standard odour criteria calibrated against annoyance resulting from intensive livestock, for example, or other activities may not be sufficiently conservative to be protective against annoyance. For this reason a value of 0.5 ppb – towards the conservative end of the identified threshold range – is recommended.

As the Browse LNG Precinct has both predicted intermittent hydrogen sulphide stack emissions and is situated in a coastal location the EPA recommends that precinct hydrogen sulphide emissions meet the following modelling criterion when operating at the full planned capacity:

- 1 hour average 99.9th percentile concentration limit of 1.6 ou (C_{99.9,1hr}=1.6 ou) at sensitive receptors such as the accommodation zone,
- modelled at a constant emission rate equivalent to three thermal oxidizers being off line, and
- using a hydrogen sulphide odour detection threshold (1 odour unit equivalent) of 0.5 ppb.

This criterion is likely to err on the side of conservatism, in line with the EPA's position on this issue, assuming that the probabilities quoted for thermal combustion units being off-line and their emission rates are realistic.

If individual derived proposals are being considered, it is recommended that the above criterion be modelled for each future proposal using an emission rate proportional to their expected contribution to total anticipated hydrogen sulphide emissions.

In short, the EPA recommends that, regardless of the number of operators, hydrogen sulphide emissions are controlled so that a level of 0.5 ou is met at the

outer boundary of the inner buffer zone and at the seaward port boundaries, as shown on Figure 2, and wherever public access is permitted otherwise.

The EPA notes that the proponent has committed to the use of smokeless flares resulting in near-zero particulate emissions (DSD, 2010a). The meaning of 'smokeless flares' should be defined in any licence issued to users of the precinct who operate flares.

All other pollutants should meet NEPM or other appropriate standards at the outer boundary of the inner buffer zone and seaward boundaries of the port area of the precinct. The EPA has recommended conditions in Appendix 4 to ensure that other pollutants (carbon monoxide, nitrogen dioxide and sulphur dioxide) and particulates (PM₁₀ and PM_{2.5}) remain within accepted limits.

Increased potential ignition sources from Precinct-related activities could lead to more bush fires. Alternatively, improved control of regional fires to protect the Precinct could reduce the incidence of large scale fires. The EPA notes the proponent's commitment to prepare a fire management plan to manage the fire regime in the James Price Point area and encourages the reduction of frequent, high intensity fires. The EPA also notes, however, that some plant species depend on occasional fire to stimulate reproduction and recommends that appropriate periodic burning is factored into fire management plans in consultation with the DEC and other appropriate land and fire management agencies.

Reduced high intensity burning has the potential to reduce emissions of particulates and pollutants, as well as reducing greenhouse gas emissions. The EPA encourages the wide application of improved burning practices in the Kimberley savannah, across and beyond the Dampier Peninsula (EPA, 2006). This issue is addressed further in the following section dealing with greenhouse gases.

The EPA notes the proponent's commitment to a Construction Environmental Management Plan to control dust during construction and considers that this should be an adequate mechanism to manage this issue.

Management of noise will need to take account of construction workers housed in the accommodation area but this area will be about 5 - 6 km from the Precinct. The EPA notes that the proponent has committed to incorporate noise management in a Fauna Management Plan. Implementation of this plan will manage noise so that the noise impacts on fauna are appropriately managed. The EPA is satisfied that the provisions of the Noise Regulations can adequately manage noise in regard to sensitive receptors.

The EPA notes that there is limited turtle nesting on beaches adjacent to the Precinct and that migratory bird flyways are likely to be within sight of the Precinct. The EPA therefore expects that attention is given to the management of light spill as outlined in its Guideline Number 5 (EPA, 2010) during the design of facilities associated with the Precinct. Implementation of light spill avoidance strategies as set out in EAG No. 5 would manage light emissions so that the EPA's objective for this factor could be met.

Summary

The EPA considers the key environmental factor of air emissions has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures as recommended in this report. The relevant recommended conditions for this factor include:

- Condition 21 relating to Emissions to Air.

3.9 Greenhouse gases

Description

Greenhouse gas emissions from the proposal will mainly depend on the annual rate of LNG production and the carbon dioxide content of the feed gas. Actual production rates and feed gas carbon dioxide contents are not certain at this stage as they will depend on future proposals. The proponent has provided estimates of carbon dioxide emissions based on a range of LNG production rates up to the maximum anticipated rate for the precinct of 50 Mtpa. The carbon dioxide content of feed gas has been assumed to range from 6% to 12%. The emission rates are set out in Table 14 below based on Tables 2.9-3 and 2.9-4 in the SAR (DSD, 2010a). These figures are for carbon dioxide produced in Australia during LNG production only and do not include figures to transport or burn the exported gas outside Australia.

Table 14. Predicted annual greenhouse gas emission rates per annum (Mtpa) – Browse LNG Precinct.

Emission source	LNG production rate			
	15 Mtpa	25 Mtpa	35 Mtpa	50 Mtpa
Energy generation	5.6	9.3	13	19
CO ₂ removal unit ¹	6.2	10.3	14	20
Flares	0.020	0.033	0.046	0.066
Fugitive emissions	0.002	0.003	0.004	0.006
Other sources ²	0.95	1.31	2.03	2.17
Total	13	21	29	41

¹Assumes 10% average CO₂ content in feed gas

²Energy to support workforce needs assuming 36t per capita per annum

Depending on the LNG production rate, emissions from the Browse Precinct could represent between 16% and 52% of Western Australia's emissions based on 2007 levels and between 2% and 6.5% of Australia's emissions. The emissions from energy generation alone listed above equate to a greenhouse gas intensity of 0.37 to 0.38 t of carbon dioxide equivalent (CO₂e) per tonne of LNG produced. This does not include carbon dioxide emissions from the reservoir gas (attributed to the CO₂ removal unit in the table above). The projected intensity rate for combustion (energy generation) emissions for the recently assessed Wheatstone project at Onslow, in a similar environment, was around 0.28 t CO₂e per tonne of LNG produced.

The proponent of this strategic proposal considers that future proponents would be expected to demonstrate best practice measures to further reduce greenhouse gas emissions.

In order to offset some of the project emissions the proponent proposes to establish a fire management regime on the Dampier Peninsula in cooperation with State agencies and Traditional Owners that could reduce greenhouse gas emissions associated with wildfires, similar to the West Arnhem Land Fire Abatement (WALFA) project in the Northern Territory. Controlled, early season burning could reduce greenhouse gas emissions by avoiding more intense late season wildfires when there is more, drier fuel present (EPA, 2006).

Submissions

A summary of the submissions and recommendations about this factor can be found in Appendix 3. Illustrative comments are summarised below.

Department of Environment and Conservation (DEC)

Points from the DEC submission relevant to this factor of the assessment include:

- global greenhouse gas abatement benefits of LNG should be discussed in the context of a lifecycle assessment and the proponent should acknowledge that global benefits will only be delivered for that portion of LNG that displaces more carbon intensive fuels; and
- consideration be given to applying a carbon constraint to the proposal in the absence of a carbon pricing mechanism.

Public submissions and conservation groups raised concerns regarding:

- the facility will be the most pollution intensive LNG facility in the world emitting 0.65 tonnes of CO₂ for every tonne of LNG produced.
- lack of consideration of offsets in relation to greenhouse gas;
- impacts to Australia's commitment to achieve 5% reduction in greenhouse gas emissions by 2020 and global emissions;
- unsubstantiated comments that LNG will reduce global greenhouse gas emissions by displacement;

- cumulative impacts from other proposed developments in WA;
- the application of best practice bearing no relationship to climate science or the need to reduce emissions;
- best practicable measures include consideration of economics which is outside the scope of the EPA; and
- the possibility that geo-sequestration would be considered as a derived proposal.

Assessment

The EPA's environmental objective for this factor is to minimise greenhouse gas emissions to levels as low as practicable on an ongoing basis and consider offsets to further reduce cumulative emissions.

The EPA expects all large emitters of greenhouse gases to develop and implement a greenhouse gas abatement program to encourage best practice in design and operation of facilities. The greenhouse gas abatement program should include measures to minimise net greenhouse gas emissions and reduce emissions per unit of production as far as practicable. The EPA also encourages proponents to consider opportunities to offset the remaining greenhouse gas emissions throughout the life of a project.

The EPA is aware that adaptation to changes in climate is likely to be necessary for a proposal such as this that has a lifespan extending over decades. Management responses should thus incorporate the capacity to adapt to a changing climate.

The EPA has previously recommended conditions to offset the reservoir carbon dioxide gas released during the life of a project. This position was adopted on other proposals assessed by the EPA, including the Gorgon, Pluto and Wheatstone projects.

The EPA understands that, with the introduction of the Commonwealth Government's carbon pricing scheme on 1 July 2012, greenhouse gas conditions set by the Minister for Environment should not result in additional regulatory impacts to industry with no corresponding environmental benefits. That is, they should be complementary to a carbon price.

The EPA has been advised that conditions related to offsetting reservoir emissions are likely to be non-complementary to the carbon pricing scheme because a proponent who emits carbon dioxide is required by Federal legislation to pay a price per tonne of carbon emitted.

For greenhouse gas conditions, the Minister for Environment has established a process to review the complementarity of State greenhouse gas conditions with Federal legislation, and it is expected that the EPA's recommended greenhouse gas abatement conditions for this proposal will be subjected to similar review at the appropriate time.

The EPA is aware that other projects around the world have achieved emission intensities as low as 0.22 tonnes CO₂e from energy generation per tonne of LNG produced and that emissions are dependent on a number of factors, including design, gas source and local climatic conditions. The EPA considers

that future proponents should implement best practice in design and operation to minimise emissions of greenhouse gases consistent with what is achievable under local climatic conditions. For example, typical open cycle gas turbines could be made more efficient by using waste heat recovery (DSD, 2010a). Accordingly the EPA has recommended a condition in Appendix 4 which sets an initial target of 0.26 t CO₂e from energy generation per tonne of LNG produced and requires further improvements over time. This target is consistent with that recently set for the Wheatstone proposal.

The EPA recommends that any future proponent offset remaining greenhouse gas emissions and as a minimum, the reservoir gas emissions released during the life of their project.

The appointment of an independent specialist to audit performance against the objectives of the greenhouse gas abatement program biennially would provide an important degree of public accountability in the face of community concern about the environmental impact of greenhouse gas emissions. Appointment of an independent specialist is consistent with the approach taken to the Bluewaters power station expansion and to the Wheatstone project.

Recognising that a national framework for greenhouse gas emissions has been introduced, the EPA recommends a condition in Appendix 4, exempting future proponents from the requirements to develop and implement a greenhouse gas abatement program and an offset package if those requirements are deemed non-complementary to Commonwealth greenhouse gas reduction legislation applicable to a future proposal. This is consistent with the approach taken to the Wheatstone project and conditions applied by the Commonwealth Government with respect to the Shell Prelude project.

The EPA considers that establishing a cooperative fire management strategy with Traditional Owners and other land managers would be a very useful initiative to assist in limiting late season fires, reduce greenhouse gas emissions from burning and help to offset emissions from the proposal. This initiative is also likely to have other benefits in terms of conservation and indigenous employment on country.

Up to 20 Mtpa of reservoir carbon dioxide releases and 41 Mtpa of total carbon dioxide releases may occur as a result of this proposal. Extension of fire management beyond the Dampier Peninsula is likely to be required to maximise offsets, given these levels of emissions. Accordingly, the EPA considers that this initiative should be supported and should be extended across the savannah habitats of the Kimberley, wherever greenhouse gas offset benefits would accrue.

Injection of carbon dioxide into reservoirs deep under the ground is another option that may assist in offsetting the considerable quantity of greenhouse gas emissions that may accrue from this proposal, along with other options like reforestation. The EPA notes, however, that the scale of emissions is such that reforestation, while worth encouraging because it is valuable for a number of environmental reasons, is only likely to practicably account for a fraction of the total emission load. The EPA recommends future proponents thoroughly examine and implement all practicable opportunities to offset carbon dioxide emissions.

Summary

The EPA considers the key environmental factor of greenhouse gases has been adequately addressed and the strategic proposal can meet the EPA's objectives for this factor provided that conditions are imposed requiring the proponent for the strategic proposal and the proponent(s) of any subsequent derived proposal(s) to mitigate impacts using all appropriate management measures and offset the residual impacts as recommended in this report. The relevant recommended conditions for this factor include:

- Condition 22 relating to Greenhouse Gas Abatement.

3.10 Environmental principles

In preparing this report and recommendations, the EPA has had regard for the object and principles contained in s4A of the EP Act.

The following principles were considered by the EPA in relation to the strategic proposal:

- a) The precautionary principle;
- b) Intergenerational equity;
- c) Conservation of biological diversity and ecological integrity;
- d) Improved valuation, pricing and incentive mechanisms and;
- e) Waste minimisation.

Appendix 3 contains a summary of the EPA's consideration of the principles.

4. Conditions

Section 44 of the EP Act requires the EPA to report to the Minister for Environment on the key environmental factors relevant to the strategic proposal and on the conditions and procedures to which the strategic proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

4.1 Recommended conditions

Having considered the information provided in this report, the EPA has prepared a Statement regarding the implementation of future proposal(s) identified in the strategic proposal which specifies the conditions and procedures the EPA recommends should be applied, subject to any notice given under section 45A(3) of the EP Act and or any inquiry under section 46 or assessment under section 46B of the EP Act, to any future proposal, declared to be a derived proposal. These conditions are presented in Appendix 4. Matters addressed in the conditions include the following:

- a. Condition 5 'Terrestrial Facilities and Disturbance Footprint Plan' to show the location and limits of disturbance from the proposal;
- b. Condition 6 'Terrestrial Baseline State Report', to define the location of important terrestrial elements of the environment including Monsoon Vine Thickets and threatened fauna like the Greater Bilby ;
- c. Condition 7 'Terrestrial Environment Protection Program' to ensure terrestrial facilities are sited, constructed and operated to avoid and minimise adverse impacts;
- d. Condition 8 'Terrestrial Environment Monitoring Program' to establish a program of ongoing monitoring to detect any material or serious environmental harm outside the disturbance footprint;
- e. Condition 9 'Marine Facilities and Impact Zones Plan' to define the location and configuration of all marine facilities and zones of High and Moderate Impact and Zones of Influence from the proposal in the marine environment;
- f. Condition 10 'Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program' to ensure that turbidity generating activities achieve environmental protection outcomes, are managed to defined targets and exercise all reasonable and practical means to reduce adverse effects on benthic habitats;
- g. Condition 11 'State of the Marine Environment Surveys' to survey the condition of the marine environment before, during and after marine works to determine baseline conditions, impacts and recovery;
- h. Condition 12 'Coastal Processes Monitoring and Management Program' to minimise and manage erosion, sediment transport and impacts on recreational beaches induced by the proposal;

- i. Condition 13 'Marine Environmental Quality and Marine Outfalls' to define the location of outfalls from onshore facilities, the quality of wastewater discharges and the environmental quality objectives to be met;
- j. Condition 14 'Pipeline Shore Crossing Management and Monitoring Program' to limit adverse impacts to the shoreline by restricting pipe placement to tunnelling methods rather than open trenching unless the proponent can demonstrate that tunnelling is technically infeasible and an alternative method is warranted;
- k. Condition 15 'Marine Fauna Interaction – Marine Pile-driving, Dredging and Marine Construction Vessels and Light Sources' to require dedicated marine fauna observers and trained crew members for dredging and piling operations, lodgement of cetacean records, limits on work vessel speeds, conditions for the commencement and suspension of piling operations and a Conservation Significant Marine Fauna Interaction Management Program and an Underwater Noise Monitoring and Review Program;
- l. Condition 16 'Marine Drilling and Blasting Activities' to require that these operations are managed to minimise adverse impacts to marine fauna;
- m. Condition 17 'Introduced Marine Pests' to prevent introductions and detect and control marine pests;
- n. Condition 18 'Surface and Groundwater Management and Monitoring' to ensure that groundwater abstraction and construction and operation of the proposal do not adversely affect groundwater dependent vegetation, including the Monsoon Vine Thicket and drainage basin vegetation communities;
- o. Condition 19 'Weeds' to prevent the introduction of new weeds and the spread of existing weeds in the vicinity of the proposal and to undertake weed control and rehabilitation, where necessary;
- p. Condition 20 'Rehabilitation' to require progressive rehabilitation and the development of completion criteria for rehabilitation;
- q. Condition 21 'Emissions to Air' to require best practice for minimising emissions of volatile organic compounds, hydrogen sulphide, oxides of nitrogen, criteria pollutants and to optimise the smokeless capacity of flares and minimise non-emergency flaring of gas;
- r. Condition 22 'Greenhouse Gas Abatement' to require the development and implementation of an approved Greenhouse Gas Abatement Program and the offsetting of the emission of reservoir carbon dioxide to the atmosphere;
- s. Condition 23 'Fossil Heritage Management' to ensure that fossilised dinosaur footprints in the vicinity of the precinct are not damaged by excluding proposal activities from certain areas and requiring proper survey and salvage where damage cannot reasonably be avoided ;
- t. Condition 24 'Decommissioning' to set decommissioning criteria prior to closure;

- u. Condition 25 'Residual Impacts and Risk Management Measures' to be implemented to address the residual environmental impacts and risks of the proposal to important environmental assets such as fossilised dinosaur footprints and Monsoon Vine Thickets;
- v. Condition 26 'Preparation and Review of Plans and Programs' to ensure that environmental management plans referred to in the proponent's Strategic Assessment Report are prepared, that consultation on those plans occurs with relevant stakeholders and amended plans are implemented as amended;
- w. Condition 27 'Staging and Timing for the Submission of Programs' to allow programs to be prepared in advance of components or stages of the facility;
- x. Condition 28 'Minor or Preliminary Activities' to enable the CEO to allow minor or preliminary activity to occur prior to certain conditions being met; and
- y. Condition 29 'Public Availability of Data, Plans, Programs and Surveys' to require all validated environmental data to be made publicly available, except where it can be demonstrated it is confidential commercially sensitive information or where publication would put important environmental assets such as dinosaur footprints or threatened species at risk.

It should be noted that other regulatory mechanisms relevant to the proposal include:

- Works approval and licensing by the DEC;
- Development approval from the Broome Port Authority;
- Major hazard facility licensing from the DMP;
- Oil spill management plan requirement by the DoT and the DMP,
- Sea dumping permit from the DSEWPC;
- Rezoning/development approval from the Shire of Broome;
- Water abstraction licences from the DoW;
- Permission for disturbance of Aboriginal sites from the Minister for Indigenous Affairs;
- Commonwealth government approvals relating to offshore operations; and
- Commonwealth government cetacean interaction guidelines.

4.2 Consultation

In developing these conditions, the EPA consulted with the proponent, and relevant decision making authorities and agencies in respect of matters of fact and matters of technical or implementation significance. The agencies included were:

- Department of Regional Development and Lands,
- Department of Water,
- Department of Environment and Conservation,
- Department of Indigenous Affairs,
- Department of Mines and Petroleum,
- Department of Transport,
- Department of Fisheries,
- Department of Planning,
- Department of State Development, and
- Department of Sustainability, Environment, Water, Population and Communities.

4.3 Derived proposal(s)

The relevant conditions and procedures attaching to the implementation of this strategic proposal are to attach to the implementation of any proposal that is declared by the EPA to be derived from the strategic proposal.

5. Other advice

Precinct configuration

During its consideration of this proposal, the EPA noted that opportunities may exist to reduce the extent and environmental impact of the proposal by consolidating some elements of the Precinct. A fundamental element of minimising environmental impacts is to limit the footprint to what is absolutely necessary. To that end, the EPA expects that the proponent for this strategic proposal require that future project proponents make efficient use of space within the Precinct. This principle should be applied to ensure that early projects do not unnecessarily constrain subsequent projects to the extent that there is insufficient space to reach the approved capacity of the Precinct (expected to be 50 Mtpa) without further applications for additions to any approved Precinct footprint.

The EPA understands that the southern feed gas pipeline corridor (Area E on Figure 2) was located south of the main precinct to accommodate issues on the coast relevant to Aboriginal interests. If the northern and southern feed gas pipeline corridors were consolidated into a single (perhaps wider) corridor, either to the north or the south, the extent of edge effects and isolation of what would become remnant patches of vegetation may be reduced. Consolidation to the south could also reduce impacts around James Price Point itself, which is clearly an iconic element of the landscape to Traditional Owners, Broome residents and visitors. The EPA recommends that the possibility of a consolidated approach to feed gas pipeline locations that considers the optimum solution on both environmental and heritage grounds should be carefully evaluated before decisions are made that preclude this possibility.

Given the landscape values of James Price Point itself, and the location of important fossils of dinosaur footprints nearby, the EPA notes and supports the proponents commitment to locate port infrastructure and the connections between the port and the precinct south of a line 900 m south of the northern limit of the port crossing area in such a way that no development occurs within Area H shown in Figure 2.

The EPA also notes that only 200 ha of each of the ~1000 ha sites designated in the SAR for a light industrial area and workers accommodation (areas C and D respectively on Figure 2) will actually be required for a 50 Mtpa LNG production facility. Location of the workers accommodation to the east of Area D would limit the impact of these facilities on visitors using Manari Road and reduce the prospect of direct access to the coast from the accommodation area. Setting both the light industrial area and accommodation back from the access road and retaining a screen of native vegetation would also screen the small scale clutter associated with such facilities from passers-by using the access road.

The EPA recommends that configuration options should be considered with due regard for environmental impact minimisation, particularly where key environmental assets and factors (e.g. MVTs, long term aesthetic values, and dinosaur footprints) are concerned. Consideration should be given to opportunities to minimise overall impacts to the environment and to heritage sites, as set out above, as the design of the precinct proceeds.

Efficient use of precinct capacity

The EPA notes that it is intended that there should be at least two LNG plants located in the Precinct. The EPA expects that the DSD and other State agencies responsible for allocating and managing space in the Precinct ensure that the earlier users make efficient use of space, including in the port, to ensure that subsequent users do not need to apply for any extension to the Precinct to accommodate production up to the limit of 50 Mtpa of LNG that is contemplated in this assessment. To this end the EPA has recommended conditions that require the Browse LNG Precinct Control Group to endorse plans prior to their submission showing the layout of terrestrial and marine facilities to indicate that they satisfy the State's needs with respect to efficient use of the available land, adequate sharing of infrastructure etc. The EPA also expects that future proponents make use of the feed gas pipeline corridor(s) efficiently and locate pipelines as close together as possible to avoid an unnecessarily large environmental footprint or the need for subsequent proponents to request additional space for pipelines.

A similar principle of 'efficient and proportional use' should be applied to the allocation of capacity in the air-shed, the wastewater outfall area in the port, the clearing of MVT vegetation and any other situation where discharges or impacts on particularly sensitive or restricted elements of the environment are planned to occur. That is, allocation of discharge capacities should be proportional to that fraction of the 50 Mtpa limit of the Precinct that each user is actually producing, recognising that best practice controls available at the time should always be applied when new production capacity is sanctioned.

In allocating fractions of the MVT vegetation that may be cleared by each precinct user, sensible consideration of the actual distribution of the MVT will need to be taken into account. The general principle of ensuring that an early user does not unnecessarily preclude future users by clearing a disproportionate amount of the overall limit on MVT clearing still applies, however.

Regional conservation initiatives

The EPA notes that this proposal has considered the environmental, social, economic, heritage and strategic implications of the Precinct following an extensive site selection process over a number of years. The EPA recognises the environmental benefits in confining an LNG Precinct to one location, thereby minimising the potential for more widespread environmental impacts that would arise from unconstrained development in a relatively undisturbed region with high environmental, cultural and heritage values.

At a regional scale, the Western Australian Government has undertaken a number of initiatives that will improve conservation outcomes for the Kimberley. These have been undertaken either in concert with, or independently of, negotiations about the Browse LNG precinct strategic proposal including:

- a commitment to establish additional nature reserves and/or national parks within the Dampier Peninsula to secure representative vegetation of the Peninsula in reserves, protect fauna habitat of rare and specially protected fauna and to protect Aboriginal culture and heritage;

- creation of a multiple use marine park at Camden Sound, a known calving and resting area for Breeding Stock D Humpback whales; and
- creation of a multiple use marine park at Roebuck Bay, a regionally significant dugong and snubfin dolphin aggregation area.

The EPA also notes previous recommendations by government agencies for additional land to be added to the Coulomb Point Nature Reserve to create a Dampierland National Park (Burbidge *et al.*, 1991; EPA, 1993). The EPA notes that the proposal for a Browse LNG Precinct overlaps the southern part of the land referred to in those earlier recommendations. If a decision is made to allow the implementation of the Precinct, the EPA recommends that land between the Precinct and Coulomb Point is added to the Coulomb Point Nature Reserve and its extent, tenure and purpose is determined to meet the intent of the previous recommendations to the fullest extent possible. Reservation of this area should also be consistent with the ongoing protection of dinosaur footprints in Area H on Figure 2.

Residual impacts and risks

Notwithstanding the important regional conservation initiatives above, the EPA, in assessing each key environmental factor, has formed the view that residual environmental impacts and risks remain to:

- the Monsoon Vine Thicket Threatened Ecological Community;
- marine fauna and their habitat, including whales, dolphins, dugong and turtles;
- benthic habitat; and
- heritage, including regionally significant dinosaur footprints.

While strategic proposals, in and of themselves, do not have an impact on the environment, it is clear that any remaining residual impacts and risks would need to be addressed with appropriate, additional measures in the consideration of any derived proposal. Advice about the matters needing attention to be given to offsets is contained in each relevant sub-section of Section 3 of this report.

Relationship between strategic and future derived proposals

The purpose of a strategic proposal is to consider the environmental impacts of a future proposal, or group of future proposals. A strategic proposal does not of itself lead to the implementation of an actual project. It is thus expected that a future proponent would refer a proposal for the implementation of a project and request that it be considered to be a derived proposal. In effect this offers the prospect that the issues around the referred proposal should have been considered during the assessment of the strategic proposal and that no further assessment of the derived proposal should be necessary. Any relevant conditions applied when a decision was made about the strategic proposal should then apply to the derived proposal.

The EPA envisages the following requirements for strategic and subsequent derived proposals.

Strategic proposals

In assessing a strategic proposal, the EPA should be able to reasonably conclude at an appropriately high level that the proposal could be implemented without significant deleterious impacts on the environment. Sufficient detail should be available to allow the EPA to conclude that:

1. The strategic proposal does not contain obvious fatal flaws.
2. Significant deleterious impacts at the population level on important components of the biota are not likely. This explicitly recognises that there may be deleterious impacts to individual organisms, but they should not be likely to have an impact on the long term viability of the population.
3. The strategic proposal contains sufficient information for the EPA to make reasonably informed decisions about points 1 and 2 above.
4. The strategic proposal specifies any work required in a derived proposal to provide additional, more detailed information about potential impacts to a level that allows for the development of environmental management plans for their proper management. The work required should be framed in the form of proposed draft conditions.
5. The work specified in relevant conditions set under point 4 above should specify to what end or for what purpose that work is to be performed.
6. Conditions in point 4 above should specify by whom the work should be done and by when.

Judgements about the likely environmental impact and acceptability or otherwise of a strategic proposal will incorporate the EPA's collective wisdom and experience of similar proposals that have been assessed at the project level.

Derived proposals

For the EPA to give consideration to declaring a future proposal to be a derived proposal the future proposal would be expected to:

1. Lie within the footprint of the assessed strategic proposal. This means the final footprint, reflecting what was in the SAR, as modified by any refinements made during the assessment process.
2. Demonstrate best contemporary practice (as defined in EPA Guidance Statement No. 55) for all construction and operational impacts (for example atmospheric emissions, marine emissions and noise).
3. Meet all relevant conditions set out in the Ministerial Statement issued for the strategic proposal. This means that any conditions that limit impacts to levels less than those contemplated in the original proposal set out in the SAR must be complied with.
4. Meet the requirements of the *Environmental Protection Act 1986* which requires:
 - a. the proposal was identified in the strategic proposal; and
 - b. the strategic proposal Ministerial statement provides that the referred proposal may be implemented.

5. Provide Environmental Management Plans (EMPs) required by the Precinct Ministerial Statement that demonstrate how relevant conditions and outcomes have been met. The EMPs must be in a form that is close to final and consultation with key stakeholders should be completed prior to submission.

An explanation of these requirements is set out in EPA Environmental Protection Bulletin No. 17 “Strategic and derived proposals”.

Following referral of a proposal that the proponent requests should be declared a derived proposal, the EPA will consider it a derived proposal if it considers that:

- the proposal was identified in the strategic proposal that has been assessed by the EPA; and
- following assessment of the strategic proposal, it was decided that the referred proposal could be implemented.

The EPA may refuse to declare the referred proposal to be a derived proposal if it considers that:

- the environmental issues raised by the proposal were not adequately assessed when the strategic proposal was assessed;
- there is significant new or additional information that justifies reassessment of the issues raised by the referred proposal; or
- there has been a significant change in the relevant environmental factors since the strategic proposal was assessed.

If the EPA declares the referred proposal to be a derived proposal, it will not assess the proposal, except for the purposes of conducting an inquiry into whether or not any conditions should be changed. The EPA may thus recommend changes to conditions to apply to a derived proposal.

The EPA notes that many submissions raised concerns about the limited level of detail in the SAR. Considerable further detail, particularly about management actions, would be expected to accompany the numerous management plans that have been foreshadowed in the SAR. It is understandable that decision making authorities (DMAs) and stakeholders would wish to understand this detail and comment on it.

The EPA expects, therefore, that a proponent making a request for a derived proposal would have extensively consulted DMAs and other affected stakeholders with the detailed material that the proponent intends to submit to the EPA in support of its request for the declaration of a proposal as a derived proposal. The EPA also expects the proponent to document this consultation and to demonstrate how it has responded to comments and concerns raised by DMAs and stakeholders. The EPA envisages that this process should be modelled on the procedures for an Assessment on Referral Information (ARI) level of assessment, as set out in the EPA’s *Environmental Impact Assessment Administrative Instructions 2010*.

The EPA has prepared a Bulletin (EPA, 2012) on strategic and derived proposals. The Bulletin explains the purpose and intent of strategic and derived proposals, outlines the strategic proposal assessment process, and the process

to determine derived proposals. It also describes the opportunities and EPA's expectations for public consultation, and outlines the EPA's principles and approach to the assessment of proposals and setting of conditions.

Operational port management

The operational management of the port has not been assessed for this proposal. It is anticipated that the Broome Port Authority (BPA) would ultimately take over control of the port and its operation. An appropriate level of environmental management and monitoring for the operational port would need to be put in place to achieve good environmental stewardship.

The EPA recommends that a marine environmental quality management program would need to be prepared by future proponents in consultation with the BPA for the initial stages of the development prior to the BPA assuming control of the port.

Once the port is vested in the BPA, the *Port Authorities Act 1999* requires a strategic development plan which must set out an environmental management plan for the port. The EPA recommends that the management plan considers such environmental issues as the impact on benthic habitat of maintenance dredging, planning of water quality management, especially for additional outfalls, vessel impacts to marine fauna, oil spill management and introduced pest management.

The EPA recommends to the Minister for Environment that upon issuing the statement for the implementation of the proposal, if the Minister so decides, the Minister writes to the proponent and the Minister for Transport (as the Minister with responsibility for the BPA) reiterating the EPA advice above.

