ASSESSMENT REPORT 39

DARWIN 10 MTPA LNG FACILITY

(WICKHAM POINT)

ENVIRONMENTAL ASSESSMENT REPORT AND RECOMMENDATIONS

by the

OFFICE OF ENVIRONMENT AND HERITAGE

DEPARTMENT OF INFRASTRUCTURE, PLANNING AND ENVIRONMENT

May 2002

Northern Territory Government
Department of Infrastructure, Planning and Environment

TABLE OF CONTENTS

ABBREVIATIONS

µg/m^3	microgram (one millionth of a gram)/cubic metre
AAPA	Aboriginal Areas Protection Authority
AHD	Australian Height Datum (a measurement of height relative to mean sea level)
AQIS	Australian Quarantine and Inspection Service
AMSA	Australian Maritime Safety Authority
Bq/m^3	Becquerel per cubic metre (a unit of radioactivity; = one disintegration or nuclear transformation per second, per cubic metre)
CASA	Civil Aviation Safety Authority
CBD	Central Business District (of Darwin)
CO_2	carbon dioxide
CPI	corrugated plate interceptor
DAC	Darwin Aquaculture Centre (Channel Island)
dB(A)	decibels (a measuring unit for noise)
DBIRD	Northern Territory Department of Business, Industry and Resource Development (formerly DPIF, DME)
DHCS	Northern Territory Department of Health and Community Services (formerly THS)
DIPE	Northern Territory Department of Infrastructure, Planning & Environment (formerly Department of Lands, Planning and Environment; Department of Transport and Works; and Parks and Wildlife Commission)
DLPE	Department of Lands, Planning and Environment (now part of DIPE)
DPC	Darwin Port Corporation
DPIF	Department of Primary Industry and Fisheries (now part of DBIRD)
EIS	Environmental Impact Statement
EMP	Environmental Management Program (or Plan)
EPBC	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth Act)
ERM	Emergency Response Manual
ERP	Emergency Response Plan
GHG	greenhouse gas
IMO	International Maritime Organisation
LNG	liquefied natural gas
LPG	liquefied petroleum gas
m^3	cubic metre (a volume 1 m x 1 m x 1 m)
micron	one millionth of a metre
MAGNT	Museums and Art Galleries of the Northern Territory
MTPA	million tonnes per annum
MW	megawatt (unit of power)
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NHMRC	National Health and Medical Research Council
NHT	Natural Heritage Trust
nm	nautical mile
NOI	Notice of Intent
NORM	naturally occurring radioactive material
NO_x	nitrogen oxides
OEH	Office of Environment and Heritage (in DIPE)
OSCP	Oil Spill Contingency Plan
PAWA	Northern Territory Power and Water Authority
PER	Public Environmental Report
pers comm.	personal communication/s

PM10	particulate matter (in air emissions) $\leq$ 10 microns in size
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
RAAF	Royal Australian Air Force
SBWDS	Shoal Bay Waste Disposal Site
TPA	tonnes per annum
SO_2	sulphur dioxide
TBT	tributyltin (toxic anti-foulant added to boat paints)
ZOC	Timor Gap Zone of Co-operation between Australia and Indonesia (to be known in future as the Joint Petroleum Development Area between Australia and East Timor)
ZOCA	Section A of the ZOC

EXECUTIVE SUMMARY

In 1997, Phillips Oil Company Australia submitted to the NT Government a proposal to construct a Liquefied Natural Gas (LNG) facility at Wickham Point (on the Wickham Point Peninsula, between East Arm and Middle Arm) in Darwin Harbour. The proposed facility comprised a single train plant to produce LNG at a maximal rate of 3 million tonnes per annum (MTPA) from gas transported from the Bayu-Undan field (in the Timor Sea) to Wickham Point via a sub-sea pipeline. (A "train" is a production pathway and related infrastructure, having its own process area at the facility.)

The proposed project included

- a sub-sea pipeline;
- a land-based facility for liquefaction of natural gas and storage of LNG;
- marine loading facilities; and
- a dedicated fleet of ships to transport LNG product.

The proposal went through a detailed Environmental Impact Assessment process, at the level of an Environmental Impact Statement (EIS) and received approval from Commonwealth and Northern Territory Environment Ministers in early 1998. The NT Government analysis of the project, comments and Supplement formed the basis of the Territory's Environmental Assessment Report 24.

In March 2002, Phillips submitted a revised proposal for a 10 MTPA plant (comprising two trains, each with a maximal output of 5 MTPA) that could capture and process natural gas from additional offshore fields, e.g. the Greater Sunrise field in the Timor Sea.

The environmental assessment of the proposed 10 MTPA facility is being conducted at the level of a Public Environmental Report (PER) primarily under the Northern Territory *Environmental Assessment Act 1982* and concurrently reviewed under the Administrative Procedures approved under the Commonwealth *Environment Protection (Impact of Proposals) Act 1974*.

Environmental impact assessment is the process of defining those elements of the environment that may be affected by a development proposal and of determining the significance, risks and consequences of the potential impacts of the proposal. Recommendations arising from the assessment address methods to mitigate these impacts.

The PER describes the predicted and potential environmental impacts of the expanded LNG facility, with particular emphasis on differences between the previously approved 3 MTPA LNG facility and the proposed 10 MTPA plant. The PER also describes measures to avoid or mitigate these impacts.

This Environmental Assessment Report identifies the key environmental issues relating to the project (as described in the PER) and evaluates the adequacy and appropriateness of the proposed measures to mitigate the potential and anticipated impacts. Where the proponent's commitments are considered adequate and appropriate, they have been included, as proposed, in this Report. Where commitments or safeguards are considered incomplete or not specific enough, or particular impacts have not been addressed adequately in the PER, recommendations have been put forward to redress these issues.

Comments from the public and Northern Territory Government agencies on the PER, and the proponent's responses to these comments, have been used to develop the recommendations made in this Assessment Report.

Major Issues

The major impacts of the proposed 10 MTPA facility compared to the approved 3 MTPA facility will result from the increased capacity of the plant and will be as follows:

1. Increased area of ground disturbance, from 66.8 ha to 88.3 ha;
2. Increased demand for power generation, from 18.2 MW to 48.4 MW;
3. Increased operating work-force, from 75 to 120 personnel;
4. Increased demand for process water, from 6 to 12 m^3/hr;
5. Increased volumes of waste-water requiring treatment/disposal, from 4.5 to 11 m^3/hr;
6. Increased volume of storage tank hydro-test water discharge prior to plant start-up;
7. Increased volume of solid and semi-liquid waste generated and requiring disposal (from 143,050 to 242,600 kg/yr);
8. Increased risk to the public and the environment from greater volumes of LNG storage tanks (from 190,000 m^3 to 360,000 $m^{3)}$;
9. Increased risk to the public and the environment from increased shipping movements, from 78 visits to approximately 160 visits per year, and the navigation risk associated with using larger vessels; and
10. Increased atmospheric and greenhouse gas emissions (especially CO_2, which, at full plant capacity, will be generated at a rate of 4.5 MTPA compared to 1.7 MTPA).

Conclusions

The Office of Environment and Heritage considers that the environmental issues associated with the proposed project have been adequately identified. Appropriate environmental management of some of these issues has been identified through the assessment process, whereas resolution of other matters will be achieved through monitoring and management actions detailed in a comprehensive Environmental Management Program (EMP).

In November 1998, a *Preliminary EMP* was produced (for the 3 MTPA proposal; Dames and Moore 1998b) which incorporated comments by and approval conditions set by the Commonwealth and NT Governments, based on their review of the Draft EIS (Dames and Moore 1998a). Phillips proposes to complete the EMP for the 10 MTPA facility in stages, before the start of construction, by building on the commitments in the *Preliminary EMP* and focusing on the additional level of potential environmental impacts associated with the expanded project. Comments submitted by the public and Northern Territory Government during the review of the PER will also be used to develop new mitigation measures for impacts associated with the proposed expansion or to revise, where appropriate, those developed for the 3 MTPA plant.

This final EMP will be subject to review and approval by relevant Northern Territory and Commonwealth Government agencies.

The EMP will be the major vehicle for implementing management and monitoring commitments made by the proponent in the PER and the recommendations detailed in this Assessment Report. As such, it will be a working document for the life of the plant and it will require continual review in the light of operational experience and changed circumstances.

The proposed expansion will have two main environmental impacts during the construction and commissioning stages of development:

- the clearing of an additional 21.5 ha of regionally-significant dry rainforest (monsoon vine thicket) which comprises a 32% increase over clearing for the 3 MTPA plant; and
- the discharge of an increased volume (not specified in the PER) of hydrotest water (possibly with chemical additives) from three LNG storage tanks instead of two and from a smaller tank for condensate.

To offset the loss of dry rainforest, the proponent is working with the Department of Infrastructure, Planning and Environment (DIPE) to identify and acquire another area of equivalent or better quality rainforest for conservation.

To mitigate potential impacts on marine biota from discharge of hydrotest water, the proponent has undertaken to work with DIPE to identify appropriate treatment and release options (e.g. dilution before release, release during tidal phases that will promote further dilution and transport out of the Harbour, release at a slow rate, etc.). If analysis of the proposed formulation of hydrotest water indicates a potential for toxic impacts on marine life, the proponent will need to obtain a Waste Discharge Licence from the Office of Environment and Heritage to release this water into Darwin Harbour and must comply with all conditions attached to that Licence.

During the operational life of the facility, the expanded development will also have several significant on-going environmental impacts:

- Perhaps the most significant of these will be a 2.5x increase in greenhouse gas emissions, particularly CO_2.

  Section 4.5 of this Assessment Report discusses the implications of the increased production of CO_2, and a number of mitigating actions will be undertaken by the proponent in order to reduce or offset the production of this greenhouse gas as the operation proceeds. (The plant will also produce a number of other atmospheric pollutants; however, the proponent's modelling of "worst-case" scenarios indicates that these will be kept within national and international guideline levels.)

- Another significant potential impact associated with the proposed expansion is an increased risk for groundings, collisions or other incidents from the near doubling of visits by LNG vessels (especially the risk of oil spills).

  At peak production, vessels will berth and load LNG every two to three days (instead of once per week, for the 3 MTPA facility). The Hazard and Risk Assessment for shipping concluded that the established design, construction and operating practices of LNG vessels, combined with the Darwin Port Corporation controls and safety measures, will ensure that the risk of a major incident resulting in spills from an LNG vessel will be very small. The increased shipping is therefore considered to pose minimal additional risk compared to that for the 3 MTPA facility.

  Despite the low risk, the proponent will develop site-specific oil spill contingency plans (OSCPs) for the construction and operation phases of the project. These OSCPs will integrate effectively with the Darwin Harbour OSCP and the Commonwealth's *National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous Substances*. It will also identify options for utilising expertise and equipment from the industry-based Australian Marine Oil Spill Centre (Geelong).

- A third source of increased public and environmental risk will be from increased production (10 instead of 3 MTPA) and a near doubling of volumes of LNG in storage tanks at Wickham Point.

  The increased risk to people, the environment and adjacent facilities from potential incidents relating to increased production and storage of LNG was addressed in a Hazard and Risk Assessment study and report (Bechtel 2002, Appendix G of the PER). This report focuses on the main changes in risk profile between the 3 MTPA and 10 MTPA facilities: two LNG "trains" (i.e.

production pathways and related infrastructure) instead of one; greater LNG storage capacity; and more frequent shipping.

The Hazard and Risk Assessment concluded that the codes and standards governing the design and operations at the LNG plant will maintain, at an acceptably low level, potential hazards to site personnel, the public and the environment. The remote location of the plant in relation to residential areas provides a further safeguard to the public.

- Volumes of waste-water will increase nearly 2.5x, and solid and semi-liquid waste (e.g. domestic waste, oils, sludge) will increase approximately 1.7x.

  Phillips has undertaken to use all treated wastewater for on-site irrigation. Discharge to the Harbour will be considered only as a contingency option (e.g. during the wet season, if soils are already saturated), and a Waste Discharge Licence will have to be obtained in advance from the Office of Environment and Heritage.

  The increased levels of solid and semi-liquid wastes were re-assessed, and the proponent has demonstrated that the volumes and range of non-hazardous and hazardous wastes can be appropriately managed and disposed of safely in accordance with the provisions of the *Waste Management and Pollution Control Act*. The LNG plant will require one or more licences under this Act and the *Water Act* to regulate emissions to air, management of wastes and any discharges to Darwin Harbour. The proponent will be required to comply with all licence conditions and regulations under these acts, including regular compliance audits and reports.

Based on its review of the PER and the proponent's Response to Submissions from relevant NT Government agencies and the public, the Office of Environment and Heritage considers that the project can be developed and managed in a manner that avoids unacceptable environmental impacts, provided that the environmental commitments, safeguards and recommendations detailed in this Assessment Report and in the final EMP are implemented, and regular compliance auditing and reporting are undertaken.

LIST OF RECOMMENDATIONS FROM ASSESSMENT OF 10 MTPA PROPOSAL

During the implementation of proposals outlined in the PER, flexibility is necessary and desirable to allow for minor changes to the design and specifications that have been examined as part of this assessment. Where it can be shown that such changes are not likely to have a significant impact on the environment, an adequate level of environmental protection may still be achieved by the following recommendations, modifications to these recommendations or by conditions attached to relevant statutory approvals for these modifications.

These Recommendations have been cross-referenced to ones included in the previous assessment for the 3 MTPA LNG plant and pipeline. The " = " symbol indicates that the new Recommendation is virtually unchanged from the previous one; the " ~ " symbol indicates that the new Recommendation is similar to the previous one but has been substantially modified.

Subject to decisions that permit the Darwin 10 MTPA project to proceed (e.g granting of development permits and issuance of both freehold and long-term leasehold titles), the recommendations resulting from the assessment are set out below.

Note: unless superseded by recommendations in the current Assessment Report, recommendations in the previous Assessment Report (No. 24) should be considered current.

Recommendation 1

The proponent shall ensure that the proposal is implemented in accordance with the environmental commitments and safeguards

- **identified in the Darwin 10 MTPA Facility Public Environmental Report and as modified in the proponent's response to issues raised by the public and NT Government agencies that reviewed the PER; and**
- **as recommended in this Assessment Report (No. 39) which includes relevant recommendations from the previous Assessment Report (No. 24).**

[= Recommendation 1 in Assessment Report 24]

Recommendation 2

If expansion of the 10 MTPA plant is proposed, the revised project design shall be submitted to the NT Government for further assessment under the NT *Environmental Assessment Act 1982.*

[~ Recommendation 3 in Assessment Report 24]

Recommendation 3

The proponent shall quantify the major emission sources during commissioning of the project, by periodic emission testing programs. Dependent on the results of this verification process, the proponent will establish a monitoring system for oxides of nitrogen (NO_x) from key emission sources at the facility and shall verify that standards contained in the Ambient Air Quality National Environment Protection Measure (NEPM) are not exceeded.

Procedures for monitoring and reporting shall be developed in consultation with the Office of Environment and Heritage and shall meet relevant NEPM requirements and Australian Standards.

[~ Recommendation 13 in Assessment Report 24]

Recommendation 4

The proponent's Environmental Management Program shall include a section specifically addressing commitments and strategies aimed at reducing greenhouse gas emissions. This shall include (for example) provisions for regular greenhouse gas audits, a process for continuous review of new technologies to identify opportunities to reduce emissions, and benchmarking against other LNG facilities with a view to achieving international best practice in terms of carbon dioxide emissions per unit of production. Opportunities for offsetting greenhouse gas emissions, including support for relevant research, shall also be addressed.

In developing its greenhouse gas strategy, the proponent shall consult with the Greenhouse Unit of the NT Office of Environment and Heritage, and the strategy shall be provided to Environment Australia.

[~ Recommendation 14 in Assessment Report 24]

Recommendation 5

This Assessment Report acknowledges the negotiations between the proponent, the Civil Aviation Safety Authority (CASA), Darwin Airport authorities and other relevant agencies to resolve outstanding concerns regarding potential impacts from flaring on aviation. If continuing studies indicate a potential significant risk to aviation, further analysis of hazards and risks to aircraft from flaring shall be required prior to the proponent's final decisions on the design and operation of flares.

[~ Recommendation 16 of Assessment Report 24]

Recommendation 6

If chemical additives used in hydrotest water pose a risk of toxicity to marine life in the Harbour, the proponent will require a Waste Discharge Licence. The Licence will require the proponent to analyse the hydrotest formulation to be used (to assess the potential toxicity to marine biota) and to monitor the receiving water to ensure adequate dilution and dispersion to reduce toxicity to an acceptable level. Further, if there is a credible risk of toxicity in the discharge, the proponent will provide adequate notice to nearby aquaculturists to allow them time to implement desired precautionary measures. (This will comprise an additional safeguard to protect stock at these facilities.)

[New Recommendation]

Recommendation 7

Treatment and disposal (by irrigation) of wastewater will need to comply with the *Guidelines for Sewerage Systems – Use of Reclaimed Water* (ANZECC/ARMCANZ 2000) and *Site Specific Type Approval* by the NT Department of Health and Community Services (DHCS). This will require the proponent to

- **Conduct a detailed assessment of areas proposed for treatment and disposal using the DHCS Site Report template;**
- **Evaluate the site constraints in order to choose the most suitable system for treatment and disposal of wastewater; and**

- **Submit the report to DHCS supporting an application for the *Site Specific Type Approval*. Treatment and disposal systems must comply with the requirements of the DHCS *Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal and Reuse of Sewage Effluent.***

[~ Recommendation 8 in Assessment Report 24]

Recommendation 8

The proponent will consult with Office of Environment and Heritage to develop preferred and contingency options for management and disposal of waste oil and will include these in its Environmental Management Program.

[New Recommendation]

Recommendation 9

The proponent's Environmental Management Program shall contain a *Dredge and Spoil Disposal Management Plan* that evaluates options for dredging, excavation and spoil disposal and addresses potential environmental impacts. This *Plan* shall include proposed measures to ensure protection of the Channel Island coral assemblages. The *Plan* shall also include a "Reactive Monitoring Program" that implements baseline studies (to set environmental triggers for concern), turbidity plume monitoring, a reactive coral monitoring program (if required), and contingency measures to be implemented if environmental triggers are exceeded or if monitoring detects potentially unacceptable environmental impacts.

Development of the *Dredge and Spoil Disposal Management Plan* shall be done in consultation with relevant NT Government agencies and shall be submitted to the NT Government for approval prior to commencement of dredging.

[~ Recommendation 6 of Assessment Report 24]

Recommendation 10

An emergency management plan addressing LNG carrier operations at sea, in Darwin Harbour and at the loading jetty shall be developed in consultation with relevant authorities such as the Darwin Port Corporation and the Australian Maritime Safety Authority. The plan shall include

- **measures to ensure compliance with national and international safety regimes;**
- **reporting procedures and organisational responsibilities in the event of incidents;**
- **contingency measures to minimise risks to human safety and the environment;**
- **specification of adequate resources to be held on ship and at berth to deal with credible contingencies; and**
- **a communication strategy to ensure effective and efficient liaison among shore-based and ship-based emergency response teams.**

[~ Recommendation 18 in Assessment Report 24]

Recommendation 11

Oil spill contingency plans for the construction dock and product-loading jetty shall be prepared by the proponent, within the overall context of the Darwin Port Corporation's Oil Spill Contingency Plan. The site-specific plan shall include

- **an assessment of potential risks of spills of credible volumes;**
- **potential oil spill trajectories;**
- **maps of priority areas for protection (including aquaculture facilities);**
- **details for deployment of equipment to protect priority areas,**
- **demonstrated integration with the Darwin Port Corporation Plan;**
- **inventory of equipment for control and clean-up (including materials held at the jetty and/or construction dock for immediate clean-up of minor spills);**
- **strategies, actions and responsibilities for any clean-up; and**
- **a training and exercise strategy that includes relevant NT Government response personnel.**

[~ Recommendation 19 in Assessment Report 24]

Recommendation 12

The proponent's Environmental Management Program shall include specific measures to minimise loss and disturbance to remaining mangrove and dry rainforest habitat at Wickham Point. This shall include measures to avoid unnecessary clearing and disturbance during construction, measures to monitor and control weed and feral animal incursions, and measures to minimise fire risks.

[= Recommendation 11 in Assessment Report 24]

Recommendation 13

As part of the proponent's Environmental Management Program, an *Acid Sulfate Soil Management Plan* shall be prepared in consultation with relevant NT Government agencies. Sampling and analysis of potential acid sulfate soils shall be conducted as part of preparing the *Plan*. The *Plan* shall include monitoring of leachate from any soil or spoil retention areas and reclamation areas, and contingency measures in the event leachate is found to be excessively acidic.

[= Recommendation 7 in Assessment Report 24]

Recommendation 14

In preparing the Environmental Management Program (EMP), the proponent shall include any additional measures for environmental protection and monitoring contained in recommendations made by the Northern Territory and Commonwealth Governments with respect to the proposal. The EMP shall be referred to relevant NT agencies and Environment Australia for review prior to finalisation, after which it shall become a public document. The EMP shall form the basis for relevant approvals and licences issued under NT legislation.

[~ Recommendation 2 in Assessment Report 24]

Recommendation 15

The proponent shall ensure that decommissioning is done according to the best environmental standards available at the time.

[= Recommendation 20 of Assessment Report No. 24]

LIST OF RECOMMENDATIONS FROM ASSESSMENT OF 3 MTPA PROPOSAL (from Assessment Report 24, February 1998)

Thirteen of the following twenty-one recommendations from Environmental Assessment Report 24 (for the proponent's earlier 3 MTPA LNG project) have also been included, in original or modified form, in the current Assessment Report for the 10 MTPA plant (Assessment Report 39). In the development of conditions for licences and permits, the current modified versions of earlier Recommendations, in addition to the two new Recommendations, should be considered.

Eight of the earlier Recommendations were not included in Assessment Report 39 and are indicated in ***italics*** in the following list. They should, however, also be implemented by the proponent in development of the full-scale project (plant and sub-sea pipeline). The following ones have not been included because they relate specifically to the sub-sea pipeline, which was not relevant to the current proposal: Recommendations 4, 5, 9, 10 and 17.

Recommendations 12, 15 and 21 were not included in the current Assessment Report because the environmental protection measures they describe have been undertaken as commitments by the proponent in the PER or the proponent's Response to Submissions for the 10 MTPA facility. These should, however, also be considered in the setting of conditions for permits and licences.

Recommendation 1

The proponent shall ensure that the proposal is implemented in accordance with the environmental commitments and safeguards identified in the Darwin LNG Plant draft Environmental Impact Statement, as modified in the Supplement to the draft EIS and as recommended in this assessment report.

Recommendation 2

In preparing the Environmental Management Plan (EMP) the proponent shall include any additional measures for environmental protection and monitoring contained in recommendations made by the Commonwealth and Northern Territory Governments with respect to the proposal. The EMP shall be referred to Environment Australia and relevant NT agencies for review prior to finalisation, after which it shall become a public document. The EMP shall form the basis for any approvals and licences issued under the forthcoming *Waste Management and Pollution Control Act.*

Recommendation 3

In the event that an expansion of the LNG Plant is proposed, the revised project design shall be submitted to the NT Government for further assessment under the *NT Environmental Assessment Act.*

Recommendation 4

The final route of the sub-sea pipeline and any associated surveys, studies and consultations undertaken to determine the final alignment, shall be made available to relevant NT agencies for comment. In particular, the proponent shall demonstrate that the route has been selected to avoid:

- ***areas requiring blasting or substantial preparatory earthworks;***
- ***areas of recreational or conservation significance;***
- ***areas of significance to fishing activity;***

- ***areas which may be inhabited by rare or endangered species;***
- ***protected maritime heritage areas;***
- ***shallow water depths, or shoals, where corals or other significant habitat may exist; and***
- ***marine Aboriginal sacred sites.***

Recommendation 5

The proposed pipeline alignment survey shall be undertaken in close consultation with relevant Northern Territory agencies. In the event that new wrecks or other historical materials are found, the proponent shall advise the Heritage Conservation Branch of the DLPE.

Recommendation 6

The proponent shall prepare an evaluation of the dredging, excavation and spoil disposal options. A dredging plan, addressing the environmental impacts, shall be submitted to the NT Government and Environment Australia for approval prior to commencement. The plan shall include proposed measures to ensure protection of the Channel Island coral assemblages. These measures shall include implementation of baseline studies, turbidity plume monitoring, a reactive coral monitoring program (if required), and contingency measures to be implemented if monitoring indicates adverse impacts. Development of any monitoring and assessment programs associated with the dredging plan shall be undertaken in consultation with the relevant NT Government agencies.

Recommendation 7

An Acid Sulphate Soil Management Plan and Monitoring Program shall be prepared in consultation with relevant NT Government agencies. Sampling and analysis of potential acid sulphate soils should be conducted as part of preparing the plan. The plan shall include monitoring of leachate from any soil or spoil retention areas and reclamation areas, and contingency measures in the event leachate is found to be contaminated.

Recommendation 8

The proponent shall consult with relevant NT Government agencies on measures needed, and applicable standards, for use of wastewater for land irrigation and/or as filtered discharge through mangroves, with a view to avoiding direct discharge to the waters of Darwin Harbour. If direct discharges are required, modelling of the effluent mixing zone shall be undertaken to the satisfaction of relevant NT Government agencies to ensure that sufficient dilution will occur at the proposed discharge point to minimise impacts on nearby marine habitats.

Recommendation 9

The pipeline component of the Environmental Management Plan (EMP) shall address preparatory requirements for the pipeline (e.g. spanning support, rock dumping and stabilisation requirements) and measures to be implemented for the protection of the environment. The EMP shall also include measures to avoid and minimise impacts associated with laybarge operations including liquid and solid waste management and disposal, anchoring systems, and control of turbidity associated with rock dumping.

Recommendation 10

The proponent shall advise all mariners, including commercial fishing operators and DPIF, of the detailed pipeline construction timetable and route, when available, and undertake to negotiate changes if necessary, to assist in minimising timing conflicts between pipeline laying and fishing.

Recommendation 11

The proponent shall include, as part of the EMP, specific measures to minimise loss and disturbance to remaining mangrove and dry rainforest habitat at Wickham Point. This shall include measures to avoid unnecessary clearing and disturbance during construction, measures to monitor and control weed and feral animal incursions, and measures to minimise fire risks.

Recommendation 12

The proponent shall ensure that on-going management of remaining vegetation and fauna habitats will be undertaken, including monitoring of weeds and feral animals and prevention of fires. The EMP shall include measures to mitigate any impacts in the event that adjacent vegetation appears to be affected as a result of the operation of the plant. Vegetation management and mosquito breeding sites shall be included in the Site Environmental Audit.

Recommendation 13

The proponent shall consult with DLPE regarding preparation of the atmospheric emissions inventory and any related monitoring. Both the inventory and any monitoring shall be implemented to the satisfaction of the DLPE. The proponent shall verify, by monitoring for NO2, that there will be no exceedances, arising from atmospheric emissions, of the standards contained in the proposed Ambient Air Quality NEPM. Monitoring procedures and data reporting must meet the NEPM requirements and Australian Standards. Monitoring points shall be determined in consultation with DLPE.

Recommendation 14

The EMP shall include a section specifically addressing commitments and strategies aimed at reducing greenhouse gas emissions. This shall include, for example, provisions for regular greenhouse gas audits, a process for continuous review of new technologies to identify opportunities to reduce emissions, and benchmarking against other LNG facilities with a view to achieving international best practice in terms of CO_2 emissions per unit of production. Opportunities for offsetting greenhouse gas emissions, including support for relevant research shall also be addressed. The greenhouse gas strategy shall be provided to Environment Australia and the DLPE for comment. Participation in the Greenhouse Challenge Program should also be explored by the proponent.

Recommendation 15

The proponent shall ensure that relevant components of the Hazard and Risk Assessment cover ecological risk as well as risk to human life. All components of the Hazard and Risk Assessment, including Emergency Response Plans, shall be provided to the NT Government for review before finalisation.

Recommendation 16

Negotiations between the proponent, the RAAF, Darwin Airport authorities, Air Services Australia and the Civil Aviation Authority to resolve outstanding concerns in regard to safety interactions between flaring and approaches to the north-south runway at the airport are noted. If negotiations indicate the potential for safety interactions, further analysis of hazards and risks to aircraft from flaring shall be required prior to a final decision on the type or nature of flaring to be used.

