9 OTHER RELEVANT FACTORS IMPACTS AND MANAGEMENT

The preliminary risk assessment identified that the other environmental factors relevant to the Harriet Point Dredging Project are marine habitat disturbance (non-mangrove), marine fauna, marine pest species, coastal processes, terrestrial flora and fauna, construction dust, construction noise, visual amenity, indigenous heritage, recreation, waste management and hydrocarbons and hazardous materials.

For each other relevant factor the environmental objective and potential impacts of the proposed Harriet Point Dredging Project are discussed. Each assessment has demonstrated that the potential impacts can be managed to as low as reasonably practicable through the implementation of BHPBIO's existing construction Environmental Management Plan (EMP) and the key management plans where applicable.

9.1 OTHER MARINE HABITAT

9.1.1 Overview

The proposed DMMA, Spoil Ground 'I' and the dredging footprint are located across a range of marine habitats, including subtidal and intertidal BPPH. BPPH that may potentially be affected by the proposed dredging and disposal activities have been described in the Biological Marine Environment section (**Section 4.3**) and are illustrated in **Figure 4.8**.

Subtidal BPPH

Subtidal BPPH that has been identified as potentially being affected by the project includes hard substratum supporting mixed sessile biota, including corals, macro-algae, turf algae, sponges, and other sessile and motile fauna. Macro-algae and turf algae have mainly been recorded within the project area on patches of hard substratum where mixed sessile invertebrate communities also occur (SKM 2007a). In this section, the potential impacts of project activities on macro-algae and turf algae will be considered in conjunction with potential impacts on corals and other invertebrates under the title of 'subtidal BPPH'.

Subtidal BPPH have been identified within the project area in the following locations:

Inner Harbour

- A small area of BPPH (~50-75 m^2) immediately adjacent to the proposed sea wall construction footprint for DMMA B2. The BPPH consists of a shallow depression in the hard substratum that allows water to be retained at low tide and supports a mixed community of BPP including hard and soft corals, turf algae, macro-algae and sponges.

Inshore

- BPPH situated on the north-eastern side of Finucane Island, comprised of a rocky reef with sink holes that retain shallow pools of water at low tide. This BPPH supports a community consisting mostly of hard corals from the families Faviidae and Poritidae (URS 2006b, SKM 2007a), along with turf algae, macroalgae, sponges and other invertebrates.
- Patches of BPPH near Weerdee and Downes Islands, northwest of Finucane Island. These patches support mixed communities of hard corals (mainly *Turbinaria* spp.) soft corals, macro-algae, turf algae, sponges and other sessile invertebrates (SKM 2007a).

Offshore

- BPPH consisting of hard substratum along ridge lines that run parallel to the coast, generally located beyond the 10 m depth contour and greater than 10 km offshore from Port Hedland Harbour. These ridges of BPPH support sparse and sporadic communities consisting of hard and soft corals, sea whips, turf algae, sponges, macro-algae and various motile fauna.

Intertidal BPPH

Intertidal BPPH that has been identified as potentially being affected by the project includes salt marshes and cyanobacterial mats.

Salt marshes are an intertidal habitat, dominated by salt tolerant plants (e.g. samphires) typically lying above the seaward zone of mangroves and fringing bare tidal pans where soil salinities are too high (and soil moisture content too low) for flora. Salt-marsh communities in this region contain limited

faunal and floral diversity, are generally sparse in coverage and do not contribute significantly to primary production when compared to high canopy cover mangroves and other BPP (ENV 2008). Salt marshes likely to be impacted by the dredging project occur within DMMA A (refer to **Section 4.3**).

Some intertidal areas between the salt marsh habitat and mangrove zones at times may support cyanobacterial mats (Paling et al. 2003). Cyanobacterial mats were observed as a narrow band, parallel to the shoreline within DMMA B1 and B2 (SKM 2008c).

While the presence of scattered clumps of samphires is relatively easy to ascertain, the presence and extent of cyanobacterial mats are much more difficult to determine. This is because the mats are very thin layers that are not always evident in aerial photography and the mats are ephemeral, increasing in size and thickness when sufficient moisture is present in surface layers, making the exact extent of these habitats (both present and past) difficult to determine (Paling 1989).

9.1.2 EPA Objective

The environmental objective for other marine habitat is to ensure that dredging and reclamation does not significantly impact on subtidal and intertidal BPPH within the Port Hedland harbour.

9.1.3 Policy and Standards

The key guidelines relevant to the management of mixed BPPH communities include:

- EPA Guidance Statement No. 29: Benthic Primary Producer Habitat Protection for Western Australia's Marine Environment (2004); and
- Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006c).

9.1.4 Potential Impacts

Both direct and indirect impacts to subtidal and intertidal BPPH may occur as a result of project activities:

- Direct impacts where construction, dredging or disposal activities directly impact the survival of BPPH and associated biotic communities; and
- Indirect impacts to BPPH potentially occurring as a result of altered water quality and sedimentation.

Direct Impacts

Subtidal and intertidal BPPH that will be lost as a result of the project includes:

- The small area (~50-75 m^2) of mixed BPPH, including hard and soft corals, turf algae, macroalgae and sponges, immediately adjacent to the proposed sea wall construction footprint for DMMA B2;
- Approximately 11.19 ha of samphire-dominated salt marsh community, interspersed with unspecified (seasonally variable) amount of cyanobacterial mats from within the construction footprint of DMMA A; and
- An unspecified amount of cyanobacterial mats from the construction footprints of DMMA B1 and B2.

The small area (~50-75 m^2) of mixed BPPH is located only 7 m from the proposed sea wall footprint. Sedimentation and smothering of this community is expected to occur when materials are laid down for sea wall construction. There may be additional, minor flow-on effects for transient marine fauna, such as fish, that use this habitat for foraging and shelter during high tide periods. However, the overall significance of the loss of this area in the context of local ecosystem integrity and maintenance of biodiversity is considered to be minor for the following reasons:

- The community is sparse, of small area coverage (~50 to 75m^2) and of low topographical complexity (e.g. coral colonies are only a few cm high), and is therefore not considered to form a major shelter or foraging habitat for marine fauna;

- The community consists of species that are common elsewhere in greater abundances and the corals are generally small (<10cm) and would likely not have significant reproductive input to local or regional populations; and
- The presence of only small, newly recruited corals, rather than old, mature colonies, suggests a dynamic system with high natural turnover. The location of this BPPH within the inner harbour suggests it would experience freshwater plumes and high sediment loads during wet weather events, probably resulting in high natural mortality.

No BPPH or biota of significance are known to occur within the spoil ground. Spoil Ground 'I' has been used extensively for disposal of dredge material by PHPA since 2001. While a sparse coverage (~5%) of sessile biota was observed within the spoil ground prior to the commencement of the first disposal activities (GHD 2007), there has been no significant recolonisation of BPP to Spoil Ground 'I' in subsequent years, likely a result of the disposal of large volumes of unconsolidated material and subsequent lack of hard substratum available for recruitment of sessile biota such as corals and algae (GHD 2007). Occasional shoots of seagrass have been observed within Spoil Ground 'I', however these are in such small quantities and temporally variable that they are not considered a BPP of major significance to other trophic levels.

Indirect Impacts

Indirect impacts could occur as a result of altered water quality, turbidity and sedimentation on inshore and offshore BPPH communities from dredging activities and excess water discharge. Potential impacts and management of water quality is discussed in **Section 8.1**.

9.1.5 Management of Impacts

The construction footprints for DMMA A, B1 and B2 were designed to be of the minimum possible size necessary to achieve material disposal objectives within logistical and engineering constraints. In particular, design criteria focused on minimising the loss of high value mangrove areas, including closed canopy forest.

Direct losses of the small area (~50-75 m^2) of mixed BPPH immediately adjacent to the proposed sea wall for DMMA B2, 11.19 ha of samphires within DMMA A, and losses of cyanobacterial mats within the construction footprints of DMMA B1 and B2 are expected as a result of project activities. There is limited scope to reduce impacts to these areas or management measures that can be implemented to mitigate or minimise this loss.

However, to ensure there are no impacts on subtidal and intertidal BPPH outside the construction footprints of DMMA A, B1 and B2, management measures included in the construction EMP will be implemented including:

- Clear flagging of the construction footprints;
- Restriction of vehicle and equipment movement and access to within construction areas; and
- Monitoring of construction activities to avoid clearing of vegetation outside designated areas.