Recommendations to the DEC

The recommended Ministerial Conditions for this proposal set out the environmental quality management framework that the proponent and regulators need to use for establishing management objectives for any waste water discharges associated with this proposal. The EPA recognises that regulation and ongoing management of the discharge would be through the Department of Environment and Conservation discharge licensing process under Part V of the *Environmental Protection Act 1986*. The EPA therefore provides the following recommendations to help guide on-going regulation and management of wastewater discharges to achieve the environmental quality objectives and levels of ecological protection it has established for the proposal. The EPA recommends that:

1. The proponent should demonstrate implementation of the waste management hierarchy and that best practice waste water treatment and management procedures are being applied at all times to minimise the discharge of brine and other contaminants into the marine environment.
2. Any discharge licences issued for the Browse LNG Precinct by the Department of Environment and Conservation under Part V of the EP Act include conditions that ensure that the environmental quality objectives and levels of ecological protection outlined in Schedule 4 of the recommended Ministerial Conditions are achieved.

3. If the results of monitoring indicate that the environmental quality objectives or levels of ecological protection outlined in Schedule 4 of the recommended Ministerial Conditions are not being achieved then the CEO of the Department of Environment and Conservation should require measures to be taken, including revision of the discharge licence, to ensure that the requirements of Schedule 4 are met.
4. Prior to application for any licence to discharge the relevant future proponent should prepare a Marine Environmental Quality Management Program to the satisfaction of the CEO of the Department of Environment and Conservation to ensure that the environmental quality objectives and levels of ecological protection outlined in Schedule 4 of the recommended Ministerial Conditions are achieved on an on-going basis for the Low, Moderate and High Ecological Protection areas.
5. The Department of Environment and Conservation should ensure that any licence requirements for discharges from the Browse LNG Precinct require the proponent to implement the Marine Environmental Quality Management Program. The results of the Marine Environmental Quality Management Program should be reported to the CEO of the Department of Environment and Conservation within 18 months of commissioning, and annually thereafter. If monitoring results indicate that the environmental quality objectives and levels of ecological protection outlined in Schedule 4 of the recommended Ministerial Conditions may not be met then the report should include discussion of the management strategies necessary to achieve, and ensure ongoing compliance with, the environmental quality objectives and levels of ecological protection.
6. The Department of Environment and Conservation should require the proponent to verify the performance of any outfall diffuser under the conditions of the discharge licence and to report the results within 12 months of commissioning of that outfall. The objective of diffuser performance monitoring is to determine whether the required number of dilutions is being achieved to meet the requirements of Schedule 4 of the Ministerial Conditions, under a range of flow rates, meteorological and sea state conditions. The report should include any management strategies necessary to ensure ongoing compliance with environmental quality objectives and levels of ecological protection outlined in Schedule 4.
7. If the results from any monitoring program indicate that the environmental quality objectives or levels of ecological protection outlined in Schedule 4 of the recommended Ministerial Conditions are not being achieved then the CEO of the Department of Environment and Conservation should revise the licence conditions accordingly to ensure the requirements of Schedule 4 are met.
8. The EPA recommends that the proponent should incorporate the procedures contained in the *Manual of Operating Procedures for Environmental Monitoring Against the Cockburn Sound Environmental Quality Criteria* (EPA, 2005b) when preparing and implementing the Marine Environmental Quality Management Program.

9. In the absence of any quality assured baseline data on the background concentrations of seawater constituents in local marine waters, analysed to ultra-trace levels, the proponent should refer to the results in McAlpine *et al.*, (2012).

The EPA recommends the following requirements in works approvals and licensing for marine outfalls:

- continuous monitoring of flow, pH, temperature and turbidity with targets and limits set by the DEC;
- contaminant discharge to the environment to be managed by setting both concentration (to manage acute and chronic effects) and load (to manage long term impacts due to bio-accumulation and bio-magnification) limits and targets; and
- to ensure Best Practice, operation of wastewater treatment plant (WWTP) targets be set for wastewater quality for Biological Oxygen Demand (20 parts per million (ppm) flow weighted monthly average); Chemical Oxygen Demand (100 ppm flow weighted monthly average) and Total Suspended Solids (25 ppm flow weighted monthly average).

To prevent soil, marine, surface and groundwater pollution during construction and operation the EPA recommends to the DEC that works approval and licensing address the following:

- environmentally hazardous substances should have secondary containment;
- groundwater should be monitored on an annual basis around facility pad and other potentially contaminating infrastructure;
- spills should be reported to the DEC, with the DEC to define the reporting limits for spills;
- a plan for fire fighting foam management to the satisfaction of the CEO of the Office of the EPA should be submitted prior to commissioning and should cover fire fighting training, emergency response and foam storage;
- stormwater facilities should allow segregation of uncontaminated and contaminated stormwater;
- uncontaminated stormwater should be routed through detention basins to allow monitoring of quality and flow. Contaminant limits and targets for uncontaminated stormwater should be set by the DEC, noting the EPA's recommendation that the concentration of Total Petroleum Hydrocarbons in stormwater should be less than 1 ppm for discharge to any creek or the marine environment; and
- contaminated stormwater should be routed to the WWTP for treatment prior to discharge to the marine environment.

The EPA recommends to the DEC that works approvals and licensing for air emissions take particular account of the recommendations in regard to BTEX, hydrogen sulphide and other matters in Section 3.8 of this report and also address the following:

- a licence condition to require the proponent to periodically carry out ambient air quality monitoring (combustion emissions and relevant air toxics) to verify modelling predictions. Monitoring over one year every five or ten years, depending on the rate at which industrial activity at the Precinct increases, is suggested;
- for flares, a condition to cover installation of flow metres and flare gas sampling points to allow estimation of emissions. It is recommended that flaring targets be conditioned based on assumptions in the SAR or future refinements used for modelling. It is suggested that one target be set for mass or volume of gas flared per year; or mass/volume of gas flared per tonne of LNG produced per year. Another target should be the number of hours per year of black smoke emitted from the flare, again based on assumptions used in modelling for particulate emissions from flares. It is recommended that an annual flaring report is submitted to the DEC covering the metrics above. The works approval should also consider noise from flares;
- for air toxics, a condition to apply targets for BTEX and mercury based on assumptions in the SAR or subsequent refinements; and
- for fugitive emissions, a condition to require a Leak Detection and Repair program covering all potential leak points consistent with the USEPA Method 21 protocol to be carried out every two years. The definition of a leak should be a concentration of 1000 ppm or greater. Repair times for leaks are recommended as follows:
 - Leak concentration > 100,000 ppm, 2 weeks;
 - Leak concentration >10,000 but < 100,000, 6 weeks; and
 - Leak concentration >1000ppm but < 10,000ppm 12 weeks.

If a shutdown is required to repair a leak, the repair should be carried out at the next available shutdown.

It is recommended that the leak detection and repair program is carried out by conventional means using a Flame Ionization Detector or Photo Ionization Detector.

6. Recommendations

The EPA submits the following recommendations to the Minister for Environment:

1. That the Minister notes that the strategic proposal being assessed identifies future proposals which will be designed to include one or more of the developments/activities listed in Table 1 of this report for the Browse LNG Precinct, including LNG processing plants, a port and supporting infrastructure;
2. That the Minister considers the report on the key environmental factors and principles as set out in Section 3;
3. That the Minister notes that the EPA has concluded that future proposals, identified in the Browse LNG Precinct proposal and designed to include one or more of the developments/activities listed in column 1 of Table 1 of this report may be implemented, if declared to be derived proposals, in such a way as to meet the EPA's environmental objectives provided;
 - a. no future proposal designed to include one or more of the developments/activities listed in column 1 of Table 1 of this report, developed either singly or in combination with other proposals, exceeds the extent/limits of the developments/activities listed in column 2 of Table 1 of this report,
 - b. the proponent of any future proposal ensures that that proposal is implemented in accordance with the recommended conditions as are relevant to their future proposal as set out in Appendix 4 and summarised in Section 4,
 - c. future derived proposals have key attributes identified by the EPA in this report,
 - d. environmental issues raised by future proposals were adequately assessed when the strategic proposal was assessed,
 - e. there is no significant new or additional information that justifies the reassessment of the issues raised by the future proposal, or
 - f. there has not been a significant change in the relevant environmental factors raised by the future proposal since the strategic proposal was assessed.
4. That the Minister imposes the conditions and procedures recommended in Appendix 4 of this report; and
5. That the Minister notes the EPA's 'Other advice' presented in Section 5 in relation to the configuration of the Precinct and efficient use of its capacity, offsets for residual impacts, the relationship between this assessment of a strategic proposal and future derived proposals, operations of the port and recommendations for consideration during the DEC works approval and licensing process.

Appendix 1

List of Submitters

The following organisations and individuals provided individual submissions on the proposal. In addition, approximately 11,000 proforma submissions were received.

Organisations:

Alliance for a Clean Environment Inc	Friends of the Earth
Australasian Wader Studies Group	Friends of the Earth Australia
Australian Conservation Foundation	Global Exchange
Australian Marine Conservation Society	Humane Society International
Blue Frontier campaign	Kimberley Development Commission
Blue Ocean Institute	Kimberley Land Council
Centre for Biological Diversity	Kimberley Whale Watching
Cetacean Society International	Ohio Environmental Council
Chamber of Commerce and Industry WA	Open Society Foundation-Angola
Conservation Council of Western Australia	Pacific Environment
CounterCorp	Pearl Producers Association
Crude Accountability	PRETOMA
Defenders of Wildlife	Project Maje
Department of Education	Rainforest Action Network
Department of Environment and Conservation	Safe Climate Perth
Department of Health	Save the Kimberley
Department of Indigenous Affairs	Sea Stewards
Department of Planning	Sea Turtle Conservancy
Department of Training and Workforce Development	Shire of Broome
Department Of Transport	Sierra Club
Department of Water	The Wilderness Society
Discover Australia	Turtle Island Restoration Network
Earth Day Network	WA Fishing Industry Council Inc
Earth Island Institutes International	Whale and Dolphin Conservation Society
Marine Mammal Project	Woodside Energy Ltd
Earth Rights International	WWF Australia
Environs Kimberley	

Individuals:

Alex Campbell	Beth Neate
Alex Mountford	Bonnie Derne
Alexandra Pentelow	Carmel Leahy
Ali Batten	Carolyn Holmes
Amanda & Dean McInerney	Celeste Allan
Amanda Hodgson	Chris Maher
Anna Turnbull	Christine Cattnach
Annette Batten Fine	Christine Elsasser
Beatrice Mead	Claire Farley

Cornelia Grohmann
Craig Phillips
Daniel Balint
Dave Brophy
Dave Morris
David Dureau
Deane Spurge
Deborah Vincent
Denise Broux
Denise Dillon-Smith
Donald Grey Jnr
Donald Grey Snr
Dylan Lehmann
Earl Hughes
Elisabeth Tinarran
Evelyn Chaloupka
Fae Gerrits
Finn Pedersen
Francesca Guzzetta
Gerard Renehan
Giovanna Field
Glenice Allan
Gundela Gloede
Gwen Knox
Heather Black
Hon. Lyn MacLaren MLC
Isolde Scherrer
J Capozzelli
Jael Johnson
James Pillsbury
Jan Lewis
Jane Lawton
Janet Krombach
Jeanette Bray
Jeanne Browne
Jennifer Payne
Jenny Costigan
Jenny Nichol
Jessamy Ham
Jessica Holmes
Jo Vallentine
John Curran
Josephine Batten
Josephine Mell
Joshua Smith
Joyce Hudson

Julie Dewar
Julie Halstead
Julie Weguelin
Kandy Curran
Karen Monson
Karl Mittermayer
Kate Gilson
Kathleen Murray
Kerry Anne Jordinson
Kerry Firkin
Kerstin Robinson
Kevin Blatchford
Kevin Smith
Kristen Kovacevic
Kylie Weather
Lars Bejder
Lauren McGregor
Leon David D'Alton
Leonie Stubbs
Lesley Letham
Lesley Morris
Lisa Mazella
Lisa Pelosi
Loreena Walsh
Lorraine Grey
Louisa Grey
Lynette McDonald
Malcolm Burton
Mandy Juniper
Margaret Coombes-
Pearce
Martin Pritchard
Martine Docherty
Matt Grigg
Maxine Burke
Melanie Queenan
Nathan Laird
Nici Min
Nik Wevers
Nina Fitzgerald
Oliver Crosthwaite
Oskar Booth
Pam Jennings
Pat Lowe
Patrick Amadiou
Patrick Wells

Paul Mason
Penelope Normington
Penny Anderson
Petrine McCrohan
Phil Docherty
Portia Hulsewede
Prof Sandy Toussaint
Rachel Aldridge
Rebecca Edwards
Regina Gina
Rhoda Mason
Rhona Dawson
Ric Buist
Richard Bartlett
Richard Mayhew
Robyn Wells
Robyn Worth
Rod Heyns
Ruth Balint
S Edwards
Sam Bright
Senator Bob Brown
Serena Williams

Shane Hughes
Sharon Griffiths
Sheila Boyle
Shelley Jordans
Shely Ourana
Silvia Cetti
Simon Allen
Sophie Plowman
Steve la Puma
Sue Urquart
Tess Beckett
Therese Tucker
Thomas Luck
Valerie Burgess
Venita Stewart-Donaldson
Veronica Yeo
Vicki Carroll
Vivieene O'Shea
Wade Freeman
Wendy Boyes-Hunter
Wilhelmina Sarubin
William McMullen

Appendix 2

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Appendix 3

Summary of Identification of Key Environmental Factors and Principles

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
BIOPHYSICAL			
Marine Environmental Quality	<p>Construction and ongoing maintenance of the BLNG Precinct have the potential to impact on marine water quality through disturbance and excavation resulting in disturbance of contaminants, increased suspended sediments and turbidity.</p> <p>Construction and operation will result in routine discharges such as sewage and grey water, brine from desalination process and storm water and hydrotest fluids, potentially from and non routine marine discharges including condensate, hydrate inhibitors MEG, LNG, fuels and chemicals, which may impact upon water quality.</p> <p>Vessel marine discharges will also occur including deck drainage, antifouling, ballast, food scraps and waste water (produced water, sewage, grey water etc).</p>	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • potential impacts of wastewater discharge from operations on marine fauna; • impacts as a result of cumulative marine discharges over the life of the project have not been adequately considered; • potential impacts to marine water and sediment quality in the vicinity of James Price Point and the wider Kimberley Region which currently has little or no anthropogenic contamination as a result of lack of industry and large population centres in the region; • the quantity of wastewater from processing, storm water and grey water to be pumped to sea; • discharge of industrial waste water; • potential significant effects of slight nutrient input as the waters are naturally nutrient poor; • risks to marine fauna as a result of vessel discharges, and the need analyse, quantify and put measures in place to eliminate potential impacts; • potential impacts as a result of marine discharges from ships; 	<p>Considered to be a key environmental factor. See Section 3.3.</p>

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • the proposal relies on compliance with International Maritime Organisation MARPOL 73/78 Annex IV to address vessel discharges, however this allows for discharge of untreated discharge of greywater from galleys; • inadequate consideration of potential impacts of desalination; • inadequate consideration of marine pollution; • the risk of oil spill to the Kimberley coastal environment and marine fauna; • the adequacy and robustness of hydrocarbon spill modelling; • the preparedness of the proponent to both prevent and manage a major oil spill; • emergency response and management particularly during cyclones, oil spills and well blow-outs; • potential impacts to the southern edge of Roebuck bay – Bush Point and impacts to migratory shorebirds; • a detailed oil spill management plan not being made available for public scrutiny; • the potential impacts as a result of the use of dispersants and burns in the cleanup operations in the event of an oil spill; • appropriate management of fauna, in particular endangered species, in the event of an oil spill; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • the effects of the port development on the environment between the Lacepede Islands and Broome; • the effects of the nearshore oil and gas development in state and federal waters between Broome and Cape Leveque; and • that Halpern <i>et al</i> (2008) in assessing the world's oceans reported that only 3.7% of oceans were rated as 'very low impact' and this included the Kimberley and emphasizes the global conservation significance of the area. <p>Public submissions and environmental non government organisations recommended:</p> <ul style="list-style-type: none"> • that the coastal waters of the Kimberley should be designated a 'particularly sensitive area' under the International Maritime Organisation to achieve protection from large vessels including no discharge zones; • an extended marine water quality monitoring program focusing on physical aspects of water quality, in particular turbidity, suspended solids and benthic illumination be undertaken; and • a dredging experts panel be established to investigate all dredging and spoil placement activities. 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>The Department of Environment and Conservation raised concerns about:</p> <ul style="list-style-type: none"> • water quality monitoring not being undertaken over a full 12 months and therefore may not fully represent seasonal cycles, affecting ability to assess the potential impacts; and • insufficient information on wastewater discharge to assess the impacts. <p>The Western Australian Fishing Industry Council (WAFIC) raised concerns about:</p> <ul style="list-style-type: none"> • salt water intake and brine discharge associated with a potential desalination plant and considers that further information is required to demonstrate how brine will or will not impact the industry. Discharge may impact on osmoregulation of organisms, whereas intakes may result in entrainment and entrapment of larvae, fish and invertebrates (including prawns) and may potentially ingest and kill prawn larvae and nauplii and disrupt critical alongshore water movement and salinity. More details on times of water extraction and impacts on prawn production are required. <p>The WAFIC also advised:</p> <ul style="list-style-type: none"> • it supports the preparation of a BLNG Precinct Environmental Management Plan (EMP) for the Port area and recommend that the Department of Fisheries be included in the formal consultation for the EMP; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • the EMP should also include the collation of adequate baseline data for fish and a mechanism for aquaculture industries to have input; • the use of dispersants in responding to oil spill have adverse impacts of fish and marine life, and impacts to the commercial fishing industry; • the commercial fishing, pearling and aquaculture industries should be consulted in the development of spill contingency planning; and • spill contingency planning should include the commitment to compensate businesses who suffer loss as a result of a spill. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • oil spill sensitivity maps, supported by field surveys to ground truth sensitive habitats, should be required as part of the Oil Spill Response prior to construction; • Traditional Owners should be given opportunity to review and approve key Oil Spill Contingency Plan prior to these being approved by Government; • binding commitments are required to ensure that the responsible organisations, such as the Broome Port Authority, have the skills and resources to provide effective oil spill preparedness and response for such a large hydrocarbon processing development; • few details are provided on the locations of outfalls 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>and the treatment options for discharges that will be adopted. These are required for a full understanding of the likely impacts and assessment of mitigation measures proposed;</p> <ul style="list-style-type: none"> • it is unclear whether the assumed use of multiport diffuser for marine outfalls in the discharge modelling is a design commitment; • it is unclear whether all proponents will utilise the same outfalls or if individual proponents will have their own; • the Marine Wastewater Discharge Management Plan will be critical in providing specific details on treatment standards, outfall location and mitigation measures and will need to be reviewed and endorsed by the Traditional owners; • future proponents should be required to demonstrate that they will meet ANZECC/ARMCANZ 2000 (where applicable) as a minimum and that other best practice initiatives will be adopted; and • best practice should be applied in regard to wastewater treatment options and outfall design. 	
Benthic Primary Producer Habitat (BPPH)	Construction and ongoing maintenance of the BLNG Precinct will result in the permanent loss of up to 1138 hectares of BPPH through site disturbance and excavation within the Zone of High Impact.	<p>Public submissions and conservation groups raised concern about:</p> <ul style="list-style-type: none"> • increased turbidity as a result of dredging reducing light availability and smothering benthic 	Considered to be a key environmental factor see Section 3.2.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	<p>Permanent loss to BPPH is also expected in the dredge disposal ground.</p> <p>BPPH within the Zone of Moderate Impact and Zone of Influence may be impacted as a result of sediment deposition and turbidity, routine and non routine discharges and invasive marine species.</p>	<p>communities; in particular sea grass;</p> <ul style="list-style-type: none"> • benthic surveys being undertaken over one season and therefore not allowing for seasonality; • impacts to fauna as a result of loss of BPPH; • the extent of the zone of high and moderate impacts; • information gaps in sea grasses and corals; • that the predicted loss of BPPH as a result of dredging will exceed the EPA's guidelines (EAG 3); • loss of habitat effecting ecological balance in state and commonwealth waters; • that cumulative impacts as a result of interrupted long shore movement may impact sea grass communities downstream; and • potential impacts to benthic habitat at the area known as the Peanut and flow on effects on the fisheries at Roebuck Bay. • the likelihood of seagrass recovery, and potential cascading ecological effects; and • the threshold for change has not been adequately addressed. <p>The Department of Environment and Conservation raised concerns regarding:</p> <ul style="list-style-type: none"> • the loss of benthic primary producer habitat and 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>potential to directly and indirectly impact fauna.</p> <p>The Pearl Producers Association raised concerns regarding:</p> <ul style="list-style-type: none"> <li>• potential for turbidity and sedimentation to interfere with photosynthetic processes critical to plankton production that constitute pearl oysters food supply. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> <li>• specific management measures are required in terms of BPPH loss so Traditional Owners can gain an understanding of impacts and the ability to manage these impacts. <p>Woodside advised:</p> <ul style="list-style-type: none"> <li>• that the site selection process considered technical social and environmental attributes including BPPH; <li>• the Strategic Assessment Agreement was entered into with an objective to concentrate development at JPP; <li>• a key principle of EAG is minimisation, the EPA should give greater consideration to the Site selection process as opposed to cumulative loss calculations of BPPH in the Local Assessment Unit; <li>• their support of the strategic nature of the Precinct 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>to prevent proliferation of development along the Kimberley Coastline.</p> <ul style="list-style-type: none"> • considers the use of EAG 3 in the determination of offsets to be inconsistent with the proposal to develop a multiuser LNG precinct for the reasons above; • notes that due to the strategic nature of the proposal the predictions of the range of impacts are conservative, e.g. dredge modelling, concern that this may result in undue stakeholder concern, management measures not commensurate with the actual likely scale of impact and offsets being specified in proportion to conservative impacts and not the actual environmental outcomes. 	
Marine Sediments	Construction and ongoing maintenance of the BLNG Precinct have the potential to impact on marine sediment quality and constituents through disturbance and excavation; deposition and turbidity and marine discharges.	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • the amount of dredging required for the proposal; • the lack of detail regarding dredging or blasting or spoil grounds, breakwaters; • the lack of detail on sediment transport and re-suspension as a result of dredging, tidal processes, wave action or cyclonic events; • impacts to filter feeders as a result of increased sedimentation from dredging and dredge spoil disposal; • heavy metals and toxic chemical attaching to sediment ultimately resulting in bioaccumulation; 	Considered to be a key environmental factor see Section 3.3.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • nutrient and contaminant release from sediments during maintenance dredging; • potential impacts of sedimentation to the Lacepede Islands and Pender Bay; • impacts to the pelagic fish feeding ground known as the Peanut as a result of dredge and spoil dispersion; • the validity of the modelling avoiding the Peanut in the dredge spoil dispersion modelling; • the lack of details regarding the length, location and design of the shipping channel and breakwaters; and • no comprehensive studies had been conducted in federal waters adjacent to the proposed port. <p>The Pearl Producers Association (PPA) raised concerns about:</p> <ul style="list-style-type: none"> • turbidity and sedimentation impacts resulting in long term changes to water quality and nutrient levels; • the spatial extent of plumes during summer/spring where TSS from dredging and spoil disposal are predicted to reach 10 mg/L above background. Consultation is required with Clipper Pearls and Paspaley pearling companies on this issue. 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>The PPA also advised:</p> <ul style="list-style-type: none"> • that pearl oyster optimal growth and pearl quality impacts need to be addressed simultaneously when determining the impacts of TSS and turbidity outputs during both construction and maintenance dredging. It is understood this will be managed through engagement with pearling representatives; • levels of Total Suspended Solids are not expected to increase above the range of tolerance of <i>Pinctada maxima</i> with the exception of the northern most section of the Clipper Pearls lease, the PPA is confident that the pearling industry can continue to operate in the region and to plan for new pearl leases with the support of the Government and BLNG proponents; • that pearling representation should be included on the dredge management advisory group; and • it is difficult to comment on the impacts associated with dredging and disposal of dredge spoil due to lack of detail regarding the dredge campaign, but would like to work through modelling results to assess impacts and develop mitigation processes for any issues that are identified. <p>The Western Australian Fishing Industry Council advised:</p> <ul style="list-style-type: none"> • that it supports the establishment of a Dredging Management Advisory Group (DMAG) and asks 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>that commercial fishing, pearling and aquaculture expertise be represented on the group or at least closely consulted.</p> <ul style="list-style-type: none"> • The DMAG’s role should include risk assessments of dredging on intersecting and adjacent fishing pearling and aquaculture operations; and • spoil disposal grounds should be situated to avoid prominent commercial fishing areas as much as possible. The general principle for compensating pre-existing users for significant loss should be respected. <p>The Department of Environment and Conservation (DEC) raised concerns about:</p> <ul style="list-style-type: none"> • potential bioaccumulation of contaminants in marine mammal, reptiles and birds. <p>The DEC recommended that:</p> <ul style="list-style-type: none"> • the Broome Port Authority seek agreement with the Office of the EPA regarding benchmark sediment and water quality trigger values for metals and organics, and remain accountable for these values. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • further and more detailed dredging and dredge spoil modelling is proposed for derived proposal, the fragmented approach contributes to the uncertainties around cumulative and additive 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>impacts, the SAR should undertake a more robust cumulative assessment so affected communities can understand the impacts and respond accordingly;</p> <ul style="list-style-type: none"> • the Dredge Spoil Disposal Management Plan (DSDMP) will be critical in providing specific details on how impacts from dredging will be reduced and managed and will need to be reviewed and endorsed by the Traditional Owners; • it is unclear whether only one DSDMP will be prepared or if separate plans will be prepared for each of the dredging activities; • it is unclear if or what opportunity there is for Traditional Owner review and consultation on the suitability of spoil grounds; and • further specific details are required on the predicted impacts to coastal habitats as a result of changes to sediment transport and their extent which need to be presented to Traditional Owners for review and comment. 	
Marine Fauna (Mammals, Reptiles, Fish)	Construction and operation of the BLNG Precinct have the potential to impact upon marine fauna including fish, mammals and reptiles through site disturbance and excavation, physical presence, light emissions, sediment deposition and turbidity, marine noise and	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • the impacts of the proposal on marine megafauna; • the extent and scientific rigor of the studies conducted on megafauna; • potential impacts as a result of increased vessel 	Considered to be a key environmental factor see Section 3.1.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	<p>vibration, routine and non-routine marine discharges, introduction of invasive marine species.</p>	<p>movements, noise and oil spills;</p> <ul style="list-style-type: none"> • impacts to marine faunas and their habitat; in particular turtles, dugongs, whales and nearshore dolphins • the importance of the James Price Point area to whale and calf migration, and dolphins; • the extent, timing, methodology and scientific rigor of surveys in relation to marine fauna, and therefore the validity of data and conclusions drawn from them; • potential influence of seismic testing, tidal currents and vessel interactions on survey results; • scientific knowledge gaps in relation to turtles, snubfin dolphins, dugongs and whales; • that impacts to marine fauna and ecosystems have been downplayed; • inadequate consideration of cumulative impacts; • large numbers of Humpback whales, dolphins, turtles, sharks and dugongs occur in the region and may be impacted by the proposal; • the lack of consideration for the importance of foraging, migratory habitat for marine fauna; • the lack of consideration for the importance of inter-nesting and post-nesting habitat of turtles which will be at risk from shipping and onshore operations; • the need to consider Loggerhead, Hawksbill and 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>Leatherback turtles;</p> <ul style="list-style-type: none"> • impacts to turtles that use the area between Quondong Point and Flat Rocks for turtle nesting as indicated by local knowledge; • the relationship between turtles that nest at Barrow Island and migrate through the James Price Point area; • potential impacts to EPBC Act recovery plans for turtles and whales, and international conventions; • lack of management measures to prevent harm to marine fauna and their habitat; • the need for turtle recovery and management plans in all Australian waters; • the lack of substantiated population claims for dugong in the Kimberley; • the lack of understanding of the importance of sea grass at James Price Point; • cumulative impacts of the annual incidence of algal blooms (<i>Lyngyba sp</i>) at Roebuck Bay increasing distribution and abundance further threatening dugong habitat; • impacts to marine fauna, including whale calving habitat, as a result of shipping movement, vessel strikes and dredging; • potential influence of existing pearl lines excluding whales from Quondong to James Price Point on 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>survey results;</p> <ul style="list-style-type: none"> • impacts of underwater noise and vibration as a result of pile driving, marine blasting, dredging dumping, seismic testing and drilling on marine fauna, which may impact in particular dugongs, and communication between whale mothers and calves; • that there are currently no Australian standards that govern underwater acoustic noise; • cumulative impacts on whales including from developments at Wheatstone, Ashburton North, Anketell and Gorgon; • lack of documentation of any new marine species; • impacts to pelagic fish as a result of dredging and impacts to benthic habitat; • the importance of the area as evidence by the diversity of fish being greater than that at the Great Barrier Reef; • lack of regional context for intertidal study and fish surveys; • lack of assessment of fish aggregation areas; • lack of consideration of the highly productive pelagic zone located 15nm off the coast; • lack of information about sawfish and the Northern River Shark; • impacts to migratory route of sawfish and Northern 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>River Shark as a result of infrastructure; and</p> <ul style="list-style-type: none"> • need for further studies to determine whether the area is an important habitat and/or migration zone for the three endangered sawfish found in the Kimberley. <p>Public submissions and environmental non government organisations recommended that the proposal should be subject to:</p> <ul style="list-style-type: none"> • 500 m exclusion zones within which seismic activity cannot occur where whales are within this zone, • ramp up and shut down procedures for seismic surveys, collection and removal of floatsam, • reduction of speeds when marine animals are sited, maintenance of separation distances to cetaceans; • educational signage; and • reporting of sightings and locations of injured or dead animals. <p>The Western Australian Fishing Industry Council (WAFIC) raised concerns about:</p> <ul style="list-style-type: none"> • a detailed assessment has not been undertaken for fish; • references to research into noise impacts to oysters were not considered; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • the lack of reference to fish in the proposed Port Environmental Management Plan, in particular with regard to noise management; • predictions that the cumulative impacts to fish abundance is predicted to be low; • the impacts of seismic surveys on commercial fish populations and the need for further research; and • cumulative impacts of loss of coastline to collection activities of the specimen shell and marine aquarium commercial fishers business viability. <p>The WAFIC also advised that:</p> <ul style="list-style-type: none"> • consideration of Managed Commercial Fisheries needs to be expanded to include species of fish targeted by commercial fishermen in the Northern Demersal Scale Fishery; • the Fishing Industry Impact Study (Big Island Research,2009) has been reassessed and should be considered; • the proposal is not 'near' mackerel grounds it intersects them; • research is required into the impacts of large vessel noise and propeller turbulence on prawn distribution; and • research into impacts of seismic testing at Scott Reef did not include consideration of prawns, pearl 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>oyster or commercially targeted demersal fish.</p> <p>Murdoch University Cetacean Research Unit (MUCRU) raised concerns about:</p> <ul style="list-style-type: none"> <li>• the extent, timing, methodology and scientific rigor of surveys in relation to marine fauna, and therefore the validity of data and conclusions drawn from them; <li>• unsubstantiated statements that mitigation measures for larger cetaceans are suitable for smaller cetaceans; <li>• lack of consideration of smaller cetaceans (delphinids) which are likely to be impacted in different ways due to different habitat requirements; <li>• the threat of coastal zone development to snubfin and indo-pacific Humpback dolphins which are considered data deficient and nearly threatened; <li>• the lack of scientific knowledge regarding dolphins presence/absence, abundance or habitat use in the entire Pilbara/West Kimberley that might provide the basis to assess potential impacts of the development; <li>• there has been no effort to identify and quantify the abundance of coastal delphinid species, and therefore assumptions that they are not likely to be impacted are unsubstantiated; <li>• the ability to exhibit an avoidance response does 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>not mean that species are not impacted at a population level or have long term effects to distribution and abundance;</p> <ul style="list-style-type: none"> • that subspecies have not been differentiated which may impact on assumptions about abundance distribution and impacts on protected species; • the use of fauna aerial surveys to delineate between inshore delphinid species; • unsubstantiated claims that dugongs will move away in the event of an oil spill; • impacts to dugongs and dolphins from oil by covering nostrils, congesting or damaging the respiratory system, and inhaling droplets of oil or oil fumes. Dugongs may also ingest oil with seagrass or sediments, or suffer starvation due to seagrass death; • studies of 3 tracked whales in the Dampier and Port Hedland area being used to infer that vessel strikes are not of a concern; • direct impacts to dugongs as a result of loss of sea grass through dredging potentially resulting in death or emigration of dugongs; • limiting access to foraging for dugongs may result in delayed breeding and reduced population growth; • impacts to dugongs as a result of vessel movement within 50-500 m interrupting feeding which may lead to reduced energy intake, increased energy 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>expenditure and exclusion from preferred sea grass patches with potential to lead to emigration, reduced fecundity or starvation;</p> <ul style="list-style-type: none"> • the vulnerability of dugongs to large and/or high speed vessels due to their delayed response to boats; • impacts to acoustic communication between Humpback dolphins and their ability to maintain a cohesive group as a result of boat traffic and noise; • behavioural disruptions to dolphins may lead to displacement from preferred habitat, reduced fitness and fecundity and therefore population declines. • the inference that as only 1% of the dugong population was sighted at James Price Point that only 1% of the population will be susceptible to impacts and no population impact will occur. Changes in dugong density over time and satellite tracking suggest that dugongs transit the James Price Point area; • lack of investigation into preferred habitat characteristics, and the relative importance of these, as a result of studies for the SAR suggesting that whales migrate north past James Price Point and south around the Lacepede Islands; • limitations of whale surveys including a sea state of 4 or higher, behavioral comparisons are biased towards mothers and calves, and observer bias; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • distances of whales off shore do not account for tidal variation; • that 650 (5%) is not a low number of whales; • higher numbers of whales at Pender Bay may be due to this being a resting area; • methodology for population estimates and density comparisons; and • use of aerial surveys. <p>MUCRU also advised that:</p> <ul style="list-style-type: none"> • previous Murdoch University surveys have noted multiple groups of snubfin, indo-pacific Humpback and indo-pacific bottlenose dolphins in the Canning Marine Bioregion; and • stretches of open coastline (e.g. around James Price Point) are likely to represent avenues of connectivity between hotspots of delphinid activity. <p>The Department of Environment and Conservation (DEC) raised concerns regarding:</p> <ul style="list-style-type: none"> • insufficient survey of indo-pacific and snubfin dolphins. <p>The DEC also recommended:</p> <ul style="list-style-type: none"> • further survey of indo-pacific and snubfin dolphins; • further survey for the proposed development areas (including pipelines) for Humpback whales and 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>calves;</p> <ul style="list-style-type: none"> • specific contingencies for protection of local and regional habitats for turtles dugongs Humpback whales, indo-pacific and snubfin dolphins; • that surveys for dugongs and cetaceans be undertaken both during and immediately after construction; • that the Broome Port Authority (BPA) ensure all vessel operators avoid impacts to marine mammals consistent with the Wildlife Conservation (Closed season for Marine Mammals) Notice 1998; • that the Broome Port Authority, Department Of Transport and AMSA designate vessel corridors that avoid critical habitat for dugongs and cetaceans specially protected under the <i>Wildlife Conservation Act 1950</i> and marine turtles; • that all operational and support vessels log marine mammal information and submit it to DEC; • that verification of underwater acoustic models be undertaken to determine specific marine fauna management zones; • noise management procedures for pile driving and blasting be developed; • no anchoring occur in proximity to the Lacepede Islands or mainland turtle nesting beaches; • best practice lighting be applied, including; zero 	