Recommendation 17

The proponent shall provide a Pipeline Rupture Management and Contingency Plan for the entire length of pipeline, prior to its commissioning. This Plan should outline detailed measures to minimise risks of leakage and rupture, including external risks to the pipeline, and strategies and systems to monitor, detect and repair leaks (including measures to detect and repair potential areas of leakage). Detailed contingency measures to ensure quick reaction to major incidents, including measures to minimise environmental harm and environmental remediation if required, shall also be included. The plan shall be prepared to the satisfaction of Environment Australia, the Commonwealth Department of Primary Industries and Energy and the Northern Territory and Western Australian Governments.

Recommendation 18

An emergency management plan addressing LNG carrier operations at sea, in Darwin Harbour and at berth shall be developed in consultation with relevant authorities such as the Darwin Port Authority and Australian Maritime Safety Authority. The plan shall include matters such as measures to ensure compliance with national and international safety regimes, reporting procedures and organisational responsibilities in the event of incidents, control of incident responses, contingency measures to minimise risks to human safety and the environment, minimum resources to be held on ship and at berth to deal with credible contingencies, and interactions with shore based or other emergency response teams.

Recommendation 19

An oil spill contingency plan for the port facility shall be prepared by the proponent, within the overall context of the Darwin Port Authority Oil Spill Contingency Plan. The site specific plan should include an assessment of potential risks of spills and credible volumes, potential oil spill trajectories, maps of priority areas for protection including aquaculture facilities, deployment of equipment to protect priority areas, integration with the Darwin Port Authority Plan, inventory of equipment to deal with control and clean-up (including materials held at the wharf for immediate clean-up of minor spills), strategies , actions and responsibilities for any clean-up, and a training and exercise regime (including with Northern Territory authorities).

Recommendation 20

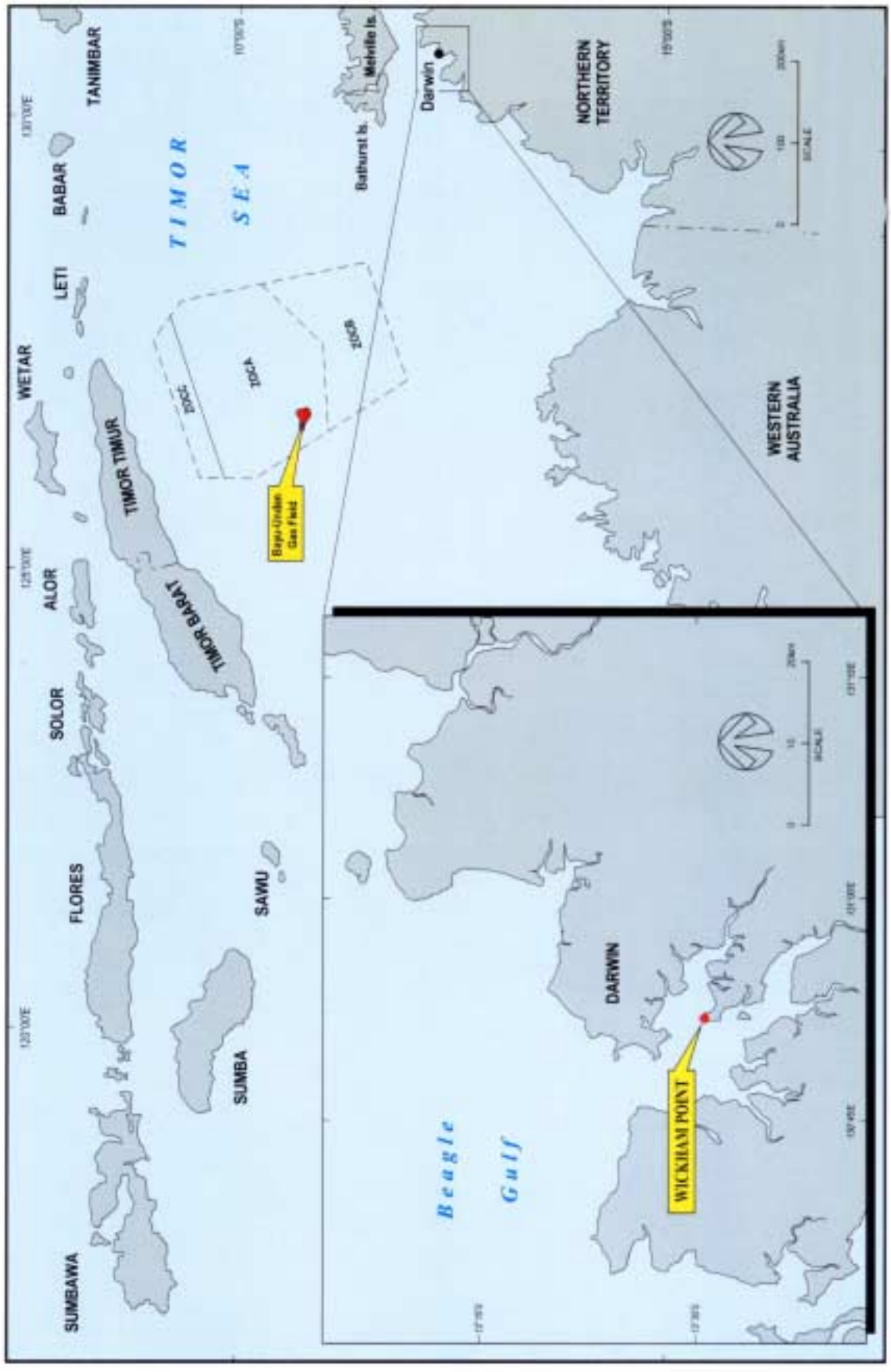
The proponent shall ensure that decommissioning is carried out according to the best environmental standards available at the time.

Recommendation 21

The proponent shall consult with the DLPE in the preparation, implementation and review of all monitoring programs. The DLPE shall also be consulted regarding any mechanisms and actions developed as a response to monitoring results.

FIGURES

Mon 11 Mar 02



Job No.	00533-244-562
Report No.	R841
Date	Dec 01

Phillips Petroleum Company Australia Pty Ltd
10MTPA LNG PLANT AT WICKHAM POINT - PER

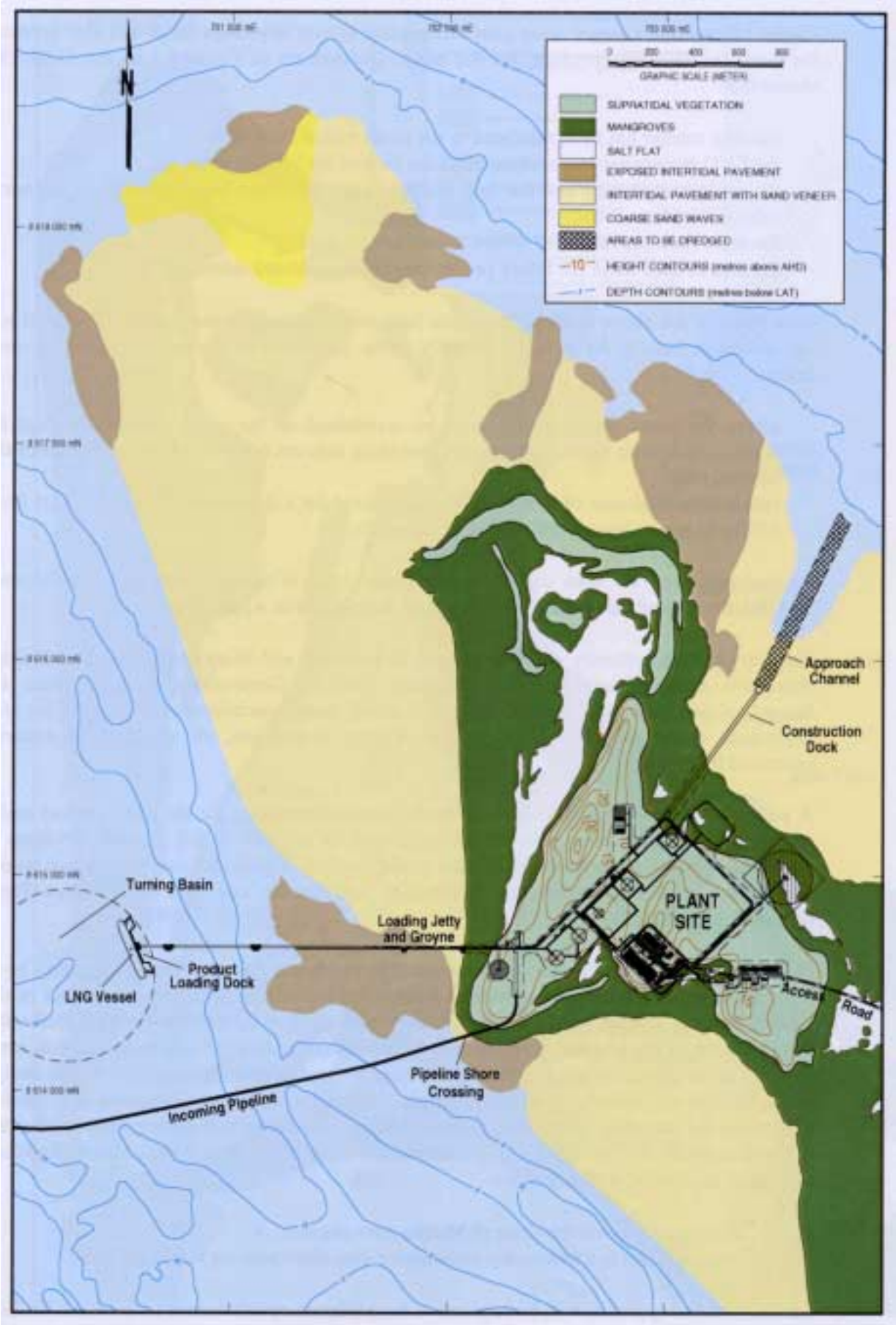
LOCATION PLAN

Figure 1.1

URS

URS AUSTRALIA PTY LTD Perth Office +61 8 9221 1630

Mon 11 Mar 02



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Report No.	R841
Date	Dec 01

Phillips Petroleum Company Australia Pty Ltd
10MTPA LNG PLANT AT WICKHAM POINT - PER

MAJOR COMPONENTS OF APPROVED 3 MTPA LNG PROJECT

Figure 1.2

URS

URS AUSTRALIA PTY LTD Perth Office +61 8 9221 1630

00533244r011f1-2.dgn

Mon 11 Mar

701 750 mE | 702 000 mE | 702 250 mE | 702 500 mE | 702 750 mE | 703 000 mE | 703 250 mE | 703 500 mE | 703 750 mE | 704 000 mE | 704 250 mE | 704 500 mE

8 616 250 mN
8 616 000 mN
8 615 750 mN
8 615 500 mN
8 615 250 mN
8 615 000 mN
8 614 750 mN
8 614 500 mN
8 614 250 mN
8 614 000 mN

PREVAILING WIND

MEAN SEALEVEL

MEAN SEALEVEL

HOLD
N.8616030
E.703552

EDGE OF WATER
N.8615638
E.703291

EDGE OF WATER
N.8614850
E.702232

PIPELINE END
N:8614643.874
E.702482.505

Disturbed Area Boundary

LEGEND

ITEM No.	DESCRIPTION	QTY
1	GUARD HOUSE	
2	ADMINISTRATION	
3	MAINTENANCE SHOP AND LAB.	
4	CONTROL ROOM	
5	WAREHOUSE	
6	PAWA SUBSTATION	
7	SWITCHGEAR YARD	
8	FIRE WATER STORAGE	
9	TRAIN 1 PROCESS AREA	
10	TRAIN 2 PROCESS AREA - FUTURE	
11	LNG STORAGE - TRAIN 1 - 100,000 M3	
12	LNG STORAGE - TRAIN 2 - 160,000 M3 - FUTURE	
13	GROUND FLARE	
14	GROUND FLARE - ALTERNATE LOCATION	
15	REFRIGERANT STORAGE	
16	CONSTRUCTION DOCK	
17	JETTY	
18	MARINE FLARE	
19	PIPELINE FROM BAYU-UNDAN	
20	RECEIVER	
21	RECEIVER - ALTERNATE LOCATION	
22	CONSTRUCTION / LAYDOWN AREA	
23	DISTURBED AREA BOUNDARY	
24	TEMPORARY TELECOMMUNICATIONS SHELTER	
25	FLARE KNOCK-OUT DRUMS	
26	FREEHOLD BOUNDARY	
27	PIPELINE PULL ZONE	
28	PLANT MONUMENT 1	
29	FUTURE SULPHUR RECEIVER	
30	MARINE FLARE - ALTERNATE LOCATION	
31	CONDENSATE TANK / TRUCK LOADING	
32	FIRE STATION & MEDICAL	
33	SULPHUR STORAGE	

Job No.	00533-244-562
Report No.	R841
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Phillips Petroleum Company Australia Pty Ltd
10MTPA LNG PLANT AT WICKHAM POINT - PER

PROPOSED 10MTPA LNG FACILITY LAYOUT

Figure 1.3

URS

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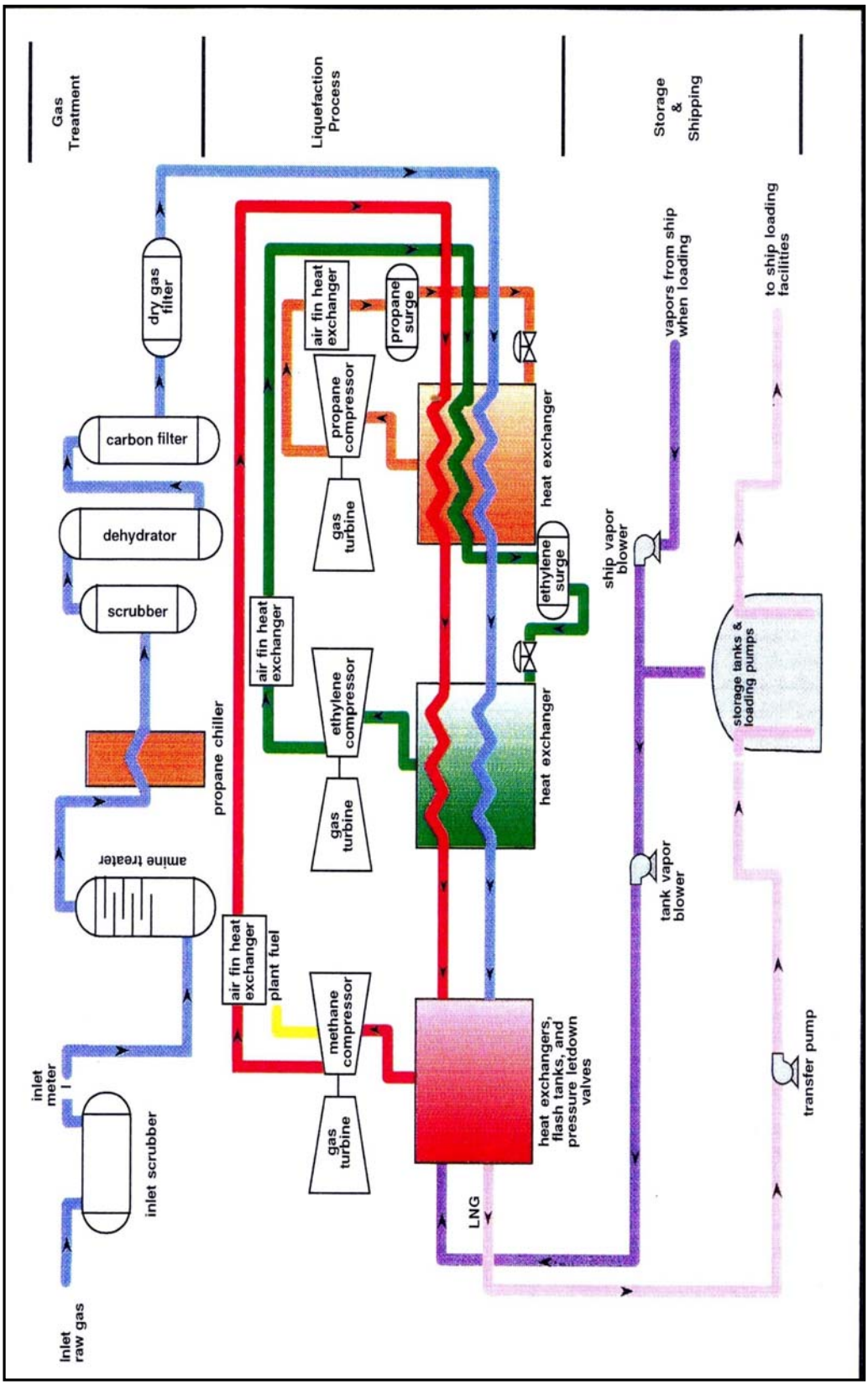

FIGURE 1.4
PHILLIPS OPTIMISED CASCADE LNG PROCESS

Adapted from URS Report 00533-244 'Phillips 10 MTPA LNG Plant – Public Environment Report'

1 INTRODUCTION AND BACKGROUND

This Report assesses the environmental impact of a proposal by Phillips Petroleum Company Australia P/L to construct a Liquefied Natural Gas (LNG) plant with a maximal output of 10 million tonnes per annum (MTPA) at Wickham Point in Darwin Harbour. Figure 1.1 indicates the location of the initial natural gas source, the Bayu-Undan field, in the Timor Sea. Figures 1.2 and 1.3 indicate the location of the LNG plant on Wickham Point and the layout of major components at the facility. Figure 1.4 illustrates the Phillips' Optimised Cascade LNG process.

This Environmental Assessment Report is based on a review of the Public Environmental Report (PER); comments from the public and Northern Territory Government agencies on the PER; and responses by Phillips to these comments.

A list of respondents to the PER and issues raised in their submissions are provided in Appendix 1 and 2, respectively. More detailed comments are listed Appendix 3.

1.1 Environmental Impact Assessment Process

One of the major objectives of environmental impact assessment is to fully define those elements of the environment that may be affected by a proposed development and to determine the significance, risks and consequences of the potential impacts of the proposal. The potential impacts are considered at both local and regional levels.

This report evaluates the adequacy of undertakings and environmental safeguards proposed by Phillips to avoid or mitigate the 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 buildings and other infrastructure on site;
- Management of construction activities; and
- Management of processes used in operations at the facility (e.g. inputs and outputs).

A list of undertakings made by the proponent in the PER and in their "Response to Submissions" from the public and NT Government is provided in Appendix 4. Additional safeguards are recommended in this Assessment Report where appropriate.

The contents of this Assessment Report form the basis of advice to the NT Minister for the Environment on the environmental issues associated with the project.

1.2 Environmental Impact Assessment History

In 1997, Phillips Oil Company Australia submitted to the NT Government a proposal to construct a Liquefied Natural Gas (LNG) facility at Wickham Point (on the Wickham Point Peninsula, between East Arm and Middle Arm) in Darwin Harbour. The proposed facility comprised a single train plant to produce LNG at a maximal rate of 3 million tonnes per annum (MTPA) from gas transported from the Bayu-Undan field (in the Timor Sea) to Wickham Point via a sub-sea pipeline. (A "train" is a production pathway and related infrastructure, having its own process area at the facility.)

The proposed project included

- a sub-sea pipeline;
- a land-based facility for liquefaction of natural gas and storage of LNG;

- marine loading facilities; and
- a dedicated fleet of ships to transport LNG product.

The proposal went through a detailed Environmental Impact Assessment process, at the level of an Environmental Impact Statement (EIS) and received approval from Commonwealth and Northern Territory Environment Ministers in early 1998. The NT Government analysis of the project, comments and Supplement formed the basis of the Territory's Environmental Assessment Report 24.

In May 2001, Phillips submitted a Notice of Intent (NOI) to the NT Department of Lands, Planning and Environment (now Department of Infrastructure, Planning and Environment) for a proposed LNG facility of up to 10 MTPA at the same site. The expansion would allow Phillips to access and process gas from other fields in addition to their Bayu-Undan field, e.g. the Greater Sunrise field which has a "proven plus probable" 9.2 trillion cubic feet of gas (approximately 2.7x larger than the Bayu-Undan field).

Phillips has indicated that the 10 MTPA proposal comprises the optimal-sized facility at Wickham Point and any material expansion in the future, other than de-bottlenecking, would be unlikely. ("De-bottlenecking" involves the incorporation of additional or more efficient components or activities to increase output, e.g. by using more powerful pumps or adding additional storage tanks or pipelines.)

In June 2001, the Minister for Lands, Planning and Environment determined that the new proposal would be assessed at the level of a Public Environmental Report. Draft guidelines covering issues to be addressed in the PER were subject to public review from 21 July – 3 August 2001.

Subsequent to the public review of the draft Guidelines, Phillips referred the proposed expansion to the Commonwealth for a determination under the *Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999.* On September 20, 2002, the Commonwealth determined that it would review the project under the *Environmental Protection (Impact of Proposals) Act 1974* and not the *EPBC Act*, as the original assessment was done under the former Act. Once the Commonwealth made its determination, the NT Minister for the Environment issued final guidelines (31 October).

In March 2002, Phillips submitted its PER for the 10 MTPA plant (comprising two trains, each with a maximal output of 5 MTPA).

The PER was placed on public review for 5 weeks, from 18 March to 19 April 2002. It was also circulated to NT Government advisory bodies for review and comment. Eight public submissions were received within the review period. Comments from NT Government agencies were consolidated into one submission and forwarded, with the public submissions, to the proponent and Environment Australia at the close of the public review period.

The proponent prepared a "Response to Submissions," addressing the issues raised by the public and NT Government. This Response was received by the Office of Environment and Heritage on 8 May 2002 and taken into account in the preparation of this Assessment Report. A copy was also forwarded to Environment Australia, which will prepare its own report under the *Environment Protection (Impact of Proposals) Act 1974.*

2 THE PROPOSAL

Detailed descriptions of the major components of the proposal are presented in the PER. The following is a short summary.

2.1 Objectives of the Expanded Proposal

The objective of the entire proposal is to transport natural gas from the Timor Sea, via a sub-sea pipeline, to Wickham Point for processing into liquefied natural gas (LNG). The original proposal for a 3 million tonnes per annum (3 MTPA) was based on using a single processing "train" to process gas just from the Bayu-Undan field, and this proposal was approved by both the Commonwealth and NT Governments.

Phillips, however, wishes to expand the scope of the original proposal to a 10 MTPA plant (with two 5 MTPA trains) that can capture and process gas from additional offshore fields, e.g. the Greater Sunrise field in the Timor Sea.

2.2 Alternatives to the Proposal

As the 3 MTPA proposal for Wickham Point had previously been approved, the proponent did not re-consider alternative sites.

Regarding alternatives for expansion at Wickham Point, however, the proponent had previously developed a scenario to allow for future expansion to a 9 MTPA plant (Supplement to the Draft EIS, Dames and Moore 1998a), involving three 3 MTPA trains.

The PER for a 10 MTPA plant indicates that SO_2 emissions for a facility of this size would substantially exceed that predicted for the 9 MTPA plant, because of higher sulphur content in feed gas from other offshore reserves and because, in the earlier proposal, volumes of SO_2 vented to the atmosphere were not fully taken into account.

Most other emissions (including greenhouse gases) and volumes of solid waste would, however, be less for the 10 MTPA plant than projected for the 9 MTPA plant. These decreases relate to the use of only two trains (each with a maximal output of 5 MTPA) instead of three trains (each 3 MTPA at full capacity) and integration of new technologies (e.g. waste heat and vapour recovery systems, and more efficient turbines).

In addition to the desirable environmental outcomes above, "economies of scale" issues would result in significant financial savings to the proponent were they to construct a two-train rather than a three-train facility.

Further, the proponent has developed a standard technology for construction of (modular) 5 MTPA facilities that use its "Optimised Cascade LNG Process."

For all of these reasons, the proponent considers that the 10 MTPA proposal represents the optimal-sized LNG facility for the Wickham Point site and it is unlikely that the proponent would consider any material expansion of such a facility in the future, other than for "de-bottlenecking improvements."

2.3 Major Components of the Proposal

Figure 1.3 shows the layout of major components of the proposed 10 MTPA facility.

2.3.1 Metering Station

An inlet metering station (south of the main plant area) will receive natural gas from the offshore pipeline, measure various aspects of the gas (for use in pipeline monitoring and gas sales accounting) and condition the gas for delivery to the LNG plant or to domestic markets.

2.3.2 LNG Plant

The proposed facility will include a two-train LNG plant of up to 10 MTPA capacity with the following major components:

- Gas processing facilities to remove impurities and refrigerate the natural gas;
- Product storage tanks; and
- Plant infrastructure and utilities.

Initial site preparation is expected to start in late 2002. Construction of the first process train (up to 5 MTPA) is expected to commence in early 2003 and be completed by early 2006. Construction of the second LNG process train, if additional gas supply arrangements can be secured, is expected to commence in late 2003 and be completed in late 2006.

The operational life of the project is expected to be 20-25 years (with extension subject to discovery and capture of additional reserves of natural gas).

Production of LNG will involve

- removal of components within the gas stream that are detrimental to the natural gas liquefaction process (e.g. carbon dioxide, hydrogen sulfide, mercury and water);
- refrigeration to liquefy the gas; and
- storage prior to loading into tankers for export.

Approximately 88.6 ha of land at Wickham Point will be cleared to accommodate the plant facilities. (Figure 2 shows the layout of major components).

2.3.3 LNG Ship-loading Facilities

A loading jetty will be constructed on the west side of Wickham Point (in Middle Arm of Darwin Harbour) to transfer LNG (and some condensate) to vessels for export. The jetty will comprise a 925 m rock groyne abutting the shoreline, with an adjoining open-piled trestle structure, approximately 500 m long, leading to a pile-supported loading dock (36 m x 16 m). Up to 100,000 m^3 of sea-bed sediment may have to be dredged at the head of the jetty, to provide at least a 600 m diameter turning basin for vessels and a 400 m x 70 m "berthing pocket."

2.3.4 Construction Dock

A construction dock will be built on the north-east side of Wickham Point to receive heavy equipment, pre-fabricated process modules and possibly plant personnel. The dock will include a 20 m-wide rock groyne extending approximately 470 m into East Arm and a rock-fill dock (approximately 50 m x 30 m). A 200 m x 40 m berthing pocket and a 1-km long approach channel (70 m wide and dredged to - 6 m AHD) will be provided.

2.3.5 LNG Tankers

LNG will be exported from Wickham Point via purpose-built tankers, all of double-hull design. They are expected to have a draught of 11.5 m and be between 250 and 290 m in length, with a capacity of up to 145,000 m^3 of LNG. If running at the full 10 MTPA capacity, vessels will arrive every 2-3 days for loading and export. Turnaround time for vessels will be approximately 24 hrs, with product-loading expected to take approximately 14 hrs.

2.4 Key Differences between the 3 MTPA and 10 MTPA Proposals

The major impacts of the proposed 10 MTPA facility compared to the approved 3 MTPA facility will result from the increased capacity of the plant and will be as follows:

- Increased area of ground disturbance, from 66.8 ha to 88.3 ha;
- Increased demand for power generation, from 18.2 MW to 48.4 MW;
- Increased operating work-force, from 75 to 120 personnel;
- Increased demand for process water, from 6 to 12 m^3/hr;
- Increased volumes of waste-water requiring treatment/disposal, from 4.5 to 11 m^3/hr;
- Increased volume of storage tank hydro-test water discharged prior to plant start-up;
- Increased volume of solid and semi-liquid waste generated and requiring disposal (from 143,050 to 242,600 kg/yr);
- Increased risk to the public and the environment from greater volumes of LNG storage tanks (from 190,000 m^3 to 360,000 $m^{3)}$;
- Increased risk to the public and the environment from increased shipping movements, from 78 visits to approximately 160 visits per year, and the navigation risk associated with using larger vessels; and
- Increased atmospheric and greenhouse gas emissions (especially CO_2, which, at full plant capacity, will be generated at a rate of 4.5 MTPA compared to 1.7 MTPA).

The PER describes two other key modifications for the 10 MTPA plant:

- The new facility will not produce commercial quantities of propane or butane (LPG) for export, as proposed in the 3 MTPA EIS, as the feed stock gas will be processed offshore to remove LPGs. The LPG storage tanks (at Wickham Point) in the earlier proposal have therefore been eliminated from the current design. The only other saleable product will be much smaller volumes of stabilised condensate than those associated with the 3 MTPA proposal, as most of the condensate will also be removed offshore from the natural gas extracted from the field.
- Instead of the elevated main flare included in the 3 MTPA design, a large ground flare will be used for the 10 MTPA plant, and the flare has been relocated to the south of the plant site. This change was made to accommodate a proposed future road transport corridor from Darwin to Palmerston and an air-traffic corridor for aircraft approaching Darwin Airport.

3 REGIONAL SETTING: DARWIN AND DARWIN HARBOUR

The information in this section is largely a summary of that presented in the Environmental Assessment Report (No. 24) for the proponent's original EIS; however, the proponent updated the environmental descriptions on the basis of review of recent literature and consultations with specialists.