Management measures for potential indirect impacts to subtidal and intertidal BPPH communities as a result of altered water quality and excess water discharge are addressed in **Section 8.1** and in the DMP (**Appendix C**).

9.1.6 Outcome

A summary of the key potential impacts to other marine habitat, associated management measures to reduce the severity of these risks and the resulting residual risk for each impact is provided in **Table 9.1**.

Table 9.1 – Summary of Potential Impacts to Other Marine Habitat and the Associated Management Measures, Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Direct loss of subtidal and intertidal BPPH as a result of the construction of DMMA A, B1 and B2.	Implementation of the construction EMP including measures for restricting loss of BPPH to within the proposed construction footprints for DMMA A, B1 and B2.	1	1	1 (minor)
Indirect impacts to BPPH as a result of altered water quality and excess water discharge.	Implementation of the DMP and the management measures outlined in **Section 8.1** addressing potential impacts to water quality.	3	0.3	0.9 (minor)

9.2 MARINE FAUNA

9.2.1 Overview

Of the five species of marine turtles known to occur in the Pilbara region, only the green and flatback turtles have been recorded as utilising the surrounds of Port Hedland harbour. It is unlikely that any nesting areas will be disturbed during dredging activities for the project and reclamation of DMMA B1 and DMMA B2, as the closest nesting area (i.e. Cemetery Beach) is over 3 km distance (**Figure 4.3**) (Pendoley Environmental 2008) from the mouth of the harbour. However, juvenile green turtles routinely use the waters of the harbour and the surrounding mangrove creeks for foraging, predominantly utilising the seaward fringes of the mangrove habitat (Pendoley Environmental 2008).

Although the Port Hedland area is not a known calving or aggregation area, humpback whales (*Megaptera novaengliae*) may be encountered offshore during their northern migration, which peaks between late June and mid July. It is very unlikely that encounters with these whales will occur within the harbour, whilst the dredge vessel is operating and may only be possible during the journey of the barge vessels to Spoil Ground 'I'. Large cetaceans are likely to be found in waters deeper than 20 m (Prince 2001). The maximum depth within this inner harbour is <13 m, and therefore very unlikely that large cetaceans will occur in the harbour due to the shallow environment.

Dolphins and dugong may also be found in the Port Hedland area, however, no known resident populations of either occur in the area and it is therefore not expected that these marine fauna will be present in significant numbers (Prince 2001).

There a number of fish and invertebrate species that occurs in the creeks in the Port Hedland region. Within the harbour, 106 species of fish have been identified (Ecoscape 2004). Some of these species are anticipated to occur in the creek systems adjacent to DMMA A such as mullets, gobies and perchlets.

9.2.2 EPA Objective

The environmental objective for marine fauna is to ensure that dredging, offshore disposal and reclamation activities do not significantly impact on the marine fauna of Port Hedland Harbour and its surrounds.

9.2.3 Policy and Standards

The relevant policies and standards that need to be addressed for marine fauna include:

- EPA Guidance Statement No. 1: Protection of Tropical Arid Zone Mangroves along the Pilbara Coastline (2001);
- EPA Guidance Statement No. 8: Environmental Noise (Draft) (2007); and
- Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006c).

9.2.4 Potential Impacts

Harbour dredging activities have the potential to adversely impact, both directly and indirectly, on various species of marine turtles, dugongs, whales and dolphins that have been recorded in the Pilbara region (**Section 4.3.3**), direct impacts may result from:

- vessel collisions;
- underwater noise;
- light spill and disorientation (i.e. marine turtles);
- excess water discharge from DMMA; and
- potential toxicity caused by hydrocarbon spills.

Indirect impacts could occur as a result of loss of mangrove habitat for marine fauna.

Direct Impacts

Vessel Collisions or Entrapment

The physical presence of dredge vessels within the harbour and those travelling to and from the offshore spoil ground may increase the risk to marine fauna of injury or death from collisions. There is also the risk that marine fauna may become entrapped within the cutter head of the dredge during dredging operations.

Any marine mammals and sea turtles within the harbour are likely to exhibit avoidance behaviour once dredging is underway and are not expected to remain in close proximity to the dredge due to noise and vibration levels generated. The potential for collisions with cetaceans, dolphins and sea turtles is considered to be minor due to the application of management measures proposed in the DMP (**Appendix C**).

The disposal of surficial sediments from Harriet Point at the offshore spoil ground is scheduled to occur during the first quarter of 2009. Therefore, barges carrying dredge material from Harriet Point to the spoil ground will operate outside the peak humpback whale northern migration, which occurs in this region from June to July. In addition, Spoil Ground 'I' lies outside their primary migration route which is in deeper water off the coast.

Noise

Marine fauna are unlikely to be affected by noise and vibration generated by the dredge vessels due to the already high background noise levels created by shipping activity in the harbour itself as well as offshore in the Port Hedland shipping channel. Noise levels encountered by fauna are only likely to be above background levels when the fauna are within close proximity to the dredging operation. Noise is therefore not likely to be a major problem for migrating whales and cetaceans occurring offshore. Turtles are the main faunal group that may occur inshore, in close proximity to the dredging operation, and therefore may encounter 'above background' noise levels.

Light Spill

Studies have shown that turtle hatchlings have a strong tendency to orient towards the brightest direction, which on natural beaches is typically towards the ocean where the horizon is open and unhindered by dune or vegetation shadows (Pendoley Environmental 2008). However, on nesting beaches which are exposed to artificial lighting, turtle hatchlings can become disorientated.

Cemetery Beach, Cooke Point and Pretty Pool have been identified as key flatback turtle nesting habitats in the Port Hedland area (refer to **Section 4.4.3**). Dredging activities will be undertaken approximately 3-4 kilometres from Cemetery Beach. As key nesting habitats are all outside the zone of influence of the project, potential impacts to turtle nesting areas is considered to be minor.

Excess Water Discharge from DMMA

Excess water discharge from DMMA A has the potential to impact marine fauna, in particular fish and invertebrate species that inhabit the creek system in the discharge receiving environment. Excess water discharge from onshore placement of dredged material at DMMA B1 and B2 is less likely to

impact marine fauna in the receiving environment due to the high level of flushing that exists in the harbour due to tidal flow and the volume of water moving past these discharge points on high/low tides.

The main potential impacts to fish and invertebrate species include those related to:

- disturbed sediments; and
- changes in temperature, salinity, pH, and dissolved oxygen.

Temporary disturbance associated with the disruption of sediments may affect marine fauna in certain situations such as disorientation of fish and marine turtles and displacement to benthic invertebrates. Sedimentation of food sources may also indirectly affect marine fauna by increasing their foraging efforts. It is anticipated that this is only likely to occur in the immediate vicinity of the discharge area.

Previous studies have shown that fish densities, species type and distribution in tidal estuaries, salt marsh and mangrove areas can be affected by changes in turbidity, temperature, salinity and dissolved oxygen (Cyrus & Blaber 1992; Sheaves 1992; Robertson & Alongi 1992). Changes in these parameters therefore have the potential to slightly alter the species composition that occurs in the creeks adjacent to the discharge area temporarily during the dredging process. It is anticipated that any changes to these parameters are likely to occur in the immediate vicinity and will be quickly homogenised within the surrounding environment.

These discharges are proposed to be managed in accordance with water quality monitoring of the discharge as described in **Section 8.1**.

Hydrocarbon Spills

Potential impacts to marine fauna as a result of a hydrocarbon spill include:

- Physical effects - including smothering/coating that may lead to contamination and mortality; and
- Chemical and biological effects - including toxicity and bioavailability that may affect feeding, reproduction and growth.

Physical effects can include a severe coating on wildlife that can restrict vital life functions including the ability to feed and to maintain insulation, respiration and movement/migration. Water soluble aromatic hydrocarbons and lower molecular PAHs can cause chemical and biological effects. Sub-lethal effects can limit organism's capacity to feed, grow and reproduce while chronic exposure at varying concentrations can lead to mortality.

Indirect Impacts

Loss of Mangrove, Cyanobacterial Mats and Salt Marsh Habitat

The mangrove areas in the Port Hedland area provide habitat for juvenile fish and crustaceans, and feeding areas for fish, reptiles (e.g. juvenile green turtles), invertebrate benthos and birds, particularly at high tide. Potential minor impacts may include some decreased foraging success as a result of increased turbidity levels from dredging within the harbour, loss of mangrove habitat at Harriet Point and avoidance of areas with elevated turbidity levels. These potential impacts are likely to be relatively minor given that Harriet Point is not an area of significant nursery habitat for marine fauna.

