Northern Territory Government

DEPARTMENT OF
NATURAL RESOURCES, ENVIRONMENT, THE ARTS AND SPORT

ASSESSMENT REPORT 67

EAST ARM WHARF EXPANSION PROJECT

NT DEPARTMENT OF LANDS AND PLANNING

ENVIRONMENTAL ASSESSMENT REPORT
AND
RECOMMENDATIONS

by the

Environment and Heritage Division
Department of Natural Resources, Environment
the Arts and Sport

December 2011

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Glossary

AAQ NEPM	National Environment Protection (Ambient Air Quality) Measure
AQMP	Air Quality Management Plan
ASS	Acid Sulphate Soils
CEMP	Construction Environmental Management Plan
CO_2-e	Carbon Dioxide Equivalent
CSD	Cutter Suction Dredge
DCM	Department of the Chief Minister
Draft EIS	Draft Environmental Impact Statement
DHAC	Darwin Harbour Advisory Committee
DLP	Northern Territory Department of Lands and Planning
DMP	Dredge Management Plan
DPC	Darwin Port Corporation
DSEWPC	Australian Department of Sustainability, Environment, Water, Population and Communities
EA Act	NT *Environmental Assessment Act 1982*
EAAP	NT *Environmental Assessment Administrative Procedures 1984*
EAW	East Arm Wharf
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environment Management Plan
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GHG	Greenhouse Gas
INPEX	Ichthys Gas Development Project
MSB	Marine Supply Base
NES	National Environmental Significance
NEPM	National Environment Protection Measure
NOI	Notice of Intent
NRETAS	Department of Natural Resources, Environment, the Arts and Sport
NT	Northern Territory of Australia
NTG	Northern Territory Government
NTU	Nephelometric turbidity unit
PASS	Potential Acid Sulphate Soils
PM	Particulate Matter

PM_{10}	Particulate Matter with an Average Aerodynamic Diameter of 10 µm and Less
RLO	Rock Loadout
the Minister	Northern Territory Minister for Natural Resources, Environment and Heritage
the Project	East Arm Wharf Expansion Project
the Report	This Assessment Report 67, for the East Arm Wharf Expansion Project
the responsible Minister	Minister for Lands and Planning
TAG	Technical Advisory Group
TPWC Act	*Territory Parks and Wildlife Conservation Act*
TSP	Total Suspended Particulates
WWII	World War II

Units and Symbols

>	Greater than
<	Less than
%	Percent
/L	Per litre
g	gram
ha	hectare
L	litre
m	metre
m^3	Cubic metre
M	Million
Mm^3	Million cubic metres

Definitions

CO_2	Carbon dioxide
CO_2-e	CO_2 equivalent: A unit of greenhouse gas emissions calculated by multiplying the actual mass of emissions by the appropriate Global Warming Potential. This enables emissions of different gases to be added together and compared with CO_2.
ESD	Using, conserving and enhancing the communities' resources so that ecological processes, on which life depends, are maintained and the total quality of life now and in the future can be increased. ESD is development that aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations

Executive Summary

Environmental impact assessment (EIA) is the process of defining those elements of the environment that may be affected by a development proposal and analysing the risks associated with the identified potential impacts. This Assessment Report (the Report) assesses the environmental impact of the East Arm Wharf Expansion Project (the Project), proposed by the Northern Territory (NT) Department of Lands and Planning (DLP) (the Proponent) of the Northern Territory Government (NTG).

The expansion of the East Arm Wharf (EAW) in the Eastern Arm of Darwin Harbour, in the Northern Territory (NT) of Australia is proposed to address increased demands on the wharf for export of bulk minerals, storage, and from the Department of Defence and other industries. The proposal is to construct a:

- Marine Supply Base (MSB) to service oil and gas industries;
- Barge ramp and hardstand area, including berthing for barges and facilities for loading and unloading; and
- Extension of existing wharf bund and additional mooring facility to accommodate tugs, customs boats and other smaller vessels.

While this assessment is for the above three project components, it is inappropriate to isolate the monitoring and management of environmental impacts of this Project from the ongoing operations of the existing port facility. The Darwin Port Corporation is responsible for the management of land, waterways and facilities within the Port of Darwin. Recommendations made in this assessment report address relevant construction activities and ongoing expanded port operations.

The Project is being assessed under the Bilateral Agreement for Environmental Impact Assessment between the NT and Australian Governments, to satisfy requirements of both the NT *Environmental Assessment Act 1982* (EA Act) and the Australian *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This Assessment Report forms the basis of advice to the NT Minister for Natural Resources, Environment and Heritage on the environmental issues associated with the Project. The Minister is required to make comment and/or recommendations with regard to the proposal to the Minister for Lands and Planning (the responsible Minister).

The Report is based on a review of the draft Environmental Impact Statement (EIS), Supplement to the draft EIS (Supplement), project variations as approved by the Minister, further information request, and comments from the public and NT government agencies.

Major Issues

The major issues associated with the Project, and measures identified to address them, are:

- Direct loss of potentially significant benthic habitat from seabed excavation for dredging activities and placement of project footprints. The design of the largest project component - the Marine Supply Base, was revised significantly over the course of this assessment reducing the potential of negative impacts on benthic habitats associated with dredging. The revised MSB access channel design decreased estimated dredging volume from 1 008 320m^3 to

640 000m^3, the channel footprint reduced from 18.5 ha to 8.4 ha and the access channel re-located 300 metres away from South Shell Island where significant coral reef communities exist.

- A lack of information presented for this EIS has led to an incomplete understanding of the significance of the benthic habitat at the site, and on a regional scale. Ongoing biodiversity monitoring of benthic species at East Arm and South Shell Island has been recommended to be incorporated into the Darwin Port Corporation Environmental Monitoring Program. The draft Dredge Management Plan (DMP) also commits to monitoring pre-dredging conditions, monitoring in areas of predicted dredging effects and comparing monitoring results (species abundance, health of benthic taxa) to baseline conditions at completion of dredge works. The monitoring plans should consider the outcomes of previous studies and monitoring specific to this location. It is recommended that some final monitoring programs and reports are subjected to independent expert review prior to provision to relevant government agencies.
- The potential for dredging to impact the marine environment at EAW including smothering of the sea floor by mobilised sediment, increased water turbidity and altered water current directions and flow rates caused by dredging access channel and berths. A final Dredge Management Plan and Contractor Method Statement is required prior to dredging works to address the environmental aspects of the dredging activity and provide suitable management measures to minimise identified environmental impacts.
- Dredging activities have the potential to impact marine water quality. A Water Quality and Sedimentation Monitoring program will be implemented before, during and after dredging, to allow determination and documentation and, if required, adaptive management of the effects on water quality. The DMP commits to establish existing conditions to detect unacceptable levels of change associated with dredging.
- The potential impacts of dredge spoil disposal onshore in existing Pond K cannot be adequately assessed in the absence of detailed characterisation of the dredge spoil and investigations into whether Pond K is of sufficient design and capacity for dredge spoil disposal. The DMP commits to characterising sediments to be dredged and devising a treatment and return water release strategy from onshore ponds prior to any dredging.
- The EIS did not present a clear assessment of terrestrial water quality. The stormwater management strategy and management actions have not yet been developed to respond to the detection of unacceptable stormwater contaminants discharging into the Darwin Harbour. While stormwater management was provided for individual Project components, it is inappropriate to isolate the assessment of these components from the overall, existing port facility. No details were provided on alternative ponds to Pond K (currently used for stormwater management purposes) to manage stormwater at the port.
- The potential for stormwater runoff and/or wastewater runoff impacting marine water quality in Darwin Harbour. This Report recommends the EAW Drainage Strategy and Retention Pond Designs be independently reviewed prior to submission to NRETAS.
- Species listed as being of National Environmental Significance (NES) under the EPBC Act and their habitats may be impacted by the Project. These

species include coastal dolphins, dugong, sawfish, marine turtles and migratory birds and the Project may impact on their feeding/roosting/breeding habitats from dredging activities, increased marine vessel traffic (noise and collisions) and reduced water/sediment quality. In the absence of long-term scientific research and monitoring, it is not known whether the EAW is a significant habitat for these species and how Project activities may challenge coastal dolphin species, and whether this will add pressure to their small and susceptible populations in the Harbour. The draft Dredge Management Plan provided a draft marine megafauna response procedure detailing management actions when marine fauna is observed. The Proponent commits to Standard Operating Procedures within marine fauna exclusion zones (extending 500m from the source of noise) to protect marine fauna species from impacts of marine noise. Further research into coastal dolphin populations in the EAW area and additional monitoring on whether migratory birds can and do use nearby areas once dredge spoil ponds are filled is recommended.

- The cumulative impacts from this Project and related projects (INPEX, increased bulk materials from mining projects through the EAW port), and combined impacts of underwater noise, increased vessel movements, turbidity and sedimentation, increases the risks of impact on Darwin Harbour and regional marine ecosystems. The Proponent will need to ensure its activities are managed with consideration of the INPEX dredge management and monitoring programs within Darwin Harbour. While the Project construction period is not lengthy, it is anticipated there will be residual detriment to the Harbour from an operating, expanded port facility.

Conclusions

Following review of the draft EIS, Supplement and further information requested, significant uncertainties associated with the Project remain. The level of information provided in the EIS has not been of a standard to enable comprehensive assessment of the risks. While the documentation provided commits the Proponent to minimising environmental impact, less predictable impacts such as impacts on marine megafauna and benthic habitat will need to be managed to an acceptable level.

The levels of uncertainty for impacts on the marine environment can be addressed by continuing to develop knowledge of the marine environment in the Project area. Further collection of baseline information and intensive monitoring will inform the tolerance of these ecosystems to external pressures such as dredging and general port operations. The Proponent should also acquire and analyse the existing background environmental data that has been collated for dredging-relevant environmental variables (e.g. turbidity, sediment deposition rates, coral health, and climate) from previous dredging campaigns and other projects in the Harbour, to increase and retain knowledge of natural tolerances and susceptibilities of local benthic organisms, and inform the development of monitoring programs for this Project.

While this assessment is of the expansion project components only, the Project will form part of the entire port operations and the monitoring and management of the existing port facility will require review to accommodate outcomes of this assessment. The Darwin Port Corporation is responsible for the management of land, waterways and facilities within the Port of Darwin. Recommendations made in

this assessment report address relevant construction activities and ongoing expanded port operations.

Due to information gaps remaining in this assessment, the Proponent, government and community will be reliant on intensive, post-assessment data collection and monitoring to determine the significance of, and appropriate responses to, key impacts. These monitoring requirements are captured in the commitments made by the Proponent and recommendations of this Report. The ongoing environmental monitoring and adaptive management required from the Proponent must demonstrate that any environmental impacts from the Project are no greater than those predicted in this assessment.

Information needs highlighted in this assessment must be addressed and appropriate management procedures included in the Environmental Management Plans (EMP) implemented. The project will proceed in accordance with a suite of EMPs that the Proponent has committed to finalising in consultation with relevant government agencies. As the EMPs are an integral component of managing environmental impact and given the amount of further development work required, it is recommended the relevant EMPs undergo independent review to ensure the adequacy of those plans and monitoring programs.

Based on its review of the EIS and the Proponent's response to submissions, the environmental impacts of the project can be managed at an acceptable level, provided that the environmental commitments, safeguards and recommendations detailed in the EIS, this Assessment Report and in the final management plans are implemented and are subject to regular reporting and compliance auditing.

List of Recommendations

1. Recommendation

The Proponent will ensure that the proposal is implemented in accordance with the environmental commitments and safeguards:

- **Identified in the East Arm Wharf Expansion Project's Environmental Impact Statement (draft EIS and Supplement); and**
- **Recommended in this Assessment Report.**

All safeguards and mitigation measures outlined in the Environmental Impact Statement are considered commitments by the Proponent.

2. Recommendation

The Proponent will advise the Minister of any changes to the proposal in accordance with clause 14A of the Environmental Assessment Administrative Procedures, for determination of whether or not further assessment is required.

3. Recommendation

The Proponent work closely with INPEX regarding dredge management planning and related monitoring programs so that activities for the two projects consider the temporal and spatial scale of each other's activities and a consistent approach that maximises synergies and learning outcomes is achieved.

4. Recommendation

The Contractor Method Statements (CMS) include best practice outcomes to minimise environmental impact and shall undergo review by the Technical Advisory Group to ensure they are consistent with the requirements of the final Dredge Management Plan prior to the commencement of dredging works.

5. Recommendation

The East Arm Wharf dredge dispersion modelling must be verified with monitoring of sedimentation and water quality and appropriate ecological indicators.

6. Recommendation

A Monitoring Program (and subsequent contingencies to manage dredging in the event monitoring indicates a significant departure from predicted impacts) needs to be specified in the final Dredge Management Plan, to the satisfaction of the Technical Advisory Group.

7. Recommendation

Prior to dredge spoil disposal to existing dredge spoil retention ponds, the Proponent shall provide information in the final Dredge Management Plan for review by the Technical Advisory Group on:

- **a treatment and return water release strategy and water quality monitoring from onshore emplacements; and**
- **capacity of ponds and proposed design of settling and de-watering structures for dredge spoil disposal of approximately 800 000m^3 of material.**

8. Recommendation

The Proponent shall implement an on-site sediment sampling and testing survey to identify the quality and potential contaminants and/or ASS contained within target dredged sediments.

9. Recommendation

As part of the final Dredge Management Plan, the Proponent must undertake a *Benthic Habitat Survey* to establish ground conditions and address the following prior to commencement of dredging works:

- **Conduct field surveys to verify desktop benthic habitat mapping;**
- **Establish threshold for ecological receptor sensitivities (linked to select "lead" impact indicators for water quality);**
- **Monitoring design to enable comparative analysis identifying target benthic parameters, duration for monitoring and the relationship to short term water quality monitoring;**
- **Methods for the surveys following commencement and completion of dredging to identify effects outside the Zone of High Impact;**
- **Location and establishment of survey sites in Zones of Moderate Impact and Zone of Influence and Reference sites;**
- **Timing and frequency of monitoring and treatment of survey data; and**

- **Identifying unacceptable impacts through identification of monitoring thresholds.**

10. Recommendation

The proponent shall further define the spatial Zone of Moderate Impact and the Zone of Influence for the EAW dredging program, based on methodology described in *Environmental Assessment Guideline for Marine Dredging Proposals* (Environmental Protection Authority, Government of Western Australia, 2011) and use the resultant spatial margins to define an area of common impact with the INPEX dredging program. If present, this area of common impact should be defined, and specific management measures should be developed in consultation with INPEX, and on the advice of the TAG.

11. Recommendation

The Proponent consider appropriate mitigation measures or offsets to compensate for potential residual detriment of Project activities on migratory bird species.

12. Recommendation

The Proponent contributes to coastal dolphin research effort and uses information gained in dolphin research to mitigate cumulative impacts of the project occurring on coastal dolphin species.

13. Recommendation

The Relevant EMPs are to be amended to include measures for minimising vessel interactions / collisions with coastal dolphins, marine turtles, dugongs and other large marine fauna for dredging operations and ongoing port operations. The relevant plans should include:

- **details on procedures to reduce the risk of vessel strikes on large marine vertebrates (marine turtles, dugongs and cetaceans) such as speed limits;**
- **details on procedures for monitoring and reporting of vessel strikes on large marine vertebrates;**
- **details of adaptive management measures if monitoring indicates increased vessel strikes; and**
- **plans to monitor for stranded, injured or dead large marine vertebrates.**

14. Recommendation

Following completion of dredging, a report detailing the outcomes of the associated monitoring (including coral health) is to be made publicly available. The report should indicate whether there has been any significant ecological effect detected outside of the approved Zone of High Impact to inform the need for further monitoring, and whether collection of tissue sample collections are advised.

15. Recommendation

Prior to commencement of any site development works, the Proponent shall prepare and submit a Water Quality and Sedimentation Monitoring Program to the approval agencies. The program shall address the following:

- **Statistical design for comparative analysis describing spatial and temporal trends in ambient water quality and sedimentation rates near the dredge source;**
- **Identify key parameters for monitoring including turbidity and sedimentation rates but also, depending on sediment content, potential contaminants and aquatic health indicators;**
- **Propose rapid and reliable methods for data collection, acquisition and interpretation to enable adaptive management of future dredge activity; and**
- **Analysis of monitoring data to establish dredge effects.**

16. Recommendation

The East Arm Wharf Drainage Strategy and Retention Pond Design must include the following:

- **details of alternative ponds that will be constructed for stormwater management purposes;**
- **progress of the implementation of short and medium term management and engineering actions to address stormwater impacts;**
- **current monitoring at EAW and the adequacy of the management actions to address stormwater management at EAW based on stormwater, marine and sediment quality monitoring results;**
- **proposed monitoring program that will enable the development of water quality objectives linked to a set of management responses;**
- **water monitoring program to verify the systems in place are adequately treating stormwater to an acceptable standard; and**
- **triggers for storm water quality standards at discharge points so that appropriate management actions are instigated should those triggers be reached.**

17. Recommendation

It is recommended that the Proponent:

- **secure connection to the mains sewer to mitigate any public health and environmental issues resulting from effluent discharges; and**
- **investigate and incorporate options for stormwater/waste water recycling and reuse during construction and operation of the Project into the Environmental Management Plan.**

18. Recommendation

The Air Quality Management Plan (AQMP) is to address both construction and operation and include management actions to ensure PM_{10} levels are within acceptable ranges. The AQMP should include:

- **24 hour average HiVol samples of PM_{10} levels;**
- **determine trip points where action should be taken to identify air pollutant sources; and**
- **list management actions to mitigate impacts to air quality.**

19. Recommendation

Incorporate GHG emissions into the accounting and reporting mechanisms described within the EAW EMP. The Greenhouse Gas Management Plan as part of the EMP should include:

20. Recommendation

It is recommended that the Proponent develop a Territory-based offsets package to offset residual impacts to marine biodiversity from the construction and operation of the Project.

21. Recommendation

The following Environmental Management Plans, incorporating relevant environmental monitoring programs, are to be independently reviewed by a suitably qualified expert(s) prior to submission to relevant government agencies:

- **Water Quality and Marine Sediment Management Plan;**
- **Darwin Port Corporation Environmental Monitoring Program including ongoing benthic habitat monitoring; and**
- **Stormwater Management Plan (including East Arm Wharf Drainage Strategy and Retention Pond Design Report).**

Remaining EMPs are to be provided to relevant government agencies for approval prior to commencement of Project activities.

22. Recommendation

Environmental performance, based on the results from the Darwin Port Corporation Environment Monitoring Plan and relevant EMPs for the Project are to be incorporated into the public Darwin Port Corporation (DPC) Annual Reports on the DPC website.

The proponent should provide public access to final environmental management plans and a reporting mechanism to inform compliance with the plans.

1 Introduction and Background

This Report assesses the environmental impact of the East Arm Wharf Expansion Project (the Project).

The Northern Territory (NT) Department of Lands and Planning (DLP) (the Proponent) of the Northern Territory Government (NTG) proposes to expand the East Arm Wharf (EAW) in the Eastern Arm of Darwin Harbour, in the Northern Territory (NT) of Australia to address increased demands on the wharf for export of bulk minerals, storage, and from the Department of Defence and other industries. The proposed expansion includes a:

- Marine Supply Base (MSB) to service the existing and developing oil and gas industries;
- Barge ramp with hardstand area and loading facilities; and
- A series of pontoons and construction of moorings to accommodate tugs and other smaller vessels.

This Environmental Assessment Report (the Report) is based on a review of the draft Environmental Impact Statement (draft EIS), Supplement to the draft EIS (Supplement), further information provided and comments from the public and Government agencies on the draft EIS. The draft EIS, Supplement and further information are collectively referred to as the EIS. Submissions received on the draft EIS are summarised in Appendix 1.

The EIS can be viewed on the Department of Natural Resources, Environment, the Arts and Sport (NRETAS) website at:
http://www.nt.gov.au/nreta/environment/assessment/register/eastarm

1.1 Environmental Impact Assessment Process

Environmental impact assessment (EIA) should:

- identify potential impacts on the environment (where environment is defined broadly according to the *Environmental Assessment Act*); and
- evaluate the risks of those impacts occurring.

Through its assessment of Project risks the Proponent must demonstrate:

- that these risks can be satisfactorily managed within acceptable levels e.g. impacts would not result in long term environmental detriment; and
- the effectiveness/feasibility of management measures in a precautionary/risk management framework.

Assessment gives weighted consideration to:

- values and risks;
- estimation of the likelihood of success of preventative and remedial measures; and
- the validity and comprehensiveness of monitoring programs established to provide ongoing measures of the environmental effects of the proposed Project.

The assessment of risks can be more reliably evaluated where there is good baseline information. Where this information is limited or not available, risk assessment is constrained and it is appropriate to use the precautionary principle in the evaluation of potential impacts. If potential impacts are understood with a reasonable level of certainty, monitoring programs can be better informed to detect impacts, and management measures can be more effectively targeted to address those impacts.

This Report evaluates the adequacy of baseline information, commitments and environmental safeguards proposed by the Proponent to avoid or mitigate the risks of potential impacts identified in the assessment process. The safeguards may be implemented at various levels within the planning framework of a project and include (among other approaches):

- Design and layout of components and other infrastructure on the site;
- Management of construction activities; and
- Management of processes used in operations of the facility (e.g. inputs and outputs).

Appendices 2 and 3 list the commitments made by the Proponent. Additional safeguards are recommended in this Assessment Report where appropriate. The contents of this Report form the basis of advice to the NT Minister for Natural Resources, Environment and Heritage (the Minister) on the acceptability of environmental impacts, the adequacy of mitigation measures and the residual risks to the environment that are to be borne by the current and future community.

1.2 Regulatory Framework

Environmental assessment was undertaken in accordance with the requirements of the Northern Territory *Environmental Assessment Act 1982* (EA Act). The proposal was also declared a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it was considered likely to have significant impacts on the following Matters of National Environmental Significance that are protected under Part 3 of the EPBC Act:

- Sections 18 and 18A (Listed threatened species and communities); and
- Sections 20 and 20A (Listed migratory species).

The Project is being assessed under the Bilateral Agreement for Environmental Impact Assessment between the NT and Australian Governments, to satisfy requirements of both the EA Act and the EPBC Act.

This Report forms the basis of advice to the Minister on the environmental issues associated with the Project and informs the decision as to whether or not the Project should proceed. The Minister is required to make comment and/or recommendations with regard to the proposal to the Minister for Lands and Planning (the responsible Minister).

The responsible Minister will then make a determination as to whether or not development consent in the form of a development permit under the *Planning Act* will be issued to expand the East Arm Wharf. As well as a development permit, the Proponent will need to obtain a number of other permits, licenses and approvals under various Northern Territory legislation.

The Australian Government Minister for Sustainability, Environment, Water, Population and Communities (Australian Government Minister) will need to consider

the Project for an approval decision under the EPBC Act. This Assessment Report will inform such consideration.

A more complete list of Government approvals and relevant legislation for the regulation of the proposal is provided in Chapters 1.4 and 1.5 of the draft EIS.

1.3 Environmental Impact Assessment History

On 6 July 2009, a Notice of Intent (NOI) outlining the proposed expansion of the EAW was submitted by the Department of Planning and Infrastructure (now DLP), to the NT Minister for Natural Resources, the Environment and Heritage (the Minister).

On 2 November 2009 the Minister determined that the proposal required formal assessment under the EA Act, at the level of an EIS. The Project was referred under the EPBC Act to the Australian Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) on 11 January 2010 and DSEWPaC advised on 8 February 2010 that the Project was a controlled action.

Final EIS Guidelines were issued to the Proponent on 11 December 2009. The Proponent began work on preparation of the draft EIS in September 2010 (section 1.3.4, draft EIS).

On 3 June 2011, DLP advised of alterations to the proposal, in accordance with clause 14A of the NT Environmental Assessment Administrative Procedures 1984 (EAAP). Alterations presented a reduced scope of works at the East Arm Wharf. The revised scope of works included:

- revised impact on the new rail infrastructure (reduced footprint from 685.5 hectares to 70 hectares);
- the disposal of approximately 1.2 million cubic metres of dredge spoil has changed from on shore disposal to proposed offshore dumping at an approved dumping site (note the Supplement indicates dredge spoil will be disposed onshore and this assessment report assumes onshore disposal);
- the proposed Marine Supply Base has changed from a nominal 24 hectares of reclaimed land to 10 hectares of reclaimed and 40 hectares of previously reclaimed land;
- the Defence Hardstand will be made available for use by local commercial barge operators and has changed from an area of 3 hectares to 3.5 hectares; and
- the deletion of the development of waterfront industrial blocks (footprint 80 hectares).