As per the Guidelines issued to the proponent, the focus is on the main features of the environment that could be affected by the expanded project, particularly in relation to the Darwin air-shed and catchment of Darwin Harbour. The offshore region (which is relevant to the pipeline to the Bayu-Undan gas field in the Timor Sea) is not considered here, as this component of the proposal is unchanged and was approved as an outcome of the earlier assessment of the 3 MTPA project.

3.1 Physical

Darwin Harbour, with an area of about 500 km^2, is a large ria system, or drowned river valley, formed by postglacial marine flooding of a dissected plateau. In its southern and south-eastern portions, the harbour has three main components: East, West and Middle Arms which merge at their mouths to form the central portion of the Harbour, along with the smaller Woods Inlet, before joining the open sea. Freshwater inflow to the Harbour occurs primarily from January to April, when estuarine conditions prevail in all areas (Hanley 1988).

Over the 6-8,000 years since Darwin Harbour was formed by rising sea levels, erosion from the adjoining terrestrial environment has carried substantial quantities of sediment into the harbour. This sediment now forms much of the intertidal flats that cover the pre-flooding bedrock. The sea-bed of Darwin Harbour is dominated by gravel. The centre of the Harbour comprises a scour zone where the hard pavement substrate is covered by only a thin layer of sediment, grading into terrigenous sand offshore from the tip of Wickham Point. The intertidal area off the point itself comprises large sand and mud flats.

Phillips proposes to locate the LNG plant on Wickham Point, toward the sea-ward end of Wickham Point Peninsula between East Arm and Middle Arm. Both arms are the estuaries of rivers which during the wet season drain much of the hinterland behind Darwin and Palmerston. The Elizabeth River flows into East Arm; the Darwin and Blackmore Rivers flow into Haycock Reach which then flows into Middle Arm.

Most of the Harbour is less than 10 m in depth; however, a channel with depths exceeding 20 m extends in a south-easterly direction from the mouth of the Harbour toward the confluence of Middle and East Arms. The channel continues into East Arm at water depths greater than 15 m. A slightly deeper channel extends into Middle Arm. The tidal range in Darwin Harbour reaches 8 m.

Wickham Point is on the north-west tip of Wickham Point Peninsula. This peninsula is characterised by two small 'islands' of terrestrial vegetation surrounded by intertidal mangrove forests that are partially or completely inundated by water at high tide. For the purposes of this report, Wickham Point refers to the western-most island. This is the proposed site for the LNG plant.

3.2 Areas with Significant Conservation Values and/or Management Issues

3.2.1 Biological

Marine/Estuarine (subtidal and intertidal habitats)

Darwin Harbour has a diverse assemblage of species typical of the Indo-west Pacific Biogeographical province. Protected species in the Harbour include turtles, sea-snakes, dugongs and dolphins, which are all listed under the Commonwealth *Environment Protection and Biological Conservation Act 1999*.

Coral communities occur where the substrate is rocky in the lower intertidal and shallow subtidal zones. 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 *Northern Territory Heritage Conservation Act 1991*. This declaration was based on the presence of an unusually diverse coral community.

Wickham Point is surrounded by an extensive mangrove community, typical of the majority of the shoreline of Darwin Harbour. Other intertidal communities include rocky shores and pavements, sand beaches and sand and mud flats. The Darwin Harbour wetlands (mangroves) are listed as an "Indicative Place" nominated for inclusion on the Register of the National Estate.

Other areas of conservation significance include the Charles Darwin National Park, Casuarina Coastal Reserve, Blackmore River Conservation Reserve, East Point Aquatic Life Reserve and Doctors Gully Aquatic Life Reserve.

Terrestrial

The terrestrial flora of the Wickham Point islands is dominated by dry rainforest (also known as "monsoon vine thicket") with limited areas of paperbark-dominated woodlands. No rare or endangered floral species has been recorded at Wickham Point; however, the dry rainforest is of regional conservation interest.

The fauna, particularly birds, is diverse, with a number of migratory species known in the area; however, none of these species is regarded as threatened in the Darwin region. Substantial populations of medium and large sized mammals such as Northern Brown Bandicoot, Northern Brushtail Possum and Agile Wallaby on Wickham Point occur in the area. None of these species is rare or endangered. The area has not been recently burned, and introduced weeds and feral animals are uncommon. The undisturbed nature of the "islands" makes them of conservation interest.

3.2.2 Cultural

Nine archaeological sites were identified on Wickham Point during the original environmental assessment, most located either within or immediately adjacent to the proposed plant area: six are prehistoric shell middens; two are historic sites dating from World War II; and one is the remains of the "Mud Island" leprosarium. A further five shell middens, and a WWII heritage site, were recently discovered and are currently subject to complete heritage surveys in consultation with the Office of Environment and Heritage.

No Aboriginal burial grounds are known on Wickham Point, but it is likely that burials did occur near the leprosarium site and possibly in shell middens in the area. The leprosarium is located north of the LNG plant site.

3.2.3 Socio-economic

Darwin is the major city along Australia's northern coastline and the capital of the Northern Territory. The total population of the Darwin region (including Darwin, Palmerston and Litchfield Shire) is about 107,000. As a major city, Darwin has a wide variety of infrastructure, including port facilities at Frances Bay and in East Arm, an airport, national highways to other cities, and other facilities needed for the LNG plant and its personnel. The nearest community to Wickham Point by highway is Palmerston (population about 25,000), approximately 25 km by road to the east.

Wickham Point is considered a significant place by the Larrakia and other Aboriginal people living around Darwin Harbour. In 1999 an agreement was reached with various Native Title parties and the Northern Land Council to resolve native title and Aboriginal land rights claims previously lodged for the area.

Darwin Harbour is widely used for a variety of activities, including recreational fishing, scuba diving, boating and aquaculture. Some of these activities occur within 5 km of the proposed LNG site.

The proposed Wickham Point site lies along the flight path to the runway at Darwin's regional airport used by smaller private and commercial airplanes. Submarine telecommunication and power cables cross the Harbour from Darwin to Mandorah; therefore, anchoring is prohibited in these areas.

4 ENVIRONMENTAL IMPACT ASSESSMENT

4.1 Introduction

The main purpose of this Environmental Assessment Report is to determine if the proposed project can proceed without unacceptable environmental impacts. It does this by identifying all relevant potential environmental impacts and evaluating the feasibility and likely effectiveness of environmental safeguards put forth by the proponent. Where the proposed safeguards were considered incomplete or inadequate, or for safeguards that are particularly crucial, this Assessment Report makes recommendations to complete or emphasise the safeguards and commitments made by the proponent.

The environmental acceptability of the project is based on consideration of the following, from the PER:

- adequacy of information outlining the proposal (particularly which structures 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
- adequacy of the proposed safeguards to avoid or mitigate potential impacts.

Conclusions are then based on comments from review of the PER by relevant government agencies and the public, and responses from the proponent to these comments.

The outcome of the environmental impact assessment for this proposal is that the NT Government believes that the project can be implemented without unacceptable environmental impacts. This outcome is dependent on the proponent implementing the environmental safeguards identified in its PER in addition to recommended measures for environmental management presented in this Environmental Assessment Report.

Because minor and non-substantial changes may be made to the design and specifications presented in the PER, some degree of flexibility is desirable and will be necessary for adapting the environmental safeguards defined in the PER and this Assessment Report. Where it can be shown that such changes are not likely to have a significant impact on the environment, an adequate level of environmental protection may still be achieved by the following recommendations, modifications to these recommendations or by conditions attached to relevant statutory approvals for these modifications.

4.2 Integration of recommendations from assessments for the EIS and PER

The remainder of this section (Section 4) provides the major outcomes of the environmental impact assessment for the proposed expansion of Phillips' original 3 MTPA plant to a 10 MTPA facility. Because this proposal does not involve changes to either the proposed sub-sea pipeline or the access road, these elements will not be discussed here. The recommendations in the previous Assessment Report (No. 24) that relate to these components are, however, to be considered current and are to be implemented as written.

As presented in Section 2.4 of this Assessment Report, the expansion will have an increased level of potential or anticipated impact for a range of environmental effects identified during the earlier assessment of the 3 MTPA plant.

Some of the recommendations from the previous Assessment Report (No. 24, 1998) are still adequate and appropriate for the expanded proposal; however, some need modification to cover a change in environmental risk. Further, the current assessment has also resulted in several additional recommendations.

To include all relevant outcomes from the environmental assessment of the EIS in addition to those from the PER, and to present them in a logical sequence, easily cross-referenced to the previous Assessment Report, the following approach has been taken for the remainder of Section 4:

- Description of environmental impacts and proposed safeguards/mitigation will follow fairly closely the order in which they were introduced in the PER;
- Additional potential impacts identified from the review of the PER by the public and NT Government agencies and from the previous Assessment Report will be added to the most closely-related issue in the PER; and
- Recommendation number will follow this order but be cross-referenced to the previous recommendation number in Assessment Report 24.

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

Subject to decisions that permit the project to proceed, the primary recommendation of this assessment is

Recommendation 1

The proponent shall ensure that the proposal is implemented in accordance with the environmental commitments and safeguards

- **identified in the Darwin 10 MTPA LNG Facility Public Environmental Report (PER) and as modified in the proponent's Response to Submissions from the public and NT Government agencies that reviewed the PER; and**
- **as recommended in this Assessment Report (No. 39) which includes relevant recommendations from the previous Assessment Report (No. 24).**

[~ Recommendation 1 in Assessment Report 24]

4.3 Issues Raised in Submissions

A list of respondents to the PER and issues raised in their submissions are presented in Appendices 1 – 3.

The major environmental issues identified in review of the proposed construction and operation of the 10 MTPA LNG plant at Wickham Point are as follows and are in a similar order to those presented in the PER:

1. Atmospheric emissions
2. Greenhouse emissions
3. Heat emissions (flaring)
4. Waste-water discharges
5. Solid and semi-liquid waste disposal
6. Dredging and disposal of spoil
7. Risks from shipping

8. Hazard and risk assessment (public and environmental)
9. Ecological impacts
10. Noise
11. Work health issues (including biting insects)
12. Impacts on visual amenity
13. Socio-economic impacts
14. Cultural impacts
15. Other potential impacts (including erosion)
16. Sustainability.

The remainder of this section (Section 4) identifies the issues raised in submissions on the PER and presents commitments made by the proponent (in the PER or in its Response to Submissions) to avoid or mitigate potential or anticipated environmental impacts. Recommendations to strengthen the proponent's commitments or to provide safeguards that may not have been provided by the proponent are also presented.

4.3.1 Issues Outside the Scope of this Environmental Impact Assessment

Plant location

Several submissions raised the issue of location of the plant within Darwin Harbour. This issue is, however, outside the scope of the PER, as approval has already been given to the proponent to develop a 3 MTPA facility at this site. The current proposal is an extension of that original proposal.

Planning, zoning and Native Title

Other submissions raised issues relating to strategic planning and zoning which are also outside the scope of the current review; however, the NT Government is addressing these on a number of fronts. For example, completion of the Litchfield Planning Concepts and Land Use Objectives (DLPE 2001a) will identify the land at Wickham Point for industrial purposes taking account of the need to protect environmental values particularly of the mangroves and the Harbour. Amendments to the Litchfield Area Plan, as a consequence of the Planning Concepts and Land Use Objectives, will identify specific zones to accommodate industrial development.

The proponent will lodge an appropriate Development Application for this site to meet requirements of the expanded 10 MTPA facility.

The northern tip of Wickham Point (within Section 1861) is not affected by the proposed LNG plant; however, because of its significant heritage value (including WWII and leprosarium ruins), one submission indicated that the area should be managed for conservation purposes as a buffer to the proposed development.

The proponent has indicated its availability to liaise with DIPE further on this issue, however, it has no authority to control access to this location.

The PER details the specific area within Section 1861 wherein plant construction and operational activities will be conducted. As not all land within this Section will be disturbed, the proponent suggests that the remaining lands will comprise a *de-facto* conservation area.

In addition to completing plans for Litchfield, the Government is developing a *Darwin Harbour Strategic Plan for Beneficial Uses*. This will contain strategies to plan for and manage competing activities and interests in the Darwin Harbour catchment, with the aim of maintaining the Harbour's declared Beneficial Uses: protection of aquatic ecosystems, recreational water quality and aesthetics.

The expanded development is within the boundaries of the draft lease developed in 1999 and has Native Title clearance; therefore, there is no impediment to proceeding with a revised offer and lease, taking into account the proposed expansion.

Future Expansion (beyond 10 MTPA facility)

As noted in Sections 1 and 2 of this Assessment Report, the proponent is unlikely to pursue any material expansion of the 10 MTPA facility (other than for "de-bottlenecking) in the future, because the proponent considers a 10 MTPA plant to represent the optimal-sized facility for Wickham Point. The proponent, however, acknowledges throughout the PER that any proposed expansion will be subject to further assessment under the NT *Environmental Assessment Act.*

Recommendation 2

If expansion of the 10 MTPA plant is proposed, the revised project design shall be submitted to the NT Government for further assessment under the NT *Environmental Assessment Act 1982.*

[~ Recommendation 3 in Assessment Report 24]

4.4 Further Impact Assessment Studies Relating to Proposed Expansion

Since the previous environmental assessment, the following studies have been done to update baseline information for the existing environment and to assess the significance of potential impacts associated with the expanded project:

- Updated atmospheric dispersion modelling (incorporating predicted increases in emissions and cumulative impacts with emissions from Channel Island Power Station);
- Greenhouse gas emissions assessment (addressing increased production and options for mitigation);
- Assessment of heat envelope from flares on air traffic (incorporating change to a main ground flare instead of elevated flares);
- Wastewater discharge analysis (addressing increased volumes and feasibility of on-site irrigation with treated effluent);
- Analysis of solid and semi-liquid waste management (including capacity of existing infrastructure and services to handle increased production of wastes);
- Updated noise modelling (taking into account increased construction period);
- Revised comparative visual impact assessment (addressing increased size of storage tanks but decrease in impact from ground vs. elevated main flare);
- Revised hazard analysis and public risk assessment (incorporating two process trains vs. one; greater LNG storage capacity; and more frequent shipping movements);
- Assessment of dredging and spoil disposal options and impacts (accounting for anticipated decreased requirement for dredging for off-loading jetty);
- Updated ecological impact assessment (addressing increased amount of dry rainforest to be removed);
- Socio-economic and cultural impact assessment (incorporating new archaeological finds) ; and
- Assessment of the sustainability of the project (incorporating environmental, social and economic aspects).

4.5 Atmospheric Emissions

4.5.1 Existing Environment and Potential Impact on Air Quality

The PER acknowledges that Channel Island Power Station is currently the main source of emissions to air in the vicinity of the proposed LNG plant; however, emission levels are generally low and have no detrimental effect on regional air quality.

The PER presents results from a revised air modelling study (Appendix C), including potential cumulative effects of emissions from the proposed 10 MTPA LNG plant and those from the Channel Island Power Station. These showed that predicted worst-case concentrations of all pollutants would meet accepted National Environment Protection Measures (NEPM) standards, with no adverse impacts on the residents of Darwin; however, these predictions need to be verified, especially for oxides of nitrogen (NO_x) the pollutant most likely to approach ambient limits.

Recommendation 3

The proponent shall quantify the major emission sources during commissioning of the project, by periodic emission testing programs. Dependent on the results of this verification process, the proponent will establish a monitoring system for oxides of nitrogen (NO_x) from key emission sources at the facility and shall verify that standards contained in the National Environment Protection Measure (NEPM) for Ambient Air Quality are not exceeded.

Procedures for monitoring and reporting shall be developed in consultation with the Office of Environment and Heritage and shall meet relevant NEPM requirements and Australian Standards.

[~ Recommendation 13 in Assessment Report 24]

4.5.2 Adequacy of Modelling

The proponent used a regulatory air dispersion model to predict the behaviour and impact of emissions from the facility.

Several submissions on the PER questioned the validity of results from simulations, because the model did not integrate data on humidity and precipitation. The proponent has responded by explaining that these data cannot be directly input into the model and that the regional meteorological conditions needed for simulations are better described by wind speed and direction, atmospheric stability, mixing depth, temperature profiles and topographical influences of the surrounding terrain.

The proponent explains further that by not taking into account the scavenging effects of wet deposition, it has provided a more conservative (i.e. slightly greater) estimate of ground-level concentrations of pollutants over the regional air-shed. As the predicted acid-forming compounds (in particular, SO_2) will be well below those concentrations that are likely to lead to acid rain, inclusion of scavenging effects for wet deposition is not warranted.

4.5.3 Sulphur Dioxide (SO_2)

The original 3 MTPA proposal indicated that hydrogen sulphide (H_2S) from the amine treatment unit would be vented to the atmosphere or partially combusted. In the current proposal, an acid gas incinerator has been provided to combust all H_2S removed; therefore SO_2 emissions are greater than in the original proposal.

The ultimate concentration of H_2S in the gas stream coming to the Wickham Point plant will remain uncertain prior to the commencement of Bayu-Undan production activities and could change over the

life of the Bayu-Undan field or as gas from additional fields are added to the influent gas stream to the LNG Plant. The concern is that the H_2S concentration (3-15 ppm) could be high enough to preclude its venting both for safety reasons or to continually meet ground level concentration standards of 0.2-2.0 $\mu g/m^3$ (30 min average) defined by WHO (1999) Guidelines for odour threshold and NHMRC (1986) discharge limit of 5 mg/m^3. In consideration of the regulatory and health considerations, the proponent included the acid gas incinerator and calculated emissions based on the maximum design premise concentration for H_2S.

The air dispersion modelling for the PER showed that maximum ground level concentrations of SO_2 are predicted to be approximately 0.0004 parts per million (or 0.4 ppb) on an annual averaging period, which represents only 2% of the current acceptable ambient standard in the National Environment Protection Measure (Air NEPM). On the basis of this modelling, there is little justification for continuous SO_2 monitoring.

One hundred thirty (130) tonnes per year is the lowest potential SO_2 emissions given the current estimated H_2S concentration in the feed gas. Information in the PER suggests that SO_2 emissions could potentially be as high as 706 tonnes per year if the facility produces LNG at the maximal rate, i.e. 10 MTPA (based on a concentration of H_2S of 15 ppm). The PER indicates that the H_2S concentration of the feed-gas has the potential to vary because of differing quality of gas from other fields.

The potential for the feed gas H_2S to increase up to 15 ppm was put forth to address higher emissions scenarios that may be seen as gas from different fields are introduced to the LNG plant. If H_2S increased from 3 to 15 ppm, then ground level concentration of SO_2 would be expected to increase by a similar factor. Even if the H_2S concentration is 15 ppm, the maximum ground level concentration will be 0.002 $\mu g/m^3$, which is less than 10% of the NEPM standard. On the basis of this modelling, the maximum ground level concentrations of SO_2 for the higher feed gas H_2S should still be acceptable.

4.5.4 Nitrogen Oxides (NO_x)

Ground-level concentrations of NO_X arising from the operation of the proposed LNG plant (in addition to the Channel Island Power Station) are not predicted to significantly impact regional air quality. Any proposals that may substantially increase NO_X emissions from the LNG plant (e.g. resulting from upgrading or expansion) will require further assessment.

The feed gas from Bayu-Undan has a nitrogen content of approximately 4%. The PER indicates that the majority of this nitrogen must be removed to meet LNG specifications, and it is added to the fuel system used by the gas turbines for the refrigerant compressors. Combustion of this "lean" (or high nitrogen-content fuel) reduces NO_x by approximately 30.1% compared to emissions for the same turbine using other fuel sources with a higher methane content.

4.5.5 Potential Generation of "Acid Rain" (from sulphur dioxide or nitrogen oxides)

Atmospheric deposition is the process whereby airborne particles and gases are deposited on the earth's surface and may arise from both natural and anthropogenic sources. Wet deposition is the fraction of atmospheric deposition contained in precipitation, while dry deposition (the remainder) is

the fraction deposited in dry weather through such processes as settling, impaction, and adsorption. Acidic wet deposition is called acid precipitation (or acid rain), from secondary pollutants that form from the oxidation of nitrogen oxides (NO_X) or sulphur dioxide (SO_2) gases that are released into the atmosphere. Impacts from acidic deposition are largely witnessed in areas such as North America and European countries where high concentrations of these pollutants are elevated by anthropogenic sources.

Of the pollutants that are of primary relevance to acidic deposition, emissions of SO_2 are responsible for 60-70 % of the acid deposition that occurs globally. As noted previously, dispersion modelling has demonstrated that maximum annual SO_2 concentrations from the LNG plant are predicted to be only 0.0004 ppb, which represents 2% of the NEPM standard or 1% of the World Bank Guidelines. Advice from the *Ambient Air Quality Final Impact Statement for the National Environment Protection Measure* indicates that compliance with the 0.02 ppm annual average should ensure that any effects of acid deposition remain minor.

In addition, the typically high pH (low acidity) conditions of Darwin Harbour, reported to range from 8.3 to 8.7 by DIPE (Padovan 1997), and the significant buffering capacity of estuarine waters, suggests there is little potential for acidic effects on waterways in the Darwin region to occur with minimal SO_2 released from the proposed plant.

4.5.6 Potential Impacts on Public Health

The standards of the Ambient Air Quality NEPM have been selected by all Australian jurisdictions to ensure the protection of human health and well-being, as a result of reviewing the latest epidemiological studies of known health end points from atmospheric pollutants. Long-term (chronic) health effects of NO_x (modelled to be only 4.3% of the annual ambient standard, from cumulative emissions from the power station and the proposed LNG plant) are therefore unlikely, as the proponent has indicated that the facility will comply with these standards.

(The proponent acknowledges a typographical error in the PER which reported higher NO_x annual concentrations than was actually modelled: the correct maximum predicted concentration of NO_x is 0.0013 ppm (4.3 % of the NEPM), instead of 0.013 ppm as reported in Table 4.3 of the PER.)

4.5.7 Particulates

Regarding levels of particulates, especially under dry season conditions, the proponent indicated that the 10 MTPA LNG facility will be a very minor contributor to ambient particle levels in the Darwin region. The proposal is anticipated to release 537 tonnes per annum (TPA) of particulates, with dispersion modelling showing that maximum concentrations of PM10 from the plant alone would be in the order of only 2.9 $\mu g/m^3$ (or < 6% of the NEPM standard). (PM10 is particulate matter, in air emissions, that is $\leq$ 10 microns in size.)

Modelling did not include contributions of PM10 from bushfires; however, the Darwin Air Emission Inventory (DLPE 2001b) indicates that annual emissions of PM10 are in the order of 6,200 tonnes, with 91% or 5,640 tonnes of the emission from bushfires occurring during the dry season.

In contrast, the proposed 10 MTPA LNG Plant is anticipated to release 537 TPA of particulates, not necessarily solely PM10. Half (or 268 tonnes) would be released over the period of the dry season. This represents < 5 % of the bushfire contribution over the dry season.

The proponent notes that the 2001 Air NEPM Monitoring Plan for the NT (DIPE, May 2001) demonstrates benchmark PM10 data collected at Berrimah between February and December 2000 typically ranging from 20-40 $\mu g/m^3$ (24 hour average) during the dry season, and exceeding the 50 $\mu g/m^3$ NEPM standard on a number of occasions due to bushfire smoke. It is therefore considered that the low 2.9 $\mu g/m^3$ concentration from the LNG facility would not influence the existing particulate levels attributable to fires in the region. The proponent recognises that the management of particulates from bushfire smoke or fuel reduction burning is the primary air quality issue in the Northern Territory, as stated in the Final Impact Statement for the Air NEPM (NEPC 1998).

4.5.8 Odours

The proponent indicated in its Response to Submissions that an LNG plant will generate unpleasant odours. The current plant design incorporates an acid gas incinerator, which will combust all hydrogen sulphide (H_2S) removed by the amine unit, which would have been a primary source of odours associated with the project. In addition, all domestic and sanitary wastes will be professionally handled and managed by a waste management contractor in accordance with *the Waste Management and Pollution Control Act* and general requirements of the DIPE, PAWA and Department of Health and Community Services (DHCS). As such, no significant off-site odour impacts are anticipated from operation of the Darwin LNG project. The proponent has indicated that it will ensure a high standard of housekeeping practices throughout the life of the project to minimise potential sources of odours as appropriate.

4.6 Greenhouse Gas Emissions

4.6.1 Greenhouse Gas Offsets

The PER predicts that the LNG facility will produce 18,000 tonnes/day of CO_2 ; however, in a global context, these emissions will be offset by reduced emissions of CO_2 from LNG customers: per unit energy produced, burning LNG produces less CO_2 than fossil fuels and no SO_2 or particulates, which are of health concerns.

The PER guidelines required the proponent to provide information on a range of offsets including off-site energy efficiency measures. The PER and Offsets study did not consider potential options other than vegetation sinks and geological sequestration (i.e. re-injection of CO_2 into the offshore gas reservoir before natural gas is piped to Darwin).

The proponent should note that future carbon prices are likely to be higher than current prices. Carbon is currently inexpensive as a result of uncertainty associated with future mandatory emission limits. With increased certainty, demand for emission 'offsets' is likely to rise more than supply. It should also be noted that deforestation abatement is not an option under the Kyoto Protocol; however, it has the potential to be a domestic trading option.

The Offset Study recommendation to use oil mallee carbon offsets in preference to pine and eucalypt plantations is sound; however, the relative attraction of these options may change in time, as uncertainties regarding Australia's ratification position and future carbon accounting modalities are resolved.

The proponent has indicated that, during the design and construction phases, it will continue to evaluate offset options as part of its ongoing management commitment and agrees these options need

to not just include vegetation-related offsets but also other options that result in a reduction of greenhouse gases.

In its Response to Submissions, the proponent indicated that, as part of its identification and evaluation of options, it will include consideration of reforestation projects in East Timor and offsets within the Northern Territory. For the latter, the proponent will work with the Greenhouse Unit of the Office of Environment and Heritage.

Recommendation 4

The proponent's Environmental Management Program shall include a section specifically addressing commitments and strategies aimed at reducing greenhouse gas emissions. This shall include (for example) provisions for regular greenhouse gas audits, a process for continuous review of new technologies to identify opportunities to reduce emissions, and benchmarking against other LNG facilities with a view to achieving international best practice in terms of CO_2 emissions per unit of production. Opportunities for offsetting greenhouse gas emissions, including support for relevant research, shall also be addressed.

In developing its greenhouse gas strategy, the proponent shall consult with the Greenhouse Unit of the NT Office of Environment and Heritage, and the strategy shall be provided to Environment Australia.

[~ Recommendation 14 in Assessment Report 24]

4.7 Flaring (Heat Emissions)

Several submissions indicated that the PER did not provide adequate background information on flaring. The following description provides a more complete summary of key issues.

Flaring occurs at the LNG plant either as a result of the need to safely dispose of gases that cannot be recovered within the plant process (as a fuel source) or as a means to safely route gas from the facility. The processes that generate gas that requires flaring include

- Plant upsets, which interrupt processing and generate gases;
- Commissioning and initial start-up processing; and
- During loading of LNG vessels, when LNG cannot be kept at low enough temperatures to maintain its liquid state.

The facility will have three types of flares:

- Wet gas flare (for gas streams that may contain moisture);
- Dry gas flare (for gas streams that are too cold to combine with moist streams); and
- Marine flare (to combust vapours displaced from ships' tanks during loading).

In the 10 MTPA proposal, the wet and dry gas flares will be combined as a "main process flare" on the ground (to minimise visual and heat impacts). The marine flare will be elevated (13 m).

One of the main environmental impacts from flaring methane is that it generates a significant amount of CO_2 although almost an order of magnitude less than that produced by the gas turbine generators (0.3 MTPA vs. 2.6 MTPA CO_2).

The other key issue is the potential impact of the main process flares on air traffic using Darwin Airport. Information received to date indicates no impact to the approaches is expected; however, the proponent is in ongoing discussions with the Civil Aviation Safety Authority (CASA) and its consultants in identifying and quantifying any potential impacts to airspace by the facility and in developing appropriate measures for mitigation.

Recommendation 5

This Assessment Report acknowledges the negotiations between the proponent, the Civil Aviation Safety Authority (CASA), Darwin Airport authorities and other relevant agencies to resolve outstanding concerns regarding potential impacts from flaring on aviation. If continuing studies indicate a potential significant risk to aviation, further analysis of hazards and risks to aircraft from flaring shall be required prior to the proponent's final decisions on the design and operation of flares.