Cyanobacterial mats and salt marsh communities are both considered to be of limited importance to fauna (ENV 2008), primarily because both habitat types occur at levels on the shore where soil salinities are elevated and soil moisture content is low, few organisms can tolerate these physiological stresses. Surveys of representative areas of these habitats (SKM 2008) revealed a virtual absence of fauna. The crab species *Neosarmatium meinerti* is sometimes present in these habitats and bare areas of substrate support the fiddler crab *Uca elegans* but these are present throughout the region and the limited fauna that may depend upon this habitat are able to utilise similar habitats in nearby locations.

Loss of Habitat within DMMA B1 and B2

Potential minor impacts from the reclamation of the B1 and B2 bays include the loss of habitat for visiting migratory wading birds, some fish species, flatback turtles, dugongs and other fauna. The likely impact of the loss of habitat is considered to be minor as no unique habitat occurs in the B1 or

disposal will not commence until the sea turtle or marine mammal has moved beyond 500 m or has not been sighted for 10 minutes.

As dolphins are a more mobile and agile species in comparison with large and slower moving cetaceans, they are not considered to be at risk from impact from the disposal activities and as such will not trigger a "do not commence" response.

Any incidents that occur during dredging or disposal operations that result in the injury or death of marine mammals or turtles will be reported immediately. Details of the incident including time and date of incident, cause of injury/ mortality and the species (if known) will be recorded and reported to the DEC and DEWHA within 24 hours of the incident occurring.

Noise

Impacts to sea turtles, fish and marine mammals is unlikely to be significant as mobile species will move away from the area. However, as a precautionary measure to mitigate any noise impacts to sea turtles and dolphins:

- All activities will be conducted in accordance with the construction EMP; and
- Appropriate and well maintained equipment will be used.

Light Spill

Lighting for this project may cumulatively add to existing light emissions from urban and industrial sources in the Port Hedland region. However, lighting impacts on nesting areas and turtle hatchlings due to the dredging operations are considered to be negligible as these areas are more than 3 km distant to the harbour and are separated by topographical features (e.g. dunal system) and existing residential, commercial and other industrial land uses within the West End of Port Hedland.

The disposal of dredged material to Spoil Ground 'I' will result in additional shipping traffic within the existing Port Hedland Harbour shipping channel. To minimise the impact associated with light emissions from the project on turtle nesting areas at Cemetery Beach, the following management measures will be undertaken:

- Lighting will be limited to navigational lights and those lights required for the safe and efficient operation of the dredging vessels;
- Where practical, down lights will be used; and
- Operational lights will not be shone directly onto the water unless required during operations

These measures are outline in Section 6.7 of the Dredging Management Plan.

Excess Water Discharge from DMMA

The quality of the excess water discharged from the DMMA will be managed as per the water quality measures described in **Section 8.1** and the DMP (**Appendix C**). The impact to marine fauna such as fish and invertebrates is considered to be minor and localised to the immediate vicinity of the discharge point.

Hydrocarbon Spill

Prevention and management of hydrocarbon spills will follow the BHPBIO Major and Minor Spill response procedure as well additional measures as described in **Section 9.13**.

Impacts to marine fauna from artificial lighting generated by the dredging related vessels.	Lighting limited to the use of navigational lights and those needed for safe operations. Operational lights will not be shone directly on the water unless necessary for operations.	3	0.1	0.3 (minor)
Impacts to marine fauna from a reduction in water quality resulting from excess water discharge from DMMA.	Implementation of the DMP and water quality management measures described in **Section 8.1**.	3	0.3	0.9 (minor)
Impacts to marine fauna from hydrocarbon spills.	Implementation of the construction EMP and the management measures described in **Section 9.12**.	3	0.03	0.09 (low)
Impacts to marine fauna from mangrove, cyanobacterial and salt marsh habitat loss.	Implementation of the MMP and the management measures described in **Section 8.3**.	1	1	1 (minor)
Impacts to Marine Fauna from the reclamation of DMMA B1 and B2.	Implementation of the DMP	3	1	3 (minor)

9.3 MARINE PEST SPECIES

9.3.1 Overview

Non-indigenous marine species are organisms that have been introduced into an area beyond their natural range. Invasive Marine Species (IMS) are those that are then capable of establishing a viable population and capable of spreading by either natural or human mediated processes. Past experience has demonstrated the serious environmental social and economic implications that may result following the introduction of IMS. The pest potential of IMS, however, depends on the species characteristics.

Port Hedland is currently recognised as an “at risk” ports within Australia. This assessment is based on the level of activity that occurs within the port environment and is primarily related to vessel mediated incursions. These incursions take one of two common pathways, ballast water or biofouling. The latter includes external hull fouling and internal seawater system fouling.

Considering the level of commercial activity that occurs within Port Hedland the number of known IMS and cryptogenic species is lower than expected (CSIRO 1999). The species that are known to be present are either well known cosmopolitan, common fouling species or species with less obvious impacts or inconspicuous by nature (**Section 4.3.4**).

9.3.2 EPA Objective

The environmental objective for marine pest species is to minimise the risk of marine pest species introduction establishment and spread into and within West Australian waters as a result of the dredging, reclamation and disposal activities.

9.3.3 Policy and Standards

The relevant policies and guidelines for the management of marine pest species include:

- Australian and New Zealand Environment and Conservation Council (ANZECC) Code of Practice for Anti-fouling and In-Water Hull Cleaning and Maintenance 2000; and
- Australian Quarantine and Inspection Service (AQIS) guidelines for ballast water management.

9.3.4 Potential Impacts

Port environments provide suitable natural and more often suitable artificial substrates (Tyrrell et al. 2007) for marine pest species establishment. As with any invasive species, suitable habitat to support establishment is only part of the incursion process. Vessel movement also supports the introduction and facilitates the spread of marine pest species. Marine pest species may be transported by vessels

either through ballast water or as fouling organisms attached to the vessel hulls or internal seawater systems.

Potential environmental impacts that may occur as a result of the introduction of marine pest species include the following:

- Establishment of non-indigenous marine pest species;
- Competition for food and space with native species;
- Removal of native species;
- Predation of native species; and
- Introduction of associated pests and disease.

9.3.5 Management of Impacts

Preventative Management

As per the PHPA Long Term Dredging Management Plan, all dredging related vessels will undergo inspection prior to the commencement of dredging to ensure that they are free of known or suspected marine pests. This requirement will be waived however in the event that the vessel is mobilising from another project within Port Hedland. The requirement may also be waived in the event that the vessel has undergone cleaning and pre-mobilisation inspection in dry dock immediately prior to mobilisation and has undertaken a direct sail to Port Hedland. All vessels will comply with the AQIS mandatory ballast water requirements.

All vessel marine pest species inspections will be undertaken by a qualified marine scientist. The person undertaking the inspections will be required to be experienced in the identification of marine pest species and the assessment of the risk posed by such species. A detailed description of the inspection requirements is provided in the DMP.

Contingency Measures

- In the event that suspected marine pest species are found during pre-mobilisation inspections, the vessel will undergo full cleaning and re-inspection prior to mobilisation. Treatment and cleaning and inspection will be undertaken to the satisfaction of the DoF and a copy of the treatment/cleaning and inspection report will be provided to DEC;
- In the event that suspected marine pest species are found during arrival or departure inspections or during dredging operations, the vessel will be moved offshore (preferably to waters at least 200 m deep) as soon as practically possible. The vessel will undergo full cleaning and re-inspection prior to remobilisation. Treatment, cleaning and inspection will be undertaken to the satisfaction of the DoF and a copy of the treatment/cleaning and inspection report will be provided to DEC; and
- In the event that suspected marine pest species are found on vessels within WA State waters, a monitoring program and control plan (if necessary) will be developed and implemented in consultation with the PHPA, DEC and DoF with the aim of determining if the marine pest has become established and if measures to control and eradicate the species are required.

Monitoring

- A marine pest species establishment monitoring program will be developed in consultation with the DEC in the event that marine pests are found on dredging vessel within WA State waters.

Reporting

- A vessel inspection checklist (field report) will be completed and provided to DEC and DoF within 48 hours of each pre mobilisation and arrival inspection; and
- A vessel inspection report (i.e. more detailed report) detailing the results of any inspection and/or risk assessment will be provided within 14 days of completion of the inspection or assessment. A report will be provided to the DEC and DoF at anytime where suspected marine pests are identified.

9.3.6 Outcome

A summary of the key potential impacts related to marine pest species, the associated management measures and the resulting residual risk is provided in **Table 9.3**.

