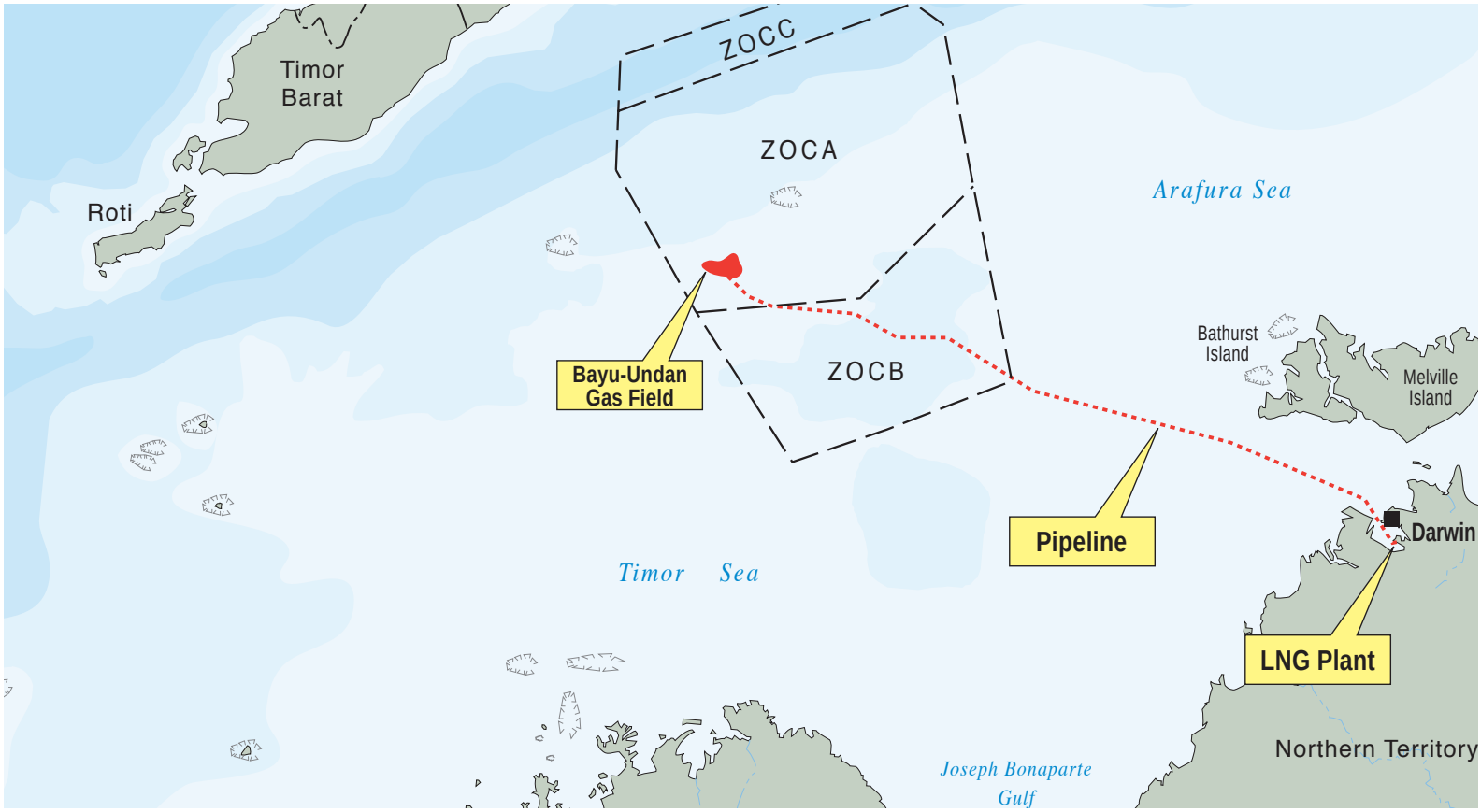

DARWIN LNG PLANT

Supplement to
Draft Environmental Impact Statement

DAMES & MOORE PTY LTD
A DAMES & MOORE COMPANY

PHILLIPS OIL COMPANY AUSTRALIA

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I. INTRODUCTION

I.1 PURPOSE OF THIS DOCUMENT

The purpose of this document is to respond to submissions made on the *Darwin LNG Plant Draft Environmental Impact Statement* produced by Phillips Oil Company Australia. The document was available for government and public review from 2 August until 29 September 1997. The deadline for submission of comments was 29 September 1997.

This Supplement provides detailed responses to comments made and questions raised in the submissions and also provides information on project-related changes made as a result of the consultation process. It also updates several aspects of the project with information developed since the Draft EIS was written. In particular, it provides a revised site plan, information on possible expansion to nine million tonnes per annum (MTPA), an updated draft of the Environmental Management Plan for the EIS and a summary of commitments.

This Supplement, plus the original Draft Environmental Impact Statement (EIS), constitute the final EIS for the proposed Darwin LNG Plant. It now forms the basis for government decisions which require consideration of the environmental implications of the proposed project.

Copies of the Supplement have been sent to the relevant Commonwealth and Northern Territory government departments and to all individuals and organisations who provided submissions on the Draft EIS.

I.2 STRUCTURE OF THIS DOCUMENT

Roman numerals are used in this Supplement to indicate sections of the document. Standard numbering used in Section III of this Supplement refers to sections in the Draft EIS. Similarly, Appendices in this document are numbered 1 to 9, whereas Appendices in the Draft EIS were presented alphabetically (A-O). This numbering system has been adopted to minimise confusion in referencing the relevant documents (i.e. the Draft EIS or Supplement).

This document comprises text and appendices. The text presents seven sections as follows:

I. An Introduction which outlines the number and source of submissions received, presents a summary of issues raised in submissions and describes some proposed modifications to the project.

II. A brief Erratum.

III. Responses to all submissions received are provided in this section. Each submission is presented (in summary form) in italics and the response is provided immediately below. Section III.1 presents submissions received on the main text of the Draft EIS (Volume 1), while Section III.2 presents submissions received on the appendices to the Draft EIS (Volumes 2 and 3).

The submissions are presented according to the section in the Draft EIS to which they refer to enable cross-referencing to the Draft EIS. The source of the submission is also identified to enable the originators of the submissions to identify responses to their comments and questions.

IV. A revised Environmental Management Plan (EMP) is presented in this section. The original EMP presented in Section 8 of the Draft EIS has been amended and updated as a result of both submissions received and additional planning work undertaken by Phillips and its contractors.

V. A summary of commitments made by Phillips.

VI. References used in responses to the submission comments.

VII. An acknowledgment of the assistance provided by a number of government officers and members of the study team in producing this Supplement.

Eight appendices are presented as follows:

1. Summary of Northern Territory Government submissions.

2. Summary of Commonwealth Government submissions.

3. Summary of submissions received from public and community groups.

4. An assessment of the potential effects of a fully expanded three process train LNG plant of 9 MTPA capacity.

5. A supplementary anthropology report which presents the results of further consultations with the Larakia.

6. Correspondence from the Northern Territory Power and Water Authority which describes a proposal to supply power to the LNG plant from the Channel Island Power Station. This is an option being considered by Phillips as an alternative to producing power at the LNG plant.

7. Phillips' response to two public submissions received from East Timorese community and action groups.

8. A preliminary geotechnical review of potential dredging and spoil disposal requirements for the LNG project.

I.3 ASSESSMENT PROCESS FOR THIS SUPPLEMENT

The Final EIS will be assessed under both the Northern Territory *Environmental Assessment Act* 1982 and the Commonwealth *Environment Protection (Impact of Proposals) Act* 1974. Under Clauses 12 to 14 of the NT *Environmental Assessment Act* Administrative Procedures, 35 days are allowed for the review of the Supplement by the Department of Lands, Planning and Environment (in consultation with relevant departments and agencies), development and consideration of advice on the results of the assessment, and the passing of recommendations from the Environment Minister to the Minister responsible for approving the project. Provision exists for the extension of this time frame under certain circumstances; for example, if the Minister requires more information to assist in the review of the proposal.

A similar process and slightly longer time frame exists under the Commonwealth Act. Under Paragraphs 8.1 to 9.5 of the Administrative Procedures, a time period of 42 days is allowed following the submission of the Final EIS. During this period, Environment Australia reviews the Supplement and reports to the Environment Minister, and the Minister provides advice and recommendations on the results of the assessment to the Action Minister or other relevant Minister. Paragraph 9.2 outlines situations in which the time frame can be extended.

The Western Australian Government will also be advised of the results of the environmental assessment since part of the pipeline passes through WA waters.

I.4 NUMBER AND SOURCE OF SUBMISSIONS RECEIVED

One joint submission from departments and authorities of the Northern Territory Government was forwarded by the NT Department of Lands, Planning and Environment (Appendix 1). One joint submission was submitted for all Commonwealth government departments and agencies by Environment Australia (Appendix 2). Each of these submissions included comments and questions from a number of departments within the respective governments. In addition, there were 10 submissions from private individuals and local government and non-government organisations. These submissions were summarised by the Northern Territory Department of Lands, Planning and Environment and the summary is presented in Appendix 3.

I.5 SUMMARY OF ISSUES RAISED IN SUBMISSIONS

Table I.1 presents a full list of submissions for which responses are provided in this Supplement and a brief summary of the topic raised. Full responses are provided in Section III. The submissions included a total of 167 specific comments covering all eight chapters of the Draft EIS and three of the appendices. Submissions were received on 89 separate sections of the Draft EIS. As would be expected, the largest number of submissions (51) were received on Section 7 of the Draft EIS, which assessed the impacts of the proposal, and Section 8 (42), which detailed the proposed Environmental Management Programme.

Many submissions were received on the following points:

- need to provide additional information on the release of greenhouse gas emissions;
- need to address the potential effect of a three train or 9 MTPA (fully expanded) LNG plant;
- more detail required on the effect of subsea pipeline construction and release of hydrotest water;
- more detail on source and volume of rock armour required for pipeline;
- more detail on access road design, construction, management and monitoring;
- justify need for solid groyne in loading jetty, temporary reclamation area, spill impoundment area in mangroves, and need to discharge wastewater directly into harbour;
- need to protect and document additional maritime heritage sites to those reported in the Draft EIS, particularly the *SS Ellengowan*;
- need to address spiritual significance of Wickham Point to Larakia Nation by further consultation;
- concern over turbidity caused by marine construction activities and effects on corals and potential loss of corals;
- importance of protecting Channel Island corals;
- concern over visual impacts of plant during the day and the flare at night;
- potential effects of pipeline rupture;
- management of acid soils;
- need for additional monitoring; and
- need to address public risk aspects of LNG plant.

I. Introduction

Table I.1

Summary of Submissions

Source	EIS Section	Issue	Page No. in Supplement
NLC	1.3	What is life of project?	17
NT	2.2	Planning and licensing issues (including Table 2.1)	13, 17
NT	2.2	Emergency procedures and NT requirements	13
Cwlth	3.2	No Development option	18
ECNT	4.2	Onshore/offshore comparison	19
GANT	4.2	Alternative site selection inadequately addressed	20
ECNT	4.3.1	Incorporate Native Title issue on Cox Peninsula	20
NT	4.3.1	Address effects of 9MTPA LNG Plant	20
PB	4.3.1	---------- --"----------	20
ECNT	4.3.1	----------"----------	20
NLC	4.3.1	----------"----------	20
GANT	4.3.1	----------"----------	20
Cwlth	4.3.1	Site selection	21
PB	4.3.3.2	Margaret Point is better site than Wickham Point	21
LSC	4.3.3.2	Why not build at Gunn Point?	21
Cwlth	4.4	Pipeline route selection	21
ECNT	4.4	Exclude pipeline from military exercise area	22
Cwlth	4.5	Access route selection	22
NT	4.7	Loading facility alternatives	23
PB	4.8	Opportunity to develop new technology	24
NT	5.2.5	Access road realignment near Channel Island road	24
NT	5.2.6	Clarify LNG tanker fuel	24
Cwlth	5.3.1	Construction programme and schedule	25
Cwlth	5.3.2	Pipeline and shore crossing	25
NT	5.3.2.1	Pipeline construction	26
NT	5.3.2.2	Source of rock armour	27
Cwlth	5.3.2.4	Hydrotest	27
NT	5.3.2.4	Effects of hydrotest water discharge	27
AHC	5.3.2.4	----------"----------	27
Cwlth	5.3.3	Access road	28
NT	5.3.3	Access road construction and ownership status	28
GANT	5.3.4.4	Ensure storm surge/cyclone protection	28
Cwlth	5.3.5	Justify need for groyne in ship-loading facility; extent of exclusion zones	28, 29
NT	5.3.5	Suggestion to increase diameter of turning basin	29
NT	5.3.5	Suggestion to coordinate dredging activities	29
LSC	5.3.5	Justify need for temporary reclamation area	29
Cwlth	5.4.2	Pipeline	30
ECNT	5.4.3.3	Report on studies into reduction of height of flare	30
Cwlth	5.4.3.3	Utilities - flare tower operation	61
NT	5.4.3.4	Storage: clarify need for Spill Impoundment Area	30
Cwlth	5.4.5.2	Wastewater discharges	31
NT	5.4.5.2	Amend Table 5.7 to reflect ANZECC Guidelines	31
NLC	5.4.5.2	Zero release of contaminants wastewater strategy	31
NT	5.4.5.3	NT definition of hazardous wastes	32
NT	5.4.5.3	Are any wastes generated by pigging pipeline	34

Legend:

NT = NT Government
Cwlth = Environment Australia
NLC = Northern Land Council:
LN = Larrakia Nation
GANT = Greening Australia NT
ECNT = Environment Centre NT
PB = Pam Burdfield
LSC = Litchfield Shire Council
SJ = Silvano Jung
MC = MA Clinch
AHC = Australian Heritage Commission