[~ Recommendation 16 of Assessment Report 24]

The proponent has indicated that after the plant is commissioned and operational, typical flaring durations during a plant start-up are expected to be less then 4 hours. The frequency and duration of the flaring shown in the PER reflects the proponent's best estimate of how often these events will occur based on experience from the proponent's Kenai LNG facility and also the Atlantic LNG facility (Trinidad) which also uses the same LNG liquefaction technology.

The ground flare is expected to operate less than 108 hours/year. The marine is expected to operate approximately 200 hours per year per train or 400 hours per year for the full 10 MTPA facility.

4.8 Wastewater and Stormwater Management

4.8.1 Temporary Sanitation Facilities

The PER indicated that during the construction phase, portable toilets would be used to accommodate the workforce; however, this approach may not be sufficient for management of sanitary waste if the maximal predicted workforce of 1600 is realised.

In recognition of this potential inadequacy, the proponent, through its primary contractor, has undertaken to establish procedures and plans for handling waste products generated on the construction site. These procedures will be developed to manage waste products in accordance with the regulations of the DHCS. The proponent indicates that sanitary waste will be handled through a contract established with a removal and disposal company. The toilet facilities will comply with all requirements of local health authorities and will likely consist of localised multi-station toilet buildings. These will be dispersed where necessary throughout the construction site. The sanitary waste from these toilet buildings will likely be collected in holding tanks. The sanitary waste from the holding tanks will be frequently collected and taken off site for disposal. A possible scenario is that the removal and disposal Company will contract with the local sewage treatment works for disposal of the sanitary waste.

4.8.2 Hydrotest Water

To verify the integrity of pipelines and storage tanks, the proponent will conduct a "hydrotest" of these structures, i.e. fill storage tanks and transfer pipelines with water to test their strength. The proponent will use freshwater or seawater with a range of chemical additives if necessary (to protect these structures from any potential impact from the hydrotest water).

Use of freshwater

To minimise demand for freshwater, the proponent has considered the use of seawater to hydrotest the LNG storage tanks and believes that this may be a viable option. It is concerned about the impact of the higher corrosion rates that would result from the use of seawater, and the proponent's ability to ensure a timely and adequate cleaning of the interior of the tanks with freshwater after completion of the hydrotest. As a result of these concerns, the proponent currently prefers the use of freshwater for the hydrotest of the tanks/pipelines. The use of seawater for the hydrotest of the tanks/pipelines will, however, be considered further and will be pursued if the proponent concludes that it is a safe and viable option.

Potentially toxic additives

The proponent is not yet certain that any potentially-toxic additives will be added to the hydrotest water; however, if additives are required, based on current practice, Nalco EC1157A would probably be selected. A product bulletin for Nalco EC1157A describes it as a "proprietary blend of water soluble components including a non-aldehyde, low toxicity biocide, a bisulphitic based oxygen scavenger, and a phosphorous based corrosion inhibitor". Features and benefits include that the "low toxicity of this material allows easy disposal of hydrotest fluid into the sea or effluent waters without further treatment".

If toxic additives are to be used and pose a potential risk to marine biota, a Waste Discharge Licence will be required. The Licence will require the proponent (in consultation with OEH) to assess the potential toxicity of the hydrotest water and to monitor the receiving water to ensure dispersion and dilution reduce the risk to an acceptable level. Compliance with these guidelines should ensure protection of the marine ecosystem and nearby aquaculturists; however, as an added safeguard, the proponent will provide adequate notice to aquaculturists before hydrotest water is released to allow these facilities time to implement any desired safety measures.

Recommendation 6

If chemical additives used in hydrotest water pose a risk of toxicity to marine life in the Harbour, the proponent will require a Waste Discharge Licence. The Licence will require the proponent to analyse the hydrotest formulation to be used (to assess the potential toxicity to marine biota) and to monitor the receiving water to ensure adequate dilution and dispersion to reduce toxicity to an acceptable level. Further, if there is a credible risk of toxicity in the discharge, the proponent will provide adequate notice to nearby aquaculturists to allow them time to implement desired precautionary measures. (This will comprise an additional safeguard to protect stock at these facilities.)

[New Recommendation]

4.8.3 Irrigation with Treated Wastewater and Stormwater

Regarding wastewater management, the PER indicates that a closed-circuit re-use system will be implemented (other than for contingent events such as saturation of the site from high intensity rainfall or plant breakdown) and process-contaminated stormwater will be included in this circuit.

The CPI oil/water separator will receive potentially contaminated stormwater from the process areas only. The most probable contaminants will be a small quantity of oil and suspended solids. Design of the treatment system includes a secondary oil removal system and a final holding tank. Discharge from the holding tank to irrigation system will be monitored to ensure that the water quality is satisfactory for the purpose of irrigation.

Given the substantial volumes of wastewater involved (288 m^3/d), management strategies will have to consider evaporation, transpiration, and perhaps infiltration within the disturbed area footprint.

The proposed facility includes effluent treatment (for subsequent irrigation on-site) for both process wastewater streams and potentially contaminated stormwater. In addition, a separate treatment package is proposed for treating sanitary wastes. The PER does not identify the anticipated effluent criteria that will apply to the process wastewater and potentially contaminated wastewater. The level of treatment prior to irrigation (other than the removal of oil, grease and suspended solids) is not stated in the PER.

Recommendation 7

Treatment and disposal (by irrigation) of wastewater will need to comply with the *Guidelines for Sewerage Systems – Use of Reclaimed Water* (ANZECC/ARMCANZ 2000) and *Site Specific Type Approval* by the NT Department of Health and Community Services (DHCS). This will require the proponent to

- **Conduct a detailed assessment of areas proposed for treatment and disposal using the DHCS Site Report template;**
- **Evaluate the site constraints in order to choose the most suitable system for treatment and disposal of wastewater; and**
- **Submit the report to DHCS supporting an application for the *Site Specific Type Approval*.**

Treatment and disposal systems must comply with the requirements of the DHCS *Code of Practice for Small On-site Sewage and Sullage Treatment Systems and the Disposal and Reuse of Sewage Effluent.*

[~ Recommendation 8 in Assessment Report 24]

Detailed design of the proposed wastewater disposal system is not yet available. Once the amount of grassed and landscaped areas available for irrigation is determined for the plant site, the proponent will liaise with the DIPE, DHCS and other relevant NT Government agencies to design the most environmentally-appropriate system for the site.

In its Response to Submissions, the proponent has undertaken to evaluate (during the detailed design phase) the feasibility and benefit of using local hardwoods for landscaping and soaking up irrigation water.

To avoid impacts on the ecological integrity of surrounding dry rainforest, treated effluent will not be used to irrigate this vegetation.

The proponent has indicated that it will obtain the approvals and licences specified above and comply with their conditions.

4.8.4 Discharge (to Darwin Harbour) of Treated Wastewater and Stormwater

The proponent has indicated that uncontaminated stormwater will be segregated from potentially contaminated streams and disposed of by direct discharge to adjacent waters. Any stormwater collected within the process area (which will be fully contained with bunds) will be routed to a drain sump and any potential oil derivatives skimmed from the collected water prior to discharge. As a result, all best available measures will be employed to ensure that there will be no impact on Darwin Harbour water quality from stormwater exiting the site.

Heavy wet season flows are likely to overwhelm the stormwater treatment system at Wickham Point, resulting in discharge of only partially treated stormwater to the Harbour. Once the design of the overall wastewater treatment system is completed, the proponent will confirm with DIPE the conditions under which direct discharge to the Harbour may be required. If potential waste loads are of such magnitude that discharge may comprise a risk to nearby aquaculture facilities, the proponent will model the likely trajectory of the wastewater discharge. If results of this modelling indicate that particular facilities would be at risk of taking up contaminated water, then the proponent will liaise with these facilities to develop contingency plants to protect their operations

The proponent acknowledges that a Waste Discharge Licence will be required for discharge of treated effluent to Darwin Harbour.

In its Response to Submissions, the proponent addressed the potential cumulative impacts of direct discharge of effluent and provided further details on treatment processes and segregated waste streams (produced water, wastewater from plant operations and treated sewage).

The predicted annual loads of contaminants from the plant were compared to the current (estimated) annual loads from stormwater into Darwin Harbour (DLPE 2000).

In brief, the comparisons indicated that the contribution of potential contaminants to Darwin Harbour from the facility would be small:

- Total Nitrogen – Annual load from plant = 86.7 kg/yr vs. 589,000 for the total catchment, 144,000 kg/yr from PAWA sewage plants;

- Total Suspended Solids – Annual load from the plant = 4.4 tonnes/yr vs. 25,326 tonnes/yr from catchment inflows; and

- Oil – No data available on annual loads. Total load from the plant, however, will be approximately 6.6 tonnes (approximately 8 – 9 m^3); therefore, the load will be very small. Potential impacts will be minimised because, when released in low concentrations into receiving waters, this oil should rapidly bio-degrade, weather and therefore not accumulate. Further, where/when possible these effluents will be discharged on-site for irrigation, to minimise discharges to the Harbour.

4.8.5 Radioactive Waste

The PER does not indicate whether the production of LNG is associated with radiological issues. In its Response to Submissions, the proponent reported that analysis of the LNG feed gas indicated radioactive material of 29 +/- 22 Bq/m^3. The proponent considers these levels to be very low and does not anticipate any significant issues with respect to contaminated waste streams (owing to plating-out of mercury onto process piping). There will be no produced water at the LNG plant in that the product feed gas stream will be dry gas. The formation of naturally-occurring radioactive materials (NORMs) will be largely related to radioactive films of decay products of radon gas (^{210}Pb and ^{210}Po) on internal process piping. (The radon gas is generated by decay of radium in the formation sands in the offshore production process and a fraction of radon is mixed with the gas stream.)

Should there be any disposal requirements the proponent will comply with all applicable NT regulations and the *"Guideline for Application for Approval to Dispose of Petroleum Related NORM - EG 506"* (DBIRD 2002).

4.9 Solid and Semi-liquid Waste Disposal

The proponent will be actively working to identify waste minimisation and recycling opportunities to reduce solid and semi-liquid waste streams where possible. An *Operational Waste Management Plan*, prepared as part of the Environmental Management Program (EMP), will detail the proponent's approach to managing these wastes. The EMP will be subject to approval by the NT Government.

4.9.1 Adequacy of Shoal Bay Waste Disposal Site (SBWDS)

The proponent indicates that the volumes of waste generated from the proposed 10 MTPA plant will be of a suitable quantity for disposal to Shoal Bay Waste Disposal Site (SBWDS). A third cell has recently been constructed at the SBWDS to accommodate Darwin and Palmerston municipal waste (combined population in excess of 115,000 people). The PER (Table 4.1) indicates that the proposed 10 MTPA facility will generate approximately 157.5 tonnes of municipal rubbish (trash), ceramic balls and molecular sieve waste per annum. The Darwin City Council publication *'Waste Management Strategy: Towards 2000'* (1995) estimates that Darwin residents generate approximately 1 tonne municipal waste per annum. The 10 MTPA plant will therefore generate the equivalent waste from approximately 158 people, which is anticipated to be easily accommodated at the SBWDS, or alternatively the Humpty Doo Landfill.

The SBWDS is not suitable for disposal of the following wastes (refer Table 4.1):

- Waste Lubricating oils;
- Spent Oils;
- Biological Sludge;
- Inorganic Sludge;
- Oily sludge; and
- Spent Solvents.

These wastes will be disposed of by commercial waste management contractors as appropriate (e.g. oils to the Mataranka Lime Kiln). The PER indicates that the proponent will review waste-tracking documentation from the contractor to ensure these wastes are disposed in a manner approved by OEH.

4.9.2 Construction Wastes

The PER provides annual operational waste generation estimates (in Table 4.1 'Estimated LNG Facility Solid Waste Quantities'). The types of construction wastes anticipated are detailed under Table 2.1 and in Section 4.3.5.1 of the PER; however, the proponent did not indicate likely quantities (citing the difficulty in predicting these).

In its preliminary EMP, the proponent indicated that, where practical, it will use cleared terrestrial vegetation and/or mangroves for rehabilitation. Excess amounts may be chipped and used as mulch. Cleared vegetation should not be stockpiled on-site as this could create breeding habitat for biting insects. Burning of cleared vegetation containing noxious weeds is under consideration as a best management practice to prevent the spread of noxious weeds and/or plant pathogens.

In order to avoid land subsidence, geo-technical advice should be sought if vegetation will be left in place and covered with fill.

The proponent does not anticipate excess clean fill from land operations. Cut and fill requirements are expected to be balanced. Transportation of suitable dredged materials to East Arm Port remains under consideration.

There is no recycling facility planned on-site for construction wastes. A temporary area will be established for the stockpiling of scrap metal (which will be collected for off-site recycling and/or disposal). Construction wastes will not be disposed of on-site.

A full description of the proponent's plans for management of construction wastes will be included in the Construction EMP.

4.9.3 Biological Sludge

The PER indicates that approximately five tonnes of biological sludge will be generated annually. The sludge from the sewage treatment plant will be de-watered by waste contractors, with the residual solids tested (as required) and disposed to landfill. Five tonnes of biological sludge per year is the equivalent annual waste generation of approximately five people, and the SBWDS is anticipated to have adequate capacity to accommodate this volume.

4.9.4 Disposal of Cellulose/Molecular Sieves and Ceramic Balls

Cellulose/molecular sieves are used in the dehydration unit to absorb moisture out of the gas stream. Ceramic balls are used to support the molecular sieve and to break-up the gas flow so a better gas distribution through the sieve can be achieved. (The balls are approximately 1-3 cm in diameter.) These wastes have been classified as non-hazardous and suitable for disposal in landfills, based on the proponent's experience in disposal of these wastes in similar service. Typical disposal techniques are described in the PER.

4.9.5 Spent Amine

Amine treatment will be used to strip acid gas from the gas stream prior to entering the liquefaction process.

The proponent does not intend to dispose of spent amine but instead recover amine for re-use within the process. The plant design will incorporate various piping systems and equipment to facilitate the collection and re-use of amine. Reaction of amine with other constituents to form chemicals of concern is also not expected based on the proponent's past experience; however, the proponent will address options for disposal of spent amine in the *Operational Waste Management Plan*.

4.9.6 Carbon Beds (containing waste mercury)

When the facility is to be decommissioned, the proponent acknowledges that carbon beds containing a predicted 132 kg of mercury (3.3 kg/yr for 20 yrs x two beds) may not be suitable for disposal at any landfill site. The proponent indicates that other options for treatment and disposal of this waste will be addressed in the *Operational Waste Management Plan*.

4.9.7 Waste Oil

The PER indicates that waste oils will be recycled or disposed of through a commercial contractor, e.g. for delivery (as fuel) to the Mataranka Lime Kilns. Because of volatile market-driven factors, however, at times there may be no ability to recycle or re-use this oil locally, and alternative arrangements will have to be made (e.g. stockpiling on-site until suitable disposal can be arranged). The proponent should liaise with OEH to develop acceptable options for management of waste oil.

Recommendation 8

The proponent will consult with the Office of Environment and Heritage to develop preferred and contingency options for management and disposal of waste oil and will include these in its Environmental Management Program.

[New Recommendation]

4.10 Impact of Rock Groynes

Introduction of rock groynes and other structures has the potential to cause erosion on the "downstream" side and sedimentation on the "upstream" side. These disturbances to sea-bed sediments could, at least until a new equilibrium is reached, also increase the level of suspended solids in Harbour and thus decrease water quality.

Hydrodyamic modelling for the previous environmental impact assessment (for the 3 MTPA plant) indicated that tidal velocities near the construction dock were low (< 0.05 m/s) and changes from installation of the dock were undetectable. Tidal velocities in the lee of the product-loading jetty were predicted to be reduced, particularly during ebb tides, potentially resulting in deposition of sediments on both sides of the groyne, as has been observed for the East Arm Port groynes.

Both groynes are predicted to result in increased stability and sedimentation of the adjacent shoreline, without significant erosion. Current speeds will increase slightly at the seaward end of the loading jetty groyne, but, as this will be located on existing rock pavement, no erosion is anticipated.

4.11 Dredging and Disposal of Spoil

The proposed construction dock will require dredging, and some dredging may also be necessary at the head of the product-loading jetty. Introduction of rock groynes and other structures may affect the hydrodynamics of the harbour (e.g. cause erosion and/sedimentation in adjacent areas). The dredging itself will have impacts on water quality, and a prolonged significant decrease in water quality could potentially impact attached or slow-moving biota or aquaculture facilities (which depend on water quality of an acceptably-high standard).

In its Response to Submissions, the proponent indicated that it will further characterise seabed sediments to refine predictions on the likely extent and duration of dredge plumes, as part of its *Dredge and Spoil Disposal Management Plan* (part of the EMP).

The PER indicated that the proponent may apply for a permit to side-cast dredged material (i.e. discharge dredged spoil into the Harbour without prior settlement and clearing of water in retention ponds before discharge of decant water back to the Harbour). This would be allowed only if the nature of the material, timing of dredging and discharge, and other management approaches were determined by OEH to pose minimal risk to the biota of Darwin Harbour and industries dependent on high water quality. The proponent would need to obtain a Waste Discharge Licence prior to dredging and comply with all requirements attached to the Licence.

The PER indicates other options for management of dredge spoil, including use (as fill) on-site or at East Arm Port (if material is of acceptable quality), or discharge of decant water after dredge spoil has been settled in retention ponds. The proponent will apply a "decision-matrix" in its consideration of use/disposal options, in consultation with DIPE and the Darwin Port Corporation (DPC) in development of the *Dredge and Spoil Disposal Management Plan* indicated above and prior to any dredging activities off Wickham Point. Discharge of decant water from ponds would also require the proponent to obtain a Waste Discharge Licence.

To avoid the unacceptable impacts that might be associated with production of plumes from simultaneous dredging at both Wickham Point and East Arm Port, the proponent and the DPC will need to work together to coordinate their dredging schedules and Reactive Monitoring Programs.

One submission from the review of the PER suggested that the Darwin Aquaculture Centre (DAC) may be at risk from sediment plumes generated by dredging during the construction and operational phases of this project, as the centre is located close to Wickham Point. At present, wet season impacts on sediment transport throughout the Harbour already result in a few days each year when water quality is reduced to a level unacceptable for aquaculture. If the period of unacceptable water quality were to be extended for longer periods by dredging, this might seriously impact the operation of the DAC.

The PER suggests that water quality impacts will not be detectable more than 700 m from the site of dredging. The very fine nature of some of the sediments and high current speeds in Darwin Harbour, however, can quickly transport sediments over great distances, and even minute changes in water quality can affect the DAC's production and experiments. Dredging for the construction dock poses a smaller risk of impact on the Centre than dredging for the product-loading jetty, as the former is in East Arm and the latter in Middle Arm and closer to the DAC. The project will require dredging at the construction dock; however, dredging may not be needed at the jetty.

The proponent consulted with the DAC during preparation of the PER, and the proponent indicated its intention to continue a close liaison role with the Centre prior to dredging activities. Previous modelling has predicted that the extent of turbid plumes would be unlikely to impact the activities of the DAC or the nearby Channel Island coral community. The proponent will, however, as part of the *Dredge and Spoil Disposal Management Plan*, outline management measures to ensure that dredging will cause no adverse impacts, including the establishment of a reactive turbidity monitoring program similar to that endorsed by DIPE for the East Arm Port development.

The *Plan* will be developed in consultation with Fisheries Division (DBIRD), DPIE and DAC and approved by these agencies before dredging commences.

Recommendation 9

The proponent's Environmental Management Plan shall contain a *Dredge and Spoil Disposal Management Plan* that evaluates options for dredging, excavation and spoil disposal and addresses potential environmental impacts. This *Plan* shall include proposed measures to ensure protection of the Channel Island coral assemblages. The *Plan* shall also include a "Reactive Monitoring Program" that implements baseline studies (to set environmental triggers for concern), turbidity plume monitoring, a reactive coral monitoring program (if required), and contingency measures to be implemented if environmental triggers are exceeded or if monitoring detects potentially unacceptable environmental impacts.

Development of the *Dredge and Spoil Disposal Management Plan* shall be done in consultation with relevant NT Government agencies and shall be submitted to the NT Government for approval prior to commencement of dredging.

[~ Recommendation 6 of Assessment Report 24]

4.12 Risks from Shipping

The proponent considers the main threat of significant, irreversible environmental damage associated with the project would be from a shipping incident in the Harbour, which could result in a substantial oil spill with consequential mortality of mangroves and associated biota. The risk, however, will be mitigated by controls on navigation, the double-hulled design of vessels, and oil spill contingency plans to be prepared by the proponent and included in the EMP.

Shipping movements will be coordinated through the Darwin Port Corporation. Vessels will be escorted by tugs in the vicinity of the loading jetty and will be under the control of a pilot within Harbour waters, to ensure compliance with all procedures for safe navigation, including maintenance of required separation distances from other vessels.

A 500 m "moving exclusion zone" around each LNG ship as it proceeds through the Harbour to the product-loading jetty is proposed, to minimise safety risks. The proponent has also undertaken to liaise with the Royal Australian Navy to eliminate traffic conflicts and minimise risks from possible interactions with naval traffic.

The PER also indicated that an emergency plan for LNG carriers will be based on an understanding of the types of accident that could occur and their possible consequences, together with an effective system of communication. The proponent indicated that written procedures will be developed in liaison with the Darwin Port Corporation.

Recommendation 10

An emergency management plan addressing LNG carrier operations at sea, in Darwin Harbour and at the loading jetty shall be developed in consultation with relevant authorities such as the Darwin Port Corporation and the Australian Maritime Safety Authority. The plan shall include

- **measures to ensure compliance with national and international safety regimes;**
- **reporting procedures and organisational responsibilities in the event of incidents;**
- **contingency measures to minimise risks to human safety and the environment;**
- **specification of adequate resources to be held on ship and at berth to deal with credible contingencies; and**
- **a communication strategy to ensure effective and efficient liaison among shore-based and ship-based emergency response teams.**

[~ Recommendation 18 in Assessment Report 24]

The Darwin Port Corporation (DPC) has jurisdiction for spills in Darwin Harbour and has an Oil Spill Contingency Plan (OSC) as part of the *National Plan to Combat Pollution of the Sea by Oil (NATPLAN)*. Oil spills could occur during the construction or operational phases of the project, from incidents involving dredges or vessels using the construction dock or product-loading jetty. The proponent has indicated that it will prepare OSCP's for each of these phases, in consultation with the Darwin Port Corporation and other relevant authorities, and integrate these into the existing Darwin Harbour OSCP.

Recommendation 11

Oil spill contingency plans for the construction dock and product-loading jetty shall be prepared by the proponent, within the overall context of the Darwin Port Corporation's Oil Spill Contingency Plan. The site-specific plan shall include

- **an assessment of potential risks of spills of credible volumes;**
- **potential oil spill trajectories;**
- **maps of priority areas for protection (including aquaculture facilities);**
- **details for deployment of equipment to protect priority areas,**
- **demonstrated integration with the Darwin Port Corporation Plan;**

- **inventory of equipment for control and clean-up (including materials held at the jetty and/or construction dock for immediate clean-up of minor spills);**
- **strategies, actions and responsibilities for any clean-up; and**
- **a training and exercise strategy that includes relevant NT Government response personnel.**

[~ Recommendation 19 in Assessment Report 24]

4.12.1 Navigational Hazard from Charles Point Patches

The PER indicated that there are no tidal constraints for vessels up to 11.5 m draft; however, the proponent should note that access to Darwin Harbour (for a static draft of 11.5 m plus under-keel clearance) will be restricted by the present 12.2 m clearance depth at low water at Charles Point Patches. This matter is recognised by the Darwin Port Corporation (DPC) and is the subject of separate capital works programming and environmental impact assessment process. The proponent has indicated that it will continue to liaise with the DPC to resolve this issue.

4.12.2 Berthing and Departure Procedures

Simulation of vessel movements was required to identify any restrictions to be applied to vessel movements to ensure safe navigation for berthing and departing the jetty at the LNG plant.

In February 1997 the proponent undertook a Ship Manoeuvring Study using the Ship Handling Simulator at the Australian Maritime College. This study was done to gain an understanding of the tug requirements and operational constraints and other aspects of ship handling and navigation in regard to this project. The area adopted for the study was bounded in the north by the offshore pilot boarding area northeast of the Charles Point Patches Buoy (No.5) in a depth of 18-20 metres and to the south by the proposed berth site in Middle Arm, west of Peak Hill.

As a result of this study, issues such as berth location, berth alignment, tug requirements, berth availability, and dredging requirements were identified and assessed. The proponent has indicated that it will review the results of this study with the Darwin Port Corporation, including any changes the project has incurred since that time or as a result of this study, and determine what additional simulation efforts are required to finalise the berthing and departures procedures for the LNG vessels for all states of the tide and weather conditions.

In response to one submission, the proponent reported that neither the Darwin Port Corporation nor the Australian Navy raised concern about the potential hazard posed by the Darwin Naval Base breakwater to navigation of LNG vessels. The proponent, however, indicated that continuing hazard and risk assessment studies that consider marine transportation issues will include grounding and fixed-object collision concerns.

4.13 Hazards and Risks (public and environmental)

4.13.1 Hazard and Risk Analysis

In 1998, the proponent was given approval to construct a 3 MTPA LNG plant at Wickham Point, on the basis that a Hazard and Operational (HAZOP) Study and Quantitative Risk Assessment (QRA) would be done for the proposal, and results presented in the Environmental Management Program.

During the detailed design stage for the 10 MTPA LNG project, the proponent has undertaken to complete the following and include results in the EMP:

- A final HAZOP Study, to identify all potential scenarios arising from the failure of valves/controls or other plant upsets;

- A final QRA, to identify, evaluate and manage all potential risks associated with the project; and

- A detailed Safety Report for the LNG plant, in accordance with relevant Worksafe Australia Standards and prepared on the basis of the HAZOP and QRA studies indicated above.

The purpose of the Hazard and Risk Assessment presented in Appendix G of the PER is to demonstrate that the 1 km buffer around the proposed site and 7 km separation from the Darwin CBD is sufficient to ensure that in the event of catastrophic failure of the plant there will be minimal risk of loss of property and human life at Darwin. The Proponent acknowledges however that Appendix G is long and technical in nature and may be difficult for laypersons to understand. The concern regarding the downwind dispersal of an "asphyxiating and potentially flammable" cloud of LNG gas is addressed in the Preliminary Siting Study by Quest in Table 4-4 and Figure 4-5a of the PER.

Table 4-4 – "The maximum downwind distance to the hazard endpoint" – indicates the maximum distance that an asphyxiating and potentially flammable hazard originating from the liquefaction plant could occur in any direction under worst case conditions which are at low wind speeds. Higher wind speeds disperse the gas more quickly and result in a smaller downwind hazard distance. As indicated in Table 4-4, the maximum distance downwind that a hazard may exist is 575 m for a release from the ethylene refrigerant surge drum. Figure 4-5a presents this hazard diagrammatically and shows the location of the hazard area under a light (2m/sec) south east wind and stable atmospheric conditions (worst case for dispersal of gas).

Similar assessments are available for the LNG storage tanks (Refer Table 4-2 and Figure 4-1: note that the hazard is maintained within the overall LNG spill impoundment area) and the jetty head (refer Figure 4-2).

Table 4-4 also indicates the maximum downwind distance that radiant heat is a hazard from the liquefaction plant. Please note that for this hazard, higher wind speeds (9 m/sec) are considered worst case because strong wind can blow the heat plume a small distance downwind.

Figures presenting modelling results in the Quest report show that all hazards (both radiant heat and flammable dispersion) occur within the plant site boundary or within approximately 400 m of the jetty head (hence the proposed 500 m safety exclusion zone).

LNG is stored at atmospheric pressure and would not explode if vessels storing the material were ruptured. In such an event, the LNG, being very cold and dense, would flow downhill into a containment pond. The LNG would only ignite if a naked flame is present, and even then it would burn rather than explode.

The proponent indicates that results from the Qualitative Risk Assessment presented in the PER indicate that the potential hazards to the public and on-site personnel, arising from operation of the LNG plant, would be maintained at an acceptably low level at the plant boundary.

The Quantitative Risk Assessment is likely to indicate an even smaller risk, because the preliminary analyses (i.e. Qualitative Hazard and Risk Assessment, in Appendix G of the PER) used much more conservative assumptions than those required once final plant design details are known and final risk and hazard analyses are completed.

Approval of the EMP will include acceptance of the outcomes of these studies, i.e. that the risks to people, the environment and adjacent facilities (e.g. power plant and aquaculture centre on or near Channel Island) are considered acceptably low.

If an arterial road from Wickham Point is constructed and development occurs along that road, the proponent has agreed to liaise with relevant authorities and key stakeholders on Wickham Point Peninsula to fully investigate the potentially greater risk to the public.