Table 9.3 – Summary of Potential Impacts for Marine Pest Species and the Associated Management Measures, Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Introduction of marine pests from dredge vessels through ballast water, hull fouling or residual sediment and associated impacts on the marine environment.	Implementation of the DMP including the following management measures: - Vessel pest inspections in compliance with the PHPA requirements; - Reporting of suspected marine pests to the DEC and DoF; and - Development of a marine pest species monitoring program in the event that marine pest species are found.	10	0.1	1 (minor)

9.4 COASTAL PROCESSES

9.4.1 Overview

Dredging and reclamation activities for the project may alter the existing configuration of the Port Hedland harbour. In particular, the reclamation of embayments north of Utah Point to form DMMA B1 and B2 requires the construction of seawalls which will consist of rock armour and have a height of approximately 7 m AHD. This has the potential to impact on coastal hydrodynamics and geomorphic processes and on natural sedimentation within the harbour.

9.4.2 EPA Objective

The environmental objective for coastal processes is to maintain the integrity and stability of the coast, seafloor and tidal creeks.

9.4.3 Policy and Standards

The key guideline of relevance to the management of coastal processes is:

- Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives (DoE 2006c).

9.4.4 Potential impacts

Potential impacts arising from the establishment of sea walls at DMMA B1 and B2 include:

- Alteration of coastal hydrodynamic and geomorphic processes in the immediate vicinity at DMMA B1 and B2; and
- Alteration of natural movement of sedimentation (erosion and deposition rates) potentially leading to enhanced erosion and alterations to the coastline.

Cardno Lawson Treloar undertook numerical modelling investigations to describe the effect of the seawall construction (and subsequent reclamation of the two bays north of Utah Point) on tidal currents (Cardno Lawson Treloar 2008).

The modelling investigations considered a period of spring tides with the existing bathymetry and with the presence of the seawall across both DMMA B1 and B2. The results show that the currents are reduced by approximately 0.2 m/s near the proposed sea walls. Current directions may change by up to approximately 20° near, along and approximately 150 m away from the proposed sea walls. However, adjacent to current Berths C and D the current direction change is less significant and up to approximately 10° with a more north-south orientation (i.e. along the berth). Approximately 200 m away from the sea walls and generally within the shipping channel the change in current magnitude is minimal at less than 0.05 m/s, while the change in current direction is predicted to be less than 5°.

9.4.5 Management of Impacts

Potential impacts to hydrodynamic processes resulting from the construction and location of the sea walls are considered minor. BHPBIO has ensured that the sea walls have been configured to minimise impact on currents within the harbour.

9.4.6 Outcome

Based on the numerical modelling investigations (Cardno Lawson Treloar 2008) it is expected that the establishment of reclaimed DMMA B1 and B2 and the construction of the permanent sea walls will have a minor to negligible impact on the hydrodynamic and geomorphic processes on the inner Port Hedland harbour.

A summary of the key potential impacts to coastal processes, the associated management measures and the resulting residual risk is provided in **Table 9.4**.

Table 9.4 – Summary of Potential Impacts for Coastal Processes and the Associated Management Measures, Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Alteration of coastal hydrodynamic and geomorphic processes.	Optimise design and layout of the marine infrastructure, including configuration of sea walls.	1	1	1 (minor)
Alteration of natural movement of sedimentation (erosion and deposition rates) potentially leading to enhanced erosion and alterations to the coastline.	Optimise design and layout of the marine infrastructure, including configuration of sea walls.	3	0.3	0.9 (minor)

9.5 TERRESTRIAL FLORA AND FAUNA

9.5.1 Overview

Potential terrestrial flora and fauna impacts are only applicable to DMMA A and DMMA B2, as all other land-based areas associated with this project are located within intertidal areas where vegetation is classed as BPPH. DMMA A is located west of the existing Finucane Island access road in an area characterised by hypersaline, tidal mudflats with scattered remnant vegetation. DMMA B2 is located on the north-eastern side of Finucane Island and is represented by mainly coastal dune vegetation along the shoreward margins.

An 85 ha area will be disturbed as a result of this project within DMMA A. This will include approximately 15 ha for construction of bund walls and a laydown area. The remaining 70 ha area will be left uncleared but will form a settlement area which will be permanently covered with up to approximately 7 m AHD of dredged material. Some clearing of vegetation will be required to provide access to earthmoving equipment building the perimeter bunds at DMMA A. Terrestrial vegetation under the bund wall footprint will be removed from supratidal areas.

Within DMMA B2, approximately 2.31 ha of coastal dune vegetation will be disturbed, less than half of which is required for sea wall construction access, the remainder lies below the height of the sea walls and will be subject to inundation by dredged material.

9.5.2 EPA Objective

The environmental objective for terrestrial fauna and flora is to maintain abundance, diversity, geographic distribution and productivity of flora and fauna at species levels through avoidance or management of adverse impacts and improvement in knowledge.

9.5.3 Policy and Standards

Key EPA Position Statements and Guidelines relevant to the management of terrestrial flora and fauna include:

- EPA Position Statement No. 2: Environmental Protection of Native Vegetation in WA (2000);
- EPA Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection (2002);
- EPA Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (2004); and
- EPA Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (2004).

9.5.4 Potential impacts

DMMA A will require the removal of some vegetation prior to the construction of the bund walls. Vegetation will also be removed from the laydown area to the south of DMMA A. The general approach to other vegetation within the footprint of the bund walls is that terrestrial vegetation within supratidal areas will be cleared and stockpiled.

Approximately, 20.43 ha of *Triodia* grasslands on low sandy islands will be disturbed within DMMA A (**Figure 9.1**). In addition, approximately 60 ha of tidal mudflats and samphires will be disturbed, which is considered to be marine habitat and is discussed in **Section 9.2**. (Note: impacts to fauna which inhabit both marine and terrestrial habitats are discussed in this section).

The loss of *Triodia* grasslands through dredge inundation and earthworks represents a less than <0.01 % loss of Pre-European extent of Hummock grasslands at the Bioregional-scale (ANRA 2008).

Within DMMA B2 approximately 2.31 ha of coastal dune vegetation will be disturbed for construction access and through inundation with dredged material (**Figure 9.2**).

Factors or activities contributing to impacts on terrestrial flora and fauna include:

- Clearing of vegetation;
- Earthworks;

- Construction of bund walls;
- Movement of vehicles; and
- Inundation with dredged material.

The potential impacts as a result of these activities are:

- Direct loss of flora and vegetation communities within DMMA A and B2;
- Modification to and loss of fauna habitat;
- Introduction and spread of weeds;
- Injury and mortality of individual fauna; and
- Indirect disturbance affects to fauna from construction e.g. noise and dust.

Although a number of listed priority and migratory species may potentially use these areas for habitat and foraging, the development of DMMA A and DMMA B2 is unlikely to impact on significant areas of habitat for these species or impact on their conservation status (also refer to **Section 5**). Priority and migratory species that may occur in DMMA A and B2, with reference to their preferred habitat and wider regional distribution, are listed below:

- **Little North-Western Bat (*Mormopterus loriae cobourgensis*) – Priority 1**

  The Little North-Western Bat which is known to occur in mangrove areas in the Port Hedland harbour. It is relatively widespread and well represented in mangroves elsewhere along the Pilbara coast (Churchill 1998), which feature more substantial and better quality habitat than is present in DMMA A.

- **Australian Bustard (*Ardeotis australis)* – Priority 4**

  The Australian Bastard has previously been recorded at various locations within the Abydos Plain (within the Pilbara) and has been sighted flying over *Acacia* low shrubland within ~20 km of DMMA A and DMMA B2.

- **Eastern Curlew (*Numenius madagascariensis*) – Priority 4**

  The Eastern Curlew was sighted during field surveys of DMMA A. However, it is commonly found along tidal mudflats, reef flats and sandy beaches of the Pilbara coast and its distribution is relatively widespread across coastal Western Australia (Johnstone & Storr 1998).

- **Common Sandpiper (*Tringa hypoleucos*) – Migratory**

  The Common Sandpiper is commonly found on the edge of sheltered waters such as mangrove creeks and estuaries along the West Australian coast and on many islands (Johnstone & Storr 1998).

- **Grey-tailed Tattler (*Tringa brevipes*) – Migratory**

  The Grey-tailed Tattler inhabits tidal mud flats and estuarine sand flats along most of the northwest Australian coastline (Johnstone & Storr 1998).