Table I.1

Summary of Submissions

Source	EIS Section	Issue	Page No. in Supplement
Cwlth	6.2.4	Hydrodynamics and oceanography	34
NT	6.2.4.1	Datum for storm surge	34
NT	6.3.1.2	Invertebrate terrestrial fauna	34
Cwlth	6.3.2.2	Darwin Harbour assemblages - occurrence of dugong	35
Cwlth	6.3.3	Ecological function	35
Cwlth	6.3.3.1	Rainforest vegetation	36
Cwlth	6.3.3.2	Mangroves	36
GANT	6.3.3.2	Mangroves	36
ECNT	6.3.3.3	Clarify Little Tern usage of site	36
ECNT	6.3.3.3	Migratory patterns of JAMBA/CAMBA species	36
ECNT	6.3.3.5	Insert Section 3.3.5 Appendix D into EIS	37
Cwlth	6.4.1	Land use tenure and zoning (Native Title)	38
ECNT	6.4.1	Need for harbour management plan	38
LN	6.4.1	----------"----------	38
GANT	6.4.1	----------"----------	38
ECNT	6.4.2.1	Clarify navigation requirements of Navy and LNG tankers	39
NT	6.4.6.2	Maritime heritage	39
SJ	6.4.6.2	Other "non-protected" wrecks in Harbour	39
MC	6.4.6.2	Importance of SS Ellengowan	39
ECNT	6.4.7	Request for further consultation with Aboriginal groups	40
Cwlth	6.4.7	Anthropology and Aboriginal sites of significance	40
NLC	6.4.7	Address spiritual significance of Wickham Point to Larakia	40
LN	6.4.7	----------"----------	40
Cwlth	7.2.2.1	Effects of clearing site on flora and fauna	41,42
NT	7.2.2.1	Justify statement that Beach Stone-curlew will stay	41
NT	7.2.2.1	Effect of night lighting on fauna	42
Cwlth	7.2.2.2	Effects of excavation and levelling	42
NT	7.2.2.2(v)	Effect of temporary reclamation area on mosquito breeding	43
ECNT	7.2.3	Effects of marine construction on protected species	43
NT	7.2.3.1	Benefits of artificial reefs	44
NT	7.2.3.2	Need for more hydrodynamic modelling	44
Cwlth	7.2.3.3	Turbid water plumes	45
NT	7.2.3.3	Effect of rock armouring pipeline on turbidity	45
NT	7.2.3.3	Reliability of turbidity model	45
NT	7.2.3.3	Disposal of dredge spoil	46
PB	7.2.3.3	Effect of turbidity on corals	46
ECNT	7.2.3.3	Concern over cumulative loss of corals	47
Cwlth	7.3.2.1	Loss of archeological sites	47,48
NT	7.3.2.1	Rephrase paragraph 5 to include requirement for analysis	48
Cwlth	7.3.2.3	Increased road traffic	48
Cwlth	7.3.2.4	Construction workforce impacts	48
ECNT	7.3.2.5	Include sketches from Appendix O into EIS	49
SJ	7.3.3.2	Address effects on "non-protected" wrecks	50
MC	7.3.3.2	Address effects on SS Ellengowan	50
Cwlth	7.3.3.8	Conservation and national estate values (dugongs)	50
PB	7.3.3.8	Integrity of mangrove ecosystem not to be compromised	53

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AHC = Australian Heritage Commission
NLC = Northern Land Council:
ECNT = Environment Centre NT
SJ = Silvano Jung

Table I.1

Summary of Submissions

Source	EIS Section	Issue	Page No. in Supplement
Cwlth	7.4.2	Atmospheric emissions	53
PB	7.4.2	Atmospheric emissions and pollution of Darwin	53
PB	7.4.2	Photochemical smog and health problems	53
PB	7.4.2	Thermal pollution	53
NT	7.4.2	Atmospheric emissions	56
NT	7.4.2.1	Effect of atmospheric emissions on vegetation	57
GANT	7.4.2.1	----------”----------	57
PB	7.4.2.3	Potential of emissions to cause local climate change	54
Cwlth	7.4.2.3	Greenhouse gas emissions	58
ECNT	7.4.2.3	Request to implement CO_2 reduction technology	58
NT	7.4.2.3	Greenhouse Challenge	59
NT	7.4.4	Alternatives to sewage discharge into harbour	59
NT	7.4.4	Sewage treatment on pipelay barge	60
Cwlth	7.4.5	Rainfall runoff discharges	60
NT	7.4.6	Disposal of solid and semi-liquid waste	60
NT	7.4.7	Ballast water discharge effects	60
NT	7.4.10	Wave wash effects on mangroves of Wickham Point	61
Cwlth	7.5.1.3	Visual impacts	61
NT	7.5.1.3	Detail on flare emissions and visual impact	62
PB	7.5.1.3	Plant will destroy aesthetics of Darwin harbour	62
Cwlth	7.5.1.5	Effects on other harbour users	63
Cwlth	7.6.2	Pipeline leakage or rupture	63
AHC	7.6.2	Effects of pipeline rupture and diesel spill on marine biota	63
ECNT	7.6.2	Does “low risk”include military mishaps?	64
Cwlth	7.6.4	Product spill on plant site	64
Cwlth	7.6.5	Plant process upset and effect on aircraft	64
Cwlth	8.2	Preliminary Environmental Management Plan	64
Cwlth	8.2.2.1	Plant site and access road construction	65
NT	8.2.2.1	Fire management and weed control on roadside reserves	43, 65
ECNT	8.2.2.1(i)	Clarify disposal intentions for washdown water	65
NT	8.2.2.1(iii)	Drainage control works & stormwater disposal	65
NT	8.2.2.1(iv)	Management of acid dredge spoil	66
PB	8.2.2.1(iv)	Management plan for acid sediments is required	66
NT	8.2.2.1(v)	Biting insect management	67
NT	8.2.2.1(vi)	Heritage sites management	67
NT	8.2.2.1(vii)	Management of central island	67
ECNT	8.2.2.3	Dispose of oil and wastes at commercial products site	68
NT	8.2.2.3	Wastewater discharge contaminants	68
NT	8.2.2.4	Determine end use of spoil	68
ECNT	8.2.2.4	Determine end use of spoil, rehabilitation and monitoring	68
NT	8.2.2.5	Archaeological survey required of wrecks near pipeline	68
SJ	8.2.2.5	Protect other wrecks near pipeline and do archaeological survey	50
MC	8.2.2.5	Protect SS Ellengowan	50
Cwlth	8.2.3.1	Plant site management	69

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Table I.1

Summary of Submissions

Source	EIS Section	Issue	Page No. in Supplement
Cwlth	8.3	Monitoring programme	69
Cwlth	8.3.2.1	Weeds and feral animals	69
NT	8.3.2.1	Quantitative baseline monitoring of weeds and feral animals	69
NT	8.3.2.2	Baseline biting insect monitoring programme	70
Cwlth	8.3.2.3	Pipeline shore crossing	71
AHC	8.3.2.3	Channel Island reef must be protected	71
NT	8.3.2.3/4	Coral monitoring during dredging operations	104
Cwlth	8.3.2.4	North-east Wickham Point corals	71
NLC	8.3.2.4	Request for monitoring water quality during dredging	72
Cwlth	8.3.2.5	Spoil reclamation stilling basin and overflow	72
GANT	8.3.2.5	Effect of temporary reclamation area on adjacent mangroves	72
NT	8.3.2.7	Request for ambient air monitoring	72
NT	8.3.2.9	Recommended baseline monitoring programme	73
NT	8.3.2.10	Request for ballast water monitoring	73
NT	8.3.2.11	Request for monitoring access road effects on mangroves	73
ECNT	8.3.2.11	Request for monitoring of mangroves and mudflats	73
NLC	8.3.2.11	Request for monitoring mangroves and vegetation	73
NT	8.5	OSCP for pipelay barge	74
NT	8.5	Need for cyclone emergency response plan	74
PB	8.5.1	Zero risk to life from LNG explosion	74
ECNT	8.5.1	More comprehensive risk assessment from explosion	74
AHC	8.5.6	Risk assessment of pipeline rupture	75
NT	8.6	Pipeline decommisioning alternatives	75
		Submissions on Appendices to Draft EIS Volumes 2 and 3	
Cwlth	Appendix C Process Design Alternatives	Liquefaction and cooling systems, ship vapour handling and heavy hydrocarbon removal	75
Cwlth	Appendix D Offshore Pipeline	Pipeline geometry, route, construction and operation	77
		Seafloor modifications,water quality impacts, commercial fishing activities, construction management	
ECNT		Effect of pipeline rupture on offshore ecosystem; decommissioning	79, 80
Cwlth	Appendix P Hazards and Risk Assessment	Comments from WA Department of Environmental Protection	81
NT		Who is Industry Inspection Supervisor in NT	80
		Effect of lightning strikes on power supply	84
Cwlth		Outline range of studies and reports to be produced	84

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I.6 ISSUES RAISED OUTSIDE THE GUIDELINES

The Bayu-Undan field, which will provide the initial natural gas feedstock for the Darwin LNG Plant, is located in Area A of the Zone of Cooperation in the Timor Sea between Australia and Indonesia. Two submissions dealt entirely with political issues related to East Timor. These are outside the guidelines for the Environmental Impact Statement issued by the Department of Lands, Planning and Environment and agreed to by the Commonwealth (Appendix A of the Draft EIS). Phillips is not required to respond to the submissions, but has provided some additional views on this matter in Appendix 7 of this Supplement.

Three submissions stated there should be an overall management plan for Darwin Harbour. Development of such a plan is not the responsibility of Phillips; however, it is understood that this matter is being considered by the Northern Territory Government. Information generated by studies already undertaken by Phillips and work to be done through the Environmental Management Plan will provide considerable additional data on the harbour for use by government in the event that a harbour-wide management plan is developed.

I.7 CLARIFICATIONS

Meetings and telephone conversations were arranged with selected government officers to discuss and clarify the intent and meaning of a number of submissions. The individuals contacted are acknowledged in Section VII. Further discussions have also been held with members of the Larakia.

I.8 PROJECT MODIFICATIONS

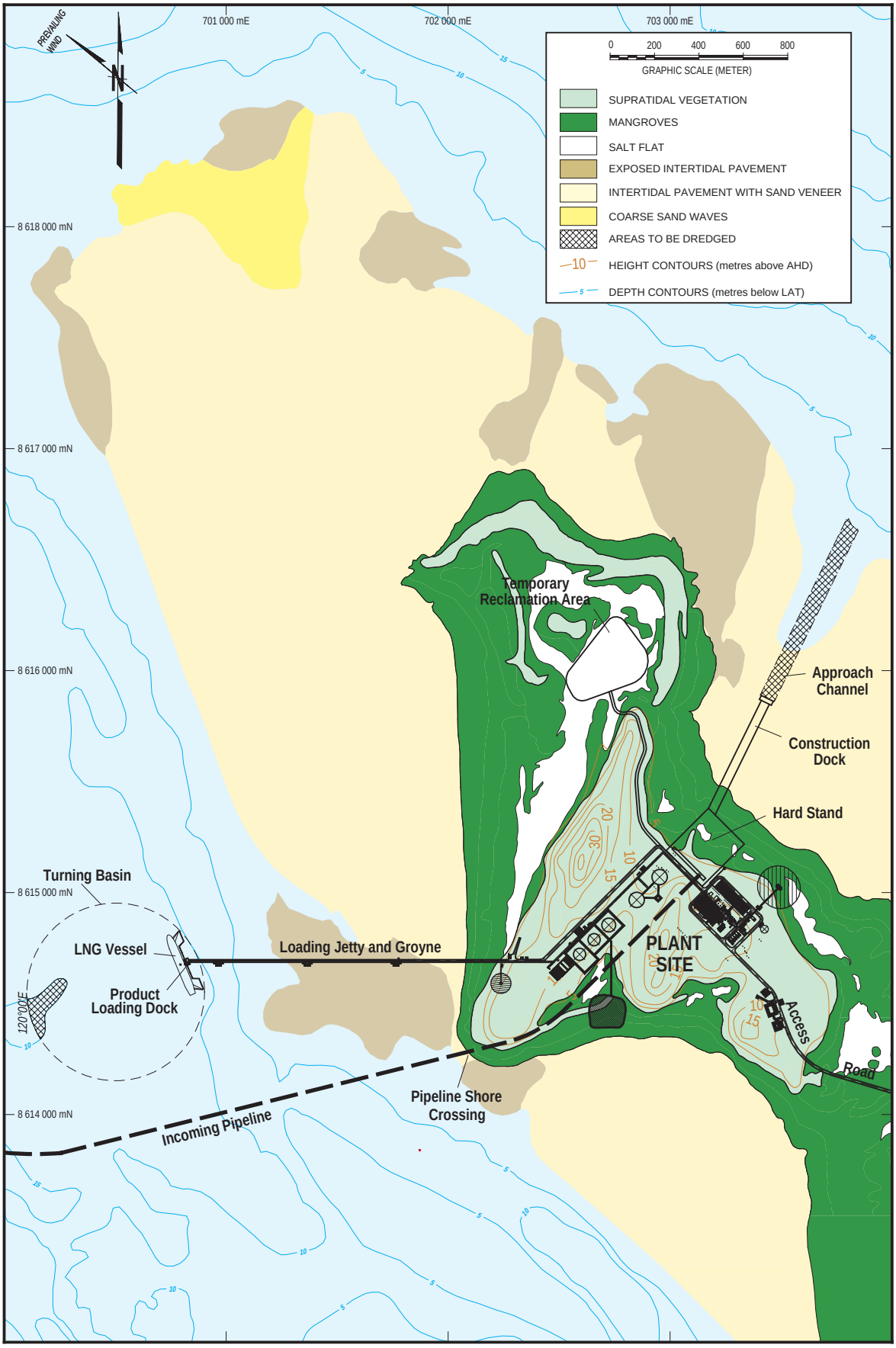
As shown in Table I.1, the public and government submissions provide a series of constructive criticisms of the proposal plus some useful suggestions, and Phillips sincerely appreciates the time and effort which went into the preparation of the submissions. These and continuing inhouse planning for the subsea gas pipeline and the LNG Plant have resulted in several significant and beneficial changes to the project which have improved the design.

The most significant changes have been:

(i) the re-design of the project footprint for both a 3 MTPA and 9 MTPA plant. The necessity to address the effect of a three train (9 MTPA) plant led Phillips to investigate the land area requirement, layout and method of construction for such a plant. As a result of additional studies, it was acknowledged that, by relocating the original 3 MTPA process train, future expansion to a 9 MTPA (three train) plant could be optimised. This has resulted in relocating the initial train to the south side of Wickham Point, thereby enabling gradual expansion to the north where the construction dock is located. This eliminates the possible need to build another construction dock on the south side of Wickham Point for future expansion.

Figure I.1 presents the new project development plan for the Wickham Point site. Comparison to Figure 1.3 of the Draft EIS reveals the following modifications:

- the loading jetty may be extended approximately 250 m westward into deeper water to reduce the amount of dredging required. This extension would be a trestle structure;
- the process train is now located on the south side of Wickham Point;
- the temporary reclamation area and access road have been deleted [refer (ii) below]; and
- the administration centre and access road alignment have been relocated.



Phillips Oil Company Australia
DARWIN LNG PLANT, DRAFT EIS, EXECUTIVE SUMMARY

MAJOR COMPONENTS

Figure I.2 presents a larger scale plan of the plant site on Wickham Point and also presents the proposed clearing envelope for the plant. Comparison to Figure 5.1 in the Draft EIS shows that:

- the slug catcher has been relocated to the south end of Peak Hill;
- the LNG storage has been relocated to the base of the loading jetty;
- the refrigerant storage and the spill impoundment area have been relocated to the north side of Wickham Point;
- the main flare has remained where it was; and
- the area of hard stand (or future process area) has increased substantially.

As a result of the above modifications, the land area required for the three MTPA plant site has increased from 61 ha to approximately 68 ha. However, on the positive side, the new design:

- allows for fauna access corridors to be maintained on the south side of the plant by moving back from the mangroves and providing culverts beneath the landward end of the loading jetty;
- reduces the total area of Wickham Point required for a three train (9 MTPA) plant from 150 ha to approximately 100 ha (refer Appendix 4)

An assessment of the area of habitats removed from Wickham Point by both the new 3 MTPA design and that for the 9 MTPA plant is provided in Appendix 4..