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		<p>light horizon at all turtle nesting beaches; and</p> <ul style="list-style-type: none"> • dredges be fitted with tickler chains and overflow screens, no pumping occurs in transit; stop pumping when drag head is more than 0.5m from sea floor; and all accessible machinery inspected after each dredge cycle. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • qualitative surveys for crustaceans need to be undertaken; • dry season vessel based surveys are unlikely to be sufficient to establish a baseline for turtles in the areas given the importance of turtles to Traditional Owners; • given the highly variable nature of seagrass caution needs to be applied when considering dugong survey results and drawing conclusions on the importance of the area to dugongs; and • the SAR should provide a robust and detailed assessment on cumulative and additive impacts for fish, marine fauna and marine reptiles as this is a key concern for traditional owners. 	
Coastal Processes (including Tidal Regimes, Wave Climate, Currents)	Construction of the BLNG Precinct would require dredging, dredge spoil disposal, drilling, breakwater construction and pipeline trenching which have the potential to impact	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • negative impacts on coastal and marine 	Considered to be a key environmental factor see Section 3.5.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
and Hydrodynamics)	<p>upon coastal process.</p> <p>Physical presence of the BLNG precinct including coastal and near shore infrastructure and pipeline infrastructure have the potential to change coastal processes through alterations to tidal and current flow, and sediment transport.</p>	<p>environments as a result of the proposal;</p> <ul style="list-style-type: none"> • impacts on littoral drift with effects to sea grass beds, natural creeks, mangroves and other habitats that may be adversely affected by sand movements; and • that the development will impact upon Cable Beach. <p>The Department of Transport advised:</p> <ul style="list-style-type: none"> • the SEA appears to have identified the majority of key environmentally related coastal engineering issues, and these have been reported in a transparent manner; • the potential impacts of climate change do not appear to have been considered. Of particular relevance to this proposal is the potential for changes in cyclone intensity and sea level rise; • it appears very likely overtime sediment will accumulate on the northern and southern side of the facility, resulting in subsequent erosion of areas further away. This can usually be managed by undertaking sand bypassing or back passing; • the evaluation of the extent of impacts (erosion and deposition) is greatly dependent on the underlying geomorphology assessment, which provides an initial assessment of the sediment sources, sinks, and transport pathways through the application of sediment cells. This method of assessment is supported provided it is underpinned by a 	

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		<p>comprehensive field sampling program. However, it is of some concern that this study was primarily focused on investigating the shoreline and considered very limited information from offshore. A full analysis of the offshore geomorphology is considered essential to understanding the availability of sediment and how it is transported within this natural system;</p> <ul style="list-style-type: none"> • the review and interpretation of historic aerial photography in the geomorphology assessment would be significantly improved if the photography were assessed in stereo and not as mosaics; • it is difficult to interpret the sediment transport modelling as the limitations of the sediment transport models (LITPACK and Mike 21 ST) are not clearly stated. This causes some confusion regarding the model capacities versus their limitations. It is also not clear what the limitations are of the models when simulating the movement of fine or cohesive sediments; • it is not clear as to whether the LITPACK model is capable of predicting changes to the coastline morphology or position of the shoreline. Over a 20 year period it is considered likely that the morphology of the shoreline (orientation, profile shape) and grain size will change, in particular in the immediate vicinity of proposed facility. This will in turn change the sediment transport rates and should be taken into consideration; • a key element for sediment transport estimates is 	

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		<p>the calculation of the bottom current velocity. The SEA uses a depth-averaged model for the offshore area including deep channel. The assumptions regarding the vertical current velocity distribution should be clearly documented and the model derived bottom current velocity compares with Acoustic Wave and Current (AWAC) field recordings;</p> <ul style="list-style-type: none"> • the sediment transport estimates would benefit from more extensive offshore sediment sampling. The current modelling assumes a uniform grain size over the entire area; however this is unlikely to be the case. In deep water, cohesive sediment may have higher resistance to currents and waves, resulting in lower transport rates; and • the proposed development may redefine the boundary and position of the sediment cells. In part it will be this change in the position of the sediment cell along with the change in the sediment budget within the cell which will determine where the coastal impacts (such as erosion) will occur. <p>The Department of Transport recommends that:</p> <ul style="list-style-type: none"> • the geomorphology assessment is reviewed to consider in more detail the offshore sediment availability (sources), sediment sinks and sediment transport pathways. It is expected that this could be done by: <ul style="list-style-type: none"> ○ review of the existing Laser Airborne Depth 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>Sounder (LADS) offshore bathymetry;</p> <ul style="list-style-type: none"> ○ review of the existing benthic habitat mapping; ○ more extensive offshore sediment sampling and composition analysis similar that undertaken for onshore sediments; and ○ collection of offshore geotechnical data (e.g. seismic data) to determine the thickness of sediments overlying the rock platforms. <ul style="list-style-type: none"> ● the proponent is required to contribute to scientific research, to improve our general understanding of underlying environmental processes to inform our assessment of subsequent projects. For example further research is needed to understand the mechanisms by which sediment is resuspended to allow modelling of 'natural' or background turbidity; ● consideration should also be given to determining a 'best estimate' which may allow more efficient management of the environmental impacts during and following construction. Over estimation of the potential impacts can have the flow on effect of placing monitoring sites in ineffective locations or result in ineffective selection of management options. This is particularly relevant to: <ul style="list-style-type: none"> ○ estimation of reductions in water quality resulting from turbidity generated by dredging and associated activities; and ○ estimation of the long-term sediment transport rates. 	

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		<ul style="list-style-type: none"> • initial modelling results and predictions of impacts should be validated following the commencement of construction. Where predictions significantly differ from those actually monitored, management plans should be revised accordingly; • management plans when developed should seek to undertake proactive management. Models developed through the SEA to predict impacts could potentially be operated as forecast models during construction, especially if they have been validated/ calibrated against monitoring results during construction; and • a number of similar projects have required subsequent changes to early stage designs to replace piled structures with causeways. Some broader consideration should be given to the potential for changes to the trestle structure following the full geotechnical investigation. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • further details are required on the phasing of the pipeline infrastructure and corridors so that Traditional Owners can gain a better understanding of the potential impacts and timing of these impacts; • the SAR refers to the need for the most invasive near shore pipeline construction; evidence should be provided as to why a less invasive construction technique is not viable; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • a future Coastal Process Management Plan will be critical in providing specific details on how impacts from dredging will be reduced and managed and will need to be reviewed and endorsed by the Traditional Owners; and • the proposed environmental conditions in relation to tidal regimes, wave climate, currents and hydrodynamics do not specify an environmental outcome and therefore an understanding of the ability to manage these impacts cannot be made. 	
Marine Ecosystem Integrity (Including Invasive Marine Species)	The proposal may result in impacts to marine ecosystem integrity including the introduction of invasive marine species.	<p>The Pearl Producers Association (PPA) raised concerns about:</p> <ul style="list-style-type: none"> • the adequacy of mitigation and management to protect the pearling industry which has been relatively free of parasites and disease that have plagued the industry in other parts of the world; and • the need for a quantitative assessment of the biodiversity risks and increased susceptibility to invasive marine species. <p>The PPA also recommended:</p> <ul style="list-style-type: none"> • that IMS management plans be prepared to the satisfaction of the Minister for Fisheries who has legislative responsibility for invasive marine pests in WA. 	Considered as part of Marine Fauna see Section 3.1.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>The Western Australian Fishing Industry Council advised that:</p> <ul style="list-style-type: none"> • it supports the mitigation and management measures associated with invasive marine pests; and • that management plan should be subject to approval by the Minister for Fisheries. 	
<p>Terrestrial Flora and Vegetation (including Species of Ethno-biological Significance)</p>	<p>Development of the BLNG Precinct would result in the clearing of up 3037 hectares of native vegetation including:</p> <ul style="list-style-type: none"> • Monsoon Vine Thicket (TEC) up to 132.4 ha • Coastal heath Dwarf Pindan Heath (Priority 1 PEC) up to 8.9ha • Coastal communities up to 34.5ha • At least 6 priority flora species • 77 species of ethno-biological significance <p>Groundwater abstraction, site disturbance and excavation for construction, groundwater abstraction operation, and the physical presence of the BLNG Precinct may result in alteration of hydrology and hydrogeology which may impact groundwater dependant vegetation including Monsoon Vine Thickets</p>	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • the extent, timing, methodology and scientific rigor of surveys and therefore the validity of data and conclusion drawn from them; • the need for a comprehensive scientific study to understand the ecology and groundwater dependency of the Monsoon Vine Thicket (MVT) prior to any clearing and to inform management; • the hydrological impact of ground and surface water requirements and quality on vegetation, in particular theMVT, pindan heath, dwarf pindan and drainage basin communities; • that the MVT has been described as floristically similar to other vine thickets on the Dampier Peninsula; • the importance of the MVT as a corridor for fauna movement along the Dampier Peninsula; and its 	<p>Considered to be a key environmental factor see Section 3.4.</p>

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	(TEC) and drainage basin vegetation communities.	<p>potential listing as a TEC under the EPBC Act;</p> <ul style="list-style-type: none"> • the importance of the MVT at James Price Point being a priority patch in terms of its conservation significance, biodiversity, structure and location and it's interconnection to other patches of MVT; • impacts to vegetation as a result of the hydrological impacts will not be localised; • potential impacts to yet undiscovered species; • the extent of required clearing; • impacts to priority flora; • impacts of wet and dry deposition of chemicals on flora, including bush food such as Gubinge; • impacts to species of ethno-biological significance; • concern that focus on species of ethno-biological significance has been limited to <i>Terminalia ferdinandiana</i> because of its known commercial value, however there could be other species equally of value which have not yet been identified; • concern regarding indirect impacts to vegetation as a result of changes to fog, dew and air circulation which may be of importance; • the disparity in amount of MVT at James Price Point between Black <i>et al</i>, DEC and the proponent which may result in an underestimation of the impacts of clearing. The percentage cleared should be considered on a patch group basis; and 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • previous EPA decisions (Bulletin 434) rejecting mining exploration in the MVT have not been taken into consideration. <p>The Department of Environment and Conservation raised concerns regarding:</p> <ul style="list-style-type: none"> • the level of detail provided to adequately assess the impacts, particularly for threatened, restricted or endemic flora species and communities potentially warranting additional protection; specific design or management provisions; • the direct loss of 132 hectares of MVT; • a need for further investigations to confirm statement in the SAR that the MVT on the Dampier Peninsula is unlikely to be floristically distinct; • potential for significant indirect impacts to MVT as a result of: alteration of hydrology; co-dependence with other flora and fauna; fragmentation and loss of ecological connectivity; and edge effects; and • extent of MVT loss may be sufficiently significant to require mitigation of residual impacts. <p>The Department of Environment and Conservation recommend that:</p> <ul style="list-style-type: none"> • residual impacts to MVT are offset through contributions to a MVT TEC recovery plan; • surveys in accordance with EPA Guidance 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>Statement No. 51 be undertaken prior to any ground disturbing activities in particular to identify <i>Pittosporum moluccanum</i> which is only found at James Price Point;</p> <ul style="list-style-type: none"> • outcome based conditions to monitor and manage the impacts on vegetation should be applied; in particular to ensure no direct impacts on drainage basin communities; to ensure avoidance of good condition Pindan vegetation; and • outcome based conditions requiring monitoring and management of indirect impacts to Monsoon Vine Thicket and Drainage Basin Communities including for trigger levels and adaptive management. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • insufficient detail is provided on the presence of groundwater dependant ecosystems, given the highly sensitive nature of impacts to groundwater and the uncertainty around the impacts further work is required to inform Traditional owners on the potential impacts; • the risk of impacts to vegetation communities from groundwater abstraction needs to be assessed in more detail and presented so the Traditional owners can understand the level of risk to important vegetation communities; • firmer commitments are required regarding the protection of the Monsoon Vine Thicket given their 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>ecological value. Use of the term where practicable is not appropriate where impacts on ecological communities of high value need to be avoided;</p> <ul style="list-style-type: none"> • loss of MVT will have an impact on Traditional Owners ability to harvest Gubinge. The SAR needs to demonstrate losses to vine thickets have been minimised by optimizing the plant layout; and • details on measures to reduce the amount of vegetation clearing are required, if all the vegetation is to be cleared justification is required as to why this is necessary. 	
Terrestrial Fauna	<p>Vegetation and habitat clearing of up to 3037 ha has potential to impact on native terrestrial fauna including;</p> <ul style="list-style-type: none"> • 194 vertebrate fauna species • 19 species of conservation significance – 8 recorded on site • up to 5 species listed under EPBC Act. • 1 species listed under WC Act. • 6 Priority fauna species • up to 69 migratory bird species (39 recorded). • Stygofauna and troglofauna • short range endemics. 	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • the extent, timing, methodology and scientific rigor of surveys and therefore the validity of data and conclusion drawn from them; • potential impacts to fauna and their habitat, including threatened and protected species, in particular bilbies, Gouldian Finch; and bats; • scientific knowledge gaps on Golden Bandicoots, bilbies, White-bellied Sea Eagles and Masked Owls; • potential impacts on bilbies as a result of increases in predation through creating corridors for predators to move along, habitat destruction and degradation and road mortality; • potential impacts to short range endemics, in 	<p>Considered to be a key environmental factor see Section 3.4.</p>

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	<ul style="list-style-type: none"> • 27 species of ethno-biological significance; <p>through loss/decline of habitat availability and fragmentation</p> <p>Increased vehicle movement may result in increase fauna injury and mortality.</p> <p>Site disturbance and excavation may remove or disturb subterranean fauna habitat and alter hydrology, in turn affecting fauna.</p> <p>Open excavations may result in fauna injury and mortality.</p> <p>Light emissions, noise and vibration as a result of the BLNG Precinct may impact fauna behavior and movement.</p> <p>Groundwater abstraction, site disturbance and excavation for construction, groundwater abstraction operation, and the physical presence of the BLNG precinct may result in alteration of hydrology and hydrogeology which may impact groundwater dependant vegetation and hence fauna habitat.</p>	<p>particular the <i>Simoselaps minimus</i> (Dampierland Burrowing Snake) and <i>Lerista apoda</i> which are only found in the Monsoon Vine Thicket on the Dampier Peninsula;</p> <ul style="list-style-type: none"> • that there is a high degree of vertebrate endemism in the short range endemics in the Monsoon Vine Thicket which have not been adequately surveyed; • that the proposal may result in the extinction of unknown or unidentified species of short range endemics; • lack of consideration of the distinct fauna assemblages in the Monsoon Vine Thicket as opposed to pindan and open woodland; • the SAR identified both snails and millipedes which have potential to be new unnamed species or taxa; • the need for further investigation of the role of frugivorous birds and bats on the Dampier Peninsula and their role in thicket seed dispersal, and the impacts of the on Monsoon Vine Thicket and the complementary adjacent habitats in the JPP area on the provision of resources for frugivorous fauna; • impacts to migratory birds of the East Asian Australasian Flyway, and their habitat as a result of the proposal; • the regional assessment of migratory shorebirds is inadequate and the conclusions that James Price 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	<p>Non-routine discharges and spills have potential to impact on fauna.</p>	<p>Point is of low significance is unfounded;</p> <ul style="list-style-type: none"> • indirect and cumulative impacts to migratory shorebird habitat Roebuck Bay or Eighty Mile Beach (including from increased recreation use, storm water runoff, disturbance of hinterlands of Roebuck bay from new developments, increased vessel movement at Broome Port; disturbance to birds from low flying aircraft; increase urban runoff and wastewater increasing the risk of blue green algae and reduction of benthic invertebrates); • sensitivity of migratory shorebirds to subtle changes in the environment such as acid sulphate soil disturbance and at Willie Creek Wetland; and • the importance of migratory shorebirds as recognised under JAMBA, CAMBA, ROKAMBA, the Bonn Convention, EPBC Act and the <i>Wildlife Conservation Act 1950</i>; <p>The Department of Environment and Conservation raised concerns about:</p> <ul style="list-style-type: none"> • the level of detail provided to adequately assess the impacts, particularly threatened, restricted or endemic fauna potentially warranting additional protection, specific design or management provisions. <p>The Department of Environment and Conservation recommended:</p> <ul style="list-style-type: none"> • surveys in accordance with EPA Guidance 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>Statement No. 56 are undertaken prior to any ground disturbing activities (including for bats);</p> <ul style="list-style-type: none"> • surveys in accordance with EPA Guidance Statement No. 20 be undertaken for short range endemics prior to any ground disturbing activities; • surveys in accordance with EPA Guidance Statement No. 54 be undertaken for subterranean fauna prior to any ground disturbing activities; • potential impacts of open trenches and vessel strike of fauna be addressed through an appropriate condition requiring monitoring and management actions; • conditions be applied such that if monitoring identifies significant impacts (direct or indirect) to fauna either during construction or operation that investigations, reporting and remedial actions are required; and • that consultation is undertaken with DEC prior to any attempts to relocate fauna. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • no discussion is provided on the impacts of increased vehicle traffic as a result of the development on the road to and from Broome is provided in the SAR, which is highly likely to significantly increase fauna deaths. 	

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<p>Landscape Values (Soils and Geomorphology,)</p>	<p>Excavation of 5-20 m of topsoil within the Precinct area, blasting, excavation of bedrock where leveling is required, site contouring, removal and stabilization of dunes within area of precinct to link land to marine port area.</p> <p>Installation of site drainage, sediment and erosion control measures.</p> <p>Foundation preparation earthworks and ground stabilisation dependant on foundation construction methodology dependent on pending geotechnical assessments.</p> <p>Site disturbance and excavation may increase run off and erosion</p>	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • impacts on the coastline including destruction of pindan cliffs and coastal landforms as a result of shoreline crossings; • potential for erosion of Cable Beach as a result of the breakwater and dredging; • changes to vegetation as a result of the proposal making the coast more vulnerable to erosion; • the risks associated with Climate Change and the vulnerability of the area to erosion and extreme weather events (including storm surges) in the event of anticipated sea level rise. • the suitability of the site in relation to its elevation and protection from high tides, cyclones, storm surges; • uncertainty for building on pindan as a foundation; and • potential disturbance of acid sulphate soil. <p>The Department of Environment and Conservation raised concerns regarding;</p> <ul style="list-style-type: none"> • the potential direct and indirect impacts on flora, fauna and vegetation communities as a result of sand dune crossings, disturbance of acid sulphate 	<p>Considered to be a key environmental factor see Section 3.5.</p>

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>soils and alteration of hydrology;</p> <ul style="list-style-type: none"> • the potential to intersect the groundwater table during construction and earthworks; • the lack of information regarding the potential direct and indirect impacts associated with excavation, fill stabilization and amouring requirements for marine and terrestrial structures, the source of fill and associated quarrying, in addition to appropriate disposal of excavated material; and • the lack of information regarding emissions to be discharged to the terrestrial environment including acid sulphate soils, dust, and contaminated sites. <p>The Department of Environment and Conservation recommended:</p> <ul style="list-style-type: none"> • conditions be applied to ensure appropriate investigations, monitoring and management during construction and earthworks; and • conditions are applied requiring assessment and management of potential impacts of sand dune crossings including investigation and management of acid sulphate soils, alteration of hydrology including saltwater interface; appropriate reconstruction measures and risk management. 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
<p>Water Quantity and Quality (Surface Water)</p>	<p>Site disturbance and excavation for construction and operation, and the physical presence of the BLNG precinct may result in alteration of surface water hydrology.</p> <p>Potential impacts to groundwater dependant ecosystems (e.g. Monsoon Vine Thicket) and drainage basin communities, and aquifer recharge.</p>	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • the timing of the development of an ecological surface water requirements plan; • the frequency of heavy rainfall events increasing the likelihood of unplanned discharge events being transported to the marine environment or drainage basins; • the potential for acidification of lakes and streams; and • the potential for chemical deposition to affect Woganut springs which flow into the Yellow River and Coulomb Point Nature Reserve. <p>The Department of Environment and Conservation (DEC) raised concerns about:</p> <ul style="list-style-type: none"> • potential hydrological impacts as a result of physical presence of the proposal, sand dune crossings and water abstraction resulting in potential impacts to groundwater dependant ecosystems, riparian vegetation and species which utilise this habitat. <p>The DEC recommended:</p> <ul style="list-style-type: none"> • that conditions are applied requiring that hydrological investigations are conducted to determine impacts of the proposal prior to ground 	<p>Considered to be a key environmental factor see Section 3.6.</p>

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>disturbing activities. The results of such investigations should be used to inform monitoring, management, design, construction and operation of the precinct;</p> <ul style="list-style-type: none"> • that conditions require consultation with DEC regarding the assessment of impacts of groundwater abstraction on conservation values; and • that specific conditions be included to address potential impacts of a desalination plant should that option be pursued. <p>The Department of Water advised:</p> <ul style="list-style-type: none"> • that the main surface water issues associated with the precinct will be managed through the requirement to develop an ecological surface water requirements management plan and Construction Environmental Management Plan (CEMP); • the scope of the CEMP should be broadened or a separate operational management plan be developed to assist with best practice management of water related issues associated with the ongoing management of the precinct – in particular stormwater management which would not be covered in the operating strategy for the groundwater licence under the RIWI Act; and • the Better Urban Water Management Framework (WAPC 2008) is applicable to surface water 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>management, and ensures the total water cycle is considered at each stage of the planning process.</p> <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • sensitivity of surface water hydrology to the precinct is unknown; • it is unclear when this information gap will be filled and how the results will be used to inform the current assessment process; and • adoption of water use efficiency methods should be a priority. 	
Water Quantity and Quality (Ground Water)	<p>Water supplies for Precinct Activities including groundwater borefields and/or desalination infrastructure to produce up to 8Gl per annum.</p> <p>Water supply source being investigated includes options of:</p> <p>Desalination of seawater</p> <p>Desalination of saline aquifer (wallal/grant)</p> <p>Fresh water abstraction superficial (broome sandstone)</p>	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • the amount of water required by the precinct; • potential impacts to groundwater; • the lack of knowledge regarding the aquifers, regional systems, sensitivities and usage; • the inadequacy of investigations undertaken for the proposal; • potential impacts to the Broome town water supply and other groundwater users if aquifer recharge is reduced; 	Considered to be a key environmental factor see Section 3.6.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	<p>Potential Aquifers for source/impact are Quaternary Superficial Aquifer(s)</p> <p>Broome Sandstone Aquifer, Wallal aquifer and Grant Group (including poole Sandstone)</p> <p>Groundwater abstraction for construction and operation, site disturbance and excavation for construction and the physical presence of the BLNG precinct may result in alteration of hydrology and hydrogeology which may impact on groundwater quantity and quality.</p> <p>Potential impacts to groundwater dependant ecosystems (Monsoon Vine Thicket) and drainage basin communities.</p>	<ul style="list-style-type: none"> • the ability to predict long term impacts even where information is known; • the potential for contamination of groundwater; • the potential for saltwater intrusion; • the need for monitoring to ensure no unacceptable impacts occur; • impacts to water quality; • impacts to vegetation, in particular groundwater dependant ecosystems due to groundwater use and changes in water quality; • potential impacts of desalination, particularly on the marine environment, and lack of information regarding this option. <p>The Department of Water advised that:</p> <ul style="list-style-type: none"> • the proposal is located within both the Canning-Kimberley and Broome Groundwater areas; • identification of sustainable water supplies for the construction and operation phases of the project is a significant issue; • the groundwater management plan must include an options analysis of all potential water supplies which may include groundwater from the deeper Wallal and Grant Aquifers, water reuse recycling and desalination of sea water; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • further investigations are required to support licensing applications under the RIWI Act; and • the CEMP should identify techniques for water reuse and recycling, including stormwater capture and reuse, in order to reduce reliance on groundwater. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • further work is required to characterise existing groundwater conditions and is considered crucial to inform potential impacts; • it is unclear of the timing of these works and how the results be used to inform the current assessment process; • given options for groundwater abstraction are not finalised it is difficult to see how a robust assessment can be undertaken without the full details on potential groundwater uses and the associated impacts; • insufficient detail is provided on the presence of groundwater dependant ecosystems, given the highly sensitive nature of impacts to groundwater and the uncertainty around the impacts further work is required to inform Traditional Owners on the potential impacts; and • adoption of water use efficiency methods should be a priority. 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>The Shire of Broome advised:</p> <ul style="list-style-type: none"> that access to the Broome aquifer should only be made available to the precinct if there is absolute confidence that it will not in any way endanger the supply of water for the future growth and development of the town of Broome; and the Shire will further consider this matter when the details of water source and water usage for the proposed precinct are available. 	
<p>Terrestrial Ecosystem Integrity (Introduced pests and weeds)</p>	<p>Clearing of vegetation for the BLNG Precinct and associated infrastructure, may impact terrestrial ecosystem integrity through direct removal, edge effects and fragmentation.</p> <p>Groundwater abstraction, site disturbance and excavation for construction, groundwater abstraction operation, and the physical presence of the BLNG precinct may result in alteration of hydrology and hydrogeology effecting ecosystem integrity.</p> <p>Increased volumes of vehicles and machinery during construction and operation have the potential to introduce and further spread weeds and pests.</p>	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> the potential introduction of weeds; that the region is globally significant due to its grand landscapes, rare and endangered fauna and biodiversity; and there are few other places in the world with such high marine and terrestrial biodiversity where large areas of land remain uncleared and relatively pristine; where naturally functioning biological and hydrological processes continue without significant disturbance. 	<p>Considered as part of: Terrestrial Biota, see Section 4.0; Surface and Groundwater, see Section 3.6; and Other Advice, see Section 5.</p>