- **Little Curlew (*Numenius minutus*) – Migratory**

  The Little Curlew's abundance in the Pilbara region is variable. It prefers short-grass plains as habitat, including sports grounds and tidal mud flats.

- **Oriental Plover (*Charadrius veredus*) – Migratory**

  The Oriental Plover typically inhabits sparsely vegetated plains, beaches and tidal flats (Johnstone & Storr 1998). It has been sighted within ~ 60 km of DMMA A and B2.

- **Oriental Pratincole (*Glareola maldivarum*) – Migratory**

  The Oriental Pratincole typically roosts on bare ground beside water and feeds in tidal flats and floodwaters (Johnstone & Storr 1998). Large flocks of this species have been sighted within the Port Hedland area.

- **Rainbow Bee-Eater (*Merops ornatus*) – Migratory**

  The Rainbow Bee-Eater occurs in habitats that provide suitable soil for nesting and a tall stratum of vegetation for perching. It nests in small holes excavated in sandy banks or flat sandy surfaces. The Rainbow Bee-Eater is found widely across Australia.

- **Whimbrel (*Numenius phaeopus variegates*) – Migratory**

  The Whimbrel was recorded in site surveys of DMMA A. However, it has also been recorded elsewhere within the Port Hedland area, usually foraging or roosting in moderate sized groups. The Whimbrel is also common on northwest Australian coasts and south to Cape Naturaliste (Johnstone & Storr 1998).

9.5.5 Management of Impacts

The greatest impacts to terrestrial flora and fauna are via the physical process of clearing and the loss of approximately 20 ha of *Triodia* grasslands on supratidal areas within DMMA A and 2.31 ha of sandy dune vegetation in DMMA B2. To limit other potential impacts to terrestrial flora and fauna as a result of the project, BHPBIO's construction EMP will be implemented, including the following key management and mitigation measures:

Worker Awareness

BHPBIO shall notify all personnel involved in clearing activities of any nearby protected areas (flora, fauna, heritage areas and other features), and the conditions that apply to each area. BHPBIO shall ensure all employees are competent in managing risks around these sensitive areas.

Minimising Areas to be Cleared

Clearing of vegetation will be kept to the minimum necessary for the safe and efficient construction of DMMA A and B2. The construction boundary will be demarcated by temporary fencing and/or flagging so as to avoid unnecessary clearing. Monitoring of clearing activities will be undertaken to avoid clearing of vegetation outside designated areas. Construction machinery and vehicles will be restricted to the construction boundary.

Management of Weeds

Five weed species in total have been identified within DMMA A and DMMA B2. Weed management measures detailed in the construction EMP include cleaning of all earthmoving and tracked equipment prior to arrival on site and departure; immediate reporting of any new weeds; and, appropriate handling of removed weeds to prevent spread of weed species.

Management of Removed Vegetation

Due to the characteristics of the areas to be disturbed, it is not expected that there will be limited value in stockpiling removed vegetation for future use. Removed mangroves will be collected and transported to the Hedland waste management facility. Vegetation from terrestrial and supratidal areas that is removed is to be placed either directly on disturbed areas to reduce erosion, or depending on the presence of weeds, stockpiled for later use in rehabilitation. Cleared vegetation will be stockpiled away from streams, creeks and large drainage lines to avoid pollution or disturbance of the water flow.

Fauna Management

To avoid inadvertent injury and/or mortality of fauna speed restrictions will be applied in construction areas and approach roads to reduce the risk of road kill. In the event of road kill, remains are to be removed from the road to avoid attracting other species (e.g. birds of prey). Road kills will be monitored with particular attention to the deaths of any significant species. Driver awareness training will also be conducted prior to and during construction.

9.5.6 Outcome

Based on the studies of the area (Biota 2008) it is not expected that the development of DMMA A will have a major impact on terrestrial flora and fauna. In the localised area, 85 ha loss for DMMA A and 2.31 ha loss for DMMA B2, is not expected to adversely affect the community and the species dependent on the area for habitat and foraging.

A summary of the key potential impacts to terrestrial flora and fauna, the associated management measures and the resulting residual risk is provided in **Table 9.5**.

Table 9.5 – Summary of Potential Impacts to Terrestrial Flora and Fauna and the Associated Management Measures, Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Direct loss of flora, vegetation and fauna habitat within DMMA A and DMMA B2.	Implementation of the construction EMP including the restriction of vegetation disturbance to within the approved construction footprints.	3	1	3 (minor)
Introduction and spread of weeds.	Implementation of the construction EMP including weed management measures.	1	0.3	0.3 (minor)
Injury and mortality of individual fauna.	Restriction of vehicle speeds within the construction area and on approach roads.	1	0.3	0.3 (minor)
Disturbance to fauna from construction activities (noise and dust).	Implementation of the construction EMP and management measures detailed in **Sections 9.6** and **9.10**.	1	0.3	0.3 (minor)

9.6 CONSTRUCTION NOISE

9.6.1 Overview

Construction, dredging and reclamation activities which generate noise have the potential to impact on the amenity of nearby residents and/or sensitive receptors located in close proximity to the proposed development footprints for the project. However, given existing background noise levels in the Port Hedland area, construction activities for the project are expected to have minimal impact.

9.6.2 EPA Objective

The environmental objective for construction noise is to protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.

9.6.3 Policy and Standards

Applicable legislation and guidelines for the management of construction noise include:

- Australian Standard AS 2436-1981: Guide to Noise Control on Construction, Maintenance and Demolition Sites 1981;
- Environmental Protection (Noise) Regulations 1997;
- EPA Guidance Statement No. 8: Environmental Noise (Draft) (2007); and
- EPA Guidance Statement No. 55: Implementing Best Practice in Proposals Submitted to the Environment Impact Assessment Process (2003).

9.6.4 Potential Impacts

Construction, dredging and reclamation activities will generate noise that may interfere with the amenity of nearby residents. Activities associated with the Harriet Point Dredging Project that have the potential to impact on the local community include:

- Earthworks related to the construction of DMMA A, B1 and B2;
- Creation of temporary laydown areas;
- Dredging using backhoe and cutter suction dredges;

- Pipelaying; and
- General construction traffic.

Noise generated from the project is not anticipated to have a significant impact on the local community due to high existing background noise levels and the implementation of suitable administrative and engineering control methods.

To investigate the worst case impacts from dredging and reclamation activities, noise modelling was undertaken by SVT Engineering Consultants (SVT) as detailed in **Appendix I**. A noise model was developed for dredging and for each of the DMMA. Noise sources in the model were arranged so that they would provide the worst case noise impacts for Port Hedland and Wedgefield.

A summary of the predicted worst-case noise levels at various receptor locations are given in **Table 9.6**. Predicted noise levels due to dredging activities at Brearly Street, Pretty Pool, South Hedland and Wedgefield are below the regulatory assigned noise levels, while the areas surrounding the hospital, police station and Laurentis Point are above the assigned levels. All areas comply with the day time assigned levels. The Hospital and Laurentis Point both exceed the evening and night time assigned levels, while the Police Station only exceeds the night-time level.

Table 9.6 – Summary of Noise Levels (LA_{10} in dB(A)) as a Result of Dredging and Dredge Material Management

Receptor Location	Assigned Night Level	Assigned Evening Level	DMMA A	DMMA B1	DMMA B2	DMMA A	DMMA B1	DMMA B2
			Cummulative Noise leves (LA_{10} in dB(A)			Increase in Noise in dB		
Brearly Street	37	42	28.4	27.9	28.3	0.0	0.0	0.0
Hospital Site	37	42	37.8	39.1	39.7	0.0	0.0	0.1
Laurentis Point (western extent of Town of Port Hedland)	40	45	44.9	56.7	57	0.1	0.8	0.8
Police Station	52	57	45.8	52.2	52.2	0.1	0.5	0.5
Pretty Pool	35	40	17.8	16.9	16.9	0.1	0.1	0.1
South Hedland	35	40	13.5	14.3	14.4	0.2	0.2	0.2
Wedgefield	65	65	24.8	24.4	24.3	0.2	0.2	0.2

9.6.5 Management of Impacts

The noise and vibration management actions included in the construction EMP (**Appendix L**) will be implemented throughout the duration of the project. In particular, construction, dredging and reclamation noise impacts on the local community will be minimised by:

- All construction activities, including dredging, being undertaken in accordance with Environmental Protection (Noise) Regulations 1997;
- Construction activities being managed according to weather conditions and proximity to noise sensitive areas to minimise impact or noise and vibration emissions; and
- Regular monitoring and maintenance of equipment so that equipment remains in good working condition and noise emissions are kept to a minimum.