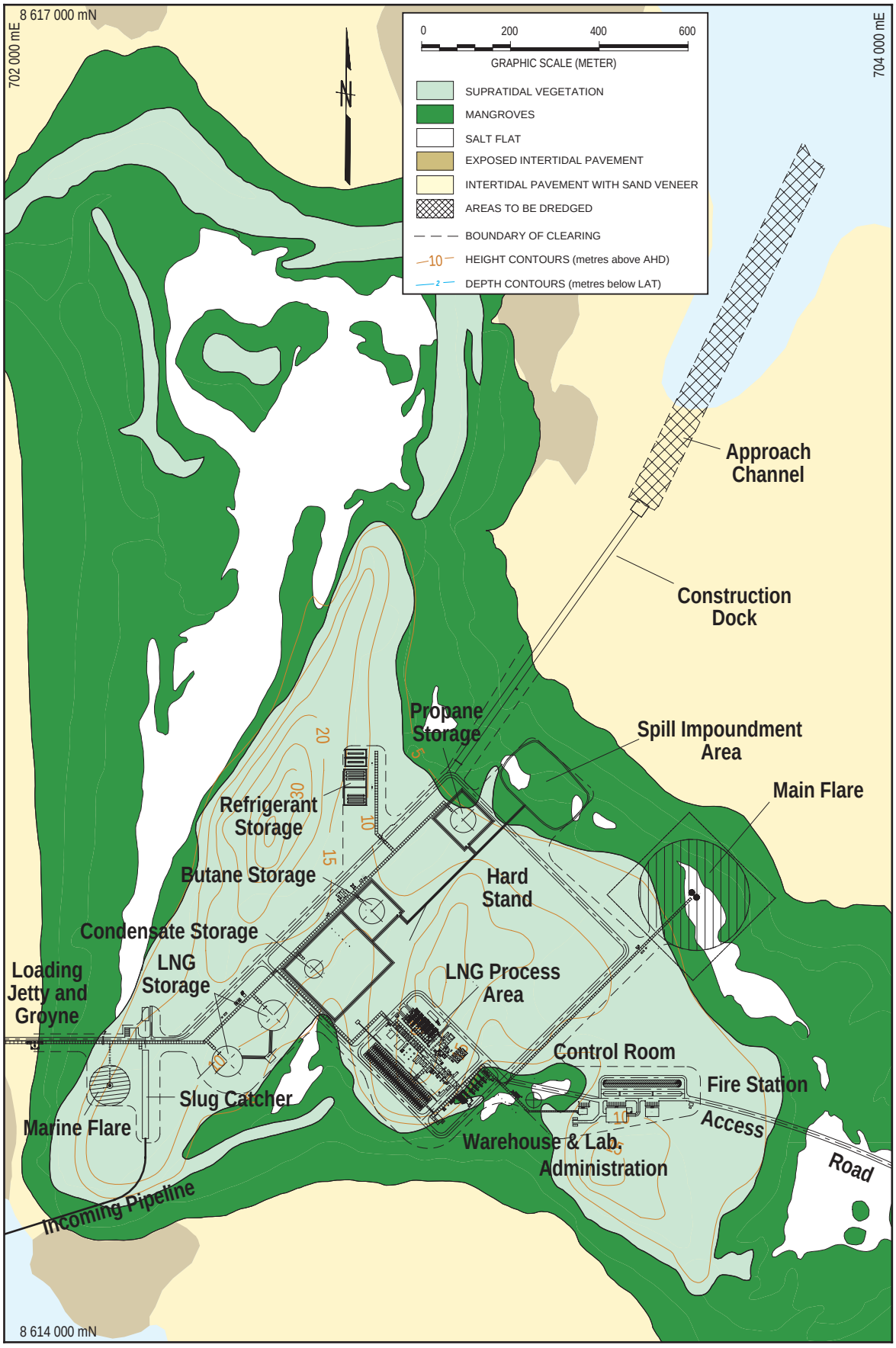
(ii) The Darwin Port Authority and Department of Transport and Works suggested that Phillips coordinate dredging activities with Northern Territory Government dredging plans for Stage 2 of East Arm Port, thereby sharing costs of dredge mobilisation. The agencies also offered to accept for disposal at East Arm Port reclamation, all suitable fill material generated by Phillips.

A preliminary geotechnical analysis of areas requiring dredging for the LNG project (refer Appendix 8) indicates that most of the spoil will be suitable as fill material. Phillips is supportive of both suggestions since they could result in a potential cost saving and would remove the need for a temporary reclamation area on the salt flats of Wickham Point (Figure 5.2, Draft EIS).

Review of the dredging operations has resulted in two minor changes. One change will be to remove the top of the submerged mound located in Middle Arm which occurs in part of the turning basin to a depth of -13 m Chart Datum as suggested by the Darwin Port Authority. Recalculation of the amount of material to be moved (refer Appendix 8) indicates that some 150,000 m^3 of primarily meta siltstone will need to be dredged. During the detailed design stage, Phillips will investigate the cost/benefit and environmental consequences of a number of options for handling this spoil. While Phillips' preference and anticipation is that the dredged material will be used in the reclamation of the East Arm Port, additional options available, in order of preference, are:

(1) sidecast spoil onto the floor of Middle Arm channel; or
(2) relocate spoil to a temporary reclamation area elsewhere on Wickham Point.

Further detailed appraisal will be required if the preferred option cannot be selected. Phillips therefore agrees that further detailed evaluation of the dredging/excavation/disposal options will be provided and a plan submitted if the preferred option is not selected.



Phillips Oil Company Australia
DARWIN LNG PLANT, PRELIMINARY EMP

LNG PLANT PROCESS COMPONENTS AND INFRASTRUCTURE

The second change involves using small equipment, rather than a large cutter suction dredge, for the excavation of about 50,000 m^3 sand-gravel/silt-clay material (Appendix 8) from the construction dock approaches. The cutter suction dredge proposed for use during Stage Two of the East Arm project will be too big to operate in such shallow waters. Options include:

- using a smaller cutter suction dredge;
- using a clam shell grab dredge;
- constructing the channel by excavator at low tide;
- constructing the channel by barge-mounted excavator at low tide;

Depending on the option selected, there is still the possibility that a temporary reclamation area may be required on Wickham Point. Phillips recognises the difficulties associated with the area proposed for use in the Draft EIS and, as a result, has investigated alternatives (Appendix 8). More suitable disposal areas have been identified adjacent to the base of both the loading jetty and the construction jetty (Appendix 8). While such a facility is not anticipated at this time, Phillips will provide detailed engineering and environmental information to the NT Government in support of a request to approve such a site should it become necessary.

(iii) Many submissions questioned the need to discharge wastewater directly into the harbour off the loading jetty. Discussions with officers from various Northern Territory Government departments have indicated that the wastewater can probably be used for irrigation of landscaping at the plant site and/or filtered through the mangroves to remove nutrients. Phillips will therefore investigate the possibility of using treated wastewater for irrigation at the plant or discharge through the mangroves in lieu of discharge off the jetty. This decision will be based on wastewater quality and cost being acceptable, and agreement by the Northern Territory government.

II. ERRATA

Draft EIS Ref.

Table 2.1 Although the Minister is responsible for rezoning of land, subsequent development will likely require the approval of the Litchfield Planning Authority.

Substitute the following words in Table 2.1 on page 2.6 (5th box/row) of the Draft EIS:

Licence Name	Legislation	Issuing Agency	Duration	Notes
Management of waste	Proposed Northern Territory Waste Management and Pollution Control Act	Department of Lands, Planning and Environment	Ongoing for life of Plant	It is expected that the LNG plant will be licensed under the Act, and that water discharge issues which would otherwise be addressed under the Water Act (see Table 2.1 in Draft EIS) will be covered by a licence under the proposed Waste Management and Pollution Control Act.

Add the following to the table as a direct addition:

Licence Name	Legislation	Issuing Agency	Duration	Notes
Building Report	Northern Territory Building Act and Regulations	Northern Territory Fire and Rescue Service	Once-off inspection and report for each building. Expansion of plant will require new reports for each new building.	Reporting is required for specified buildings such as warehouses, offices, and specialised premises. Reporting requirements are addressed under Schedule 2 of the Regulations, and covers issues such as emergency access, fire fighting equipment, smoke detectors, fire control systems, fire exit signs, etc.

Table 2.2 The references to ozone legislation on page 2.8 should also be included in the previous Table (2.1) as Northern Territory Legislation. Both the Commonwealth and the States and Territories implemented complementary ozone protection legislation. The requirements indicated in the table are provisions of the NT Ozone Protection Act. The reference to Northern Territory Fire Service in these sections is incorrect.

Emergency Procedures As the Draft EIS refers to the National Fire Protection Association (NFPA) Codes for fire fighting equipment and installations, the following list indicates both the NFPA Code and the relevant Australian Standard.

NFPA 10- Portable Fire Extinguishers
AS 1841 relates to portable fire extinguishers in general, specific types of extinguishers are covered in other parts of AS 1841, for example AS 1841.6 refers to carbon dioxide extinguishers.

NFPA 12- Carbon Dioxide Extinguishing Systems
AS 4214.3 Carbon Dioxide systems.

NFPA 13 - Installation of Sprinkler Systems
AS 2118.1 Automatic fire sprinkler systems.

NFPA 14 - Installation of Stand-pipe and Hose Systems
AS 2419 Fire hydrant installations.
AS 2419.1 System design, maintenance and commissioning.
AS 2419.2 Fire hydrant valves.
AS 2419.3 Fire brigade booster connections.
AS 2441 Installation of fire hose reels.

NFPA 15 - Water Spray Fixed Systems for Fire Protection
AS 2118 parts 1 to 10 fire sprinkler systems.

NFPA 17 Dry Chemical Extinguishing Systems
No relevant standard.

NFPA 20- Centrifugal Pumps
AS 2941 Fixed fire protection installations, pumpset systems.

NFPA 24 - Private Fire Service Mains and their appurtenances
AS 2419 and its various parts.

NFPA 30- Flammable and Combustible Liquids Code
AS 1940 The storage and handling of flammable and combustible liquids.
AS 1692 Tanks for flammable and combustible liquids.

NFPA 59A - The Production, Storage and Handling of LNG
AS 3961 Liquefied natural gas, storage and handling.

NFPA 70 - (NEC) National Electrical Codes
Numerous.

NFPA 307- Construction and Fire Protection of Marine Terminals, Piers and Wharves
No relevant standard.

NFPA 1963 - Standard for Screw Threads and Gaskets for Fire Hose Connections
AS 2419.2 Fire hydrant installations, fire hydrant valves.

NFPA 2001 - Standard for Clean Agent Fire Extinguishing Systems
No relevant standard.

Note: The NTFRS use British instantaneous couplings in accordance with British Standard 336 and AS 2419.2 on all fire hose, fire pumps and hydrants.

Section 6.2.4.1 Maximum tide range is generally accepted as 8.0 metres.

Section 6.3.1 The Sea Snake *Hydrophis elegans* is not generally considered a mangrove dweller. The correct generic scientific name for the Common Keelback is *Tropidonophis* (Section 6.3.1.2, page 6.27).

Section 6.4.1 Although the Litchfield Shire Council has some input into the process, it is the Minister for Lands, Planning and Environment who is responsible for the creation of the Proposed Litchfield Land Use Objectives.

No part of Middle Arm Peninsula is zoned for extractive industries. However, the proposed Litchfield Land Use Objectives identifies the eastern end of the peninsula as containing extractive resources.

Section 7.4.4 Reference to Table 5.6 is incorrect and should read Table 5.7.

Section 8.2.2 *Bacillus thuring**i**ensis* is the correct spelling (Section 8.2.2.1 (v)).

Appendix C An important standard and a code that needs to be included on the last page of attachment 1 of Appendix C (Design Code Specification and Regulations) in the Australian section are NOHSC:1014 (1996) "National Standard for the Control of Major Hazard Facilities" and NOHSC:2016 (1996) "National Code of Practice for the Control of Major Hazard Facilities".

Appendix P Reference to liaison being required with the Department of Mines and Energy in respect of safety and hazard issues should be amended to the Work Health Authority.

In reference to relevant standards and codes of practice in Section 2 of the Appendix, it should be noted that the major piece of applicable NT legislation will be the Dangerous Goods Act and the Australian Standards called up by that Act.

On page 27 of the Appendix it should be noted that accidents involving dangerous goods and injury to workers will be reported to the Work Health Authority.

The term “Industrial Inspection Supervisor” was a termed coined by a contractor and used in error. Phillips apologises for any confusion this term may have caused.

III. RESPONSE TO SUBMISSIONS

This section presents a summary of comments contained in submissions made as a result of public review of the Draft EIS and the associated response by Phillips. As indicated in Section 1, the submissions are presented in accordance with the section in the Draft EIS to which they refer. The submissions are presented in the order displayed in Table 1. The legend at the base of Table 1 identifies the source of each submission.

III.1 SUBMISSIONS ON DRAFT EIS VOLUME 1

INTRODUCTION (Section 1 of Draft EIS)

1.3 PROPOSED PROJECT

The NLC commented that "the approximate length of the project in years is not described anywhere in this document" and that "the potential for other developments in the ZOC to utilise the facilities should be discussed, particularly in relation to any proposed expansion of the plant and longevity of the plant".

It is stated in Section 1.3 of the Draft EIS that "... field life is estimated to be in the order of 20-25 years, and the design life for all facilities is 25 years. Plant life will probably be extended if further economic reserves of natural gas are discovered in the vicinity of the Bayu-Undan field or pipeline". This was intended to indicate that the initial length of the project is estimated to be 20-25 years, with the possibility of future extension should other developments occur.

The potential exists for expansion of the plant to three trains (nine million tonnes per annum) on the Wickham Point site. Phillips sees this as a compelling reason to develop the LNG plant onshore rather than offshore, which would impose severe constraints on expansion beyond a single train (3 MTPA) plant.

As stated in the Draft EIS (Section 1.3), Phillips has adopted a long-term perspective on development of the Bayu-Undan field, opting to establish a regional gas gathering and transmission system (including the subsea pipeline to Darwin) to enable future expansion of the plant utilising other gas reserves in the area. Future expansion of the plant will depend on the exploitation of gas reserves in the Zone of Cooperation or from other fields in the Timor Sea.

BACKGROUND (Section 2 of Draft EIS)

2.2 PLANNING AND LICENSING ISSUES

The Department of Lands, Planning and Environment provided comments which clarified the situation regarding land use planning and zoning procedures on Middle Arm Peninsula and Wickham Point. The Department advised:

> *"The proposed LNG plant is likely to be considered an Offensive or Hazardous Industry under the auspices of the Planning Act and will therefore require some form of approval. Matters which are required to be taken into account by a consent authority when considering*

a development application include: relevant land use objectives (LUOs), the control plan, interim development control orders, any report prepared within the meaning of the Environmental Assessment Act (such as a Draft EIS) and other matters such as relative merit, site characteristics, impact on existing and future amenity and the public interest.