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	Alteration of the fire regime as a result of the BLNG precinct has the potential to impact on ecosystem integrity		
POLLUTION			
Air Quality (includes Greenhouse Gases, Dust)	<p>Construction and operation of the BLNG Precinct have the potential to produce particulate (dust) emissions and odour which may impact upon human health, amenity and vegetation.</p> <p>Emissions may be produced as a result of power generation, CO₂ removal at onshore LNG processing facilities, flaring, fugitive emissions and shipping movements and smoke as a result of altered fire regimes.</p> <p>Gaseous emissions will be produced as a result of the construction and operation of the BLNG Precinct including:</p> <p>CO; NO_x; organic compounds (VOCs and PAHs); SO₂; formaldehyde;</p>	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • the integrity of the data, adequacy and rigor of air emission studies and air quality modelling and assessments and therefore the conclusion drawn from them; • this proposal will be the single largest industrial source of emissions for BTEX ,Total VOC's and Oxides of Nitrogen in Australia; • concern industries in the light industrial area will be a source of toxic and criteria air pollutants, and will be considered derived proposals; • the ability to assess and predict impacts in the absence of background/ambient air quality data; • the use of Dampier ambient air quality to represent the Kimberley as this data suggests that the air quality in the area is close to exceeding the Ozone and PM₁₀ NEPM's and exceeds the PM_{2.5} NEPM Investigation level; • the precinct when added to existing sources in the area exceeds the the ozone NEPM by 10%, this is unacceptable particularly in combination with the 	Considered to be a key environmental factor see Sections 3.8 and 3.9.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	<p>acetaldehyde; O₃; heavy metals; and Greenhouse gases (such as CO₂, CH₄ and NO₂) 39MtpaCO₂-e.</p>	<p>high levels of PN₁₀ PM_{2.5} and respirable particulates (including nanoparticles);</p> <ul style="list-style-type: none"> • the proposal is an unacceptable to further burden a regional air shed that is already close to being compromised; • the modelling does not account for daily wind or seasonal wind variation, or heavy sea mist and their role in particle deposition and photochemical smog; • potential for regular fogs and dews to concentrate emissions on the coast; • emissions from construction activities have not been predicted; • regulatory capacity to enforce monitor and control emission and pollution levels; • impacts on communities and ecosystems as a result of cumulative emissions over the life of the project have not been adequately considered; • adequacy of consideration of cumulative impacts and the level of information available to assess the cumulative impacts of the industrial emissions to air and water; • specific pollution control measure s to reduce air toxics are not provided; • release of ozone and photochemical smog precursors which have the capacity to travel large distances; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • emissions include toxic and noxious gases including known carcinogens and; in particular benzene and toluene and VOCs; • benzene emissions will exceed NSW guidelines and European standards; • that Australia does not have air quality standards for the protection of public health for Benzene and VOCs; • health risks and impacts of emissions as a result of air emissions have not been adequately addressed; • that of the 944 products and 632 chemicals identified in LNG Processing only 353 have been investigated for long term health impacts, and that exposure rates are based on adults not children who are likely to be more susceptible; • impacts to Indigenous communities who are more vulnerable to air pollution, because of their cultural and spiritual practices in their country have not been adequately addressed in the SAR; • The NEPC Ambient Air Quality consultation recently detailed information which suggests that health is being affected by levels of air pollutants that are currently below the reporting standards and are typical of exposures of many jurisdictions in Australia. It is believed that the standards will be revised downwards to reflect this evidence and if so it is likely that the modeled ambient concentrations in the Kimberely will be exceeded; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • concern over the cumulative, additive and synergistic effects of combined pollutants. • fate of mercury from the precinct, there is no indication of how it will be handled/contained and safely processed/disposed of to ensure it does not become an environmental legacy; • the level of regulatory oversight that can be provided for major industrial plants in remote locations; • it is unclear how the government agencies will be monitoring compliance of ministerial conditions, licence conditions and conducting audits; • that emissions combined with bushfires and the wet season will create a hazard to Kimberly communities, • what contingencies would occur and how the community will be advised should conditions give rise to adverse air quality or amenity issues beyond the precinct boundary; • increased emissions during non-routine events may pose an unacceptable risk to the community; • a safe buffer distance for casual users of the area; • recreational activities will be affected by H2S rotten egg gas; • the impacts of air emission on water quality and the marine environment; 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • impacts to marine habitat from increases in local ozone due to nitrogen oxide and sulfur oxide emissions from the precinct resulting in dead zones, algal blooms, deposition of particulate matter and impacts to human health; • impacts of LNG processing chemicals to both humans and wildlife; • that winds will carry emissions over Derby, Broome to Beagle Bay, and Indigenous communities at certain times of year; • the proposed precinct will pose unacceptable risk to the public health of nearby settlements; • evidence of impacts to air quality is required within a 50 km radius; • atmospheric pollution and long term impacts of continuous emission of pollutants and chemicals produced as a result of LNG processing; • the amount of greenhouse gas which will be emitted, the facility will be the most pollution intensive LNG facility in the world emitting 0.65 tonnes of CO₂ for every tonne of LNG produced; • the lack of detail surrounding abatement plans; • lack of consideration for offsets in relation to greenhouse gas; • impacts to Australia's commitment to achieve 5% reduction in greenhouse gas emissions by 2020 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>and global emissions;</p> <ul style="list-style-type: none"> • unsubstantiated comments that LNG will reduce global greenhouse gas emissions by displacement, and even if it did they are outside the scope of Australian environmental legislation and cannot be considered in the scope of this assessment; • downstream impacts of carbon pollution from burning of LNG produced from the facility as a fuel source must be taken into account in the assessment; • concern about the application of WA EPA guidance on greenhouse gas, the proposal does not comply with best practice and carbon pollution reduction technology; • cumulative impacts from other proposed developments in WA; • the application of best practice bearing no relationship to climate science or the need to reduce emissions; and which include consideration of economics which is outside the scope of the EPA; • the possibility that geosequestration would be considered as a derived proposal; • the need for requirements for the proponent to commit to geosequestration to store its reservoir and processing greenhouse gas emissions and how this would be deployed safely against alternative 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>development options;</p> <ul style="list-style-type: none"> • conditions should be placed on the proposal to ensure it results in no net increase in carbon pollution; and • links between CO₂ concentrations and ocean acidification. <p>Public Submissions and environmental non government organisations recommended:</p> <ul style="list-style-type: none"> • monitoring of air emissions should include nitrogen compounds, BTEX and H₂S; • WA establishes an emissions control area to prevent and reduce toxic air emissions from ship smoke stacks; and • there be a requirement for geosequestration or other permanent abatement of reservoir emissions from all gas development <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • there is no reference to standards (or limits to emissions) for the measures, proposed conditions and derived proposal requirements in relation to air quality; • minimum limits should be set for each key atmospheric emission (including odour) as part of 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>the current process; and</p> <ul style="list-style-type: none"> • proponents should be required to demonstrate best practice initiatives have been adopted to improve on the minimum standards specified. <p>The Department of Environment and Conservation (DEC) advised:</p> <ul style="list-style-type: none"> • the SAR contained inadequate information regarding the potential air emissions to assess the likely impacts from a regulatory point of view or to determine which activities would require Licensing under Part V of the <i>Environmental Protection Act 1986</i>; • H₂S odours will exceed the NSW odour criteria and would need to verify the emission rates in a detailed study of individual plants and that the current modeled data should be reanalysed using criteria consistent with WA practice. • BTEX emissions require verification, ambient monitoring should be undertaken to ensure levels are below acceptable criteria, and if not further emission reduction controls need to be considered; and • global greenhouse gas abatement benefits of LNG may be misleading. Benefits should be discussed in the context of a lifecycle assessment and the proponent should acknowledge that global benefits will only be delivered for that portion of LNG that 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>displaces more carbon intensive fuels.</p> <p>The DEC recommended;</p> <ul style="list-style-type: none"> • that consideration be given to applying a carbon constraint to the proposal in the absence of a carbon pricing mechanism. 	
Light Emissions	Light emissions from both terrestrial and marine components of the proposal may impact on fauna including marine turtles and migratory birds.	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • the lack of specific measures to address light emissions; • potential impacts to turtles in particular disruption of nesting behaviours. • impacts to migratory birds as a result of lighting which is likely to be increased by the isolated nature of the light source; • lack of consideration of flight paths and migratory birds that travel in a NNW direction past James Price Point; • the need for further studies to determine shorebird behaviours; altitude gain and flight paths and the effects of lighting on birds; and • lack of knowledge of migratory bird routes and an assessment cannot be made without this data 	Considered as part of Air Emissions see Section 3.8.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>Public submissions and environmental non government organisations recommended that:</p> <ul style="list-style-type: none"> • conditions be imposed to minimise the impacts of lighting including: limiting the intensity and duration of lighting to that required for operations and safety; minimise flaring at night; installation of downward facing lights; and use bird friendly lights which radiate a limited part of the spectrum to reduce distraction to migrating birds. 	
Noise and Vibration Emissions	<p>Construction and operation of the precinct may result in impacts as a result of both marine and terrestrial noise and vibration.</p> <p>Terrestrial sources during construction include vehicle movements, site clearing and earthworks, piling and blasting and power generation. During operation sources include power generation, LNG processing facilities and flare systems</p> <p>Marine sources during construction include dredge vessels/works, port facility construction, pipelay, supply vessels, pile driving, helicopter operation, drill rig and jack up barges. During operation sources include dredging vessels/works, supply vessels, shipping vessels and support vessels.</p>	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • acoustic pollution from vessel movements • marine noise and vibration as a result of seismic blasting, drilling noise, offshore rigs. • impacts to marine life; • behavioral disruptions to marine fauna as a result of noise and vibration; • disruption to communication between whales; <p>The Pearl Producers Association raised concerns about:</p> <ul style="list-style-type: none"> • potential physiological damage to pearl oysters as a result of exposure to high noise sources. 	Considered as part of Marine Fauna see Section 3.1; and Air Emissions see Section 3.8.

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
Waste	<p>The precinct will result in the production of waste. Sources include domestic, green and hazardous waste from both terrestrial and marine activities, produced water and associated effluent for processing. condensed and other waste water from ancillary equipment, surface run off including oily contaminated water from process areas, brine water from desalination of saline water and sanitary wastewater (grey and sewage).</p>	<p>Public Submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> marine debris such as plastic litter and garbage released from oil rigs and associated infrastructure which can lead to ingestion or entanglement of marine species and provides synthetic substrates, smothers benthic fauna and beach infauna and damage to the ecosystem. <p>The Department of Environment and Conservation (DEC) raised concerns about:</p> <ul style="list-style-type: none"> the ability of the current Broome waste facilities to accommodate waste as it is already near capacity. <p>The DEC advised:</p> <ul style="list-style-type: none"> it did not consider there was adequate information to determine which activities would require Licensing under Part V of the <i>Environmental Protection Act 1986</i>. <p>The Shire of Broome advised:</p> <ul style="list-style-type: none"> it understands that the precinct does not intend to access existing water treatment facilities; the Shire is already on critical path for the development of a new waste management facility without factoring in any additional waste that may 	<p>Waste to be dealt with through management plans and in accordance with the appropriate regulatory requirements, including works approvals and licensing under Part V of the Environmental Protection Act 1986.</p> <p>Factor does not require further EPA evaluation.</p>

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>be generated by the LNG precinct; if Shire facilities are required provision will have to be made for the acceleration of planning and approvals of that facility to be able to accommodate the waste; and</p> <ul style="list-style-type: none"> • the Shire cannot give any undertaking that is can accept waste form he precinct to existing facilities. <p>The Department of Health advised that:</p> <ul style="list-style-type: none"> • there are concerns with the potential reliance of high occupancy camps on wastewater treatment and effluent disposal for long periods of time; • spray irrigation of treated effluent may not be effective due to saturation of local soils during the wet and reported groundwater sheeting during long periods of heavy rain; • the early development of comprehensive reticulated sewerage system for the accommodation precinct is encouraged; and • storage and trucking off site sewage from camps is not a preferred option; <p>disposal of sludge generated by WWTP requires consideration.</p>	
HERITAGE AND SOCIAL SURROUNDINGS			
Aboriginal Heritage	The precinct may result in impacts to Aboriginal heritage including:	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • potential impacts to aboriginal heritage at the site, 	Considered to be a key environmental factor see Section 3.7

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	<p>Loss of Species of ethno-biological significance and environmental heritage and conservation areas through clearing of vegetation and altered fire regimes.</p> <p>Site disturbance, and excavation and vegetation/habitat clearing both marine and terrestrial may impact upon sites of Aboriginal significance.</p> <p>Improvements to infrastructure and increased vehicle movements and increase in population may lead to increased access and risk to sites of Aboriginal significance both terrestrial and marine.</p> <p>Off site noise impacts may disturb areas of aboriginal significance and cultural practices, particularly in relation to the song line.</p> <p>Noise and Vibration may impact of marine factors of cultural value.</p> <p>Construction and operation may impact upon cultural-scape, and cultural and marine</p>	<p>some of which are unknown;</p> <ul style="list-style-type: none"> • Legislative framework to appropriately manage Indigenous heritage; • the process surrounding gaining of indigenous consent; • disregard for National Heritage listing status; • impacts to the cultural heritage of the Goolarabaloo-Jabirr Jabirr people; • impacts to the Lurujarri Heritage Trail and reconciliation values; • disturbance of burial grounds within the proposed port area. • impacts to the song cycle, the significance of which has been accepted in western law; • loss of access to the area for customary fishers • impacts to species of ethno-biologically important species in the Monsoon Vine Thicket; • focus for mitigation has been limited to one species <i>Terminalia ferdinandiana</i> because of its known commercial value , where there could be other species equally of value which have not yet been identified. Concern that emergence and development of other industries by the local aboriginal people may be impacted; • consultation with Traditional Owners along the WA coastline which may be impacted by marine 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
	<p>interest and may constrain access to visit, maintain and undertake cultural practices;</p> <p>Sediment deposition and turbidity may impact upon both physical characteristics of cultural heritage values within marine areas, and use/access to marine resources.</p> <p>Light emissions have potential to disrupt and alter activities and behaviors impacting on use/access to marine and terrestrial resources</p> <p>Introduced species may impact on both marine and terrestrial resources and ethno-biological associations.</p> <p>Atmospheric emissions may impact on Rock Art</p> <p>Groundwater abstraction resulting in alteration of groundwater levels may impact on cultural values and access to and use of traditional resources.</p>	<p>impacts, in particular migratory species;</p> <ul style="list-style-type: none"> • that the EPA cannot abrogate any of its responsibilities to any agreement between a private entity on a heritage protection agreement that has no status in law; • that the EPA should go to the same length to understand the culture here as it did for the Red Hill Quarry; and • that the National Heritage Assessment listing be considered as part of the assessment. <p>The Department of Indigenous Affairs (DIA) advised:</p> <ul style="list-style-type: none"> • inconsistent references are made with regard to the number of registered sites within the project area; • the document should state that ethnographic surveys of the areas will take place where required and section 18 processes under the Aboriginal Heritage Act 1972 (AHA) will be complied with; • it looks forward to involvement in the development of the Dampier peninsula Land use and Infrastructure Plan and associated reserve; • it is pleased with the proponents heritage consideration of the project; • the risk rating of additional 'stressors' that are likely to Impact on Cultural Values (Including Aboriginal Heritage) Part 5 pg 3-51 are not consistent with the 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>findings on cultural values and should be adjusted accordingly;</p> <ul style="list-style-type: none"> • the DIA should be consulted regarding the land tenure reform options. Protected Area status under the AHA may result in significant barriers to management; • supports the recommendation in the report for commercial proponents to monitor the social and economic impacts of their construction and operation over time using both quantitative and qualitative measures; • the State should receive monitoring which feeds into the precinct level monitoring to enable service requirements to be tailored appropriately. • is concerned that Community Development Employment Projects program is being phased out and many of the existing fledgling enterprises set up as part of these programs are dependant of the payments to supplement their income, it is recommended that the Education Training and Employment Strategy explore some way to continue to support these enterprises until they are self sufficient. • the DIA looks forward to receiving notification of the proposed "Air Monitoring Results and Emission Control Performance Report" to be submitted to the EPA and made publically available as it is possible that air quality could affect engravings, a matter of heritage concern, as well as public health. 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • the Indigenous Impact Assessment provides a raft of useful information concerning impacts on Aboriginal people; • it is noted that indigenous people will be given the opportunity to undertake ranger training, the DIA is also has the ability to train people to give them honorary warden status under the AHA, which will give them additional powers and knowledge. • 	
Visual Amenity	<p>Physical presence of the proposal will alter the landscape and impact upon visual amenity of the area.</p> <p>Changes to landscape as a result of altered fire regimes, vegetation and habitat clearance, site disturbance and potential changes in composition as a result of atmospheric emissions or introduced species may impact upon the visual amenity.</p>	<p>Public submissions and and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • impacts on visual amenity. <p>The Kimberley Land Council advised:</p> <ul style="list-style-type: none"> • potential impact on amenity value should impacts on coastal processes occur as predicted has not been addressed. 	<p>Not considered to be a key environmental factor.</p> <p>Factor does not require further EPA evaluation</p>
Dinosaur footprints	The proposal may result in impacts to fossilised dinosaur footprints.	<p>Public submissions and environmental non government organisations raised concerns about:</p> <ul style="list-style-type: none"> • impacts of the proposal on dinosaur footprints; • National Heritage listing status is not being taken into account; 	Considered to be a key environmental factor see Section 3.7

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<ul style="list-style-type: none"> • the adequacy of the surveys undertaken in terms of length, extent and expertise; • impacts to dinosaur tracks which are reasonably abundant at James Price Point, in all states of preservation, and are of considerable scientific interest and importance; • the importance of the Broome Sandstone as Australia's only known source of sauropod dinosaurs, and also include theropod and ornithopod footprints; • that Dinosaurian ichnology is a small and specialised field, and the reports prepared for the SAR did not have input from appropriate experts; • the adequacy of the surveys particularly with regard to the area of intertidal zone surveyed and the duration of the survey; • the fossils should be left in their natural context; • dinosaur trackways have been treated with scientific disregard; and • the full range of palentological resources have not been identified. 	
Other (including process, recreational fishing, mining, tourism and social)	The proposal may result in social impacts to the James Price Point area and its surrounds, including impacts to recreational and commercial fishing, local business,	<p>Public submissions and environmental non government organisations raised concerns with regard to the Strategic Assessment process about:</p> <ul style="list-style-type: none"> • the SAR does not meet the requirements of the 	Note: Many of these issues are outside the scope of the <i>Environmental Protection Act 1986</i> , and therefore

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	mining, tourism and culture.	<p>Bilateral agreement;</p> <ul style="list-style-type: none"> • the description of the proposal and its impacts are so deficient that no proposal would be able to be declared derived under either the State of Commonwealth process; • the need for a full review of the process and reassessment based on the original bilateral agreement and Terms of Reference to restore public confidence in the process; • the need for the proposal to be assessed at a level of Royal Commission including consideration of cumulative social, environmental and economic impacts, • none of the reports constitute compliance with the terms of reference, they are preliminary at best; • the use of primary base line data in SAR to project outcomes and create mitigation and management is scientifically fraught with danger and has the potential to be highly erroneous; • the SAR does not use a conventional approach to environmental assessment where robust objectives are informed by subsequent studies allowing for conclusions that can be tracked through an evidence chain and illustrate residual risk; • the lack of integration between studies, in particular between marine and terrestrial which reflects a poor understanding of the ecological processes that drive 	<p>cannot be considered by the EPA. The issues raised here are to be dealt with through other processes and by Government agencies and have been included here for completeness.</p> <p>Factor does not require further EPA evaluation</p>

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		<p>the regions biodiversity;</p> <ul style="list-style-type: none"> • the effects of the proposal on the environment have not been quantified to allow a reviewer to understand which effects are serious or not; • the scientifically based limits/thresholds of change and values have not been identified; • use of unclear terminology and non-transparent methodology in particular the use of factors (key and relevant) and aspects are not standard terminology and therefore it is unclear how they fit into a standard assessment approach; • biodiversity assets of the site and their role in the ecosystem, and thresholds for acceptable change have not clearly and comprehensively been identified; • the magnitude, timing , duration and frequency of likely effects (compared to existing conditions); • landscape level changes to biodiversity (structure, function and process) and consequence of changes in a local regional, national and international landscape have not been adequately predicted; • there have been few detailed biological surveys undertaken for the Dampier Peninsula; • studies undertaken for the SAR are too short term to adequately address the values of the area and impacts. Seasonal and annual variation should be addressed; 	

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		<ul style="list-style-type: none"> • all details necessary to assess impacts, including information regarding existing environment have not been provided; • best practice parameters have not been set for infrastructure of technologies to be permitted in and associated with the precinct; • general risk assessments in the SAR are subjective, and where threats are identified unqualified assumption are made about the potential risk which are counteracted by hypothetical risk mitigation actions that are not elaborated; • studies should be undertaken by a neutral third party. The preparation of the SAR by the proponent is a conflict of interest; • the fact that the State Government is the proponent, assessor and approver is a conflict of interest; • where studies indicated that further work was required this has not been done; • that the process allows for derived proposal to be approved without further environmental assessment; • the project should be assessed in its entirety to include activities in both State and Federal jurisdiction; • the rationale for the need to develop the precinct is inadequate; • many of the impacts and issues will be addressed 	

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		<p>by proponents at a future date and are unlikely to be adequately monitored, enforced or abate people's concerns;</p> <ul style="list-style-type: none"> • the number of future management plans, and that they will not be prepared until the derived stage and will not be subject to public or independent scientific scrutiny; • inability for the EPA and Ministers to make an informed decision due to inadequate information; • potential government influence on the EPA's decision; • time constraints in relation to retention leases interfered with the examination of suitable options and the adequacy of environmental studies; • political interference and corruption of the process undermining the transparency and correct EIA studies prior to decision making; • the conditions surrounding negotiations with the traditional owners particularly with regard to time, money, adequacy of information and threats of compulsory acquisition of land; • loss of public confidence in the assessment process, its findings or any approvals based on it. • the public was lead to believe that the SAR process would occur in parallel with the Commonwealths National Heritage Listing and Northwest Bioregional Planning process, and the State Kimberley Science 	

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		<p>and Conservation Strategy. These have not been combined with the assessment to ensure the full range of issues have been properly addressed;</p> <ul style="list-style-type: none"> • environmental, social and economic impacts as a result of the proposal; • the impacts of the proposal are irreversible; • the proposed offsets will in no way compensate for the impact at JPP and the industrialisation of the Dampier Peninsula; • governance and ability to manage impacts (social and environmental); • implementation of commitments and enforceability of management plans; • capacity for monitoring and compliance enforcement; • representation on the proposed management committees should be expanded to include eNGO's and the wider community; • the premise that the Kimberley will only receive royalties, Indigenous and regional benefits if project proceeds, as resources can and are already being provided under the royalties for regions program, as can be set aside regardless of where the gas is processed, including offshore developments; • the premise that the proposal will provide health, education and training opportunities as these should already be provided by the State 	

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		<p>Government;</p> <ul style="list-style-type: none"> • the premise that the proposal will prevent multiple developments of the coast as each of these would be subject to the approvals process; • that the land subject to acquisition by the government is 5 times larger than previously indicated was required for the precinct; • the proposal proceeding without Indigenous Consent as required by Terms of Reference; • feasible alternatives outside the Kimberley, including for the use of floating platforms or use of existing facilities or no development scenarios were not adequately considered; • the proposal will lead to the industrialisation of the Kimberley; • further large scale industrial processing facilities will be collocated or located within the vicinity of the precinct; • cumulative impacts were not adequately assessed at a local, regional or global scale; • all indirect activities and actions as a result of the BLNG Precinct should be considered as one assessment if it can't go ahead without them, i.e. Broome Port, Air Port Cape Leveque Rd; • the SAR is based on details of the foundation proponents proposal and does not include a detailed assessment of other users or downstream 	

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		<p>processing;</p> <ul style="list-style-type: none"> • the SAR is written at a technical level, spread over multiple volumes with references to a multitude of external documents which makes it hard for the average person to read, understand and critique; • individual reports are inconsistently cross referenced leading to confusion and questions about the rigor of the assessment – particularly with regard to all foreseeable risks of the proposal; • too many references to modelling work, survey work and management processes that is not yet published or easily accessible; • the size of the documentation and limited time provided to review; • the 12 week public review should not have commenced until the release of the Supplementary Information; • resources should be made available to NGO's to enhance capacity to participate in Community Reference Groups or wider consultation processes; • availability of hard copies of appendices to the SAR and limited internet access in Broome; • the adequacy of community consultation, in particular questions asked remain unanswered, supply of inaccurate information and not enough consultation undertaken with non-indigenous people; 	

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		<ul style="list-style-type: none"> • the need for a major disaster assessment; • that the studies do not take into consideration the potential impacts of cyclones, tsunamis or earthquakes; • that gas is being sourced from depths not previously sourced from; • that emergency procedure were not adequately addressed; and • it is unclear who would be responsible if a major incident were to occur and if the appropriate equipment will be available to deal with it. <p>Public submissions and environmental non government organisations raised concerns with regard to social impacts about:</p> <ul style="list-style-type: none"> • that compulsory acquisition of the land is a breach of the UN Declaration on the rights of indigenous peoples by the State Government; • impacts to the coastline which is important to the Goolarabooloo and is well documented and that a failure to understand this would violate the human rights of these people; • impacts to local Aboriginal communities, in particular less connection to country, culture and family; • loss of land and sea may have social, cultural and 	

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		<p>spiritual ramifications;</p> <ul style="list-style-type: none"> • the disproportionate impact to Indigenous people needs to be addressed; • division amongst traditional owners as a result of monetary pay off; • Indigenous education, training and employment benefits will not be realised; • specific information on the extent of local job opportunities is needed so that the social impacts and suggested options for mitigation can be assessed; • higher skilled Aboriginal workers will be drawn away from communities and leave skill shortages; • social impacts to Broome in particular additional pressure on social services; housing availability, increased house prices and cost of living, fire services and health system, schools; water and power supply and infrastructure; • impacts to small business, in particular competition for employment; • Government should hold a referendum or align with the majority of the Broome community who do not support the proposal or heavy industry in the Kimberley; • impacts to the culture of Broome, in particular turning into a mining town; 	

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		<ul style="list-style-type: none"> • the impacts of 8000 construction workers on Broome/Dampier Peninsula/Kimberley; • that the Waterbank Structure Plan which included future growth onto the Dampier Peninsula including small scale industrial development, residential areas and significant environmental areas, including James Price Point, was not considered; • negative economic impacts to Broome as a result of the proposal including widening of 'the gap' between class divisions; • negative health impacts such as increase in disease such as asthma, cancer, mental health, sexually transmitted diseases; family dysfunction, behavioral problems, abuse, suicide, drugs, alcohol and trauma; • social fallout and dysfunction as a result of imposed industrial development on a community; • Impacts to existing multi-cultural social cohesion; • Lack of real employment opportunities of Kimberley Aboriginal people and local Broome people due to lack of education and training; • the proposed benefits of the proposal will not come to fruition; • rehabilitation plans are proposed to be approved by the Minister for Environment. How will he be satisfied with the social or economic rehabilitation that needs to occur if the development takes place; 	

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		<ul style="list-style-type: none"> • the gas should be saved for future when higher in value and technology improvements mean it can be sourced in more environmentally friendly ways; • impacts to the remote, pristine and iconic Kimberley tourism brand and the image of Broome as an unspoiled nature based holiday town; • impacts to tourism as it is the largest employer (30%) in the region; • impacts to tourism that would provide more to the region in the longer term than the short term gains of the proposal; • impacts commercial pearling, trawling, charter fishing and whale watching operations in the marine environment adjacent to the precinct which make significant contributions to the regional economy; • the adequacy of the Tourism Impact Assessment (TIA); • lack of consultation throughout the Kimberley as it is a highly mobile population; • a specific and detailed TIA and plan is required for the health and safety of the already created sustainable tourism enterprise on the Peninsula/Kimberley and should be subject to consultation with the whole of the tourism industry; • the plan should demonstrate inclusiveness of sustainable tourism in Government Policy and recognition of the ongoing value of tourism to 	

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		<p>regional WA;</p> <ul style="list-style-type: none"> • consideration of impacts to the Dampier Peninsula and Gibb River Road is required which will potentially be adversely affected by heavy duty works and will have a flow on affect to the East Kimberley; • impacts to recreational fishing and boats; • impacts to community activities, and restricted access on the Dampier Peninsula. <p>Public submissions and environmental non government organisations recommended that:</p> <ul style="list-style-type: none"> • support for Kimberley land and sea conservation should be increased in areas such as the Indigenous Rangers and Indigenous Protected Areas Programs; • support for sustainable regional economic development projects should be increased; and • general baseline data of key indicator species should be collected now to determine the impact of the proposal in the future. <p>The Department of Indigenous Affairs (DIA) recommended:</p> <ul style="list-style-type: none"> • that future economic impacts be monitored and feed in to the housing and other proposed mitigation 	

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		<p>strategies, and the results be provided to Traditional Owners and the State;</p> <ul style="list-style-type: none"> • that the education, training and employment strategy be designed to incorporate lessons learned by the smaller locally based Registered Training organisations whose delivery methods incorporate learning styles preferred by indigenous people and their commitment to meet the needs of indigenous clients; • that the agreements between the proponent and Traditional Owners include provision for recruiting and retaining Aboriginal counselors and bolstering services provided to counter substance abuse, other education, social and youth services which will directly assist the Aboriginal community; • that the proposed project level Social Impact Assessment include an Indigenous component in consultation with Yawuru as Native Title Holders; • that the BLNG Precinct Indigenous Social Impact Monitoring and Management Board as recommended in the ASIA be established to address concerns regarding implementation of agreements between indigenous people and resource companies. Alternatively the composition of the recommended committees should include wider intergovernmental participation in monitoring the agreement, as well as continued Traditional Owner involvement; and also noted • are concerned regarding potential changes in cost 	

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		<p>of living to the Broome community.</p> <p>The Pearl Producers Association advised that:</p> <ul style="list-style-type: none"> • offsets of activities from related projects for the BLNG precinct by the development of the DEC Marine Management Plans for Roebuck Bay and 80 Mile beach will invariably impact other industries while exonerating the oil and gas industry; • the requirement for offsets admits impacts on adjacent areas and acceptance of liability for those impacts. Impacts to commercial industries should be acknowledged upfront; • the need for offsets contradicts statements that the impacts of the precinct are low; • that the area of Quondong to Columb point is a significant contributor to high quality pearl exports; • the need to rest or fallow pearl lease areas is not relevant in Australia, nor is the terminology 'final make up culture period'; • there are significant pearling interests throughout the Kimberley ; • concerns regarding potential displacement of pearling operations both directly as a result of specific developments and indirectly as a consequence of the imposition of environmental offsets; 	

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		<ul style="list-style-type: none"> • the findings in the SAR establish a benchmark for proponents in regard to meeting compensation or displacement claims from the pearling industry should future impacts on industry be attributed to the activities carried out by the LNG proponents during both construction and operation; • the SAR relies on the Fisheries Impact study which acknowledges that impacts of the precinct on the fishing and pearling industry are difficult to quantify due to lack of detailed research on environmental impacts; and • supports the development of a Fishing Industry Mitigation and Management strategy with the commercial and recreational fishers, and tourism operators which will enable co-existence with the LNG Precinct. <p>The Western Australian Fishing Industry Council advised:</p> <ul style="list-style-type: none"> • the findings in the SAR establish a benchmark for proponents in regard to meeting compensation or displacement claims from the commercial fishing, pearling and aquaculture industry should future impacts on industry be attributed to the activities carried out by the LNG proponents during both construction and operation; • the proposal will preclude access to the vicinity for some commercial fishers and will have, at the least, a temporary impact on fish habitats and stocks in 	

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		<p>the vicinity. This may impact on the viability of commercial fishing operations;</p> <ul style="list-style-type: none"> • there will be direct impact to the pearling industry; • there is uncertainty regarding the effect to commercial fishing and DSD and proponents should continue to liaise with intersecting and adjacent fishing operations to mitigate any impacts; • concerned that activities arising from indirect and related projects of the BLNG precinct will be offset by the development of DEC Marine Management plans for Roebuck Bay and 80 Mile Beach. These "offsets" often impact the commercial fishing, pearling and aquaculture industries while exonerating the oil and gas industry for environmental impacts. There are significant commercial fishing and pearling interests in these areas announced and they should not be compromised to offset impacts of the precinct; • notes that a feedstock pipeline is proposed within the limits of the Broome Prawn Fishery and will result in interference and exclusion of pearling trawl vessels. It is unclear if this should refer to prawn trawling vessels which will be precluded both during and after construction, while other fishing and pearling vessels will only be precluded during construction; • the BLNG Precinct intersects the Managed Mackerel Fishery and poses a direct impact to fishermen using the area. 	

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		<ul style="list-style-type: none"> • the Precinct area has been significant contributor to high quality pearl exports over last 15yrs and is crucial for holding juvenile pearl oysters after release from land based hatcheries; • supports the initiative for proponents of derived proposals to develop a fishing industry mitigation and management strategy with the commercial and recreation fishers and tourism operators to mitigate and manage impacts from the BLNG Precinct; • is of the view that more research is required into the current recreational fishing in the area in order to accurately assess the impacts associated with increased recreational fishing in the area as a result of the BLNG Precinct; • that impacts of risks to fish stocks as a result of increased recreational fishing needs to be addressed and strategies to mitigate impacts identified; • recreational fishing from commercial oil and gas infrastructure and /or vessels is not supported; • is concerned about the methodology analysis and findings of appendix D4, particularly with respect to the Broome Prawn Fishery; and • the SAR was cumbersome and repetitive and the review period too short to acquire proper technical expertise. 	