4.13.2 Cyclones

The Hazard and Risk Analysis above included the potential for damage by cyclones, and infrastructure at the plant has been designed to minimise the risk of significant damage (e.g. LNG storage tanks have a concrete outer shell). The proponent has indicated its proven experience in the design of facilities vulnerable to tropical storms (i.e. the Atlantic plant at Trinidad), and the design for the plant will be in accordance with the requirements of AS 1170.1, SAA Code: *Dead and Live Loads and Load Combinations* (Australian Standards Australia 1989), which would specify minimum standards for resistance in high winds.

Further details relating to the proponent's contingency planning for cyclones are included in Section 5 of this Assessment Report.

4.13.3 Lightning Strikes and Power Failures

In its Response to Submissions, the proponent indicated that the entire plant is protected with an earthing grid and lightning rods installed at high points within the plant. In addition, all of the equipment, piping, etc. within the plant is grounded to the earthing grid. This will protect the plant from lightning strikes by channelling the lightning to ground and preventing damage to the plant. The proponent indicates that this is similar in principle to the system that PAWA uses to protect the electrical distribution line from Channel Island to Darwin.

In the rare event that lightning were to strike part of the control system within the plant, it would disable that individual control loop; however, the plant control system is designed to allow the plant to safely operate with individual control loop failures.

In the event of a power failure to the plant for any reason, the plant is designed to automatically shutdown (fail safe). For this purpose, the plant incorporates various back-up systems, such as battery back-up power for critical systems and valves that fail to a safe condition.

4.13.4 Transport of Hazardous Materials

An assessment of hazardous goods transported to, and hazardous wastes transported from, the plant is warranted. The amount of hazardous petroleum waste produced by the facility could be significant (in a regional or local context), and the transport corridor for the facility will extend through sensitive natural environments and populated areas (such as Palmerston).

The proponent has undertaken to do an assessment of hazardous wastes transported to and from the plant. Contingency plans to be prepared for the EMP will incorporate a plan to deal with any accidental spillage of hazardous goods during transport.

4.13.5 Safety Report

In the PER, the proponent indicates that, during the detailed engineering phase of the project, a comprehensive Safety Report will be prepared for the LNG plant in accordance with the requirements of the *National Code of Practice for Major Hazard* Facilities. The proponent will consult with the NT Government during development of the Safety Report and emergency response manuals to ensure the safe design and operation of the LNG plant.

4.13.6 Environmental Performance of Kenai LNG Plant (Alaska)

Subsequent to provision of the Response to Submissions, the proponent provided a summary of the environmental performance of its LNG Plant in Alaska, in particular leaks/spillage of oils and hazardous substances. (This information was requested by OEH to supplement summary tables of incidents specifically involving LNG, in Appendix G of the PER.) From January 1995 to May 2001, there were fourteen spills/leaks of diesel, turbine oil, hydraulic fluid, lube oils, glycol, steam condensate and sulfuric acid. More than half of these were under 20 litres and resulted primarily from hose leaks or during transfers. The most significant spills were

- 227 litres of diesel, from a leak in a bunker loading line (during re-commissioning);
- 76 litres of turbine oil, during a propane compressor oil transfer;
- 95 litres of diesel, during de-inventory of a loading line; and
- 7 litres of sulfuric acid, from a leaking pipe at the cooling tower.

The proponent indicated that equipment re-design will prevent leaks of turbine oil at the Darwin facility; glycol will be removed from the gas stream offshore; and because there is no cooling tower at the Darwin facility, no sulfuric acid is needed to clean the tower.

4.14 Ecological Impacts

4.14.1 Dry Rainforest (= monsoon vine thicket)

Clearing of vegetation

Fourteen plant communities have been identified at Wickham Point. No rare, endangered or threatened plant species were recorded for the site; however, the dry rainforest is recognised to be of conservation interest. The *Litchfield Area Plan* 1992 applies to the site and indicates that

- Except with the consent of the [Development Consent] Authority, the removal of natural vegetation from an area within an allotment exceeding approximately 50% of the area of the allotment is prohibited; and

- Where removal of native vegetation is proposed for an area exceeding 50% of an allotment, the vegetation is removed in accordance with environmental guidelines.

The PER indicates that the total land area for the LNG site is 88.3 ha, which is approximately 48% of the current total site; therefore, consent for vegetation clearance is not required.

Clearing of vegetation should be staged to meet the minimal requirements of constructing and operating the facility and to avoid clearing land that might never be used.

Recommendation 12

The proponent's Environmental Management Program shall include specific measures to minimise loss and disturbance to remaining mangrove and dry rainforest habitat at Wickham Point. This shall include measures to avoid unnecessary clearing and disturbance during construction, measures to monitor and control weed and feral animal incursions, and measures to minimise fire risks.

[= Recommendation 11 in Assessment Report 24]

Selection of offset area(s)

The acquisition of an area of dry rainforest is proposed in the PER to offset removal of dry rainforest within the project area; however, the size of the area to be acquired and the long term management arrangements for this acquired land are not discussed in the PER.

The proponent has maintained an ongoing dialogue with DIPE throughout the preparation of the PER to identify an acceptable dry rainforest mitigation strategy. It will continue to liaise with DIPE and jointly develop a program to offset the area of dry rainforest that has been removed for the development of the LNG facility.

4.14.2 Mangroves and Salt-flat Habitat

The proposed expansion will require removal of 88.3 ha of native vegetation, of which 11.9 ha comprise mangrove community (of a Harbour total of 20,400 ha) and 1.8 ha comprise salt-flat habitat.

The preliminary EMP (Dames and Moore 1998b) includes the proponent's commitment to mangrove monitoring in relation to productivity of mangroves adjacent to the development site. Mangrove monitoring procedures for Darwin Harbour have been further developed by DIPE and the Northern Territory University (NTU) since preparation of the preliminary EMP.

In its Response to Submissions, the proponent states that it intends to review the proposed mangrove monitoring procedures in consultation with the DIPE, to ensure current recommended methods are used. These updated procedures will be incorporated into the revised EMP.

4.14.3 Impacts on Terrestrial Fauna

Fauna corridors

The proposed site layout does not appear to provide any fauna corridors linking the northern tip of Wickham Point to the remainder of the peninsula.

The proponent does not intend to fence-off the landward approaches to the construction dock. It is anticipated that most animals will be able to traverse the landward end of the construction dock at night during the construction period, and at any time thereafter. The proponent will mitigate the effect of the barrier presented by the construction groyne at the high tide level by constructing earth ramps on either side of the groyne, if deemed necessary by DIPE.

Birds

Regarding potential impact on federally listed migratory species such as the Melville Cicadabird and the White-Bellied Sea Eagle, information from the Parks and Wildlife Division (of DIPE) suggests that local populations of these species are unlikely to be affected by the loss of habitat what will result from the proposal. The Melville Cicadabird prefers dense mangrove habitat (of which only 11.9 ha will be cleared), and the Sea Eagle prefers high trees for roosting and nesting.

4.14.4 Impacts on Marine Biota

The proponent has undertaken to mitigate risks to the marine biota of Darwin Harbour by minimising the discharge of potential contaminants into the Harbour and by ensuring that discharges comply with requirements attached to Waste Discharge Licences obtained by the proponent.

Details regarding management of wastewater, stormwater and dredge spoil have already been provided under other headings in this Section of the Assessment Report (Section 4).

4.14.5 Fire, Weeds and Feral Pests

The proponent has undertaken to produce and implement a comprehensive weed management plan prior to construction of the facility. The proponent has indicated that it is fully aware of the requirements of the *Weeds Management Act* and will ensure that all activities are in full compliance with the Act. The proponent has undertaken to liaise closely with the DIPE to minimise the spread and prevalence of weeds on Wickham Point.

4.14.6 Exotic Marine Pests (from discharge of ballast from ships)

Each LNG vessel coming to Darwin will be discharging up to 48,000 m^3 of ballast water. Darwin Harbour has already experienced several outbreaks of exotic pests in recent times, although the most serious of these probably resulted from organisms attached to the hulls of vessels rather than by discharge of ballast. These outbreaks have been successfully treated. The Fisheries Division of the Department of Business, Industry and Resource Development (DBIRD) operates a program to monitor for exotic marine pests.

Shipping activities under the proponent's control will comply with the Australian regulations for the management of ballast water and general Australian Quarantine and Inspection Service(AQIS) guidelines, which will ensure that no ballast water exchange occurs within or near Darwin Harbour. Re-ballasting at sea, as recommended by the IMO & AQIS guidelines, currently provides the best available measure to reduce the risk of transfer of harmful aquatic organisms.

In its Response to Submissions, the proponent acknowledged the requirement to liaise with DBIRD regarding the exotic marine pests monitoring program and mitigation of potential impacts from shipping associated with the proposed project. The proponent indicated that it is aware of additional R&D efforts currently underway to identify additional ballast water treatment technologies, such as sterilisation by ozone, ultra-violet light, electric currents and heat treatment, or chemical treatment methods such adding biocides to ballast water to kill organisms. These technologies are, however, not yet proven and not currently accepted by the global R&D community.

4.15 Noise

4.15.1 Construction Phase

Pile-driving

One submission raised the issue of potentially unacceptable levels of noise from pile-driving.

In its Response to Submissions, the proponent indicated that it is not certain that pile driving operations will be required to construct the load-out jetty. Recently completed geo-technical investigations indicated that drilling and grouting the piles may be a preferable approach. In the event that pile driving is considered necessary, the proponent indicated that the potential noise impacts on the residents of Darwin and Palmerston will be modelled. If findings indicate a significant potential for disturbance to residents, a Noise Management Plan for this temporary activity will be prepared (in consultation with OEH) and implemented by the proponent.

Noise propagation over water

Another submission indicated that construction noise from the East Arm Port development could be heard at residential areas 6 km away (straight-line distance, over water). As the LNG plant is 7 km away from the Darwin CBD, the proponent was asked (in the NT Government submission) to verify its prediction of no significant impact off-site from noise. In response, the proponent has re-stated its commitment to undertake construction work during daylight hours, when background levels of noise at these nearby populated areas will be high.

Blasting/detonations

In its Response to Submissions, the proponent indicated that recently completed geo-technical investigations suggest that the rocky material on the site is readily rippable by standard earth-moving equipment; therefore, the use of explosives should not be required. In the unanticipated event that explosives are required, noise reduction measures, such as the use of weighted blankets, will be adopted.

4.15.2 Noise during Upset/Emergency Operating Conditions

The proponent indicated that during plant upsets/emergency operation, various areas within the plant might experience higher noise levels for brief periods of time. The most significant increase would be from compressor recirculation, which occurs during the majority of plant upsets. Estimated noise level increase from this source is expected to be up to 10 db in the A-weighted sound pressure level but the impact at the plant boundary may be higher by only 2-5 dBA. As this attenuates outward it is expected that the noise levels off the plant site will stay below World Bank guidelines for day- and night-time noise in residential areas. During this recycle situation alternate compressors may not be operating thus overall impact will not be significant.

4.15.3 Requirements under the NT draft Waste Management and Pollution Control (Environmental Noise) Regulations

Although the PER refers to USEPA and World Bank guidelines in its prediction and assessment of noise, the more locally-relevant NT *draft Waste Management and Pollution Control (Environmental Noise) Regulations* were not adequately considered. These regulations are likely to come into effect during construction of the LNG facility.

The proponent indicated that it will contact the OEH to confirm the requirements of the draft Regulations. Based on the modelling undertaken to date (Appendix E of the PER), the LNG facility is

predicted to generate no significant off-site noise impacts. The proponent has indicated that it will ensure that noise during construction and operation of the plant will be managed to comply with the Regulations when they come into effect.

4.16 Work Health Issues

4.16.1 *Biting Insects*

The PER indicates that biting insects (mosquitoes and midges) are common at Wickham Point and pose a potential nuisance and health risk to staff.

Mosquitoes

The greatest potential for the creation of new mosquito breeding sites will arise with disturbances by construction activities in or near tidal areas. Given the increased size of the proposal, there is a greater potential for creation of new breeding areas during construction.

In its Response to Submissions, the proponent acknowledged that management of biting insects is an issue it needs to address in relation to the Wickham Point site. The proponent indicated its commitment to minimising impacts that the plant construction could have on existing biting insect numbers and to controlling the effects of biting insects on the health and well-being of personnel in the vicinity of the site.

The Preliminary EMP committed the proponent to complying with the NT Government's guidelines, "*Construction Practice near Tidal Areas in the Northern Territory – Guidelines to Prevent Mosquito Breeding* (Whelan 1988*).* In completing the final EMP, the proponent will further refine its approach, which will form the basis of a *Biting Insects Management Plan* to be established in accordance with Department of Health and Community Services recommendations.

Biting midges

The biting midge species *Culicoides ornatus* is likely to be a severe pest in at least the eastern half of the "island" and possibly the whole of the island area. Significant sources of *C.ornatus* are likely to originate from the wide mangrove margins at the south-east end of the island.

The control of biting midges is not likely to be practical or effective under most circumstances. Strategies to mitigate the potential pest problem should therefore include avoiding known problem areas by siting any high-use personnel areas in the south west of the island. Any personnel facilities should be constructed with the ability to be screened or sealed from biting midge entry. (Biting midges will penetrate standard insect screening.)

Personal protection of employees from biting midges will be employed and induction training implemented to ensure that the problem is managed in accordance with recommendations by the DHCS. The proponent will detail its approach to these issues in the EMP.

4.16.2 Radiation

As indicated in Section 4.8.5 of this Assessment Report, the proponent indicated that the LNG feed gas contains only low levels of radioactive material (29 +/- 22 Bq/m^3).

With regard to occupational risk, although considered to be low, the proponent has undertaken to address this issue by developing procedures for naturally occurring radioactive materials (NORMs),

which will be implemented for protection of personnel during plant shutdown and maintenance activities.

Final equipment selection will occur during the detailed design phase of the plant. At that time any equipment that is likely to contain radiation sources and/or irradiating apparatus will be identified. The proponent indicated that operation of this equipment will comply with the provisions of the NT *Radiation (Safety Control) Act*.

4.17 Impacts on Visual Amenity

The PER summarises results from a visual impact assessment that compared the 3 MTPA plant to the 10 MTPA facility, based on a number of vantage points on land and on the water and an aerial view. The results indicate that the visual impacts associated with both plants are comparable, with the exception of the larger capacity LNG storage tanks; however, these were not likely to significantly impinge on the landscape from Darwin Harbour.

The results indicate that some components, such as the main process flares, would have a much smaller impact because of their location on the ground rather than elevated (as was proposed for the 3 MTPA plant).

The visual impacts would be greatest within 500 m of the facility, jetty, construction dock, etc. Beyond 500 m, the visual impact of the development would diminish. The PER considered that sensitive locations would be well in excess of 500 m from Wickham Point.

In its Response to Submissions, the proponent indicated that the plant site was selected to minimise the amount of earthworks and utilise the western ridge to shield it from view from Darwin. Peak Hill, the taller of the two primary ridgelines on the Wickham Point Peninsula, will remain largely intact to minimise visual impact on the Darwin community.
Light emanating from the plant at night could have impacts on visual amenity (detract from the night sky) and attract migrating fauna (which might interfere with nesting, for example). The proponent acknowledges that it did not assess this issue for the previous EIS nor for the current PER; however, it has undertaken to investigate, during the detailed design stage, opportunities to minimise light spill at night.

4.18 Socio-Economic Impacts

4.18.1 Construction Work-force

The PER indicates that one of the key benefits of this proposal will be socio-economic, with approximately 25% of the work-force sourced from Darwin. The remainder, comprising workers with particular expertise that is not available in Darwin, will need to be brought in from other areas.

In 2001, the proponent had its contractor address the local labour market for its construction workforce. Conclusions were drawn concerning the availability of skilled workers in the local labour market using qualitative and limited quantitative data. It is envisioned that the proponent will commission a skills audit of the Darwin area in the near future to update the previously acquired information. Data obtained from the skills audit will be compared to the anticipated required craft levels and any shortfalls will become evident and quantifiable at that time.

Another major factor in the proponent's 25% estimate is that there will likely be a local labour shortfall for this project because of other competing local projects. In 2001 the potential local competing projects were identified as the following: Subsea Gas Pipeline ($ 525 million, start 2003), Darwin Port Development ($66 million, start 2003), Darwin to Moomba Pipeline ($550 million, start

2002), and Darwin to Alice Springs Rail Link ($990 million, start 2001). The proponent concluded that these other projects will likely result in strong competition for locally available skilled labour. Conversely, if any of these projects do not happen as anticipated, this could make more local labour available for the LNG Facility project.

4.18.2 Impacts on Commercial and Recreational Fishing in Darwin Harbour

The PER acknowledges that Darwin Harbour is closed to commercial haul net fishing and commercial mud crab fishing, but that limited gill netting and line fishing are permitted. It also recognises the important recreational resource Darwin Harbour represents to the people of Darwin, other Territorians and tourists.

The PER also recognises that a favoured fishing area occurs off the northern tip of Wickham Point, which will not be affected by the LNG plant (i.e. there will be no restriction of fishing in this area). Similarly, there will be no restricti`on of access to landing in the region of the old leprosarium. The only restrictions to fishing will be adjacent to the loading jetty and construction dock (both of which are well away from the area of greatest fishing interest) and within 500 m of LNG vessels approaching or departing the jetty.

One submission raised the issue of potential impacts on recreational fishing yields, from the noise of LNG carriers (vessels).

In response, the proponent indicated that it is unaware of any research which links reduced fish catch rates to increased vessel traffic within harbours. It suggested that the low intensity noise levels generated by slow-moving ships on approach to or departure from the jetty are likely to be much less intrusive and disturbing to fish than the high intensity noise levels associated with recreational fishing vessels travelling at high-speed.

The fact that fish are regularly caught off the jetties and breakwaters of Darwin Harbour (which contains a significant commercial port) would suggest that ship movements do not deter fish. The load out jetty might provide shelter to recreational fish and act as an artificial reef, especially once corals and other organisms colonise the structure and increase its habitat complexity.

Given that a 500 m exclusion zone will be set around the load-out terminal, fishing will be prohibited near the jetty. As such, the restricted area is likely to act as a refuge for fish with habitats within this area. This effect has been noted in the vicinity of many offshore oil and gas installations and the LNG and condensate jetties in Dampier associated with the Northwest Shelf LNG project.

4.19 Cultural Impacts

4.19.1 Discovery of Archaeological/Heritage Places and Objects

The PER identifies the archaeological sites that were previously recorded (as part of the original assessment for the EIS) within the proposed LNG Plant area and others that have been discovered since. The additional archaeological sites were reported to OEH and investigated in consultation with Heritage Conservation Services (within OEH). Two preliminary reports were consequently prepared, and a third is currently being prepared by a heritage sub-consultant. The proponent will ensure that copies of all reports will be forwarded to the Manager of Heritage Conservation, as required under the *Heritage Conservation Act*.

The PER refers to recently discovered shell middens MA19, MA20, MA21, MA22 and MA23. The PER states that stone artefacts were not located in association with these sites; however, a site

inspection conducted by the OEH in 2001 found several stone artefacts at these sites. Ministerial approval may be needed if such features are to be disturbed or destroyed. Under the *Heritage Conservation Act*, the proponent must inform OEH of any new archaeological sites or features discovered prior to or during the construction and operational phases of the project.

The PER has acknowledged that additional archaeological sites may be uncovered during construction. The proponent, however, does not outline in detail appropriate procedures to be followed in this event (although it is noted that the Darwin LNG Plant Draft EMP (Effect LNGP 8) does address this issue to a limited extent).

The proponent is working with OEH to establish an *Archaeological Sites Register* for Wickham Point and a comprehensive procedure for the discovery of archaeological sites. This will be completed by the proponent and endorsed by OEH during completion of the Construction EMP. The proponent is supportive of the proposal to have an archaeologist on-site during initial land clearing, or alternatively be on alert to enable a rapid response and assessment should any additional sites or objects be discovered during clearing activities.

Other procedures will include that

- OEH will be immediately notified of any archaeological sites discovered during site preparation and construction; and
- Vegetation clearing and other threatening activity will cease in the area of the site until OEH has a chance to inspect the newly-discovered site and advise on when/how the threatening activity can recommence.

4.19.2 Aboriginal Sacred Sites

The proponent has undertaken to consult with the Aboriginal Areas Protection Authority (AAPA) and confirm that no sacred sites will be affected by the proposed expansion (to a 10 MTPA facility).

The proponent has indicated its intention to establish a "Heritage Issues Committee", comprising representatives from OEH, AAPA and the Larrakia Association, to act as an advisory body for procedures regarding sacred sites on Wickham Point. The proponent will consult with the AAPA on an ongoing basis prior to and during the construction phase.

An Authority Certificate issued to the proponent in 1997 identified four sacred sites (in Darwin Harbour) to be avoided; however, that Certificate has lapsed. The proponent has indicated that it will ensure that a current Certificate is obtained from AAPA prior to initiating any on-site works.

4.20 Other Issues

4.20.1 Mercury in Domestic (Industrial) Gas

To protect equipment at the plant, the proponent will remove mercury from the natural gas stream before it enters the refrigeration system (to liquefy the gas); however, before this treatment occurs, gas for domestic supply would be diverted to another pipeline.

One submission queried how domestic industrial users (and equipment/structures to deliver domestic gas) would be protected from potential impacts of mercury in the delivered product.

In its response to submissions, the proponent indicated that mercury concentrations in the gas from the offshore producers are expected to be very low (less than 0.6 micrograms per normal cubic metre) and therefore are currently within the gas specification required for delivery to domestic gas purchasers. A mercury guard bed, similar to what will be installed at the LNG plant, could be installed on the

domestic gas stream if additional mercury removal were required in the future. This additional treatment would be determined by the terms and conditions of any subsequent sales contract.

4.20.2 Requirements for Fill (during construction phase)

In reviewing the Litchfield Shire's Seasonally Waterlogged Soils Map, the proponent recognised that the area of the development footprint most prone to waterlogging will be mainly the intertidal areas located on the perimeter of the proposed plant site. Most of the plant site itself is not prone to waterlogging, except in an area currently dominated by Pandanus swamp. Given that an all-weather access road will be completed to the site prior to construction works commencing, and that on-site fill material will be available to raise the level of the swamp, the proponent considers it unnecessary to import fill material, and proposes to use fill material cut from the site. Rock fill, however, will be required for purposes of armouring the load-out jetty groyne and construction dock, and the proponent plans to import this material from quarries located near Darwin.

4.20.3 Erosion and Sedimentation

The proponent has indicated that it will submit a draft *Erosion and Sedimentation Control Plan* to DIPE for approval prior to any construction works. This *Plan* will confirm key drainage flows across the site and specify a range of management measures to minimise erosion and siltation of the surrounding environment during plant construction and operation. Control measures such as silt traps will be established based on advice received from DIPE.

4.20.4 Acid sulfate soils

The proponent has undertaken to prepare an A*cid Sulfate Soil Management Plan* as part of the EMP process, which will include those areas affected by the proposed expansion. This will involve ground-truthing to confirm those areas on-site that may be at risk from acid sulfate soil characteristics, and preparation of a comprehensive set of management procedures detailed in the plan to be adhered to by the construction contractor. The proponent will submit the *Plan* to DIPE for review and endorsement prior to the commencement of construction activities.

Recommendation 13

As part of the proponent's Environmental Management Program, an *Acid Sulfate Soil Management Plan* shall be prepared in consultation with relevant NT Government agencies. Sampling and analysis of potential acid sulfate soils shall be conducted as part of preparing the *Plan*. The *Plan* shall include monitoring of leachate from any soil or spoil retention areas and reclamation areas, and contingency measures in the event leachate is found to be excessively acidic.

[= Recommendation 7 in Assessment Report 24]

4.20.5 Anticipated Freshwater Usage (during construction phase)

Although the proponent is requesting that a water line capable of supplying 80m^3/hour be available for the construction phase, the water will not flow continually during construction at its maximum rate. During construction the water supplied by PAWA will primarily be used for personnel needs (drinking water etc.), the mixing of concrete and for dust suppression. It will also be available for fire suppression.

Preliminary estimates provided by the proponent's contractor indicate peak average daily water usage may amount to approximately 680 m^3/day, excluding that required for LNG tank hydrotesting. Based

on this figure, the following feasible scenario of daily water usage is offered, which will be confirmed during detailed design:

- Personnel drinking water – 6 m^3;
- Personnel sanitary water – 85 m^3;
- Concrete mixing water – 455 m^3; and
- Dust/fire suppression water –135 m^3.

The drinking water will be consumed, the sanitary sewage/water will be removed from the site, the water used for concrete mixing will hydrate from the concrete during curing, and the water used for dust suppression will evaporate.

In the PER, the proponent indicated that there will be no point-source discharges of wastewater to the Harbour from construction activities or temporary facilities during the construction phase. Prior to commissioning of the facility, freshwater is likely to be used to hydrotest tanks and piping. In advance of this activity, maximum water flows could occur for a time as water is accumulated at the site for hydrotesting. (Discharge of hydrotest water is described in Section 4.7.2 above.)

4.20.6 Fuel Storage

The proponent has indicated that fuel storage at the facility will fully comply with AS 1940 (Australian Standards Australia 1993) requirements for the storage and handling of flammable and combustible liquids on-site. This will ensure that the best industry methods of handling on-site fuel storage are adopted, including the capacity of bunds to fully contain the largest potential spill, inclusion of properly-sited and maintained sumps, and comprehensive inspection and emergency response procedures and pumping systems. The proponent has also indicated that it will liaise with the NT Government to ensure that all local requirements are met for safe construction and storage of fuels required for the Darwin LNG Project.

4.21 Sustainability

In the PER, the proponent indicates that the EMP will address sustainability issues in a "triple bottom line" approach, integrating environmental, social/cultural and economic factors. As described in Section 4.12 of this Assessment Report, the proponent sees the main threat of serious or irreversible environmental damage posed by the project would be from a shipping accident in the Harbour which could result in widespread oil spillage and mortality of mangroves and associated biota. The risk, however, will be mitigated by controls on navigation, the double-hulled design of vessels, and oil spill contingency plans to be prepared by the proponent and included in the EMP. The proponent also supports its view that the risk of an oil spill is low by citing the safety record of LNG vessels (detailed in Appendix G of the PER).

The proponent indicates that the project will not threaten any populations of rare or endangered species, nor threaten currently designated conservation reserves in the Darwin region. The proponent plans to mitigate the loss of dry rainforest habitat at Wickham Point by ensuring the protection of a suitable portion of that habitat elsewhere.

For all of the above reasons, the proponent believes the expansion of the LNG project from a 3 MTPA plant to a 10 MTPA facility is consistent with the principles of Ecologically Sustainable Development. The proponent points out (in the PER) that, with the exception of greater atmospheric emissions, the environmental costs of the larger plant are generally the same for both proposals.

In the EMP, the environmental, social and economic factors that define the sustainability of the LNG project will become Key Result Areas (KRAs) for the project, with Key Performance Indicators (KPIs) determined for each factor. These KRAs and KPIs will then form part of the business planning process for the project to be adopted by the proponent. They will also provide the basis of communicating the company's goals, objectives and performance measures with the Darwin community through a public Sustainability Reporting process.

5 ENVIRONMENTAL MANAGEMENT PROGRAM

5.1 Introduction

This section of the PER confirms the environmental management commitments made by the proponent and recommendations made by the NT Government as an outcome of the previous environmental impact assessment for the 3 MTPA LNG plant (1998). It also identifies additional commitments and recommendations to address the potential environmental impacts of the proposed expansion, taking into account the environmental studies done subsequent to completion of the original assessment.

5.2 Preliminary EMP (Dames and Moore, 1998b)

The Preliminary EMP prepared in 1998 included the following components (based on key project activities) that are relevant to the current 10 MTPA proposal:

- Dredge and Spoil Management Plan;
- LNG Plant Environment Plan;
- Emergency Response Manuals;
- Oil Spill Contingency Plans;
- Corporate Relations Plan; and
- Compliance Auditing and Reporting Plan.

The Preliminary EMP committed the proponent to developing and implementing a detailed *Environmental Monitoring Program* for the following:

- Abundance of weeds and feral animals outside the disturbed "footprint" of Wickham Point;
- Abundance of biting insects within the footprint;
- Effects of dredging for the loading jetty and construction dock on the corals of Channel Island and Wickham Point;
- Productivity of mangroves adjacent to the plant site;
- Quantity, quality and methods of disposal of construction and operational wastes;
- Confirmation of the quantity and quality of atmospheric emissions;
- Wastewater discharge volumes and quality, including effluent dispersal studies;
- Concentrations of selected metals, TBT and total petroleum hydrocarbons in marine sediments and selected marine biota in areas to be dredged; and
- Contribution to the DPC's monitoring program for introduced marine organisms.