The proposed LNG plant is considered to be in accordance with the relevant land use objectives and structure plans, however, the subject site is presently zoned FU (Future Use) in the Control Plan. This is a land use zoning which applies to land where intensive development is premature due to a current lack of services or infrastructure. The only uses permitted as of right in the FU zone is "passive agriculture" and "flora and fauna sanctuary".

An "offensive and hazardous industry", a prohibited use in the FU zone, will therefore require a rezoning of the land to either I 3 (Offensive and Hazardous Industry) or SU (Specific Uses). An SU would be the more appropriate zoning given that the ultimate land use would be known. It is important to note that the proposed development, even in the event of re-zoning, may require development consent.

Rezoning is a relatively lengthy process under the requirements of the Planning Act, with a duration in the order of between 3-12 months (commonly 6 months). Consent for development will likely take an additional 6-10 weeks."

Once the land acquisition process is complete, Phillips will commence the rezoning process with the NT Government and Litchfield Shire Council.

PROJECT JUSTIFICATION (Section 3 of Draft EIS)

3.2 NO DEVELOPMENT OPTION

Environment Australia requested that the EIS should briefly outline the environmental, social and economic costs and benefits of not developing the Bayu-Undan field.

The Draft EIS identifies two "no development" options. The first involves abandonment of the Bayu-Undan Field as non-commercial in which case neither the gas liquids or the natural gas resources would be developed. The second involves production of the gas liquids and reinjection of the natural gas into the reservoir from offshore production facilities. In this case, the proposed pipeline to Darwin and LNG facilities at Wickham Point would not be constructed and the gas resource would not be developed.

While a decision regarding the commerciality of the Bayu-Undan Field has not been taken, results from over ten appraisal wells strongly suggest that sufficient resources exist to support such a declaration. Engineering studies have begun to finalise a comprehensive, investment-quality development plan for the field and to determine the capital and operating costs associated with that plan. A decision to proceed with construction on the initial phase of development of Bayu-Undan (i.e., liquids recovery/gas recycling) is anticipated by mid-1998.

While it is expected these studies will result in a decision to develop the field, should these engineering/economic studies by the Bayu-Undan joint venture partners conclude that the field cannot be commercially developed, the following outcome might be expected. The Timor Gap Joint Authority likely would seek to award this area to another contractor in anticipation that they might be able to develop the field commercially. In that instance the costs incurred by the current joint venture partners in exploring and appraising the field might be forfeited.

Such a decision not to develop the Bayu-Undan Field would be accompanied by environmental, social and economic costs and benefits.

Of positive environmental significance, this option would eliminate relatively minor environmental impacts associated with construction, commissioning, operation and decommissioning of offshore production facilities associated with the field. These include the discharge of cooling water, treated produced water and domestic waste waters from the platforms, release of atmospheric pollutants from fossil fuel fired units and other equipment on the platforms, disposal of solid wastes from well drilling/completion and process operations, and possible hydrocarbons spills from the platforms, facilities or ships serving the facility. Of negative environmental significance, failure to develop this resource will reduce the production and availability of cleaner burning fuels, such as natural gas and LPG.

Of positive social significance, this option would eliminate potential interference with marine shipping operations in the vicinity of the Bayu-Undan field. Of negative social significance, it would eliminate meaningful employment opportunities associated with construction and operation of hydrocarbon production facilities at the Bayu-Undan field and subsequent local and regional businesses that would have provided goods and services to this project.

There would be no positive economic benefits to the project co-venturers or the citizens or governments of the two nations associated with a decision not to develop the Bayu-Undan Field. Of negative economic significance, this option would eliminate substantial royalty and tax revenue that is expected to be generated for the Republic of Indonesia and the Commonwealth of Australia over the economic life of the Bayu-Undan resource. It would also prevent the secondary economic activity likely to develop within the region in connection with such a significant hydrocarbon resource development, and would eliminate a considerable source of export income for the two nations.

ALTERNATIVE ANALYSIS (Section 4 of Draft EIS)

4.2 ONSHORE/OFFSHORE COMPARISON

ECNT requested that a more comprehensive comparison between the onshore and offshore LNG options is carried out to enable a well informed assessment to be made by themselves and members of the public.

Phillips cannot discuss the environmental implications of the current BHP Petroleum offshore LNG proposal. However, it is not anticipated that the atmospheric, water, and solid waste discharges would vary significantly between the two locations. Obviously an offshore location would eliminate terrestrial disturbances at Wickham Point and would involve less disturbance associated with installation of a gas pipeline from Bayu-Undan to an LNG plant at Wickham Point. However, as described in the Draft EIS and elsewhere in this Supplement, the pipeline-related impacts from Phillips' proposed Darwin LNG plant are not considered significant or adverse, and the terrestrial impacts, whilst significant, are acceptable within the existing planning framework for Darwin Harbour. Further, with regard to developing the gas reserves of the Bayu-Undan field, the onshore option provides the greatest economic value to the proponents and the two nations (combining construction and operating costs), the lowest technology and market risks, and the best opportunity to maximise the development of central Timor Sea gas resources through a regional gathering system and expansion of LNG production facilities onshore.

GANT commented that alternative site selection had been inadequately addressed

Site selection for this type of project is done early in the process to eliminate sites based on criteria selected. These criteria were thoroughly described in the Draft EIS. This overcomes the need to conduct costly evaluations such as the EIS on sites that can be rejected for economic, safety, logistics or engineering reasons. Wickham Point was clearly the best site. available considering the important criteria and thus was selected for further, more detailed, investigation.

4.3.1 Site Selection Criteria

The ECNT does not support the approval of any Application for Compulsory Acquisition of Land, including the area sought for the LNG plant at Wickham Point, until negotiations with the indigenous people have resolved all issues to their satisfaction.

One of the site selection criteria used by Phillips in assessing each of the potential locations of the proposed LNG plant was that "there should be no impediments to obtaining freehold title to the necessary land."

Phillips is aware of the issues associated with native title rights and interests in Australia. Relevant documents and informed sources regarding applicable statutory authority and Aboriginal tradition concerning indigenous interests in land have been consulted. The *Native Title Act of 1993* and *the Land Acquisition Act (NT)* provide a legal structure for negotiation to resolve any native title rights and interests and the acquisition of Wickham Point by the NT Government. In addition to those legal procedures, Phillips has undertaken direct discussions with the parties to the native title in regard to the land and waters of Wickham Point and Darwin Harbour.

While the details of these discussions are not properly a matter for public disclosure, it is anticipated that upon resolution of this matter each of the parties to these native title negotiations will regard the outcome positively and will be supportive of Phillips' moving forward with the construction and operation of a submarine pipeline from the Bayu-Undan field through Darwin Harbour and an LNG production and loading facility on Wickham Point.

The ECNT also commented that the Draft EIS … makes no mention of native title issues on the Cox Peninsula in Section 4.3. These issues should be incorporated into the final EIS report.

A significant number of land rights claims have been made by or on behalf of Aboriginal people regarding the Cox Peninsula and adjacent islands. Some of these claims pre-date and others post-date enactment of the *Aboriginal Land Rights (Northern Territory) Act of 1976*. None of these claims relating to the Cox Peninsula, however, extend over the lands subject to other claims under the *Native Title Act of 1993* on Middle Arm Peninsula and Wickham Point. Consequently, the resolution of native title claims over the LNG Plant site is not dependent upon or legally related to the Aboriginal land rights claims over the Cox Peninsula. On the basis of recent and comprehensive consultations with both Larakia and Danggalaba Aboriginal interests, an updated anthropological report regarding indigenous interests on the Middle Arm Peninsula is discussed at Section 6.4.7 of the Draft EIS and presented in Appendix 5 of this Supplement.

The NT Government submission expressed concerns about the effects of possible future plant expansion and requested that project expansion be addressed in terms of:

- *the amount of additional vegetation clearing that would be required (shown on a map);*
- *the numbers of ships arriving at the Plant (and the associated increase in flare operation);*
- *the increase in air emissions; and*
- *the size of the pipeline and the additional area of Darwin harbour affected."*

Pam Burdfield (PB) noted: "Any assessment of the suitability of the proposed site must include consideration ..... of future expansion."

The ECNT "seeks an inserted section into the final EIS outlining possible significant or cumulative effects on the environment from the proposed LNG plant"

NLC noted: "there is a capacity for the plant to be expanded should other resource reserves be processed at the plant. The NLC wish to know what processes would be put into place for assessing the environmental impact of any expansion."

GANT noted: "an addendum to the EIS detailing effects of a 150 ha development would be useful to the decision making process."

The Draft EIS was written to provide information on the Phillips proposal to develop an LNG plant with a capacity of three million tonnes per annum (MTPA). The EIS also indicated that one of the site selection criteria was the availability of 150 ha of land to allow for a possible expansion of the plant to a capability of 9 MTPA. As indicated above, several of the comments received asked for an evaluation of the impacts of the larger capacity, should it be developed in the future. It should be recognised that a decision to enlarge the plant has not been made. If sufficient natural gas feedstock is made available from the central Timor Sea resources and Phillips decides in the future that such expansion is economically feasible and justified, the proposed expansion will be subject to detailed analysis under relevant government environmental impact assessment processes. Phillips has addressed this issue in further detail in Appendix 4.

PB noted that Margaret Point is better site than Wickham Point.
Litchfield Shire Council (LSC) asked Why not build at Gunn Pt?

Phillips evaluated both Margaret Point and Gunn Point. Both sites were eliminated from further studies as they did not meet the site selection criteria for the reasons discussed in the Draft EIS. Since completion of the Draft EIS, it has become known that alternative locations for the space launch facility proposed for Gunn Point are being considered. Whilst construction of an LNG plant at Gunn Point appears feasible, it is commercially and logistically unattractive in comparison to the sheltered waters and existing infrastructure provided by Darwin Harbour at Wickham Point. Phillips believes that the physical attributes of Wickham Point and the sheltered waters of Darwin Harbour provide the best location for an LNG production and distribution facility processing gas from the Bayu-Undan Field.

4.4 PIPELINE ROUTE SELECTION

Environment Australia noted that the factors, including environmental criteria, to be taken into account in determining the final route should be specified. The authorities agencies and groups to be consulted in finalising the route should be stated.

The final alignment of the subsea pipeline is not yet fixed and will be determined following conclusion of detailed seabed evaluations along the preferred final pipeline route and discussions with:

- Northern Territory Department of Lands, Planning and Environment,
- Northern Territory Department of Mines and Energy,
- Northern Territory Department of Primary Industry and Fisheries,
- Western Australian Department of Minerals and Energy,
- Department of Defence (Royal Australian Navy),
- Northern Defence Command,

- Darwin Port Authority,
- Commonwealth Department of Primary Industries and Energy,
- Maritime Heritage Authorities,
- Timor Gap Joint Authority,
- representative indigenous parties, and
- representative community interest groups.

The main environmental criteria to be taken into account in determining final pipeline route selection will be avoidance of:

- areas requiring blasting or substantial preparatory earthworks;
- areas of recreational or conservation significance;
- protected maritime heritage sites;
- marine Aboriginal sacred sites;
- navigation lanes and mooring areas in Darwin Harbour;
- water depths less than -5 m AHD wherever possible.

The ECNT supports minor amendments to the military exercise area to exclude the pipeline route and urges recognition of important existing archaeological, heritage and biotic areas.

Phillips is currently conducting a survey to provide information for use in finalising the pipeline route, and has taken a decision to relocate the pipeline outside of the military exercise area in the Timor Sea offshore Darwin. Discussions with NORCOM in Darwin have been valuable in resolving this matter to the mutual satisfaction of Phillips and the military authorities.

During the preparation of the Draft EIS Phillips was provided with information on the protected aircraft and shipwrecks. The proposed pipeline route was developed to avoid these protected sites. Phillips has since become aware of the presence of numerous other wrecks which are not formally protected. The locations of some of these are reliably known but others are inadequately recorded or not known at all. Prior to finalising the pipeline route in Darwin Harbour, Phillips will undertake a detailed survey of the proposed route using a magnetometer and side scan sonar to search for potential wrecks. Significant magnetic anomalies will be recorded on DGPS and checked. This work will be undertaken in close consultation with appropriate staff of the Museums and Art Galleries of the Northern Territory.

The archaeological, heritage and biotic areas of importance along the pipeline route in the harbour are shown on Figure 6.15 in the Draft EIS.

4.5 ACCESS ROUTE SELECTION

Environment Australia requested that the EIS should clarify the criteria under which the final alignment of the access road to the Wickham Point site will be selected.

Discussions were held with the NT Department of Lands, Planning and Environment (Lands Division) as part of the process of reviewing and responding to comments provided on the Draft EIS and to clarify the delineation of responsibility between Phillips and the NT Government for planning and development of infrastructure needed for future proposed development of the Middle Arm Peninsula.

Phillips has been advised that all matters relating to the planning and alignment of the access road from Channel Island road to the boundary of the LNG plant site on Wickham Point are the responsibility of the NT Government. It is understood that the NT Government will comply with its own environmental standards related to the design and construction of the access road. Phillips will continue to coordinate its plans for the development of Wickham Point with the NT Department of Lands, Planning and Environment and the NT Department of Transport and Works.

4.7 LOADING FACILITY ALTERNATIVES

The NT Government commented that development in the harbour is at present centred on the development of the East Arm Port Facility. Besides the need for economic development, there is also a need to protect Darwin Harbour environment, which is considered to be relatively pristine. For management purposes it may be beneficial to keep economic developments contained in the same area, as this may minimise impacts to other areas in Darwin Harbour.

It is suggested that placement of the loading facility and pipe access on the Middle Arm side of Wickham Point will spread impacts into areas that are still relatively protected from development. It may be more appropriate to combine the construction dock and the loading facility and place this on the East Arm side of Wickham Point.

In developing a response to this submission, Phillips held discussions with the Darwin Port Authority to explore the potential for re-orienting the project toward East Arm and away from Middle Arm. These discussions, however, have confirmed that the loading jetty should remain in Middle Arm primarily for safety reasons.

The area of water available for navigation in East Arm is much smaller than that available in Middle Arm, is much more congested and will become even more so when the new port becomes fully operational. An exclusion zone of 500 m is under consideration for the LNG tankers on the move and such a zone would adversely affect maritime activity in East Arm every time there was an LNG tanker movement.

In addition, the relative narrowness of East Arm means that there would be little room for error in handling a vessel of this size, whereas the large area of navigable water available in Middle Arm substantially reduces the risk of accident. Furthermore, in the unlikely event of an accident occurring at the loading jetty, there is less likelihood of collateral damage occurring in Middle Arm than there is in East Arm.