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		<p>The Department of Training and Workforce Development advised:</p> <ul style="list-style-type: none"> • it supports the objectives and outcomes the proposed strategies in relation to education, training and employment, and Indigenous workforce development. <p>Woodside advised:</p> <ul style="list-style-type: none"> • of its Indigenous Communities Policy which it has applied in its engagement with Indigenous people in the Kimberley; • of its Reconciliation Action Plan (RAP) which it reports against annually; • of its engagement with the west Kimberley Indigenous community since 2007 regarding a suitable site for the LNG development; • of its continued negotiations following the signing of the Heads of Agreement Act (HoA) in 2009 by Woodside the State Government and the Goolarabooloo - Jabirr Jabirr people; • independent work has been commissioned into Indigenous capacity in the Kimberley to build on the ASIA done for the SAR; • has structured a communication process to ensure engagement, and works through communication and consultation to understand how the LNG 	

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		<p>precinct may impact on local heritage and culture;</p> <ul style="list-style-type: none"> • Woodside undertake cultural awareness training, and a program will be tailored for the Browse LNG precinct; • its support of the Repatriation Program and the Yiriman Project in accordance with its 2 year agreement with the Kimberley Aboriginal Law and Culture Centre; • its commitment to Native Title and regional benefits, training and employment and support for Indigenous businesses under the HoA; • its sustainable communities policy to address the social and economic effects of Browse; • a Browse Social Impact Assessment will build on the SAR and focus on project specific impacts and opportunities from their development resulting in a Social Impact Management Plan; • the precinct is expected to be predominately FIFO so should not affect housing; • Woodside Category C activities will be managed consistently with SAR projects; • Woodside the Western Australian Fishing Industry Council and Pearl Producers Association have established a marine users working group; • its focus on local employment opportunities and economic benefits; 	

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		<ul style="list-style-type: none"> • a consultation process with the Broome Shire and community has been established; • a Community Grants Program has been established; • \$80 million has been invested in environmental studies to support both their development and the SAR; and • of support for the commitments and proposed conditions in the SAR so far as they relate to a proponent in the precinct. <p>The Department of Health advised that:</p> <ul style="list-style-type: none"> • health and wellbeing can be influenced by environmental change including new developments; • a Health Impact Assessment should form part of these assessments; • WA Health has established procedures for new developments; • the EPA has limited authority to assess social issues and there is no information on how the information and recommendations developed for the SIA are to be incorporated into the decision making process; • health issues raised in the ASIA and the SIA do not align well and clarification is required on some issues, if this is done within the decision making 	

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		<p>process it is important to address health implications appropriately through further consultation and planning with and among key stakeholders;</p> <ul style="list-style-type: none"> • the revised Health Pesticides Regulations 2011 should be noted and implemented at the BLNG Precinct; • any on-site fumigation requires a wash down facility and the proponent should consult with WA Health and AQIS regarding requirements under Pesticide Regulations and AS 2476:2008; • risks associated with pesticides and fumigants include chemical spills, leaks and misapplication; appropriate control measures are required to ensure public health and environmental impacts are minimised during such events or emergencies; • the proponent should develop an integrated mosquito and nuisance insect management program and implement suitable control measures before construction or on ground works begin; • the proponent must also clearly indentify its management responsibilities and times frames within which they must be completed and provide these to WA Health; • proposals will need to address the Australian Drinking Water Guidelines 2004; • development of Drinking Water Quality Management Plans and establishment of a water 	

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		<p>quality reporting procedure with WA Health is required;</p> <ul style="list-style-type: none"> • the use of rainwater tank collection to supplement the Water Supply in Broome if scheme water supplies are insufficient is not a reliable option for the townsite; • the mechanisms to be used for decision making by Government and setting conditions arising from the SIA and ASIA and the outcomes and subsequent management requirements should be made public; • the social management committee identified in the precinct management structure should have representation on the BLNG Precinct Control Group; • the Kimberley Health Sector is represented on the Social Management Committee with the decision for representation made through recommendation from KAHPF; • that the Plan of Work for the Social Management Committee include a requirement for ongoing consultation between the KAHPF and the KLC on health and wellbeing objectives and strategies; • that the Government should acknowledge the importance of, and endorse a review of the SIA process for the BLNG Precinct to assess and document learnings for use in future assessments; • diversion of greywater to increase capacity of Broome WWTP would require additional substantial 	

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		<p>treatment infrastructure;</p> <ul style="list-style-type: none"> • the proponent should be aware of operation, treatment processes and ongoing monitoring obligations associated with a recycled water scheme; • consideration is required as to where the volumes required to be diverted to increase the WWTP capacity would be treated and recycled. While industry is suggested it is not clear these flows can be absorbed. Industrial use can also necessitate the high treatment of wastewater to ensure it is fit for purpose; • the draft Alternative Water Supply Guidelines - Storm Water and Rainwater and the Guidelines for the Use of Recycled Water in Western Australia should be referred to; • increased nutrient loading as a result of wastewater discharge to the marine environment and the potential significance of algal blooms or phytoplankton numbers that could affect primary (swimming or fishing) or secondary contact (fishing or boating) recreational activities and needs to be addressed; • there is potential for an increase of shellfish poisoning by algal species; • it has previously recommended monitoring of the distribution and abundance of phytoplankton located in the oceanic waters of the Kimberley and 	

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		<p>Canning bioregion;</p> <ul style="list-style-type: none"> • recreational water quality monitoring should be undertaken in accordance with the NHMRC 2008 guidelines for managing risk in recreational waters and the ANZECC and AMCANZ 2000 Guidelines as relevant; • water samples should be analysed for phytoplankton species known to produce toxins which may be concentrated in shellfish - concern is with regard to food poisoning; • trigger cell counts for each type of toxic phytoplankton have been established at levels where appropriate action should be taken; and • consideration should be given to the implementation of a Smoking Management Plan for the precinct. <p>In relation to Indigenous Communities the DOH recommended:</p> <ul style="list-style-type: none"> • that a sealed road be provided from Broome up to the Peninsula to allow for all weather access and reduce need for 4WD and additional expenses; • a freight subsidy be provided for nutritious food to be delivered to community stores; • enhance waste management services be enhanced; and • waste water ponds be designed to ensure effluent 	

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		<p>does not leak into surrounding country and wetlands, particularly in the wet season; and</p> <ul style="list-style-type: none"> • better management of internal community roads and provision of footpaths emergency services cafe/tearooms at Ardyaloon for employment and business opportunity, and covered sporting facilities to encourage physical activity. <p>The Kimberley Development Commission advised that:</p> <ul style="list-style-type: none"> • a regional benefits package is required to be established to provide contributions to necessary community infrastructure that will enable the whole community to gain lasting benefit from the project. However, there is no visible mechanism in place to ensure regional benefits are captured and monitored. Monitoring and Reporting are required; and • lack of engagement with the Yawuru people is a concern and a strategy to rectify this is required. <p>The Chamber of Commerce and Industry advised:</p> <ul style="list-style-type: none"> • it strongly supports the proposal; • the proposal will deliver significant benefits to the state; • the Browse Basin is one of Australia's most hydro- 	

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		<p>carbon rich basins and holds recoverable gas reserves of approximately 35 trillion cubic feet;</p> <ul style="list-style-type: none"> • it is concerned that the existing assessment framework will be overwhelmed by vocal and populist arguments against development, which jeopardizes WA' reputation as a desirable location for major investment; • the benefits of a common user framework which improves economic viability and reduces duplication of infrastructure, limits and manages the impacts on the regions environment, social and heritage sensitivities; • they acknowledge the unique environmental and heritage qualities of the Kimberley, but believe that industrial development and the environment can coexist; • the precinct site was chosen following and extensive evaluation; • while development can poses risks to the local indigenous population they can be controlled and mitigated – they are not unmanageable; • the development also presents opportunities to local indigenous populations and can ease existing social pressures in the region; • Tourism and LNG development are not mutually exclusive; • The BLNG Precinct is unrelated to other industrial 	

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		<p>proposal in the region which would be subject to separate assessment processes; and</p> <ul style="list-style-type: none"> • Natural gas is a cleaner energy source than more carbon intensive fuels and can assist Australia and the world to a less carbon intensive future. <p>The Kimberley Land Council advised that:</p> <ul style="list-style-type: none"> • the SAR is considered seriously deficient in many respects such that it cannot provide a basis on which relevant Ministers can take decisions in relation to the Precinct; • the SAR fails to develop management strategies or plans to avoid or mitigate social or cultural impacts which are deferred to the derived stage, as a result it is impossible to judge whether the impacts can be avoided or mitigated; • the SAR does not present detailed and specific measures or management arrangements for managing potential impacts on indigenous people and culture as required by the Terms of Reference (TOR); • the SARs proposals for avoiding or mitigating the potential social and cultural impacts of the precinct are entirely inadequate and unacceptable; • the Indigenous Impact Assessment Reports commissioned for the purpose of managing social and cultural impacts were undertaken by appropriately qualified and experienced persons in 	

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		<p>accordance with the TOR;</p> <ul style="list-style-type: none"> • the Indigenous Impact Reports include findings and recommendations that are reliable, valid, and the recommendations are justified, and justifiable by the TOR; • the recommendations of the Indigenous Impacts Report, have been largely ignored and not rationale is provided for doing so. If the proponent is of the view that the findings or recommendations are not justifiable, or do not meet the TOR, the proponent should undertake further assessments for the SAR; • proposed management structures for the precinct: <ul style="list-style-type: none"> ○ deny any effective representation to Traditional Owners and other affected Indigenous people. ○ focus heavily on operations rather than impact management ○ are controlled by State Government agencies with no specific expertise in cultural, social or environmental management; • proposed management arrangements and structure are inadequate as they: <ul style="list-style-type: none"> ○ fail to identify a government entity capable of managing social impacts; ○ focus on the management of the precinct rather than wider social issues; ○ give Traditional Owners no role in decision making, because the management committees 	

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		<p>they are on are advisory only;</p> <ul style="list-style-type: none"> ○ the SAR does not accept the ASIA's recommendations, many of which constitute specific measures or management arrangements, but rather state that they will inform later development of management strategies; ○ the SAR assumes a single measure – operating the construction camp as a managed access facility will allow many potential social impacts to be avoided or mitigated. There is no basis for this assumption. ○ the SAR discussion of Indigenous Consent omits critical information and does not adequately address the issue of whether Traditional Owners have provided their consent to the BLNG Precinct in a culturally appropriate manner. <ul style="list-style-type: none"> ● the SAR does not develop standards for environmental outcomes that can be used in designing the precinct facilities and in monitoring and evaluating the environmental impacts; ● management and mitigation measures proposed to address the impacts of the plan and actions cannot be justified by reference to the findings and recommendations of the impact assessment reports; <p>it is not appropriate for the proponent to adopt a high level strategic approach to the SAR where this</p>	

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		<p>does not meet the TOR;</p> <ul style="list-style-type: none"> • the management and mitigation particularly in relation to social, heritage and cultural impacts on Indigenous people and culture rely largely on agreements that are in place or the process of being negotiated by the State, the Foundation Proponent and the registered native party represented by the KLC – the Head of Agreement, the Heritage Protection Agreement and Indigenous Land Use Agreement as contemplated by the HOA. Due to confidentiality constraints it is not possible for the relevance or effectiveness of these to be properly considered by any person reviewing the SAR or Ministers making decisions; • reliance on the agreements does not satisfy the TOR which requires detailed and specific management and mitigation measures, and an opportunity for the public to comment on these measures as incorporated in the SAR; • the Heritage Protection Agreement (HPA) may have limited relevance during construction; however it is not relevant to the management of heritage impacts of the precinct during operations and decommissioning; • the HPA is not relevant to, and is inadequate to address the cultural heritage impacts of the Precinct as identified in the Indigenous Impact Reports; • the Commonwealth Minister must be satisfied in relation to all of the matters in the TOR, this is not 	

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		<p>clear in Part 6 of the SAR;</p> <ul style="list-style-type: none"> • the SAR provides an accurate summary of the ASIA's findings on existing social and economic conditions of the area of impact, and of the concerns and aspirations expressed by the Traditional Owners and other affected Indigenous people in relation to the precinct through the ASIA consultations; • the proponent was advised of the issues the KLC saw as major problems in the approach to the SAR in the 12 months prior to its release in both written and verbal form; • a "managed access" facility is not considered to address a lot of the precincts social impacts, including impacts on the Dampier Peninsula communities, and there is no basis for the assumption it will; • a "managed access" will do nothing to address issues associated with increased rate of Broome's population growth and visitor numbers to the Dampier Peninsula, pressure on costs of living, impacts of easier access to the Peninsula, and rising incomes on social issues such as substance abuse; • no indication is provided as to what will happen if proposed strategies to minimise social impacts are not effective or how it will be determined if they are working; • the proposed "Management Strategies" express goals without any indication of how these will be 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>achieved. This concern is in relation, but not limited to, impacts on marine resources, education, employment and training, housing, and invasive marine species;</p> <ul style="list-style-type: none"> • outcome based conditions have not been adopted for social issues consistent with the approach to determine if environmental impacts are acceptable; and • the SAR fails to quantify or address come critical environmental impacts and issues in particular the effects of groundwater extraction, dredging and cumulative environmental effects and associated economic activities. <p>The Department of Planning advised</p> <ul style="list-style-type: none"> • there is limited assessment or discussion on how successfully impacts can be managed through the proposed management strategies. • the SAR is unclear on the planning approval processes. It is understood that the proponent is considering 3 options <ul style="list-style-type: none"> ○ A state Agreement where various 'Heads of Power' legislation, including planning, are effectively signed over to the Minister for Planning; ○ An improvement plan under the Planning and Development Act 2005 which transfers approval responsibility from the Shire of 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>Broome to the Western Australian planning commission; and</p> <ul style="list-style-type: none"> ○ The zoning of land as a 'Strategic Industrial Area' under the Shire of Broome Town planning Scheme, thereby requiring approvals for use and development of the land to be issued by the Shire. • the Shire of Broome Town Planning Scheme would facilitate the zoning of a land use 'buffer' area surrounding a strategic industrial and establish which, if any land uses could be considered within this 'buffer', however if the intent is to use a State Agreement or improvement Plan, this will not occur and consideration will need to be given to achieving and regulating separation distances; and • the Shire of Broome Local Planning Strategy supports the findings of the Social Impact Assessment that there is an adequate supply of zoned land to support both residential and industrial demand, however the SIA does not provide strategies to ensure that appropriate housing is provided for workers that does not complete with housing for Broome residents, or the short stay tourism market. <p>The Shire of Broome advised that the social impacts assessment has not adequately addressed:</p> <ul style="list-style-type: none"> • Provision for general practitioner sustainability in 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>Broome;</p> <ul style="list-style-type: none"> • Expansion of youth engagement programs that promote community pride and citizenship; • Completion of a waste management assessment and provision for the development of a new resource recovery eco-industrial park; • establishment of a coastal development fund and coastal access plans; • sufficient resourcing to the Shire of Broome to enable an adequate level of service to the community and resource sector, in particular with regard to staffing levels, equipment and information technology, and office accommodation, infrastructure and services during the development and operational phases • inclusion of the Shire as a key stakeholder in: <ul style="list-style-type: none"> ○ the planning and management for the implementation of industrial development in or adjacent to the Shire; ○ the implementation of any State Agreement Actor alternative mechanism related to the development of the precinct including rates; service levels, special disability factors to be applied to grants and enhancement funds and industry co0ordinating committee; ○ the precinct control group, with appropriate resourcing for involvement in the development and monitoring of various management 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>strategies;</p> <ul style="list-style-type: none"> • disadvantages to the Shire by Landcorp and other State Trading Enterprises not paying rates; and • resourcing for enhancement scheme for the Chinatown to protect and maintain the character of Broome. <p>The Shire of Broome advised:</p> <ul style="list-style-type: none"> • of importance of various management plans; • they wish to be involved in the preparation and assessment of future detailed proposals; • that the managed access camp must be properly managed and the Shire involved in monitoring the impacts; • they require involvement in the development and implementation of any socio economic strategy and resourced accordingly; • a regional economic impact model is an essential component that has not been addressed at this stage; • of difficulty in assessing the economic benefits and impacts as there has been no attempt to quantify them; • affordability and access to housing is critical to the local community, a continued ready supply is needed into the future as a perceived shortage 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>would have an immediate impact;</p> <ul style="list-style-type: none"> • additional planning and engineering resources are required to carry out their responsibilities in the land supply process; • they require involvement in the development, implementation and monitoring of the strategy to manage impacts on housing and supply costs; • the existing power generating facility has the capacity to be expanded on an incremental basis and there is adequate land available for that expansion to occur; • the provision of reticulated gas to the Shire has not ever been seriously contemplated or any cost benefit analysis undertaken, reticulated gas provision would be welcomed if it is shown to be economically viable; • the Shire supports any improvement to the telecommunication facilities and services to the town and considers the precinct may assist in such improvement • the Shire does not support the use of Manari Road for access to the precinct during construction and operation; • access to the precinct from Broome Road will become the responsibility of MRWA and may affect the Shire's road grant funding; • any increased usage of the port of Broome may 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>necessitate the upgrading of facilities;</p> <ul style="list-style-type: none"> • the airport is critical to the town, the future airport site should be vested with the Shire to ensure it is available when required; • increased usage of the airport has the potential to adversely affect amenity in the town and the progress of an agreement on the timing and programming of the relocation of the airport to the new site is fundamental to managing these impacts; • the Shire expects that the State will ensure the delivery of health services in town will be maintained at an acceptable level • the Shire understands primary health care will be provided at the precinct minimizing any impact on existing facilities; • additional demand of the precinct may aggravate existing difficulties the town faces in the provision of general practitioners; • measures to improve employment, education and training opportunities are supported. It is suggested that Broome become a centre of education and technology; • recommends that camping grounds be established between Willie Creek and Quondong to cater for existing and increased demand; • the BRAC development plan needs review and programs of facility development are required to 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>ensure facilities are adequate for an expanded population and increased demand;</p> <ul style="list-style-type: none"> • measures are required to manage FIFO workforce in a manner that will not be detrimental to the character of the area; • Indigenous tourism on the Peninsula requires development of an overall strategy to ensure it is able to be managed in a manner appropriate to its capacity; • measures are required by land managers on the Peninsula to ensure they can implement the necessary controls over access and parking; • the Shire will continue to support tourism as one of Broome's Key industries; • the provision of appropriate management and security should ensure minimal impact on the Shire's ranger services, these issues should be monitored to ensure appropriate and effective management measures are implemented; • impacts from additional demand on the airport roads and port during construction can be minimised through the development and implementation of appropriate strategies; • considerable work is required to establish an appropriate level of understanding between the various components of the Indigenous community, commonwealth, state and local government, precinct proponents and the local community of the 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		<p>particular roles and responsibilities of the various parties, if these roles and responsibilities are not properly defined there is a high risk of the undertakings not being fulfilled. Necessary resources need to be available to enable the parties to properly carry out their responsibilities;</p> <ul style="list-style-type: none"> • inclusion of consultation with Yawuru is an integral part of the consultation process; • the Shire expects to be engaged on any aspects arising from the Heads of Agreement that would require actions or commitments from the Shire or that may impact the broader community; • the Shire is concerned that consideration may be given to issues of service delivery and infrastructure and land tenure which could impact the delivery of services in the Shire and resource requirements, without adequate consultation; • The Shire should be actively involved in the Dampier Peninsula land use and infrastructure plan as it will directly impact Shire infrastructure and services; • the Shire should be involved in consideration of creation of new reserves by the State, particularly with regard to fire and weed management issues; and • any buffers of special control areas should be identified in the Dampier peninsula Plan and be able to be incorporated in the local planning scheme; this plan should also include a robust 	

Preliminary Environmental Factors	Proposal Characteristics	Government Agency and Public Comments	Identification of Key Environmental Factors
		tourism strategy for the Peninsula addressing location access services and standards.	

PRINCIPLES		
Principle	Relevant Yes/No	If yes, Consideration
<p>1. The precautionary principle</p> <p><i>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</i></p> <p><i>In application of this precautionary principle, decisions should be guided by –</i></p> <p><i>(a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</i></p> <p><i>(b) an assessment of the risk-weighted consequences of various options.</i></p>	YES	There is uncertainty over the level of impact to the marine and terrestrial environment; however studies undertaken are sufficient to demonstrate that environmental impacts will not be significant on a regional scale provided mitigation measures as well as opportunities for environmental offsets are implemented.

		Impacts to marine environmental quality, benthic primary producer habitat, marine fauna, terrestrial biota, landscape processes, surface and groundwater, air quality, heritage, air emissions and greenhouse gases are considered in the assessment and a precautionary approach adopted.
<p>2. The principle of intergenerational equity</p> <p><i>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</i></p>		
	YES	<p>The proposal has the potential to impact on access by future generations to natural values and Aboriginal and paleontological heritage. Heritage is considered in the assessment</p> <p>The proposal would emit a large quantity of greenhouse gases that has the potential to affect the options available to future generations. Greenhouse gases are considered in the assessment.</p>
<p>3. The principle of the conservation of biological diversity and ecological integrity</p> <p><i>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</i></p>		
	YES	<p>The proposal has the potential to impact upon already threatened species of marine fauna and terrestrial vegetation and fauna. Marine fauna and terrestrial biota impacts have been considered in the assessment.</p> <p>Studies have been undertaken at the site to assess the environmental value of areas which could be impacted by construction and operations and management plans will be developed and implemented as required. Although the marine and terrestrial environments will be disturbed, the overall biodiversity and ecological integrity of the region will be maintained.</p>

<p>4. Principles relating to improved valuation, pricing and incentive mechanisms</p> <p>(1) <i>Environmental factors should be included in the valuation of assets and services.</i></p> <p>(2) <i>The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</i></p> <p>(3) <i>The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</i></p> <p>(4) <i>Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.</i></p>		
	YES	The proponent should bear the cost of avoiding or abating pollution. Where environmental assets are lost, the proponent should bear the cost of offsetting those losses.
<p>5. The principle of waste minimisation</p> <p><i>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.</i></p>		
	YES	Emissions of greenhouse gas and pollutants to the air and marine environment should be avoided or minimised.

Appendix 4

Identified Decision-making Authorities and Recommended Environmental Conditions

Identified Decision-making Authorities

Section 44(2) of the *Environmental Protection Act 1986* (EP Act) specifies that the EPA's report must set out (if it recommends that implementation be allowed) the Conditions and procedures, if any, to which implementation should be subject. This Appendix contains the EPA's recommended Conditions and procedures.

Section 45(1) requires the Minister for Environment to consult with decision-making authorities, and if possible, agree on whether or not the proposal may be implemented, and if so, to what Conditions and procedures, if any, that implementation should be subject.

The following decision-making authorities have been identified for this consultation:

Decision-making Authority	Approval
Minister for Environment	<i>Wildlife Conservation Act 1950</i>
Minister for Mines and Petroleum	<i>Petroleum Pipelines Act 1969</i> <i>Petroleum (Submerged Lands) Act 1982</i>
Minister for Water	<i>Rights in Water and Irrigation Act 1914</i>
Minister for Transport	<i>Marine and Harbours Act 1981;</i> <i>Harbours and Jetties Act 1928;</i> <i>Jetties Act 1926;</i> <i>Port Authorities Act 1999</i>
Minister for Lands	<i>Land Administration Act 1997</i>
Minister for Indigenous Affairs	<i>Aboriginal Heritage Act 1972</i>
Department of Mines and Petroleum	<i>Dangerous Goods Safety Act 2004</i>
Department of Environment and Conservation	Works Approval and Licence under <i>Environmental Protection Act 1986</i>
Shire of Broome	<i>S162 Planning and Development Act 2005</i>
Broome Port Authority	<i>Port Authorities Act 1999</i>

Conditions

STATEMENT THAT A FUTURE PROPOSAL(S) IDENTIFIED IN A STRATEGIC PROPOSAL MAY BE IMPLEMENTED (Sections 40B and 45 of the *Environmental Protection Act 1986*)

Strategic Proposal: Browse Liquefied Natural Gas Precinct located at James Price Point as shown and delineated on Figure 1 attached to this Statement

Proponent: Minister for State Development

Proponent Address: 197 St George's Terrace, PERTH WA 6000

Assessment Number: 1730

Report of the Environmental Protection Authority: 1444

Pursuant to sections 40B and 45 of the *Environmental Protection Act 1986* (the Act), it has been agreed or decided that in the event of a declaration by the Environmental Protection Authority pursuant to section 39B of the Act that it is a derived proposal, a proposal to do one or more of the Developments, Activities, Operations or Changes in Land Use listed in Column 2 of Table 1 in Schedule 1 of this Statement and which was identified in the Strategic Proposal to which Report 1444 relates, may be implemented. Upon declaration that the proposal is a derived proposal, subject to the Minister for Environment's identification of relevant conditions under section 45A(3) of the Act, the implementation of the proposal shall be subject to the following implementation conditions and procedures:

Note: Words and expressions used in these conditions shall have the same respective meanings as in the *Environmental Protection Act 1986* or as provided for in Schedule 5.

1 Development, Activities, Operations or Changes in Land Use shall not exceed Limits/Extents in Table 1 in Schedule 1

1-1 Proposals referred to the Environmental Protection Authority and declared to be derived proposals containing one or more of the Developments, Activities, Operations or Changes in Land Use listed in Column 2 of Table 1, shall not exceed the Description of Limits/Extent, relevant to the Developments/Activities/Operations or Changes in Land Use provided for in Column 3 of Table 1.

Note: It may be that more than one proponent implements the Proposal identified in Table 1.

2 Proponent Details

2-1 The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within 28 days of such change. Where the proponent is a corporation or an association of persons, whether

incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.

3 Time Limit of Authorisation

- 3-1 The proponent must ensure that the Proposal is substantially commenced within five years of the date of the Section 45A Notice.
- 3-2 The Proponent shall provide the CEO with written evidence which demonstrates that the Proposal has substantially commenced on or before the expiration of five years from the date of the Section 45A Notice.

4 Compliance Reporting

- 4-1 The proponent shall continuously monitor its compliance with the implementation conditions and shall, subject to specific reporting requirements referred to in the conditions below, advise the CEO of any non-compliance or potential non-compliance within seven days of the non-compliance or potential non-compliance being known to the proponent.
- 4-2 The proponent shall submit to the CEO an annual Compliance Assessment Report, with the first Compliance Assessment Report addressing the 12 month period commencing from the date of the Section 45A Notice and being submitted on or before the expiration of 15 months after the date of the Section 45A Notice and with subsequent Compliance Assessment Reports addressing the 12 month period commencing one day following the date the previous reporting period ceased and being submitted on or before the expiration of 12 months from the due date for the submission of the first Compliance Assessment Report.
- 4-3 The proponent shall ensure that each Compliance Assessment Report is:
 - i. prepared in accordance with the Office of the Environmental Protection Authority's *Directions for Proponents – Preparing a Compliance Assessment Report*, as amended from time to time.
 - ii. accurate and includes the following information:
 - a. an audit framework prepared in accordance with the Office of the Environmental Protection Authority's *Directions for Proponents – Preparing an Audit Table*, as amended from time to time;
 - b. details of, including where relevant the extent of and impacts associated with, all non-compliances and potential non-compliances with the implementation conditions, which apply to the Proposal, within the preceding 12 month period;
 - c. all remedial and/or corrective action taken in respect of the non-compliance; and

- d. procedures, protocols, practices (“**measures**”) in place to prevent the non-compliance or potential non-compliance before it occurred and details of any amendments to those measures to prevent re-occurrence.
 - iii. signed by the proponent, if the proponent is an individual, or a person who is a director or the director’s delegate, if the proponent is a public body, company or association or body of persons, corporate or unincorporated.
 - iv. made available to the public in accordance with the Office of the Environmental Protection Authority’s *Compliance Factsheet 1 – Making Documents Publicly Available*, as amended from time to time.
 - v. retained and accessible for the life of the Proposal.
- 4-4 The proponent shall prepare and submit to the CEO, the audit framework referred to in Condition 4-3 within 60 days of the date of issue of the s45A Notice.
- 4-5 The CEO has the discretion, by notice in writing, to:
 - i. require the proponent to submit a Compliance Assessment Report more or less frequently than annually and alter the period addressed by the Compliance Assessment Report;
 - ii. alter the due date of the Compliance Assessment Reports;
 - iii. prescribe the manner in which Compliance Assessment Reports are made available to the public, should this be necessary; and
 - iv. where a Compliance Assessment Report contains trade secrets or documentation that would reveal information of a commercial value, the CEO has the discretion to waive the requirement to make any of the Compliance Assessment Report, in part or wholly, publicly available, should this be requested by the proponent.

5 Terrestrial Facilities and Disturbance Footprint Plan

- 5-1 The Proponent shall not undertake any ground disturbing activities or commence installation of the terrestrial facilities prior to having obtained the Minister’s approval, on advice of the EPA, of its Terrestrial Facilities and Disturbance Footprint Plan.
- 5-2 In seeking approval for the Terrestrial Facilities and Disturbance Footprint Plan, the Proponent shall submit the following information relevant to the Proposal:
 - i. a plan showing the proposed terrestrial facilities and disturbance footprint for:
 - a. the infrastructure / corridor developments and uses listed in Table 1, within 13 kilometres of the boundary of Area B, as

depicted in Figure 1 and defined by coordinates in Schedule 2;

- b. heavy industrial and supporting developments and uses listed in Table 1, within the boundaries of Area B shown on Figure 1 and defined by the coordinates in Schedule 2;
 - c. light industrial developments and uses listed in Table 1, within the boundaries of Area C shown on Figure 1 and defined by the coordinates in Schedule 2;
 - d. accommodation developments and uses, listed in Table 1, within the boundaries of Area D shown on Figure 1 and defined by the coordinates in Schedule 2;
 - e. the terrestrial component of the pipelines listed in Table 1, within the boundaries of Areas E or F shown on Figure 1 and defined by the coordinates in Schedule 2; and
 - f. the terrestrial components of the Integrated Marine Facility listed in Table 1, within the boundaries of Area A shown on Figure 1 and defined by the coordinates in Schedule 2.
- ii. spatial data in a format compatible with a Geographical Information System acceptable to the CEO;
 - iii. confirmation that the total area of terrestrial native vegetation cleared directly and indirectly as a result of the terrestrial disturbance proposed in the Terrestrial Disturbance Footprint Plan does not exceed the extent of clearing of terrestrial native vegetation permissible for the Proposal as set out in Table 1.
 - iv. confirmation that the total area of Monsoon Vine Thicket vegetation cleared directly and indirectly as a result of the terrestrial disturbance proposed in the Terrestrial Facilities and Disturbance Footprint Plan does not exceed 132 hectares.
 - v. the advice of the Browse LNG Precinct Control Group that the Terrestrial Facilities and Disturbance Footprint Plan meets the following criteria:
 - a. the proposed disturbance footprint ensures that the facilities' design meets best practice standards;
 - b. the facilities' design minimizes the disturbance footprint having regard to other likely future proposals;
 - c. the facilities' design provides for a sharing of infrastructure and services corridors so that the disturbance footprint from related future proposals is minimised;
 - d. the facilities design meets the State's needs for infrastructure sharing.
 - vi. the Terrestrial Baseline State Report required by Condition 6-1; and

- vii. evidence that relevant stakeholders have been consulted about the terrestrial facilities and disturbance footprint; been given a reasonable opportunity to comment and how their comments have been addressed.

5-3 The Proponent shall not cause or allow Material or Serious Environmental Harm outside of the terrestrial facilities disturbance footprint as shown in the approved Terrestrial Facilities and Disturbance Footprint Plan and shall ensure construction of the terrestrial facilities is consistent with the approved Terrestrial Facilities and Disturbance Footprint Plan.

5-4 The total area of Monsoon Vine Thicket vegetation cleared, directly and indirectly, as a result of the implementation of the Proposal, shall not exceed 132 hectares within the area delineated by a green bold line in Figure 3 and defined by coordinates in Schedule 2.