The NT Minister accepted the alteration on 21 July 2011 and the Australian Government accepted the proposed variation under the EPBC Act on 28 July 2011.

On 18 June 2011, the draft EIS was made available for public comment for a period of six weeks. Six government agency and four public submissions on the draft EIS were submitted to the Proponent to be addressed in the *Supplement.* The submissions raised the following issues:

- Biodiversity impacts;
- Impacts of dredging and dredge spoil disposal;
- Benthic habitat mapping and description;
- Terrestrial and marine water quality;

- Sediment characterisation;
- Uncertainty in final design and management of project components;
- Inadequate description of existing surface water, groundwater and sediment quality;
- Disturbance of contaminated and/or potentially acid-producing dredge spoil and soil;
- Air quality and Greenhouse gas emissions;
- Cumulative impacts; and
- Environmental offsets.

A more detailed list of issues raised is included in Appendix 1 of this Report.

The Proponent lodged the Supplement in response to the submissions with the Environment and Heritage Division (EH) of NRETAS on 3 November 2011.

On 18 November 2011, the Proponent submitted a second notice under clause 14A of the NT Environmental Assessment Administrative Procedures to alter the Project by withdrawing the rail loop and spur component of the Project. This was due to uncertainty around timeframes and design of the rail loop and related inability to provide adequate information for assessment at this point in time. While a strategic environmental impact assessment is encouraged by assessing all future project components of the area, this EIA is not a strategic assessment and the removal of the rail loop and spur reduces the risk setting of this component. The Minister accepted the alteration on 5 December 2011. The Australian Government accepted the proposed variation under the EPBC Act on 19 December 2011.

Further information was requested from the Proponent on 23 November 2011, and on 19 December 2011, the Proponent supplied additional information. The additional report along with the EIS, Supplement, public and government comments have been taken into account in the preparation of this Assessment Report.

On 23 December 2011, EH Division prepared this Report, and provided the Report to the Minister. The Minister issued final advice and recommendations on the Project to the responsible Minister and the Australian Government Minister.

1.4 Ecologically Sustainable Development

Australia developed the National Strategy for Ecologically Sustainable Development (ESD) identifying four national principles. The Strategy also identified ways to apply the principles to a range of industry sectors and issues such as climate change, biodiversity conservation, urban development, employment, economic activity, and economic diversity and resilience.

In December 1992 the NT Government endorsed the National Strategy and agreed, along with all other States and Territories, to the Intergovernmental Agreement on the Environment. The Strategy defines ESD as:
'*Using, conserving and enhancing the communities' resources so that ecological processes, on which life depends, are maintained and the total quality of life now and in the future can be increased.*

ESD is development that aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations.'

The principles of ESD as defined in the National Strategy are:

ESD Principle	Definition
Precautionary principle	Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Inter- and intra-generational equity	The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of present and future generations.
Conservation of biological diversity and ecological integrity	The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making
Improved valuation, pricing and incentive mechanisms	Should be promoted to ensure that the costs of environmental externalities are internalised and that the polluter bears the costs associated with environmental pollution.

In response to the draft EIS, some submissions raised issues relating to the application of ESD principles – specifically the precautionary principle (where data collection was perceived to be lacking), and the principle of biodiversity conservation (in respect to mangrove and benthic habitat removal and potential impacts to marine megafauna).

The EPBC Act requires that in considering economic and social matters, the Minister must take into account the principles of ESD. To achieve the objective of ESD, the Project needs to continually be informed and guided by the ESD principles. Accordingly, the assessment of this proposal, its potential impacts (positive and negative) and the management measures used to enhance positive and reduce negative impacts was undertaken in the context of ESD principles.

Subsequent decision-making processes by approval bodies also must be guided by ESD principles and the continued project design and development, as well as the development and implementation of management and monitoring programs by the Proponent, should all aim to meet the objective of ESD.

1.5 Territory 2030 Strategy

Territory 2030 is a 20-year strategic plan for the Northern Territory developed by an independent Steering Committee and was produced as a road map for the future. Developed in consultation with the Territory community, Territory 2030 is a means for setting priorities and guiding government's efforts over the next two decades.

As the principal policy document for the NT it is appropriate that this Project is considered and assessed and implemented within the framework of Territory 2030. Identified as one of the issues requiring immediate focus is the priority "kick-starting

key projects and initiatives", recognising the lasting difference of key initiatives and projects to the community because of their ability to create benefits beyond their initial investment. The Economic Sustainability objectives relevant to the EAW Expansion are:

Objective 3: Growing local industry

- Establish Darwin as a key centre for oil and gas operations, maintenance and workforce;
- Increase the number of aviation passengers and shipping movements in the Territory;

Objective 5: Cutting edge businesses

- The Territory offers a highly competitive business environment.

The Territory 2030 document also identifies Environment objectives and some of those relevant to the EAW Expansion include:

Objective 1: Custodians of our natural heritage

- Ensure no deterioration in the health of biodiversity in the Northern Territory
- Manage the Northern Territory's natural resources according to the principles of ecologically sustainable development.

Objective 2: Sustainable living

- Ensure efficient use of water by business and industry;
- Continue to meet or better national air quality standards across the Territory;
- The Northern Territory contributes to the national target for greenhouse gas reduction.

The NT Government aims for a balanced decision making model that considers the economic, social and environmental impacts of every funding and policy decision made by government. This ensures that policy and decision-makers critically examine the tensions that exist between and across some of the targets. Accordingly, when decisions are made, all impacts (positive and negative) across targets are taken into consideration.

It is appropriate to apply these same decision making principles when making an assessment and decision on the EAW project. Where appropriate, the Report will draw from, and refer to, the targets contained in the Territory 2030 plan when reviewing and assessing the key elements of the EAW proposal.

It is anticipated that the private and community sectors will share ownership of, and become directly involved in, progressing targets within the plan. Industries and organisations will be encouraged to "own" targets and contribute to them in meaningful ways. This provides the opportunity for the Proponent to offset some of the challenges that arise through its Project by contributing to other targets (such as employment, and investment in "green energy" targets).

1.6 Darwin Harbour Strategy

The Darwin Harbour Strategy is a comprehensive guide for the responsible stewardship and sustainable development of the Darwin Harbour region. The Strategy was prepared to ensure that future development maintained or enhanced values and functions associated with the Harbour. The Strategy supports the integrated management of the Darwin Harbour region's environmental, social, cultural and economic values and uses.

To achieve this aim, the Strategy identified five key goals for Darwin Harbour and these goals are relevant to the EAW Project:

- Maintain a healthy environment;
- Support recreational use and enjoyment of the environment;
- Ensure that development is implemented in an ecologically sustainable manner;
- Protect cultural values and heritage; and
- Foster community awareness, industry partnerships and stewardship of the Darwin Harbour region.

The Strategy sets out goals, principles and guidelines for all users and stakeholders of Darwin Harbour and its catchment to imbed in their planning for any action which could have an impact on the region. A key objective is to achieve a balance between environmental, social and economic values.

2 The Proposal

2.1 The Proponent

The Proponent of the EAW Expansion Project is the NT Department of Lands and Planning (DLP), which is responsible for developing and providing strategic planning and growth frameworks, strategies and infrastructure plans required to develop the NT.

The Proponent is acting on behalf of:

- Darwin Port Corporation (DPC), a NTG body responsible for the control and management of the land, waterways and facilities within the Port of Darwin; and
- Department of the Chief Minister (DCM) seeking to collaborate with a single operator or an operator-led consortium with experience in developing and operating a Marine Supply Base to service the offshore oil and gas exploration and production industries.

2.2 Project objective

The EAW Expansion Project is part of the EAW Master Plan developed for managing land and sea-based activities at EAW. The project is to accommodate projected trade growth and provide for the staged expansion of the existing facilities and infrastructure.

2.3 Project location and description

Figure 1 illustrates the location of EAW within the NT and in relation to Darwin city. The EAW extends into Darwin Harbour and is bounded by Bleesers Creek to the north and Hudson Creek to the east.

Figure 2 illustrates the layout of the proposed expansion of EAW that broadly comprises three separate developments within the EAW precinct which are outlined below:

1. Hardstand area and barge ramp;
2. Marine supply base (MSB); and
3. Tug and small vessel berths.

These three components represent the scope of the EAW Expansion Project assessed in this report. Figure 2 also shows the rail loop spur which has now been removed from the scope of this Assessment.

2.3.1 Hardstand Area and Barge Ramp

Figure 2 illustrates the proposed hardstand area and barge ramp on the southern side of the peninsula. The hardstand area, barge ramp, and dredged channel would encompass an area of approximately 7.12 ha:

- Hardstand: 2.94 ha;
- Barge ramp: 0.4 ha;
- Access channel: 2.32 ha (dredge duration maximum 43 days, volume 62 000m^3); and

- Bunds and batters: 1.46 ha.

This facility would be used by private barge operators and Department of Defence for the berthing of barges and loading or unloading of cargo and Defence equipment. A shed will be constructed to temporarily house loads for each barge operator. Access to the hardstand, shed and barge ramp would be available on a 24/7 basis.

The hardstand area (Figures 2 and 3) would comprise a land-based section and an offshore section, and would be constructed on a combination of disturbed land, backfilled bunded ponds, and harbour foreshore. The on-shore and off-shore sections would be constructed by linking the sections with a harbour facing sea wall, and then backfilling the enclosed space with suitable materials.

2.3.2 Marine Supply Base (MSB)

Figure 3 shows the proposed Marine Supply Base which will have capacity to service over 400 vessels per annum to support the existing and expanding offshore oil and gas industry into the future. Initially the MSB would be used for Rock Load-Out (RLO) to specifically service the rock armoring requirements of the forthcoming INPEX Ichthys LNG project. The RLO facility would operate for approximately 133 days. A secondary purpose of the MSB is for refueling of tugs.

The construction of the MSB is the first component of the project. It is anticipated dredging would commence in the first quarter of 2012. The Proponent did not update the ultimate footprint of this revised project component in the Supplement and was unclear on the final location of the RLO facility. Based on Figure 2-2, draft EIS, it comprises 49 ha and includes:

- Hardstand (including storage, buildings, and truck path): 8 ha;
- Wharf for mud tanks, water services, and fuel storage: 5 ha;
- Potential Extension to Wharf for mud tanks, water services, and fuel storage: 11 ha;
- Rock Loadout wharf (option 1): approximately 1 ha
- Rock Loadout wharf (option 2): approximately 1 ha
- Dredged channel: 8.4 ha (maximum duration 64 days, dredge volume 640000m^3).

The MSB (Figures 2 and 3) would be established on a combination of disturbed land, backfilled bunded ponds, and harbour foreshore. It would comprise reinforced concrete wharf decks supported by steel piles to provide berths for platform supply vessels (PSV) (rig tenders). Construction methodology would depend on the final configuration (refer to section 2.7.3, draft EIS) and the successful Developer. Discussion of construction methodology, alternative and their resultant environmental residual risk was sought, but the Proponent has not provided any further detail.

2.3.3 Tug Pens and Small Vessels Berths

Figure 4 illustrates the proposed construction of a mooring facility suitable for tugs and small craft that will be created by extending the existing quay line. Increased traffic at East Arm requires a greater number of tug boats and other small vessels to accommodate up to 12 tugs (35 m length, 10.6 m beam and 6 m draft).

The total footprint of this project component would be approximately 9.37 ha. This includes:

- Dredged channel: 5.88 ha (duration maximum 6 days dredge volume 115300m^3)
- Wharf bund extension: 0.66 ha
- Anchorage: 2.83 ha.

The tug and small vessel berths will be constructed as systems of pontoons and gangways behind the current berths and is shown in Figures 2 and 3. The proposed extension of the quay line was removed from this assessment under the first clause 14A alteration.

2.4 Ongoing Maintenance

Each component of the proposed development would require maintenance over the life of the project. Maintenance programs and their execution would be the responsibility of the operators of the various project components. All project components would require regular cleaning and rust proofing.

All channels and berths would be regularly surveyed to assess built up of sediment. It is proposed that maintenance dredging would be undertaken every ten years, or as indicated from the marine surveys. Marine surveys would also be undertaken prior to and after any maintenance dredging program.

Figure 1 Location of East Arm Wharf within the Northern Territory (from Figure 1-1, draft EIS)

Figure 2 General Arrangement of the Proposed EAW Expansion (From Figure 5-1 Supplement – Proposed Rail Loop has now been removed from this Assessment)

Figure 3 Marine Supply Base (from Figure 6-1 – Supplement)

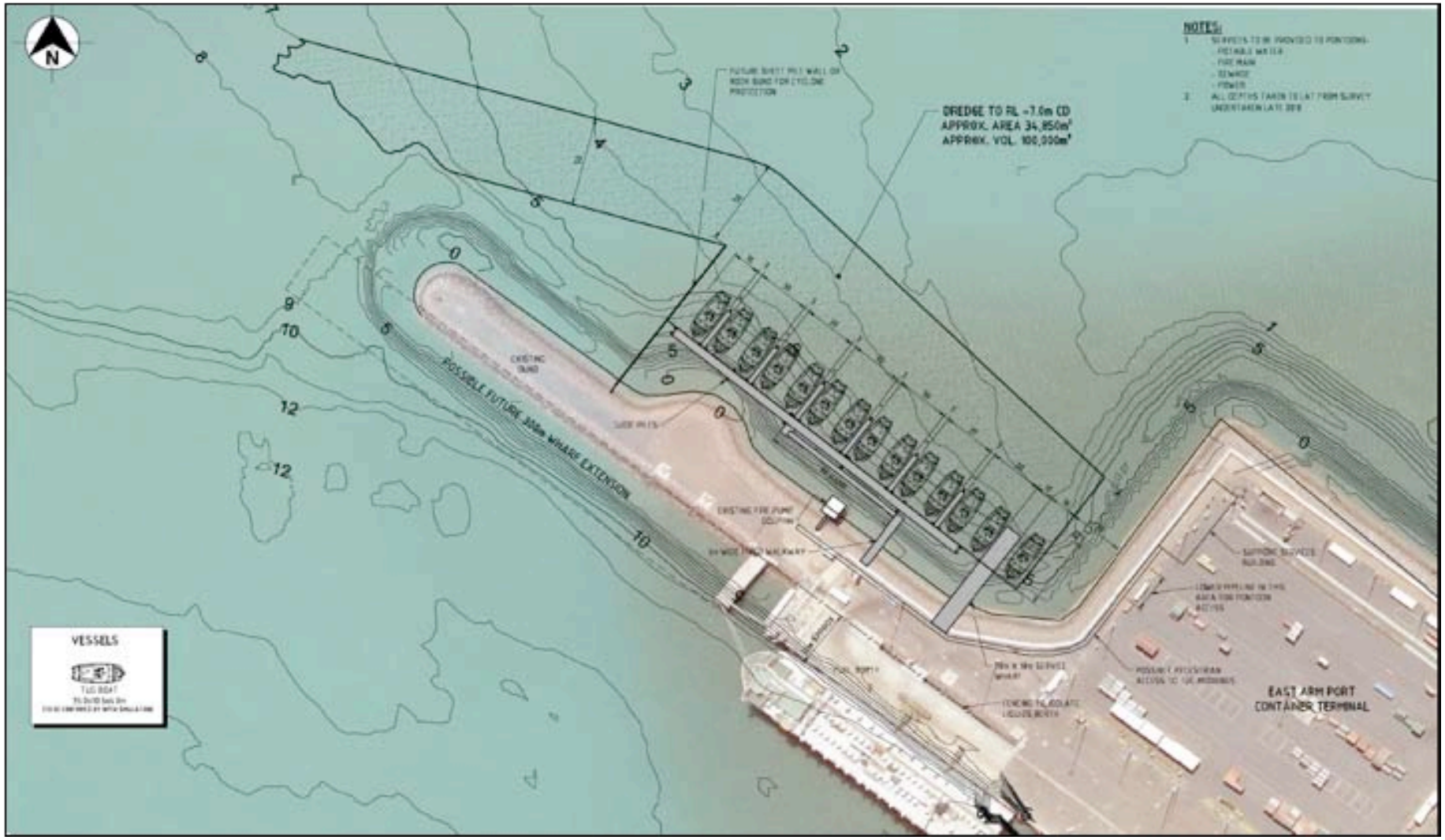

Figure 4 Proposed tug and small vessel berths (from Figure ES-1, draft EIS)

3 Regional Setting

3.1 Physical

EAW is situated on the East Arm Peninsula of Darwin Harbour within the monsoonal tropics of Northern Australia. The Peninsula has been extended and developed to form the EAW and support associated wharf related industries. The EAW extends into Darwin Harbour and is bound by Bleesers Creek to the north and Hudson Creek to the east. Two small islands lie directly south and east of the project area; South Shell Island and Catalina Island.

Darwin Harbour is a large ria system, with a surface area of about 500 km^2. In its southern and south-eastern portions, the Harbour has three main components: East, Middle and West Arms, which merge into a single unit, along with the smaller Woods Inlet, before opening into Beagle Gulf to the north. The Elizabeth River flows into East Arm, while the Darwin and Blackmore Rivers flow into Middle Arm. Freshwater inflow into the Harbour occurs from January to April, when estuarine conditions prevail in all areas (Hanley, 1988). Within the Harbour, shores are characterised by extensive intertidal mud flats and mangroves. Corals exist in several areas within the Harbour.

The general landform in the coastal area of EAW area is described as marine and comprises a combination of the following:

- Lower intertidal areas of marine alluvium consisting of wet clays and silts with variable sand content; and
- Upper intertidal areas of mixed marine colluvium and alluvium consisting mainly of silty sand and gravelly sand.

Generalised soil and soil drainage classification for EAW indicates that the northern part of the project area (the area comprising the current rail line and the coastal fringe to the north of the rail line) comprises seasonally or permanently wet soils, which in terms of soil drainage classification are poorly or very poorly drained. The area of EAW to the south of the rail line includes similar soils and drainage characteristics, but also includes a significant area of soils without structure (earths); these are described as rapidly well or moderately well drained soils. The area is known to have various levels of Acid Sulfate Soils (ASS) and potential ASS (PASS).

3.2 Biological

3.2.1 Marine Ecology

Darwin Harbour has a diverse assemblage of species typical of the Indo-west Pacific Biogeographical province. Significant species in the Harbour include marine turtles, sea-snakes, sea horses, dugongs and several species of coastal dolphin, including the snub-fin dolphin. These significant species are listed under the Australian Government EPBC Act and some under the *Territory Parks and Wildlife Conservation Act* (TPWC Act).

Coral communities occur where the substrate is rocky in the lower intertidal and shallow subtidal zones and hydrodynamic conditions permit. The intertidal platform between Channel Island and the mainland is listed on the Register of the National Estate and has been declared a Heritage Place under the NT *Heritage Conservation Act 1991*. This declaration was based on the presence of an unusually diverse coral

community. Other areas of conservation significance include the Charles Darwin National Park, Casuarina Coastal Reserve, East Point Aquatic Life Reserve and Doctor's Gully Aquatic Life Reserve. Other intertidal and marine communities in Darwin Harbour include rocky shores and pavements, sand beaches and sand and mud flats, macroalgae, seagrass beds, soft sediments and mangroves. Darwin Harbour is considered a biodiversity "hotspot" for some benthic fauna and many communities contain endemic species (Hooper *et al.,* 2002).

The south side of EAW contains moderate to high densities of sponge and soft coral beds, and includes areas of hard coral communities. The reefs around South Shell Island and Old Man Rock are areas of high biodiversity and conservation value (Alvarez, *et.al,* 2002).

3.2.2 Terrestrial Ecology

The terrestrial vegetation in the project area is dominated by mangroves, with several smaller areas of terrestrial vegetation situated on the higher ground. The majority of the terrestrial vegetation is a disturbed/regrowth type and the remainder is comprised of remnant vegetation types. In some areas reclamation works have impacted on the condition of both the mangrove and terrestrial vegetation types (EMS, 2011).

A flora survey recorded a total of 105 flora species, including 94 native flora species, 11 naturalised flora species and five 'Declared Weeds' under the *Weeds Management Act 2001*. Four vegetation communities were recorded within the study area two of which are classified as sensitive or significant according to the NT Land Clearing Guidelines: the Monsoon Vine Forest (MVF) and the Mangrove Communities. The remaining vegetation communities were Mixed Species Open Woodland to Woodland and Disturbed Areas with Regrowth.

A total of 141 species of native terrestrial vertebrate species were recorded within the study area, including seven amphibian, 11 reptile, 109 birds and 14 mammal species. Two introduced species, the Cane Toad (*Rhinella marina*) and the Asian House Gecko (*Hemidactylus frenatus*), were recorded within the study area.

Significant threatened species which are listed in the higher categories of critically endangered, endangered, vulnerable or near threatened under Commonwealth or NT legislation recorded in the field surveys were:

- One plant species, *Cycas armstrongii*, listed as Vulnerable under the TPWC Act;
- One fauna species, the Bush Stone-curlew (*Burhinus grallarius*), listed as near threatened under the TPWC Act; and
- 59 species of birds listed as migratory wetland or marine species under the EPBC Act.

3.3 Socio-economic

The estimated NT resident population at June 2009 was 225,900, showing an annual increase of 5,400 people (2.5%). Over the same period, the population of the Darwin region was 124,800, with Darwin City 75,900, and Palmerston-East Arm 30,000 people. The main Indigenous group within the region is the Larrakia people. Darwin's economy has been based on the Australian Defence Force and mining industries, and more recently on tourism. Approximately 686,000 people visited the Darwin tourism region in 2010

Aquaculture industry in Darwin Harbour includes two pond-based barramundi farms in the upper reaches of the Blackmore River and a sea cucumber research farm on Middle Arm peninsula. The NT Government owned Darwin Aquaculture Centre on Channel Island supports research and development into aquaculture species such as barramundi, pearl oysters, sea cucumbers, giant clams and rock oysters.

At present, there is limited heavy industry in the Darwin region. The Darwin LNG facility operated by ConocoPhilips is at Wickham Point, and the East Arm Port is a major point of export by the resource sector to Asia. Other important industries in the Northern Territory are commercial fishing, tourism, the pastoral industry, mining and defence.

The unemployment rate in the Darwin region (1.9%) has consistently been lower than the state and national average. The Project will employ approximately 200 people during construction and long term employment of an additional 20 full-time staff.

A recognised hub of community amenity in Darwin and Palmerston is the Harbour foreshore, and the Harbour itself, which provide a place for people to meet, play sport, fish and undertake cultural practices. The Harbour holds a strong value and appeal for communities and tourism owing to the existing balance of the natural environment, landscaping and community infrastructure. Recreational fishing is a well established activity, concentrating on mud crabs, barramundi and a wide variety of reef fish. Scuba diving and boating are other important recreational activities that occur in the Harbour.

3.4 Cultural/Historical

Field surveys and desktop research commissioned for an archaeological assessment for the proposed EAW Expansion resulted in the identification of Indigenous, historic and maritime archaeological places located in the vicinity of EAW with only one Indigenous site located within the proposed development. Its Heritage Assessment Value was described as ‘of very high cultural and archaeological significance’. The archaeological sites were described as containing a representative sample of the significant archaeological features of the general Darwin Harbour area. Impacts are not expected upon sites outside the development area.

Many wrecks are found within Darwin Harbour. These include ships and aircraft from World War II, wrecks from cyclones and deliberately scuttled boats for use as fishing and diving sites.

4 Environmental Impact Assessment

4.1 Introduction

The purpose of this Report is to evaluate the Project and to determine whether it can proceed without unacceptable environmental impacts. This is achieved by identifying the risk of an environmental impact occurring as a result of Project components and activities, and evaluating the Proponent's corresponding safeguards or prevention measures to remove or mitigate the risks. Where the proposed safeguards are considered insufficient, or where a safeguard is deemed particularly important, recommendations are made in this Report to add to or emphasise those commitments made by the Proponent.