The amount of dredging required to construct navigable approaches to a loading jetty on East Arm would also be substantially more than is presently proposed. Combination of the construction dock with the loading jetty would not be possible for future plant expansions and would necessitate establishing a construction dock on the south side of Wickham Point in Middle Arm, thereby defeating the purpose of the suggestion.

For the reasons stated above, Phillips and the Darwin Port Authority do not favour bringing LNG tankers into East Arm. Therefore, Phillips proposes to maintain its current plans for the location of the pipeline and loading jetty in Middle Arm.

4.8 LNG PROCESS ALTERNATIVES

PB commented on the opportunity to develop new technology.

LNG is the cleanest large-scale energy source in the world today. The only energy sources that may be environmentally cleaner than LNG would be some form of solar or wind-powered energy. Current technology cannot provide this energy continuously from day to night and in all weather conditions and in the amounts required to operate a 3 MTPA LNG plant. Further, such alternative energy facilities would result in other environmental impacts involving the need for additional terrestrial resources (additional land) to install and operate the solar or wind energy facilities. Such facilities, if technically feasible and available, would be substantially more expensive than conventional gas turbines and would not be favourably considered by the current LNG market.

The manufacture of LNG is also an energy efficient process. Phillips' Darwin LNG plant will use natural gas to fuel both the gas turbines which drive the compression equipment and the gas turbines used to produce plant electricity. (An option to contract with the NT Power and Water Authority to provide electricity to the plant would also involve the use of natural gas to fuel gas turbines. (Refer Appendix 6.)

PROJECT DESCRIPTION (Section 5 of Draft EIS)

5.2.5 Access Road

The NT Government has commented that the first two kilometres of the access road may need to be realigned to the west to allow for future development of a prawn farm on the northern side of Channel Island Road.

Discussions with the NT Department of Primary Industry & Fisheries have disclosed that a large parcel of land on the Middle Arm Peninsula may be developed as an aquaculture venture. The final access road route design will be undertaken by the NT Government, and therefore will accommodate all government commitments.

5.2.6 LNG Tankers

The NT Government has queried, in their comments on Appendix P, whether the LNG tankers will be fuelled by fuel oil or gas.

In Section 5.2.6 of the Draft EIS, it is stated that "... gas evaporation, or 'boiloff', is collected, compressed and used as fuel in the ship propulsion system. Fuel requirements in excess of this natural 'boiloff' can be supplied by fuel oil or by forced vaporising of the LNG cargo". The LNG tankers will have the capability of being fuelled by both gas and fuel oil. Fuel oil may be the prime fuel on the inbound journey when empty, and gas will probably be used during the outbound journey when loaded with LNG. It is also possible that a LNG heal will be left in the tanker to keep the storage tanks cold. As such, the tankers may be fuelled by gas on the inbound journey as well.

5.3.1 Construction Programme and Schedule

Environment Australia commented that tides should be taken into account in the timing of construction activities (for the access road).

Construction of the access road to the plant boundary will likely be undertaken by the NT Government. Timing of site preparation and the construction of roads and other related earthworks will, to a large extent, be determined by the overall project. However, Phillips is aware of the need to avoid tidal areas where possible, particularly during the high spring tide period. Avoiding areas inundated by tides helps to reduce environmental damage, including acid drainage problems and the creation of mosquito breeding areas.

Environment Australia requested that comment should be provided as to whether flora and fauna surveys are proposed or required prior to construction

General fauna surveys conducted during the course of the Draft EIS preparation are considered adequate to describe the existing fauna species composition and the distribution of habitats in the areas to be disturbed and it is not proposed to repeat these. However, it is proposed to obtain a quantitative baseline characterisation of the abundance of weeds and feral animals on selected portions of Wickham Point which will not be disturbed by construction activities prior to construction commencing.

5.3.2 Pipeline and Shore Crossing

5.3.2.1 Construction and installation

Environment Australia commented on the trenching required for the pipeline in Darwin Harbour. They requested provision of descriptions of the dredging method and any measures needed to minimise siltation during trenching and spoil disposal.

It is anticipated that the pipeline may require additional stabilisation and protection. This will be achieved by either additional concrete weight coating, lowering of the pipeline below seabed level (trenching) and/or placement of rock on top of the pipeline (rock dumping).

Pre-lay sweeping and trenching of soft materials along the pipeline route will be performed in shallow water by the trailing suction hopper dredge. Post-lay trenching (or ploughing) will be performed by a support vessel, towing the trench cutting machine along the installed pipeline. The trench cutting machine is designed to control the pipe radius whilst creating a trench along the pipeline. The pipeline is lowered into the trench by the trench cutting machine and the soil is left to backfill itself by the sea motion later. This option is expected to be employed in soft and moderately hard soils within the harbour and the shallow sand wave areas which occur in the approaches to the harbour.

Based upon the results of hydrodynamic modelling (as discussed in Section 7.2.3.3 of the Draft EIS), suspended sediment concentrations within plumes generated by pipeline trenching activities are predicted to fall to background levels within 100 m and disperse rapidly, obviating the need for silt minimisation measures.

As discussed in Section I.8, Phillips will try to coordinate dredging activities with the Darwin Port Authority and Department of Transport and Works. If the dredged material cannot be used as fill for the East Arm Port reclamation, it will either be sidecast or disposed onshore, after first obtaining separate environmental approval to do so from the NT DLPE.

The NT Government expressed concern that the presence of steep sloped valleys and shoals along the pipeline route may require the seafloor to be dredged or filled. They indicated that techniques, sources of fill and destination of dredged material had not been addressed, and commented that the potential impacts from these "earthworks" may have a large impact on the local shelf benthos and coastal environments.

Attention is drawn to the necessarily exaggerated vertical scale used in Figure 5.1 of the Draft EIS. As explained in Section 2.3 of Appendix D in the Draft EIS, local rerouting of the pipeline will be used to detour around any escarpments ('steep sloped valleys') which may be present.

Preparation of the pipeline route prior to the actual laying of the pipeline will be limited as much as possible through route optimisation efforts during the detailed engineering phase of the project. At the few places where localised pre- and post-construction cutting or filling is still required, it is proposed to use construction methods which minimise environmental impact.

Across areas of rough terrain and hard substrate near the Bayu-Undan field, it is likely that rock filling, rather than blasting, will be employed. The sources of rock fill are given in Section V.3.2.2 of this Supplement. As indicated in Section 7.2.3.1 of the Draft EIS, the rock fill is expected to be colonised by epibiota representative of those already occurring on the hard substrates in the vicinity of the pipeline corridor. Closer to shore, ploughing is likely to be used to install the pipeline through the areas of soft sand waves near the entrance to Darwin Harbour. The areal extent of potential impact is considered to be of low significance when considered in the context of the widespread distribution of similar habitats across the Sahul Shelf.

Environment Australia has requested further information on the likely overall extent of span support required for the pipeline.

The pipeline route will be resurveyed during detailed engineering for the pipeline, and the final route will be selected to avoid excess spanning and/or overstressing of the pipeline. The extent of span support required can only be determined after actual laying and sub-sea inspection of the pipeline.

5.3.2.2 Construction materials

Environment Australia requested an explanation of the basis for calculation of the volumes of rock required for pipeline stabilisation and protection and for shore crossing construction, together with an estimate of likely trucking movements associated with these works.

About 360,000 tonnes of rock will be required for pipeline stabilisation and protection, and will be transferred from either of two quarries to the laydown area in close proximity to the East Arm Port Facility. One quarry is located within 15 km from East Arm Port (at Palmerston) and the other (Mt Bundey) is 100 km away. The rock characteristics and cost differs greatly between the quarries. Copies of rock test certificates from each quarry have been received and are being reviewed to select the quarry. The test certificates define such attributes as bulk density, moisture content, and flakiness of the rock. Two grades of rock are anticipated: 200 mm to 800 mm and 800 mm to 1,200 mm diameters.

The DLPE has been contacted concerning the availability of the East Arm Port facility for stockpiling rock. The Lands Development section of the DPLE has indicated there would be a suitable site available in close proximity to the Port. If this laydown area is in use, the Government will make available alternate land, approximately 1.5 km from the East Arm Port.

It is anticipated that Phillips will begin stockpiling the major portion of the rock from the quarry 12 to 15 months prior to construction of the pipeline. This would require truck movements to commence in mid 1999 and continue through to mid 2000. Assuming three trailer road trains with a capacity of approximately 75 tonnes are used, a maximum of 15 to 20 truck loads per day, working 12 hours per day, six days per week would be required. All trucks would be registered and loading would be in accordance with the regulatory authority, the Department of Transport and Works.

The Port will be available for loading barges according to the Project Manager for the East Arm Port Development (NT Government).

The NT Government has indicated that if the rock required for the pipeline work cannot be sourced from existing quarries, it will be necessary to provide information about new sources.

Local reserves of quartzite and granite rock are well in excess of the current estimate of 360,000 tonnes potentially required for the pipeline project. Quartzite could be sourced from up to three quarries near Darwin (one currently active and two under development) and granite could be sourced from a quarry where reserves are probably >10 million tonnes (Mt Bundey).

5.3.2.4 Hydrotest

Both Environment Australia and the NT Government requested details of the discharge quality guidelines to be applied to the disposal of the hydrotest water. They further requested an estimate of the volume of hydrotest water to be discharged, and a discussion of the likely impacts of the discharge, the extent of those impacts from the discharge point and requirements for monitoring. AHC also request further discussion on the impacts of hydrotest water disposal.

For a ND650 pipeline system, approximately 150,000 m^3 of water would be used. Actual volumes of hydrotest water would be dependent upon the final pipeline size selected.

As described in Section 5.3.2.4 of the Draft EIS, it is proposed to fill the pipeline with filtered seawater including a water soluble blend of corrosion inhibitor, biocide and oxygen scavenger. Only minimum dosages of oxygen scavenger (e.g. sodium sulfite) and an organic biocide will be added to prevent corrosion of the internal pipe surface. The corrosion inhibitors are not considered to be toxic to marine life.

During displacement of water from the pipeline, which is proposed to be done at the Bayu-Undan Central Process and Compression Platform, the test water will be sprayed high into the air to maximise the re-introduction of oxygen as it falls into the surrounding waters. No significant adverse impact has ever been reported from the offshore release of hydrotest water and none is anticipated for this project.

Hydrostatic testing will be based on:

- Australian Standard AS2885.1-1997, Part 1 Pipelines, Design and Construction;
- Australian Standard AS1978-1987, Pipeline, Field Pressure Testing; and
- DNV 1996 Rules for Submarine Pipeline Systems.

The discharged water will meet ZOCA water quality guidelines.

Prior to the granting of a permit to discharge the hydrotest water (under the Commonwealth Petroleum (Submerged Lands) Act 1967, information on the ecotoxicity of the hydrotest water additives (i.e. oxygen scavenger and biocide) will be required.

It is unlikely that in situ monitoring of the discharge will be required (G. Cobby, Department of Minerals & Energy Western Australia, pers. comm.)

5.3.3 Access Road

The NT Government noted that the Final EIS should state the actual road height (for surge protection) and clarify rationale for using the height of 1.5m above high tide and storm surge levels. Does the 1.5 m above high tide and storm surge levels refer to "extreme high water levels" in Section 6.2.4.1 of the Draft EIS? Which return period will be used and will the access road embankment be rock armoured?

Environment Australia noted that there was no reference in the Draft EIS to the status of the access road.

It should be noted that construction of the access road is provided for in a future NT Government Capital Works Programme and that it will ultimately be handed over to Department of Transport and Works for maintenance. Since the Draft EIS was prepared, the NT DLPE has confirmed that the NT Government has assumed the lead for the design of the access road (see Section IV.5 above).

Road design will comply with typical NT Government design standards regarding tidal and storm surge conditions in the Darwin area.

5.3.4.4 Construction standards/design principles

GANT noted the need to ensure storm surge/cyclone protection.

The plant finished grade level is established at an elevation of 8.1 m AHD. This elevation was established using the 1 in 1,000 years storm probability under peak cyclone storm surge plus cyclone wave set up plus astronomical tide. In addition, foundations and structures within the plant cater to cyclone wind velocities of 57 m/s in accordance with the Australian standards.

5.3.5 Ship-loading Facilities and Construction Dock

Environment Australia commented that the Draft EIS proposes a 750 m rock groyne and 550 m trestle structure. The basis for determining these lengths should be more clearly explained. Likely cost penalties for construction of a 100 per cent trestle structure, which would minimise environmental impacts, should be provided.

Further explanation of likely volumes of cut and fill may be desirable. Figures on page 5.17 appear to indicate a balance of only 25,000 m^3 from the site. Under this scenario, there would be a significant shortfall in site fill for the groyne, which appears to contradict statements that there would be substantial cost savings from this option. It is not clear whether the estimated dredge spoil of 334,000 m^3 could be used as fill on site, or for the groyne.

Phillips undertook a cost comparison study on the optimum amount of trestle versus rock groyne that should be installed for the loading jetty. The study concluded that a groyne was the most cost effective construction to be pursued, even past the 1,000 m length the groyne is presently proposed. Beyond the 1,000 m length, however, Phillips opted for a trestle to minimise the environmental impact a groyne could have in the deeper water beyond this point. At about 1,000 m from the high water mark, the seafloor increases significantly in depth.

As Plates 2, 8, 9 and 13 of the Draft EIS clearly demonstrate, the rock groyne portion of the loading jetty is to be constructed on intertidal rock platform which is exposed at low tide. This platform is a major impediment to water flow and the groyne has no substantive effect on regional flow into Jones Creek. This is shown by the similarity in water speed contours for the existing versus proposed situation presented in Figure 7.1 of the Draft EIS. The rock groyne is unlikely to have more than highly localised impact resulting in localised increase in sedimentation mainly on the north side. Given the low level of impact anticipated, there is little justification in pursuing other than the most cost effective engineering solution.

All fill and armour for the proposed groyne will come from Wickham Point. Dredge spoil is not suitable fill material for the groyne and is unlikely to be used as such.

Environment Australia commented that the extent of the exclusion zone proposed around the loading and construction docks should be specified to assist in assessing possible impacts on boats and fishing.

Regarding the boundary of the Darwin Port Authority Exclusion Zone, the following is envisaged:

(1) a 500 m zone around the berth when the berth is occupied. The 500 m circle would be centred on the planned centreline of the ship when in position at the berth (i.e. approximately 25 m from the centre of the dock). Users of the harbour will receive notification of this exclusion zone through the "Australian Pilot" publication, the Darwin Port Manual and the Australian chart issuing group (the Royal Australian Navy Hydrographic Office);

(2) a 500 m 'moving exclusion zone' around each LNG ship as it proceeds through the Port to its berth. This will ensure that all ships and boats will be clear of the ships as they move, enhancing safety and further assuring public safety. In addition to notifications as above, the shipping agent, as part of the normal arrivals messages, would normally advise the Darwin Port Authority of impending arrival and requested exclusion zone.

The NT Government suggested an increase to diameter of the turning basin and coordination of dredging activities.