5-5 The total area of native terrestrial vegetation, other than Monsoon Vine Thicket vegetation, cleared directly and indirectly, as a result of the implementation of the Proposal, shall not exceed the values as set out in Table 1 of Schedule 1.

6 Terrestrial Baseline State Report

6-1 The Proponent shall not commence any ground disturbing activities or commence installation of the terrestrial facilities prior to:

- i. submitting a Terrestrial Baseline State Report to the CEO, and
- ii. receiving written notice from the CEO, having consulted DEC, that the Terrestrial Baseline State Report meets the requirements in Condition 6.

6-2 The Terrestrial Baseline State Report shall cover the following ecological elements:

- i. *Wildlife Conservation Act 1950* declared Rare Flora (Declared Rare Flora), Threatened Ecological Communities and other significant vegetation and flora; and
- ii. Specially protected (threatened) fauna, other significant fauna and habitat.

and must meet the requirements of condition 6-3 and 6-4 below.

6-3 The Terrestrial Baseline State Report shall:

- i. identify, define and map the pre-development baseline state for the ecological elements, referred to in Condition 6-2, inside and outside the terrestrial facilities and disturbance footprint, defined in the Terrestrial Facilities and Disturbance Footprint Plan, that

may be at risk of Material or Serious Environmental Harm due to the implementation of the Proposal;

- ii. identify, define and map the ecological elements at reference sites (see Condition 8-3), which are not at risk of Material or Serious Environmental Harm due to the implementation of the Proposal;
- iii. identify, define and map the likely threats to the ecological elements identified, defined and mapped in accordance with condition 6-3i, including clearing, emissions and discharges; and
- iv. define indicators, parameters and criteria to be used in measuring changes to the ecological elements outside the terrestrial facilities and disturbance footprint and the ecological elements reference sites (see Condition 8-3).

6-4 The Terrestrial Baseline State Report shall include:

- i. results of the further assessment of the likelihood and consequence of the impacts of the implementation of the Proposal's terrestrial facilities on the ecological elements identified in the Baseline State Report required by Condition 6-1;
- ii. details of the methodology used to survey, collect and collate the baseline data and information for all ecological elements identified in Condition 6-3;
- iii. a description and map of the ecological elements which are at risk of Material or Serious Environmental Harm outside the Terrestrial Facilities and Disturbance Footprint due to the implementation of the Proposal;
- iv. a description of existing areas of disturbance, including cleared areas, existing areas containing weeds and disturbed landscapes;
- v. spatially accurate, rectified and geographically referenced maps showing the baseline data and information for the ecological elements identified in Condition 6-3;
- vi. discussion of the data on the baseline biological, physical and chemical variables including any significant relationships, for the ecological elements identified in Condition 6-3;
- vii. ecological elements to be protected, such as Declared Rare Flora, threatened ecological communities, Threatened Species under the EPBC Act, habitats of specially protected (threatened) fauna and other significant fauna;
- viii. an analysis of, and procedures to address data and information gaps associated with the baseline data for the areas identified in Condition 6-4 iii;

- ix. a description and map of the ecological elements at reference sites in locations which are not at risk of Material or Serious Environmental Harm due to implementation of the Proposal; and
- x. evidence of consultation with the DEC in the preparation of the Report and in determining the methodology used to survey, collect and collate the baseline data and information referred to in Condition 6-3.

7 Terrestrial Environment Protection Program

7-1 The Proponent shall not commence any ground disturbing activities or commence installation of the terrestrial facilities prior to:

- i. submitting a Terrestrial Environment Protection Program to the CEO; and
- ii. receiving written notice from the CEO, having consulted DEC that the Terrestrial Environment Protection Program meets the requirements of Condition 7.

7-2 The Terrestrial Environment Protection Program must meet the following objectives:

- i. to locate the terrestrial facilities within the areas identified in Figure 1 to avoid and minimise the adverse impacts from the construction and operation of the terrestrial facilities as far as practicable;
- ii. to reduce adverse impacts from the construction and operation of the terrestrial facilities as far as practicable; and
- iii. to ensure that construction and operation of the terrestrial facilities does not cause Material or Serious Environmental Harm outside the terrestrial facilities and disturbance footprint identified in the Terrestrial Facilities and Disturbance Footprint Plan.

7-3 The Terrestrial Environment Protection Program shall include the following:

- i. management measures informed by the results of the assessment required by Condition 6-3 i to reduce adverse impacts (including from light and noise) from the construction and operation of terrestrial facilities as far as practicable;
- ii. management measures, triggers and strategies to ensure that the implementation of the Proposal does not cause Material or Serious Environmental Harm outside the terrestrial facilities and disturbance footprint identified in the Terrestrial Facilities and Disturbance Footprint Plan;
- iii. a clear demonstration that contemporary best practice has been used in the design, location, construction and operation of the

Proposal to minimise clearing and indirect impacts on Threatened Ecological Communities including Monsoon Vine Thicket vegetation; and

- iv. a regional survey, management measures, triggers and strategies to ensure that construction and operation of terrestrial facilities does not result in a reduction in the overall regional conservation status of the Greater Bilby (*Macrotis lagotis*).

7-4 The measures required by Condition 7-3 shall address but not be limited to:

- i. vegetation Clearing Audit Procedures to ensure the extent of clearing and rehabilitation can be determined on an annual basis;
- ii. procedures in relation to, and protocols for capturing, relocating, handling, housing, caring for and reporting specially protected (threatened) fauna, and other significant fauna found within the terrestrial facilities and disturbance footprint identified in the Terrestrial Facilities and Disturbance Footprint Plan;
- iii. procedures to avoid and mitigate secondary impacts to specially protected (threatened) fauna or other significant fauna including events such as fauna being trapped in construction trenches or subject to vehicle strike;
- iv. the Proponent reporting any specially protected (threatened) fauna or other significant fauna deaths within the terrestrial facilities and disturbance footprint as identified in the Terrestrial Facilities and Disturbance Footprint Plan attributable to the implementation of the proposal;
 - a. to the CEO within 48 hours of detection; and
 - b. in its Compliance Report required by Condition 4;
- v. management strategies and options to reduce the risk of disturbance, injury or mortality to individual Greater Bilbies (*Macrotis lagotis*) including things such as design and location of infrastructure, imposition of speed limits and curfews on vehicle movement in areas where evidence of Greater Bilby activity has been observed within the previous 12 months;
- vi. a translocation strategy developed in consultation with DEC where impacts to occupied Greater Bilby (*Macrotis lagotis*) burrows are unavoidable; and
- vii. performance standards against which achievement of the objectives of Condition 7 can be determined.

7-5 The Proponent shall report any Material or Serious Environmental Harm outside the Terrestrial Disturbance Footprint to the CEO within 48 hours of detection.

7-6 The Proponent shall advise relevant stakeholders of the opportunity to comment on a draft copy of the Terrestrial Environment Protection Program required under Condition 7-1 and provide those stakeholders at least 14 days to comment on the program before it is submitted to the CEO for approval under Condition 7-1.

7-7 The Proponent shall implement the Terrestrial Environment Protection Program which meets the requirements specified in these conditions.

8 Terrestrial Environment Monitoring Program

8-1 The Proponent shall not commence any ground disturbing activities or commence installation of any terrestrial facilities prior to:

- i. submitting a Terrestrial Environment Monitoring Program to the CEO, and
- ii. receiving written notice from the CEO, having consulted DEC, that the Terrestrial Environment Monitoring Program meets the requirements of Condition 8.

8-2 The objective of the Terrestrial Environment Monitoring Program is to establish a statistically valid ecological monitoring program to ensure the detection and immediate cessation of any Material or Serious Environmental Harm to the ecological elements outside the Terrestrial Disturbance Footprint.

8-3 The Terrestrial Environment Monitoring Program shall include:

- i. indicators, parameters and criteria to be used in measuring changes in the ecological elements identified in the Terrestrial Baseline State Report that are at risk of Material or Serious Environmental Harm due to construction and operation of terrestrial facilities;
- ii. protocols for on-going reporting of adverse changes to the ecological elements identified in the Terrestrial Baseline State Report;
- iii. Management Triggers linked to management measures set out in the program required under Condition 7-1 designed to prevent environmental harm;
- iv. protocols for identifying additional areas not originally identified that are at risk of sustaining Material or Serious Environmental Harm from the Proposal, and for adding monitoring sites to include these additional locations, if required;
- v. establishment of an ecological monitoring program based on tests using appropriate effect size(s) and that has statistical power values as approved by the CEO, to detect any environmental harm to the ecological elements identified in the Terrestrial Baseline State Report;

- vi. location of monitoring sites in areas that are at risk of Material or Serious Environmental Harm due to construction and operation of terrestrial facilities; and
 - vii. location of reference sites which will not be at risk of Material or Serious Environmental Harm due to construction and operation of terrestrial facilities so that they can serve as a basis for comparison with sites containing the same ecological elements at risk of Material or Serious Environmental Harm due to construction and operation of terrestrial facilities.
- 8-4 The Proponent shall implement the Terrestrial Environment Monitoring Program which meets the requirements specified in Condition 8.

9 Marine Facilities and Impact Zones Plan

9-1 The Proponent shall not commence any installation or maintenance of any marine facilities as defined in Table 1 in the Port Area; the Pipeline Corridor Areas or the Shipping Channel Area prior to obtaining the Minister's approval, on advice of the EPA, of a plan showing the Marine Facilities and Impact Zones (the "Marine Facilities and Impact Zones Plan") which meets the requirements specified in this condition.

9-2 In seeking approval for the Marine Facilities and Impact Zones Plan, the Proponent shall submit the following information:

- i. the advice of the Browse LNG Precinct Control Group that the Marine Facilities and Impact Zones Plan meets the following criteria:
 - a. the design of the marine facilities meets contemporary best practice standards;
 - b. the marine facilities design minimizes the area of marine impact having regard to other likely future proposals;
 - c. the marine facilities design provides for a sharing of infrastructure and services so that the marine impact zones are not extended and will not be exceeded as a result of the implementation of any future proposals; and
 - d. the marine facilities design meets the State's needs for infrastructure sharing.
- ii. the Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program (see Condition 10); and
- iii. the Report on the outcomes of the baseline State of the Marine Environment Surveys (see Condition 11).

- 9-3 The Marine Facilities and Impact Zones Plan shall:
- i. define the location and configuration of all marine facilities and Zone(s) of High Impact, Zone(s) of Moderate Impact and Zone(s) of Influence associated with installation, operation and maintenance of the marine facilities;
 - ii. include spatial data in a format compatible with a Geographical Information System, acceptable to the CEO, that defines the locations of all marine facilities and zones of impact and influence described above; and
 - iii. meet all the requirements specified in Conditions 9-4 to 9-7.

Note: The Zone of High Impact, Zone of Moderate Impact and Zone of Influence have meanings as defined in the EPA's Environmental Assessment Guideline No.7.

- 9-4 All marine facilities must be designed using contemporary best practice so as to ensure:
- i. environmental impacts are minimized and the Zone of High Impact is limited as far as practicable notwithstanding the specifications provided for in condition 9-5; and
 - ii. that all marine facilities are wholly located within the boundaries of the Port Area, Shipping Channel Area and the Pipelines Corridor Area shown on Figure 1 and defined by coordinates in Schedule 2.

- 9-5 The outer extremities of the Zones of High Impact defined in the Marine Facilities and Impact Zones Plan must be;
- i. less than 500 metres from the marine facilities located in the Port Area or Shipping Channel Area; and
 - ii. less than 500 metres from the centreline of any pipeline in the Pipeline Corridor Area

unless and until revised boundaries are approved by the Minister in accordance with Condition 10-8.

- 9-6 The Zone of Moderate Impact referred to in the Marine Facilities and Impact Zones Plan must be confined to an area bounded by a line extending two kilometres due south from Cape Boileau, then west to the State Waters boundary, and a line west from a point 3 kilometres south of Coulomb Point to the boundary of State Waters unless and until revised limits are approved by the Minister in accordance with Condition 10-8.

- 9-7 The Zones of High Impact, Moderate Impact and Influence defined in the Marine Facilities and Impact Zones Plan must be based on

outputs of impact simulation modelling that incorporate specific mitigation measures and contemporary best practice management of turbidity generating activities.

- 9-8 The Proponent shall ensure construction, maintenance and operation of the marine facilities achieves the following marine environmental protection outcomes:
- i. no irreversible loss of, or serious damage to, benthic habitats outside the Zone of High Impact shown in the approved Marine Facilities and Impact Zones Plan; and
 - ii. no detectable negative changes to benthic habitats relative to the baseline state of those habitats outside the Zones of High and Moderate Impact shown in the approved Marine Facilities and Impact Zones Plan.

Note: benthic habitats relevant to this Condition are those that include seagrass, filter feeders, algae or scleractinian corals as their major biological components.

- 9-9 The Proponent shall ensure that no dredge spoil is placed in State Waters.

10 Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program

- 10-1 The Proponent shall not commence any turbidity-generating activities or commence installation of or maintenance of the marine facilities, prior to:
- i. submitting a Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program to the CEO, and
 - ii. receiving written notice from the CEO that the Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program meets the requirements of Condition 10.
- 10-2 The Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program shall meet the following objectives for turbidity-generating activities which are part of the installation and maintenance of marine facilities:
- i. achieve the environmental protection outcomes specified in Condition 9;
 - ii. achieve management targets established under Condition 10-3; and
 - iii. reduce adverse impacts on benthic habitats by exercising all reasonable and practicable means.

10-3 The Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program shall include:

- i. a set of management targets for zones of impact defined in the approved Marine Facilities and Impact Zones Plan which the Proponent shall aim to achieve;
- ii. descriptions of monitoring sites in coastal waters and creeks, including key physical attributes, geographic locations and measures of the baseline condition indicators relevant to the benthic habitats to be monitored;
- iii. descriptions of the environmental variables to be monitored, and the monitoring and data evaluation procedures to be applied, for determining achievement of the environmental protection outcomes specified in Condition 9 and management targets required by 10-3 above;
- iv. the monitoring methodologies to be applied so as to:
 - a. measure relevant physical indicators (e.g. water currents, water quality conditions including turbidity, photosynthetically active radiation and light attenuation coefficient, and sediment deposition rates) at a frequency to allow near-real time dredge and dredge overflow management and the validation and calibration of numerical models that may be used to assist in the management of dredging activities; and
 - b. routinely measure biological indicators to inform adaptive environmental management;
- v. management trigger indicators and values for relevant physical and biological indicators to be applied in a risk-based tiered approach for the management of the environmental impacts of turbidity generating activities which are part of the construction and maintenance of marine facilities;
- vi. evidence demonstrating that the monitoring required to assess achievement of the management targets required by 10-3 above, is based on tests using appropriate effect size(s) and has statistical power values, as approved by the CEO;
- vii. management actions that will be implemented in the event that the management trigger values required by Condition 10- 3 v are not met;
- viii. methods and procedures that will be implemented to regularly characterise, spatially-define and report the realised Zone of Influence caused by turbidity-generating activities which are part of the installation and maintenance of marine facilities; and

- ix. requirements for timely reporting of monitoring data, management responses and contingency measures.
- 10-4 The Proponent shall advise relevant stakeholders of the opportunity to comment on a draft copy of the Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program and provide those stakeholders at least 14 days to comment on the plan before it is submitted to the CEO.
- 10-5 The Proponent shall implement the Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program which meets the requirements specified in these conditions.
- 10-6 In the event that monitoring carried out under the approved Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program determines that any of the environmental protection outcomes set in Condition 9 are not being achieved by construction of the marine facilities, the Proponent shall:
- i. immediately suspend all turbidity-generating activities which are part of the installation or maintenance of the marine facilities that are causing the exceedance;
 - ii. within 24 hours of that suspension, report the non-achievement to the CEO and that it has suspended all turbidity-generating activities which are part of the installation or maintenance of the marine facilities that are causing the exceedance; and
 - iii. within 48 hours of that suspension, report to the CEO:
 - a. the results of the monitoring that led to that suspension;
 - b. the findings of investigations into the status of relevant environmental measures against achievement of the environmental protection outcomes specified in Condition 9;
 - c. the turbidity-generating activities which are part of the installation or maintenance of the marine facilities and metocean conditions occurring in the monitoring period prior to detecting the non-achievement of environmental protection outcomes set in Condition 9; and
 - d. the results of the most recent water quality and sediment deposition monitoring.
- 10-7 If, after having complied with Condition 10-6, in the report required by Condition 10-6iii, the Proponent:

- i. finds that all environmental protection outcomes specified in Condition 9 are being achieved; or
- ii. provides strong evidence that a particular turbidity generating activity did not cause the non-achievement;

and the CEO concurs with the findings of the Proponent's report, then the CEO may authorise the Proponent to recommence turbidity-generating activities which are part of:

- iii. the installation of marine facilities if Condition 10-7 i applies; or
- iv. the installation of which-ever particular marine facilities that are determined not to have caused the non-achievement if Condition 10-7ii applies, consistent with relevant management programs.

10-8 If Conditions 10-7 iii and iv do not apply, and the Proponent wishes to recommence the turbidity-generating activities which remain suspended under Condition 10-6, the Proponent:

- i. shall submit to the Minister an additional report detailing the following:
 - a. the results of the most recent environmental monitoring for all monitoring and reference sites, including identifying where an environmental protection outcome is not being achieved, and those sites where there is strong evidence that non-achievement of an environmental protection outcome is reasonably expected to be recorded as part of the same event;
 - b. the turbidity-generating activities which were being undertaken in the monitoring period prior to the environmental protection outcome not being achieved and until the time of suspension;
 - c. the metocean conditions as monitored in the most recent monitoring period prior to the environmental protection outcome not being achieved and until the time of suspension;
 - d. the results of the most recent water quality and sediment deposition monitoring;
 - e. proposed revised Zone of High Impact and Zone of Moderate Impact, including spatial data in a format compatible with a Geographical Information System specified by the CEO that defines the locations of all infrastructure and proposed revised zones of impact and influence consistent with the requirements of Condition 9-3; and

- f. any other information considered relevant by the Proponent in support of its Proposal to recommence all turbidity-generating activities that remain suspended after implementing Condition 10-6.
- ii. shall, if an environmental protection outcome (or any approved revised environmental protection outcome) is not being achieved outside the Zones of Moderate Impact (not including the Zone of High Impact), include in the report required by Condition 10-6iii, additional management actions proposed to be implemented so that the recommencement of turbidity-generating activities which are part of the construction or maintenance of the marine facility:
 - a. will not cause non-achievement of an environmental protection outcome for the Zone of High Impact and Zone of Moderate Impact as set out in the approved Marine Facilities and Impact Zones Plan or a revised Zone of High Impact and Zone of Moderate Impact proposed by the Proponent in Condition 10-8 i; and
 - b. will ensure the environmental protection outcomes set in Condition 9 continue to be achieved.

10-9 The Minister may, having regard to the report submitted by the Proponent under Condition 10-8 and on the advice of the Chairman of the EPA, approve a revised Zone of High Impact or Zone of Moderate Impact to have effect for the purpose of Conditions 9-5 and 9-6 in which case the Proponent may then recommence turbidity-generating activities which are part of installation or maintenance of marine facilities subject to the approved revised Zone of High Impact and Zone of Moderate Impact. The Minister may also, having regard to the reports submitted by the Proponent under Condition 10-6iii and Condition 10-8, require the Proponent to implement the additional management actions proposed in Condition 10-8ii above, or other additional practicable management actions, as part of the approved Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program required by Condition 10-1.

10-10 If under Condition 10-9 any revised Zone of High Impact or Zone of Moderate Impact is approved, or additional management actions are required to be implemented, those approved revised zones and additional management actions required by the Minister under Condition 10-9 shall have effect as if they were part of the approved Marine Facilities and Impact Zones Plan and the approved Dredging, Marine Facilities and Pipeline Installation Environmental Monitoring and Management Program.

11 State of the Marine Environment Surveys

- 11-1 The Proponent shall, at least three months prior to the commencement of any marine works that may impact the marine environment, prepare and submit to the CEO a scope of works for surveys of the marine environment (Scope of Works for Marine Surveys). The CEO, on advice from DoF, is to determine whether the Scope of Works for Marine Surveys submitted meets the requirements of these conditions and is to notify the Proponent accordingly.
- 11-2 The surveys of the marine environment are to be conducted in accordance with the Scope of Works for Marine Surveys at the times indicated below:
- i. the baseline state of the marine environment survey is to be completed prior to the commencement of any marine works;
 - ii. the mid-term state of the marine environment survey is to be undertaken at the mid-term of the marine works period associated with the construction of any marine facilities;
 - iii. the first post-development state of the marine environment survey is to be undertaken within three months of completion of each construction phase associated with the construction of any marine facilities; and
 - iv. a second post-development state of the marine environment survey shall be undertaken having regard to the findings of previous surveys.

Note: The Proponent at the time responsible for the relevant marine works that trigger Condition 11-1 will be responsible for the repeat surveys.

- 11-3 The Scope of Works for Marine Surveys for Marine Surveys shall include the following where relevant:
- i. Procedures and methods for the collection of quantitative environmental data for:
 - a. water quality;
 - b. hydrodynamic conditions including direction and velocity of water currents;
 - c. the physical characteristics of native sediments and development-influenced sediments suspended in the water column and deposited on the benthos;
 - d. the natural and development-influenced rates, and spatial and temporal patterns of sediment deposition;

- e. the spatial extent, distribution, biotic community composition (at a suitable taxonomic resolution to differentiate different communities), natural variability including seasonality and condition of benthic habitats; and
 - f. the preparation of benthic habitat maps showing the extent, distribution of benthic habitats and condition of benthic habitats at representative sites.
- ii. timing for the implementation and completion of the surveys having regard to the types and sequence of surveys referred to in Condition 11-2;
 - iii. procedures for the use of survey data to assess achievement of the marine environmental protection outcomes set out in Conditions 9-5 and 9-6; and
 - iv. timing and frequency of reporting.
- 11-4 Prior to the commencement of marine works and in accordance with the approved Scope of Works for Marine Surveys, the Proponent shall undertake the baseline state of the marine environment survey.
- 11-5 At the time specified in the approved Scope of Works for Marine Surveys and in accordance with the approved Scope of Works for Marine Surveys, the Proponent shall undertake the surveys for the state of the marine environment at the mid-term of the marine works.
- 11-6 At the time specified by the approved Scope of Works for Marine Surveys and in accordance with the approved Scope of Works for Marine Surveys, the Proponent shall undertake the post-development surveys for the state of the marine environment at the completion of the marine works.
- 11-7 No longer than five years following completion of marine works required for the construction of marine facilities and in accordance with the approved Scope of Works for Marine Surveys, the Proponent shall undertake a second post-development state of the marine environment survey to determine achievement of the marine environmental protection outcomes set out in Conditions 9-5 and 9-6.
- 11-8 The Proponent shall report the findings of the baseline state of the marine environment survey required by Condition 11-4 to the CEO within six months of having completed that survey.
- 11-9 The Proponent shall report the findings of subsequent state of the marine environment surveys required by Conditions 11-5, 11-6 and 11-7 and include in each report an appraisal of the degree of

conformance with environmental protection outcomes set in Conditions 9-5 and 9-6 and an appraisal of the achievement of the management targets set in Condition 10-3, having regard to any relevant approved revised Zone of High Impact and Zone of Moderate Impact, to the CEO within four months of having completed each survey.

12 Coastal Processes Monitoring and Management Program

12-1 The Proponent shall ensure that installation and operation of the nearshore marine facilities achieve the following outcomes as measured under the Coastal Processes Monitoring and Management Program required by Condition 12-3:

- i. no significant changes to littoral sediment transport under non-cyclonic conditions;
- ii. no significant changes in erosion trend under non-cyclonic conditions or in the position of the mean sea level shoreline and dune vegetation line north and south of the nearshore marine facilities;
- iii. no significant impacts on the recreational value of beaches north and south of the nearshore marine facilities;
- iv. no significant impact on heritage sites north and south of the nearshore marine facilities.

12-2 The Proponent shall not commence installation of the nearshore marine facilities prior to:

- i. submitting a Coastal Processes Monitoring and Management Program to the CEO, and
- ii. receiving written notice from the CEO, having consulted with DoT (Maritime Planning Division), that the Coastal Processes Monitoring and Management Program meets the requirements of these conditions.

12-3 The Coastal Processes Monitoring and Management Program shall include:

- i. quarterly site inspection of beach and dune conditions for at least 5 kilometres north and south of the nearshore marine facilities;
- ii. quarterly measurement of beach and dune width and height using a combination of topographic surveys and aerial photography or satellite imagery;

- iii. quarterly recording of beach profile using on-ground photography;
- iv. annual hydrographic survey of the near-shore area;
- v. a community liaison strategy to obtain feedback on impacts on recreational values;
- vi. culturally appropriate annual review and investigation of heritage locations to assess the condition and potential threats to Aboriginal and natural heritage locations;
- vii. a table showing the type of monitoring and monitoring frequency for each of the coastal features to be protected under Condition 12-1;
- viii. management triggers relevant to achieving the outcomes specified in Condition 12-1; and
- ix. management actions (for example, active sand bypass) that will be implemented in the event that management triggers are or are likely to be exceeded.

12-4 The Proponent shall implement the Coastal Processes Monitoring and Management Program which meets the requirements of these conditions.

12-5 The Proponent shall report any non-achievement of the management triggers referred to in Condition 12-3, along with measures taken and proposed to be taken, and strategies to be implemented in response to the non-achievement, to the CEO within 21 days of the non-achievement being identified.

13 Marine Environmental Quality and Marine Outfalls

13-1 The Proponent shall not discharge to the marine environment from any facility, or install any infrastructure for this Proposal related to waste water discharge, whichever occurs first, nor apply for a works approval for any discharge under Part V of the *Environmental Protection Act* 1986, prior to:

- i. submitting a Port Environmental Quality Management Program to the CEO, and
- ii. receiving written notice from the CEO, having consulted with DoF and the relevant Port Authority, that the Port Environmental Quality Management Program meets the requirements in this condition.

- 13-2 The Port Environmental Quality Management Program shall:
- i. spatially define all port infrastructure, discharge infrastructure (including by reference to maps) and the areas referred to below consistent with Condition 9-3;
 - ii. show a Moderate Ecological Protection Area (MEPA) extending to no further than 250 m from inner Port Facilities, including the shipping berths and ship turning basin and the area enclosed by breakwaters and the Integrated Marine Facility, but excluding the shipping channel;
 - iii. show a High Ecological Protection Area (HEPA) outside the MEPA and including the Shipping Channel Area;
 - iv. require all port-related activities and wastewater discharges to be managed with the objective of achieving a level of environmental quality such that all Environmental Values defined in Schedule 3 are protected within the Port Area and any other areas influenced by port activities except in treated sewage mixing zones;
 - v. define the environmental quality guidelines and standards that apply to the HEPA, MEPA and Low Ecological Protection Area (LEPA) and are to be used as benchmarks for assessing environmental performance against the ecological protection objectives, consistent with Schedule 4 attached to this Statement;
 - vi. include a regular environmental performance monitoring and reporting schedule; and
 - vii. provide spatial data in a format compatible with a Geographical Information System acceptable to the CEO.
- 13-3 Wastewater treatment and wastewater discharge infrastructure must comply with contemporary best practice principles including modelling based on a specific port design, diffuser performance, effluent characteristics and toxicity, ambient water quality conditions and specific mitigation measures.
- 13-4 The Proponent must only discharge wastewater to the marine environment through purpose-built outfalls and diffusers, and locate all waste water discharge outfalls so that their associated Low Ecological Protection Areas are entirely contained within the Moderate Ecological Protection Area of the Port.

- 13-5 The Low Ecological Protection Area for any wastewater discharges must not extend beyond 70 metres from any point of the diffuser structure.
- 13-6 The Proponent shall ensure that all wastewater discharges, singly and in combination, are managed to achieve the environmental quality objectives and levels of ecological protection as identified through Condition 13-2 and described in Schedules 3 and 4.
- 13-7 Prior to or on submission of an application for a works approval to the DEC for any discharge from the terrestrial facilities, the Proponent shall submit a report to the DEC that:
- i. spatially maps the areas where each environmental quality objective and level of ecological protection is to be achieved;
 - ii. identifies the environmental quality criteria, for constituents of the discharge considered relevant by the DEC, that should be achieved to maintain the environmental quality objectives and levels of ecological protection established through Condition 13-2;
 - iii. predicts the toxicity of the final discharge under typical conditions;
 - iv. predicts the number of dilutions necessary to meet the required environmental quality objectives and level of ecological protection. That is, a moderate level of protection at the boundary between a Low and Moderate Ecological Protection Area and a high level of protection at the boundary between a Moderate and High Ecological Protection Area; and
 - v. presents contingency options for additional treatment or modifying the diffuser to achieve greater dilutions if environmental quality objectives or levels of ecological protection are not being met.
- 13-8 Prior to submitting an application for a works approval to the DEC for any operational discharge from the terrestrial facilities, the Proponent shall develop an Effluent Quality Validation and Reporting Program in consultation with the DEC that addresses the following issues:
- i. a Whole Effluent Toxicity Testing program for determining:
 - a. the actual toxicity of any discharge post commissioning and post operation of the outfall and following any significant change in effluent composition; and
 - b. the number of dilutions required to achieve each relevant level of ecological protection.

Testing is to be undertaken on a minimum of five locally relevant biota species from four different taxonomic groups using the recommended protocols from ANZECC and ARMCANZ (2000)¹;

- ii. characterisation of any waste water discharge under typical operational conditions and after any significant changes in effluent composition;
- iii. a revised set of environmental quality criteria based on the contaminants considered relevant by the DEC identified from Condition 13-7ii;
- iv. the number of dilutions required to achieve the environmental quality objectives and levels of ecological protection identified in Condition 13-2 and described in Schedule 4 based on the results from Conditions 13-8i, ii and iii; and
- v. reporting to the DEC within six months of commissioning of a discharge or within six months of any significant change in composition of a discharge, including any management actions necessary to ensure ongoing compliance with the environmental quality objectives and levels of ecological protection established through Condition 13-2 and described in Schedules 3 and 4.

13-9 In the event that the monitoring and reporting required by Conditions 13-1, 13-7 and 13-8 or through the discharge licences issued under Part V of the *Environmental Protection Act 1986* indicates that the environmental quality objectives and levels of ecological protection established through Conditions 13-2 and 13-7, and described in Schedules 3 and 4, are not being met, or are not likely to be met, the Proponent shall report the findings to the CEO and the DEC as soon as practicable, but within five working days, along with a description of the management actions to be taken to meet the required level of ecological protection.

14 Pipeline Shore Crossing Management and Monitoring Program

14-1 The installation of pipeline shore crossings shall not cause direct or indirect disturbance to the surface of the land or the surface of the seabed in the intertidal zone and adjacent coastal strip unless the Proponent demonstrates to the Minister's satisfaction that some disturbance to the surface of the land or the seabed in the intertidal zone and adjacent coastal strip is unavoidable having regard to currently available technology, the geology of the land and the geology of the seabed in the Pipeline Corridor.

¹ ANZECC and ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Report 4, National Water Quality Management Strategy.