The environmental acceptability of this project is based on analysis of the following from the EIS:

- Adequacy of information outlining the proposal (particularly which components or activities are likely to impact the environment);
- Adequacy of information on the existing environment (particularly environmental sensitivities);
- Adequacy of information on the range and extent of potential impacts and the risks of those impacts occurring within the Project context; and
- Adequacy of the proposed safeguards to avoid or mitigate potential impacts.

Conclusions and recommendations are then based on comments from the review of the EIS by relevant government agencies and the public, and responses from the Proponent to those comments in the Supplement and further information request.

The EIA has been limited by a number of information gaps within the presented EIS, compared to the scope of information requested by the EAW EIS Guidelines. The decision by the Proponent not to review existing relevant information has prevented a sound desktop assessment of existing conditions and potential environmental impacts.

Throughout the assessment, it has been highlighted to the Proponent that a number of reports exist that were relevant to review and information contained in these reports could have supported many of the assumptions made in the EIS (Hanley & Caswell, 1995, 1997, GHD, 2006). The EIS could have been improved by reviewing existing data collected in past dredging campaigns and presenting it in a format that allowed thorough assessment of potential impacts. The field data sheets for the geotechnical studies in Attachment 1 (Supplement, 2011) and historical water quality monitoring weekly reports for Stage 1 dredging in Attachment 2 (Supplement, 2011) needed comprehensive review and analysis to make the information contained within these reports useful for this assessment.

In this Report, the recommendations (in **bold**) are preceded by text that identifies concerns, suggestions and undertakings associated with the project. For this reason, the recommendations should **not** be considered in isolation.

As minor and insubstantial changes are expected in the design and specifications of the proposal following the conclusion of the EIS process, it will be necessary for approval mechanisms to accommodate subsequent changes to the environmental safeguards described in the EIS and the recommendations in this Report. If the Proponent can demonstrate that such changes are not likely to significantly increase

the risks of an impact on the environment, an adequate level of environmental protection may still be achieved by modifying the conditions attached to relevant statutory approvals governing this project. Otherwise, further environmental assessment may be required. Given the sensitivity of the marine environment the project is located in, it is expected the successful operators remain within the described development footprints outlined in the EIS.

Therefore, subject to decisions that authorise / permit the project to proceed, the primary recommendations of this assessment are:

1. **Recommendation**

The Proponent will ensure that the proposal is implemented in accordance with the environmental commitments and safeguards:

- **Identified in the East Arm Wharf Expansion Project's Environmental Impact Statement (draft EIS and Supplement); and**
- **Recommended in this Assessment Report.**

All safeguards and mitigation measures outlined in the Environmental Impact Statement are considered commitments by the Proponent.

2. **Recommendation**

The Proponent will advise the Minister of any changes to the proposal in accordance with clause 14A of the Environmental Assessment Administrative Procedures, for determination of whether or not further assessment is required.

4.2 Issues outside the scope of the assessment

Certain issues are associated with aspects of the proposal that are beyond NTG jurisdiction or could not be considered the responsibility of the Proponent and are therefore deemed outside the Project scope in the NT. This includes consideration of:

Source of fill and rock armour
Quantities and sources of fill material are yet to be finalised and will be the responsibility of the contractor. Most of this material is expected to be available from existing quarries. Assessment of material sources not already approved will be undertaken through processes outside of this assessment.

Rail Loop and Spur and Subdivision Works
The rail loop and spur (70 hectares) and subdivision works on Land Development Corporation land along the shoreline (80 hectares) have been removed from the scope of the EAW Expansion Project.

4.3 Design and Construction

In response to the draft EIS, several comments expressed concern regarding the lack of detailed design options and lack of environmental management detail. Factors that may affect environmental outcomes such as final configurations and construction timing are to be determined after the completion of the assessment process. Areas where detailed information was particularly lacking in the draft EIS were:

- Dredging areas and depths for the project;
- Size of tug berth component;

- Barge landing design and use; and
- Design and construction of the rail loop.

In the Supplement the Proponent states that an agreement was reached with NRETAS that it would not be possible to show actual details of the final project component designs, but rather overall "development envelopes". While it is recognised that detailed engineering designs are not expected as part of the assessment, it is expected that the Proponent has examined a number of designs and ensures the contractor chose construction methodologies and designs that consider the residual environmental risk. This was not made clear in the Supplement.

4.3.1 Dredging

Dredging is required to construct the berthing areas and channels from the proposed facilities to existing channels within Darwin Harbour. In the Risk Assessment conducted as part of the EIA, dredging was identified as an activity creating a known moderate level impact (Appendix Q, draft EIS). Known moderate impacts listed in the Risk Assessment included smothering of the sea floor by sediment during dredging operation, direct removal of marine biota during dredging operations and altered water current directions and flow rates caused by dredging the access channel and berths.

Table 1 lists some of the past capital dredging works that have been undertaken or proposed in the Northern Territory.

Table 1: The East Arm Wharf Expansion project dredging volumes in the NT context

Project	**Operator**	**Dredge Volume**	**Dredge Disposal method**
East Arm Wharf Stage 1 - May 1995 to March 1996	NT Department of Transport and Works	2.5Mm^3	Onshore
East Arm Wharf Stage 2 - July 1996 to November 1996.	NT Department of Transport and Works	3.65Mm^3	Onshore
Cullen Bay 1993	Thiess Contractors	850 000m^3	Onshore
Waterfront 2005	Department of Infrastructure, Planning and Environment	650 000m^3	Onshore – ponds at EAW
Bayu Darwin Pipeline Project	Conoco Phillips	42 197m^3	Offshore
Ichthys Gas Field Development Project	INPEX	15.9 Mm^3 proposed	Offshore
East Arm Wharf Expansion 2011	Department of Lands and Planning	820 300m^3 proposed	100% onshore – Pond K

In the context of previous dredging campaigns, the Project does not constitute a large volume of dredging. Given that onshore spoil disposal is proposed, turbidity plumes and sedimentation associated with offshore disposal will not be an issue. However, information gaps still remain on the following:

- physical and chemical characteristics of the sediment to be dredged, including potential for re-mobilisation of contaminants;

- whether Pond K onshore is of sufficient design and capacity for the proposed rate of dredge spoil disposal;
- treatment and return water strategy from onshore emplacement of dredge spoil;
- cutter suction dredgers are most likely to be the predominant plant and method of dredging although final methods will be determined by the contractor and are dependent of the type of material to be dredged and location of the dredging works; and
- consideration and management of cumulative impacts of dredging works being undertaken in the Harbour within a similar timeframe as the INPEX Project.

The Proponent did not address concerns raised regarding the possible cumulative impacts that might arise as a result of other projects (e.g. INPEX) occurring in the Harbour in a similar timeframe. Cumulative impacts of increased shipping movements, dredging effects, noise and pile driving on the Darwin Harbour marine environment were not assessed. It is recommended that the Proponent work closely with INPEX regarding its final Dredge Management Plan, ecological monitoring programs and outcomes of monitoring programs. It is expected that activities for the two projects will consider the temporal and spatial scale of each other's activities. Robust monitoring and adaptive management is required to ensure cumulative impacts are minimised.

For this Project, the Proponent commits to the use of an independent Technical Advisory Group (TAG) to advise on management of dredging and disposal works (section 4.2, draft Dredge Management Plan). The TAG will be responsible for providing scientific, environmental and technical advice on all aspects of dredging and disposal works. The role of TAG will be to provide advice, including but not limited to:

- the marine management plans;
- the marine monitoring program;
- overall dredging method and plans;
- the management of turbidity generating activities and marine works;
- impacts on marine fauna and flora, including benthos and mangroves;
- reporting; and
- new management measures.

The formation of a TAG is supported. In addition to the above functions, the TAG will be required to advise on the management of cumulative impacts associated with the INPEX dredging program. It is proposed that the Proponent consider membership on the TAG to best facilitate a smooth coordination between INPEX and DLP. This role will involve coordinating the above functions with regard to advice that is being provided to INPEX from the panel of experts appointed as a key outcome on the INPEX Assessment Report 65.

3. Recommendation

The Proponent work closely with INPEX regarding dredge management planning and related monitoring programs so that activities for the two projects consider the temporal and spatial scale of each other's activities and a consistent approach that maximises synergies and learning outcomes is achieved.

In the draft DMP, it is detailed that the contractor will be required to develop a Contractor Method Statement (CMS) before undertaking any major works including dredging and disposal, floating pipeline installation, surveying etc. These will be required to address the environmental aspects of the proposed activity and provide suitable management measures to minimise identified environmental impacts consistent with the requirements of the final DMP. The CMS will require approval by the Proponent prior to commencement of works. It is recommended that the CMS undergoes review by the proposed Technical Advisory Group TAG and the timing of dredge works consider potential cumulative impacts from other projects within the Harbour (refer to section 4.3.1.2 below).

4. Recommendation

The Contractor Method Statements (CMS) include best practice outcomes to minimise environmental impact and shall undergo review by the Technical Advisory Group to ensure they are consistent with the requirements of the final Dredge Management Plan prior to the commencement of dredging works.

4.3.1.1 Dredging area of the Marine Supply Base

The draft EIS indicated that the location of the MSB and dredging access channel would directly impact sensitive benthic habitat such as Scleractinian reefs and moderate-high density sponge and soft coral beds (Fig 15-1, draft EIS). The extent of indirect impacts (zone of moderate impacts, zone of influence) due to smothering of the sea floor by sediment during dredging operation and decreased light attenuation from turbidity were not quantified.

Concern was raised during review of the draft EIS of the proximity of the dredge access channel and alternative rock load out (RLO) wharf to South Shell Island, described as one of the most significant hard coral communities in Darwin Harbour (GHD, 2006, Alvarez *et al.,* 2002). In the Supplement, the Proponent revised the design of the MSB and location of the MSB access channel. The MSB access channel has been moved approximately 300m away from South Shell Island to reduce the potential for direct removal of Scleractinian coral reefs. The revised MSB access channel design also results in a decrease of dredging volume from 1 008 320m^3 to 640 000m^3 and the channel footprint has been reduced from 18.5 ha to 8.4 ha (Section 6.1, Supplement).

Figure 6-3 in the Supplement indicates the revised MSB access channel relative to the former design in the draft EIS. An updated figure showing the benthic habitat map relative to the revised scope has not been provided. In an oral presentation by the Proponent given to government agencies (11 November 2011), it was confirmed the alternative RLO wharf option 2 and optional dredging on top of sensitive benthic habitat are no longer part of the MSB footprint. This report is based on this scenario and any alteration should be referred under clause 14A of the EAAP.

4.3.1.2 Predictive modelling

The potential impacts of dredging activities associated with the MSB, barge ramp and hardstand area, and tug and small vessel berths were presented in a technical report Dredge Dispersion and Spoil Disposal Modelling for the EAW Expansion (Appendix E, draft EIS). Table 2 lists the quantities of dredge material and duration used for the

modelling that were included in the draft Dredge Management Plan (Appendix E, Supplement).

Table 2: Quantities of dredge materials and period of dredging compared to proposed INPEX dredging campaign

Area of operation	**Marine Supply Base**	**Ramp and hardstand area**	**Small vessel berth area**	**Proposed INPEX dredging**
Estimated Dredge Volume	640 000m^3	62 000m^3	115 300m^3	16 000 000m^3
Duration of dredging operation (days)	63.1 (max)	42.8 (max)	6	Approx. 1460
Average Modelled Dredge Rate	17 750 m^3/day	1450m^3/day	17 900m^3/day	Unknown

An assumed one percentage rate of sediment loss from the dredgers was agreed prior to commencing the modelling simulations. The model predicted the following 95th percentile concentrates of suspended sediment:

- **MSB dredge** – less than 5.0mg/l on top of background concentrations which drop to 2mg/l further to the west into Hudson Creek. The elevated suspended sediment concentrations are generally confined to the dredge area, the southern face of the East Arm Wharf and the outer edge of Frances Bay;
- **Barge ramp and hardstand** - suspended sediment concentrates exceeded 1mg/l and beyond 100m from the dredge location, fell to 0.2mg/l;
- **Tug and small vessel berth at neap tide** - highest suspended sediment occurred at the dredge location (5.0 -10.0 mg/l), with concentrations reducing to 2.0-5.0mg/l (no distance from dredge location provided);
- **Tug and small vessel berth at Spring tide** – 1.0 – 2.0mg/l to south of East Arm Wharf (spring tides lead to an increase in current speeds and resulting bed sheet stresses) (Appendix E, draft EIS).

Deposition of suspended sediments was predicted to occur north of the EAW with an unconsolidated thickness of 1.0-5.0mm (Figure 16-1, Supplement). It was not clear whether the modelling conducted had taken into account the strong tidal water movement in the area. The strong currents associated with muddy and sandy substrates can create very turbid plumes that extend over wide areas of the Harbour (Williams & Wolanski, 2003).

The modelled values indicate that suspended sediment concentrations due to the dredging operations, in isolation from background values, would stay below the average Darwin Harbour values of 14.0 mg/l. This average was approximated from a water quality survey conducted on behalf of INPEX (Table 9-1, EIS). A model limitation is that only average samples for the Harbour were provided for sampling sites not relevant to the East Arm Wharf area (Figure 9-1, EIS). Overall, water quality within the Darwin Harbour is known to be affected by season, location within the Harbour and tidal conditions (Padovan, 2003). In the URS study (2009b), turbidity for the one site relevant to East Arm ranged from 6 – 17 NTU (turbidity) (Fig. 3.5, URS, 2009b) at different tidal conditions and 6-18mg/l for suspended sediments (Fig. 3-6, URS 2009). Consideration of background plus modelled dredging values suggest that dredging plumes may contain suspended sediment loads up to 23mg/l

from MSB access channel dredging, and 28mg/l from dredging for the tug and small vessel berth at neap tide.

Understanding of the tolerance thresholds of local sensitive benthic species, such as Scleractinian corals, is necessary to understand expected zones of impact from elevated suspended sediment loads from dredging. The draft Dredge Management Plan included commitment to deriving a pressure-response relationship for local coral species, potentially using existing data and assistance of the Technical Advisory Group (TAG). A valid understanding of pressure-response relationship is also necessary before appropriate monitoring thresholds can be set, to avoid significant impacts on nearby corals.

The dredging program would be carried out by a dredging contractor engaged after conclusion of the environmental assessment process. The proposed dredging campaign is not significant in terms of scale and duration compared to past campaigns in the harbour, however it is occurring in a known biodiversity hotspot (Alvarez, *et al.,* 2002, BMT WBM, 2011) and potentially at the same time as the INPEX dredging program. The modelling assumes that each dredge scenario occurs independently and the mobilisation of multiple dredgers operating concurrently has not been considered (section 6.1.1, Appendix E, draft EIS). If dredging works occur simultaneously, cumulative impacts need to be considered and modelled to determine ultimate zones of dredging impacts.

Modelling discussion in the draft EIS recommended dredging not occurs during ebb (outgoing) tides. Dredging of the MSB channel during ebb tides would direct the suspended sediment plume onto adjacent sensitive coral habitats, with potential to impact light-dependent species. Limiting dredge activities to avoid ebb tides would reduce the potential impact on adjacent coral habitats, located west of the MSB and barge ramp areas.

Previous studies have indicated corals exhibit signs of stress due to exposure and solar radiation at low tidal heights (Hanley & Caswell, 1995). The Proponent will need to consider the depths of nearby coral habitats and timing of low tides that would cause natural exposure stress. It is recommended dredge activities are timed to avoid these times of lowest tidal height when natural stress is expected and providing an appropriate depth buffer before dredging re-commences. The onset of the monsoon is associated with rapid and persistent deterioration in marine water quality in the Harbour, due to river inputs, causing natural stress to corals from high turbidity levels/light attenuation and reduced salinity. Avoidance of dredging during the wet season should also be considered by the Proponent.

The model assumed cutter suction dredger will be the only dredge method. The mobilisation and deposition of coarse sediments was not included in the modeling. Dredging of the MSB approach channel could lead to coarse sediments smothering some coral colonies within the South Shell Island coral community, if dredging occurs in close proximity during ebb tides. The revised channel alignment now located 300m away from South Shell Island has been assumed by the Proponent to decrease the risk of impacts to nearby marine habitats. The Supplement did not provide an updated dredge dispersion model to verify this assumption or provide commitment to monitoring programs proposed to validate the dredge dispersion model predictions of sedimentation and turbidity. In the further information submitted, the Proponent states that once a dredging contractor is appointed with an actual dredging methodology, the scenario will be modelled and confirmed and

incorporated into the final Dredge Management Plan. It is expected that the final modelling outcomes are within the predicted impacts provided in this assessment.

If changes to the proposed dredging occur that result in changes to the predicted environmental significance of the proposal, then the Proponent is required to submit a variation under clause 14A of the EAAP for reassessment under the EA Act, in accordance with Recommendation 2 of this Report.

5. Recommendation

The East Arm Wharf dredge dispersion modelling must be verified with monitoring of sedimentation and water quality and appropriate ecological indicators.

6. Recommendation

A Monitoring Program (and subsequent contingencies to manage dredging in the event monitoring indicates a significant departure from predicted impacts) needs to be specified in the final Dredge Management Plan, to the satisfaction of the Technical Advisory Group.

A mechanism for in-situ continuous monitoring of water turbidity levels at Scleractinian coral habitat between South Shell Island and the proposed MSB access channel would be a useful addition to the dredging monitoring program and would guide management decisions where predetermined turbidity thresholds to protect coral health are exceeded.

4.4 Dredge spoil disposal

Concerns were raised in submissions to the draft EIS about the potential impacts from dredge spoil disposal. In the draft EIS two dredge material disposal options were provided – 100% offshore and 80/20% offshore-onshore disposal. In the draft EIS it was assumed that any material disposed of onshore will be high quality material suitable for onshore disposal. It was requested the Supplement provide more detail on this material proposed for disposal onshore.

The Supplement detailed that all dredged spoil will be disposed onshore within an existing dredge spoil retention ponds at EAW (Pond D and K) and potentially a portion of Pond E (see figure 10-1 Supplement). The estimated dredging volume for the Project decreased from 1 008 320m^3 to 802 000m^3. The Proponent indicated that onshore dredge spoil disposal will have no impact on local adjacent mangrove habitat although this assumption was not substantiated. Anecdotal observation indicates that past maintenance dredging disposal (past volumes disposed were not provided) has not impacted on mangrove habitat based on the negligible impact to mangrove health associated with the current EAW development (Section 21, Supplement). The Environment and Heritage Division reviewed a Mangrove Reactive Monitoring Report which indicated no recorded impact from dredging of the wharf precinct on the mangrove canopy cover and leaf litter cover (GHD, 2006a).

The decision not to release dredge spoil directly into the marine environment will avoid the potential risk of increased water turbidity impacting marine communities at the proposed spoil disposal site. While marine water turbidity and sedimentation impacts may not occur with onshore disposal, there are other impacts to consider for disposal of dredge spoil on land. The EIS Guidelines and comments on the draft EIS

requested that the Proponent demonstrate a thorough understanding of the physical characteristics of the sediment to be dredged including the contamination status of the site. No details were provided on whether this dredge spoil is a practical and suitable material to dispose on land and the Proponent did not indicate whether Pond K was originally designed and constructed for the purpose of storing dredge spoil and whether it has the capacity to store 802 000m^3. When transporting and disposing dredge spoil material on land, substantial ponds are required to allow for settling of fine suspended sediments, prior to discharge of the return water (Appendix E, Supplement). The ponds will also require partitioning to facilitate settling. The management of these dredge spoil ponds has not been adequately addressed in the EIS and the Proponent will be responsible for ensuring the dredge spoil does not create unanticipated impacts on the marine environment.

4.4.1 Stage 2 EAW dredging monitoring program 1996

In a report analysing monitoring data collected during the Stage 2 phase of dredge monitoring (1996) associated with the original construction of the East Arm Wharf, it was stated that the design of dredge spoil ponds used in the East Arm Wharf should be constructed to a minimum acceptable standard for pond design (Hanley Caswell and Associates Pty Ltd, 1997). The report detailed substantial increases in turbidity and Total Soluble Solids (TSS) observed in the area around the retention ponds where highly turbid dredge return water discharged back into the Harbour. Substantial volumes of water also leached through and under, the bund walls of retention ponds, adding further fine sediments to the Harbour. This event was reported to have a noticeable impact on corals and other biota with divers reporting all corals at South Shell Island and Wickham Point covered by a thin sediment layer of up to 5mm for a period of 7-10 days. Bleaching of tagged corals at the primary impact site of South Shell Island was observed but recovery occurred the following weeks. It is uncertain whether the corals at South Shell Island would have recovered if dredging and the release of highly turbid return water had continued over a longer period. This historical event highlights the importance of providing adequate attention to the size and design of retention ponds for dredge spoil.

In the same report, it was stated that water from the dredge spoil retention pond discharging through the mangroves, created a plume that at times extended over 1km^2 in the Harbour (Hanley & Caswell, 1997). This occurred due to:

- bund walls constructed onto mangrove muds, leading to compression of muds once the ponds were full and the movement of very substantial amounts of material under the bund walls. This led to one bund wall collapsing on 24 September, 1996;
- materials used for bund walls being unable to prevent direct movement of water through the wall; and
- ponds were not large enough to keep pace with the rate of dredging. Once the capacity of ponds was filled, there was no choice but to release dredge return water back into the harbour before its suspended sediment had time to settle out.

Pond K is currently being used as a sediment retention pond for storm-water runoff and historically it has been used for disposal of maintenance dredge spoil (volumes of spoil were not provided in this EIS). No details were provided on whether alternative ponds will be constructed for stormwater management purposes prior to commencement of dredging works, the characteristics of the dredge spoil and

whether Pond K is of sufficient design and capacity for dredge spoil disposal additional to its current use of stormwater sediment retention.

In the draft Dredge Management Plan, the Proponent has committed to the following prior to any dredging:

- characterisation of sediments to be dredged in order to segregate potentially contaminated sediments and clean materials;
- development of a treatment and return water release strategy from onshore emplacements; and
- review of the DMP and approve the Dredge Contractor's EMP and Final DMP.

7. Recommendation

Prior to dredge spoil disposal to existing dredge spoil retention ponds, the Proponent shall provide information in the final Dredge Management Plan for review by the Technical Advisory Group on:

- **a treatment and return water release strategy and water quality monitoring from onshore emplacements; and**
- **capacity of ponds and proposed design of settling and de-watering structures for dredge spoil disposal of approximately 800 000m^3 of material.**

4.4.2 Sediment

The most comprehensive data available on sediment characteristics (grain size and heavy metal content) was provided in a report by Fortune (2006) based on data collected from 114 samples throughout the Harbour in 1993. The age of this report indicates no recent data has been gathered to describe existing conditions at the wharf with particular regard to contaminant loads in marine sediments. Given that East Arm Wharf has been operating since 1994, it can be expected that existing data on sediments in the vicinity of the wharf would differ to those collected in 1993 (pre establishment of EAW industrial facilities). It is essential that a current baseline of the proposed dredging area is established to indicate changes to physio-chemical parameters and metal concentrations that have occurred over time and which may require a change in process.

In a study prepared for INPEX which was not discussed in the EAW draft EIS, a range of surface and subsurface samples taken in the East Arm area were classified as potential for Acid Sulfate Soil (ASS) risk (section 3.2.6, URS, 2009b). While these sites are not in the direct area where dredging works are proposed, it highlights the potential of sediments in the area to generate acidity if disposed on land. The generation of acidity could also mobilise metals present in the sediments, increasing metal bioavailability and increasing metal concentration in water. It is essential that the sediments are kept saturated following disposal on land.

Review of the draft EIS identified the requirement for site specific geotechnical and soil investigations, including recommended drilling of the boreholes. The results of these investigations were intended to show a thorough understanding of the physical and chemical characteristics of the sediment to be dredged, including the contamination status of the site. A geotechnical report on Vibrocore sample acquisition was provided as Attachment 1 in the Supplement. This report did not provide an indication of how the results were used in determining potential

sedimentation, heavy metal mobilisation and turbidity impacts from dredging activities. The core samples taken at East Arm appear to have been described, photographed and discarded without any samples kept for physio and chemical analyses (Attachment 1, Supplement).

There is a lack of information on sediments in areas proposed to be dredged. The Proponent commits to implementing an on-site sediment sampling and testing survey to identify the quality and potential contaminants contained within target dredged sediments (Section 10.1, Supplement) to inform management of potential marine water quality impacts.