As indicated in Section I.8 of this Supplement, Phillips agrees with these suggestions and will work with the Darwin Port Authority wherever possible to coordinate future dredging activities. Removal of the upper portion of the 'pinnacle' in the turning basin will effectively increase the diameter of the turning basin.

The Litchfield Shire Council requested Phillips to justify the need for the temporary reclamation area.

As outlined in Section I.8 of this Supplement, Phillips recognises that further detail is required on the proposed dredging and spoil disposal activities, and commits to providing that detail and obtaining separate environmental approval as necessary for these works prior to construction. Phillips' preference is to avoid the need for a temporary reclamation area and, to this end, will work with the NT Department of Transport & Works in an effort to coordinate dredging operations and to relocate suitable fill material to the East Arm Port reclamation area. As a result, the current plans don't include the use of a temporary spoil reclamation area and it has been removed from the site plan.

Alternatively should the new port not be able to accommodate dredged material from certain areas of the harbour, a temporary reclamation area would need to be utilised or sidecasting of a portion of the dredged material into nearby areas is an option. Further information regarding alternative sites for temporary reclamation areas is contained in Appendix 9. Any plans for side casting dredged material would be preceded by a request to the NT Government for approval.

5.4.2 Pipeline

Environment Australia commented that visual inspection of the pipeline route by ship and/or air, as suggested, appears unlikely to detect leaks. Inspection of the pipeline by ROV is proposed, to detect leaks and other risks to the pipeline (Section 7.6.2). Further information should be provided on the likely frequency and efficiency of ROV inspection to detect relatively minor leaks. Some discussion on the purpose and intent of surface and aerial inspections would be helpful.

Safe pipeline operations will be assured by a number of different methods which are all designed to prevent and discover pipeline problems and specifically leaks. Primary leak protection is provided by means of an on-line leak detection system which uses operating data (inlet and outlet pressures, temperatures and flow rates) to continuously compare actual versus simulated pipeline pressure changes and mass flow balance differences. Alarms will be raised alerting the pipeline controller to potential leak problems.

In addition, internal devices (smart pigs) will be passed at pre-determined intervals and on an as-needed basis to check the pipe wall conditions throughout. Submarine inspections by means of direct diving and/or ROV of the pipeline external conditions (e.g. support, spans, protection, soils displacement as well as cathodic protection, etc.) will be performed at pre-determined intervals (e.g. 5-year) and as needed for specific sections (e.g. upon passing of a severe storm, unstable slope if applicable, to check on a report of potential damage, etc.)

5.4.3.3 Utilities

The ECNT sought further information on the flare and relief system as it holds concerns over the proposed height of the flame and heat envelope of the wet and dry gas flares. The ECNT supports the current investigations being carried out by Phillips into alternative means of wet and dry gas flaring aimed at reducing the height of the flame and associated heat envelope.

Phillips has been in contact with the Civil Aviation Safety Authority (CASA) and RAAF and will continue to work with the Authorities until a mutually agreed upon solution is reached. Currently, Phillips is in the process of determining the impact the flare stacks, flame, and associated heat envelope may have on air traffic. Current studies include a conventional elevated flare as well as a ground flare. Phillips will share the results of these studies with CASA after the studies are complete and a recommendation formulated. In addition Phillips will review and seek approval for the selected flare design from appropriate NT Government and Commonwealth authorities.

5.4.3.4 Storage

The NT Government suggested that little information has been provided on the Spill Impoundment Area (SIA). It is not clear whether this area will be a constructed facility. Because it is located across the eastern end of a sand spit and mangrove area the SIA has the potential to impound storm water and tidal water in a tidal inlet. Mosquito breeding may be aggravated in this inlet which has been identified as primary breeding site for Aedes vigilax and Ae. funereus. An alternative to the proposed subsoil pipe to overcome this problem is the relocation of the SIA.

The SIA is a holding area for accidental releases of liquid product from the LPG storage tanks. It is designed to hold twice the maximum capacity of tank storage and is located down gradient of the tanks so that liquids will gravitate to the area.

The SIA has been relocated from the south side of Wickham Point to the north side as a result of relocating the process area. It needs to be located at a low level relative to the storage tanks so the released product flows away from the tanks. The only location which satisfies this requirement occurs within the mangrove environment.

The SIA will be a concrete-lined pond using low density cement. Provision will be made to drain storm water from the SIA to prevent ponding and breeding of biting insects.

5.4.5.2 Wastewater discharges

Environment Australia requested further information on the basis for selecting the proposed wastewater discharge point should be provided. The Draft EIS states that about 146 tonnes of effluent will be discharged per day (Figure 5.14), at the continuous rate of 1.7 L/sec (page 7.30). The Draft EIS estimates that contaminants will return to background levels within a 'few metres of the outfall'. Has modelling been undertaken to confirm this, or is this estimate based on experience? Further comment should be provided on the likely size of the mixing zone, and impacts on the marine environment within this zone.

The NLC wishes to see a cost-benefit analysis of installing a zero release of contaminants water management strategy, rather than relying on a dilute and disperse method of contaminant disposal.

The prediction that contaminants will return to background levels within a few metres of the outfall is based on the experience of the author (LeProvost) having monitored a similar outfall for Woodside on the Burrup Peninsula, and with due consideration for the lack of contaminants and the high degree of flushing anticipated at the discharge site.

Phillips has agreed to investigate alternatives to discharging treated wastewater directly into the harbour (refer Section I.8). Subject to positive cost-benefit and approval being obtained by the NT Government, Phillips could pursue this course of action. If it is not feasible to use the water after evaluating other alternatives, the effluent mixing zone will be estimated by modelling.

The NT Government commented that anticipated levels of mercury, silver and oil and grease exceed the discharge standards outlined in Table 5.7 of the Draft EIS. These 'Standards' should reflect the Marine Aquatic Ecosystems protection.

The table presented in the Draft EIS was incorrect in that the < sign should have been shown in the right hand column instead of the middle column. Further investigations have confirmed that there should be no metals in the discharge because none are being used in the process. As such, the wastewater discharge will be in compliance with all discharge standards. The new Table 5.7 (Effluent Discharge Limits) is presented below.

Table 5.7 : Effluent Discharge Limits to the Marine Waters

Parameters	Victorian EPA Outfall Standard Discharge mg/L	Project Standard mg/L
pH (in standard units)	6 - 9	6.5 to 8.5
BOD_5	20/40 max	20
TSS	30/60 max	20/60 max
Oil and Grease	20 (none visible)	20 (none visible)
Temperature	1 °C above Amb.	1 °C above Amb.
Floatable/Settleable Matter	None	None
Arsenic	0.50	None Expected
Cadmium	0.10	None Expected
Total Chromium	0.30	None Expected
Copper	0.20	None Expected
Iron	5.0	None Expected
Lead	0.10	None Expected
Manganese	0.5	None Expected
Mercury	*(0.1 µg/L) 0.005	None Expected
Nickel	0.50	None Expected
Silver	*(0.1 µg/L) 0.10	None Expected
Zinc	0.50	None Expected
Acute Toxicity	None	None
Coliform	< 400 MPN	< 400 MPN

NB: * ANZECC Guidelines for Protection of Marine Ecosystems guidelines value.
MPN = Most Probable Number.

5.4.5.3 Solid and semi-liquid wastes

The NT Government commented that, throughout the Draft EIS, spent oils and most other wastes are considered to be non-hazardous. This definition of hazardous does not accord with that of the NT Government. Waste and spent lubricating oils, biological sludge, inorganic sludge and oily sludge should be treated as hazardous (tables 5.1 & 5.8). It is not clear what is contained in the molecular sieve wastes.

Apart from oily wastes there is little appropriate infrastructure in the NT for treating and disposing of wastes which can not go into a municipal landfill. There is no controlled or secure landfill in the NT. Reliance on "registered treatment and disposal facilities" in the NT is ill founded, given the lack of local waste management infrastructure. Interstate disposal and treatment options would need to be explored.

The waste classifications used in Table 5.8 were based on the definition of solid waste in the US, the criteria being toxicity, reactivity, ignitability and corrosivity, in addition to how the material is handled. Table 5.8 has been modified to reflect the classification of the waste stream as defined by the Northern Territory's proposed "Waste Management and Pollution Control Act".

Table 5.8

Anticipated LNG Plant Solid Waste Generation

Type of Solid Wastes	Source of Solid Wastes	Classification	Quantity kg/yr
Waste lubricating oils	Plant area	Hazardous	8,300
Spent oils	Hot-oil system	Hazardous	950
Cellulose	Plant area	Non-hazardous	1,020
Biological sludge	Sewage treatment plant	Non-hazardous	4,000
Inorganic sludge	Demineralisation unit	Non-hazardous	200
Oily sludge	CPI separator	Hazardous	40,000
Spent solvents	Plant area	Hazardous	100
Ceramic balls	Dehydration unit	Non-hazardous	3,100
Molecular sieve waste	Dehydration unit	Non-hazardous	35,380
Mercury-contaminated carbon beds	Mercury removal unit	Hazardous	*
Trash	Plant area	Non-hazardous	50,000

* The carbon utilised for mercury removal has sulphur impregnated in the pores of the carbon granules. Based on preliminary testing of the Bayu-Undan gas, the amount of mercury that would accumulate over the life of the project would be approximately 3.3 kg/yr. This would equate to a 20 year life for a single carbon bed (which contains some 24,000 kg of carbon) and the current LNG plant design includes two such beds. In addition, it has been the experience of a leading carbon supplier that the carbon does not test hazardous for mercury based on the United States EPA test method for toxicity and meets current standards for disposal in industrial landfills.

Phillips recognises the importance of handling all waste streams in an appropriate manner. Before any industrial type waste will leave the plant site, the disposal method and location will be reviewed to ensure that the method of disposal/treatment is appropriate.

As pointed out in the comment, there is little waste treatment capability at this time in the Northern Territory apart from oily wastes. Phillips has been in contact with Hannons regarding the handling of waste lubricating oils/spent oils. It is Phillips' understanding that used oil from the Darwin area is processed by Hannons before being used as kiln fuel in Mattaranka. The waste lubricating oils/spent oils are very similar to used oil from any major piece of machinery and could potentially be handled in this manner.

The biological sludge from the sanitary sewage treatment plant and the inorganic sludge from the demineralisation plant will be similar to that produced by the sewage treatment plants and drinking water purification systems in use in Darwin. This material will be handled in a similar manner after the waste is characterised and approved for disposal.

Molecular sieve is primarily composed of an alumina/silica base. It is used to dehydrate the gas. After a period of time, the material can no longer be used and will need to be replaced with new product. At this point, the material is very inert and may contain trace amounts of carbonaceous material.

Phillips believes that the only potential waste stream that will need to be handled outside of the NT are spent solvents and in dealing with these wastes, Phillips will comply with government requirements. Phillips is continually evaluating alternative products to minimise the generation of wastes that require special management facilities and which may present a hazard to the environment.

The NT Government asked what types of wastes are produced as a result of cleaning the pipeline using pigs and how is it proposed to treat/dispose of these wastes?

Wastes produced as a result of pigging a pipeline usually include an oil/water mixture that could contain some solid scale from the inside pipe wall. The oil (condensate) and water would be separated, with the water being handled in the wastewater system and the condensate going to product storage or waste oil. Any scale collected from pigging operations would have to be tested for hazardous constituents and handled accordingly.

DESCRIPTION OF ENVIRONMENT (Section 6 of Draft EIS)

6.2.4 Hydrodynamics and Oceanography

Environment Australia commented that an estimate of extreme high water levels, including cyclone surge, is provided at page 6.5. It is not clear whether this takes into account forecast greenhouse rises. If not, the implications of this for the calculations should be explained.

The plant finished grade level now is established at elevation 8.1 m AHD. Since the level of water for a 1 in 1,000 years storm probability will rise to 6.4 m under peak cyclone storm surge plus cyclone wave set up plus astronomical tide, the difference in levels of 1.7 m will be more than sufficient to allow for climate-induced sea-level change. If a storm probability of 1 in a 100 years is assumed, the highest water level is estimated to be 5.1 m which will leave 3.0 m spare for climate-induced sea-level change.

6.2.4.1 Darwin Harbour Hydrodynamics

DLPE correctly noted that storm surge levels are related to Chart Datum.

Chart Datum is 4.0 m below Australian Height Datum (GHDM 1997). Extreme high water levels at Wickham Point are therefore 3.8 m (10 year return period), 5.1 m (100 year) and 6.4 m (1,000 year) (GHDM 1997).

6.3.1.2 Fauna

The NT Government commented that the issue of invertebrate terrestrial fauna has not been addressed in the EIS.

The only terrestrial invertebrate fauna group surveyed for the Draft EIS were biting insect pests. Terrestrial invertebrate groups are not usually investigated for environmental impact assessment in Australia, and they were not mentioned for study in the Guidelines for this EIS. Some terrestrial invertebrate groups, notably ants and termites, have great value in the environmental assessment of mining projects, as they are early colonisers and good indicators of environmental stability. They are therefore useful groups to monitor success of rehabilitation.

There are many difficulties in assessing the conservation values of terrestrial invertebrates. The most prominent of these is a general lack of detailed knowledge on the abundance, distribution, ecology and, in many cases, the identity of most species when compared to vertebrate fauna. Even if surveys were restricted to the most prominent group, the insects, a high level of research effort would be required just to identify the species present. As an example, studies in Kakadu National Park over the last 15 years have indicated that there are over 10,000 species of insects there, including 49 termites, 91 grasshoppers, 850 beetles, 1,000 flies, 1,500 butterflies & moths, and more than 500 wasps. In most groups, 40% to 50% of specimens collected were undescribed (Press et al 1995).

Although the insect fauna of the Wickham Point area is poorly known, it is likely to be prolific. Prominent groups such as butterflies, flies and grasshoppers form an important part of the ecology, and species such as the Orange Lacewing Butterfly are dependent on vine forests (Section 6.3.3.1 of Draft EIS). However, insects also occupy a much smaller niche than most vertebrates and would therefore be able to better cope with a reduction in available habitat that large vertebrates such as wallabies and scrub fowl. Since the project has been designed to retain large areas of most currently available habitats at Wickham Point, it is very probable that existing insect populations will survive in the area.

6.3.2.2 Darwin Harbour Assemblages

Environment Australia noted that page 6.33 refers to possible occurrences of dugongs in Darwin Harbour. Further information, if available, should be provided on the likely occurrence of dugong in the vicinity of Wickham Point, and whether they are likely to be dependent upon the area affected by the proposal.

Discussions with Neil Smith of the NT Parks and Wildlife Commission indicate that no information on local dugong population characteristics or preferences are available with which to respond to the above questions. However, the fact that Wickham Point does not support extensive seagrass areas suggests that it is not particularly important as a feeding ground.

(Refer also to the response to Section 7.3.3.8 of the Draft EIS).