- 14-2 The Proponent shall not commence construction of any pipeline shoreline crossing prior to:
- i. submitting a Pipeline Shoreline Crossing Management and Monitoring Program, for the management of pipeline shoreline crossing activities, to the CEO; and
 - ii. receiving written notice from the Minister, having consulted the CEO, that the Pipeline Shoreline Crossing Management and Monitoring Program meets the requirements in this condition.
- 14-3 The Proponent shall consult with the DEC, DoF, DoT and DMP in the preparation of the Pipeline Shoreline Crossing Management and Monitoring Program.
- 14-4 The objectives of the Pipeline Shoreline Crossing Management and Monitoring Program are to:
- i. avoid impacts to fossilised dinosaur footprints in the intertidal zone;
 - ii. minimise impacts to intertidal benthic habitats, coastal landforms and vegetation and Monsoon Vine Thicket vegetation; and
 - iii. avoid significant adverse environmental impacts from the disturbance of acid sulfate soils.
- 14-5 The Pipeline Shoreline Crossing Management and Monitoring Program, shall include:
- i. in the event that the Proponent asserts that it is not practicable to avoid direct or indirect disturbance to the surface of the land or the seabed in the intertidal zone and adjacent coastal strip when installing a pipeline shoreline crossing, an analysis and comparison of different methods for the installation of the pipeline shore crossing. The analysis and comparison must identify the methods (including tunnelling and other trenchless technologies), the likely direct and indirect disturbance to the surface of the land or the seabed in the intertidal zone and adjacent coastal strip resulting from the use of that technology and a justification for the preferred alternative method;
 - ii. management measures to reduce the impacts from pipeline shoreline crossing activities, in particular with regard to fossilised dinosaur footprints, acid sulfate soils and coastal landforms and vegetation including Monsoon Vine Thicket, as far as practicable;
 - iii. management measures to ensure that pipeline shoreline crossing activities do not cause Material or Serious Environmental Harm in the intertidal zone and adjacent coastal strip comprising the area

between the Lowest Astronomical Tide mark and the eastern extent of Monsoon Vine Thicket vegetation as depicted in Figure 2; and

- iv. performance standards against which achievement of the objectives of this Condition can be determined.

14-6 The methods and measures required by Condition 14-5 i and 14-5 ii shall address:

- i. management and disposal of drill cuttings and fluids returned to the surface by circulation to prevent pollution;
- ii. the generation and dispersion of turbidity associated with any discharge of drill cuttings and fluids to the marine environment;
- iii. dewatering of trenches;
- iv. preventing adverse environmental impacts from acid sulfate soils;
- v. noise and percussion;
- vi. direct and indirect disturbance of habitat;
- vii. preventing harm to, or fatalities of marine vertebrates;
- viii. the use of low toxicity polymer drilling fluids or water based fluids unless otherwise authorised by the Minister; and
- ix. a marine monitoring program to detect changes to ecological elements outside the Zone of High Impact associated with the pipeline corridor.

14-7 The Proponent shall implement the Pipeline Shoreline Crossing Management and Monitoring Program which meets the requirements in these conditions.

15 Marine Fauna Interaction – Marine Pile-driving, Dredging and Marine Construction Vessels and Light Sources

15-1 The Proponent shall engage dedicated Marine Fauna Observers who must:

- i. demonstrate a knowledge of marine wildlife species in the Kimberley region, including Threatened and Migratory Species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, and their behaviours;

- ii. be on duty on vessels actively engaged in pile-driving or dredging during all daylight hours when pile-driving operations or dredging are conducted; and
- iii. maintain a log of:
 - a. their observations of cetaceans in a format consistent with the National Cetacean Sightings and Strandings Database;
 - b. their observations of other marine fauna, including injured or dead fauna noted within 500 metres of the vessels referred to in 15-1 ii above;
 - c. their observations of fauna behaviours, in particular any behaviours that could be interpreted as a display of disturbance or distress;
 - d. management responses by the Proponent in relation to any observation of disturbed or distressed fauna, and injured or dead fauna; and
 - e. observation hours and the duration of the pile-driving or dredging activity.

15-2 The Proponent shall within six months of completing pile-driving operations, lodge cetacean records with the National Cetacean Sighting and Strandings Database at the Australian Antarctic Division and with the DEC.

15-3 At least one member of the crew on each vessel undertaking construction activities will be trained in marine fauna observations and mitigation measures, including the requirements of the Wildlife Conservation (Closed Season for Marine Mammals) Notice 1998, as amended or replaced from time to time, and shall maintain a log of fauna observed during transit and construction activity consisting of GPS coordinates, species (if known), and behaviour. Logs are to be submitted to the DEC on an annual basis at the same time as submitting the compliance assessment report required by Condition 4-2 to the CEO.

15-4 Vessels engaged in construction of the marine facilities or pipelines shall not exceed those speeds specified in the Conservation Significant Marine Fauna Interaction Management Program required under Condition 15-10 or a speed designated by the DoT or relevant Port Authority, whichever is the lesser.

15-5 Subject to Condition 15-9, no marine pile-driving operations shall commence until the Marine Fauna Observer (or observers) required by Condition 15-1 have verified that no cetaceans or dugongs have been observed within a radius of 1500 metres or marine turtles within a radius of 300 metres from the planned pile-driving operation during

the 30 minute period immediately prior to commencement of pile-driving operations.

- 15-6 Prior to commencement of full power marine pile-driving, the Proponent shall implement soft start-up procedures that slowly increase the intensity of noise emissions over a period of no less than 15 minutes.
- 15-7 If the Marine Fauna Observer(s) required by Condition 15-1, or any other person, observes a marine turtle within 100 metres of a marine pile-driving operation, or cetacean or dugong within 500 metres of a marine pile-driving operation, the marine pile-driving operation within 100 metres of a marine turtle or 500 metres of the cetacean or dugong is to be suspended.
- 15-8 Marine pile-driving that has been suspended in accordance with Condition 15-7 shall not recommence until the cetacean or dugong has moved beyond 1500 metres from the suspended marine pile-driving operation or the marine turtle beyond 300 metres from the suspended marine pile-driving operation or the cetacean, dugong or marine turtle has not been observed within the exclusion zone for a period of no less than 30 minutes. Marine pile-driving that has been suspended for more than 15 minutes shall recommence with soft start-up procedures as required by Condition 15-6.
- 15-9 No marine pile-driving operations or start up of marine pile driving operations shall occur between the hours of sunset and sunrise during June to November in any year unless those marine pile-driving operations commenced prior to sunset and were not suspended for more than 15 minutes.
- 15-10 The Proponent shall not commence any works associated with the marine facilities and pipelines that may impact on the marine environment or terrestrial facilities prior to:
- i. submitting a Conservation Significant Marine Fauna Interaction Management Program to the CEO, and
 - ii. receiving written notice from the CEO, having consulted with DEC and SEWPaC, that the Conservation Significant Marine Fauna Interaction Management Program meets the requirements of these conditions.
- 15-11 The objective of the Conservation Significant Marine Fauna Interaction Management Program is to ensure that the Proponent constructs and operates the marine facilities, pipelines and terrestrial facilities so as to:
- i. detect; and

- ii. avoid, or where avoidance is not practicable, mitigate impacts upon conservation significant marine fauna, from construction and operation of marine facilities, pipelines and terrestrial facilities.

Note: For the purposes of this Condition the term 'conservation significant marine fauna' includes marine mammals, marine turtles, whale sharks and sawfish.

15-12 The Proponent shall include the following in the Conservation Significant Marine Fauna Interaction Management Program:

- i. a description of the environmental stressors relating to the construction and operation of near-shore and offshore marine facilities, pipelines and terrestrial facilities which are likely to impact on marine fauna. (environmental stressors may include, but are not limited to, noise, vibration, light spill and glow, vessel strike, dredge entrainment, marine discharges and changes to coastal processes with the potential to impact on important marine fauna habitats);
- ii. a description of design features and management actions which the Proponent will implement to avoid, or where this is not practicable, mitigate impacts of the environmental stressors relating to the construction and operation of near-shore and offshore marine facilities, pipelines and terrestrial facilities on conservation significant marine fauna (for example, darkness strategies that avoid, or where this is not practicable, limit the impact of lights or light glow from the construction and operations of the Proposal, vessels and any other equipment, likely to interfere with female turtles and hatchlings);
- iii. environmental performance standards to determine whether the design features and management actions are achieving the objectives referred to in Condition 15-11; and
- iv. a process (including a monitoring programme) to determine that the environmental performance standards are being met.

15-13 The Proponent shall implement the Conservation Significant Marine Fauna Interaction Management Program which meets the requirements of these conditions.

15-14 The Proponent shall review annually the approved Conservation Significant Marine Fauna Interaction Management Program in consultation with the DEC and SEWPaC and implement any changes approved by the CEO.

- 15-15 The Proponent shall report to:
- i. the CEO any non-achievement of the environmental performance standards referred to in Condition 15-12iii within 21 days of it having determined non-achievement and its recommendations as to how the program should be amended to ensure standards are achieved.
 - ii. the DEC any natural or Proposal attributable injury or mortality of conservation significant marine fauna within 24 hours of the observation of an injury or mortality.
- 15-16 The Proponent shall not commence marine pile driving activities prior to:
- i. submitting to the CEO an Underwater Noise Monitoring and Review Program which has been prepared and designed in consultation with DEC, SEWPaC and following the advice of an independent expert(s) in the field of noise propagation modelling in the marine environment, and
 - ii. receiving written notice from the CEO, having consulted DEC, that the Underwater Noise Monitoring and Review Program meets the requirements in these conditions.
- 15-17 The Underwater Noise Monitoring and Review Program shall include programs to:
- i. measure underwater noise from pile-driving operations to establish a library of sound signals:
 - a. at varying distances from the noise source;
 - b. when driving piles of different sizes and types;
 - c. during the concurrent pile-driving of different numbers of piles;
 - d. in conditions of different water depths; and
 - e. in different pile-driving conditions (substrate types).
 - ii. review the predictive capacity of the noise propagation model used for the pile-driving and make recommendations for improving the accuracy of underwater noise modelling in the future and the management of noise emitting activities as provided for by Condition 15.
- 15-18 The Proponent shall implement the Underwater Noise Monitoring and Review Program which meets the requirements in these conditions.

15-19 The results of the approved Underwater Noise Monitoring and Review Program are to be published within one year after the completion of the pile-driving operations in a manner approved by the CEO and a copy provided to the DEC and SEWPaC.

16 Marine Drilling and Blasting Activities

16-1 The Proponent shall not commence marine drilling and blasting activities which are part of the construction of the marine facilities prior to:

- i. submitting a Drilling and Blasting Management Program to the CEO, and
- ii. receiving written notice from the CEO, having consulted DEC, DoT (Marine Division), DoF and SEWPaC, that the Drilling and Blasting Management Program meets the requirements in Condition 16.

16-2 The objectives of the Drilling and Blasting Management Program are to ensure that drilling and blasting activities which are part of the construction of the marine facilities are managed to minimise adverse impacts on all marine fauna.

16-3 The Drilling and Blasting Management Program shall include:

- i. a description of the geographical location and duration of drilling and blasting required;
- ii. a description of likely blast pressures and potential environmental impacts of these pressures;
- iii. management actions to avoid or minimise environmental impacts. The management actions shall include;
 - a. actions for the disposal of drilling mud;
 - b. avoidance of marine blasting and drilling activities at night during the peak southern migration of mother and calf Humpback whale pods defined as June to November in any year and in seasonally sensitive periods for other marine fauna as far as practicable; and
 - c. establishment of observation zones depending on predicted and received noise levels to ensure impacts on cetaceans, dugongs and turtles are minimised as far as practicable.
- iv. management actions for dead and injured wildlife;
- v. stakeholder communication; and
- vi. reporting procedures and time frames.

16-4 In the event that marine drilling and blasting is required, the Proponent shall implement the Drilling and Blasting Management Program which meets the requirements in Condition 16.

17 Introduced Marine Pests

17-1 The Proponent shall manage non-trading vessel and immersible equipment activities whilst engaged for the construction, operation, maintenance and decommissioning of the Proposal so as to prevent the introduction of Introduced Marine Pests into State waters.

17-2 Prior to any non-trading vessels or immersible equipment entering the Zone of Moderate Impact as defined by Condition 9-6, the Proponent shall prepare an Introduced Marine Pest Risk Assessment Procedure to the satisfaction of the CEO in consultation with the DoF which includes but is not limited to the following:

- i. all factors to be considered in the risk assessment;
- ii. limits for unacceptable risk of introducing an Introduced Marine Pest;
- iii. a tool for performing Introduced Marine Pest Risk Assessments; and
- iv. measures to be implemented to reduce risks to an acceptable level, where the risk assessment identifies an unacceptable risk.

17-3 The Proponent shall ensure that any non-trading vessel or immersible equipment is subject to an Introduced Marine Pest Risk Assessment, prior to entering or demobilising from the Marine Project Area, in accordance with the Introduced Marine Pest Risk Assessment Procedure approved pursuant to Condition 17-2.

17-4 The Proponent shall ensure that any Introduced Marine Pest Risk Assessment undertaken pursuant to Condition 17-3 is recorded and that record is provided to the DoF within seven days of the Introduced Marine Pest Risk Assessment being undertaken.

17-5 The Proponent shall ensure that any non-trading vessel or immersible equipment that poses an unacceptable risk, as defined by the limits identified under Condition 17-2ii, of introducing Introduced Marine Pests, as determined by an Introduced Marine Pest Risk Assessment undertaken pursuant to Condition 17-3, does not enter the Marine Project Area.

17-6 Prior to any non-trading vessel or immersible equipment entering the Marine Project Area, the Proponent shall prepare an Introduced Marine

Pests Monitoring Program to the satisfaction of the CEO in consultation with the DoF that:

- i is consistent with monitoring design, implementation and reporting standards as set out in the *National System for the Prevention and Management of Marine Pest Incursions (Marine Intergovernmental Agreement, April 2005)*;
- ii includes a minimum monitoring frequency of once per year; and
- iii requires opportunistic sampling and analysis of specimens removed during port, vessel and immersible equipment monitoring activities.

17-7 The Proponent shall implement the Introduced Marine Pests Monitoring Program approved pursuant to Condition 17-6, or amended versions approved by the CEO for the life of the Proposal, prior to any entry to the Marine Project Area by a non-trading vessel or immersible equipment.

17-8 The Proponent shall provide the results of monitoring undertaken pursuant to Condition 17-7 to the CEO and the DoF annually.

17-9 Prior to any non-trading vessel or immersible equipment entering the Marine Project Area, the Proponent shall prepare an Introduced Marine Pests Management Strategy to the satisfaction of the CEO in consultation with the DoF, to prevent wherever practicable, the establishment and proliferation of any Introduced Marine Pest, aiming to control and potentially eradicate that Introduced Marine Pest, and to minimise the risk of that Introduced Marine Pest being transferred to other locations within Western Australia.

17-10 The Proponent shall notify the CEO, DoF and any relevant Port Authority:

- i within 24 hours following initial detection of a suspected Introduced Marine Pest; and
- ii within 24 hours following subsequent analysis and confirmation of species identification of the suspected Introduced Marine Pest.

17-11 In the event that any Introduced Marine Pest is suspected or detected, the Proponent shall, in consultation with the DoF and the CEO implement the Introduced Marine Pests Management Strategy.

17-12 The Proponent is to submit a report detailing the outcomes of any implementation of the Introduced Marine Pests Management Strategy to the DoF and the CEO within 30 days of the commencement of the implementation of the Introduced Marine Pests Management Strategy and thereafter as required by the CEO in consultation with the DoF.

18 Surface and Groundwater Management and Monitoring

- 18-1 The Proponent shall not commence ground disturbing activities or develop or construct a borefield prior to:
- i. submitting a Surface and Groundwater Management and Monitoring Program to the CEO, and
 - ii. receiving written notice from the CEO, having consulted DoW, that the Surface and Groundwater Management and Monitoring Program meets the requirements of these conditions.
- 18-2 The objectives of the Surface and Groundwater Management and Monitoring Program are to ensure that:
- i. the Proponent demonstrates that groundwater is required for that particular phase of the implementation of the Proposal and that Environmental Harm associated with commissioning of a borefield, including clearing of native vegetation has been avoided where practicable, or minimized where avoidance is not possible and does not exceed the limitations/extent of clearing related to the development of the borefield provided for in Column 3 of Table 1;
 - ii. groundwater abstraction, construction and operation of any facilities and use of groundwater within of the BLNG Precinct (including construction and operation of port related facilities or pipelines) do not adversely affect surface and groundwater quality and vegetation dependent on groundwater or surface water flows, including the Monsoon Vine Thicket and Drainage Basin vegetation communities; and
 - iii. changes in the routing, availability and quality of surface waters do not adversely affect Monsoon Vine Thicket or Drainage Basin vegetation.
- 18-3 In seeking approval for the Surface and Groundwater Management and Monitoring Program, the Proponent shall provide to the CEO the following information:
- i. monitoring data approved by the CEO for groundwater levels; surface and ground water quality in and around the Monsoon Vine Thicket and Drainage Basin communities;
 - ii. monitoring data approved by the CEO for soil moisture levels in the root zone within the Monsoon Vine Thicket and Drainage Basin communities;
 - iii. monitoring data approved by the CEO for the health, cover and composition of vegetation within the Monsoon Vine Thicket and Drainage Basin communities; and
 - iv. an endorsement from a suitably qualified independent specialist that the monitoring undertaken and the Surface and Groundwater Management and Monitoring Program meets

contemporary best practice standards and will ensure Condition 18 will be met.

18-4 The Surface and Groundwater Management Monitoring Program must include the following:

- i. a monitoring program development in consultation with DoW which is to continue until the Proposal is decommissioned, or until such time as the CEO determines that monitoring and management actions may cease.
- ii. appropriate trigger values, developed to the satisfaction of the CEO on advice from the DoW and the DEC to be applied to the monitoring undertaken which will provide an indication of any decline in condition or change in composition of vegetation, including Monsoon Vine Thicket and Drainage Basin vegetation communities as a result of changes in levels, flows or quality of groundwater or surface waters;
- iii. justification for the selection of the trigger levels;
- iv. a detailed management strategy developed to the satisfaction of the CEO on advice from the DoW and the DEC to avoid and mitigate any environmental harm to the Monsoon Vine Thicket and Drainage Basin communities detected by the monitoring program required by Condition 18-4i;
- v. identification of the terrestrial facilities' design features, management measures and protocols, to be implemented by the Proponent, which will ensure that all stormwater (including rainwater and water generated within the Terrestrial Disturbance Footprint), if discharged outside the Terrestrial Disturbance Footprint, will:
 - a. not cause pollution; and
 - b. be consistent with the pre-development run-off regime (for example, maintain the same groundwater recharge; ponding and streaming patterns);
- vi. development of a groundwater model and verification of the groundwater model against actual data collected; and
- vii. recalibration of the model and implications of any deviation from the model on the Monsoon Vine Thicket and Drainage Basin vegetation communities.

18-5 The Proponent shall implement the Surface and Groundwater Management Monitoring Program which meets the requirements of these conditions.

18-6 In the event that monitoring indicates an exceedance of the trigger levels determined, the proponent shall:

- i. immediately implement mitigation measures;
- ii. report to the CEO, within seven days of the exceedances being identified, on the following matters:
 - a. mitigation measures taken;
 - b. evidence which allows determination of the cause of the exceedances and if the exceedance is project attributable submit actions to be taken including those required to be included in the Surface and Groundwater Management Monitoring Program.

19 Weeds

19-1 The Proponent shall ensure that:

- i. no new species or outbreaks of weeds are introduced into the BLNG Precinct as a direct or indirect result of the implementation of the Proposal;
- ii. existing weeds are controlled so that their distribution does not increase in the vicinity of the BLNG Precinct and surrounding buffer zones;
- iii. prior to ground disturbing activities, unless otherwise approved by the CEO, the Proponent shall undertake a baseline weed survey to determine the species and extent of weeds present at weed monitoring sites within 50 metres of the outer boundary of each terrestrial element of the BLNG Precinct and at least three reference sites on nearby undisturbed land beyond 200 metres from the BLNG Precinct disturbance footprint in consultation with the DEC;
- iv. baseline and reference weed monitoring sites surveyed as required by Condition 19-1, except those adjacent to common-user facilities, are to be monitored every 2 years for the life of the proposal to determine whether changes in weed cover and type within 50 metres of the BLNG Precinct disturbance footprint have occurred and are likely to have resulted from implementation of the proposal or from broader regional changes;
- v. baseline and reference weed monitoring sites adjacent to common-user facilities are required to be monitored every 2 years up until the Proponent has provide written notice to the EPA that is ceases to have responsibility for the common-user facilities; and
- vi. if the results of monitoring under Condition 19-1 indicate that adverse changes in weed cover and type within 50 metres of the BLNG Precinct are attributable to the implementation of the proposal, the Proponent shall report the monitoring findings to the

DEC within 3 months of completion of the monitoring and shall immediately undertake weed control and rehabilitation in the affected areas, where Proposal attributable weed cover has adversely changed, using native flora species of local provenance.

20 Rehabilitation

20-1 The Proponent shall undertake progressive rehabilitation of areas temporarily disturbed by construction and operation of terrestrial facilities for the duration of the construction and operation of terrestrial facilities to ensure the following outcomes are achieved:

- i. the percentage cover and species diversity of living self sustaining native vegetation meet the completion criteria approved by the CEO under Condition 20-2iii;
- ii. no species of weeds are introduced into the rehabilitated areas;
- iii. the cover of weeds in rehabilitated areas shall not exceed the lesser of:
 - a. that identified in the baseline weed survey in Condition 19-1;
or
 - b. that existing on comparable nearby land which has not been disturbed during implementation of the Proposal or previously.

20-2 The Proponent shall:

- i. prior to any ground disturbing activities, unless otherwise approved by the CEO, conduct surveys of each of the vegetation communities that are likely to be impacted by construction and operation of terrestrial facilities to collect adequate information to assist setting completion criteria for rehabilitation;
- ii. prepare and submit for the approval of the CEO, on advice from the DEC, the methodology of the survey required in Condition 20-2i;
- iii. within 18 months of having completed the surveys referred to in Condition 20-2i, unless otherwise approved by the CEO, develop rehabilitation completion criteria which are comparable to sites undisturbed by the proposal or other activities to be approved by the CEO on advice from the DEC; and
- iv. commence rehabilitation of areas temporarily disturbed by construction and operation of terrestrial facilities within six months of the completion of the temporary disturbance.

20-3 The Proponent shall progressively monitor the rehabilitation for a range of sites against the completion criteria developed and approved

pursuant to Condition 20-2iii with appropriately timed surveys as agreed with the DEC, until the completion criteria are met and sustained for a period of not less than five years. The monitoring shall be conducted annually unless otherwise agreed by the CEO, on advice from the DEC.

20-4 The Proponent shall include the results of the rehabilitation monitoring required pursuant to Condition 20-3 in the compliance assessment report referred to in Condition 4-2. The report shall address the following:

- i. the progress made towards meeting the completion criteria developed pursuant to Condition 20-2iii; and
- ii. contingency management actions if the monitoring required by Condition 20-3 indicates that the completion criteria required by Condition 20-2iii are unlikely to be met or sustained.

21 Emissions to Air

21-1 The Proponent shall install equipment and manage ongoing operations such that contemporary best practice for an LNG Plant is achieved for environmental and amenity protection with respect to:

- i. minimising emissions including those of benzene, toluene, ethylbenzene, xylene (collectively known as BTEX), other volatile organic compounds, hydrogen sulphide, oxides of nitrogen, sulfur dioxide and carbon monoxide;
- ii. optimising the smokeless capacity of flares so as to minimise the frequency and duration of visible smoke; and
- iii. minimising non-emergency flaring of gas.

21-2 The Proponent shall establish and implement an air emissions monitoring programme for the life of any relevant part of the proposal to monitor the emissions listed in 21-1 above and provide the data collected to the DEC at least annually.

21-3 As part of a Works Approval application under Part V of the *Environmental Protection Act 1986* for any LNG Plant the Proponent responsible for the relevant works shall provide reports to the DEC showing:

- i. specific design features that have been used to minimise and monitor emissions to air, pursuant to Condition 21-1;

- ii. how the design features compare with contemporary best practice and lowest emissions for similar operations and proposals internationally and within Australia; and
 - iii. a peer reviewed report as required by Condition 21-4.
- 21-4 The Proponent shall commission an independent peer reviewer(s), approved by the CEO to undertake the following, in accordance with terms of reference also approved by the CEO:
- i. a review of the reports referred to in Condition 21-3 i and ii;
 - ii. provide comment on the basis and validity of the conclusions in the reports; and
 - iii. provide comment on the relevance of the described Australian and international contemporary best practice and standards for this Proposal.
- 21-5 Where practicable, the Proponent shall replace plant and equipment with that which meets the contemporary best practice standards at the time of replacement. Replacement equipment shall not result in an increase in emissions or reduction in air quality.

22 Greenhouse Gas Abatement

- 22-1 Prior to commencement of construction of any LNG plant, unless otherwise approved by the CEO, the Proponent shall prepare and submit to the CEO for approval a Draft Greenhouse Gas Abatement Program for the LNG plant, including all flares, which has the objectives of minimising net greenhouse gas emissions from the Proposal and reducing emissions per tonne of product as far as practicable.
- 22-2 The Greenhouse Gas Abatement Program shall:
- i. demonstrate that the Proposal is designed and operated in a manner which minimises greenhouse gas emissions as far as practicable;
 - ii. demonstrate that maximising energy efficiency and opportunities for future energy recovery have been given due consideration in the design and operation of the Proposal;
 - iii. include measures aimed at achieving as low as practicable greenhouse gas emissions from the LNG Plant, including all flares, and report emissions against an initial target of 0.26 tonnes carbon dioxide equivalent (CO₂-e) per tonne of LNG produced, excluding consideration of reservoir carbon dioxide, with further improvements over time;

- iv. include measures aimed at achieving a greenhouse gas intensity (i.e. quantity of CO₂-e generated per tonne of product produced) that is equivalent to, or better than published benchmarked contemporary best practice for equivalent plants; and
 - v. achieve continuous improvement in net greenhouse gas emissions and emission intensity through the periodic review of, and where practicable, adoption of advances in technology and process management.
- 22-3 Prior to commissioning of the LNG plant, unless otherwise approved by the CEO, the Proponent shall prepare and submit to the CEO for approval a Final Greenhouse Gas Abatement Program for the LNG Plant, including all flares, referred to in Condition 22-1 and meeting the requirements of Condition 22-2.
- 22-4 The Proponent shall provide relevant stakeholders with a draft copy of the Greenhouse Gas Abatement Programs required under Conditions 22-1 and 22-3, and provide those stakeholders a reasonable opportunity to comment on the plans before they are submitted for approval to the CEO under Conditions 22-1 and 22-3.
- 22-5 The Proponent shall review the Greenhouse Gas Abatement Program each calendar year and submit a review assessment report to the CEO on the performance of the Proposal against the requirements of Condition 22-2 annually commencing one year from issue of the Section 45A Notice.
- 22-6 The Proponent shall implement the Greenhouse Gas Abatement Program required under Conditions 22-1 to 22-5.
- 22-7 In addition to Condition 22-5, the Proponent shall commission an independent specialist to review and assess the Proponent's performance against the Final Greenhouse Gas Abatement Program which meets the requirements of Condition 22-2 at intervals of no greater than 2 years, with the independent specialist's assessment report being provided to the CEO within 20 business days of it being received by the Proponent.
- 22-8 The Proponent shall make the Draft Greenhouse Gas Abatement Program required by Condition 22-1, the Final Greenhouse Gas Abatement Program required by Condition 22-3 and the reviews under Conditions 22-5 and 22-7 publicly available on its website within six weeks of the approval of the Final Greenhouse Gas Abatement Program or otherwise in a manner approved by the CEO.
- 22-9 The Proponent shall develop and implement a greenhouse gas offset package approved by the Minister which, as a minimum, offsets the reservoir carbon dioxide released to the atmosphere during the life of the proposal.

22-10 Conditions 22-1 to 22-9 continue to have effect and condition the implementation of the proposal until such time as it is determined by the Minister for Environment that it is non-complementary to the Commonwealth Government's greenhouse gas reduction legislation applicable to the proposal.

23 Fossil Heritage Management

23-1 The Proponent shall:

- i. ensure no part of the proposal encroaches on the area shown as Area H on Figure 1 and defined by co-ordinates in Schedule 2;
- ii. not cause or allow any direct or indirect environmental harm to the fossilised dinosaur footprints in Area H as depicted in Figure 1 and defined by coordinates in Schedule 2; and
- iii. ensure, to the fullest extent practicable, that activities including the installation and operation of any facilities located on land where Broome Sandstone is exposed at the surface on any predicted tide, either naturally or by activities associated with the implementation of the proposal, do not cause environmental harm to fossilised dinosaur footprints, and other fossils associated with them.

23-2 The Proponent shall not commence installation of facilities or conduct activities causing ground disturbance on land where Broome Sandstone is exposed at the surface on any predicted tide, either naturally or by activities associated with the implementation of the proposal, prior to conducting a detailed Fossil Heritage Survey of fossilised dinosaur footprints and other fossils associated with them.

23-3 The Fossil Heritage Survey shall be conducted in a manner approved by the CEO in consultation with the native title claimant for the land and the Western Australian Museum and shall be peer reviewed by a suitably qualified independent specialist.

23-4 The Proponent shall prepare a Fossil Heritage Management Program that identifies how fossils found during the survey required by condition 23-2 and additional fossils that may be exposed during the implementation of the Proposal will be either avoided, salvaged or adequately recorded, prior to disturbance, in a manner approved by the CEO in consultation with the native title claimant for the area and the Western Australian Museum and a suitably qualified independent specialist.

23-5 The Proponent shall implement the Fossil Heritage Management Program required by condition 23-4 in the event that fossils are found.

24 Decommissioning

24-1 After the Proponent permanently ceases to operate the Proposal for the purposes for which it is implemented, the Proponent shall:

- i. remove or, if agreed in writing by the CEO on advice from the appropriate regulatory authority in consultation with relevant stakeholders, retain (that is, leave in-situ) plant and infrastructure;
- ii. rehabilitate the site to a standard suitable for the future land use(s) as agreed pursuant to the consultation referred to in Condition 24-1i; and
- iii. investigate soil and groundwater quality and remediate contaminated areas to protect the environment to a standard suitable for future land uses to the satisfaction of CEO on advice from the DoW and DEC.

25 Residual Impacts and Risk Management Measures

25-1 The Proponent shall not carry out ground disturbing activities prior to:

- i. submitting a program of Residual Impact and Risk Management Measures to the CEO; and
- ii. receiving written notice from the CEO, having consulted DEC, that the Residual Impact and Risk Management Measures meets the requirements of these conditions.

25-2 The Residual Impact and Risk Management Measures shall be developed consistent with the *WA Government Environmental Offsets Policy 2011* and *EPA Position Statement 9* and *Guidance Statement 19* on environmental offsets, or subsequent versions thereof.

25-3 The Residual Impact and Risk Management Measures shall contain project(s) to mitigate residual impacts of the proposal where each project has the following elements:

- i. an outline that identifies each project(s) relationship to the affected environmental assets and the related residual impacts and risks to those environmental assets from the proposal;
- ii. objectives and targets to be achieved;
- iii. timeframes and responsibilities for implementation;
- iv. funding schedule and financial arrangements;
- v. governance arrangements; and
- vi. monitoring, reporting and evaluation mechanisms.

25-4 The Proponent shall implement the Residual Impact and Risk Management Measures which meet the requirements of these conditions.

26 Preparation and Review of Plans and Programs

26-1 If the Proponent amends any plan, program, report or strategy required by these Conditions, the Proponent must implement the amended plan, program, report or strategy from the date of approval of the amendment.

26-2 If any plan, program, report or strategy is required to be approved under these Conditions, the Proponent may only make a significant amendment to the plan, program, report or strategy if the amendment is also endorsed by the BLNG Precinct Control Group and approved by the CEO. Significant amendments are those amendments which alter the obligations of the Proponent, that is, are not minor or administrative.

26-3 The Proponent shall prepare all plans for the management of the environment documented in the Strategic Assessment Report Response to Submissions Annexure 4 Tables A4.1 to A4.6 of September 2011.