8. Recommendation

The Proponent shall implement an on-site sediment sampling and testing survey to identify the quality and potential contaminants and/or ASS contained within target dredged sediments.

4.5 Habitat mapping

East Arm Wharf is situated adjacent to the rocky reefs and sponge communities around South Shell Island and Old Man Rock. South Shell Island contains a high diversity of sensitive filter-feeding sponges and other communities and has the highest diversity of sponges and soft corals in Darwin Harbour (Alvarez *et al.,* 2002). The entire diversity of sponges in the Harbour is represented at South Shell Island indicating its ecological significance in Darwin Harbour. The existence of small range endemic sponges and soft corals is also highly likely (BMT WBM, 2011). South Shell Island reefs' proximity to EAW and dredging were not indicated on maps showing the realigned MSB footprint (Fig 6-3, Supplement) nor on figures showing dredge dispersion results (Figures 4-3 – 4-14, Appendix E, draft EIS).

Description of benthic[1] habitat is a critical piece of information for assessing the impacts associated with dredging (WA EPA, 2011). The benthic habitat map provided in the EIS was based on limited data, primarily substrate data, collected in large part by Government and Proponents of previous projects in the Harbour (Figure 15-1, draft EIS). The mapping was sparse and restricted to the immediate area surrounding East Arm Wharf which made understanding the extent and significance of these habitats within the Darwin Harbour difficult. This was of particular concern given areas within EAW, such as South Shell Island, are considered biodiversity "hotspots" (Hooper *et al.,* 2002).

Further information (NRETAS, 2011) requested a habitat map to enable adequate assessment of the extent and intensity of potential impacts from dredging on marine habitats and the biological communities these habitats support. Specifically the Proponent was asked to address:

- Calculation of areas occupied by significant communities (e.g. corals, reefs, seagrass, mudflats) in predicted zones of direct impact (i.e. area of seabed removal by dredging and immediate area adjacent affected by elevated turbidity and sedimentation resulting in permanent loss of benthic habitat);

[1] Benthic habitat includes live hard and soft coral communities, sponge and other filter feeding and marine plant communities.

- Commitment to field validation particularly in areas predicted to be directly impacted by project components;
- Use of existing knowledge and compiled data sets to develop models to predict the distribution of habitat class in zones of impact and influence for dredging activities; and
- Identification of significant habitats that may be threatened by dredging activities (zones of moderate impact and adjacent zone of influence e.g. frequent turbid plumes with occasional light attenuation resulting in temporary reduction in benthos (from Table 16, AECOM 2011, Supplement).

A Marine Habitat Survey has been submitted, that partially addresses the requirements of this EIA (Geo Oceans, 2011). This Survey has included a discussion of habitat types likely to be permanently modified and presents these as a percentage of the total amount of each habitat present within Darwin Harbour, to attribute levels of significance (described in more detail in Section 4.5.1).

For adaptive monitoring purposes, benthic habitat information is required to allow development of monitoring programs with suitable monitoring sites that can deliver impact assessments and management actions. The Proponent has committed in the draft Dredge Management Plan that the planned activities for the Benthic Habitat Survey would be submitted to the TAG prior to commencement of site works (section 3-1, Table 17, Appendix E) and this is reiterated in the below recommendation.

9. <u>Recommendation</u>

As part of the final Dredge Management Plan, the Proponent must undertake a *Benthic Habitat Survey* to establish ground conditions and address the following prior to commencement of dredging works:

- **Conduct field surveys to verify desktop benthic habitat mapping;**
- **Establish threshold for ecological receptor sensitivities (linked to select "lead" impact indicators for water quality);**
- **Monitoring design to enable comparative analysis identifying target benthic parameters, duration for monitoring and the relationship to short term water quality monitoring;**
- **Methods for the surveys following commencement and completion of dredging to identify effects outside the Zone of High Impact;**
- **Location and establishment of survey sites in Zones of Moderate Impact and Zone of Influence and Reference sites;**
- **Timing and frequency of monitoring and treatment of survey data; and**
- **Identifying unacceptable impacts through identification of monitoring thresholds.**

4.5.1 Establishing zones of impact

In the draft Dredge Management Plan the Proponent has indicated the following information is required to create an informed dredge assessment framework:

- Range of likely impacts on different in habitat benthos immediately outside the dredged seabed area;

- an up-to-date data and mapping of sensitive benthos types in the area and region; and
- predict the extent of sediment ”pressure” fields.

The above information is essential to confirm and delineate impact zones for each of the dredging activities.

The Environment and Heritage Division (NRETAS) has assessed the proposed marine dredging program using the methodology outlined in *Environmental Assessment Guideline for Marine Dredging Proposals* (Environmental Protection Authority, Government of Western Australia, 2011). This assessment approach was also used for the Environmental Assessment of the INPEX Ichthys Gas Field Development Project (Assessment Report 65, NRETAS 2011).

The proponent, in its draft Dredge Management Plan (Supplement; Appendix E; table 16) has presented a methodology framework for identifying zones of impact, based on the WA EPA Guideline (2011). To be able to provide an assessment of the acceptability of this proposed dredging program, the proponent was asked to use its proposed methodology to produce a benthic habitat map of the EAW region, overlaid with predicted zones of impact. This step was critical to complete the environmental assessment (WA EPA, 2011).

Impact zones are defined as:

- Zones of High Impact – seabed removal at the EAW by dredging, plus an area adjacent to the dredge source where there is elevated turbidity and sedimentation causing permanent loss of habitat;
- Zones of Moderate Impact – moderate detectable, temporary reduction of marine benthos.
- Zones of Influence – detectable changes in environmental quality associated with dredge plumes but do not result in detectible impact on benthos (from Table 16, DMP).

The Draft Dredge Management Plan defines direct impacts associated with the project to be predominately within and immediately adjacent to infrastructure footprints such as excavated seabeds. Direct impacts usually involve irreversible loss of benthos and communities, including soft corals and sponges. Reversible impacts are those that prevail for less than five years (WA EPA, 2009, 2011).

As discussed in section 4.5 of this Report, an adequate benthic map has been produced. The Zone of High Impact seems to be generally consistent with the proponent’s proposed methodology, and WA EPA guideline, however the Zones of Moderate Impact and Influence presented, are not consistent with WA EPA methodology and will not be used in this assessment.

This report will assume that the Zone of High Impact for the proposed dredge program will occur to the margin of the dredge footprint, plus a 20 metre buffer extending outward of that footprint, consistent with the assessment of the INPEX dredging program. The information provided by the proponent did not clarify the extent of the Zone of High Impact, nor whether a buffer was included. The mapping provided is assumed to indicate that the outer margins of the dredge footprint were used. Table 3 lists the following values of each habitat type within the Zone of High Impact. The report was not clear how the total areas for each habitat type in the

Darwin Harbour Management Unit (Figure 2, GeoOceans 2011) were determined and this will require further clarification in the final Dredge Management Plan.

Table 3: Habitat type and area identified in the Zone of High Impact

Habitat type	**Total area in Darwin Harbour Management Unit (ha)**	**Zone of high impact (ha)**	**% of total available habitat in MU**
Filter feeders; reef	8173	3.09	>1%
Hard coral; reef	433	0.02	>1%
Macroalgae; reef	234	0.01	0%
Macrobiota <10%; Reef	2337	23.43	1%
Seagrass; sediment	1735	0.00	0%
Mangrove: sediment	19657	0.33	0%
Sediment	40532	17.24	>1%

The values presented above indicate that the predominant habitat type that will be impacted is the Macrobiota <10% reef. This habitat type is defined by the proponent as moderate to high density sponge and soft coral beds, of which approximately 1% of the total area represented in the Harbour will be removed by this project.

It is known that the Zones of Moderate Impact and Influence will extend over a much wider area than has been presented by the Proponent, but those areas will be expected to recover within a period of five years following completion of dredging activities, unlike the benthic organisms in the Zone of High Impact, which are predicted to be irreversible (WA EPA, 2011).

In order to inform the final Dredge Management Plan, the Proponent will be required to present further information, correctly defining the Zones of Moderate Impact and Influence. This will provide a clear indication to the spatial extent of expected impact. This information will indicate whether there are areas that may be impacted by both the EAW and INPEX dredging programs, and the habitat types most likely to be subject to cumulative impacts.

10. Recommendation

The proponent shall further define the spatial Zone of Moderate Impact and the Zone of Influence for the EAW dredging program, based on methodology described in *Environmental Assessment Guideline for Marine Dredging Proposals* (Environmental Protection Authority, Government of Western Australia, 2011) and use the resultant spatial margins to define an area of common impact with the INPEX dredging program. If present, this area of common impact should be defined, and specific management measures should be developed in consultation with INPEX, and on the advice of the TAG.

4.6 Biodiversity impacts

4.6.1 EPBC Matters

A number of EPBC listed species are present in the project area and may be impacted by the Project. These species are listed as matters of National Environmental Significance (NES) under the EPBC Act and include coastal dolphins, dugong, sawfish, marine turtles and migratory birds.

Issues raised during the review of the draft EIS related to a lack of discussion, analysis, quantification and mitigation of potential impacts of:

- dredge plume on listed species foraging habitat;
- terrestrial and piling noise on migratory birds and marine species with proposed exclusion zones to be based on an understanding of the noise propagating characteristics of the area;
- release of PASS or ASS on listed marine species or their habitat;
- lighting impacts during construction or operations on listed species including marine turtles and migratory birds;
- removal of habitat including the removal of the dredge spoil ponds that are currently utilised by migratory birds;
- increased vessel traffic – noise and vessel collision impacts; and
- over-water maintenance – including the clean-up of anti-fouling coatings from steel structures on listed marine species or their habitat.

In most cases, survey techniques were unclear concerning geographical extent, survey timing and targeted species.

Impacts to freshwater sawfish and green sawfish were addressed in the Supplement, however a third species of sawfish (dwarf sawfish) has been recorded in the area (or estuaries) of Darwin and the Proponent will need to consider potential impacts of Project activities on that species.

4.6.1.1 Over-water maintenance

In the draft EIS, the Proponent stated over-water maintenance of steel structures is required for corrosion control. This involves abrasive blasting or grinding/sanding of surfaces to remove paint and anti-fouling residues and corrosion (rust). The majority of this material comprise of inert particulates (paint chips, rust flakes, blasting grit, etc.) but there may be a release of toxins (most likely copper-based) from anti-fouling coatings.

In the Supplement, the Proponent stated that over water maintenance is not required because the preferred design of the Project no longer uses sheet and pile construction. Anti-fouling coatings will not be required for the proposed development structures, and toxic TBT (tributyltin) anti-fouling paints are banned under the International Maritime Organization's Anti-fouling Systems Convention (of which Australia is a member state).

4.6.1.2 Migratory birds

Migratory bird species recorded within the study area were predominantly within the mangroves, saline wetlands and the dredge spoil ponds. Numbers of migratory shore-birds present in local roost sites, mangroves and near-coastal habitats are low when compared to other sites to the north of Darwin (e.g. Lee Point) and Darwin

Harbour can be described as modest compared to these identified areas (Chatto, 2003).

However the area does support nationally significant numbers of some migratory shorebirds.

The EPBC Act policy statement 3.21 provides a set of criteria for determining the importance of habitat for migratory shorebirds in Australia (DEWHA, 2009), which rates a site as nationally important habitat if:

- The site is identified as internationally important under Ramsar: or
- The site supports at least 0.1% of the flyway population of a single migratory shorebird species; or
- At least 2000 migratory birds; or
- At least 15 shorebird species.

The study area meets the criteria for supporting nationally important migratory shorebird habitat in that:

- Five migratory shorebird species have been recorded within the study area at numbers greater than 0.1% of the flyway population, including Lesser Sand Plover, Greater Sand Plover, Far Eastern Curlew, Terek Sandpiper and Sharp-tailed Sandpiper (Plate 12) (Table 7.4, Appendix M, draft EIS);
- At least 2000 migratory birds; and
- Twenty-two migratory shorebird species have been recorded within the study area, exceeding the significance threshold of 15 species (EMS, 2011).

Approximately 24 ha of low tidal mud flat habitat would be either reclaimed or substantially disturbed during construction of the project, including the existing dredge spoil ponds. These areas have been identified as feeding, roosting and nesting habitat for shorebirds, including migratory species listed under the EPBC Act (Appendix M, draft EIS).

The proponent was asked to quantify the potential impacts to migratory birds from removal of habitat. Several migratory bird species utilise the dredge spoil ponds at EAW for roosting habitat. Some reduction in pond area at EAW will occur as a result of filling of dredge spoil ponds (Section 7.2, Supplement). Most of the bird observations during the bird surveys were at Pond D (2169 sightings of 3722 sightings at 14 sites in total). Pond D is currently scheduled for reclamation from 2030. The Proponent stated that birds that utilise Pond K will, once pond K is filled, utilise Pond D instead, or utilise natural habitat types within Darwin Harbour. No evidence was provided to substantiate this statement. Further information submitted indicates fine sediment dredge material will be introduced at Pond D, with coarser material to be discharged into pond K. Finer sediments held in suspension longer will be deposited closer to the outlet of the pond network in pond E.

The further information request suggested the Proponent refer to previous studies conducted on marine and migratory birds in the Darwin Harbour to show potential alternate foraging and roosting areas that the birds may use (Chatto, 2003). Chatto's report is a comprehensive report documenting the location and status of selected faunal assemblages in the Northern Territory coastline, offshore island and Top End wetlands. The report summarises the status and distribution of migratory and resident shorebirds in this large area – covering 15 separate survey blocks, with survey Block 4 being the closest to Darwin. Information presented by Chatto was

taken from a long term and complex series of surveys and equates to approximately 2000 hours, over more than 600 days between 1990 and 2001 (aerial and ground surveys).

While the Proponent did not appear to use this report for quantification, Table 4 below was produced by the Environment and Heritage Division to summarise the numbers of significant migratory birds recorded at EAW at greater than 0.1% of the fly away population compared to the total recorded numbers for the survey block conducted by Chatto, 2003. The figures show these species do occur elsewhere in Darwin Harbour region and would indicate there is alternate foraging and roosting areas within the region. It also shows most of these species were recorded in Pond D, not scheduled for reclamation until 2030. This pond is already subject to regular wetting and drying and noise and lighting disturbances from surrounding industrial activities.

Table 4: Numbers of migratory birds that recorded >0.1% flyway population at EAW Ponds K and D compared to general Darwin Harbour region (survey block 4 from Chatto, 2003).

Species	**Combined Nov 2010 – Jan 2011 (EMS, 2011) Pond K numbers**	**Combined Nov 2010 – Jan 2011 Pond D numbers**	**Recorded Numbers around Darwin Harbour (survey block 4 from Chatto, 2003)**
Lesser Sand Plover	2	320	1800 (6%[1] Figure 104)
Greater Sand Plover	16	276	3410 (11% Figure 106)
Far Eastern Curlew	-	123	200 (4% Figure 64)
Terek Sandpiper	-	-	1099 (7% - Figure 74)
Sharp-tailed Sandpiper	1	249	370 (2% - Figure 92)

[1]Percentage of numbers of total survey blocks (15 survey blocks in total)

While the risks to migratory birds from habitat removal are acknowledged to be low, migratory birds do exhibit high site fidelity and are sensitive to disturbance (DEWHA, 2009). In addition, the flora and fauna survey conducted by EMS (2011), indicated a lack of habitat connectivity in the project area and it could not be known where the birds would subsequently forage and roost during high tides. The further information submitted did not adequately quantify alternate habitats for the displaced roosting birds. This information is required to properly understand impacts to migratory birds. While it is recognised that dredge spoil ponds are highly disturbed artificial wetlands, these areas have become nationally important habitat for migratory and wetland birds. It should also be noted that this assessment is based on a single count during one wet season (EMS, 2011).

DPC conducted a 10 month survey monitoring shorebirds and wetland birds within the EAW, mainly at the dredge spoil ponds although no details on this monitoring program were provided in the Supplement or further information request (Estbergs, 2011). EMS, 2011 recommended that monitoring is continued and expanded to include the saline flats/tidal mudflats and a dry season survey conducted. Monitoring should also be continued to determine whether the migratory birds can and do use other nearby areas once the dredge spoil ponds are filled. The aim of the surveys is to substantiate the assumption that migratory and shorebirds will utilise alternative habitat types within Darwin Harbour.

In Section 16.5, draft EIS, the Proponent commits to the recommended management actions listed in the EMS 2011 report to mitigate impacts to migratory and shorebirds currently using the EAW project area and these include (but not limited to):

- Minimise the area of mangrove, salt pan and tidal mudflat areas disturbed for any works or reclamation;
- Strict controls on sedimentation or other impacts that may impact shorebird feeding sites;
- Protection of high tide roost sites and provision of additional high tide roost sites if there are opportunities in the design for the project (e.g. within the proposed rail loop component of Area 1);
- Controls on activities or facilities that might disturb feeding and roosting birds (e.g. noise, nocturnal lighting);
- Continued restricted access to the public and animals (dogs) to areas where migratory shorebirds roost and feed;
- Continued monitoring of shorebirds, expanded to include the western component of Area 1;
- Undertake significant works in the vicinity of areas where migratory shorebirds inhabit in the Dry season when most northern hemisphere migrants are absent (May – August); and
- Inclusion of buffer zones to important migratory shorebird sites where possible.

The above commitments to minimise impacts to migratory birds and habitat are supported.

11. <u>Recommendation</u>

The Proponent consider appropriate mitigation measures or offsets to compensate for potential residual detriment of Project activities on migratory bird species.

4.6.1.3 Coastal Dolphins

As a result of mainly human activities, coastal and river dolphins are among the world's most threatened mammal species (Thompson *et al.* 2000, Kreb and Budiono 2005). These species show reasonable levels of site fidelity and when combined with a restricted coastal distribution, are vulnerable to coastal habitat degradation (Parra *et al*. 2006). The snubfin (*Orcaella),* Indo-Pacific humpback (*Sousa chinensis*) and Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) are the most commonly recorded cetacean species in Darwin Harbour (Palmer, 2008). Over the last 15 years, Darwin and its Harbour have experienced rapid development associated with a significant increase in population. Dolphin species inhabiting Darwin Harbour may be vulnerable to displacement from these anthropogenic activities because their population size is small, reproductive rate is low and they are long lived (Palmer, 2010).

The baseline information provided in the draft EIS and Supplement was insufficient to determine whether the EAW area contains significant habitat for these species. The Proponent indicated that the marine megafauna[2] abundance information was from surveys conducted for INPEX (GHD, 2011a, 2011b, 2011c). These dolphin surveys

[2] Marine megafauna include coastal dolphins, dugongs, sawfish and marine turtles

were not specific to the EAW and the predicted dredge plume area (Figures 14-9 – 14-11, Supplement). Based on these surveys the draft EIS stated the density of all three species of coastal dolphins is greater or comparable in the western part of Darwin Harbour than the EAW area (GHD, 2011). This is not an accurate statement and based on existing NTG surveys and photo-identification of dorsal fins, the majority of individual dolphins occur in both the eastern and western parts of Darwin Harbour (Palmer 2008, 2010, 2010b, INPEX Supplement 2011).

The lack of baseline information presented a high risk of inaccurately representing and underestimating how local populations of coastal dolphins use the area. Further information was requested to provide information on survey techniques (timing and duration) and to provide evidence that the EAW area was not an important habitat for coastal dolphins and this has not been provided. In Figure 4 of the submitted report (Geo Oceans, 2011), the Proponent used results by Palmer (2010) to show frequent observations of the Indo-Pacific humpback around the EAW area. In the two year surveys conducted monthly by Palmer (2010), Indo-Pacific humpbacks were recorded predominantly in areas around EAW (transect 3 and 4), with foraging observed as the dominant behaviour. Snubfin and Indo-pacific bottlenose were not observed in significant numbers around EAW (Figure 4, Geo Oceans, 2011, Table 3 and Figure 2, Palmer 2010).)

In the further information response submitted, the Proponent asserts the area does not contain important habitat for coastal dolphin species (DLP, 2011). The assertion cannot be substantiated or denied without further monitoring to indicate whether the coastal dolphin species are permanent or seasonal residents in the area. Preliminary results by NTG indicate that a large proportion of the identified individual dolphins have been observed only once over two years (56% for Indo-Pacific humpback). Such a high proportion of individuals sighted only once suggest that a possibly large proportion of the individuals of each population spend most of their time outside the study area (Palmer, 2010b, INPEX Supplement 2011), indicating that EAW area may not be an important habitat.

Alternatively, no surveys have been provided to indicate that EAW is not an important habitat for coastal dolphins and evidence to date indicates is it a foraging habitat for Indo-Pacific humpbacks (Palmer, 2010). Under the Significant Impact Guidelines (2009), a critical habitat refers to areas *that are necessary for activities such as foraging, breeding, roosting or dispersal.* In addition, the lack of baseline information on population trends in coastal dolphins makes it difficult to assess whether the EAW area is important habitat defined under the Guidelines as *habitat within an area where the species is declining* (DEWHA, 2009). This is because population trends in coastal dolphins are extremely difficult to detect in short-term studies unless changes in population size are dramatic (greater than 20% per year). Research by NRETAS indicates patterns of residency within the Darwin Harbour populations. This makes them susceptible to extinction if rates of dispersal between populations are adversely affected. Without knowledge of the meta-population structure, the degree of dispersal and an understanding of how to manage the meta-populations, the future of these species in the Darwin region is unknown (EHD, INPEX Assessment Report 65, 2011). Updated modelling of dredging effects for the confirmed dredging methodology is required to quantify the zones of moderate impact (temporary five year effects) with respect to habitat value for listed coastal dolphin species.

In acknowledgement of the paucity of knowledge around coastal dolphins in Darwin Harbour, and their response to the expansion of industry and services in the Harbour, NRETAS is currently studying coastal dolphins to improve and expand on the

understanding of this species to inform conservation management strategies (Palmer, 2010). It was recommended in the INPEX Assessment Report (EHD, 2011) that INPEX continue to fund and support research into coastal cetaceans in Darwin Harbour and the wider region to determine the importance of Darwin Harbour for the regional coastal cetacean population and the potential cumulative impacts from various projects in the Harbour on these populations.

In recognition that the cumulative impact of multiple projects on a sensitive species may be greater than the sum of its parts, it is recommended the Proponent liaise with INPEX and NRETAS to coordinate research effort and share information gained in this research to mitigate cumulative impacts of the project on these species. While it is acknowledged that the Proponent has not demonstrated to a level of certainty that the Project will have an acceptable impact on coastal dolphins, certainty will not be achieved without the support from the proponents of projects in Darwin Harbour region, to progress the research that will inform management objectives.

12. Recommendation

The Proponent contributes to coastal dolphin research effort and uses information gained in dolphin research to mitigate cumulative impacts of the project occurring on coastal dolphin species.

4.6.1.4 Marine Turtles and Dugongs

Six species of marine turtles are known to occur in the waters of northern Western Australian and the Northern Territory—the green turtle (*Chelonia mydas*), flatback turtle (*Natator depressus*), hawksbill turtle (*Eretmochelys imbricate*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Dermochelys coriacea*) and the olive Ridley turtle (*Lepidochelys olivacea*). Of these, the green, hawksbill and flatback turtles are seen foraging for food in Darwin Harbour with the olive Ridley and loggerhead turtles suspected to be infrequent users (section 15.3, draft EIS). The Proponent states that the area to be affected by dredging for the EAW Project represents a small proportion of the total available marine turtle habitat, the impacts of dredging will be relatively short term, and suspended concentrations resulting from dredging operations will remain below the average for Darwin Harbour.

Nesting habitat areas within the Darwin Harbour region was addressed and indicated that only the flatback is known to nest close to Darwin harbour at Casuarina beach.

The Geo Oceans report submitted did not include maps showing areas within East Arm that are potential foraging habitat for marine turtles and dugongs despite the Proponent indicating that there is potential foraging habitat within EAW (DLP, 2011). In the impact assessment conducted for INPEX, the potential for significant disturbance to foraging habitat for turtle and dugong was assessed by determining the total area of foraging habitat for each species within a defined study area, and then comparing this with the area of potential impact from dredge related activities (Section 4.1.10.2, INPEX Supplement, 2011). Figures 4-22 – 4-24 (INPEX, Supplement, 2011) show potential marine turtle and dugong foraging habitat in Darwin Harbour which supports the Proponent's statement that the area to be affected by dredging for the EAW Project represents a small proportion of the total available marine turtle habitat - assuming the INPEX Project has greater impact areas than EAW Expansion Project. Table 5, reproduced below, also confirms the area around EAW is a small area compared to potential foraging habitat for turtles and dugong in Darwin Harbour (INPEX, Supplement 2011).