5.3 Revised *Environmental Management Program*

For the 10 MTPA plant, the proponent indicated its intention to build on commitments of the Preliminary EMP in development of management plans for both the construction and operational phases.

The proponent has undertaken to address the specific requirements of this Environmental Assessment Report, which are based on review of comments from the public and relevant NT Government agencies. The proponent also indicated that the final EMP will be based on all matters involving regulatory compliance as well as corporate requirements to ensure the facility has an appropriate and effective Health, Safety and Environmental Management System.

Section 5 of the PER identifies a number of community relations groups and liaison committees through which various stakeholders may be able to provide input into the EMP.

The final EMP will be a public document.

Completion of the EMP will involve reviewing the original commitments for their applicability. Preparation of the final plans, extended from those outlined in the Preliminary EMP, will incorporate consideration of the additional level of risk associated with the expanded project and comments received from the NT Government and Environment Australia. (Environment Australia will consider recommendations in this Assessment Report in completing their assessment under the *Environment Protection [Impact of Proposals] Act*) *1974*.

Recommendation 14

In preparing the Environmental Management Program, the proponent shall include any additional measures for environmental protection and monitoring contained in recommendations made by the Northern Territory and Commonwealth Governments with respect to the proposal. The EMP shall be referred to relevant NT agencies and Environment Australia for review prior to finalisation, after which it shall become a public document. The EMP shall form the basis for approvals and licences issued under relevant NT legislation.

[~ Recommendation 2 in Assessment Report 24]

5.3.1 Additions to Commitments in the 3 MTPA EMP

The outcomes of the updated assessment studies done for the PER confirm that most of the anticipated environmental effects of the proposed 10 MTPA plant are essentially the same as those for the original 3 MTPA proposal. For this reason, the commitments detailed in the Preliminary EMP adequately address the majority of anticipated effects of the project on biophysical, cultural and socio-economic environments.

In addition to the plans and manuals in the Preliminary EMP, the PER indicates that the proponent will include the following commitments in the final EMP to address the potential environmental impacts associated with the expanded 10 MTPA facility:

1. **Atmospheric emissions** – The proponent will quantify major emission sources during commissioning, by periodic testing programs. Results will be used to develop a monitoring system for NO_x from key emission sources. (NO_x is the most likely pollutant to approach ambient NEPM limits.)
2. **Greenhouse gas emissions –** As part of its commitment to the Commonwealth Government's *Greenhouse Challenge Program*, the proponent will develop a Cooperative Agreement with the Australian Greenhouse Office, including commitments for continual improvement in energy efficiency, development of a comprehensive greenhouse gas management strategy and action plans for mitigation measures incorporated into the design of the revised project. In addition to consideration of plantation sequestration options, the proponent will evaluate other options during the design and construction phases, with periodic reviews during the operational phase.
3. **Wastewater discharge –** Treated wastewater will be used on-site for irrigation, to minimise direct discharge into the Harbour, except on a contingency basis (e.g. if ground is saturated during heavy wet season rains). During preparation of the final EMP, the proponent will analyse the potential additives to hydrotest water, their fate upon discharge to the Harbour and potential impacts on biota. Proposed mitigation measures will be subject to approval by DIPE.
4. **Waste management –** To handle the increased levels of solid and semi-liquid wastes anticipated from the expanded plant design, proposed management measures have been revised to comply with the *Waste Management and Pollution Control Act*, which was not in force when the previous

3 MTPA proposal was developed and assessed. To reduce generation of wastes, opportunities for recycling and waste minimisation will be sought for all project operations.

5. **Clearing of dry rainforest –** The proponent has undertaken to continue consultations with DIPE to identify a suitable area of dry rainforest in the Darwin region to be acquired for conservation and offset the loss of this significant habitat within the footprint of the facility.

6. **Fauna corridors –** The proponent expects that most animals will be able to traverse the landward end of the construction dock at night during the construction period, and at any time thereafter. The proponent will mitigate the effect of the barrier presented by the construction groyne at the high tide level by constructing earth ramps on either side of the groyne, if deemed necessary by DIPE.

7. **Public risks –** A Qualitative Hazard Analysis and Risk Assessment for the 10 MTPA proposal demonstrated that the siting, design, construction and operation of the proposed LNG plant will adequately protect persons, property and the environment. During the detailed design phase, the proponent will complete the following:

   - A final HAZOP (Hazard and Operability) Study, to identify potential scenarios arising from the failure of valves and controls or other upset conditions;

   - A final QRA (Quantitative Risk Assessment), to identify, assess, evaluate and manage potential risks associated with the project; and

   - A detailed Safety Report for the LNG plant, in accordance with relevant Worksafe Australia Standards and prepared on the basis of the HAZOP and QRA studies outlined above.

8. **Sustainability framework –** The proponent has undertaken to integrate the principles of Ecologically Sustainable Development (ESD) into the environmental, social and economic aspects of the project by developing a "Sustainability Framework." This will allow a systematic approach for the proponent to maximise and track its performance in the design, construction and operation of the facility.

5.3.2 Summary of Updated Environmental Management Commitments

Appendix 4 summarises the updated commitments made by the proponent (in addition to recommendations by the NT Government), taking into account the additional measures indicated above. Issues dealing specifically with the Bayu-Undan to Wickham Point pipeline have not been included, as they were fully considered in the previous assessment and do not apply to the current proposal to expand the land-based facility.

5.3.3 Revised Environmental Management Plans (to be included in the proponent's EMP)

5.3.3.1 Dredging and Spoil Management Plan

The proponent will prepare a *Dredging and Spoil Management Plan* that addresses potential environmental impacts and includes measures to ensure protection of the marine biota of Darwin Harbour (in particular the corals at Channel Island), and nearby aquaculture facilities. The measures will be incorporated into a Reactive Monitoring Program (RMP) that includes identification of baseline conditions, turbidity monitoring, a reactive coral monitoring program (if required), and contingency measures to be implemented if monitoring indicates adverse impacts. Development of the RMP will be done in consultation with relevant NT Government agencies.

5.3.3.2 LNG Plant EMP

The *LNG Plant EMP* will include specific management and monitoring actions to be implemented by the proponent to achieve sound environmental management of the plant site and will build on prior commitments made for the 3 MTPA facility. Potential impacts and proposed mitigation strategies will include all phases of the plant's life, i.e. site preparation, construction of plant, plant operation and post-operation.

The key environmental management issues include

- Minimisation of environmental disturbance associated with development of the plant and protection of surrounding undisturbed areas;
- Protection of remaining dry rainforest, mangroves and faunal habitat;
- Management of weeds, feral animals and bushfires;
- Protection of undisturbed archaeological and heritage sites;
- Minimisation of mangrove mud disturbance and management of actual or potential acid sulfate soils;
- Management of biting insects;
- Management of wastes and discharges resulting from construction and operation;
- Minimisation of gaseous emissions;
- Training and education of the workforce in relation to environmental management objectives; and
- Minimisation of adverse socio-economic impacts on the people of Darwin, including establishment of community liaison mechanisms.

5.3.3.3 Emergency Responses

Emergency Response Manuals (ERMs)

The proponent will prepare emergency response manuals to cover the conceivable emergency situations at the plant and marine terminal, including situations off-site that could impact these facilities. The proponent will liaise with appropriate civil and port authorities to develop an emergency plan for the entire facility, to assist in continual review of the plan and procedures, to plan and run joint training and emergency exercises, and to develop effective and efficient communications during an emergency.

Cyclone Response Procedures

The proponent recognises that cyclonic activity in the area will require the preparation of appropriate contingency plan for this event. The proponent will develop these cyclone procedures in consultation with the Darwin Port Corporation, NT Emergency Services and other government agencies involved in emergency management for the Darwin area. These procedures will also be developed by consulting established plans in place for these same events at existing facilities the proponent operates in other tropical areas, particularly the South China Sea and the Gulf of Mexico. The goal of these plans will be to ensure a well-defined procedure is in place for safety shutdown and to secure the facility as required by the movement of tropical cyclones to mitigate risk to employees, the general public, and the facility from these events. Appropriate cyclone shelters and evacuation plans will be in place for all facility personnel during the construction and operational phases of the facility and will be regularly reviewed to insure the plan is kept up-to-date.

A cyclone emergency plan will be developed to address what steps the plant will go through to secure the process area. The goal of the plan will be to leave the plant in such a state that if damage to the plant occurs as a result of a cyclone, the risk of a fire/explosion is minimised, e.g. when a cyclone is imminent, the plant will be shutdown and hydrocarbon inventory will be minimised. The infrastructure at the facility will be designed to appropriate standards to minimise the risk of significant damage from cyclones.

5.3.3.4 Oil Spill Contingency Plans (OSCPs)

As described in Section 4.12 of this Assessment report, the proponent indicated that it will prepare oil spill contingency plans to enable an effective response to an oil spill during the construction and operational phases of the project. During the construction phase, potential spills could arise from incidents involving dredges or vessels using the construction dock or loading jetty. During operations, spills could result from accidents involving LNG carriers or spillages at the loading jetty.

The OSCP for the LNG facility will be developed in consultation with the DPC and other relevant authorities, and integrated into existing Darwin Harbour OSCP.

5.3.3.5 Corporate Relations Management Plan

The proponent has developed a *Corporate Relations Plan* to ensure that the local community is informed about construction and operational activities and that key stakeholders have ready access to relevant information and personnel. The Plan will establish the following:

- A Corporate Relations Manager and Department;
- A Public and Community Relations Program;
- A Larrakia Liaison Committee;
- A CASA/Air Service Australia Liaison Link; and
- An internet web site.

5.3.3.6 Compliance auditing and reporting

In the PER, the proponent restated the commitment it made in the Preliminary EMP to be responsible for regular audits and reviews of the LNG facility's environmental and safety management, including both on-site auditing and review of performance reports.

Additional inspections and investigations will be done in the event of significant environmental incidents, in conjunction with relevant government agencies. The proponent will also meet requirements under the *Waste Management and Pollution Control Act* for any additional monitoring and reporting.

The proponent has undertaken to produce an annual audit report to DBIRD, DIPE and Environment Australia (as required) and a have a triennial review of the EMP. The proponent also intends to do internal environmental audits of the site, to enable managers to assess the day-to-day environmental management of activities at the site, including all aspects of operations that result in emissions, effluent or wastes. In addition, the proponent will do regular audits of its Environmental Management System, involving assessment of the objectives, organisational structure, responsibilities, procedures, processes and resources available at the site.

The above auditing activities will facilitate the proponent's commitment to provide annual greenhouse and energy efficiency reports as part of its Cooperative Agreement under the *Greenhouse Challenge Program* and as part of its framework for public sustainability reporting.

5.3.3.7 Decommissioning

The proponent has indicated that, at the end of the project life (estimated to be 20-25 years, with the possibility of extension if future gas reserves are available), the plant will be decommissioned in accordance with standard practice applicable at the time. Plant equipment and piping will be purged of hydrocarbons, and plant and office equipment will be sold or disassembled and sold as scrap, or disposed of in accordance with regulatory guidelines. Regulatory guidelines will also be followed for the dismantling of the construction dock and product-loading jetty.

The proponent has also undertaken to rehabilitate the site in consultation with the NT Government, if the site is not sold and will not be utilised for other purposes.

Recommendation 15

The proponent shall ensure that decommissioning is done according to the best environmental standards available at the time.

[= Recommendation 20 of Assessment Report No. 24]

6 CONCLUSIONS

The Office of Environment and Heritage (OEH) considers that the environmental issues associated with the proposed project have been adequately identified. Appropriate environmental management of some of these issues has been identified through the assessment process, whereas resolution of other matters will be achieved through monitoring and management actions detailed in a comprehensive Environmental Management Program (EMP).

In November 1998, a *Preliminary EMP* was produced (for the 3 MTPA proposal) which incorporated comments by and approval conditions set by the Commonwealth and NT Governments, based on their review of the Supplement to the Draft EIS (Dames and Moore 1998a). The proponent plans to complete the EMP for the 10 MTPA facility in stages, before the start of construction, by building on the commitments in the *Preliminary EMP* (Dames and Moore 1998b) and focusing on the additional level of potential environmental impacts associated with the expanded project. Comments submitted by the public and Northern Territory Government during the review of the PER will also be used to develop new mitigation measures for impacts associated with the proposed expansion or to revise, where appropriate, those developed for the 3 MTPA plant.

This final EMP will be subject to review and approval by relevant Northern Territory and Commonwealth Government agencies.

The EMP will be the major vehicle for implementing management and monitoring commitments made by the proponent in the PER and the recommendations detailed in this Assessment Report. As such, it will be a working document for the life of the plant and it will require continual review in the light of operational experience and changed circumstances.

The proposed expansion will have two main environmental impacts during the construction and commissioning stages of development:

- the clearing of an additional 21.6 ha of regionally-significant dry rainforest (monsoon vine thicket) which comprises a 47% increase over clearing for the 3 MTPA plant; and
- the discharge of an increased volume (not specified in the PER) of hydrotest water (possibly with chemical additives) from three LNG storage tanks instead of two and from a smaller tank for condensate.

To offset the loss of dry rainforest, the proponent is working with the Department of Infrastructure, Planning and Environment (DIPE) to identify and acquire another area of equivalent or better quality rainforest for conservation.

To mitigate potential impacts on marine biota from discharge of hydrotest water, the proponent has undertaken to work with OEH to identify appropriate treatment and release options (e.g. dilution before release, release during tidal phases that will promote further dilution and transport out of the Harbour, release at a slow rate, etc.). If analysis of the proposed formulation of hydrotest water indicates a significant potential for toxic impacts on marine life, the proponent will need to obtain a Waste Discharge Licence from OEH to release this water into Darwin Harbour and must comply with all conditions attached to that Licence.

During the operational life of the facility, the expanded development will also have several significant on-going environmental impacts:

- Perhaps the most significant of these will be a 2.5x increase in greenhouse gas emissions, particularly CO_2.

Section 4.5 of this Assessment Report discusses the implications of the increased production of CO_2, and a number of mitigating actions will be undertaken by the proponent in order to reduce or offset the production of this greenhouse gas as the operation proceeds. (The plant will also produce a number of other atmospheric pollutants; however, the proponent's modelling of "worst-case" scenarios indicates that these will be kept within national and international guideline levels.)

- Another significant potential impact associated with the proposed expansion is an increased risk for groundings, collisions or other incidents from the near doubling of visits by LNG vessels (especially the risk of oil spills).

  At peak production, vessels will berth and load LNG every two to three days (instead of once per week, for the 3 MTPA facility). The Hazard and Risk Assessment for shipping concluded that the established design, construction and operating practices of LNG vessels, combined with the Darwin Port Corporation controls and safety measures, will ensure that the risk of a major incident resulting in spills from an LNG vessel will be very small. The increased shipping is therefore considered to pose minimal additional risk compared to that for the 3 MTPA facility.

  Despite the low risk, the proponent will develop site-specific oil spill contingency plans (OSCPs) for the construction and operation phases of the project. These OSCPs will integrate effectively with the Darwin Harbour OSCP, the Commonwealth's *National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous Substances* and will identify options to utilise expertise and equipment from the industry-based Australian Marine Oil Spill Centre (Geelong).

- A third source of increased public and environmental risk will be from increased production (10 instead of 3 MTPA) and a near doubling of volumes of LNG in storage tanks at Wickham Point.

  The increased risk to people, the environment and adjacent facilities from potential incidents relating to increased production and storage of LNG was addressed in a Hazard and Risk Assessment study and report (Bechtel 2002, Appendix G of the PER). This report focuses on the main changes in risk profile between the 3 MTPA and 10 MTPA facilities: two LNG "trains" (i.e. production pathways and related infrastructure) instead of one; greater LNG storage capacity; and more frequent shipping.

  The Hazard and Risk Assessment concluded that the codes and standards governing the design and operations at the LNG plant will maintain, at an acceptably low level, potential hazards to site personnel, the public and the environment. The remote location of the plant in relation to residential areas provides a further safeguard to the public.

- Volumes of waste-water will increase nearly 2.5x, and solid and semi-liquid waste (e.g. domestic waste, oils, sludge) will increase approximately 1.7x.

  The proponent has undertaken to use treated wastewater for on-site irrigation. Discharge to the Harbour will be considered as a contingency option (e.g. during the wet season, if soils are already saturated), and a Waste Discharge Licence would have to be obtained in advance from the Office of Environment and Heritage.

  The increased levels of solid and semi-liquid wastes were re-assessed, and the proponent's analysis indicates that the range and predicted volumes of non-hazardous and hazardous wastes can be appropriately managed and disposed of safely in accordance with the provisions of the *Waste Management and Pollution Control Act*. The LNG plant will require one or more licences under this *Act* and the *Water Act* to regulate emissions to air, management of wastes and any discharges to Darwin Harbour. The proponent will be required to comply with all licence conditions and regulations under these acts, including regular compliance audits and reports.

Based on its review of the PER and the proponent's Response to Submissions from relevant NT Government agencies and the public, the Office of Environment and Heritage considers that the project can be developed and managed in a manner that avoids unacceptable environmental impacts, provided that the environmental commitments, safeguards and recommendations detailed in this Assessment Report and in the final EMP are implemented, and regular compliance auditing and reporting are undertaken.

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APPENDICES

1. **LIST OF RESPONDENTS TO THE PER**

2. **ISSUES RAISED IN SUBMISSIONS**

3. **SUMMARY OF GOVERNMENT AND PUBLIC COMMENTS ON THE PER**

4. **ENVIRONMENTAL COMMITMENTS AND SAFEGUARDS**

APPENDIX 1

LIST OF RESPONDENTS TO THE PER

SUBMISSION NO.	NAME	ORGANISATION	STATE/ TERRITORY
1	Norman Fry	Northern Land Council	NT
2	Gerry Wood MLA	Member for Nelson	NT
3	Kirsten Blair and Mark Wakeham	Environment Centre NT	NT
4	Rob Wesley-Smith	Private submission	NT
5	Margaret Clinch	Planning Action Network	NT
6	Scott Whiting	Private submission	NT
7	Rodney Wheeler	Private submission	NT
8	Duncan Dean	Save Darwin Harbour Group	NT
9	Jeff Butler	Private submission	NT
10		NT Government	NT

ISSUES RAISED IN SUBMISSIONS

ISSUE	RESPONDENT (Numbers refer to submissions in Appendix 1)										TOTAL
	1	2	3	4	5	6	7	8	9	10	
PLANNING:											
Location of plant			√	√	√	√	√	√		√	7
Future expansion	√	√		√							3
Management of adjacent areas for conservation										√	1
Zoning		√			√					√	3
WASTE MANAGEMENT & POLLUTION CONTROL:											
Hydrotest water (composition, risks from discharge)	√		√	√			√			√	5
Discharge of treated effluent (including sewage) & stormwater	√						√	√		√	4
Sanitation facilities (construction phase)										√	1
Irrigation with treated wastewater	√						√	√	√	√	5
Wastewater recycling within plant	√										1
Waste management (hazardous & non-hazardous; recycling)	√			√						√	3
Management of waste vegetation (construction phase)										√	1
Dredging				√						√	2
Contamination on-site	√										1
Contamination of food fish	√							√			2
Contamination of Darwin Harbour		√			√		√	√			4
Atmospheric emissions (adequacy of modelling, acid rain, smog, odours)	√				√			√	√	√	5
Greenhouse gas emissions (quantification, offsets & re-injection)		√	√	√	√			√	√	√	7
Visual impacts (amenity & lighting)		√			√			√		√	4
Noise				√				√		√	3
ECOLOGICAL IMPACTS:											
Dry rainforest (removal, mitigation & offset areas)	√									√	2
Mangroves (removal/disposal & monitoring)										√	1
Dugongs, dolphins, turtles, fish & birds (including threatened & vulnerable species)			√			√		√		√	4
Fauna corridors										√	1
Fire, weeds and feral animals										√	1
Modelling for long term impacts	√										1
	1	2	3	4	5	6	7	8	9	10	

	1	2	3	4	5	6	7	8	9	10	
HAZARDS & RISKS:											
Cyclones, earthquakes, lightning strikes & storm-urge			√	√	√			√		√	**5**
Public risk					√					√	**2**
Shipping risk (grounding, collision, oil spills & exotic marine pests)				√		√	√	√		√	**5**
Aviation risks (from flares)		√	√	√	√	√	√	√		√	**8**
Terrorist act								√			**1**
OTHER ISSUES:											
Archaeological/Heritage sites & objects					√					√	**2**
Aboriginal Sacred Sites & Authority Certificate										√	**1**
Impacts of rock groynes		√									**1**
Impacts on tourism					√			√			**2**
Environmental Management Program & Plans	√				√		√			√	**4**
Restricted maritime access	√				√						**2**
Utilities (power, water & fuel gas)			√					√	√	√	**4**
Turbines (steam instead of gas & more efficient models)	√		√							√	**3**
East Timor (socio-economic & political issues)				√	√						**2**
Inadequate time for public review of PER							√				**1**
Work health issues (including biting insects							√			√	**2**
Pipeline issues					√		√				**2**
Mercury in domestic (industrial) gas supply										√	**1**
Increased run-off to Darwin Harbour										√	**1**
Increased road traffic (construction phase)										√	**1**
Road transport of hazardous waste										√	**1**
Erosion & sediment control										√	**1**
Acid sulfate soils										√	**1**
Fuel storage on-site										√	**1**
Environmental performance of proponent's other LNG plants										√	**1**
Size of construction workforce										√	**1**
Economic benefits for Darwin, the NT and the Commonwealth	√									√	**2**
Flaring (other than potential impact on aviation)	√										**1**
Relocation of LPG production to offshore	√										**1**
Financial responsibility for disasters or environmental damage							√				**1**
Decommissioning/Rehabilitation										√	**1**

SUMMARY OF GOVERNMENT AGENCY AND PUBLIC COMMENTS ON THE PER

AUTHOR	COMMENTS
NT GOVERNMENT	• Request for reports on new archaeological discoveries associated with project for site monitoring purposes. • New discoveries to be reported to the Office of Environment and Heritage during site construction. • Currently there are satisfactory protection and mitigation measures for all archaeological sites identified on site, which may be impacted by the proposal. • Requirement to identify long term protection measures for the remnants of the Mud Island Leprosarium. (Site MA17) • Requirement for reconfirmation of stated procedure (Effect No. LNGP 8, *Preliminary EMP* 1998), regarding discovery of additional archaeological sites during construction phase. • Recommend on-site archaeologist during site clearing activities for advice on assessment and preliminary management of any cultural material discovered. • Archaeological sites register to be established and site management commitments to be provided in detail.
NT GOVERNMENT	• No special reference to Aboriginal sacred sites within the PER. • No Authority certificate currently applies to the project. • Phillips Company is advised to seek an Authority Certificate for the project.
NT GOVERNMENT	• Acquiring dry rainforest as a greenhouse emissions offset mitigation measure requires further consideration, especially in relation to long term land management issues. • In addition to vegetation sinks and geological sequestration, it is suggested that non-vegetation related greenhouse offset options be investigated by the proponent. Offset projects related to the NT would be appropriate. • All cleared vegetation should be used for revegetation. • Management of waste vegetation should avoid potential greenhouse emissions caused by stockpiling vegetation. • Increased SO_2 emissions and the potential environmental impacts on the local environment require more discussion. • Reasons for including acid gas incinerator and hence increasing SO_2 emissions not clearly explained. • Air monitoring for the project could include SO_2.
NT GOVERNMENT	• Deforestation abatement is not a Kyoto option but has the potential to be a domestic trading option. • Oil mallee carbon offsets over pine and eucalypt plantations may change over time due to Australia's ratification position (Kyoto) and future carbon accounting modalities. • Overall offset studies accurate but limited in scope. • Post Kyoto ratification price for CO_2 equivalents is likely to be higher due to demand. • Proposed mitigation options (waste heat recovery, ship vapour recovery, upgrade of the frame 5D turbines) are all likely to be profitability efficiency improvements of which greenhouse abatement is a favourable consequence. They should not be considered mitigation options.

	• Use of high nitrogen content fuel would reduce NO_x concentrations but the greenhouse implications of this are not clear. NO_x is not listed as a greenhouse gas. • Greenhouse emissions from the plant are estimated to be 4.6 Mt of CO_2 equivalent annually or approximately 50% of NT emissions and 1% of Australia's annual emissions. • No legally binding emissions restrictions if Australia does not ratify Kyoto Protocol.
NT GOVERNMENT	• Identify type of hydrotest water (whether seawater or freshwater) and establish monitoring techniques, which will ensure compliance with discharge threshold criteria. • Potential impacts of mercury in domestic gas supply. • Request for average anticipated water use during construction stage and wastewater treatment strategies including treatment and monitoring of chemicals entering the CPI oil in water separator unit. • Impacts of noise from jetty pile installation on behaviour of local fauna. • Request to recheck SO_2 calculations in PER. • SO_2 emissions from plant have a maximum design concentration of 706 TPA rather than the 141 TPA modelled. It is recommended that variation in feed gas on SO_2 emissions be addressed by the proponent. • Variation in feed gas and associated emissions should be modelled and compared to threshold triggers in the *National Environmental Protection Measure for Ambient Air Quality*. • Suggestion that modelling be revised for predicted emission scenarios, including those for maximum design capacities. • Waste disposal options discussed may not be available for the duration of the project. Alternative disposal options should be considered. Has consultation with local disposal facilities been conducted regarding future capacity to accept estimated waste volumes? • Do waste figures per annum take into account the construction phase? • What arrangements have been made to dispose of spent amine? • If activated carbon beds are to be disposed of to landfill who will maintain responsibility for any contamination issues arising in the future? In addition, what alternative options are available for treatment /disposal of carbon beds? • Weeds may be come a problem in cleared areas outside the site boundary due to increased human activity and importation of other materials from outside the area. • Proponent will need to comply with the *Weed Management Act* and any weed management plan that may be approved for the region, district or shire, including the Wickham point area. The proponent acknowledges this issue and is preparing a site management plan, which includes vehicle wash-down and inspection procedures. • Water quality impacts of dredging may impact the activities of the Darwin Aquaculture Centre (DAC). Small changes in water quality and sediment load may affect DAC experiments and production. The DAC requests to be advised when dredging will commence so it may implement measures to minimise potential impacts on its activities. • Water quality is critical to the DAC; therefore, the DAC requests advice on discharge of wastewater, water quality and discharge volumes. • The DAC is relatively close to the new development and is taking water from the harbour. Information on the exact chemicals to be added to hydrotest water would be appreciated. • The DAC requests advice on discharge of hydrotest water and timing, so preventative measures and monitoring may be conducted. • Runoff volumes from the site have not been provided. Runoff volumes, if considerable, may impact water quality.

	• If increased sediment loads impact water quality at the DAC's operations, the proponent may want to consider upgrading the Centre's filtration system, as part of their environmental management program. • Each LNG tanker entering Darwin Harbour has the potential to discharge 48,000m^3 of ballast water. Phillips may wish to contribute to maintaining the rigorous exotic pests program currently conducted for Darwin Harbour. • Impacts of installation of the pipeline may result in alienation of recreational, indigenous and commercial fishing activities. • Impacts of high intensity sound and continuous noise activity may be responsible for reduced catch rates. • Concerns regarding impacts of increased turbidity on marine species, their prey, habitat requirements and feeding patterns. • Issue of restrictions of pipeline corridor on anchoring for recreational fishers.
NT GOVERNMENT	• PER contains only limited analysis of the significantly increased road traffic generated by construction and operation of the facility. • Assessment of hazardous goods transported is warranted, especially in relation to sensitive environments and population centres, which materials will traverse. • Public risk from transportation of hazardous goods should be assessed.
NT GOVERNMENT	• In light of the NT Government's plan to construct an access road, the continued requirement for a construction dock is queried. • The hydrodynamic modelling of Darwin Harbour conducted for the original proposal in 1997 should be revised to incorporate updates of the Darwin Harbour model. • Recommendation that a Erosion and Sediment Control Plan be prepared and submitted to DIPE Natural Resources Division for approval. • Recommendation that the land at the western end of Wickham Point be rezoned open conservation. In addition, ensure that the coastal buffer of at least 50m along the shoreline on the landward or eastern side of the development and down both sides of Wickham Point be protected. • Site disturbance has the potential to expose acid sulphate soils. It is recommended that a geotechnical investigation and analytical testing of proposed disturbance sites to identify any potential for acid leachate generation be conducted. Investigations will assist with development of short and longer term management strategies to mitigate the impacts of acid sulfate soils. • If potential acid sulfate soils are encountered, a management plan should be prepared in conjunction with the DIPE. The plan should include treatment options and monitoring regime to permit early detection of acid leachate on site. • Caution to be exercised during construction phase with regard to exposure of potentially acid sulfate soils. • Disturbance of mangroves to remain within designated areas. • Geo-technical advice to be sought, regarding placement of fill material over in-situ vegetation because of potential for land subsidence. • Mangroves not salvaged should be removed from site and taken to a green waste disposal site. Disposal offsite will reduce potential breeding habitats for biting insects on-site. • Revision of mangrove monitoring programs, committed to in 1998 EMP, is required to reflect changes in knowledge and experience with regard to mangrove monitoring. Revisions should be made with specific reference to mangroves in Darwin Harbour. • Mangrove monitoring program to be prepared in conjunction with DIPE (Natural Resources Division). • Conservation of the remnant parcel of land at the tip of Wickham Point.