Prior to the commencement of dredging and other construction activities, BHPBIO will inform the local community of these activities, including the proposed schedule and/or hours of construction works, and potential noise impacts to nearby sensitive receptors. Noise concerns raised by the local community will addressed through existing BHPBIO community response mechanisms.

The noise model will be updated once the contract to undertake the dredging has been award and specific plant has been determined. Through this process BHPBIO will work with the contractor to identify opportunities to further minimise noise emissions.

9.6.6 Outcome

It is anticipated that by implementing the noise management measures described above and detailed within the construction EMP, the generation of construction noise would be minimised and the existing amenity of nearby residents will be protected. **Table 9.7** summarises the impacts and management of construction noise, including the severity, likelihood and residual risk.

Table 9.7 – Summary of Potential Impacts Related to Construction Noise and Assoicated Management Measures, Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Reduced noise amenity for residents and sensitive receptors as a result of construction and dredging activities.	Implementation of the construction EMP and the management measures therein including; - Undertaking construction activities in accordance with Environmental Protection (Noise) Regulations 1997; - Management of construction activities according to weather conditions and proximity to sensitive receptors; and - Regular monitoring and maintenance of equipment.	1	1	1 (minor)

9.7 VISUAL AMENITY

9.7.1 Overview

The proposed development has the potential to impact on visual amenity values at receptor locations within the Port Hedland area, including residential areas, parks and recreational areas. However, given that the existing Port Hedland landscape is largely characterised by port infrastructure and operations, impacts to visual amenity values as a result of the project are considered to be minor.

9.7.2 EPA Objective

The environmental objective for visual amenity is to ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape to as low as reasonably practicable.

9.7.3 Policy and Standards

Applicable standards and guidelines for the assessment and management of visual impacts include:

- Australian Standard AS 4282-1997: Control of the Obtrusive Effects of Outdoor Lighting;
- Guidelines for Landscape and Visual Impact Assessment (United Kingdom Landscape Institute (LI) and Institute of Environmental Management and Assessment (IEMA) 2002); and
- Visual Landscape Planning in Western Australia: a Manual for Evaluation, Assessment, Siting and Design (WAPC 2007).

9.7.4 Potential Impacts

The physical presence of DMMA and the associated change to the landscape has the potential to affect the public visual amenity of the study area.

To determine the potential visual impacts from the project a visual impact assessment was undertaken by SKM (**Appendix K**). Key characteristics of DMMA B1 and DMMA B2 that were included in the assessment of visual impacts were:

- Construction of a surrounding sea walls of grey basalt rock to a height of approximately 7 m AHD; and
- Development of berms for DMMA B1 and B2, each to be approximately 17 m AHD.

These features will be visible on the eastern coast of Finucane Island when viewed from sensitive receptor locations within the Port Hedland townsite, including residential areas, parks and recreation areas approximately 1 km from the proposed location of DMMA B1 and DMMA B2 (**Figure 9.3**). These sensitive receptor locations are in close proximity to the harbour, have direct views to the proposed development locations and are publicly accessible.

The proposed location for the development of DMMA B1 and DMMA B2 is currently used for large scale shipping berths, with the area of land behind the berths used for storage and ancillary activities associated with the port area. Therefore, views of DMMAs B1 and B2 area will be partially obscured by ships and shiploading infrastructure at Finucane Island and the berms will assist in screening existing landside industrial activity on Finucane Island.

Due to the dominance of port and industrial infrastructure within the landscape, the development of DMMA B1 and DMMA B2 is considered to be in keeping with the existing port environment and visual impacts are considered to be minor.

9.7.5 Management of Impacts

To minimise impacts to visual amenity from the construction of DMMA B1 and DMMA B2, the appropriate design including configuration, landforming of berms and localised use of vegetative screening will be utilised where applicable. Large scale planting of native vegetation is not considered to be beneficial due to the low, sparse nature of native vegetation and would require a high degree of maintenance, including watering.

9.7.6 Outcome

Impacts to visual amenity values from the project are expected to be minor as the development of DMMA B1 and DMMA B2 is in keeping with the existing port and industrial landscape. Management measures including appropriate lighting, waste management and weed management will further reduce impacts to visual amenity values. **Table 9.8** summarises the impacts and management of visual amenity values, including the severity, likelihood and residual risk.

Table 9.8 – Summary of Potential Impacts to Visual Amenity Values and the Associated Management Measures, Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Loss of visual amenity from sensitive receptor locations within Port Hedland, including residential areas, parks and recreational areas, due to the development of DMMA.	- Appropriate design including configuration and landforming of berms; and - Use of vegetative screening where applicable.	3	0.3	0.9 (minor)

9.8 INDIGENOUS HERITAGE

9.8.1 Overview

The proposed Harriet Point Dredging proposal falls within the Kariyarra Native Title Claim. On 3 December 2007 BHPBIO entered into an agreement with the Kariyarra (Heritage Agreement), through MPL, to survey the RGP5 Port expansion area both ethnographically and archaeologically.

An archaeological survey of the project area (Stedman & Jackson 2008) identified nine archaeological sites within DMMA A. Ethnographic survey and cultural impact assessment (CIA) of DMMA B1 and B2, were surveyed in December 2007, and DMMA A was surveyed in March 2008. Two potential ethnographic sites were recorded as a result of these surveys (Anthropos Australis 2008). Contemporary issues identified in the CIA focussed on access to the survey areas in order to pursue traditional camping and fishing activities (Anthropos Australis 2008).

9.8.2 EPA Objective

The environmental objective for indigenous heritage is to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

9.8.3 Policy and Standards

Applicable State and Commonwealth legislation and guidelines for heritage management include:

- Aboriginal Heritage Act 1978;
- EPA Guidance Statement No. 41: Assessment of Aboriginal Heritage 2004; and
- Heritage of Western Australia Regulations 1991.

9.8.4 Potential Impacts

Potential impacts on indigenous heritage as a result of the Harriet Point Dredging Project include:

- Disturbance of culturally significant heritage sites;
- Access to traditional hunting and fishing grounds; and
- Impacts on cultural associations to the site and surrounding areas.

9.8.5 Management of Impacts

All concerns raised by the Kariyarra have been considered by BHPBIO in its management of environmental impacts as they affect heritage matters.

The area of land to be used for dredged material has been altered to enable numerous archaeological sites in the vicinity of the project to be avoided. BHPBIO has agreed to implement the recommendations of the Kariyarra's archaeological consultant, including a mitigation and salvage program for archaeological sites that will be disturbed by the project. The salvage program will consist of archaeological excavations, radiocarbon dating and laboratory analysis. No further archaeological recording is required for those archaeological sites which will be avoided by the project.

BHPBIO has also agreed to outline its heritage management practices for the protection of Aboriginal sites within the port area in a Cultural Heritage Management Plan (CHMP). The CHMP will be developed in consultation with the Kariyarra people. Heritage management practices outlined in the CHMP are likely to include:

- A heritage monitoring programme where ground disturbance is supervised by traditional owners;
- Fencing and signing heritage sites where appropriate;
- Restricting the availability of heritage information;
- Cultural Awareness training for BHPBIO employees and contractors; and
- Protective measures to ensure those archaeological sites that need not be disturbed are avoided.

Additionally, before any ground disturbance activities will be permitted within the project area the proposed activity will be considered as part of an internal Project Environmental and Aboriginal Heritage Review (PEAHR) process. The PEAHR process ensures that all heritage sites located in the project area and within in the vicinity of the project area are identified and avoided where practicable. If any additional survey work is warranted the results would be incorporated into and updated CHMP.

Section 18 Consultation Process

BHPBIO will seek to avoid all Aboriginal heritage sites where practicable. If any heritage site cannot be avoided, BHPBIO will apply for consent to use the land under Section 18 of the *Aboriginal Heritage Act 1972*.

BHPBIO has identified nine archaeological sites within DMMA A, and two potential ethnographic sites that it cannot practically avoid. BHPBIO has conducted several consultation meetings with representatives of the Kariyarra on 22 January 2008, 31 January 2008, 14 February 2008 and 31 March 2008. During these meetings BHPBIO project staff informed representatives of the Kariyarra about details of the proposed development, including potential environmental impacts as they affect heritage maters. Following these consultations an application was lodged with DIA on 20 June 2008 seeking Ministerial approval to conduct proposed works, notwithstanding the potential to impact the potential ethnographic and archaeological sites. In due course the application will be considered by the Aboriginal Cultural Material Committee (ACMC) and a recommendation made to the responsible Minister.