Table 5: Area (in hectares) of potential foraging habitat for turtles and dugong in Darwin Harbour (ref: Table 4-13, INPEX Supplement, 2011).

Species	Habitat Type				Total foraging habitat	Total direct area of impact (EAW) derived from Table 3	Percentage of total foraging habitat potentially impacted (EAW)
	Seagrass	Filter-feeder	Microalgae	Fringing mangrove			
Green turtle	2520	-	247	1743	4511	0.01	0.0002
Hawksbill turtle	2520	7912	247	-	10 679	3.1	0.03
Flatback turtle	-	7912	-	-	7912	3.09	0.04
Dugong	2520	-	247	-	2768	0.01	0.0004

Further information requested an impact assessment on foraging habitat areas and impacts from increased vessel traffic on marine turtles and dugongs. Marine turtles and marine mammals are mobile and can generally avoid impacted areas for the duration of dredging activities. The main mitigation measure is to limit the period of dredging to as short as possible by avoiding delays once dredging commences. Table 2 indicates the maximum dredging time will be 63 days for the MSB, indicating a relatively limited period of dredging associated with this Project.

4.6.1.5 Underwater noise

The Project will create additional underwater noise in various forms and intensity above current ambient levels in Darwin Harbour. The sources of noise relevant to the project include dredging, pile driving and shipping noise. Marine mammals (three species of coastal dolphins and dugongs) and marine turtles (green, hawksbill, flatback and olive ridley) may be impacted by increased noise in the underwater environment. Piling is proposed to be undertaken over a period of approximately six months for the MSB and two months at the tug pens (DLP, 2011).

Development of harbour facilities serviced by heavy vessel traffic will also elevate local background levels, and may cause some species to avoid former nearby breeding or feeding areas owing to the amount of vessel movement disturbances as well as increased noise. While some marine mammals appear more capable of habituating to such activities than others (such as some species of dolphins in urbanised estuaries), their calving or pupping areas may be restricted to less disturbed locations (section 13.3, draft EIS).

Coastal dolphins “see with sound” (echolocate). In muddy waters, sight is often of little use and these species are reliant on echolocation to explore their environment. Significantly increased underwater noise levels can compromise a dolphin’s ability to carry out normal activities.

In the draft EIS, the Proponent states, of shipping related noise, that “*the development of harbour facilities serviced by heavy vessel traffic will also elevate local background levels, and may cause some species to avoid former nearby breeding or feeding areas owing to the amount of vessel movement and disturbance as well as noise”.* The Supplement did not address if the project area contained

significant habitat for coastal dolphins or proposed monitoring and mitigation measures associated with this impact.

The Proponent used observations from Hong Kong, where two major shipping fairways – Urmston Road and the South Lantau Freeway, pass through areas used heavily by Indo-Pacific humpback dolphins to indicate shipping noise impacts to coastal dolphins would be minimal. Ongoing long-term dolphin monitoring across all of Hong Kong's western waters showed a high level of anthropogenic background noise around key habitat areas for humpback dolphins, which was comparable to the sound of a storm at sea. Disturbance from additional shipping vessels was therefore expected to be minimal (Wursig & Greene, 2002). In the absence of long-term dolphin monitoring conducted in the Darwin Harbour, it is difficult to assess the potential impacts from increases in vessel traffic noise upon dolphins.

Little information is available on the auditory systems of dugongs and the Proponent listed only anecdotal reports of dugongs avoiding areas with high boat traffic. Little research has been undertaken to investigate the sensitivity of dugongs to noise and the precautionary principle must be applied to ensure impacts of noise and vessel do not impact this species.

Displacement of marine megafauna is not necessarily the most significant effect of boat traffic. Animals can move and stay away from the disturbed area only when resources are available elsewhere. If animals can move to suitable habitat they may be less affected than animals forced to remain and tolerate the effects of disturbance (Gill et al., 2001). Both the reduction of habitat availability and the costs of disturbance can affect the survival of individual marine mammals and therefore entire population (Hodgson & Marche, 2006).

The Proponent states that the marine noise modelling conducted for INPEX was used to assist in determining underwater noise impacts relevant to EAW project. The results derived from noise modelling for the proposed INPEX pile driving program was that it could be managed so that it is unlikely to have unacceptable impacts on marine fauna, and particularly any beyond a distance of around 500 m of a pile being driven into the substrate (INPEX, Supplement 2011). The Proponent has committed to adapt these recommended measures from the INPEX noise modelling to mitigate and manage underwater noise impacts on cetaceans, dugongs and marine turtles during Project construction, including (Section 13.9.1, draft EIS):

- Prior to the commencement of any noise-intensive activity, a marine fauna exclusion zone extending 500 m in all directions from the noise source should be established;
- From one hour prior to the commencement of any noise-intensive activity, vessel based observers (or land-based observers if appropriate) should monitor the exclusion zone to check for the presence of any important marine fauna species. Activities may only commence if no important marine fauna have been sighted within the exclusion zone 30 mins prior to the commencement of the activity;
- If any such species are observed within the zone, noise-intensive activities should not commence until the animal is observed to leave the exclusion zone, or until 30 mins of observations have passed since the last sighting and no more important marine fauna have been sighted;
- Activities should only be conducted in daylight conditions and preferably with appropriate sea conditions (e.g. sea state 3 or below) so that observers have

a reasonable probability of sighting any marine fauna incursion into the exclusion zone; and

- Suitably experienced personnel should continuously maintain an adequate look-out for the presence of important marine fauna during noise-intensive activities.

The above mitigation measures are supported. These measures should be monitored to ensure their effectiveness and adapted if required to mitigate impacts. The Proponent must also consider the cumulative impacts of pile driving at two locations in East Arm and any management program proposed should consider and be consistent with the INPEX Management Plan.

4.6.1.6 Impact of vessel collision and entrainment

A number of respondents to the draft EIS raised the issue of increased injuries to, or mortalities of, marine fauna from Project-related shipping and dredging activities in the Harbour. The main concerns were boat strike to dolphins, marine turtles and dugongs, and the possible entrainment of marine animals by dredging equipment. The Supplement clarified that only Cutter Suction Dredgers would be used during construction with only the cutter head moving laterally across the face of the cut. Given the noise generated as the teeth of the cutter head grind their way through the rock substrate, it is considered unlikely that any turtles would approach within sufficient proximity to the dredge to become entrained within the suction mechanism, which is located directly behind the cutter head.

Large marine vertebrates are visible to fishers, boaters and beach walkers when stranded. The stranding of injured or dead animals could attract considerable attention from the public and conservation groups. Additionally, the marine fauna vessel co-occurrence sub-plan as part of the DMP (section 5.2.2.2, DMP), should include a program to monitor for animals that have been injured or subsequently died from entrainment injuries within Darwin Harbour during dredging operations. This should include procedures for retrieval and post-mortem and reporting all injured or dead animals to the NRETAS marine hotline.

The Proponent's response in the Supplement of no awareness of any collisions in Darwin Harbour from vessel traffic to EPBC listed species that include coastal dolphins, dugongs and marine turtles requires further discussion. Further information was requested on the number of vessels currently using EAW and additional number of vessels expected due to this project. Commercial vessel usage for the entire EAW is projected to increase from 501 in 2009 to 1130 in 2015 (DLP, 2011). Vessel traffic data, excluding fishing vessels, tugs, ferries, charter, naval and pleasure vessels will increase from 1730 in 2010/11 to 2920 in 2019/20. These projected increases in vessel traffic may increase the risk of vessel collisions.

It can be assumed the limited duration of the dredging campaign would limit vessel collision impacts on marine megafauna. However the long term increase in vessels using the EAW area and the potential impacts of vessel collision was not considered by the Proponent. It is recommended that smaller, Project-related vessels should be required to moderate their speeds to lower the risks of collision and have propeller guards fitted to reduce the impacts of collision. All boat handlers associated with the Project should be educated to watch for large marine fauna and minimise vessel interactions with these fauna. Any collisions should be reported. The Proponent should consider involving NRETAS Marine Wildwatch in monitoring for stranded fauna.

Proposed monitoring, mitigation measures and their efficacy need to be included in the Environmental Management Plan for ongoing operations at DPC. These additional measures must be included in the relevant management plans for approval by government in accordance with Section 4.12 of this Report.

13. Recommendation

The Relevant EMPs are to be amended to include measures for minimising vessel interactions / collisions with coastal dolphins, marine turtles, dugongs and other large marine fauna for dredging operations and ongoing port operations. The relevant plans should include:

- **details on procedures to reduce the risk of vessel strikes on large marine vertebrates (marine turtles, dugongs and cetaceans) such as speed limits;**
- **details on procedures for monitoring and reporting of vessel strikes on large marine vertebrates;**
- **details of adaptive management measures if monitoring indicates increased vessel strikes; and**
- **plans to monitor for stranded, injured or dead large marine vertebrates.**

4.6.2 Marine Ecology

The Proponent acknowledges there is a risk of loss of biodiversity associated with developments at EAW, but considered that there is only a low risk of significant loss occurring as a result of this Project (Section 14, Supplement). In the absence of high quality, field validated baseline benthic habitat data; the precautionary principle should be adopted for the risk rating of impacts to biodiversity. The Risk Assessment conducted by the Proponent interpreted the risk of removal of habitat as 'low' and of "minor consequence" of which the range is "low level impact for some communities, or high impact for a small number (<10) of individuals (Section 25, draft EIS). In contrast to the findings of the risk assessment, the BMT WBM, 2011 report shows an expected loss of an unspecified area of high biodiversity habitat classed as *Habitat Class 2 - Moderate-High Density Sponge and Soft Coral Beds*.

The draft DMP provided in the Supplement confirms there will be "direct impacts predominantly within and immediately adjacent to infrastructure footprints such as excavated seabeds" (Appendix E, Supplement). Direct impacts are defined as "irreversible loss of benthos and communities, including soft corals and sponges" (WA EPA, 2011). Advice from the Museum and Art Gallery NT (MAGNT) indicates that biodiversity loss in the area is already occurring with a survey undertaken on 28 October 2011 at the intertidal reef flat adjacent to the old boat ramp indicating significant decline since baseline surveys conducted in 1993 (Hanley, 1995). Approximately 40% of sponge species inhabiting the same area in 2001 were no longer present, and a significant loss of biomass of sponges and soft corals was noted (B. Alvarez de Glasby, pers. obs.). Further, like corals, some sponges are home for photosynthetic microorganisms. In these species indications of bleaching is indicative that the area is already under stress.

The importance of these benthic communities around EAW is demonstrated by the fact they are currently subject to medical (bioprospecting) research by the American National Cancer Institute in alliance with the NT Museum and Art Gallery. These

communities also hold a number of other anthropogenic values of importance to present and future generations, including values for scientific research (taxonomy, evolution, phylogeography), recreational diving and fishing, education (marine biology) and aquarium fish collection. The ESD principle of inter-generational equity suggests that the coral and sponge communities should be managed in a way that optimises potential benefits of bioprospecting and other uses in the future.

The Proponent has identified the following management measures to mitigate the loss of biodiversity associated with the project:

- relocating access channel 300m to the east of South Shell Island;
- minimising the dredged volumes and channel footprints;
- onshore disposal of dredge spoil; and
- not allowing dredging to occur close to the South Shell Island coral community during ebb tides;

The draft DMP states that biodiversity values will be determined for sites that have species assemblages that may constitute habitat of conservation significance. These sites will be discussed in comparison to reference sites and at least two surveys will be undertaken and linked to seasonal changes in fauna activity (Appendix A in DMP, Supplement). This survey work to determine a habitat of conservation significance is supported.

The Environment and Heritage Division also supports the dredging commitments listed in Table 17, draft DMP (Section 5.3.4, Supplement). Relevant benthic monitoring, assessment and reporting commitments include:

If other recent and relevant data do not exist, the Proponent shall commence and conduct monitoring described in the Benthic Habitat Survey and provide an initial report to the approval agencies;

1. *On the findings of the pre-dredging conditions, and*
2. *A plan for repeat monitoring in areas of predicted dredging effects.*

Following commencement of any dredging works, the Proponent shall:

1. *Show the locations and spatial extent of the different marine benthic habitat types and parameters such as percentage cover for each dominant taxa;*
2. *Record the abundance and health of benthic taxa observed within the indicator communities;*
3. *Compare results to baseline (pre-development) results; and*
4. *Develop and utilise a risk based monitoring and management framework.*

In addition, ongoing benthic biodiversity monitoring that includes endemic species at both East Arm and South Shell Island should be incorporated into the Environmental Monitoring Program (Appendix A, Supplement) in the identified Zones of Influence and Moderate Impact and reference sites. The monitoring program and reports should be submitted to the TAG and relevant agencies for review prior to works commencing.

If the above monitoring indicates a significant impact on benthic organisms, the Proponent should consult with the Museums and Art Gallery NT on whether it would be advisable to obtain tissue samples of a representative collection of these organisms restricted around East Arm and archive them in an Australian Marine Biodiversity library.

14. Recommendation

Following completion of dredging, a report detailing the outcomes of the associated monitoring (including coral health) is to be made publicly available. The report should indicate whether there has been any significant ecological effect detected outside of the approved Zone of High Impact to inform the need for further monitoring, and whether collection of tissue sample collections are advised.

4.6.3 Mangroves

The mangrove communities of Darwin Harbour are a significant natural resource within the local area and in a regional context. The Harbour mangroves are floristically diverse and contain 36 species of the 50 species regarded as mangroves worldwide (Brocklehurst & Edmeades, 1996). Mangroves are valued for their ecological function, community amenity and economical foundation for many industries. Specifically, mangroves:

- provide important nursery and feeding areas for marine and terrestrial animals including barramundi, mud crabs, prawns;
- Provide foreshore protection, reducing erosion by cyclones and lessening the impact of storm surge;
- provide a sink for suspended sediments important as stabilisers of sediment,
- are recognised by the community as being critical for many recreational opportunities (e.g. recreational fishing, bird watching) and supporting marine ecosystems;
- hold cultural significance to Indigenous Australians utilising mangroves as a food resource (bushtucker);
- provide breeding, feeding and nursery areas for commercial marine species (Mangrove Management in the Northern Territory, 2002)

Most mangrove tracts surrounding Darwin Harbour are zoned for "Conservation" under the Northern Territory Planning Scheme, and are classified as "significant vegetation" under NT Clearing Guidelines (2010). However, the mangroves in the EAW Project area are within the EAW Area Development Zone and are not zoned for conservation.

Potential indirect losses to mangroves in the EAW project area include:

- Degradation of mangroves due to increase in sedimentation from dredging activities;
- Disturbance of Acid Sulfate Soils creating contaminated run-off impacting mangroves; and
- Disposal of large volumes of dredge spoil in ponds within tidal flat settings establishing a hydrostatic head, displacing highly saline groundwater and elevating the water table to create a zone of impact on adjacent mangrove habitat.

In the draft EIS, up to 5 mm of sediment deposition from dredging activities was modelled (Appendix E, draft EIS). In mangrove communities, mortality from sedimentation has been recorded at deposition of > 100 mm (Section 15, draft EIS

from Ellison 1998). Based on the modelling provided in the Supplement (Figure 16-1) it can be expected that sedimentation from dredging activities is not likely to impact mangroves in the EAW area. Mangrove extent and health could be monitored and recorded during the construction and ongoing operation to support this assumption.

The Proponent did not commit to undertaking a specific mangrove monitoring program based on the observation that there has been negligible impact to mangrove health associated with the current EAW and the natural mangrove recruitment that may occur in suitable conditions. The Proponent notes that the soil monitoring program includes three monitoring locations on the eastern perimeter of the mangroves to the north of EAW and any visible impacts to the mangrove community would be noted by experienced DPC environmental professionals and investigated as per DPC's EMS. A visual monitoring approach is inadequate and by the time visual impacts are detected in mangroves, it may be too late to implement reactive management actions.

The Proponent has not addressed the risk to mangroves from the disposal of large volumes of spoil in ponds elevating the water table and creating a zone of impact on adjacent mangrove habitat (section 15.5.1, draft EIS). This is not considered to be a significant risk and groundwater monitoring that the Proponent has committed in the DPC Environmental Monitoring Program (Appendix A, Supplement), should detect significant changes.

4.7 Terrestrial and Marine Water Quality

This section focuses on the water discharges from the Project, particularly in the context of Darwin Harbour as the receiving environment. Darwin Port Corporation is responsible for managing and disposing of all wastes generated from the construction and operation of the Project and will need to ensure surface water runoff does not impact receiving waters in Darwin Harbour.

4.7.1 Marine Water

The existing marine water quality data provided in the draft EIS provides a broad baseline desktop review and the Proponent has committed to undertake additional marine water quality and marine sediment quality monitoring as described in the DPC Environmental Monitoring Program (Appendix A, Supplement). The environmental monitoring program commenced at DPC in September 2010, with marine water quality samples taken quarterly (no samples were provided as part of this EIA). Marine sediments are also collected within four sites at EAW annually (no samples provided as part of this EIA).

Specific project activities that may impact marine water quality include:

- dredging increasing turbidity and suspended sediment levels and potentially re-mobilising contaminants;
- return of dredge decant water back into the Harbour;
- excavation of intertidal and shall sub tidal sediments, bund wall construction, and armouring;
- storm and waste water;
- land clearing (sediment runoff);
- pile driving generating minor localised turbidity; and

- increases to general shipping/vessel traffic (pre, during and post construction), including operational emissions and accidental spills.

Dredging activities will create the highest impact to water quality during construction and the Proponent has committed in the draft DMP to establishing a Water Quality Monitoring Program prior to dredging to allow determination and documentation and, if required, management of the effects of dredging on water quality. The draft DMP also committed to establish baseline conditions in order to detect unacceptable levels of change associated with dredging.

The Proponent has committed to monitoring of currents, waves and suspended sediment, and bottom sediment monitoring equipment (determines sedimentation rates) would be located near the proposed dredging locations with data collected during dredging operations (section 8.3.3, EIS). The data would include suspended sediment concentrations and sedimentation thickness, in accordance with future operational EMPs. Some of the typical dredging management actions to control sediment discharges/re-suspension listed in Section 8.3.2, EIS, are:

- High rates of sediment removal, enabling shorter timeframes for discharges;
- Reduction of propeller wash by using high tide for access;
- Relocation of the dredge plant to a different dredging area until more favourable conditions prevail;
- Depending on location, dredging only on favourable run-of-tide;
- Offshore disposal further away from high productivity potential impact areas
- Reduction of dredging to single shift; and
- Use of sediment control devices (e.g. shroud for cutter-suction dredge) at source.

The Proponent also commits to the following:

- Implement preventative actions as in the Dredge Management Plan and relevant EMPs;
- Review oceanographic processes monitoring data and findings to determine need for corrective action;
- Undertake annual reporting on results of monitoring of oceanographic processes; and
- The management of potential impacts on oceanographic processes will be in accordance with relevant standards (section 8.4, EIS).

Due to the significant uncertainties, baseline surveys and appropriate monitoring programs are required to ensure impacts are managed. Similar to the previous EIA conducted for East Arm Wharf in 1994, there is a requirement for continued input on environmental issues by relevant regulatory agencies and TAG during construction and early operational stages of the project. In the draft DMP, the Proponent indicates the TAG would oversee the dredging works and provide technical advice on all aspects of dredging and disposal works. The water quality monitoring assessment and reporting framework for dredging impacts listed in section 2, Table 17, DMP (Appendix E, Supplement) is supported and it is reiterated in the recommendation below.

15. Recommendation

Prior to commencement of any site development works, the Proponent shall prepare and submit a Water Quality and Sedimentation Monitoring Program to the approval agencies. The program shall address the following:

- **Statistical design for comparative analysis describing spatial and temporal trends in ambient water quality and sedimentation rates near the dredge source;**
- **Identify key parameters for monitoring including turbidity and sedimentation rates but also, depending on sediment content, potential contaminants and aquatic health indicators;**
- **Propose rapid and reliable methods for data collection, acquisition and interpretation to enable adaptive management of future dredge activity; and**
- **Analysis of monitoring data to establish dredge effects.**

4.7.2 Sediment Quality

The chemical composition of the sediment in proposed dredging areas can impact marine water quality by remobilised contaminants becoming bio-available to marine organisms. Chemical contaminants associated with the disposal of sediments from industrialised coastlines or long-term port facilities can also impact on the recovery of benthic assemblages following dredging (GHD, 2005). The remobilisation of sediments into the water column may result in the introduction of chemical contaminants to the receiving environment

Review of the draft EIS identified the lack of information on sediment quality information in the proposed dredging areas. The information provided in the draft EIS provided conflicting advice regarding the quantities of metal in sediment at EAW that was not clarified in the Supplement. In the draft EIS, 145 surface sediments were sampled in 2008 in areas proposed for disturbance by the INPEX project from a total of 145 sites throughout East Arm and the main body of Darwin Harbour (Figure 3, Appendix 9, INPEX draft EIS). Metal levels recorded in the East Arm area (total number of samples taken in this area were not provided) generally were below screening levels, with the exception of arsenic, chromium and mercury. In Appendix B, draft EIS for the EAW Expansion, sediment samples taken at East Arm were found to have elevated concentrations of heavy metals, including lead, zinc and nickel (Fortune 2006).

As discussed in section 4.4.2 of this report, the Supplement did not provide sediment quality results relevant to the proposed dredging areas. The Proponent did commit to conducting an on-site sediment sampling and testing survey to identify the quality and potential contaminants contained within target dredged sediment (refer to Recommendation 8).

In the EAW Drainage Strategy (Appendix C, Supplement), it was recommended that further measures are implemented to reduce the risk of accumulation in sediments. The Proponent indicated that marine sediments were collected from 13 sites (sampling date not provided) within Darwin Harbour (Table 3-1, Appendix A, Supplement). The results of this sediment sampling were not provided in the

Supplement. The Proponent commits to undertaking marine sediment sampling annually (Appendix A, Supplement).

4.7.3 Surface Runoff and Stormwater

The main discharge from the East Arm Wharf to the Harbour will be stormwater. Discharges are expected to increase as a result of the project due to the creation of additional hard stands and increases in hazardous bulk mineral loads may potentially impact on surface water runoff quality. A number of submissions contained comments about stormwater runoff potentially impacting water quality in Darwin Harbour. Potential impacts to surface water identified in the draft EIS are:

- interruption or reduction of natural drainage flows;
- increase of suspended sediment loads in surface water systems/marine environment during construction;
- proposed and existing ore stockpiles e.g. metalliferous dust is likely to be washed into water ways; acidic and/or metalliferous drainage potential may exist in stockpiles, leading to contamination of stormwater runoff;
- ASS/PASS soils disturbed by construction activities may release acidic or metalliferous stormwater runoff; and
- surface runoff/pond seepage may exceed water quality objectives for Darwin Harbour or relevant standards.

The potential sources of pollutants in stormwater runoff at EAW include:

- storage, transport and loading of infrastructure and activities of bulk miners (iron ore, manganese and copper concentrate);
- storage and loading infrastructure and activities of bulk liquids including petroleum;
- storage of dangerous goods, chemicals and drilling mud;
- refueling activities;
- livestock loading;
- waste management activities;
- sewage management; and
- sedimentation and erosion from unsealed areas.

The draft EIS stated that surface water runoff for most of that East Arm Wharf hardstand areas is collected into stormwater collection pits that passively seep into the Harbour (section 10.1.1, draft EIS). Surface runoff from the ship loader catchment and the hardstand east of the bulk loader were recently diverted to discharge to a retention pond. The Proponent indicated there are further plans underway to improve stormwater management including:

- implementation of stormwater contaminant capture such as gross pollutant traps; and
- developing a “cut-off drain” along the wharf berth in front on the ship bulk loader.