6.3.3 Ecological Function and Conservation Status of Major Biotic Groups

Environment Australia notes the regional significance of dry rainforest, and the pristine nature of this vegetation type to be affected by the proposal. Figure 6.14 highlights the relatively large 'island' of dry rainforest immediately south of the development area. The Draft EIS notes that this area is largely protected from fire and degradation from weeds and feral animals, due to its isolation and mangrove surrounds. The EPG would expect that all efforts would be made to preserve the integrity of this 'island', and various comments have been made aimed at achieving this.

As pointed out by the EPG, the conservation value of the 'central island' has been documented in the Draft EIS. At the time of preparation of that document, it was unclear whether Phillips would have responsibility for construction and maintenance of the access road across the 'central island' and, if so, how far management responsibility would extend. Since that time, the NT Government has determined that they will assume responsibility for design of the access road and it appears that Phillips' control will commence on Wickham Point. Phillips is therefore not likely to have a significant role in the management of 'Central Island', which will be the responsibility of the NT Government. Comments on land use planning for the general area are presented in Section 6.4.1 below.

6.3.3.1 Rainforest Vegetation

Environment Australia commented that Appendix H to the Draft EIS notes that the Wickham Point site represents not only one of the largest stands of this vegetation type in Darwin Harbour, but represents 11% of the dry rainforest (or dry vine forests) reserves in the Darwin region, and considers that this point should be raised in the body of the text of the final EIS.

The value of Wickham Point for supporting good quality, undisturbed dry rainforest habitat is readily acknowledged in the Draft EIS, and the loss of part of this habitat is acknowledged as one of the adverse impacts of the project. For this reason, Phillips has done as much as possible, consistent with the efficient design of the plant site, to minimise loss of this habitat, and will initiate management plans to protect the remainder from further degradation. Also, as pointed out in the Draft EIS, there is an estimated 1,600 ha of dry rainforest habitat available in the Darwin region, which comprises some 4.6% of the total 34,000 ha (approx.) of similar habitat which is available in the Northern Territory.

6.3.3.2 Mangroves

Environment Australia and GANT observed that adverse effects on mangroves (especially as habitat for the Cicadabird) as a result of the access road and tidal changes should be mentioned (outlining the area to be affected) in the final EIS and how these adverse effects are to be mitigated. Comment on the importance of these mangroves in the overall context of the area. Provide definitions of Endangered or Threatened species

The high quality mangrove habitat noted as present to the south-east of the plant occurs within a small mangrove creek. The most extensive areas of prime mangrove habitat nearby are found in the upper parts of Middle Arm and East Arm. Nevertheless, areas of mangroves in the vicinity of the access road will be protected through a range of mitigating measures which are detailed in Section 8.2.2.1 of the Draft EIS. In particular, drainage and erosion control measures will reduce the likelihood of adverse impacts on the mangrove creek. Tidal patterns in the creek are not expected to change because of the development.

The *Endangered Species Protection Act 1992* (Schedule 1) and Garnett (1992a) were used to determine the conservation status of threatened species. The most recent revision of Schedule 1 available at the time of preparing the Draft EIS (May 1996) listed Melville Cicadabird (*Coracina tenuirostris melvillensis*) as an Endangered species. However, in the latest revision (August 1997) this species is no longer listed. The Beach Stone-curlew is not listed on Schedule 1, but is noted in Garnett (1992a) as Vulnerable (see Table 6.3 of Draft EIS).

6.3.3.3 Terrestrial fauna

ECNT requested clarification of whether Wickham Point is a significant breeding site for the Little Tern and whether these birds are feeding in an intertidal zone in large numbers.

The Little Tern is a seabird which nests on undisturbed, unvegetated sites near estuaries and adjacent freshwater lakes, on estuarine and continental islands and on coral cays. Nesting occurs between the high tide mark and shore vegetation (Garnett 1992b). Wickham Point, and Darwin Harbour in general are not a recognised breeding area for the Little Tern (Blakers et al. 1986; Garnett 1992b). It is possible that some breeding takes place in the area but it has not been documented to date.

Little Terns are wet season visitors in the Darwin Area. They feed mainly on fish taken in a dive from above the water surface and therefore do not use the intertidal zone for feeding.

The ECNT asked for more information on the migratory patterns of significant fauna species (especially those listed in international agreements such as JAMBA and CAMBA).

There are about 15 species of shorebirds in Australia that are resident, about 36 that are regular migrants and about 16 that are vagrants. The main habitats used by migratory shorebirds are: coastal mudflats, estuaries, shorelines and reefs; inland wetlands; and non-wetland areas (Watkins 1993).

Most of the shorebirds that migrate to Australia are trans-equatorial migrants that breed in central and north-eastern Asia during June and July and visit Australia during the summer (wet season) months. The migration paths are termed flyways and the flyway used by birds which visit Australia is known as the East Asian – Australasian Flyway. The total number of birds using this flyway is estimated to be between four and six million.

The Darwin area is recognised as being of National and International importance for migratory bird conservation. The following table (Table 1) indicates the most significant species, recorded annual visitation, rank and importance (International or National). The table is from data in Watkins (1993).

Table 6.3.3.3

Important Migratory Shorebirds of the Darwin Area

Species	Numbers	Rank	Importance
Large Sand Plover	1,024	4	I
Mongolian Plover	1,440	5	I
Black-tailed Godwit	2,000	6	I
Great Knot	14,800	6	I
Sanderling	137	16	I
Grey Plover	164	20	I
Common Sandpiper	52	3	N
Whimbrel	266	7	N
Bar-tailed Godwit	2,200	10	N
Ruddy Turnstone	267	19	N

6.3.3.5 Marine fauna (reptiles and mammals)

ECNT requested the inclusion of Appendix D, Section 3.3.5 (Conservation Status of Biota) in the main EIS.

It is noted that most of the Appendix D section appears within the main EIS, as Section 6.3.3.5. The following was not included, for brevity, but is referenced in the EIS section:

All species of marine turtle are included on the *Red List of Threatened Animals* [International Union for the Conservation of Nature and Natural Resources (IUCN) 1996]. The hawksbill is listed as 'critically endangered', meaning it faces an extremely high risk of extinction in the wild in the immediate future. Green, loggerhead and olive ridley turtles are listed as 'endangered' (very high risk of extinction in the near future), while flatbacks are listed as 'vulnerable' (high risk of extinction in the medium-term future).

Under the Commonwealth *Endangered Species Protection Act 1992*, the loggerhead turtle is listed as 'endangered', meaning the species may become extinct if the threats to its survival continue. Green and hawksbill turtles are listed under the Act as 'vulnerable', meaning they may become endangered if threats continue. All turtle species occurring in the Indo-Pacific region are a priority for conservation under the *Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention or CMS).

Dugongs and humpback whales are listed by IUCN (1996) as 'vulnerable'. Striped and spinner dolphins and short-finned pilot whales are listed as 'conservation dependent', meaning they are foci

of taxon-specific or habitat-specific conservation programmes, cessation of which would result in the species qualifying for one of the threatened categories within a five year period. Southern minke whales are listed as 'near threatened' (close to being classified as vulnerable). The common dolphin was present on the 1994 Red List, but was removed from the 1996 list. The other cetaceans known to occur in the Timor Sea-Darwin region are all listed by IUCN (1996) as 'data deficient', meaning there is inadequate information to assess the risk of extinction based on distribution or population status, and that future research may indicate that 'threatened' classification is appropriate.

6.4.1 Land Use Tenure and Zoning

Environment Australia, ECNT, the Larakia Nation and GANT expressed concern that the project is being considered in isolation from current and future developments in Darwin Harbour, and the need for a management plan for Darwin Harbour to enable cumulative impacts to be assessed.

Planning the development of the LNG plant, including the site selection process, has taken account of long term NT Government plans for the Middle Arm Peninsula. The 1990 Darwin Land Use Structure Plan considered the Middle Arm Peninsula suitable as a "future major industrial area" based on the area's "potential to be served by port development using deep water channels".

The DLPE provided comments on the Draft EIS and noted that the "…proposed LNG plant is considered to be in accordance with the relevant land use objectives and structure plans". However, the Department indicated that the current FU (Future Use) zoning of Wickham Point in the control Plan "is a land use zoning which applies to land where intensive development is premature due to a current lack of services or infrastructure".

Development of the LNG Plant at Wickham Point will require rezoning to I3 (Offensive and Hazardous Industry) or SU (Specific Use). The DLPE suggested that SU "... would be the more appropriate zoning given that the ultimate land use would be known". It is therefore considered that the LNG project is compatible with the long term plans for the area and is not being considered in isolation from other existing and proposed land uses. Assessment of the LNG project has taken into account the development and environmental impact of Channel Island Power Station, East Arm Port, and other land uses on Middle Arm Peninsula. Future projects which are judged to have significant environmental impacts, including cumulative impacts, will be assessed under appropriate EIA legislation.

Preparation and implementation of a management plan for Darwin Harbour is a policy issue for NT Government consideration and is a matter that is outside the scope of this EIS. It is noted that a report entitled "Darwin Harbour and its Catchment - A Summary of NT Government Activities" has recently been released.

Environment Australia has requested that the final EIS should identify whether there are likely to be significant implications for the site in the event that the native title claim is successful.

Phillips filed an Application for Direct Sale of Crown Land at Wickham Point on the Middle Arm Peninsula in Darwin Harbour on 24 July 1996.

The Middle Arm Peninsula, including Wickham Point, is currently subject to two claims filed under the *Native Title Act of 1993*. On 21 October 1996 a claim (No. DC96/4) was lodged by Mr. Kevin (Tibby) Quall on behalf of the Danggalaba Clan. On 6 December 1996 a claim (No. DC96/7) was lodged by Mr. Bill Risk for the Larakia.

On 29 November 1996 the Northern Territory Government (NTG) filed notices under the *Land Acquisition Act (NT)* and the *Native Title Act of 1993* to compulsory acquire all native title rights and interests, if any, in the lands and waters of a 4400 hectare estate on Middle Arm Peninsula. This

estate includes the land at Wickham Point on which the LNG project would be constructed. Negotiations in regard to that compulsory acquisition have been ongoing in accordance with statutory requirements. A final and timely resolution of this matter is expected in 1998.

Phillips has participated in these negotiations with the Northern Territory Government and representatives of the native title parties since the inception of discussions regarding Middle Arm Peninsula. Phillips has been assured of support for the project by both the NT Government and the parties to the native title claims. As a consequence of those assurances and independent of decisions concerning native title, Phillips expects to receive a grant of tenure sufficient to allow the project to be constructed and operated. As such, Phillips does not believe there are "… likely to be any significant implications for the site in the event the claim is successful".

6.4.2.1 Shipping

The ECNT commented that they were uncertain of the relationship between naval activities and LNG ship movements within the Harbour, and would request a clear separation of shipping routes, and berthing and turning areas used by the Navy and Phillips.

Discussions have been held with Northern Defence Command in which the Navy has indicated the proposed navigation route of the LNG ships through Middle Arm will not adversely affect their current or anticipated future uses of Darwin Harbour. Mooring by the Navy will take place primarily in the main port area. Berthing and turning of naval vessels occurs at the main port area, well away from Wickham Point. Phillips will continue to liaise with NORCOM and the RAN on this matter.

All movements of the LNG vessels in Darwin Harbour will be notified to the Darwin Port Authority, who will also be aware of all other vessel movements in the harbour, and will arrange the necessary separation between vessels. Berthing of the LNG vessels will be at the loading jetty on Wickham Point, where the turning basin will be located. The LNG vessels will be escorted by tugs when they are moving in designated areas. As indicated in the response to Section 4.7 of the Draft EIS, a 500 m exclusion zone will apply around all LNG tankers, both whilst underway or berthed at the loading jetty. A Darwin Harbour Pilot (provided by the Darwin Port Authority) will most likely be aboard every ship to ensure vessel compliance with all procedures including vessel separations.

6.4.6.2 Marine heritage sites

The NT Government, Silvano Jung (SJ) and M. A. Clinch (MC) note there are many more wrecks in Darwin Harbour than those listed in the EIS, including:

- *Song Saigon;*
- *Mandorah Queen;*
- *NR Dieman;*
- *Ham Luong;*
- *John Holland Barge; and*
- *SS Ellengowan.*

The existence of these additional sites are acknowledged. By listing only those sites declared under the Northern Territory Conservation Act as heritage places, it was not intended to discount the value of other non-listed sites. The *SS Ellengowan* was not discussed as it was considered to be outside of the zone of potential impact from construction and operation activities. Further information on this topic is provided in the response to Section 4.4 of the Draft EIS.

6.4.7 Anthropology

The ECNT strongly suggested that Phillips Oil Company carry out a more comprehensive consultation exercise with both Larakia and Danggalaba Aboriginal interests and include the findings in the final EIS Report.

Environment Australia also requested that further consultation should be conducted and the results of a more extensive survey of Aboriginal people provided in the final EIS.

The NLC commented that the Draft EIS gives no indication of the spiritual significance of Wickham Point to the Larakia.

The Larakia Nation commented that the Draft EIS did not adequately reflect the cultural significance of the Wickham Point area to the Larakia people and that a comprehensive site visit is required before finalisation of the EIS to address this.

As stated in the Draft EIS and noted by some reviewers, it was intended that further consultation would be undertaken with Aboriginal people identified as having cultural links with the area. Several site visits and meetings with Aboriginal groups and families were undertaken during October and November and the results of these detailed consultations are presented in Appendix 5 of this Supplement.

The supplementary anthropological study involved contact with 16 organisations and individuals, and detailed consultations with several key Larakia people and other Aboriginal people who were entitled to speak about Wickham Point and the surrounding land and waters. Field inspections were conducted with representatives of two Larakia families, the Roman and Risk families.

Information collected during the study revealed that Wickham Point is of spiritual significance to all Larakia people, which they are duty bound to protect for their descendants. Areas near Wickham Point are imbued with spiritual significance as a Larakia Ancestor travelled through there to the Sacred Site, Yirra. The Roman family have a particular attachment to this site and the associated trail as their grandmother also bore the name Yirra.

Developments which lead to a loss of access to resources and areas and the environmental degradation in Darwin Harbour are felt as personal injuries by the Larakia. Damage to an Ancestor's path is a source of loss and injury for Larakia people.

The supplementary study concluded that the Larakia seek acknowledgment of their historical and cultural connection to the land and, in particular, recognition of the impact which development of the LNG plant will have upon them.

ENVIRONMENTAL EFFECTS ASSESSMENT (Section 7 of Draft EIS)

7.2.2.1 Effects of clearing the site on flora and fauna

Environment Australia asked whether measures will be taken to facilitate fauna movement which has been affected by the road and site construction and also identify the species whose movement will be affected.

Free movement of ground dwelling fauna around the site will be interrupted by the loading jetty and pipeline crossings on the west side of the main island, part of the plant site and construction dock on the east side of the main island, and the main access road. Fencing of the perimeter of the plant area will also inhibit movement into or out of the site. The animals most affected by these obstructions would be species such as Agile Wallaby and Northern Brown Bandicoot, plus a number of the

smaller reptile and mammal species. Observations on these species in the area indicate that the main movement routes around the island are along the mangrove margins, especially at low tide.