26-4 The Proponent shall consult with relevant stakeholders as appropriate to each plan in Condition 26-3 as agreed by the CEO prior to endorsement of each plan by the CEO and prior to implementation of each plan.

27 Staging and Timing for the Submission of Programs

27-1 Where these conditions require a management, monitoring or compliance reporting program to be submitted prior to a specified activity being undertaken, if that activity is to be undertaken in stages, then the management, monitoring or compliance reporting program may be submitted that relates only to (and prior to) the undertaking of the specified activity relating to that stage. Subsequent programs submitted for the subsequent stages of that activity must update and consolidate the program. This condition does not apply to conditions relating to the submission of state of the environment baseline surveys or disturbance footprint plans.

28 Minor or Preliminary Activities

28-1 Notwithstanding those conditions which constrain the undertaking of a specified activity prior to the Proponent submitting a program to the CEO and receiving written notice from the CEO that the program meets the requirements of the condition, the CEO may consent in writing to the Proponent undertaking minor and preliminary activity, of the kind specified, provided the Proponent demonstrates to the CEO

that the minor and preliminary activity will not undermine the purpose of the condition or the objectives of the program referred to in the condition. This condition does not apply to conditions relating to the submission of state of the environment baseline surveys or disturbance footprint plans.

29 Public Availability of Data, Plans, Programs and Surveys

29-1 Subject to Condition 29-2, within a reasonable time period approved by the CEO from the date of the Section 45A Notice and for the remainder of the life of the proposal the Proponent shall make publicly available, in a manner approved by the CEO, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products (e.g. maps)) relevant to the assessment of this Proposal and implementation of this Proposal.

29-2 If any of the data referred to in Condition 29-1 contains particulars of:

- i. a secret formula or process;
- ii. confidential commercially sensitive information; or
- iii. the location of threatened species or other important environmental assets that may be threatened if their location was published

the Proponent may submit a request for approval from the CEO to not make this data publicly available. In making such a request the Proponent shall provide the CEO with an explanation and reasons why that data should not be made publicly available.

29-3 The Proponent is to make all plans approved under these Conditions, and all Programs and Surveys which meet the requirements of these Conditions, available to the public in a manner approved by the CEO.

Schedule 1

Table 1

Table 1: Description of developments/activities of future proposals and their maximum limits/extents

	Developments/activities/change in land use	Description of limits/extent
1	Hydrocarbon processing area	<p>Maximum of two heavy industrial areas of up to 500 ha each (in total up to 1000 ha) to be located within Area B identified in Figure 1 – Precinct Layout.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • Facilities for the conversion of natural gas to produce up to 50 Mtpa of LNG (plus associated LPG, condensate, other hydrocarbon products (excluding petrochemicals)), storage and export at variable rates, flare structures, other ancillary facilities and facilities for carbon dioxide export offsite. • Any relevant supporting infrastructure – including wastewater treatment facilities, water supplies, desalination water production facility (if required), electricity generation plants, concrete batching plants, rock screening and crushing facilities, relevant administration buildings and offices, internal access and haul roads. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
2	Common user area	<p>Up to 980 ha for the common user area within Area B as identified in Figure 1 – Precinct Layout.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • Lay down areas and internal buffer areas between the industrial facilities. • Administration and plant buildings. • Internal access roads. • Wastewater pipes.

		<ul style="list-style-type: none"> • Temporary stockpiles. • Contractor offices. • Concrete batch plant. • Trucking, parking and assembly areas. • Flood management works. • Clearing for bush fire management. • Service utilities. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
3	Light industrial area (LIA)	<p>Up to 200 ha within area C as identified in Figure 1 – Precinct Layout.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • Developments and uses permitted in light industrial area include all those developments and uses permissible in the Industrial Zone referred to in the Shire of Broome Town Planning Scheme No. 4 (e.g. fuel and transport depot and warehouses), subject to any buffer zone restrictions, as identified in Figure 1 - Precinct Layout. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
4	Port Area	<p>Up to 1000 ha within Area A identified in Figure 1– Precinct Layout.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • Loading berths and load out infrastructure. • Multi-user shipping channel. • Desalination seawater intake and brine outlet. • Flood management works. • Tug pens. • Support vessel area. • Storage tanks (diesel, LNG, LPG, condensate).

		<ul style="list-style-type: none"> • Marine flares. • Pipelines. • Roads. • Lay down areas. • Piled jetties. • Turning basin(s). • Breakwater(s) (as required in final design). • Wastewater disposal pipelines and diffusers. • Capital and maintenance dredging. • Integrated Marine Facilities (IMF), including connecting causeway(s), support vessel harbours, marine support facilities, marine offloading facilities (MOF) and roll-on, roll-off facilities (RORO). • Breakwater(s)/seawall(s) (as required). • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11. • Total permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat directly related to permitted uses and developments, but not exceeding the area of loss listed in item 12.
5	Shipping Channel Area	<p>Shipping channel within Area G (identified in Figure 1 – Precinct Layout) up to 550 m wide and extending from the limit of Port Area A to the limit of State Waters.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • Multi-user shipping channel.
6	Pipeline Corridor Areas	<p>Areas E and F identified in Figure 1 – Precinct Layout. Up to 250 ha of terrestrial habitat in aggregate may be utilised for pipelines and their operating/ service corridors.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • Construction of up to a maximum of 16

		<p>pipelines in total in Areas E and F for natural gas, mono-ethylene glycol, liquids, services and potentially carbon dioxide export.</p> <ul style="list-style-type: none"> • Support facilities. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11. • Total permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat directly related to permitted uses and developments, but not exceeding the area of loss listed in item 12.
7	Accommodation Area	<p>Up to 200 ha within Area D identified on Figure 1 – Precinct Layout</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • Accommodation and associated support facilities. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
8	Infrastructure and services corridors	<p>Up to a total of 297 ha located within 13 km from the boundary of Area B identified in Figure 1 - Precinct Layout.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • Borefield. • Electricity transmission services corridors. • Pipelines from borefield to Precinct . • Borefield access and service roads. • Manari Road diversion. • Service facilities. • Other access and management tracks. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.

9	Industrial land use buffer zone	<p>Area extending 2000 m from the boundary of Area B identified in Figure 1 - Precinct Layout. The outer boundary of the industrial land use buffer zone is indicated by broken yellow line in Figure 2 - Precinct Layout.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • No permanent land uses or activities are permitted save for the infrastructure and service corridor developments and activities (see item 8).
10	Sensitive land use buffer zone	<p>Area between 2000 m and 3000 m from the boundary of Area B identified in Figure 1 - Precinct Layout. The outer boundary of the sensitive land use buffer zone is indicated by broken green line on Figure 1 - Precinct Layout.</p> <p><u>Permitted Use and Development:</u></p> <ul style="list-style-type: none"> • No sensitive land uses are permitted (e.g. accommodation). • Compatible light industry uses and development permissible.
11	Clearing of terrestrial native vegetation across all Areas shown in Figure 1 - Precinct Layout	<p>Total clearing of terrestrial native vegetation permissible for all future development, activities and changes of land uses is up to a maximum of 3037 ha in the Areas and amounts as specified below:</p> <ul style="list-style-type: none"> • Area A up to 110 ha, • Area B up to 1980 ha, • Area C up to 200 ha, • Area D up to 200 ha, • Areas E and F up to 250 ha in aggregate, • Within 13 km of the boundary of Area B up to 297 ha.

		<p>Within the total area of permissible clearing no more than a maximum of 132 ha of Monsoon Vine Thicket Threatened Ecological Community to be cleared either directly or indirectly (e.g. as a consequence of groundwater drawdown).</p>
12	<p>Permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat</p>	<p>Permanent loss of Benthic Primary Producers and Benthic Primary Producer Habitat directly related to permitted uses and developments in:</p> <ul style="list-style-type: none"> • Port Area A, • Marine portions of the Pipeline Corridor Areas E and F, • Shipping Channel Area G, <p>to be confined to the Zone of High Impact.</p>
13	<p>Construction and operation of hydrocarbon processing facilities for converting natural gas to LNG plus associated LPG and condensate (excluding petrochemicals).</p>	<ul style="list-style-type: none"> • Located within Port Area A and/or heavy industrial areas located in Area B. • Up to a maximum combined operating capacity of 50 Mtpa of LNG. • LNG, condensate and LPG storage tanks commensurate with a 50 Mtpa LNG development. • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.
14	<p>Construction and operation of supporting developments and activities.</p>	<ul style="list-style-type: none"> • Located within Port Area A and/or heavy industrial area in Area B. • Discharge from wastewater treatment facilities and wastewater outfalls of up to a total of 30 GL per annum of produced water, condensed water, desalination brine, treated sewage and greywater. • First flush stormwater to be captured and treated and all captured water to be used on site or discharged via marine outfall. • Water supply by groundwater abstraction and/or desalination of up to a combined total of 8 GL per annum. • All supporting infrastructure necessary for LNG production developments/activities contained

		within Precinct boundaries A to F and the borefield within 13 km of the boundary of Area B, identified in Figure 1 - Precinct Layout.
15	Construction and operation of a marine and terrestrial port and port infrastructure including.	<p>Up to 1000 ha within Port Area A (identified in Figure 1 - Precinct Layout) comprising;</p> <ul style="list-style-type: none"> • Up to 6 loading berths. • Up to 3 piled jetties extending up to 3 km west from the current location of the Lowest Astronomical Tide. • One multi-user shipping channel to limit of Area A as identified in Figure 1 – Precinct Layout. • Turning basins. • Breakwaters extending up to 3 km west from the current location of the Lowest Astronomical Tide. • Wastewater pipelines and diffusers with up to 30 GL per annum capacity. • Up to 34 million m3 of capital dredging plus periodic maintenance dredging – (more details see item 19 below).
16	Construction and operation of the Multi-user Shipping Channel.	<p>Multi-user shipping channel in Area G identified in Figure 1- Precinct Layout.</p> <ul style="list-style-type: none"> • Up to 550 m wide and extending from the western limit of Port Area A to the limit of State Waters.
17	Construction and operation of the Integrated Marine Facilities (IMF).	<p>Contained within Area A identified in Figure 1 - Precinct Layout.</p> <ul style="list-style-type: none"> • Onshore excavation (if required) shall not extend more than 330 m east from current location of Highest Astronomical Tide. • Clearing of terrestrial native vegetation related to IMF is included in the 110 ha of permissible clearing in Area A at item 11 above.
18	Construction and use of accommodation village.	<ul style="list-style-type: none"> • Clearing of terrestrial native vegetation directly related to permitted uses and developments but not exceeding the areas listed in item 11.

		<ul style="list-style-type: none"> All access to and from accommodation village to be via Browse LNG Precinct Road (not part of this proposal).
19	Dredging and spoil disposal activities.	<ul style="list-style-type: none"> Up to 34 million cubic metres of capital dredge material plus periodic maintenance dredging as required. No dredge spoil disposal in State Waters.
20	Infrastructure and Services Corridor development activities.	<ul style="list-style-type: none"> Groundwater production limited to up to 8 GL per annum. Clearing up to 297 ha directly related to activities in this item within 13 km of the boundary of Area B indicated in Figure 1 – Precinct Layout.
21	Pipeline corridors for gas, mono-ethylene glycol, liquids, and potentially carbon dioxide export and communications.	<ul style="list-style-type: none"> Within Areas E and F identified in Figure 1 – Precinct Layout. Clearing of terrestrial native vegetation directly related to permitted uses and developments, but not exceeding the areas listed in item 11.

Schedule 2

Co-ordinates of Disturbance Footprint Boundaries

Schedule 2

Co-ordinates of Disturbance Footprint Boundaries

The co-ordinates defining the *Disturbance Footprint Boundaries* dataset are prescribed below, noting that the correct recreation of the boundaries requires the sequential connection of the co-ordinates as per its co-ordinate number. All co-ordinates are listed in Map Grid of Australia Zone 51 (MGA Zone 50), datum of Geodetic Datum of Australia 1994 (GDA94).

Co-ordinate No.	Easting	Northing	Area
1	409104.17	8065051.08	A
2	409104.23	8065050.67	A
3	409267	8065050	A
4	409323.49	8065050	A
5	409400.8	8065050	A
6	410017	8065050	A
7	410017	8063700	A
8	410017	8063280	A
9	409807.4	8063280	A
10	409267	8063280	A
11	409267	8063057.33	A
12	409267	8062100	A
13	409267	8061350	A
14	405967	8061350	A
15	405967	8062100	A
16	405967	8065200	A
17	405967	8065950	A
18	408444.06	8065950	A
19	408928.32	8065051.94	A
20	409104.17	8065051.08	A
1	414077	8067108	B
2	414077	8061908	B
3	410420	8061908	B
4	410377	8061908	B
5	410377	8061984	B
6	410377	8063280	B
7	410017	8063280	B
8	410017	8063700	B
9	410017	8065200	B
10	410017	8065950	B
11	410377	8065950	B
12	410377	8067108	B
13	414077	8067108	B
1	416077	8066097	C
2	418128	8066097	C

Co-ordinate No.	Easting	Northing	Area
3	418128	8060889	C
4	416993	8060889	C
5	416077	8062378	C
6	416077	8066097	C
1	415477.97	8051593.2	D
2	415414.35	8051853.83	D
3	415140.34	8052236.23	D
4	414866.32	8052618.64	D
5	414592.31	8053001.05	D
6	414318.29	8053383.46	D
7	414044.28	8053765.87	D
8	413770.26	8054148.28	D
9	413496.25	8054530.69	D
10	413414.11	8054645.06	D
11	418202	8057490	D
12	420129	8054357	D
13	415477.97	8051593.2	D
1	412085.9	8061914.55	E
2	412087	8059162	E
3	403716.88	8059162.02	E
4	403734.2	8059247.13	E
5	403778.82	8059433.34	E
6	403829.85	8059617.9	E
7	403827.49	8059820.88	E
8	403832.54	8060023.82	E
9	403841.04	8060161.96	E
10	411087	8060162	E
11	411087.03	8061907.96	E
12	412085.9	8061914.55	E
1	411609.95	8069857.97	F
2	411610	8067108	F
3	410610	8067108	F
4	410610.05	8068857.98	F
5	403389.89	8068857.96	F
6	403389.99	8068858.21	F
7	403422.05	8068958.86	F
8	403486.06	8069138.32	F
9	403556.18	8069315.48	F
10	403632.34	8069490.14	F
11	403714.45	8069662.08	F
12	403802.4	8069831.1	F
13	403816.96	8069857.97	F
14	403816.97	8069857.96	F
15	411609.95	8069857.97	F

Co-ordinate No.	Easting	Northing	Area
1	405967	8063500	G
2	405967	8063355.56	G
3	403540.87	8063347.06	G
4	403520.59	8063500	G
5	403502.17	8063619.13	G
6	403491.36	8063641.38	G
7	403406.48	8063823.55	G
8	403328.26	8064008.67	G
9	403256.77	8064196.5	G
10	403192.12	8064386.8	G
11	403141.14	8064545.39	G
12	403094.92	8064705.43	G
13	403053.52	8064866.79	G
14	403016.97	8065029.32	G
15	402976.23	8065222.89	G
16	402942.4	8065417.78	G
17	402931.12	8065500	G
18	405967	8065500	G
19	405967	8065200	G
20	405967	8063500	G
1	408996	8065950	H
2	409267	8065950	H
3	409274.72	8065950	H
4	410017	8065950	H
5	410017	8065200	H
6	410017	8065050	H
7	409267	8065050	H
8	409104.23	8065050.67	H
9	409104.17	8065051.08	H
10	408928.32	8065051.94	H
11	408444.06	8065950	H
12	408455.91	8065950	H
13	408487.7	8065950	H
14	408958.62	8065950	H
15	408996	8065950	H

END OF CO-ORDINATE LISTING

Schedule 3

Environmental Values and Environmental Quality Objectives for the Marine Waters off James Price Point and including the Port Area.

Environmental Values*	Environmental Quality Objectives
Ecosystem Health <i>(ecological value)</i>	Maintain ecosystem integrity <i>This means maintaining the structure (e.g. the variety and quantity of life forms) and functions (e.g. the food chains and nutrient cycles) of marine ecosystems.</i>
Recreation and Aesthetics <i>(social use value)</i>	Water quality is safe for recreational activities in the water (e.g. swimming). Water quality is safe for recreational activities on the water (e.g. boating). Aesthetic values of the marine environment are protected.
Cultural and Spiritual <i>(social use value)</i>	Cultural and spiritual values of the marine environment are protected.
Fishing and Aquaculture <i>(social use value)</i>	Seafood (caught or grown) is of a quality safe for eating. Water quality is suitable for aquaculture purposes.
Industrial Water Supply <i>(social use value)</i>	Water quality is suitable for industrial supply purposes.

* Based on the National Water Quality Management Strategy Report 4, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000).

Schedule 4

Levels of Ecological Protection to be achieved in Marine Waters

Area	Narrative Description and Criteria
Low Ecological Protection Area (LEPA)	<p>To allow for large changes in the quality of water, sediment and biota (eg. Large changes in contaminant concentrations causing large changes beyond natural variation in the natural diversity of species and biological communities, rates of ecosystem processes and abundance/biomass of marine life, but which do not result in bioaccumulation/biomagnification in nearby high ecological protection areas).</p> <p>For this protection level only the 80% species protection guideline trigger values* for potentially bio-accumulating toxicants in water apply. There should be no bioaccumulation in adjacent high ecological protection areas.</p>
Moderate Ecological Protection Area (MEPA)	<p>To allow moderate changes in the quality of water, sediment and biota (eg moderate changes in contaminant concentrations that cause small changes, beyond natural variation, in ecosystem processes and abundance/biomass of marine life, but no detectable changes from the natural diversity of species and biological communities).</p> <p>For this protection level the 90% species protection guideline trigger values* for toxicants in water apply and for discharges that contain a mixture of toxicants, the sum of the concentrations of the primary toxicants (up to 5 toxicants) should not exceed the sum of the relevant trigger values. For other physical and chemical parameters the trigger values are based on the 95th percentile of natural background measurements. Trigger values should be derived in accordance with the recommended approaches in ANZECC & ARM CANZ (2000). For sediments the ISQG-low* apply.</p> <p>For dissolved oxygen the outfalls should preferably be managed so that they do not cause the median dissolved oxygen concentration in waters ≤0.5 metres from the seafloor, calculated over a period of up to 6 weeks, to fall below 80% saturation at any site, but they should never cause dissolved oxygen concentrations to fall below 60% saturation.</p>
High Ecological Protection Area (HEPA)	<p>To allow small changes in the quality of water, sediment and biota (eg. small changes in contaminant concentrations with no resultant detectable changes beyond natural variation in the diversity of species and biological communities, ecosystem processes and abundance/biomass of marine life).</p> <p>For this protection level the 99% species protection guideline trigger values* for toxicants in water apply (except for cobalt for which the 95% species protection guideline should apply) and for discharges that contain a mixture of toxicants, the sum of the concentrations of the primary toxicants (up to 5 toxicants) should not exceed the sum of the relevant trigger values. For other physical and chemical parameters the trigger values are based on the 80th percentile of natural background measurements. Trigger values should be derived in accordance with the recommended approaches in ANZECC & ARM CANZ (2000). For sediments the ISQG-low* apply.</p> <p>For dissolved oxygen the outfalls should preferably be managed so that they do not cause the median dissolved oxygen concentration in waters ≤0.5 metres from the seafloor, calculated over a period of up to 6 weeks, to fall below 90% saturation at any site, but they should never cause dissolved oxygen concentrations to fall below 60% saturation.</p>

* From National Water Quality Management Strategy Report 4, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (2000) or its updates.

Schedule 5

Definitions

Adverse impacts – means injurious impacts to elements of the environment that render their condition significantly worse than their state as it existed prior to the influence of the adverse impact.

Best practice – has the meaning outlined in the Environmental Protection Authority's *Guidance 55 Implementing Best Practice in proposals submitted to the Environmental Impact Assessment process (2003)*.

BLNG Precinct – means Browse Liquefied Natural Gas Precinct located at James Price Point as shown and delineated on Figure 1 attached to this Statement.

Borefield – means a network of production bore pumps, valves, pipes and associated equipment used to extract and transport groundwater to the BLNG Precinct.

CEO – means the chief executive officer of the agency responsible for administering Part IV of the *Environmental Protection Act 1986*.

Clearing – without limiting the definition of clearing referred to in the *Environmental Protection Act 1986*, means removal of vegetation or any other activity that causes the death of vegetation, including the drawing down or contamination of groundwater, including causing or allowing salt water intrusion into groundwater on which vegetation depends.

Coastal Strip – means land between the level of the highest astronomical tide and the eastern extent of Monsoon Vine Thicket vegetation.

Commissioning – means the period following construction but prior to the commencement of steady state operations.

Conservation significant marine fauna – includes marine mammals, marine turtles, whale sharks and sawfish.

Construction – means construction of a facility and includes any excavation and/or dredging but excludes temporary, minor, preliminary and investigatory works, geotechnical, geophysical, biological and cultural heritage surveys,

staging works, baseline surveys, monitoring, technology trials, and works consented to by OEPA.

Contamination – means the definition provided in the *Contaminated Sites Act 2003*.

DEC – means the Department of Environment and Conservation or the agency from time to time responsible for administering the *Wildlife Conservation Act 1950* and the *Conservation and Land Management Act 1984* and relevant parts of the *Environmental Protection Act 1986*.

Demobilising – means a voyage or other movement of a vessel following completion of proposal related activities. Note: that if a demobilised vessel or immersible equipment is subsequently required to undertake proposal related activities, that vessel will be deemed to be “mobilising” and will be required to meet the relevant mobilisation requirements.

DoF – means the Department of Fisheries or the agency from time to time responsible for administering the *Fish Resources Management Act 1994*.

DoT (Maritime Planning Section) – means the Department of Transport or the agency from time to time responsible for administering the *Marine and Harbours Act 1981*.

DoW – means the Department of Water or the agency from time to time responsible for administering the *Rights in Water and Irrigation Act 1914*.

DMP – means the Department of Mines and Petroleum or the agency from time to time responsible for administering the *Dangerous Goods Safety Act 2004* or the *Petroleum Pipelines Act 1969*.

Drainage basin vegetation community – means the vegetation mapped and labelled as such on Map 3 in Appendix 3 of Appendix C-18 of the Proponent’s Strategic Assessment Report.

Immersible equipment – means any equipment that is owned by the Proponent or is contracted for the construction, maintenance, operation or decommissioning of this Proposal, and that is put into the water but which can be readily removed and transported which would not be considered as a component of the non-trading vessel from which it is deployed. Includes but is not limited to anchors, seismic spreads, well heads, acoustic seabed receivers, cutter suction heads and environmental monitoring equipment.

Independent Specialist – means an expert or person independent of the Proponent with particular recognised expertise in a subject area commissioned by the Proponent and approved by the CEO.

Inner Port Infrastructure – means that port infrastructure which lies within and including the outer breakwaters.

Installation – means placing facilities within the precinct for use; includes on-site construction within the precinct, but does not include off-site fabrication or construction.

Intertidal Zone – means the area bounded by the level of the highest astronomical tide and the level of the lowest astronomical tide.

Introduced Marine Pests – means any marine species that poses a threat to the Western Australian environment or industry, if introduced, established or translocated. The marine species that are considered to pose a threat as outlined above include those detailed in the *Western Australian Prevention List for Introduced Marine Pests*, Department of Fisheries (2012), as amended from time to time, and other species that appear to have clear impacts or invasive characteristics.

LNG – means liquefied natural gas.

Management actions – means management activities, measures, actions, strategies, undertakings or directives which may, depending on the context in which the term is used in these conditions.

1. Correct or improve upon management actions which have been ineffective;
2. Attenuate, minimise or mitigate impacts the Proposal would otherwise have on the environment if the action were not taken; or
3. Ensure compliance with conditions, or any monitoring or management triggers established by those conditions.

Marine facilities – means any facilities forming part of the proposal that are located in contact with the sea at any time.

Marine Project Area (for the purposes of managing Introduced Marine Species) – means the area bounded by a line extending from the coast at a point two kilometres south of Cape Boileau, then west to the State Waters boundary, and a line west from a point on the coast 3 kilometres south of Coulomb Point to the boundary of State Waters.

Monsoon Vine Thicket – means the vegetation mapped and labelled as such on Maps 2, 3 and 4 in Appendix 3 of Appendix C-18 of the SAR. In the context of these conditions the allowable loss of Monsoon Vine Thicket vegetation means that portion of this vegetation community that is co-incident with the outline of the BLNG Precinct as delineated by green hatching in Figure 2 attached to these conditions.

Near-shore – means situated at sea in proximity to the shore, in this case within the 3 nautical mile limit of State Waters

Non-trading vessel – means a vessel either owned by the Proponent, or contracted for construction, maintenance, operation or decommissioning of the proposal, that meet the definition of non-trading vessels as appears in the

National Biofouling Management Guidance for Non-Trading Vessels (Department of Agriculture, Fisheries and Forestry, May 2009).

Offshore – means situated at sea some distance from the shore, in this case outside State Waters.

Onshore facilities – means any facilities forming part of the proposal located on shore.

Peer review – means a documented, critical review performed by peers (where “peer” is defined as a person having technical expertise in the subject matter being reviewed which is at least equivalent to that needed for the original work) who are independent of the work being reviewed. The peer review should determine whether the material being reviewed is of reasonable quality and whether any conclusions or findings are supported by the evidence.

Pipeline Corridor Areas – means Areas E and F identified in Figure 1 – Precinct Layout. Up to 250ha in aggregate may be utilised on land for pipelines and their operating/ service corridors.

Plan – means a drawing or diagram depicting the layout, dimensions, and any other details relevant to the spatial layout of features of the proposal or condition referred to and the geographic data that defines that layout.

Port Area – means an area of up to 1000 ha within Area A identified in Figure 1 – BLNG Precinct Layout.

Port facilities – means any infrastructure that is within the area that is or will come under the jurisdiction of the relevant Port Authority.

Program – means a description of a series of events or actions designed to achieve an intended outcome. A program may include one or more plans that show the layout of facilities referred to in that program.

Section 45A Notice – means the notice issued by the Minister under section 45A of the *Environmental Protection Act 1986*.

SEWPaC – means the Australian Government Department of Sustainability, Environment, Water, Population and Communities or the Australian Government or the agency from time to time responsible for administering the *Environment Protection and Biodiversity Conservation Act 1999*.

Shipping Channel Area means the shipping channel within Area G (identified in Figure 1 – Precinct Layout) up to approximately 550 m wide and extending from the limit of Port Area A to the limit of State Waters.

Terrestrial facilities – means any facilities forming part of the Proposal that are located landward from the line of the Highest Astronomical Tide.

Terrestrial facilities and disturbance footprint – means the footprint identified in the Terrestrial Facilities and Disturbance Footprint Plan approved pursuant to Condition 5-1 of these conditions.

Wastewater treatment and wastewater discharge infrastructure – means pipes, diffusers and any other equipment located in the marine environment that is associated with the discharge of wastewater.

Weed – means any plant that is not indigenous to the Dampier Peninsula region.

Zone(s) of High Impact, Zone(s) of Moderate Impact and Zone(s) of Influence – means those zones as identified and defined in the Marine Facilities and Impact Zones Plan prepared in accordance with Condition 9 of these Conditions.

Figure 1

BLNG Precinct Layout

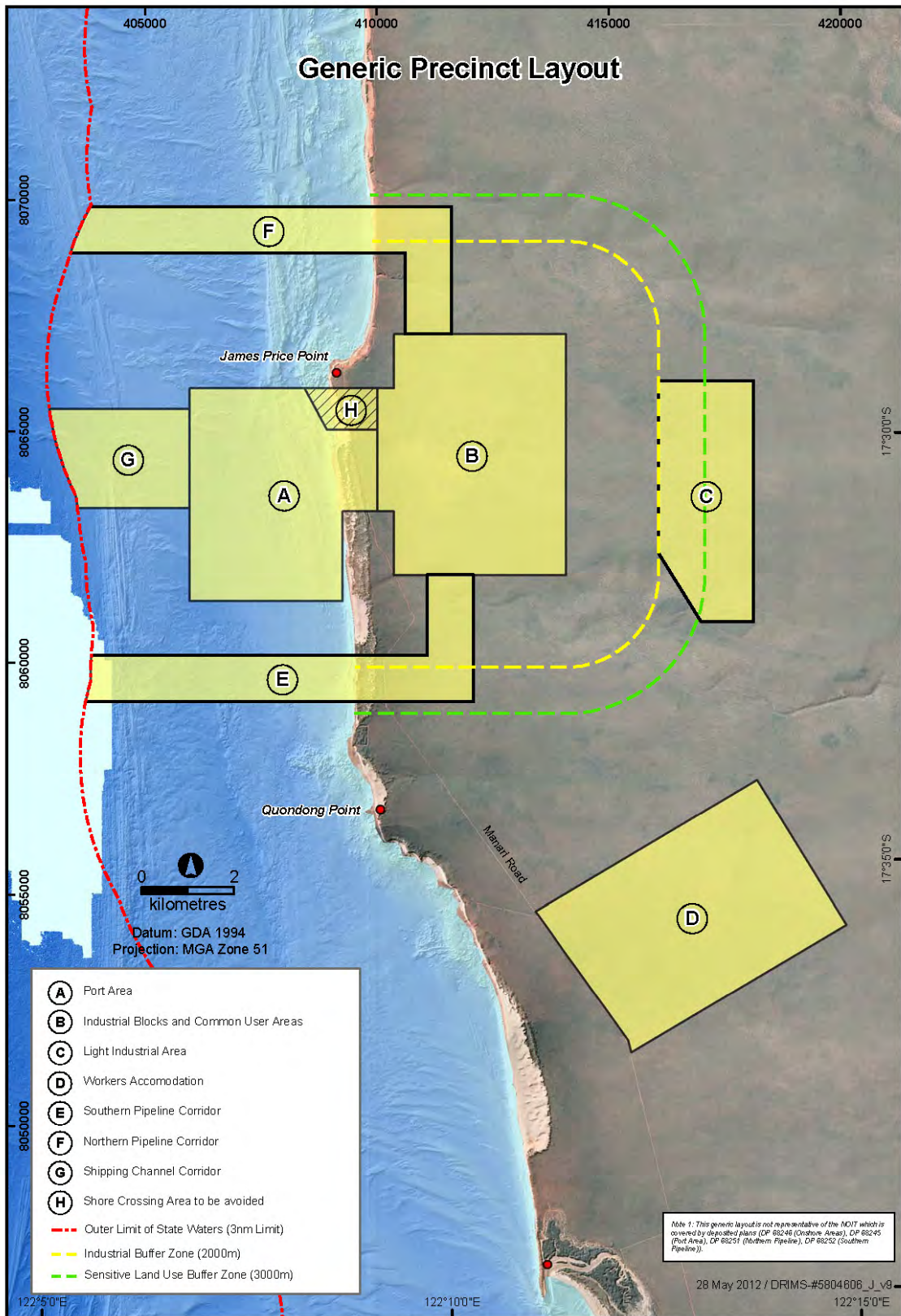


Figure 2

Area delineated by green hatching within which 132 hectares of Monsoon Vine Thicket may be cleared



Appendix 5

Proponents Response to Submissions

Provided on disc

Appendix 6

Additional Information on Dinosaur Trackways

Provided on disc

Appendix 7

Additional Information on the Greater Bilby

Provided on disc

Appendix 8

43A Application – Integrated Marine Facility

Provided on disc

Appendix 9

Additional Information on Underwater Noise

Provided on disc

Appendix 10

43A Application – Change in Dredging Volume

Provided on Disc