Other commitments listed in sections 9.3, 10.3.2, draft EIS included:

- upgrading the EAW EMP as necessary to *address any perceived additional risks associated with increased stormwater management.* The plan would address onshore storage requirements (including the need for sealed, bunded areas) and the pre-discharge capture and treatment of stormwater*;*
- interim measures for stormwater management would be integrated into the design of the drainage system for the proposed EAW extension;

- a surface water monitoring program would be implemented and periodically reviewed for the number and frequency of analyses, and amended in accordance with future operational environmental management plans;
- surface water monitoring performance would be reported to NRETAS annually;
- a drainage strategy would be developed to identify “management actions” to prevent contaminants finding their way into stormwater; and
- stormwater discharges would be monitored to verify the systems in place are adequately treating stormwater to an acceptable standard.

More information was requested to be provided in the Supplement on the conceptual layout of locations, drainage capacity, sediment and pollution retention ponds, water flow directions, areas of potentially contaminated surface water run-off (e.g. stockpile areas, hardstands) and stormwater discharge points. There was a lack of detail on the overall stormwater management strategy including management actions that would be taken if monitoring did detect unacceptable stormwater contaminants discharging into Darwin Harbour.

In the Supplement, an EAW Drainage Strategy was provided that aimed to consider management and engineering options to address minimisation, management, monitoring and response actions in relation to improving stormwater management and reducing the potential of contaminated stormwater entering the marine environment (Appendix C, Supplement). Figure 5 shows an annotated google imagery photograph of EAW. Pond F is currently being used as a settlement pond for diverted stormwater runoff from the minerals loading area.

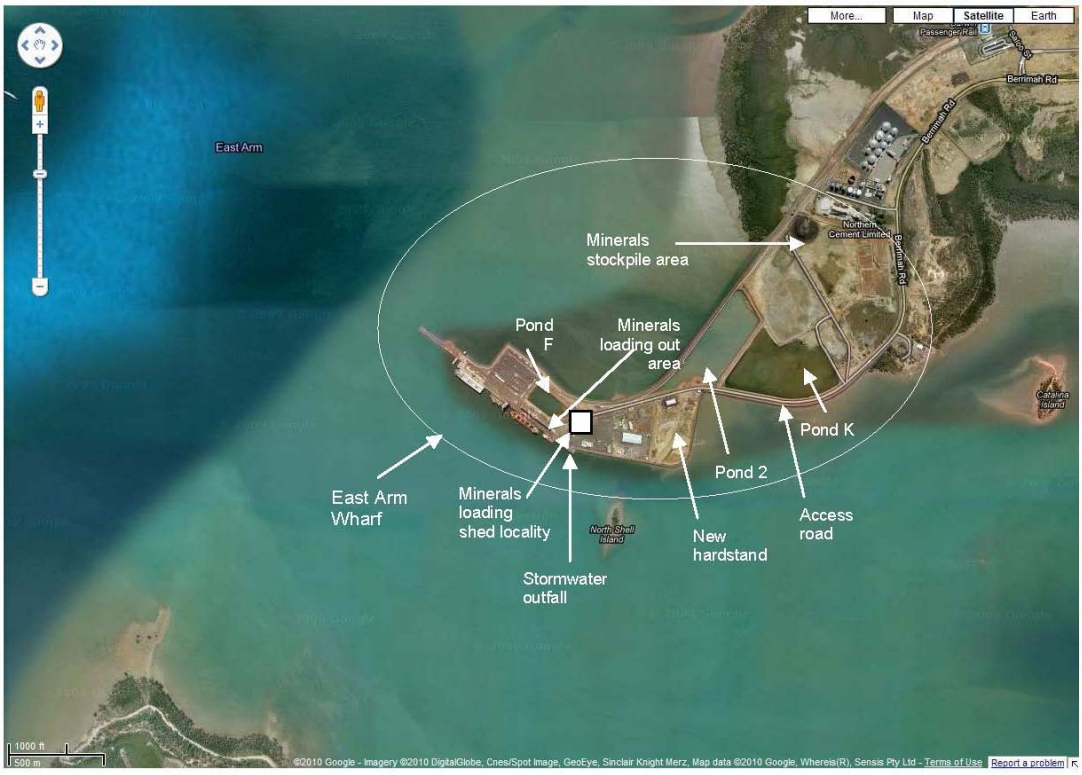

Figure 5: East Arm Wharf locality, Berrimah, NT (from Appendix C, Supplement)

The EAW Drainage Strategy did not provide details of Pond F's capacity to contain diverted stormwater, average retention times prior to any discharges/overflow of that water during high flows or details of maintenance schedules to regularly remove sediment build-up in the pond. In the Supplement, it was stated that the implementation of this Drainage Strategy was subject to review and approval by NRETAS prior to commencement of construction.

Tables 3-5 in the EAW Drainage Strategy listed short, medium and long term management and engineering actions to address potential stormwater impacts. If the Proponent ensures that the management and engineering actions are implemented within the suggested timeframes, potential impacts to marine water quality from contaminated stormwater runoff will be minimised. Examples of short term and medium term actions that are required to be implemented to manage stormwater include are listed in the EAW Drainage Strategy (Section 5.2, Appendix C, Supplement).

16. Recommendation

The East Arm Wharf Drainage Strategy and Retention Pond Design must include the following:

- **details of alternative ponds that will be constructed for stormwater management purposes;**
- **progress of the implementation of short and medium term management and engineering actions to address stormwater impacts;**
- **current monitoring at EAW and the adequacy of the management actions to address stormwater management at EAW based on stormwater, marine and sediment quality monitoring results;**
- **proposed monitoring program that will enable the development of water quality objectives linked to a set of management responses;**
- **water monitoring program to verify the systems in place are adequately treating stormwater to an acceptable standard; and**
- **triggers for storm water quality standards at discharge points so that appropriate management actions are instigated should those triggers be reached.**

4.7.4 Surface Water Monitoring

In the draft EIS, surface water sampling and analysis was based on four locations at EAW collected on 21 February 2011 – shortly after the passing of Cyclone Carlos, during which time 700mm of rainfall had fallen in the greater Darwin area over four days (section 10.1.1, draft EIS). Even after 700mm of rain, dissolved cobalt, zinc, copper and manganese did exceed adopted trigger values (Table 10.2, draft EIS). The fact there were elevated levels of dissolved metals in the four samples taken, indicates the Proponent needs to consider and manage impacts to surface water quality from activities at EAW.

The surface water sampling regime should be reviewed to incorporate a regular regime and results and analysis needs to inform proposed stormwater treatment infrastructure. The Supplement did not provide discussion on this issue although it did provide historical marine water quality monitoring data from 1992 – 1996 (Attachment 2) and an outline of the DPC Environmental Monitoring Program (Appendix A).

One short term action listed in Table 3 (Appendix C, Supplement) was to develop, implement and review/improve marine, sediment and stormwater quality monitoring program within six months. As this report was submitted in June 2011, the Supplement provided a good opportunity to present the preliminary monitoring results of the marine, sediment and stormwater quality programs. This was not submitted in any detail with a brief outline of the monitoring programs provided in Appendix A (Darwin Port Corporation Environmental Monitoring Program Outline 2010 – 2013). In this report, it is detailed that stormwater is undertaken opportunistically following rainfall and analysed for:

- total suspend solids;
- total metals;
- total nitrogen and phosphorus; and
- total petroleum hydrocarbons (TPHs).

It is intended that the monitoring program would be undertaken for one year with a discussion and review of future monitoring programs to determine whether there are actual or potential risks occurring and to assess any amendments to the monitoring program.

4.7.5 Waste water

In the draft EIS, it was indicated that the existing sewer infrastructure at EAW is nearing capacity and extensive upgrades to sewer infrastructure were necessary for the proposed expansion works. The draft EIS did not detail how wastewater would be managed at the MSB, nor the extent of sewerage to this area. In the Supplement, the Proponent indicated it was assessing the viability of providing mains sewer connections to the allotments at which the MSB, Barge ramp, small vessel berths and rail loop would be constructed. If connection to the mains sewer is not considered viable, wastewater would be collected in on-site tanks, pumped as required and disposed of to a licensed waste water treatment facility. The operators of each project component are responsible to prepare facility-specific Waste Water Management Plans (WWMP) as part of their CEMPs. There would be no discharges from the Project or docked vessels into the marine environment.

Advice from the Department of Health (DoH) indicated that there are ongoing problems with the installation and management of onsite wastewater systems in un-sewered industrial areas, especially in the existing EA industrial subdivision. DoH strongly advocates for the provision of Power and Water Corporation sewerage to the EAW Expansion project, including the MSB infrastructure. The wastewater management plans detailed in the Supplement may suffice throughout the construction phase, but they are not sustainable in the operational phase and would also be difficult to regulate by relevant NTG agencies. DoH advises it may be difficult for the Proponent to obtain approval for any new permanent onsite wastewater systems in the EAW Expansion project and that the Code of Practice requires substantial management and monitoring as well as bi-weekly servicing of the system and ongoing costs (Section 7.12 *Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal or Reuse of Sewage Effluent)*

Proposed upgrades to sewer infrastructure should also include an investigation of options for waste water reuse and on-site stormwater harvesting and reuse. Recycled water could be used for water sprays on open areas, stockpiles, wheel washes etc. In the Supplement, the Proponent stated options for stormwater/wastewater recycling and reuse during construction and operation of the Project will be investigated.

17. Recommendation

It is recommended that the Proponent:

- **secure connection to the mains sewer to mitigate any public health and environmental issues resulting from effluent discharges; and**
- **investigate and incorporate options for stormwater/waste water recycling and reuse during construction and operation of the Project into the Environmental Management Plan.**

4.7.6 Groundwater

Groundwater information provided in the draft EIS was sparse with no diagram of a conceptual groundwater model and a brief review that identified three main hydrogeological units:

- Quaternary sediments (sand, silt, clay and shells) and fill (marine dredge) material;
- Weathered zone above relatively fresh bedrock; and
- Fresh bedrock and fractures within fresh bedrock.

This description is not a conceptual model and does not provide a sufficient understanding of the underlying groundwater system and surface water/groundwater interactions. The lack of description of existing groundwater environment and groundwater monitoring program makes it difficult to ascertain whether potential impacts to groundwater are significant and whether the monitoring program would be sufficient to detect those impacts. In addition, there are no groundwater flows, rates, depths, existing groundwater quality information and assessment of whether retention ponds and dredge spoil ponds would impact groundwater levels and quality. A conceptual groundwater model is required to assist in devising a monitoring program.

Potential impacts to groundwater from the project include:

- Changes in bathymetry as a result of dredging and/or reclamation may increase groundwater flow and discharge mechanisms;
- Modification of groundwater flow regime, particularly if the hydraulic conductivity of the deposited sediments is significantly different to that of the natural soil profile of the shoreline;
- Reclamation of land may reduce groundwater discharge mechanisms, particularly where fractured bedrock is intersected;
- Disturbance of ASS during land reclamation or groundwater dewatering activities may lead to contamination of groundwater by acidification, release of heavy metals and nutrients; and
- Contamination from leaks, spills of fuels, lubricants, solvents or other products.

In the draft EIS, the following mitigation and control measures were indicated:

- Storing oils, hydrocarbons and other hazardous materials in designated locations with specific measures to prevent leakage and release of their contents on an impermeable base;
- Engineer water pollution retention ponds to mitigate seepage to groundwater; and

- Reduce or eliminate rainfall infiltration to storage stockpiles in unsealed hardstand areas.

Provided the Proponent implements the above measures, impacts to groundwater should be minimised however the lack of information on baseline conditions means it will be difficult to determine whether the expansion works will impact groundwater.

In the draft EIS (section 10.3.3), the Proponent states drilling, logging and installation of groundwater monitoring bores will provide an understanding of the site groundwater hydrology and hydraulics and will be located in areas to determine seepage quality from existing pollution and sedimentation ponds and unsealed hardstand areas.

The Proponent commits to implementing a groundwater monitoring program and the results reported to NRETAS annually (Section 10.4, draft EIS). However no groundwater monitoring program was provided in the Environmental Monitoring Program Outline 2010-2013 for the DPC (Appendix A, Supplement) and final numbers and locations of boreholes have not yet been determined (section 22.1, Supplement). Due to the lack of information on the groundwater monitoring program, no assessment can be made on whether it is adequate to assess water management strategies. In addition, NRETAS is not the regulatory body to receive annual reporting of groundwater and for maximum transparency and given the number of developments in the Darwin Harbour, it is recommended DPC report its environmental performance, including groundwater monitoring results annually in the public domain.

4.8 Air Quality

Construction and operation activities of the proposed expansion works have the potential to generate dust containing particulate matter (PM_{10}, $PM_{2.5}$) impacting local air quality and visibility. Dust generating activities relevant to the project include wind blowing over bare ground (unsealed surfaces) and stockpiles, vehicle movements and bulk material handling.

Particulate matter (PM_{10}) consists of complex and varying mixtures of particles suspended in the air and can remain airborn for extended periods. Dust particles may also impact the wider ecological receiving environments by deposition onsite and offsite in the receiving marine and terrestrial environments.

An air quality assessment was undertaken for the EAW expansion with the main focus on particulate matter (PM_{10}) emissions associated with construction works and the operation of dry bulk facilities (section 11, draft EIS). Contour maps for maximum modeled PM_{10} concentrations generated by the Project during construction and operation were included in the Supplement (Figures 2-1 and 2-2). These figures were questioned given that the wind rose data from the Bureau of Meteorology indicate primarily SE or NW wind directions.

While modeled air pollutants were shown in the draft EIS to be within the adopted criteria (NEPM, 2003), it is important mitigation measures are implemented during both the construction and operation phases to minimise air quality impacts. The following commitments were made by the Proponent in relation to air quality (Sections 11.4, 26.5.7, draft EIS,):

- a CEMP would be detailed outlining the Air Quality Management Plan (AQMP) prior to construction;
- inspections of dust releases and associated control measures would be conducted on a regular basis;
- vehicle movements on unsealed areas and roads would be kept to a minimum, to reduce dust releases from vehicle movements;
- stockpiles on site kept to reasonable size and controlled via wet suppression and covers;
- water sprays would be used on open areas and stockpiles, water trucks would be utilised on access roads and open areas, and wheel washes would be used, as appropriate;
- speed limit of 20km/hr would be enforced for all vehicles onsite to reduce dust releases from vehicle movements;
- multiple handling of construction materials would be avoided where possible;
- the dry bulk facility will incorporate specific control measures that would limit particulate matter (dust) releases;
- access roads will be sealed as soon as practicable after clearing;
- covering of construction material loads;
- all dust emission equipment such as dust suppression sprays, return belt wetting sprays, dust extractors, scrapers are operating and functioning correctly;
- undertake air quality monitoring on a quarterly basis during operations; and
- external and internal audits of the EMP biennially to audit dust management practices, including review of objectives and targets.

Appendix A in the Supplement detailed the air quality monitoring program as part of the Environmental Monitoring Program Outline 2010-2013 for the Darwin Port Corporation which looks at Total Suspended Particulates (TSP) rather than PM_{10}. This described the four air monitoring locations (Figure 9-1, Appendix A, Supplement) that are sampled on a quarterly basis at East Arm Wharf, Frances Bay Marina, Fort Hill Wharf and the East Arm stockpile. The quarterly results of this air quality program to date were not provided in the Supplement. An assessment on whether current mitigation practices are adequate to ensure adherence to the Ambient Air Quality NEPM and minimise impact to air quality was not able to be determined. The AQMP will be prepared as part of the CEMP which will undergo review by NRETAS.

It is recommended particulate monitoring incorporate "trip points" to trigger identification of sources of air pollutants warranting mitigation action. To be able to respond to high background levels of PM_{10} in the environment, live data must be available and the monitoring program provided in the Supplement is for monthly sampling of TSP (dust) rather the PM_{10}. In the Supplement it was agreed that this monitoring should commence prior to construction and continue until the early stages of operation to ensure PM_{10} levels are within acceptable ranges. The greatest health implications are due to PM_{10} and it is these particulates that should be monitored, with TSP less important. Dust however can be used as an indicator of PM_{10} and if nuisance dust is managed appropriately, generation of PM_{10} should also be minimised.

18. <u>Recommendation</u>

The Air Quality Management Plan (AQMP) is to address both construction and operation and include management actions to ensure PM_{10} levels are within acceptable ranges. The AQMP should include:

- **24 hour average HiVol samples of PM_{10} levels;**
- **determine trip points where action should be taken to identify air pollutant sources; and**
- **list management actions to mitigate impacts to air quality.**

4.8.1 Greenhouse gas emissions

A target in the *Territory 2030 Strategy* is that the Northern Territory contributes to the national target for greenhouse gas reduction. The Northern Territory Government's Climate Change Policy aims to reduce the Northern Territory's emissions by 60% by 2050, compared to 2007 levels. In the draft EIS, it is estimated that the project will emit approximately 28 976 t $CO_{2\text{-}e}$ from the combustion of fuel during construction. The total greenhouse gas emissions associated with the construction phase represents approximately 0.26% of the NT inventory for 2008 (section 12.2.1, draft EIS). A total greenhouse gas quantity for the operational phase was not provided in the draft EIS due to operational uncertainties. The Proponent did indicate it could be incorporated into the accounting and reporting mechanisms described within the EAW EMP.

The estimated average annual emission levels (for construction phase only) may be negligible however long term operational emission levels need to be considered if the NT aims to minimise greenhouse gas emissions from new and expanding operations to as low as practical (*Territory 2030 Strategy,* 2009). In the draft EIS the Proponent did commit to the following:

- A CEMP would be developed incorporating greenhouse gas saving initiates using mechanisms described within the GHG assessment;
- The CEMP would incorporate areas where GHG can be reduced and detail requirements for GHG and energy efficiency reporting
- An EMP will be prepared that will consider requirements for GHG reductions, including energy efficiency initiatives and requirements for reporting.

In the Supplement the Proponent did not commit to offsetting carbon emissions associated with construction and operation of the project (Section 11, Supplement 2011). Environmental offsets are measures taken by developers to compensate for residual effects of their projects that cannot be avoided, mitigated or repaired at the site of development reasonable cost (draft Northern Territory Environmental Offsets Policy, 2010).

19. <u>Recommendation</u>

Incorporate GHG emissions into the accounting and reporting mechanisms described within the EAW EMP. The Greenhouse Gas Management Plan as part of the EMP should include:

- **an updated greenhouse gas inventory for the proposal to include both construction and operational phases; and**
- **measures adopted to mitigate greenhouse gas emissions.**

4.9 Cultural impacts

The Project involves a combined area of approximately one square kilometre of dredging and concern was raised about the prospect of there being unrecorded but significant cultural material in these areas. The Proponent clarified side scan sonar work was conducted in the area and no anomalies were detected. There was no discussion in the Supplement if the remote sensing consultant was specifically

charged with the task of locating this type of anomaly. It is possible that a consultant was charged with the task of locating major engineering obstacles, and not charged with the task of locating small but significant sites or material. Therefore although anomalies were not detected, it is possible that the equipment was not calibrated for, nor the operator focused on, this type of target.

While there are limitations to the above surveys, these concerns can be mitigated in operational management plans of the project. The Proponent has committed to the following management of cultural impacts:

- Indigenous Site 1 (shell midden and artefact scatter) adjacent to the rail loop would be avoided as much as is practicable. If disturbance cannot be avoided, the site will be studied, documented and recorded prior to disturbance.
- The unknown shipwreck site to the south-west of the rail loop would be avoided as much as is practicable. If disturbance cannot be avoided, the site will be studied, documented and recorded prior to disturbance.
- The CEMP and EMP for the proposed development will refer to the heritage sites identified by the historic and cultural heritage surveys.

If a mechanism does not already exist, it is recommended that the Proponent include a commitment to identify and conserve cultural material discovered during the dredging phase, and other relevant stages of the project. The Proponent should note there is an obligation under the Commonwealth *Historic Shipwrecks Act,* to notify the Australian Government of the discovery of any wreck older than 75 years old, which are automatically protected under the Act.

4.10 Offsets

As defined by the draft Northern Territory Environmental Offsets Policy, environmental offsets are actions taken by developers to ensure that their developments cause no net loss of environmental quality. Offsets are proposed where impacts are reasonably unavoidable or cannot be mitigated. At this stage, the Proponent has not proposed any suitable offset program.

One of the core obligations of the NT draft Environmental Offsets policy is that the developer is to report reasons for believing that the offset benefits exceed the residual detriment at development site.

Impacts of this project that appear to be unavoidable include:

- known direct impacts on sensitive benthic habitat (44ha) due to dredging channels;
- known direct impacts on loss of habitat (24 hectares) for migratory and shorebirds currently utilising Pond K;
- unknown direct impacts on marine megafauna due to noise and vessel collisions;
- unknown indirect impacts – moderate zone of impact, zone of influence and degradation of these sites over time as a result of Project operations.

The marine environment of Darwin Harbour will be permanently impacted by the EAW Expansion project through the infrastructure components of the project and ongoing activities post construction. The most significant impacts are expected to

occur in the construction phase associated with dredging of the navigation channel and permanent impacts such as increased vessel movements in the area. Impacted species include Commonwealth listed threatened species, and as such may also require biodiversity offsets under the EPBC Act. When placed in the context of a Harbour that is coming under increasing development, this Project provides an opportunity for the NTG to collaborate in establishing a suitable offset that is relevant for the permanent changes that will occur to the natural environment of Darwin Harbour.

20. Recommendation

It is recommended that the Proponent develop a Territory-based offsets package to offset residual impacts to marine biodiversity from the construction and operation of the Project.

4.11 Road and Traffic Impacts

The EIS lacks detail about the social and economic impacts of the transport component of the Project. In addition to the significant increase in wear and tear on the Darwin road network, there are likely issues with road safety traffic congestion and delays to the travelling public. The cumulative impact on the road network of heavy vehicles associated with a combination of proposals is likely to be significant in terms of environmental, social and economic impacts.

Necessary transport details that are deficient from the draft EIS and Supplement were:

- likely sources of material (such as 'significant quantities of hard rock and riprap' from quarries at Mount Bundy and Katherine);
- scale of transport involved (e.g. estimated volumes, tonnage, composition of material for the EAW expansion area);
- method of transport (i.e. road/rail/sea);
- likely truck movements of all materials required during all phases of the proposal (i.e. an estimate of type, size and number of vehicles);
- likely routes to be taken by heavy vehicles;
- impact of transport on local communities;
- safety measures to be used to reduce transport risks (including driver fatigue management);
- any additional road infrastructure works that may be required (eg changes to site access and signage); and
- how the interface between Berrimah Road and the entrance to EAW will be managed (i.e. RND assumes that matters such as surveillance, security and waiting vehicle areas at the gates to the Port will be within the Port Authority area and on roads under the control of the Authority and not on the RND controlled road area – this may include possible road duplication, etc.).

While it is acknowledged that exact figures were not available at the time of the preparation of the EIS supplement, RND requires such information to assess the potential of the proposal to impact on NTG road infrastructure integrity and the safety and efficiency of the affected roads. Road transport and traffic issues will need to be managed through DPC's traffic management plan. This plan should be prepared in consultation with Government and will form part of DLP's Environmental

Management Program, in accordance with Recommendation 21 in Section 4.12 of this Report.

4.12 Environmental Management Program

A number of environmental management plans (EMPs) have been proposed through the course of the assessment process for the EAW Expansion. All management plans and procedures proposed to be developed for the Project must be approved by, or developed to the satisfaction of, relevant government agencies and in consultation with key stakeholders in the timeframes specified. These approved plans and procedures will be one of the primary tools by which the Proponent will implement management and monitoring commitments made in the EIS and the recommendations detailed in this Report.

The provisional EMPs referred to in the EIS provide the core information required to guide the development of Contractor Method Statements (CMS), construction EMPs (CEMPs) and operations EMPs (OEMPs). Provisional Environmental Management Plans (Construction and Operations) developed in the EIS included:

- Air Quality and Emissions Management Plan
- Biting Insect Management Plan
- Cargo Handling – Bulk Minerals Management Plan
- Communication Management Plan
- Cultural Heritage Management Plan
- Dredge Management Plan
- Energy and Resource Management Plan
- Fire Management Plan
- Flora and Fauna Management Plan
- Hydrocarbons and Hazardous Materials Management Plan
- Lands and Soils Management Plan
- Social Management Plan
- Water Quality and Marine Sediments Management Plan

Proposed monitoring programs are associated with many of the EMPs. These monitoring plans may be detailed in the management plans or developed as separate documents linked to the relevant management plans.

As identified throughout this Assessment Report, this assessment would have benefited from the provision of certain information. The absence of this information has hindered the comprehensive assessment of risks relating to the Project. Due to the uncertainties created, the risk setting of the Project has increased as a result.