NT GOVERNMENT	• PER does not indicate location or operation of wastewater reuse area. This discussion should include mechanisms by which disposal is to be achieved and how treated effluent reuse will comply with DHCS requirements and NWQMS guidelines. • Stormwater drainage construction for operational phase to be designed to minimise scour velocities in high volume flows. • Construction phase stormwater management to reference local advice and guidelines for erosion and sediment control. • More research is required to characterise material that is to be dredged, including development of a decision matrix to assist with assessing disposal options for dredge spoil. • Use of seawater as primary fluid for hydrotest. Use of potable water considered to be a waste of resource and expensive. Seawater should be utilised if there is no undue risk of corrosion or other detrimental impacts on facility infrastructure.
NT GOVERNMENT	• Wastewater discharge not adequately defined in terms of potential volumes. Further discussion is required in minimising source water cross contamination to reduce potential volumes requiring treatment. Options may include separation of wastewater streams. • Reuse of treated sewage effluent requires discussion including volume of holding tanks, location and substrate over which the irrigation water will be sprayed and any impact this will have on the stormwater runoff path. • Proponent needs to consider other waste disposal options and treatment measures rather than rely on Shoal Bay as a disposal option, especially when some of the wastes generated are inappropriate for disposal at the facility. • More detail required for reuse of dredge spoil. • More detail required for proposed recycling facility of building materials including, will the facility be on site, the basis for deciding the value and reuse of materials and contingency to control unrestricted disposal by contractors. • Disposal of sludges, alternative methods of treatment and capacity of local landfills to accept sludges requires further consideration. In addition, alternative methods should be presented for disposal/reuse of ceramic balls, cellulose and molecular sieves where disposal to landfill is inappropriate. • What alternative options for waste oil disposal are available if Mataranka Lime Kilns were to cease accepting waste oil due to availability of cheaper fuel source (potentially LNG). Does Phillips have the capacity to stockpile waste oil in Darwin? • The impacts of construction noise should be considered and mitigation measures undertaken if required. Due to temporal and physical characteristics of the adjacent environment, modelling of noise contours is suggested. • Fuel storage on site should comply with AS 1940-1993. • The PER does not provide enough detailed information about waste management and minimisation options for various waste streams, including any contingency planning in the event of market variation in disposal options.
NT GOVERNMENT	• There appears to be no reference to tidal surge at Wickham Point in the event of a cyclone. Parts of Wickham Point would be subject to tidal surge and may affect the LNG plant; this point should be addressed.
NT GOVERNMENT	• Current land zoning at Wickham point is Future Use. The designation of the plants operation is best defined as "Offensive or Hazardous Industry" and would need rezoning under the *Litchfield Area Plan 1992*. The proposed *Litchfield Planning Concepts and Land Use Objectives* identify this area as having future industrial potential. DIPE will undertake to rezone the land to reflect this intention.

	• Consent for vegetation clearance not required because less than 50% of the total lot size is proposed for clearance, in accordance with clause 22.5 Removal of Native Vegetation • Developer to be made responsible for control of biting insects, in accordance with Department of Health and Community Services recommendations. • Appropriate clearances from the Aboriginal Areas Protection Authority and Heritage Conservation Services (of OEH) should be sought prior to disturbance of any archaeological sites. • No indication given in the report to the force of destructive winds and heavy rainfall associated with cyclonic activities. Heavy rainfall associated with cyclonic activity may make the connector road from Channel Island to Wickham Point impassable. The developer should therefore construct cyclone shelters on-site. • Soil types, characteristics and potential for acid leachate generation have not been adequately described in the PER. Additional sampling to identify acid sulfate soils should be conducted, especially with reference to acid leachate weakening concrete structures. If investigations identify a problem, management strategies will need to be developed. • *Litchfield Shire Seasonally Waterlogged Soils Map* identifies that a considerable percentage of the site is subject to severe waterlogging or inundation for extended periods. • Fill not required on site, as there is an excess resulting from site cutting volumes. Excess fill maybe sold to local market or provided to government. • Side-casting into the harbour should be avoided. • Section 4.3.9 (Dredging Spoil and Disposal Impacts) does not identify disposal options for dredged material. This is of particular relevance if disposal may impact coral communities adjacent Channel Island. • Additional information including details on the location of the effluent treatment system, management and disposal of dredge spoils, potential acid sulphate soils management and adequate cyclone shelters should be incorporated into the PER. • Ongoing management, monitoring and operation of the plant could be detailed in the EMP.
NT GOVERNMENT	• Proposed greenhouse offsets require careful consideration as arrangements for this proposal may set precedents for future projects and possible expansions. • Land is within the draft lease boundaries developed in 1999, has Native Title clearance and there is no impediment to proceeding with the revised offer and lease taking into account the proposed variations.
NT GOVERNMENT	• Land zoned under Future Uses in *Litchfield Area Plan 1992* and will require rezoning and development consent to facilitate the planned development. • Rezoning is intended during finalisation of the *Litchfield Planning Concepts and Land Use Objectives* and consequential amendments to the *Litchfield Area Plan.*
NT GOVERNMENT	• Greatest potential for creation of new mosquito breeding sites will arise from disturbances by construction activities in or near tidal areas. • Construction companies are urged to adhere to specific guidelines (Construction Practice Near Tidal Areas In the Northern Territory-Guidelines To Prevent Mosquito Breeding, Whelan 1988) • Drains to be of concrete construction and be designed to ensure flow will continue despite relatively small volumes (e.g. dry season). • Drains to discharge to suitable endpoints. Each endpoint should have erosion protection to prevent creation of a plunge pool.

	• Silt traps to be constructed at all silt entry points and to require a minimum of maintenance. Silt traps to contain low flow inserts. • Rectification of mosquito breeding sites by draining or filling potential breeding sites as discussed in Section 4.4 of *Biting Insects of Medical Importance at Wickham Point, Darwin Harbour.* • Sprinkler dispersal of treated sewage should conform to National Health and Medical Research Council *Guidelines for Reuse of Wastewater*. Sprinkler to be moved once a week to prevent waterlogging of ground near sprinkler heads. • Siting of any high use personnel areas, particularly those used in the morning and evening, should be in the southwest section of the island to minimise contact with *Culicoides ornatus.* • Advisable that all personnel are provided with information about personal protection from mosquitoes and biting midges. In this regard the DHCS has produced a publication "Personal Protection from Mosquitos and Biting Midges in the NT 1997". • With a maximum workforce during construction of 1600 it is unlikely that portable toilets will be sufficient to treat sanitary waste. May need more permanent facilities installed. • PER does not provide anticipated effluent criteria for the process water and potentially contaminated storm water nor treatment thresholds. • Treatment and Disposal of wastewater will need to comply with the Site Specific Type Approval by the DHCS. • Treatment and disposal systems must comply with the *Code of Practice for Small On Site Sewerage and Sullage Treatment Systems and the Disposal and Reuse of Sewage Effluent.* • The proponent should discuss Naturally Occurring Radioactive Materials (NORM's), especially if disposal is required, and any associated requirement for protection for on-site personnel. In addition, will any radioactive sources or irradiating materials be used for the purposes of operating the plant? If so, operations will need to comply with the respective provisions of the *Radiation (Safety Control) Act.*
NT GOVERNMENT	• Consider the acquisition of dry rainforest area for conservation purposes appropriate; however a requirement to identify area of dry rainforest to be protected and who will pay. Details of proposal are important due to increased size of area to be cleared. • Recommendation that Phillips pay for dry rainforest acquired and contribute financially to fencing and management. • Dry rainforest area to be protected should be much larger than the area cleared for construction of the plant. If a precedent is set then this measure will ensure that the majority of dry rainforest in the region will be conserved. • Protection and management should be viewed as improving an area's ecological integrity by for example 10%. In this case the area protected could be ten times the area destroyed, which has had a100% reduction in ecological integrity. • Protection of surrounding ecosystems is integral to conserving an area of dry rainforest due to the reliance of fauna and flora on external habitats for foraging; therefore, the area conserved must be larger that the area which will be cleared. • Wildlife corridor presented in the original EIS is not present in the new proposal, and it is not considered that this loss can be mitigated. The loss of the corridor adds further weight to reach an agreement on protecting rainforest patches and associated surroundings. • Disposal of 11 cubic metres of water per day is noted. Surrounding dry rainforest should not be irrigated with this water. Doing so might lead to a loss of ecological integrity.

NT GOVERNMENT	• Proponent to make clear where and how fauna corridors will operate. • Greenhouse offsets in the PER are far from clear. Greenhouse offsets should be resolved and commitments made prior to the plant being put into operation. • Statement on threatened species incorrect. Three species of IUCN listed vulnerable seahorses have not been investigated. • Three seahorse species in the harbour are considered vulnerable by IUCN. One of theses species appears to be dependent on mangrove and rock mangrove habitats. • Thirteen species of fish found in Darwin harbour, including the three species of seahorse, were listed as threatened in a report prepared by the NSW Fisheries Research Institute and the Australian Museum. A conservation overview has been submitted to Environment Australia, which is still processing the submission. • Coral communities identified in plate 8 exist close to each end of the bridge not just at the place identified. • Predicted emissions appear to be close to "ambient standards" (especially NO_2 levels) and would not take much to exceed those thresholds, ie in a worst case scenario. Air dispersion modelling indicates significant levels close to ambient levels of NO_x will occur over the Darwin CBD and northern suburbs. The PER does not discuss acid rain or the long term environmental and health exposure to these pollutants. • Greenhouse gases from the expanded LNG plant are considerable. The proponent does not state how exactly they are going to compensate for this. This issue must be resolved. • LNG releases have the potential to reach and affect occupied buildings and perhaps the proposed new highway. In Appendix G (p 23) it is stated "that these potential situations will be reviewed as the project progresses" The department considers that this should be have been reviewed in the PER. • The risk assessment does not deal with catastrophic environmental influences, i.e. lightning strikes. It is suggested that maps be provided showing the effects of worst case scenario (catastrophic) incidents at the plant. • Risk assessment issues of proximity of the LNG plant to the CBD and other future developments, during the life of the plant, should have been clearly spelt out in a non-technical way in the PER.
NT GOVERNMENT	• Use of vapour recovery equipment is supported, as it will lower the cumulative impact of emissions in the Darwin airshed. • Discharges of treated effluent and potential contaminated stormwater and the cumulative impacts on Darwin Harbour should be considered, especially impacts on nearby aquaculture projects and PAWA discharges from waste water treatment plants. Proponent should check with DIPE (Natural Resources Division) on the hydrodynamics involved. • It should be acknowledged that emission levels from the Channel Island power station are generally low and have no detrimental effect on regional air quality. • PAWA is satisfied that ground level NO_x concentrations arising from the operation of Channel Island and the LNG plant will not impact regional air quality. • Any proposals to significantly increase NO_x emissions from any upgrade or expansion of the LNG plant should be referred to PAWA for comment.

NT GOVERNMENT	• Phillips should provide the NT Government copies of environmental performance reports for its plant at Kenai and for the Atlantic LNG plant (with Phillips technology but run by another energy company) in Trinidad. In particular, the frequency and extent of incidents with safety or environmental risks (e.g. gas leaks, oil spills at plant or from cargo ships, explosions, etc.). • How does Phillips plan to treat and/or dispose of mercury stripped from the natural gas? Phillips should include this in their Environmental Management Program (e.g. Waste Management Plan). • Why is only 25% of the construction workforce to come from Darwin? • Which standards or specifications will apply to fuel storage to ensure that bunds will fully contain the largest possible spill and that sumps are appropriately located? • Because of the risk of generating extensive and/or persistent sediment plumes, side-casting would be permitted only if Phillips could demonstrate (e.g. by seabed sediment analysis and hydrodynamic modelling) that material would be coarse enough to settle out quickly, e.g. gravel, rubble, coarse sand. Also, as part of the EMP, Phillips will have to produce a Dredging and Dredge Spoil Management Plan for approval by DIPE. • Darwin is subject to 2-3 "Cyclone Watches" each wet season; therefore, Phillips needs to specify the risks and responses to these annual events, especially in terms of shutdowns and safeguards. • Phillips will need to obtain a Waste Discharge Licence to discharge treated effluent to Darwin Harbour. • If a vessel is required to leave the loading dock when cyclonic winds are anticipated, where will the vessel go? Are there safe havens in the Harbour or will they be forced to put to sea? The risk of groundings and collisions must be avoided to prevent an oil spill in the Harbour, as mangrove forests are particularly vulnerable to damage from spills (i.e. hard to protect, easy to kill and nearly impossible to clean and rehabilitate). Phillips will need to provide answers to the above questions in its Emergency Response Plan(s). • The paragraph under Sec 4.2.1 indicates that the "total area of land disturbed would increase from 66.8 ha to 100 ha; however, the first dot point in the 2nd par of Sec 4.2.2 indicates that the increase of "ground disturbance" would be 88.3 ha. Phillips needs to confirm the actual amount of disturbance to build the 10 MTPA plant. • The PER indicates that H_2S from amine unit will be burned to produce *80.6 kg/hr* SO_2*;* however, Table 4.2 reports total annual emissions at *130 MTPA*. These differing units make it hard for the reader to determine the significance of this source to the total annual SO_2 output. • The PER indicates that various vapour and heat recovery technologies will reduce emissions; however, Phillips does not specify the actual reduction in volumes, except for NOx. Also, will emissions remain less than NEPM limits during the dry season with its substantial contributions of particulates from bushfires? • The PER does not discuss the generation or mitigation of odours. If odours will not be generated, then this needs to be stated explicitly. If there are odours to on-site personnel only or to people off-site (e.g. if strong winds blowing from the plant to the CBD occur), Phillips needs to discuss this potential impact and its mitigation. • Phillips will discharge clean stormwater from the clean parts of the site via drains into the "intertidal zone at selected points adjacent to the site"; however, the nature of the substrata at these sites is not specified. The risk of erosion needs to be addressed; ie the potential will be greater if water is discharged onto exposed sand- or mud flats vs. mangrove forest.

	• The proposed figure for discharge of hydrotest water is 90,000 to 100,000 m^3; however, the combined volume of the LNG storage tanks alone is 360,000 m^3 and doesn't include other storage tanks (eg. condensate). Does this mean that the tanks need not be filled to test their integrity? Phillips needs to describe the likely toxicity and persistence of the chemical additives to the hydrotest water and discuss other options to direct disposal (eg. treatment, transport off-site, etc.). • Phillips needs to include impacts of detonations (to level portions of the site not amenable to earthmovers) on noise levels. • Phillips indicates that during upset and emergency operating conditions, the "noise levels…will tend to be higher than … for normal operating conditions; however, these sources will be of short duration and very infrequent." Phillips needs to provide a more quantitative indication of the increase, duration and frequency. • Phillips also indicates that flares will not present undue risk to local air traffic; however, more information is needed for the reader to judge the nature and extent of this risk and any proposed mitigation. Further, the PER mentions ground and marine flares, wet and dry flares but background information is not adequate for the reader to understand the differences and how wet and dry flares relate to the ground and marine flares. • Phillips indicates that "the most significant heritage site on Wickham Point (MA17) will not be disturbed by construction activities"; however, Figures 3.11 and 3.12 show the road/bridge from the future man-made Goyder Island running straight through this area. • As indicated in the NT's PER Guidelines (p 5), Phillips needs to confirm that the boundaries of the 10 MTPA plant conform to the Authority Certificate previously issued by AAPA to Phillips or obtain a new or revised Certificate to cover the new "footprint." • Phillips needs to ensure the efficiency and effectiveness of its immediate response to an oil spill by frequent drills (wherein response personnel access and assemble response equipment, initiate communication and reporting networks, etc.) and desk-top exercises.
NT GOVERNMENT	• The NT Government and Phillips have been consulting on work health requirements. These were essentially notifications of work and submission to the department of appropriate safety plans/cases. In addition, discussion was undertaken identifying the requirements for compliance with the National Code of Practice for Major Hazard Facilities.
NT GOVERNMENT	• The PER indicates that there are no tidal constraints for vessels up to 11.5m in draft; this is not correct. Minor high points in the access channel require removal. The additional dredging can be undertaken using the same equipment and environmental controls for dredging activity associated with the construction dock. • Restriction in the access channel would be experienced at Charles Point Patches presently 12.2 m at low water. • Berthing and departure procedures for LNG carriers will require verification for all tide and wind states. Verification will establish any restrictions that will apply to vessel navigation. • The final EMP should be updated to reflect the present status of East Arm Port and future development plans.

NORTHERN LAND COUNCIL	• No characterisation of contaminants likely to be present in hydrotest water. • No characterisation of the process water or the proposed treatment system for that water. Without these data, the proposal to dispose of treated process water by irrigation cannot be adequately assessed. • Inadequate description of solid and semi-solid waste disposal. Contractors should be bound by conditions specified in the final EMP. • Clearing of dry rainforest should be staged to avoid unnecessary removal of this significant habitat (if portions of this habitat can remain within the disturbance footprint). Flares should be sited elsewhere to preserve areas of dry rainforest. • Local ecosystems (including vegetation in non-populated areas south of Darwin) could be adversely affected by "acid rain." Modelling should have included variables for humidity and precipitation. • Sulphur removal from the flare gas should be presented on a cost/benefit basis on available technology. • No predictive modelling was presented for long term ecological impact, e.g. insufficient characterisation of wastewater; therefore, cannot assess impact on biota and ecosystems in the long term. • Predictive modelling of airborne contaminants over the life of the plant is not possible without the inclusion of humidity and precipitation data. • The proponent should have sufficient data, based on its other plants, to provide estimates of contaminant accumulation or ecological degradation over time. • The EMP included in the PER is insufficient in detail to be assessed at this stage. The NLC would appreciate the opportunity to be involved in planning, preparation and on-going approval of the EMP. • As the 9 MTPA plant was not approved, it is inappropriate to use it for comparisons to the 3 and 10 MTPA plants in the PER. • Given the daily emission rates (water, air), it is difficult to accept the assertion that it will be a "clean" plant. • It is uncertain if the second train will be constructed. The implication is that approval of this proposal would result in a greater degree of disturbance than might be necessary for a 5 MTPA plant. • Use of this area by local fishermen (indigenous or otherwise) is not highlighted in the PER. The risk exists to the local fishery and to the safety of consuming the local catch. • On the basis of information in the PER, there are no means to assess the project in terms of royalties and other payments to the Commonwealth. • It is uncertain whether industrial benefits from the project will flow through to the Northern Territory, especially if no other fields are accessible to the proponent. • The proponent is willing to participate in an Australian venture to advance the use of mallee oil and wood as fuel for power generation, and the support of such a significant "player" has the potential to kick-start the nascent industry. The consultants engaged to do this portion of the PER have provided a very good document on current alternatives. • The employment opportunities presented by the proponent are welcomed within the NT economy, which otherwise rests on a poor skills resource base. • The contribution to the three economies (local, Territory and national) is welcome and undeniable, although not detailed in the PER. • The redesign of the on-site flare into a ground level system has advantages and disadvantages, the main disadvantage being the increased area of disturbance arising from such an arrangement. There is a need to balance aesthetic, environmental and risk considerations. • The relocation of most of the LPG liquefaction to offshore removes a potential source of contamination from the onshore facility and should be seen as a positive move as long as the process is well managed offshore.

GERRY WOOD MLA **(MEMBER FOR NELSON)**	• **CO_2 emissions**: Phillips shows a figure of 18,000 tonnes/day. What are the actual offsets or gains that can be shown in reducing this amount in a global context? • **Industrial pollution**: What controls are in place to stop general industrial pollution into the Harbour, e.g. oils? • **Rock groyne**: Will the rock groyne used as part of the jetty construction cause a change in currents that may cause other effects? Could pipes be placed through the groyne to allow for some movement of water under that part of the jetty? • **Peak Hill removal**: Will removal of part of Peak hill for fill mean that the LNG tanks will be more visible because part of the hill will have been removed? • **Future expansion**: Is there any intention to use any of the land outside the site boundary for future expansion of the project? • **Zoning**: Why does Figure 3.11 show a portion of Section 1860 taking over all of Peak Hill and including a right of way to the jetty and mangroves? Section 1860 should include the site only. The rest of the land should be Crown Land, zoned OC (Open Conservation). The public should have some access to the area and Peak Hill may allow some future opportunities for that to occur, e.g. viewing from the middle of Darwin Harbour (limited tourism). • **Effect on air traffic**: What effect will the plant have on Darwin Airport and the approaches? • **Light pollution**: Will there be any controls to reduce light pollution emanating from the site, so that the night sky is affected as little as possible?
ENVIRONMENT CENTRE NT **(KIRSTEN BLAIR & MARK WAKEHAM)**	• Major industrial development, of which this facility is just the first example, is not compatible with the significant ecological values of Darwin Harbour. • The PER does not provide adequate information about the impact of habitat loss on federally listed migratory species, such as the Melville Cicadabird and the White-Bellied Sea Eagle. • The impact of this development on dugongs, green turtles and hawksbill turtles is not adequately addressed. • With no clear information about the lifespan of either the construction or operational phases, it is impossible to estimate the total water requirement of this proposal. • There is insufficient information about the contaminant levels in the hydrotest water, proposed for discharge into Darwin Harbour. • Passing reference is made to the fact that this development is proposed within an area of high cyclonic activity. It is suggested the potential for cyclones (including wind-loading) be considered in the design of the facility. • There is no mention of mitigating any storm surge that may be associated with a cyclone, particularly if this occurred in conjunction with a high tide. • The PER states that "the use of LNG and natural gas as a preferred fuel for existing and new facilities, in place of alternative fossil fuels, will reduce global greenhouse emissions in accordance with the objectives of the Kyoto Protocol." No evidence is, however, provided. • The "no-regrets" measures are made contingent upon the "terms of any LNG sales and feed gas purchase agreements that are eventually executed." This is clearly not commitment enough. • Phillips does not appear to have explored in the PER all the potential mitigation options that may be available, e.g. steam turbines, flash gas, • Phillips does not appear to have explored whether it is possible to substantially reduce the emissions from the acid gas removal process.

	• The ECNT does not consider the offsetting of emissions through vegetative sinks (such as mallee plantation) to be a particularly useful approach. First and foremost, emissions need to be reduced at the source.
ROB WESLEY-SMITH	• Now that Phillips has approval for a 3 MTPA plant at Wickham Point, it is now relatively easier to expand this to 10 MTPA. This was no doubt a tactic. • Vastly more acceptable to the people of Darwin if the plant had not been located in the middle of the Harbour, a few km upwind of the CBD. • Phillips previous management used various pressure tactics to get the East Timor Government and the community to quickly approve the project and the LNG plant • Phillips downplays the ability of hardwood forests in the NT to ameliorate the carbon releases. Doing this locally should not be dismissed out of hand. On Wickham Point some plantings may be a good end use for excess freshwater and may be used to soften the outline of the plant. • The Los Palos area of East Timor would be a good area, subject to local wishes, for a large reforestation project. • CO_2 at 10 MTPA is to be released at 5 MTPA. This and other greenhouse gas emissions are too high. Since there is quite a bit of CO_2 in the gas from Bayu-Undan, best practice would be to ensure that it is extracted at the wellhead and pumped back into an underground reservoir. • Released gases will have a maximum concentration over the CBD, which is not acceptable. • CO_2 on a warm plume will attract insects, which will attract birds and pose a big hazard to aircraft. • Details were insufficient on the treatment and safe disposal of gases and oil sludge. • Some feel-good projects could be for Phillips to operate only new technology 'green cars,' to support solar and wind/tide research programs, even to subsidise solar panels in East Timor and remote NT. • More positive noise barriers/diversions need to be in place. • Dredging will create lots of sediment that could smother local reefs. • The greatest danger will come from 200 ship movements per year a few hundred metres from the Navy Base breakwater and point at Larrakeyah, and the consequences of coming upon the rocks. Maybe a buffer barrier should be built around this area. • Phillips could facilitate ensuring that the MoA does not jeopardise East Timor's rightful maritime boundaries.
THE PLANNING ACTION NETWORK (PLAN) **(MARGARET CLINCH)**	• The proposed LNG plant on Wickham Point is incompatible with tourism, and its impact would far outlive the life of the plant as well as reducing the Darwin airport's operational capability. • A highly visible petrochemical plant will raise alarm and a lasting impression that may well counter our tourism profile in the future. The operations of fishing charters will be restricted (because of exclusion zones). • Phillips' previous management used various pressure tactics to get the East Timor Government and the community to quickly approve the project and the LNG plant. • The omission of detail regarding the issues surrounding flight paths and the location of the LNG plant needs to be rectified and made public. No risk analysis of the impact of the LNG plant on aircraft operations was done. If alterations occur to flight paths, this could then displace aircraft over more populated areas. • Phillips is negotiating with CASA to increase flight path height, which will increase aircraft operational risk (from reduced visibility).

	• Lightning effects have not been considered in the report. • It is assumed that lightning arresters will be installed; therefore, the strike intensity will only increase and this will increase the risk to aviation. • The EIS and PER do not study the impact of the production flares and full-time lighting on insect communities and higher trophic levels. • Litchfield Land Use Objectives promote most of the Ware peninsula region as an industrial area. Assessment for this area was lacking in scope, especially aviation. • The EIS and PER fail to adequately assess the risks of chemicals other than LNG. • Phillips put forward the necessity for a 3 km buffer zone. This does not equate with the current proposed Section 1860 and 1861. • LNG and natural gas have the same general properties, i.e. are an asphyxiation hazard and can, "in the absence of an ignition source, result in a plume that could migrate downwind for a considerable distance." • Phillips will be removing Aboriginal archaeological remnants and also WWII ruins. The historical context will be lost for these sites. Would this be the case if the LNG plant were in the Glyde Point region? • That the pipeline route into the Harbour is within metres of both American and Australian War Graves is alarming. • This particular area is subject to seismic effects, as illustrated by a recent *NT News* article, dated 17 April 2001. • Australia was recently reported to be already 33% above the Kyoto Protocol in terms of GHG. The target for GHG was meant to be 8%. This shows a need for caution. • Modelling done for emissions was done with data from Darwin airport. Data from Channel Island monitoring stations show that wind strengths and directions are noticeably different. These differences need to be modelled.
SCOTT WHITING	• The potential disturbance to dugongs and turtles in the vicinity of Channel Island cannot be dismissed as easily as saying that the construction and operation of the LNG shipping and port is 4 km away. Increased boat traffic and noise can displace the local population. • Preliminary data on dugong movements in the Darwin Region will be available in the near future. • No reference is supplied for statement "Seagrasses in Darwin Harbour are known to occur off Mandorah, and between Channel Island and the mainland." • Flatback turtle has been listed with the wrong species name (on p 3-20); the correct name is *Natator depressus*. • The bottlenose dolphin also occurs in the Harbour. • The comment that a 'dugong and turtle habitat project currently underway will provide definitive mapping of favourable habitats within the Harbour' is misleading – the project will add data on distribution of dugongs, habitat use and movements, and will not be "definitive." • Important reefs and intertidal areas around Channel Island are not shown on the map.