9.8.6 Outcome

Through the implementation of the CHMP, the heritage management measures described above and with ongoing liaison with the Kariyarra people the project will comply with relevant legislative requirements and potential impacts to cultural heritage values and cultural associations with the area will be minimised. **Table 9.9** summarises the impacts and management measures for indigenous heritage, and the associated severity, likelihood and residual risk.

Table 9.9: Summary of Potential Impacts and Management for Indigenous Heritage, and the Associated Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Dredging activities and the construction of DMMA has the potential to impact on sites of Aboriginal heritage significance and on cultural associations to the area.	- BHPBIO will avoid disturbance of Aboriginal heritage sites where possible. - Project design to minimise impacts to traditional hunting and fishing grounds. - Other management measures include Section 18 approvals and the development and implementation of the CHMP.	3	1	3 (minor)

9.9 RECREATION

9.9.1 Overview

Dredging activities and the construction of DMMA has the potential to impact on recreational uses these areas and the surrounding environment by the local community, including the Kariyarra people (refer to **Section 9.8**).

9.9.2 EPA Objective

The environmental objective for recreation is to ensure that existing and planned recreational uses are not compromised.

9.9.3 Policy and Standards

Applicable legislation and guidelines for recreation include:

- Occupational Safety Regulations 1996; and
- Pilbara Coastal Water Quality Consultation: Environmental Values and Environmental Quality Objectives (DoE 2006c).

9.9.4 Potential Impacts

Potential impacts to recreation resulting from the project include:

- Short-term restricted access and exclusion of boating and fishing activities within the harbour during dredging activities;
- Long-term restricted access to DMMA, particularly to the north-eastern beach within DMMA B2; and
- Reduced amenity of immediate surrounding environment for recreational uses.

A marine construction exclusion zone adjacent to DMMA B1 and B2 will be established within the Port Hedland harbour to ensure public safety during construction of sea walls and during dredging operations. The marine exclusion zone will be in place for approximately 40 weeks and will restrict marine based recreational activities such as boating and fishing. Once dredging has been completed, access to the marine environment for recreational activities will be re-established.

The construction of DMMA A, B1 and B2 for the project will result in the permanent loss of access to these areas for recreational activities. In particular, within DMMA B2 the north-eastern beach area will be partially lost as an unofficial recreational area used by some members of the community.

Reduced amenity of the surrounding environment for recreational uses may result from the project if aspects such as excess water discharge (**Section 8.1**), noise (**Section 9.6**), dust (**Section 6.10**), waste (**Section 9.11**), hydrocarbons and hazardous materials (**Section 9.12**) are not appropriately managed and directly impact on the surrounding environment. However, the management measures outlined for each of these aspects in the respective sections are expected to minimise potential impacts to the surrounding environment and subsequently recreation.

9.9.5 Management of Impacts

BHPBIO is committed to ensuring that impacts on recreational activities are managed appropriately. BHPBIO recognises the local community has a connection to the harbour through regular recreational activities, such as boating and fishing.

Prior to the establishment of a marine construction exclusion zone and the commencement of construction of the sea walls and dredging operations, BHPBIO will inform the local community of the scheduling of these activities and of restrictions to the harbour. Scheduling of construction and dredging impacts will take into consideration potential impacts to the local recreational activities where practicable. Restricted access to the harbour area within the marine exclusion zone will only be maintained for the duration of construction and dredging activities for public safety.

In recognition of the loss of DMMA A, B1 and B2 for recreational uses, BHPBIO will work with the community to identify opportunities for maintaining and/or enhancing coastal access for recreational use. BHPBIO will also continue to work with and support the Town of Port Hedland and Port Hedland Port Authority through the Community Partnership Program.

Appropriate management of aspects which may impact on the surrounding environment and recreation, including excess water discharge, noise, dust, waste, hydrocarbons and hazardous materials, will be implemented through the DMP, construction EMP and as detailed within the respective sections of the ERD for each of these factors. In particular, BHPBIO will comply with Pilbara Coastal Water Environmental Quality Objectives to ensure that marine water quality is maintained and is safe for recreational activities in and on the water, including swimming, boating and fishing.

9.9.6 Outcome

Whilst the project has the potential to impact on recreational activities of the local community, ongoing community consultation will help ensure that any potential impacts are addressed and will enable further improvements to be made for the benefit of the local community. **Table 9.10** summarises impacts and management measures for recreation, and the associated severity, likelihood and residual risk.

Table 9.10 – Summary of Potential Impacts and Management for Recreation, and the Associated Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Dredging activities and the construction of DMMA has the potential to impact on recreational uses of these areas and the surrounding environment by the local community.	- Prior to the commencement of construction activities and dredging, BHPBIO will inform the local community of the scheduling of these activities and of restrictions to the harbour; - BHPBIO will continue to work with and support the Town of Port Hedland and Port Hedland Port Authority through the Community Partnership Program; - BHPBIO will work with the local community to identify opportunities for maintaining coastal access for recreational use; and - Management of excess water discharge, noise, dust, waste, hydrocarbons and hazardous materials, will be addressed in the implementation of the DMP, construction EMP and as detailed for each of these factors in this ERD.	3	0.3	0.9 (minor)

9.10 CONSTRUCTION DUST

9.10.1 Overview

Dust generated during construction activities and within DMMA has the potential to impact on the health, welfare and amenity of people and the surrounding environment, including mangroves (**Section 8.3**). However, appropriate site management for the project, including the use of dust suppression measures, will minimise potential impacts to people and the surrounding environment.

9.10.2 EPA Objective

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

9.10.3 Policy and Standards

Applicable legislation and guidelines for the management of construction dust include:

- EPA Guidance Statement No. 18: Prevention of Air Quality Impacts from Land Development Sites 2000; and
- Occupational Safety Regulations 1996.

9.10.4 Potential Impacts

Dust emissions may be generated during dredging and reclamation through a number of activities, including:

- Clearing and site levelling;
- Earthmoving activities;
- Vehicular movement on unsealed tracks; and
- Wind erosion on cleared/reclaimed areas.

Dust emissions arising as a result of all or some of the above mentioned activities may have the potential to adversely impact on human health, visual amenity, and the surrounding vegetation and fauna. Dust generated during construction also has a nuisance value.

To investigate dust impacts from DMMA, modelling of wind-generated dust emissions from DMMA A, B1 and B2 was undertaken by SKM (**Appendix J**). For modelling, it was assumed that dredged material was in its dry state, the surface area was untreated and there was no vegetation cover, therefore representing a “worst-case” scenario. Predicted dust emissions were assessed at two receptor locations: the Harbour monitoring location and the Hospital monitoring location.

Modelling predicted that at the Harbour monitoring location there will be a slight increase in the ground level PM_{10} dust concentrations (2.5% for maximum concentrations, 3.4% for the annual average) resulting from the project. For the Hospital monitoring location modelling predicted minimal increase in the maximum ground level dust concentration (0.1% for the 99th percentile for maximum concentrations, up to 0.9% for the annual average).

With the implementation of dust suppression measures, such as revegetation of berms for DMMA B1 and B2, it is expected that dust emissions can be reduced, minimising potential impacts to health, visual amenity and the surrounding vegetation and fauna.

9.10.5 Management of Impacts

The dust management actions included in the project construction EMP will be implemented through the duration of the project. Particular measures to reduce ambient dust levels during constructions include:

- An induction program will ensure that all employed are made aware of the need to minimise dust generation;
- Regular watering of unsealed roads, exposed surfaces, active construction areas and stockpiles;

- Restriction of vehicle movements and vehicle speeds to reduce dust emissions;
- Use of environmentally safe dust suppressants;
- General housekeeping practices to ensure that there is no accumulation of waste materials within the construction site that may generate dust; and
- Reporting of any community complaints regarding dust levels.

To assist in dust management, daily monitoring of weather / wind conditions will be undertaken. Daily inspection of site conditions and dust suppression measures will also be undertaken to ensure dust control measures are effective.

To reduce dust emissions from DMMA A, B1 and B2 as a result of wind erosion of dredged material, these areas will be revegetated where possible. Particularly, revegetation/stabilisation of berms for DMMA B1 and B2 and rehabilitation/stabilisation of DMMA A (as detailed in **Section 8.4**), will assist in reducing dust emissions.