To address this and provide additional rigor and expertise to the planning process, it is recommended the Management Plans and associated monitoring programs that cover the key environmental factors of the project are reviewed by a suitably qualified independent expert prior to submission to relevant governmental agencies for review. A register of environmental auditors has been established in accordance with Part 6 of the NT *Waste Management and Pollution Control Act* that may provide suitable qualified experts for review purposes. The register can be found on NRETAS' website: www.nt.gov.au/nreta/environment/waste/register/qualified_persons.html.

Recommendations made through the independent review are to be included as appendices to the EMPs. As the DPC is the authority ultimately responsible for the

control and management of the EAW, it is also recommended DPC is involved in the review of EMPs, prior to final submission to relevant government agencies.

It expected that the requirements in management processes, plans and procedures are incorporated into the Proponent's tendering and contracting procedures and that all contractors are fully aware of, and act in compliance with, relevant management plans.

21. Recommendation

The following Environmental Management Plans, incorporating relevant environmental monitoring programs, are to be independently reviewed by a suitably qualified expert(s) prior to submission to relevant government agencies:

- **Water Quality and Marine Sediment Management Plan;**
- **Darwin Port Corporation Environmental Monitoring Program including ongoing benthic habitat monitoring; and**
- **Stormwater Management Plan (including East Arm Wharf Drainage Strategy and Retention Pond Design Report).**

Remaining EMPs are to be provided to relevant government agencies for approval prior to commencement of Project activities.

Due to the information gaps that remain at the conclusion of this assessment, the Proponent has committed to ongoing monitoring and a post dredging report (refer to section 4.6.3, recommendation 13). The outcome of the dredge monitoring program is to generate data that will improve the reliability of predictions of dredging impacts and to quantify the effectiveness of the mitigation measures utilised.

An important consideration for this Project is transparency and accountability in impact management, including reporting of monitoring outcomes and ongoing management actions to minimise impact. In the Supplement, the Proponent indicated that reporting associated with environmental management will be undertaken in accordance with the DPC EMS (Procedure 5 – Communication and Reporting). This procedure details that there is a clear communication on environmental issues within DPC. No firm commitment has been made to publicly make available the results of monitoring programs relevant to the Project. The proximity and importance of this development to Darwin Harbour increases the importance of transparency. DPC should commit to reporting on environmental performance in its public annual reports. In addition, given the number of projects projected to occur in Darwin Harbour, publicly available monitoring results can be used strategically by developers to assist in determining cumulative impacts.

22. Recommendation

Environmental performance, based on the results from the Darwin Port Corporation Environment Monitoring Plan and relevant EMPs for the Project are to be incorporated into the public Darwin Port Corporation (DPC) Annual Reports on the DPC website.

The proponent should provide public access to final environmental management plans and a reporting mechanism to inform compliance with the plans.

5 Conclusion

The EAW Expansion Project is required to facilitate trade growth and local and regional economic development for the Northern Territory. It will provide a Marine Supply Base to support developing oil and gas industries including the proposed INPEX and the existing Bayu Undan LNG facilities. The barge ramp and hardstand area will be used by Defence and private barge operators. Increased traffic at East Arm necessitates a greater number of tug boats and small vessels requiring a dedicated mooring facility. This project is a key component of Northern Territory's export chain used by expanding mining, agriculture, horticulture and construction industries.

The Project involves the removal of approximately 800 000m^3 of dredge material from the port channel in close proximity to ecologically significant benthic habitat including rocky reefs and sponge communities around South Shell Island, Catalina Island and Old Man Rock. The EIS analysed the impact of the project by considering its impact on marine ecology, marine and terrestrial water quality, air quality, oceanic processes, marine and terrestrial flora and fauna and migratory birds and shore birds. The project will have an impact on all these components to a varying degree including direct removal of filter feeders and macrobiota (<10%, reef) communities, potential smothering and light attenuation of coral/sponge communities from dredging activities, decreased water quality, and potential disturbance to marine megafauna from vessel movements and noise.

These impacts are discussed in this report and additional recommendations have been made in the Assessment Report to ensure impacts are avoided where possible and/or minimised to the greatest extent possible. Given the cumulative impacts of this Project with other projects in the Darwin Harbour and the value the community places on the Harbour, it is essential that the Proponent makes the management plans, monitoring programs and reports available in the public domain.

A number of information gaps remain at completion of this assessment and include:

- physical and chemical characteristics of the sediment to be dredged and potential for re-mobilisation of contaminants;
- design and capacity of onshore dredge spoil ponds;
- treatment and return water strategy and monitoring from onshore dredge spoil emplacement;
- potential cumulative impacts of dredging works being undertaken in the Harbour within a similar temporal and spatial scale;
- identification of zones of moderate impact and zone of influence;
- final dredge plume modelling for the confirmed dredging methodology to ensure the environmental risk is not greater than that presented in this assessment;
- evidence of other potential habitat for migratory birds listed under the EPBC Act;
- evidence to validate the assertion that EAW is not an important habitat for coastal dolphin species; and
- identification and quantification of cumulative impacts from concurrent dredging campaigns as well as from ongoing operating expanded port and other projects in the Harbour, and the combined impacts of underwater noise, increased vessel movements, turbidity and sedimentation on regional marine ecosystems and megafauna.

The levels of uncertainty for impacts on the marine environment can be addressed by continuing to develop knowledge of the marine environment in the Project area. Further collection of baseline information and intensive monitoring will inform the tolerance of these ecosystems to external pressures such as dredging and general port operations. The Proponent should also acquire and analyse the existing background environmental data that has been collated for dredging-relevant environmental variables (e.g. turbidity, sediment deposition rates, coral health, and climate) from previous dredging campaigns and other projects in the Harbour, to increase and retain knowledge of natural tolerances and susceptibilities of local benthic organisms, and inform the development of monitoring programs for this Project.

While this assessment is of the expansion project components only, the Project will form part of the entire port operations and the monitoring and management of the existing port facility will require review to accommodate outcomes of this assessment. The Darwin Port Corporation is responsible for the management of land, waterways and facilities within the Port of Darwin. Recommendations made in this assessment report address relevant construction activities and ongoing expanded port operations.

Due to information gaps remaining in this assessment, the Proponent, government and community will be reliant on intensive, post-assessment data collection and monitoring to determine the significance of, and appropriate responses to, key impacts. These monitoring requirements are captured in the commitments made by the Proponent and recommendations of this Report. The ongoing environmental monitoring and adaptive management required from the Proponent must demonstrate that any environmental impacts from the Project are no greater than those predicted in this assessment.

Information needs highlighted in this assessment must be addressed and appropriate management procedures included in the Environmental Management Plans (EMP) implemented. The project will proceed in accordance with a suite of EMPs that the Proponent has committed to finalising in consultation with relevant government agencies. As the EMPs are an integral component of managing environmental impact and given the amount of further development work required, it is recommended the relevant EMPs undergo independent review to ensure the adequacy of those plans and monitoring programs.

Based on its review of the EIS and the Proponent's response to submissions, the environmental impacts of the project can be managed at an acceptable level, provided that the environmental commitments, safeguards and recommendations detailed in the EIS, this Assessment Report and in the final management plans are implemented and are subject to regular reporting and compliance auditing.

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Appendix 1 – Submissions

A summarised list of issues raised from public review of the draft EIS corresponding with the individuals / organisations responsible for raising those issues. The NRETAS submission on the draft EIS is not included in this summary but can be read in its entirety on the NRETAS website: **http://www.nt.gov.au/nreta/environment/assessment/register/inpex/index.html**.

Issue - Impacts	Raised By	Relevant Section in Supplement
Lack of Project Design Details • It is difficult to assess the potential of environmental impacts of the proposed works given that the areas are based on a concept design with final design and management of activities to be determined by the awarded contractor; • Insufficient detail on the rail loop about the its intended use, wider land and harbour transport implications, actual location and construction; • Rail loop only be viable with significant increase in bulk minerals handling through East Arm and no discussion on upgrades of bulk loading facilities • Rail loop not required for 5-10 years so there appears to be no pressing reason for it to be included in this project assessment • There remains a large degree of uncertainty about the final design and development making it very difficult to provide informed comment regarding environmental impact. • Limited details about the project's Environmental Management Plans and uncomfortable with relying on individual contractors to develop their own management plans after the assessment process. • Uncertainty surrounding proposed dredging program and dredge spoil disposal makes it difficult to fully assess potential risks and impact	AFANT DHAC ECNT	Section 6.3
Dredging • Additional recommendations for minimising dredging impacts were proposed: - Utilise latest technologies to track direction and scale of sediment plumes during	ECNT	Not acknowledged in Supplement

Issue - Impacts	Raised By	Relevant Section in Supplement
operations (eg innovative technique using satellite images and modelling has been developed by Geosciences Australia and the Great Barrier Reef Marine Park Authority) - Review research (or conduct where necessary) to identify how much sedimentation mangroves can tolerate - Prepare a long term management plan for the spoil disposal site that accounts for risks posed by extreme weather events • Additional and cumulative effect of dredging from EAW Project and Inpex – the extent and type of dredging required should be clearly stated • Whilst some of the material collected from dredging operations will be used at constructions site, clarification is required on what arrangements are being made to assess the spoil	Darwin City Council	
Climate Change and Storm surge Use the most contemporary available information on Climate Change and Sea Level Rise is critical to the development of the EAW Expansion project	Darwin City Council	Section 4
Shipping and Navigation in Darwin Harbour • While there have been preliminary discussions on the issue of expanded boat traffic at EAW via the MSB and Barge ramp, there has so far been no analysis of the movement of recreational vessels in and through the area combined with an analysis of the potential increased commercial vessel movements from expanded facilities at EAW. • Need for a detailed consideration of navigational safety, navigational aids, warning systems and stand-off or exclusion zones that are relevant to recreational boaters • Implications of increased shipping traffic in Darwin Harbour • Need for continued recreational fishing and other access in Darwin Harbour – Bleesers and Reichardt Creeks are in close proximity to EAW Expansion Project and any further expansion and development in area will be planned around continued recreational	AFANT	Section 19 Section 6.3

Issue - Impacts	Raised By	Relevant Section in Supplement
fishing access to these creeks.		
Cumulative Impacts and Strategic Environmental Assessment • Potential for adverse impacts on recreational fishing from developments in the EAW area and these will likely be cumulative as different projects come on line. • Cumulative impacts to Darwin Harbour not assessed • Proposal to dump dredge spoil at sea, in same area by Inpex, is supported, noting that Inpex intends developing a monitoring program o assess the impact of dredge spoil disposal and apply adaptive management if detrimental impacts above those predicted, are observed • No discussion on possible cumulative effects that might arise as a result of INPEX, EAW Expansion and Port of Darwin (All Tides Access) Project getting underway in the next few years. Cumulative impacts of dredging activities, increased shipping movements and activities such as pile driving in Darwin Harbour marine environment • Not clear on broader community consultation given it is a major development and would like to provide a more comprehensive response following a presentation by the Proponent • Need to conduct a Strategic Environmental Assessment (SEA) of the Harbour region to provide a basis for a more informed policy development for issues such as dredging and mangrove protection • Monitoring of possible recreational fishing impacts with regard to cumulative impacts of this expansion couple with Inpex, possibility of a big increase in bulk minerals handling and increased shipping traffic	AFANT ECNT Dr Ian Hollingsworth DoR DHAC Darwin City Council	Section 19.2 Section 7.2 Not directly addressed in Supplement Section 19.4 Section 19-2
Noise, Lighting and Visual Impacts • Shipping noise, particularly during the evenings. • Underwater noise with regards to piling and dredging • Project lighting being visible from Stokes Hill Wharf	AFANT DLP Dr Ian Hollingsworth	Section 23

Issue - Impacts	Raised By	Relevant Section in Supplement
• Visual impact assessment inadequate – ship loading operations, particularly dry bulk materials could be highly sensitive		
Wastewater • Information required on how wastewater will be managed at the MSB and the extent of sewerage to this area; • Further clarification about the proposed upgrades to the sewer infrastructure at EAW is required; • There have been past system failures for onsite wastewater systems resulting in effluent discharges to the environment, and onsite wastewater systems in the East Arm subdivision requires ongoing management and costs; • Recommend sewerage should be made available to all allotments in the EAW subdivision to mitigate public health and environmental issues resulting from effluent discharges. • Recommend proposed upgrades to sewer infrastructure include investigation of options for reducing water demand via waste water reuse, on-site stormwater harvesting and resuse, recycled water use for water sprays for dust control and wheel washes.	DOH ECNT	Section 13.2
Stormwater • High profile risks to water quality from contaminated water runoff from ship loading operations and hardstands, refer to monitoring and stormwater management, rather than avoidance those adequate specification of onshore facilities • Potential of stormwater contaminants impacting on Harbour water quality and Proponent to demonstrate any discharge from development site will not impact on water quality, and in turn, marine life; • Over-water maintenance – further details required on procedures for minimising the quantity of particulates entering the water during over-water maintenance of steel structures	Dr Ian Hollingsworth ECNT	Sections 16, 22 Section 6.5

Issue - Impacts	Raised By	Relevant Section in Supplement
Groundwater - Uncertainty exists regarding site's groundwater hydrology and hydraulics – proponent to monitor groundwater quality and ensure local ecosystems are not being adversely affected	ECNT	Section 22.1
Marine Ecology • Based on photo-identification of dorsal fins, the majority of individual dolphins occur in both the eastern and western parts of Darwin harbour • The coral communities around South Shell Island and Old Man rock are one of the most significant hard coral communities in the Darwin Harbour; • A number of marine megafauna are present in the EAW project area and the project has potential to impact on these during construction (dredging and pile driving) and operation (boat strikes, maintenance dredging); • Procedures for rescue and post-mortem of • Marine Supply Base is currently aligned to go straight through some high quality marine habitats. Dredging of sponge and coral communities is a clear, direct loss of sensitive, highly bio-diverse and important marine life. Strongly recommend channel dredging pathways are aligned away from these habitats.	MAGNT ECNT	Sections 7, 14
Marine Pests • The use of internationally-based vessels and equipment, particularly dredging equipment is a known pathway for the movement and establishment of marine pests. It is recommended the proponent discuss the proposal with officers from the Aquatic Biosecurity unit with a view to develop additional marine pest monitoring and management actions for the project to mitigate the risks	Department of Resources	Not addressed in Supplement
Sedimentation • Risk of smothering of coral communities by dredging activities		

Issue - Impacts	Raised By	Relevant Section in Supplement
Heritage • Terrestrial heritage – establish a protective buffer zone around the site of 100m until Ministerial approval has been obtained for disturbance of these sites • Maritime heritage – the potential of unrecorded but significant cultural material is not covered. Qualify what remote sensing data was collected for the combined project footprint to review for possible cultural anomalies.	Heritage Branch	Section 12
Sacred Sites • Draft EIS does not adequately acknowledge available information held by Government and Port Authority regarding sacred sites and protection requirements in the environs of the EAW Project • Inadequate representation of sacred site avoidance and protection issues and of the likely intended use of multiple Authority Certificates by the Project • Sacred site Yirra is of great significance to Larrakia traditional custodians. • Assertions from Aboriginal custodians with regard to sacred nature of South Shell Island • Recorded sacred sites may be specifically protected by enforceable conditions within Authority Certificates, for developments such as EAW Expansion Project.	Aboriginal Areas Protection Authority	Sections 12, Appendix G
Transport • Additional detail is required on: type, size and number of vehicles, estimated volumes, tonnage, composition, origin of traffic generated by proposal, estimated times of travel, impact of transport on local communities, safety measures, any additional road infrastructure works that may be required • No indication on completion of road upgrades before EAW expansion for transport of construction materials – safety issues associated with transport of rock and riprap from local quarries.	Roads Network Division, DLP ECNT	Section 13.1

Issue - Impacts	Raised By	Relevant Section in Supplement
Waste Management and Hazardous Materials • Recommend reporting on waste outputs, recycling and disposal be part of the environmental management program • Volume or quantity of certain materials (e.g. fuels, acids, lubricants) stored onsite and the possible threat to Harbour health in the event of storage structures being compromised	ECNT	Sections 24.1 24.2
Acid Sulfate Soils • Lack of Potential Acid Sulfate Soil and Acid Sulfate Soil Plan to mitigate risks	Dr Ian Hollingsworth	Section 10.3
Environmental Management Plans • Recommend all environmental management plans (eg Dredge management, Soil Erosion and Drainage Management, Acid Sulfate Soils Management, Oil Spill Contingency Plan, Water Management) associated with the EAW Expansion be finalised and reviewed by an independent party well in advance of the development commencing; • Clarification required on whether all environmental management plans will include triggers and management response actions that will be undertaken in collaboration with NRETAS and/or independent scientists; • Unclear whether information on state of marine communities, following construction activities and during EAW operation, will be provided regularly to the public. Recommend reporting on marine community health be included in the annual Darwin harbour Region Report Cards • Need for transparent reporting with respect to various environmental management and mitigation commitments that Proponent has made throughout Main Report • Further details required on documenting and management of complaints via DPC's	ECNT	Sections 8.1, 8.2, 19

Issue - Impacts	Raised By	Relevant Section in Supplement
incident reporting procedure – will serious complaints and issues be made public?		
Greenhouse Gas Emissions • Recommend that proponent works towards establishing power supply infrastructure that incorporates the use of renewable energy technologies; • Recommend offset greenhouse gas emissions during both construction and operational phases of EAW with offsetting of emissions during operational phase could be undertaken in partnership with other port users	ECNT	Section11
Offsets • Only a brief mention of environmental offsets in the draft EIS and a clear statement of residual detriment should be provided; • Where impacts are reasonably unavoidable or cannot be mitigated, offsets should be proposed;		Section 18

Appendix 2 – Commitments Register (Table 28-1, EIS)

No.	Commitment (Action)	Reference
1	**Infrastructure and Transport**	
1.1	Local traffic management measures will be implemented during construction to ensure that any traffic disruptions are kept to a minimum.	Chapter 5, Section 5.4
1.2	Existing stockpiling areas would be used as temporary work zones until the hardstand and MSB construction sites are developed sufficiently that they can be further utilised for construction activities, to minimise impacts to roads and road users.	
1.3	Stage construction of the rail loop section adjacent to the existing railway line to minimise the disruption to rail operations.	
2	**Geology, Landforms and Soils**	
2.1	A Soil Erosion and Drainage Management Plan would be prepared.	Chapter 6, Section 6.4
2.2	An ASS Management Plan would be prepared.	
2.3	Adequate OH&S measures for dealing with ASS soils will be incorporated into the Construction OH&S Plan.	
2.4	An Earthworks Plan (or separate Plans for the individual development areas) would be prepared that details cut and fill volumes, finished site levels, excavation or formation levels and specifications for fill materials.	
2.5	Specific site geotechnical land and marine investigations will be undertaken as required; the EIS Supplement will provide an update on any investigations undertaken.	
3	**Oceanic Process and Natural Features**	
3.1	Implement preventative actions as in the Dredge Management Plan and relevant EMPs	Chapter 8, Section 8.4
3.2	Review oceanographic processes, monitoring data and findings to determine need for corrective action	
3.3	Undertake annual reporting on results of monitoring of oceanographic processes	
3.4	The management of potential impacts on oceanographic processes will be in accordance with relevant standards.	
4	**Marine Water**	
4.1	The disturbance footprint will be minimised where possible within the constraints of infrastructure engineering and operability. Dredges will be equipped with navigational aids to ensure that dredging occurs within the specified dredging footprint.	Chapter 9, Section 9.4
4.2	A draft DMP has been prepared to address the impacts associated with dredging and dredge spoil disposal, including monitoring to protect environmental values (refer Appendix B). The DMP will be finalised following review through the EIS process and implemented during the construction period.	
4.3	Other sediment disturbing activities with a potential impact on water quality (e.g. pile driving, excavation and bund wall construction) will be addressed through the CEMP. This plan will contain similar provisions and monitoring requirements to the draft DMP with respect to water quality protection.	

No.	Commitment (Action)	Reference
4.4	The EAW management plans will be amended as necessary to address any perceived additional risks associated with construction activities and subsequently with the operations of the expanded port.	Chapter 9, Section 9.4
4.5	DPC's oil spill preparedness (equipment and training) will be upgraded as necessary to address any increased risk identified.	
4.6	The EAW EMP will be upgraded as necessary to address any perceived additional risks associated with increased stormwater management and waste handling associated with construction activities and subsequently with expanded port operations.	
5	**Terrestrial Water**	
5.1	Mitigation and control measures would be implemented as required to ensure that relevant groundwater and surface water standards are met.	Chapter 10, Section 10.4
5.2	Interim measures for stormwater management will be integrated into the design of the drainage system for the proposed EAW extension.	
5.3	A surface and groundwater monitoring program would be implemented, which would be periodically reviewed for the number and frequency of analyses, and also amended in accordance with future operational environmental management plans.	
5.4	Groundwater and surface water monitoring performance would be reported to NRETAS annually.	
5.5	A drainage strategy is being developed for East Arm Wharf for existing and new areas. Existing areas will have management improved to further reduce contaminants that can enter the stormwater system, drainage will be altered to collect stormwater and various retention and treatment systems are to be installed to ensure stormwater discharged off the site will be of acceptable quality. This strategy identifies "management actions" to prevent contaminants finding their way into stormwater. This will be applied to new areas to ensure the design and daily operations minimise stormwater contamination. Final detailed design is to ensure such management actions can be undertaken and Environmental Management Plans and operational procedures will also be developed. Areas such as General Cargo will have Gross Pollutant Traps (GPT) that remove some heavier sediment, litter and oil. Whereas areas vulnerable to greater volumes of contaminants, or more difficult to capture contaminants (such as bulk minerals) will have sediment ponds. Stormwater discharges are also to be monitored to verify the systems in place are adequately treating stormwater to an acceptable standard. Stormwater found not to be of acceptable quality will have management actions reviewed and stormwater treatment infrastructure modified where required.	
6	**Air Quality**	
6.1	A CEMP would be detailed outlining the AQMP prior to construction.	Chapter 11, Section 11.4
6.2	Inspections of dust releases and associated control measures would be conducted on a regular basis.	
6.3	Vehicle movements on unsealed areas and roads would be kept to a minimum, to reduce dust releases from vehicle movements.	
6.4	Access roads would be sealed as soon as practicable after clearing, and access restricted to open cleared areas, to reduce dust releases from vehicle movements.	