R.L.K. WHEELER	• To have a project of this nature handling an extremely volatile liquid product, less than 5 km to the Darwin CBD is frightening. • Having the facility located at Glyde Point would appear to effectively remove the risks and many of the problems with Darwin Harbour option has. • Areas of concern are the methanol manufacturing and oiled petrochemical manufacturers who inevitably will follow and be located adjacent to the LNG project. • How safe is the pipeline that is to run into and down the Harbour? • What about ships at anchor, dragging anchors in storms. Will the pipeline be buried to avoid snagging anchors or anchor damage to the pipeline? • How many ships will use the Harbour and what size will they be? • Has any consideration been made regarding the grounding of an LNG tanker on the reefs external to the Harbour? • Have various environmental issues been fully and independently assessed and honestly addressed? • Have disaster plans been considered? Will training, hospitals and emergency services be capable of handling a possible disaster? • Who will foot the bill if such a disaster occurs. • What responsibility will multi-nationals really accept for damage if it is incurred? • Will the companies concerned be footing the bill for removal and restoration of the land and Harbour disturbed by their operation? • Closeness and implications of defence establishments and effects on aviation. • Effects on the environment from wastewater used for irrigation. • What measures will be used to ensure the environmental health and safety issues are fully complied with, including OH&S matters for employees? • Is Darwin to become just another ugly, polluted and congested industrial city on the edge of a cesspool of a Harbour for the sake of progress and the almighty dollar?
JEFF BUTLER	• If all gas from Bayu-Undan will be processed for export to Japan, where will Phillips be accessing fuel to run the plant at Wickham Point? Note: gas reserves from Mereenie and Palm Valley will run out over the next few years, so this source will not be available. • Although Phillips indicates that the increase in greenhouse emissions from the expanded facility will be somewhat offset in a global sense by use in Japan rather than coal, diesel, etc., the NT will not directly benefit, and, in fact, will lose greenhouse "credits" because of Phillips' emissions. Can Phillips demonstrate offsets that are of direct benefit to the NT? • The plant will be producing 12 m^3/day of wastewater and, at the public forum, Phillips indicated that ALL of this would be treated for irrigation. What will be irrigated, and how will Phillips deal with treating the different types of wastewater (considering that the different streams will have different types and quantities of contaminants)? Does Phillips recognise that their proposal will require a significant level of staffing to achieve its proposed plan? • Considering the wind direction during the dry season and "build-up" (to the wet season) will flow from the proposed Phillips site across to Darwin, or at times to Palmerston, to what extent will odours from the plant be discernable to residents at these locations?

THE SAVE DARWIN HARBOUR GROUP **(DUNCAN DEAN)**	• The proposal by Phillips to build a 10 MTPA LNG plant on Wickham Point, opposite the CBD in Darwin Harbour, rather than at Glyde point on the Gunn Peninsula is a serious threat for the people of Darwin. • Large quantities of treated effluent from the plant would be irrigated onto the land surrounding the plant with excess effluent running off or being pumped into Darwin Harbour. • Discharges to the Harbour threaten the marine biota. • Occasional flares will occur at the plant and this could dramatically increase the amount of pollutants released. • The flares pose a risk to aviation, either directly or by entraining insects and thus birds. • If current flight paths are diverted, aircraft noise will impact the public. • The project would seriously detract from the Territory's outback image. • The plant would generate industrial lighting pollution. • A cyclone could cause a catastrophic incident at the plant. • The plant would increase the risk of terrorist attack on Darwin. • The project would put additional strain on the water supply.

ENVIRONMENTAL COMMITMENTS AND SAFEGUARDS

The following table summarises environmental commitments made by the proponent and additional safeguards arising from review of the PER. The commitments/safeguards have been taken from the PER; from the proponent's Response to Submissions (from the NT Government and the public); from the current Environmental Assessment Report (No. 39); and from the previous Assessment Report in 1998 (No. 24, for the EIS for the 3 MTPA LNG facility).

NOTE: Table 5.1 in the PER presents a similar summary of the proponent's environmental management commitments and safeguards. In developing the final EMP for the 10 MTPA facility, the proponent should refer to both documents and consult with relevant NT Government agencies to reconcile variations in approaches between these two summary tables.

COMMITMENT/ SAFEGUARD	PAGE REFERENCES				RECOMMENDATION from Assess't Report 39
	PER	Proponent's Response to Submissions	Assessment Report 39	Assessment Report 24	[Recommendation from Assess't Report 24]
PLANNING & FUTURE EXPANSION					
Proponent will liaise with DIPE regarding future management of northern tip of Wickham Point (Section 1861).		19, 35	11		
Any proposed expansion beyond the 10 MTPA plant or changes to operations that substantially increase emissions (especially NO_x) will require further assessment under the NT *Environmental Assessment Act*.		48	12, 14	11, 12	2 [3]
ATMOSPHERIC EMISSIONS					
Proponent will quantify major emission sources during commissioning, by emission testing programs; if required, monitoring will be done for NO_x to ensure compliance with NEPM standards; procedures will be developed in consultation with OEH.	4-5, 5-3	20, 43	13	28, 29	3 [13]
Acid gas incinerator, management of wastes by professional contractors and other measures will prevent production of off-site odours.		21, 22, 62	16		
To further reduce atmospheric emissions and ensure that the best environmental and economic choices are made, the proponent will continue to evaluate alternative turbine combustion technology during the design phase of the project.	4-5				

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
GREENHOUSE GAS EMISSIONS					
The project will incorporate a waste heat recovery system from the gas turbine exhaust and use it for various heating requirements. (This will mitigate the release of greenhouse gas emissions that would have been released if gas fired equipment were used to provide the same heating requirements.)	4-12				
A ship vapour recovery system will be used to minimise or eliminate flaring of gas generated during LNG tanker loading and resulting in greenhouse gas emissions.	4-13				
During design and construction phases, proponent will continue to evaluate offset options, including vegetation-related offsets and geological sequestration (= reinjection offshore) and options for reducing greenhouse gas emissions.	4-12 to 4-17	24, 47	16	29, 30	4 [14]
Consideration of vegetation-related offsets will include projects in East Timor and others specifically of benefit to the Northern Territory. For the latter, the proponent will work with the Greenhouse Unit of the NT OEH.		24, 50, 52	17	29, 30	
The EMP will contain a specific section on strategies to reduce greenhouse gas emissions, including provision for audits, a process of regular review of new technologies, benchmarking against other LNG facilities (to achieve international best practice), and consideration of offsets.			17	30	4 [14]
The proponent will liaise with the NT OEH in developing its Greenhouse Strategy, and the strategy will be provided to Environment Australia.			17	30	4 [14]
As part of the proponent's commitment to participate in the Commonwealth Government's Greenhouse Challenge Program, the proponent will develop a detailed Cooperative Agreement with the Australian Greenhouse Office which will outline: • An inventory of GHG emissions from the facility; • An action plan to minimise emissions; • Performance indicators to measure progress; and • A forecast of expected abatement of GHG emissions over a set time period.	4-16				

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
FLARING					
The proponent will continue to work with consultants, CASA and other relevant agencies to identify, quantify and mitigate any impacts to airspace from flaring.	4-17, 5-10	8, 48, 54	17	35	5 [16]
TEMPORARY SANITATION FACILITIES (Construction Phase)					
The proponent, through its main contractor, will establish procedures for collection and off-site disposal of waste products, and methods will comply with regulations of the DHCS.		5	18		
HYDROTEST WATER					
The proponent will further consider the option of using sea-water (instead of freshwater) if risks from corrosion can be sufficiently minimised and adequate cleaning tanks prior to commissioning proves feasible.	4-17, 5-3	25	19		6
If hydrotest water will contain toxic additives, the proponent will obtain a Waste Discharge Licence which will require full analysis of the hydrotest water and environmental monitoring to ensure adequate dilution and dispersion reduce risks to marine biota to an acceptable level. Before discharging such hydrotest water, the proponent will provide adequate notice to nearby aquaculturists to allow time to implement desired precautionary measures.		4, 26, 43	19		
IRRIGATION WITH WASTEWATER & STORMWATER					
To minimise discharge of wastewater and stormwater to the Harbour, the proponent will treat this water and use it to irrigate vegetation on-site, except for contingent events (such as wet season saturation).	4-17, 5-3	4, 8, 43	19	16, 30	
Low volumes of treated sewage will be pumped to a sewage treatment plant and treated effluent will be routed to an irrigation system after dechlorination. Holding tanks for treated effluent will allow testing to ensure the water quality is suitable for irrigation.	4-17				
Treatment and disposal by irrigation of all wastewater will comply with relevant NT and Commonwealth guidelines for re-use of wastewater. This will require to proponent to do detailed site assessments and submit findings to DHCS for *Site Specific Type Approval.*	4-17	8, 26, 43	20	17, 30	7 [8]

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
The proponent will liaise with DIPE, DHCS and other NT Government agencies to design the most environmentally-appropriate irrigation system for the site.	4-17	8, 43	20	17, 30	7 [8]
The proponent will evaluate (during the design phase) the feasibility and benefit of using local hardwoods for landscaping and soaking up wastewater used for irrigation.		52	20		
To avoid impacts on the ecological integrity of surrounding dry rainforest, treated effluent will not be used to irrigate this vegetation.		26	20		
DISCHARGE OF WASTEWATER & STORMWATER TO DARWIN HARBOUR					
The proponent has indicated that there will be no point-source discharge of wastewater to the Harbour from construction activities or temporary facilities during the construction phase.		11	39		
Uncontaminated stormwater will be segregated from potentially contaminated streams and disposed of by direct discharge to adjacent waters. Stormwater collected within the process area will be routed to a drain sump and oily derivatives removed prior to discharge.	4-17	11, 12	20		
Once the design of the wastewater treatment system is completed, the proponent will confirm with DIPE the conditions under which direct discharge to the Harbour may be done (in contingency situations). If such discharge is considered a risk to nearby aquaculturists, the proponent will model likely trajectories and liaise with these facilities to develop contingency plans to protect their operations. The proponent will need a Waste Discharge Licence to release treated effluent to the Harbour.		8, 11, 12, 43	21	30	
POTENTIAL FOR RADIOACTIVE WASTE STREAMS					
Although levels of naturally occurring radioactive materials (NORMs) in the feed gas will be low, the proponent will comply with all applicable NT regulations and guidelines should there be any radioactive wastes requiring disposal.		31, 32	21		

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
DISPOSAL OF SOLID & SEMI-LIQUID WASTES					
The proponent will actively pursue waste minimisation and recycling opportunities to reduce solid and semi-liquid waste streams where possible. An *Operational Waste Management Plan*, prepared as part of the EMP, will further detail the proponent's approach to managing these wastes.	5-4	43	22	32	
Non-hazardous wastes (e.g. ceramic balls, biological sludge and domestic garbage) will be disposed of by waste management contractors and will meet requirements of OEH.	4-19				
Wastes not suitable for disposal at the Shoal Bay Waste Disposal Site (e.g. waste oils, biological sludge and spent solvents) will be disposed of by commercial waste management contractors. The proponent will review waste-tracking documentation to ensure these wastes are disposed in a manner approved by OEH.		27	22		
CONSTRUCTION WASTES					
Where practical, the proponent will use cleared terrestrial vegetation and/or mangroves for rehabilitation. Cleared vegetation will not be stockpiled on-site (to avoid creating breeding habitat for biting insects).	4-18	27, 37	22		
Stockpiled vegetation will be burnt only as a last resort (as a disposal method).	4-18				
To avoid land subsidence, geo-technical advice will be sought if vegetation will be left in place and covered with fill.		27, 37	22		
Removal of domestic wastewater will be contracted to a local waste management company and the proponent will require waste tracking documentation to ensure disposal meets the requirements of OEH, DHCS and PAWA.	4-18				
Waste oils will be collected and disposed of properly through a commercial waste management contractor.	4-18				
A temporary area will be established for stockpiling scrap metal, which will be collected for off-site recycling and/or disposal. Construction wastes will not be disposed of on-site.		28	22		

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
A full description of the proponent's plans for management of construction wastes will be included in the *Construction Environmental Management Plan* (as part of the EMP)			23	26	
SPENT AMINE					
The plant design will facilitate collection and re-use of amine. If disposal is required, the proponent will include options for disposal in its *Operational Waste Management Plan* prepared as part of the EMP.		28	23		
CARBON BEDS (containing waste mercury)					
The proponent recognises that carbon beds containing mercury may not be suitable for disposal at any landfill site and will include options for treatment and disposal in its *Operational Waste Management Plan.*		28	23		
WASTE OIL (Operational Phase)					
The proponent will liaise with OEH to develop preferred and contingency plans for management of waste oil.		29	23, 24		8
DREDGING & DISPOSAL OF SPOIL					
The proponent will develop a *Dredge and Spoil Management Plan* as part of its EMP in consultation with the DPC, OEH and DBIRD (Fisheries). This *Plan* will include further characterisation of sea-bed sediments (to refine predictions about plumes) and a "Reactive Monitoring Program" (to detect and deal with unacceptably high turbidity from dredge-related activities). Monitoring will include ensuring the continued health of coral assemblages at Channel Island.	5-4	6	24, 25	15	9 [6]
The proponent will need to apply for a Waste Discharge Licence for either side-casting spoil directly into the Harbour (if this activity is permitted) or discharge of decant water from land-based settlement ponds.		6	24	14	
To avoid unacceptable cumulative impacts from discharge from both Wickham Point and East Arm Port (if dredging for these coincide) and to facilitate use of suitable spoil from the LNG project for the Port project, the proponent will liase with the DPC and OEH to coordinate their dredging schedules and monitoring programs.	5-4		24		

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
The proponent will liaise with OEH to ensure that dredging works are done in an acceptable manner and that excess dredge material will be managed and disposed of to the satisfaction of OEH.	5-4				
The proponent will liaise with nearby aquaculturists to avoid unacceptable impacts on their operations from plumes generated from dredging activities.		7			
SHIPPING					
To minimise the risk of grounding or collision, shipping movements will be coordinated through the DPC, including escort by tugs to and from the loading jetty and with the RAN. A 500 m "moving exclusion zone" around each ship is proposed. The navigational risk associated with shoals of Charles Point Patches will be addressed by continued liaison between the proponent and the DPC.	4-26	9	26	36	
To minimise the potential for direct or indirect disturbance to dugongs off Wickham Point, LNG tanker speeds will be kept at an appropriately low level within the Harbour, as agreed with NT Government authorities.	4-28				
To minimise risks to dugongs and sea turtles that forage around Channel Island, LNG shipping operations will remain away from the Channel Island area.	4-28				
To minimise potential damage from grounding, collision or other incident, the proponent will prepare, maintain, test and review Emergency Response Plans, LNG Accident Response Plans and Oil Spill Contingency Plans (prepared in consultation with the DPC, DIPE [Marine Branch] and other relevant NT Government agencies).	5-2	59	26, 27	36, 37	10 [18] & 11 [19]
LNG carriers will be designed, constructed, maintained and operated in compliance with international standards and subject to regular survey and inspection by vessel Classification Societies.	4-25				
Recognised international guidelines will be used in the design and construction of the LNG jetty and in the establishment of operating procedures for ship manoeuvres and cargo transfer.	4-25				

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
RESTRICTED PUBLIC ACCESS					
Recreational fishing off the northern tip of Wickham Point will not be affected by the LNG plant: the only restrictions will be adjacent to the loading jetty and construction dock, both of which are well away from the area of greatest fishing interest. There will be no restriction of access to landing in the region of the old leprosarium.	4-29				
HAZARD & RISK ANALYSIS					
During the detailed design phase, the proponent will complete the following: • A final HAZOP (Hazard & Operability) Study, to identify all potential scenarios involving failure of valves/controls and other upset conditions; • A final QRA (Quantitative Risk Assessment), to identify, assess, evaluate and manage all potential risks associated with the project; and • A detailed Safety Report for the LNG plant, in accordance with relevant Worksafe Australia Standards and prepared on the basis of the HAZOP and QRA studies above.	4-24, 5-4, 5-8	40	28	32, 33	
All practicable measures to prevent hazardous incidents and to mitigate their consequences will be adopted.	4-25				
TRANSPORT OF HAZARDOUS MATERIALS					
The proponent will do an assessment of hazardous wastes transported to and from the facility and prepare contingency plans to deal with any accidental spillage.		36	29		
INCREASED ROAD TRAFFIC (Construction Phase)					
Use of the road network for transport of materials and equipment will be in keeping with DIPE regulations and is not expected to have significant impact on commuter traffic.	4-30				
Potential road damage from the transport of heavy equipment will be avoided or minimised through use of barges to the construction dock.	4-30				

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
SAFETY REPORT					
The proponent will consult with relevant NT Government agencies (during the detailed design phase) during development of a comprehensive Safety Report that meets the requirements of the *National Code of Practice for Major Hazard Facilities.*	4-24, 5-4, 5-8	39, 40	29	33	
CLEARING OF VEGETATION					
Clearing of vegetation will be staged to meet the minimal requirements of constructing and operating the plant.		43, 445	30		
The proponent's EMP will include measures aimed specifically at minimising loss and disturbance to remaining dry rainforest and mangrove habitat at Wickham Point, inlcuding measures to monitor and control weed and feral animal incursions, and measures to minimise fire risks.	4-28	38	30	22	12 [11]
SELECTION OF DRY RAINFOREST OFFSET AREA(S)					
The proponent will continue to liaise with DIPE to identify an acceptable dry rainforest mitigation strategy, including identification of an appropriate area (size and location).	5-4	38	31		
MONITORING OF MANGROVES					
Monitoring of mangroves adjacent to the facility will be done by the proponent. The proponent will liaise with DIPE and NTU to ensure that current and appropriate methodology (for the measurement of productivity is used.	5-2	37	31		
FAUNA CORRIDORS					
If required by DIPE, the proponent will mitigate the potential obstacle the construction groyne might pose to faunal movements, by constructing earth ramps.	5-4	38	31	24	
MARINE BIOTA					
The proponent will mitigate risk to marine biota by minimising the discharge of potential contaminants into the Harbour and by enduring that discharges comply with relevant guidelines of the *National Water Quality Management Strategy Guidelines* and with all requirements of any Waste Discharge Licences for the project.		11	32	30, 31	

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
FIRE, WEEDS & FERAL PESTS					
In consultation with DIPE, the proponent will produce and implement a comprehensive weed management plan prior to construction of the facility.	4-28	33	32	22, 23	
All activities will fully comply with requirements of the *Weeds Management Act.*		33	32		
A Site Management Plan will include provisions for • Cleaning and inspection of construction equipment prior to deployment on site; • Monitoring for introductions (of weeds and feral pests) and their subsequent removal; and • Fire prevention and control.	4-28				
EXOTIC MARINE PESTS					
All shipping under control of the proponent will comply with the Australian regulations for the management of ballast water and general AQIS guidelines to ensure no ballast water exchange occurs within or near Darwin Harbour.	5-7	34	32	32	
The proponent will liaise with DBIRD regarding the exotic marine pests monitoring program and mitigation of potential impacts from vessels servicing the facility.		34	32	32	
NOISE					
In the event that pile-driving is considered necessary, the proponent will model potential noise impacts on the residents of Darwin and Palmerston. If findings indicate a significant potential for disturbance, a *Noise Management Plan* will be prepared, in consultation with OEH and implemented by the proponent.		29, 30	33		
In the unanticipated event that explosives are required (e.g. to prepare site for construction), noise reduction measures, such as the use of weighted blankets, will be adopted.	2-10, 4-20	30	33		
A detailed modelling study will be done after completion of the design phase to refine preliminary predictions of noise generation.	4-23				
To minimise risk of disturbance to the public, construction work will be done during daylight hours, when background levels of noise at the nearest populated areas will be greatest.		30	33		

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
The proponent will ensure that noise during construction and operation of the plant will be managed to the satisfaction of OEH and comply with the *Waste Management and Pollution Control (Environmental Noise) Regulations* (when these come into effect).		30	33, 34		
BITING INSECTS					
To avoid creating mosquito breeding areas, the proponent will comply with the NT Government's guidelines *"Construction Practice near Tidal Areas in the Northern Territory – Guidelines to Prevent Mosquito Breeding*" (Whelan 1988).	5-6	2, 15	34	16, 21	
The proponent will prepare a detailed *Biting Insects Management Plan* to comply with requirements of the DHCS and to include in the final EMP.		15, 16	34		
Personal protection of employees from biting midges will be employed and induction training implemented to ensure that the problem is managed in accordance with recommendations by DHCS, and the proponent's approach will be detailed in the EMP.		16	34		
RADIATION					
Although the occupational risk from radiation is considered to be low, the proponent will develop procedures for protecting personnel from naturally occurring radioactive materials (NORM) that may be associated with the LNG feed gas (e.g. during plant shutdown and maintenance).		31, 32	34, 35		
When final equipment selection is done (during the design phase), any apparatus that is likely to contain radiation sources and/or irradiating equipment will be identified, and operation of this equipment will comply with provisions of the NT *Radiation (Safety Control) Act.*		32	34, 35		
LIGHT EMISSION (at night)					
To avoid unacceptable impacts, the proponent will investigate (during the design phase) opportunities to minimise light emission at night.		48	35		
CONSTRUCTION WORKFORCE					
The proponent will commission a skills audit of the Darwin region to update their information on availability of skilled construction workers in the local labour market.		3	35		

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
DISCOVERY OF ARCHAEOLOGICAL/HERITAGE SITES & ARTEFACTS					
Five "highly significant" prehistoric middens (MA12, MA 13, MA 15, MA 18 AND MA 22) within or adjacent to the development footprint will be protected by erecting fencing around it and prohibiting entry and heavy machinery access to within 20 m.	4-28				
For Sites MA 14, MA 16, MA 19 and MA 21, the proponent will obtain a permit to remove the middens, under Section 29 of the *Heritage Conservation Act.*	4-28				
Newly discovered Site MH 4 is also likely to be subject to an application for disturbance and is currently the subject of further investigation in cooperation with the NT Heritage Conservation Branch (of OEH).	4-28				
The proponent will continue to work with OEH to establish a comprehensive procedure for the discovery of archaeological/historic sites, which will be completed by the proponent during development of the Construction EMP and endorsed by OEH before construction begins.		17, 35	36, 37		
The proponent will continue to work with OEH to establish an *Archaeological Sites Register for Wickham Point.*		17	37	26	
The proponent supports a proposal by OEH to have an archaeologist on-site during initial land clearing, or alternatively be on alert to enable a rapid response and assessment should any additional sites or objects be discovered during clearing activities.		35	37		
To comply with the *Heritage Conservation Act*, the proponent will inform OEH of any new archaeological sites or features discovered prior to or during the construction and operational phases of the project.		17	37	26	
On discovery of new archaeological sites or objects, vegetation clearing and other threatening activity will cease in the area of the site until OEH has a chance to inspect the site and advise on when/how the threatening activity can recommence.			37	26	

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
ABORIGINAL SACRED SITES					
The proponent will consult with AAPA and confirm that no sacred sites or burial sites will be affected by the proposed expansion to a 10 MTPA facility and will continue to liaise with this agency on an ongoing basis prior to and during the construction phase.	4-29	35	37		
A current Authority Certificate will be obtained from AAPA prior to commencement of any on-site works.		36	37		
The proponent will establish a "Heritage Issues Committee," comprising representatives from OEH, AAPA and the Larrakia Association, to act as an advisory body for procedures regarding sacred sites and burial sites on Wickham Point.	4-29	35, 36	37		
EROSION & CONTROL OF SEDIMENTATION					
The proponent will submit, as part of their EMP, a draft *Erosion and Sedimentation Control Plan* to DIPE for approval prior to any construction works. This *Plan* will confirm key drainage flows across the site and specify a range of management measures to minimise erosion and siltation of the surrounding environment during plant construction and operation.	5-6	36	38	12, 21, 31	
ACID SULFATE SOILS					
The proponent will prepare an *Acid Sulfate Soil Management Plan* to cover areas within the footprint of the 10 MTPA plant. The *Plan* will include ground-truthing to confirm areas on-site that may be at risk from acid sulfate soil characteristics and procedures to be adhered to by the construction contractor.		37	38	16	13 [7]
The *Acid Sulfate Soil Management Plan* will include monitoring of leachate from any soil or spoil retention ares and reclamation areas, and contingency measures in the event leachate is found to be unacceptably acidic. The *Plan* will be submitted to DIPE for review and endorsement prior to the commencement of construction.		37	38	16	13 [7]

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
FUEL STORAGE					
Fuel storage at the facility will fully comply with AS 1940 (1993) requirements for "*The storage and handling of flammable and combustible liquids*" on-site, including adequacy of bunds to fully contain the largest potential spill (and water from a 24-hr rainfall event), properly-sited and maintained sumps, synthetic liners under tanks and drums, and a comprehensive inspection and emergency response systems.	2-12	5	39		
SUSTAINABILITY					
The proponent's EMP will address sustainability issues in a "triple bottom line" approach, integrating environmental, social/cultural and economic factors. These factors will become "Key Result Areas," with "Key Performance Indicators" determined for each area.	4-33, 5-4	39	40		
REVISED/ FINAL ENVIRONMENTAL MANAGEMENT PROGRAM					
The proponent will prepare an *LNG Plant Environmental Management Plan* that will include specific management and monitoring actions to be implemented by the proponent to achieve sound environmental management of the plant site and will build on prior commitments made for the 3 MTPA facility. Potential impacts and associated mitigation strategies will include all phases of the plant's life.	5-1		41, 42, 43	10, 11	
The final EMP will be based on all matters involving regulatory compliance as well as corporate requirements to ensure the facility has an appropriate and effective Health, Safety and Environmental Management System.	5-1	44	41	10, 11	14 [2]
Final plans to be integrated into the EMP will incorporate consideration of the additional level of risk associated with the expanded project and advice from the NT Government and Environment Australia.			42		14[2]
The EMP will be referred to relevant NT agencies and Environment Australia for review prior to finalisation, after which it will become a public document.		44	42	10, 11	14[2]

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
EMERGENCY RESPONSE PLANS					
Emergency Response Manuals					
The proponent will prepare emergency response manuals to cover the conceivable emergency situations at the plant and marine terminal, including situations off-site that could impact these facilities. The proponent will liaise with appropriate civil and port authorities to develop an emergency plan for the entire facility, to assist in continual review of the plan and procedures, to plan and run joint training and emergency exercises, and to develop effective and efficient communications during an emergency.	5-8	39, 40	44	34	[15]
Cyclone Response Procedures					
To ensure a well-defined procedure is in place for safety shutdown and to secure the facility, the proponent will develop a cyclone contingency plan in consultation with the Darwin Port Corporation, NT Emergency Services and other government agencies involved in emergency management for the Darwin, Palmerston and Litchfield region. This plan will mitigate risk to employees, the general public and the facility, and the infrastructure at the plant will be designed to minimise the risk of significant damage from cyclones.		15, 49	44		
When a cyclone is imminent, the plant will be shutdown and hydrocarbon inventory will be minimised.			45		
CORPORATE RELATIONS MANAGEMENT PLAN					
The proponent's *Corporate Relations Management Plan* will establish the following: • A Corporate Relations Manager and Department; • A Public and Community Relations Program; • A Larrakia Liaison Committee; • A CASA/Air Service Australia Liaison Link; and • An internet web site.	5-9		45	25	

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
COMPLIANCE AUDITING & REPORTING					
The proponent will be responsible for regular audits and reviews of the facility's environmental and safety management, including both on-site auditing and review of performance reports.	5-10		45		
Additional inspections will be done in the event of significant environmental incidents, in conjunction with relevant government authorities.	5-10		45		
The proponent will meet requirements for any additional monitoring and reporting under the *Waste Management and Pollution Control Act.*	5-10		45		
The proponent will produce an annual audit report to DBIRD, DIPE and Environment Australia (as required) and have a triennial review of the EMP.	5-10		45		
The proponent will do regular audits of its Environmental Management System, including assessment of the objectives, organisational structure, responsibilities, procedures, processes and resources available at the site.	5-10		45		
MONITORING COMMITMENTS					
For the 10 MTPA project, the proponent will build on the following monitoring commitments made for the 3 MTPA plant: • Abundance of weeds and feral animals in undisturbed areas of Wickham Point; • Abundance of biting insects within the plant site; • Effects of dredging on the coral communities of Channel Island and northeast Wickham Point; • Productivity of mangroves adjacent to the plant site; • Quantity, quality and methods of disposal of construction and operational wastes; • Confirmation of the quantity and quality of atmospheric emissions; • Volumes and quality of wastewater discharges, including effluent dispersion studies; • Concentrations of heavy metals, TBT and total petroleum hydrocarbons (TPH) in the marine sediments and selected marine biota in the vicinity of the jetty and construction dock ; and • Contributing to monitoring programs for introduced noxious marine pests.	5-2 to 5.3				

COMMITMENT/SAFEGUARD	PER	RESPONSE	E.A.R. 39	E.A.R. 24	RECOMMENDATION
DECOMMISSIONING					
At the end of the project life (estimated at 20-25 years), the plant will be decommissioned in accordance with the best environmental standards applicable at the time.	5-10		46	38	20 [24]
Plant equipment and piping will be purged of hydrocarbons, and plant and office equipment will be sold or disassembled and sold as scrap, or disposed of in accordance with regulatory guidelines. Regulatory guidelines will also be followed for dismantling of the construction dock and product-loading jetty.	5-11		46	38	
The proponent will rehabilitate the site in consultation with the NT Government, if the site is not sold and will not be used for other purposes.	5-11		46	38	