9.10.6 Outcome

By implementing the dust management measures described in the construction EMP and outlined above, the generation of construction dust from DMMA will be minimised. **Table 9.11** summarises impacts and management measures for construction dust, and the associated severity, likelihood and residual risk.

Table 9.11 - Summary of Potential Impacts and Management of Construction Dust, and the Associated Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Impacts to the surrounding environment, health, welfare and amenity of people and land uses as a result of dust generated from dredging operations and the construction of DMMA.	Implementation of the construction EMP and the management measures therein including: - Regular watering of exposed surfaces; - Use of environmentally safe dust suppressants; - Restriction of vehicle speed and movement; - Monitoring of weather / wind conditions; and - Reporting of any community complaints regarding dust levels. - Revegetation/stabilisation of berms for DMMA B1 and B2 and rehabilitation of DMMA A.	3	0.3	0.9 (minor)

9.11 WASTE MANAGEMENT (SOLID AND LIQUID)

9.11.1 Overview

Solid and liquid wastes generated during dredging activities and construction of DMMA have the potential to negatively impact on the surrounding environment if not managed and disposed of correctly.

Solid and liquid wastes that may be generated by the project include:

- Packaging material (plastic wrapping, pallets, etc);
- Concrete;
- Scrap metal;
- Waste oil, hydrocarbons and hazardous materials (refer to **Section 9.12**);
- Recyclable materials (paper, cardboard, aluminium);
- General food packaging and scraps; and
- Domestic sewage.

9.11.2 EPA Objective

The environmental objective for solid and liquid waste is to ensure that wastes do not adversely affect health, welfare and amenity of people and land uses and is managed in accordance with waste hierarchy.

9.11.3 Policy and Standards

Applicable legislation and guidelines for the management of wastes include:

- Environmental Protection (Controlled Waste) Regulations 2004;
- International Convention for the Prevention of Pollution from Ships (MARPOL Convention) 1973/1978;
- Litter Regulations 1981; and
- Review of Waste Classification and Waste Definitions 1996 (as amended) (DoE 2005).

9.11.4 Potential Impacts

If not handled correctly, domestic and hazardous solid waste and sewage produced during the dredging and reclamation program have the potential to contaminate marine, ground and surface waters, impact upon marine fauna and pose a risk to human health. Furthermore, unnecessary wastes result in increased landfill requirements. BHPBIO will ensure that the generation of waste is minimised and that any waste products are handled and disposed of in an acceptable manner.

9.11.5 Management of Impacts

Waste management is addressed within the construction EMP which has been developed for BHPBIO Port Hedland Operations. Particular measures to reduce waste generation include:

- A waste hierarchy program;
- Clear signage and coverage of wastes;
- Collection of domestic rubbish in bins and recycled or disposed of by a licensed contractor at the municipal landfill. Recyclable materials will be stored in a designated area until their removal from site;
- Return of empty oil and chemical containers such as metal or plastic drums to the supplier for reuse or recycling where possible; and
- The use of absorbent material to mop up minor oil or chemical spills and disposed of appropriately as contaminated material.

During dredging operations, no sewage from dredging or support vessels will be disposed to the marine environment while operating in the port. Sewage from the vessels will either be discharged outside of Western Australia Coastal Waters (>12 nm) in accordance with the MARPOL Convention 1973/1978 and the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, or will be transferred and disposed of in shore based facilities.

There will be no discharge of materials, including liquid or solid wastes, into the marine environment unless approved. Any equipment or items that accidentally enter marine waters will be recovered as soon as practicable.

9.11.6 Outcome

By adhering to the waste management measures described in the construction EMP and the DMP, the generation of waste will be minimised and there would not be a significant detrimental effect on the health, welfare and amenity of people and land uses. **Table 9.12** summarises impacts and management measures for solid and liquid waste, and the associated severity, likelihood and residual risk.

Table 9.12 – Summary of Potential Impacts and Management of Solid and Liquid Waste, and the Associated Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Impacts to the surrounding environment, health, welfare and amenity of people and land uses as a result of incorrect management and disposal of solid and liquid waste.	Implementation of the construction EMP and the management measures therein including: - Clear signage of bins; - Segregation of waste types; - Coverage of waste materials; - Recycling; - Workforce awareness; and - Reporting of waste removed from site. No disposal of sewage within the port and no discharge of materials into the marine environment unless approved.	3	0.03	0.09 (low)

9.12 HYDROCARBONS AND HAZARDOUS WASTES

9.12.1 Overview

Hydrocarbons and hazardous wastes have the potential to impact on the surrounding environment, including marine water quality (**Section 8.1**), mangroves (**Section 8.3**), marine and terrestrial fauna (**Sections 9.2** and **9.5**), as a result of leaks, spills and incorrect storage and disposal of these materials. Appropriate management of dredging activities for the project, including dredging vessel operations, construction and management of the DMMA, will reduce the risk of hydrocarbons and hazardous materials impacting on the surrounding environment.

9.12.2 EPA Objective

The environmental objective for hydrocarbons and hazardous wastes is to ensure hydrocarbons and any other hazardous wastes are handled and stored in a manner that minimises the potential for impact on the environment through leaks and spills.

9.12.3 Policy and Standards

Applicable legislation and guidelines for the management of hydrocarbons and hazardous materials include:

- Australian Standard AS 1940-1993: The Storage and Handling of Flammable and Combustible Liquids 1993;
- Australian Standard AS 3780-1994: The Storage and Handling of Corrosive Substances 1994;
- Environmental Protection (Controlled Waste) Regulations 2004; and
- Environmental Protection (Unauthorised Discharges) Regulations 2004.

9.12.4 Potential Impacts

Diesel fuel, oil and grease are handled on a regular basis during dredging and reclamation operations. The handling of hydrocarbons creates a potential risk to the environment in the event that spillage occurs. These spills may lead to the atmospheric, ground or water contamination generating damage to intertidal marine habitats and subsequent mortality of sensitive biota. Such spills also have the potential to disrupt recreation activities and generate reduced aesthetics.

The main areas of risk during dredging and reclamation operations are:

- Refuelling of the dredge (bunkering);
- Storage and handling of oils, grease and chemicals; and
- Breakdown of grease on moving parts such as the cutter ladder and spud carriage.

9.12.5 Management of Impacts

The management of hydrocarbons and hazardous materials is addressed within the construction EMP.

Particular measures to manage hydrocarbons during the dredging activities include implementation of:

- Appropriate storage and handling procedures,;
- Segregation of hydrocarbon waste from stormwater and other water via closed systems;;
- Environmental acceptable recycling and/or disposal of captured waste. Oily wastes generated at sited will be collected and disposed of in accordance with the Environmental Protection (Controlled Waste) Regulation, 2004. An approved contractor will be used for the removal of waste oil for recycling;
- Spill contingency plans will be prepared to ensure appropriate measure are taken to manage:
    - Refuelling of the dredge (bunkering);
    - Storage and handling of oils, grease and chemicals; and
    - Oil spills will be managed in accordance with the BHPBIO Major and Minor Spill Response Plan; and
- Spill response kits will be located in close proximity to storage areas for prompt response in the event of a spill or leak.

The dredging and reclamation activities would be managed in accordance with the above measures, including maintaining the requirements for all hazardous wastes to be removed from site.

9.12.6 Outcome

The proposed dredging and reclamation activities will not result in significant changes to the amount or type of hazardous wastes generated or currently stored at the BHPBIO Finucane Island Operations. As a result, by implementing hydrocarbon and hazardous materials management measures described in the construction EMP, it is not expected there will be a significant detrimental effect in addition to, or different from, the effect of current operations. **Table 9.13** summarises impacts and management measures for hydrocarbons and hazardous wastes, and the associated severity, likelihood and residual risk.

Table 9.13 – Summary of Potential Impacts and Management of Hydrocarbons and Hazardous Materials, and the Associated Severity, Likelihood and Residual Risk

Potential Impact	Management	Risk Assessment		
		Severity	Likelihood	Residual Risk
Impacts to marine water quality, mangroves, fauna, recreation and aesthetic values as a result of spills and leaks of hydrocarbons and hazardous materials.	Implementation of the construction EMP and the management measures therein including: - Appropriate storage and handling procedures; - Clean-up procedures for spills; and - Segregation of oily waste materials from general waste. Implementation of the DMP and specific measures for dredging activities including: - Storage of oil, grease, chemicals and detergents below deck; - Development of spill contingency plans prior to commencement of works; and - Location of spill response kits in close proximity to dredging operations.	3	0.03	0.09 (low)