No.	Commitment (Action)	Reference
6.5	Water sprays would be used on open areas and stockpiles, water trucks would be utilised on access roads and open areas, and wheel washes would be used, as appropriate.	Chapter 11, Section 11.4
6.6	Where appropriate, a speed limit of 20 km/hr would be enforced for all vehicles onsite, to reduce dust releases from vehicle movements.	
6.7	All truck deliveries in and out of the construction area would have their loads covered to prevent dust releases.	
6.8	All stockpiled materials would be kept to a reasonable size and controlled via wet suppression and/or covers where deemed appropriate.	
6.9	Multiple handling of construction materials would be avoided where possible.	
6.10	A vehicle inspection and maintenance program for all on site construction vehicles would be implemented and adhered to.	
7	**Greenhouse Gas Emissions**	
7.1	A CEMP would be developed incorporating greenhouse gas saving initiates using mechanisms described within the GHG assessment (e.g. regular vehicle engine inspections)	Chapter 12, Section 12.4
8	**Marine Noise**	
8.1	Prior to the commencement of any marine noise-intensive activity, a marine fauna exclusion zone extending 500 m in all seaward directions from the noise source would be established.	Chapter 13, Section 13.11
8.2	Standard Operating Procedures (SOPs) would be implemented within the marine fauna exclusion zone to protect any important marine fauna species from the impacts of marine noise.	
9	**Terrestrial Noise**	
9.1	The CEMP to be developed prior to construction would include a Construction Noise Environmental Management Plan (CNEMP).	Chapter 14, Section 14.7
9.2	Noise monitoring will be carried out in accordance with the requirements of the NSW Industrial Noise Policy (EPA 2000) and AS1055:1997 Acoustics – Description and Measurement of Environmental Noise.	
9.3	The project will implement corrective action resulting from complaints investigations as required.	
9.4	The project will investigate all substantiated noise and vibration related complaints.	
10	**Marine Ecology**	
10.1	A Draft DMP has been prepared to address the impacts associated with dredging and dredge spoil disposal, including monitoring to protect environmental values (refer Appendix B). The DMP will be finalised following review through the EIS process and implemented by DPC during the construction period.	Chapter 15, Section 15.6
10.2	A marine pest monitoring program has been established for Darwin Harbour by NRETAS. Discussions will be held with NRETAS to determine the appropriate course of action, in particular on whether the existing program sufficiently covers EAW, or if additional monitoring is required by the EAW Expansion Project. The monitoring program will be included in the CEMP.	
11	**Terrestrial Ecology**	
11.1	Minimise areas of disturbance	Chapter 16, Section 16.5
11.2	Clearing of vegetation for construction and operational activities associated with the proposed expansion of EAW will be undertaken in accordance with the NRETAS Land Clearing Guidelines (NRETAS	

No.	Commitment (Action)	Reference
11.3	Management of the local populations of Cycas armstrongii will consider the requirements of the NT TPWC Act 2000 and the management program for Cycads in the Northern Territory (Liddle	Chapter 16, Section 16.5
11.4	Measures will be taken to minimise potential impacts on migratory shorebirds and their habitats, such as minimise the area of mangrove, salt pan/saline flats and tidal mudflat areas disturbed for any works or reclamation inclusion of buffer zones to significant habitats controls on sedimentation or other impacts that may impact shorebird feeding sites controls on activities or facilities that might disturb feeding and roosting birds (e.g. noise, nocturnal lighting) undertake significant works in the vicinity of areas where migratory shorebirds inhabit in the dry season when most northern hemisphere migrants are absent (May – August).	
11.5	Protection of high tide roost sites and the provision of additional high tide roost sites where possible.	
11.6	Restrict access to public and animals (dogs) and controlling feral animals (cats, cane toads) and weeds in the vicinity of areas where migratory shorebirds roost and feed.	
11.7	Ensure that areas that are disturbed during construction activities or no longer required will be progressively rehabilitated with due consideration of the requirements of fauna species that will potentially recolonise these areas. (In relation to this commitment it is noted that dredge spoil ponds have become locally significant habitat for migratory and wetland birds, and represent the most significant high tide roost for migratory shorebirds in the East Arm area.	
11.8	Continued monitoring of shorebirds, and expansion of the existing program to include the western component of Area 1.	
11.9	Implement controls to ensure that no cane toad breeding habitats are created during or following construction (e.g. small, still ponded freshwater or brackish areas).	
12	**Visual Amenity**	
12.1	The proposed development will be screened from the surrounding area as much as is practicable.	Chapter 17, Section 17.4
12.2	Measures will be adopted during construction and operation of the proposed development to limit dust generation.	
13	**Historical and Cultural Heritage Values**	
13.1	Indigenous Site 1 (shell midden and artefact scatter) adjacent to the rail loop would be avoided as much as is practicable. If disturbance cannot be avoided, the site will be studied, documented and recorded prior to disturbance.	Chapter 18, Section 18.13
13.2	The unknown shipwreck site to the south-west of the rail loop would be avoided as much as is practicable. If disturbance cannot be avoided, the site will be studied, documented and recorded prior to disturbance.	
13.3	The CEMP and EMP for the proposed development will refer to the heritage sites identified by the historic and cultural heritage sites.	

No.	Commitment (Action)	Reference
14	**Biting Insects**	
14.1	Advise all workers that pest and disease-carrying mosquito species may be periodically present at the wharf.	Chapter 19, Section 19.5
14.2	Provide advice on appropriate personal protection measures and ensure appropriate personal protection equipment is available, in accordance with guidelines developed by the Medical Entomology Branch of the Department of Health. .	
14.3	Ensure that the construction and operational activities associated with the proposed expansion of EAW will be undertaken in accordance with the guidelines developed by the Medical Entomology Branch of the Department of Health and the recommendations included in this Draft EIS. Wherever possible the Proponent will seek to identify opportunities to rectify existing mosquito breeding sites as part of the proposed development.	
14.4	Ensure that Landholders regularly inspect sites to identify areas requiring rectification and maintain stormwater drains and sediment ponds to prevent mosquito breeding. Any insecticide control programs will be funded by the relevant landholders and subject to ongoing evaluation to determine if insecticide resistance is occurring.	
14.5	Ensure that Landholders regularly inspect rainwater tanks and sites for unwanted artificial receptacles that could act as breeding sites for exotic dengue carrying mosquitoes. Any receptacle that has the potential to pond water should be appropriately disposed of, stored under cover away from rain, fitted with drainage holes or treated with an appropriate larvicide, to prevent endemic mosquito breeding.	
14.6	Ensure that where possible larger lots that are free of vegetation will be recommended adjacent to the mangroves, to provide a buffer to minimise the number of people working in the worst areas for biting midges. Activities such as storage will be promoted in these areas.	
14.7	Ensure that all lots will include a notification on titles mentioning the high biting midge pest problems that occur at the East Arm Port Area and adjacent areas between the wharf and Hudson Creek east of Berrimah Rd	
15	**Fire**	
15.1	An updated FMP for the EAW precinct will be prepared prior to construction commencing.	Chapter 21, Section 21.10
15.2	Managing onsite vegetation and waste to limit fuel loads.	
15.3	Fire fighting equipment will be available on site at all times, in accordance with relevant regulations.	
15.4	Cigarette butt receptacles will be provided at designated smoking areas.	
15.5	Adequate water storage facilities (at least 54,000 L) will be made available to meet fire prevention requirements (where main water supply is not available).	
15.6	Emergency alarms will be installed in accordance with the relevant regulations.	
15.7	Inductions will include emergency preparedness and response, and periodic emergency evacuation and response exercises will be undertaken.	
15.8	All site vehicles will be equipped with a compatible and appropriately sized fire extinguisher.	
15.9	All operators will to store all flammable or combustible liquids in accordance with Australian Standards.	
15.10	Fire breaks and emergency fire access tracks will be maintained.	
15.11	Review of the EAW FMP annually.	

No.	Commitment (Action)	Reference
15.12	A site-specific FMP will be prepared for each project component. Each FMP will include monitoring and reporting requirements.	Chapter 21, Section 21.10
16	**Waste, Hazardous Material and Environmental Nuisance**	
16.1	The construction contractor/s responsible for of each project component will be required to prepare a CEMP for each component/s.	Chapter 22, Section 22.4
16.2	The operator of each component of the EAW expansion will prepare an operational EMP specific to that component prior to the new component operating at the wharf.	
16.3	Waste receptacles will allow separation and recycling of materials.	
16.4	Quarantine waste will be managed in accordance with AQIS requirements.	
16.5	Manage general waste to prevent litter, odour and pest infestations.	
16.6	A CWMP will be developed	
16.7	Site specific EMPs will address waste management measures for each facility.	
16.8	All solid waste generated during construction and operation of the proposed development will be disposed of at a licensed waste disposal facility.	
16.9	Each construction laydown will have a dedicated storage area for fuels, lubricants, and small quantities of other hazardous materials.	
16.10	Security fencing and lockable doors will be installed at the MSB and barge ramp hardstand to prevent misuse of any goods and materials stored within.	
16.11	The MSB fuel supply area and barge ramp hardstand will be paved, bunded, and graded away from the harbour to an oil separator.	
16.12	MSB refuelling and rig tender sewage transfer infrastructure will be covered and bunded.	
16.13	Appropriate spill management equipment will be placed at readily accessible areas as part of emergency response measures.	
17	**Social Environment**	
17.1	Promote local content, revenue generation and skills development, as well as participation by indigenous people in the project, in the construction contracts for the project.	Chapter 23, Section 23.4
17.2	Work with other government agencies to ensure that their planning is informed by EAW activities.	
17.3	Ensure that the main EPC contractors develop a strategy to minimise impact on existing housing stock.	
17.4	Ensure that contractors and then operations include management measures for community health and safety.	
17.5	Inform communities about avoidance of environmental impacts, and environmental mitigation activities.	
17.6	Monitor and respond to community concerns about the project and operations, and implement corrective action resulting from outcomes of investigation of community concerns.	

Appendix 3 – Draft Dredge Management Plan Commitments
(from Section 5.2, Appendix E, Supplement)

Commitment	Relevant Section (draft DMP)
Within the Zone of Moderate Impact (outside of each of the Zone of High Impact and Zone of Influence, refer to Section 5.3.2), water quality thresholds are to be developed and assessed as proposed in Section 5.4.	5.2.1
Prior to dredging, develop the following: - Water Quality and Sedimentation Monitoring Program - Under advisement of TAG, a monitoring and management plan (including thresholds levels and any adaptive management) in relation to human and ecological receptor sensitivities. Prior to dredging: - establish baseline (before) existing conditions in order to detect unacceptable levels of change associated with dredge operations (use already existing information where possible) - confirm the areas and delineate the Zones of impact (High and Moderate) and Zone of Influence for each of the dredging and disposal activities - assess water quality (eg. turbidity) at "core" regional monitoring sites – for example South Shell Island; NE Wickham Point; Channel Island and Weed Reef to be consistent with previous and/or other ongoing assessments. Adopt other sites within "Zone of Moderate Impact" as required in consultation with TAG and NRETAS. - characterise the sediments to be dredged in order to segregate potentially contaminated sediment (destined for onshore disposal) and clean materials - devise a treatment and tailwater release strategy from onshore emplacements - review this DMP and approve the Dredge Contractors EMP and Final DMP. During on-water dredging: - adopt relevant technology to minimise overflows in dredging areas to limit cumulative turbidity effects - apply mitigations, where fines content is elevated and/or closest to sensitive receptors - use tidal exchange and current flows to direct location of dredgers, and subsequent plume migration - routinely monitor levels of turbidity (and other selected water quality indicators) prior to, during and post dredging campaign and the "core" sites (and as needed at temporary sites nearer to dredge areas) - establish and operate TAG to seek independent, project related advice and adaptive management practices. - if turbidity levels exceed agreed monitoring and management frameworks then the TAG will advise on what actions may alleviate effects. During land-side works and dewatering: • maximise construction activities during the dry season to reduce potential for erosion, • sedimentation and acid leachate emissions for wet season preparedness and activities, for instance: - install fencing within or gravel/rock any temporary drainage channels created during the construction phase of the development to reduce stormwater velocity - divert stormwater away from the construction site through the implementation of a temporary bund wall - apply measures such as gross pollutant traps, temporary cut off drains and bunding are to be installed where suitable to capture gross pollutants, POL, sediment and other contaminants generated by near shore activities - visually inspect stockpiled fill to identify any areas of major wind/water soil erosion (Refer to Soil Erosion and Sediment	5.2.1

Control Plan) - inspect the condition and operability of site diversionary drains and erosion control - measures silt traps, sediment fences other measures).	
TAG and the Proponent to develop the requirements of Section 5.4.1 - Monitoring contractor to apply the requirements of Section 5.3.4, Table 17 Condition 2 - Dredging contractor to apply the Final DMP and CEMP and monitor for incidents	
Prior to dredging, develop the following: - Benthic Habitat thresholds in accordance with the requirements of Section 5.4.2. - Under advisement of TAG, monitoring and management plan (including thresholds levels and any adaptive management) in relation to 'Water Quality and Sedimentation' be linked to ecological receptors to address Section 5.4. Prior to dredging: - establish baseline (before) existing conditions in order to detect unacceptable levels of change associated with dredge operations (use already existing information where possible) - assess regional "core" monitoring sites – for example, these may be South Shell Island; NE Wickham Point; Channel Island and Weed Reef to be consistent with previous and ongoing assessments. Adopt other sites within Zone of Moderate Impact as required in consultation with TAG and NRETAS. - confirm the areas and delineate the Zones of impact (High and Moderate) and Zone of Influence for each of the dredging activities - review this DMP and approve the Dredge Contractors EMP and the Final DMP. During on-water dredging and onshore disposal: - adopt relevant technology to minimise emissions in dredging areas to limit cumulative turbidity, sedimentation or other effects from potential toxicants - apply mitigations, where fines content is elevated and/or closest to sensitive receptors - use tidal exchange and current flows to direct location of dredgers, and subsequent turbid plume migrations. For instance, dredging may not be able to continuously occur close to the South Shell Island benthos during ebb tides - routinely monitor benthic health (selected indicators) prior to, during and post dredging campaign and the "core" sites - if benthic habitat loss exceeds agreed monitoring and management framework thresholds then dredging operations need be altered - establish and operate TAG to seek independent, project related advice and adaptive management practices. During associated land-side works: - check reclamation areas and discharge to onshore in approved or existing footprint - adopt the requirements for water quality, sedimentation and acid leachate management (Sub-plans 1 and 2) - clearly mark the boundaries of any areas to be cleared - revegetate or, if conditions allow, promote re-colonisation of native vegetation in the areas surrounding the development upon completion of the project - provide protective fencing and/or signage for sensitive habitat areas in proximity to works areas apply buffer areas between works and intact habitat to minimise disturbance and degradation. Post dredging: - monitoring and reporting requirements are outlined in Section 5.3.4, Table 17, Condition 3.	5.2.2.1
During on-water works: - Prior to, and during daily dredging operations, visually assess the surrounding area to identify the presence of any aquatic vertebrates in the vicinity of the proposed dredge work activity. Prior to the commencement of any noise-intensive activity, a marine fauna exclusion zone extending 500 m in all seaward directions from the noise source should be established. - If listed marine animal species, including dolphins, turtles or dugongs are identified in the vicinity of the dredger path, the dredger will re-position to avoid interactions. - Before beginning daily activities, one hour prior to commencement of any noise intensive activity, vessel and/or land based observers should monitor the exclusion zone to check for the presence of listed marine fauna. Activities may commence if no marine fauna have been sighted within the exclusion zone 30 mins prior to the commencement of the activity. - Should animal entrainment occur, alternative equipment or operational procedures	5.2.2.2

will be considered. - Vessel crew will be given training on sea turtle and marine mammal observation.	
Prior to dredging, develop the following: - Noise and Vibration Management Program. - Under advisement of TAG, monitoring and management plan (including thresholds levels and any adaptive management) in relation to Noise and Vibration should be linked to ecological receptor thresholds for marine species. Prior to dredging: - Investigate potential noise impacts on sensitive receptors from dredging. - Review current activities near the Project Area which may contribute to background levels of noise and vibration. - Establish existing background and ambient noise levels for the day, evening and night time periods in order to detect unacceptable levels of change associated with dredging and disposal activities. - Review this DMP and approve the Dredge Contractors EMP and Final DMP. During dredging and onshore material placement: - Ensure that all equipment is maintained in good operating order and is switched off when not required. - Ensure that all equipment on board the dredger will be operated in a safe and efficient manner. - Adopt relevant technology to minimise generation of noise and vibration. - Routinely monitor noise and vibration levels prior to and during dredging campaign. - If marine megafauna injury or mortality occurs then dredging operations must be ceased immediately. - Operate TAG for project related advice and adaptive management practices.	5.2.3
To create an informed, appropriate spatially-based dredge assessment framework, it is important to establish: - the range of likely impacts on different inhabitant benthos immediately outside the dredged seabed area - up-to-date data and mapping of sensitive benthos types in that area and the region - predict the extent of sediment “pressure” fields. Such information needs to be assembled and interpreted sufficiently prior to dredging to ensure: - Data on current and relevant field conditions is being utilised. - Effects from other independent activities and occurrences are being considered (for instance, cyclones, floods and/or planned Inpex development works). - Proposed applicable dredge technologies (methods and cycles) can be analysed and adapted. These antecedent conditions necessarily require that the DMP is revised prior to the commencement of the dredge program	5.3.3
At this stage, in the absence of the necessary information to complete the additional analysis required to address the information needs (refer to section 5.3.3), developing the proposed monitoring to inform adaptive management and determine if management targets are being achieved is a future task for the proponent and their dredger. They will also seek support and contributions from regulators and an independent Technical Advisory Group (TAG). Furthermore, in support of this approach, *EAG7* (WAEPA 2011) recommends that: *“when developing proposed environmental monitoring programs, proponents should consider monitoring required for adaptive management purposes and that necessary to demonstrate compliance and any efficiencies that could be realised. The overarching objective of the assessment framework, outlined in the preceding sections, is to enhance the linkage between the environmental impact predictions made for EIA and the data generated through monitoring and management programs implemented post-approval. This should generate validation data which will further increase confidence over the prediction – management continuum.”* An area of approved impact within a Zone of High Impact (refer Table 17, Section 1 – *Direct and indirect seabed disturbance*) A proposed dredge performance assessment framework utilising: o Suitable *water quality and sedimentation indicators, monitoring, assessment and reporting* (refer Table 17, Section 2) o Suitable *benthic habitat indicators, monitoring, assessment and reporting* (refer Table 17, Section 3) Monitoring for Table 17 Sections 2 and 3, to provide data for decisions on adaptive dredge management, would be designed around the application of indicators that signify progressively greater risk of unacceptable impact (WA EPA, 2011) (as	5.3.4

further described in Section 5.4). **Table 17 Elements of dredging framework with a subordinate assessment program** ***1 - Direct and Indirect Seabed disturbance*** 1-1 The proponent shall not cause permanent loss of seabed supporting actual or potential benthic habitat in excess of the Zone of High Impact areas (described in Table 16) and identified based on EAW DEIS and SEIS findings and any subsequent predictions. 1-2 Beyond the Zone of High Impact around the direct dredge areas in the Zone of Moderate Impact, if benthic ecology or water quality indicator thresholds are exceeded (based on an unacceptable extent, intensity and duration derived from Section 5.4), the proponent shall notify the approval agency, provide proposed actions being undertaken to reduce turbidity and/or sediment-generating activities which are affecting water quality and provide an assessment of the anticipated effect on the marine environment once the new management action(s) is implemented. 1-3 The proponent, under advisement from TAG, shall review dredging, excavation and disposal activities that generate conditions that are in excess of thresholds (derived from Section 5.4) within the Zones of Moderate Impact and/or Zone of Influence. **2 – *Water quality indicators, monitoring, assessment and reporting: assessment of dredging effects*** 2-1 Dredge operations management and corrective actions shall be in accordance with the Dredger's CEMP and the Final DMP. 2-2 Zones of High Impact, Zone of Moderate Impact and Zone of Influence and the areas to be stipulated in **Table 16** shall be determined and specified by maps and coordinates, accordingly. 2-3 Prior to commencement of any site development works, the proponent shall prepare and submit a "Water Quality and Sedimentation Monitoring Program" to the approval agencies. The program shall address the following: 1) statistical design for comparative analysis describing spatial and temporal trends in ambient water quality and sedimentation rates near the dredge source 2) identify key parameters for monitoring including turbidity and sedimentation rates but also, depending on sediment content, potential contaminants and aquatic health indicators 3) propose rapid and reliable methods for data collection, acquisition and interpretation to enable adaptive management for future dredge activity 4) establishment of monitoring sites within Zone of High Impact and Zone of Moderate Impact areas 5) treatment of monitoring data to establish dredge effects. 2-4 The proponent, with the agreement of the approval agencies, shall institute a **Technical Advisory Group** to act in accordance with its role described in the DMP including: 1) verify the planned activities for the "Benthic Habitat Survey" and "Water and Sediment Quality Monitoring Program". 2) consider the findings of monitoring and assist in establishing risk based pressure-response pathways (refer Section 5.4) 3) advice on the Final DMP monitoring and management framework, as required 4) develop and utilise a risk based monitoring and management framework (derived from Section 5.4). **3 – *Benthic habitat indicators, monitoring, assessment and reporting: assessment of dredging effects*** 3-1 Prior to commencement of site works, the proponent shall prepare a *Benthic Habitat Survey* to establish ground conditions and for the information of the approval authorities. The survey shall address the following: 1. establish thresholds for ecological receptor sensitivities (linked to select "lead" impact indicators for water quality) 2. monitoring design to enable comparative analysis identifying target benthic parameters, duration for monitoring and the relationship to short term water quality monitoring 3. methods for surveys following commencement and completion of dredging to identify effects outside the Zone of High Impact	

4. location and establishment of survey sites in Zones of Moderate Impact and Zone of Influence 5. timing and frequency of monitoring and treatment of survey data 6. identifying unacceptable impacts. Note: “Benthic habitats” contain live hard and soft coral communities, sponge and other filter feeding and marine plant communities. 3-2 If other recent and relevant data do not exist, the proponent shall commence and conduct monitoring described in the *Benthic Habitat Survey* and provide an initial report to the approval agencies: (1) on the findings of the pre-dredging conditions, and (2) a plan for repeat monitoring in areas of predicted dredging effects. 3-3 Following commencement of any dredging works, the proponent shall apply the Benthic Habitat Survey and provide the results to the approval agencies following commencement of any dredging works which shall: 1. show the locations and spatial extent of the different marine benthic habitat types and parameters such as percentage cover of each dominant taxa. 2. record the abundance and health of benthic taxa observed within the indicator communities. 3. compare results to baseline (pre-development) results. 4. develop and utilise a risk based monitoring and management framework (derived from Section 5.4). 3-4 Following completion of the dredging program, the proponent shall, if any significant ecological effect is detected outside of the approved Zone of High Impact, conduct field survey within 2 years and submit the findings of that survey to the approval agencies. Any initial need or further continuation of this monitoring after dredging is completed) will be based on whether compliance with criteria has been made.	
Monitoring activities will be undertaken throughout the dredging in relation to the identified performance objectives and target. Benthos at South Shell Island have been identified as potential target receptors and will need to be assessed in relation their situation in an “Impact Zonation Scheme” (Figure 11) and the degree of resilience of biota to exposure to sedimentation and elevated turbidity. EAG7 (WA EPA, 2011) suggests that the framework around which to design environmental monitoring programs should be risk-based using understanding of pressure-response pathways for key biota in the benthic communities to be monitored. In summary, this presents a framework where: - Exceedence of a primary indicator (e.g. specified turbidity level or sedimentation rate criteria) will require a Tier 1 management action (e.g. investigating the cause of the exceedence and increasing monitoring to include biota). - Exceedence of a secondary indicator (e.g. a measure of biotic stress) will require a Tier 2 adaptive management to reduce dredge-related pressure. - Exceedence of a tertiary indicator (e.g. a measure that is an immediate precursor to unacceptable impact) will require strong management action to alleviate dredge-related pressure. Such a framework will need to take account of other regional activities, under way at the time or just before, that may be major sources of sediment, such as the Inpex development. **5.4.1 Water quality** Thresholds for dredge operations will be developed to enable compliance assessment and adaptive dredge management. Note the proposed turbidity levels and/or sedimentation rates must be verified according to tabled predictions and be able to be adapted or modified by the TAG based on emergent data. Other key considerations will be: - use of water quality “early indicators” of light attenuation (turbidity or PAR) and/or sedimentation effects. These pressures necessarily must be created as a precedent to any undue effects on ecological health, so serve well as early indicators of potential stress - baseline water quality prior to the commencement of dredging activities including turbidity, salinity, dissolved oxygen and temperature, potentially by in situ data loggers - data analysed for intensity (range of NTU values), duration (range of hours), and frequency (the number of times that NTUs fall within each range for each duration) - water quality thresholds as a spatio-temporal matrix of: □□conservative turbidity levels and sedimentation rates □□periods of exposure of benthos to those “pressure” levels □□the sensitivity of adopted benthic receptors to those “pressure” levels for ecologically meaningful periods of time	5.4

- criteria/thresholds should be reviewed by the TAG once the actual turbidity and sedimentation rates are known by virtue of precedent routine monitoring - the initiation and implementation of management responses will be based on monitoring and other event based records. **5.4.2 Benthos** The benthic baseline monitoring programme will be used to develop monitoring and thresholds that can be used to guide management responses of the TAG during the dredging program. Other key considerations will be: - use of indicator benthic taxa (eg. sponges, hard corals) located within Zone of Moderate Impact, Zone of Influence (and reference locations) - baseline and dredge program assessments of the benthic communities in relation to the “Impact Zonation Scheme” (refer to Figure 11) - inter-relate to water quality thresholds established as a spatio-temporal matrix of: □□conservative turbidity levels and sedimentation rates □□periods of exposure of benthos to those “pressure” levels □□the sensitivity of adopted benthic receptors to those “pressure” levels for ecologically meaningful periods of time - criteria/thresholds should be reviewed by the TAG once the actual results known by virtue of reactive campaign monitoring - the initiation and implementation of management responses based on monitoring results.	