It is proposed to install fauna underpasses beneath the loading jetty and minimise obstruction of the mangrove hinterland fringe on the south side of Wickham Point to enable fauna movement between Peak Hill and the central island. The small area of dense rainforest situated on the south-east corner of Wickham Point 'island' will also be preserved as a fauna staging area.

To ensure free movement of fauna, vegetation clearing in the vicinity of these obstructions will be limited, easy access crossing points will be established and fauna corridors will be designated so that all areas of natural vegetation will be interconnected. It is expected that terrestrial fauna will freely cross the roads when necessary, as they do in other areas of Middle and East Arm. Most terrestrial fauna are nocturnal and would use these areas at a time when traffic would be minimal. Imposition of speed limits on access roads, and education of the workforce will help reduce the incidence of road fauna fatalities.

Environment Australia and NT Government asked for justification of the assumption that the Beach Stone-curlew will continue to use the habitat once construction phase is complete.

The Beach Stone-curlew occurs in low densities throughout its range compared with other shorebirds and lays only one egg per clutch (Lane 1987). For these reasons, it has a poor ability to recover from population decline. There has been an observed decline in this species throughout its range in areas of human habitation and the reasons have been cited as human disturbance, predation by feral cats, dogs and pigs, and possibly from egg collecting (Garnett 1992b). In the Darwin area, Beach Stone-curlews are generally seen only on the more remote beaches. For example, a pair regularly nested on South Shell Island prior to the recent construction of the East Arm Port (K. Martin pers. obs.).

Construction of the LNG plant and related infrastructure at Wickham Point will probably disrupt the local populations of this bird. However, once construction is completed, areas of beach habitat will be left undisturbed. Workers will not be allowed to enter these areas, and the program of feral animal control will reduce or eliminate the risk of cats on the island.

Considering the known reasons for decline as described above, is it reasonable to expect that the species will continue to use the Wickham Point area if human and feral animal disturbances are minimised. Beach Stone-curlews are frequently recorded on Varanus and Barrow Islands in Australia's North West. Both islands support well-managed oil and gas developments (I. LeProvost, pers. obs.).

Environment Australia asked that Phillips explore the possibility of relocating the Scrubfowl mounds that will be destroyed (for educational purposes) and outline measures to prevent disturbance to the remaining mounds.

Scrubfowl mounds are constructed of soil, leaves and, in the case of those on Wickham Point, discarded shells from Aboriginal middens. The mounds are quite large, up to eight metres in height, and feature a worked "crater" at the top, where eggs are buried for incubation. It would not be feasible to physically move a mound of this size without destroying its original structure, and it would be most unlikely that the breeding birds would continue using a translocated mound because the actual location of the mound probably plays an important role in regulating the incubation temperature.

There is no need to move a mound for educational purposes as these mounds are common in the Darwin area and can be easily viewed at many locations including East Point Reserve, Casuarina Coastal Reserve and Holmes Jungle Nature Park.

Mounds located outside the areas of direct construction activities will be left undisturbed. Restriction of public and worker access to these areas, plus feral animal control measures will ensure continued use of these nest mounds.

Environment Australia asked that Phillips:
- *outline other sources of impacts on numbers of species (other than loss of habitat);*
- *examine the effects of increased noise on fauna; and*
- *examine noise impacts on nearby fauna.*

The NT Government commented that the Draft EIS does not appear to address any potential impacts as a result of lighting the facility at night. Is the facility likely to become attractive to species which will then become a pest?

Loss and fragmentation of habitat is expected to be the primary cause of disturbance to fauna due to the project. The greatest impacts will be felt during the construction phase when vegetation clearance takes place. During the operational phase remaining habitat will be left in an undisturbed state.

Noise, especially during the construction phase, but also in the operational phase, will also have some negative effect on fauna. Individuals are expected to retreat, at least temporarily, to quieter areas. It is difficult to predict the impacts of noise on fauna, although it is likely that some species will be more tolerant than others. Various studies on noise impacts (e.g. Fletcher & Busnel 1978) on wildlife have shown that many species can tolerate levels of noise provided that there is no perceived threat. Measures to reduce noise at the site are described in 8.2.2.1 (viii) of the Draft EIS.

As with noise, the effects of lighting on wildlife are expected to be localised. Some species, such as bats, geckoes and frogs are attracted to lights to catch insects. These species are not expected to cause problems as pests as there is no evidence of this occurring elsewhere around Darwin. Fauna species such as Agile Wallabies and Northern Brown Bandicoot are still very common in close proximity to a number of similar developments in Darwin Harbour such as at Channel Island and East Arm (K. Martin pers. obs.) so it is reasonable to expect that the effects of noise and lighting will not severely affect these species.

It is likely that most fauna species will have a higher tolerance of non-threatening noise or lighting than human or feral animal disturbance. Therefore, fauna conservation measures will concentrate on feral animal control, retention of major habitats, and restriction of access to undisturbed parts of the islands.

Traffic along the new access road has the potential to increase the incidence of road killed fauna in the area, especially in the period soon after construction, when fauna will not be used to the road. As

described in 8.2.2.1.(vii) of the Draft EIS, this impact will be managed by imposing a speed limit on the road, and through the workforce induction program. Particular emphasis will be placed on care in driving on the road at dusk and at night.

7.2.2.2 Effect of excavation and levelling

(v) Drainage modification

The NT Government noted that the Temporary Reclamation Area and the access road to this area has the potential to impound tidal water and thus enhance the nearby mosquito breeding site previously identified by the MEB. Drainage provisions may be required to overcome this potential problem.

As indicated in Section I.8 of this Supplement, Phillips recognises that further detail is required on the proposed dredging and spoil disposal activities, and commits to providing that detail and obtaining separate environmental approval as required for these works prior to construction. Phillips' preference is to avoid the need for a temporary reclamation area and, to this end, will work with the NT Department of Transport & Works in an effort to coordinate dredging operations and possibly relocate suitable fill material to the East Arm Port reclamation area.

Appendix 8 addresses alternative sites that could be used in the event a temporary reclamation area is required.

(vi) Fire, weeds and feral pests

The NT Government noted that the provision of an access road to the 'central island' and Wickham Point creates an increased risk of fire and invasion by weeds and feral animals.

The risk of fire has been identified in Section 7.2.2.2 of the Draft EIS. Management of this impact is addressed in Section 8.2.2.1. (vii) of the Draft EIS and includes worker induction, availability of fire fighting equipment, and liaison with the NT Bushfires Council. Management of the access road will be the responsibility of the Northern Territory Government. Phillips will work with the NT Government and provide whatever assistance is practicable in managing this area.

7.2.3 Marine Construction Activities

The NT Government expressed concern that the potential impacts of pipeline construction on marine life, particularly higher order life such as dugongs, turtles and dolphins, have not been adequately assessed.

As detailed in the response to Section 5.3.2.1 of the Draft EIS above, route preparation works for the pipeline will be minimised through route optimisation studies. Preparation work will comprise placement of rock armour, ploughing and dredging. None of these works are anticipated to have significant adverse effects on marine life, which will have ample opportunity to avoid construction areas if undesirable noise levels or turbidity are present. It is considered highly unlikely that any migratory, feeding or breeding behaviour will be affected by the pipelaying operations, which will be transient and in areas already subject to regular shipping and trawling activity.

Numerous subsea pipelines have been laid on the North West Shelf of Australia over the past two decades and concern regarding this issue has never been raised, nor has there been any indication that such concern is in fact warranted.

7.2.3.1 Habitat replacement

The NT Government commented that there is conflicting information on the value of artificial reefs, whether they actually increase the amount of fish available or simply concentrate existing populations. Only larger structures such as the loading facility and construction bay will attract larger fish and these will be off limits to the public.

As is pointed out in the submission, there is conflicting information on whether the populations of mobile fish are increased or simply concentrated in an area by artificial structures, and the question is under active scientific investigation in many parts of the world.

In Darwin Harbour, the pipeline will be armoured by a 10 m wide strip of rocks. This new habitat will be colonised by animals similar to those which occur in rocky habitats nearby. The depth and high natural turbidity of water in Darwin Harbour mean that there will be insufficient light available for the growth of plants on the rocks armouring the pipeline. Sessile invertebrates such as sea squirts, sponges, mussels, etc. will grow on the rocks and the nooks and crannies will provide habitat for mobile invertebrates. The rocks will also provide habitat for territorial fish, increasing their populations above that of any surrounding sand bottoms. Thus a natural community will develop. The rock armoured North West Shelf gas pipeline in Mermaid Sound has become very popular with recreational fishers.

The submission is also correct in stating that the loading dock and construction bay will be off limits to the public. Recent experience with marine parks and reserves has demonstrated that fish populations return to their natural higher densities and larger fish are present once fishing is prohibited from an area. Once the carrying capacity of the area is reached, fish begin to move out of the reserved area into adjacent areas where they can be caught, thereby increasing the fishery. Therefore, such reserved areas become 'de facto' sanctuaries from which recruitment to fished areas can occur. As such, they are seen to be beneficial to both the ecosystem and the community.

7.2.3.2 Hydrodynamic changes

The NT Government noted: "It is acknowledged in the Draft EIS that disposition of sediment will occur on both sides of the loading jetty groyne. A result of this sedimentation may be the interruption of the strong species zonation evident along the coast of Wickham Point. This may cause mangrove deaths, decolonisation and changes in species composition. In order to more fully assess the effects of such sedimentation, the hydrodynamic modelling should be verified and a more accurate estimate of the amount and effects of the sedimentation determined."

Similar groynes have been built in several areas of the harbour such as East Arm Port and Channel Island. There is no evidence that these groynes have created other than very localised effects on mangroves. Any effects that do occur will probably occur slowly and, in the long term, result in a net increase in mangrove productivity locally. Given the low potential for adverse impact, it is considered that the modelling undertaken for the Draft EIS was sufficient to reasonably predict sedimentation patterns and it is not proposed to undertake further hydrodynamic modelling.

7.2.3.3 Turbid water plumes

Environment Australia asked for comment on possible sediment disturbance from propeller wash, particularly in the turning basin.

The major impact in the turning basin will come from dredging to remove the upper portion of a small submerged mound in Middle Arm. Therefore the dredging will not create a silt trap, because

there will be no basin excavated in the channel. As most of the area is naturally deep and well flushed, it is not expected to silt up once dredging has been completed. Even if propeller wash occurs, it will create much less turbidity than natural phenomena such as spring tides and freshwater flow during the wet. Furthermore, the new larger turning basin now means that the LNG vessel will be able to approach the loading jetty in a 'slow turn' manoeuvre which minimises the need for tug assistance and will require far less tug propeller revolutions than would have been the case under the previous arrangement. The LNG vessel will also operate at very low propeller revolutions when approaching the loading jetty. Hence, the potential for sediment disturbance from propeller wash is limited.

The NT Government pointed out that while the effects of dredging are discussed, the Draft EIS "does not consider possible impacts from sediments that may be released into the water column by dumping of rock fill or rock fill stirring up the soft bottom. As the proposed pipeline passes reefs along the western part of Darwin harbour, sedimentation and water quality may have an impact and may require monitoring."

Within Darwin Harbour, the proposed pipeline route approaches the LNG Plant site from the north-west to maintain optimum clearance between the pipeline and the main shipping channel as shown on Figure 1.2 of the Draft EIS. The NT Government submission draws attention to the proximity (a minimum of approximately 0.5 km) of the proposed route from the reefs at West Point. However, sedimentation is not considered to present a problem to these reefs because:

- while there will inevitably be some fine material included, the rock armouring for the pipeline will be boulder sized granitic material placed from specialist vessels using a "fall pipe" technique (basically a pipe made of chain) to control rock placement. There will be very little fine material associated with the rock dumping works;

- the proposed pipeline route is aligned along in the main current flow for tidal movements into and out of the harbour. The bottom is thus scoured, with little soft sediments to be disturbed;

- if any turbidity does arise, it will tend to move with the incoming and out going tide, not into the shallows where corals are located;

- experience of similar works on pipelines on the North West Shelf indicate little and localised turbidity increase on a transient basis. Extensive monitoring undertaken by Woodside for the installation of the North West Shelf Gas pipeline (T D Meagher & Associates 1982) concluded that there were no significant impacts on the marine environment of Mermaid Sound attributable to the pipelaying and armouring activities.

The NT Government questioned the selection by MHL of 0.02 mm for fine sediment particle size in their turbidity plume dispersion modelling. This is based upon data for Channel Island marine muds, which typically have 81% of particles <0.073 mm in diameter and a relatively uniform distribution in the range 0.073-0.0023 mm. The effect of the presence of these finer fractions on the results of the plume dispersion predictions was queried.

Particle size analysis of sediments collected from the surface of the turning basin area, where the majority of dredging is proposed, showed that only 3% of sediments were <0.075 mm in diameter. It was assumed that a greater proportion of fine sediments may be present in the vicinity of the pipeline shore crossing and the construction dock approach channel, and particle size data were adopted which were consistent with those used in modelling of plume dispersion at the East Arm Port development.

Appendix 8 presents new information on the likely characteristics of the spoil material at the various excavation sites. None of the sites comprise sediment characteristics such as those described for

Channel Island marine muds. All sites have a portion of silt and clay, but are primarily comprised of sand, gravel and rock.

The NT Government asked: (i) how long is the dredging expected to last; and (ii) request further detail on spoil disposal intentions, management and rehabilitation of reclamation area.

As outlined in Section I.8 of this Supplement, it is proposed to coordinate dredging with the Stage 2 East Arm Port works if possible. The type of dredge proposed for these works will have the capacity to continuously dredge 150,000 m^3 of metasiltstone rock within approximately 3 - 4 weeks. The volume of material to be excavated for the construction dock approaches is only 50,000 m^3, and will require a different method of excavation. It is estimated that it will require 2 - 3 weeks to complete this task.

Phillips recognises that further detail is required on the proposed dredging and spoil disposal activities, and commits to providing that detail and obtaining separate environmental approval as required for these works prior to construction. As indicated in Section I.8 (ii) of this Supplement, Phillips' preference is to avoid the need for a temporary reclamation area and, to this end, will work with the NT Department of Transport & Works in an effort to coordinate dredging operations and to relocate suitable fill material to the East Arm Port reclamation area.

PB commented that corals and sponges in the area of Wickham Point and Channel Island will be adversely affected by increased turbidity, and that the EIS does not recognise that the harbour is not fully flushed on each tide. Because of this suspended material will be washed back on the incoming tide and affect the entire harbour.

A detailed analysis of likely sediment plumes was undertaken by the Manly Hydraulics Laboratory using the results of sediment analyses undertaken for the EIS and a modified version of the mathematical hydrodynamic model for Darwin Harbour which was developed in 1993 for application during the planning of East Arm Port (DPA 1996). The hydrodynamic model incorporates tidal movements, and allows for the fact that the harbour is not fully flushed on each tide.

The Draft EIS states (p. 7.17):

"Dredging was predicted by MHL to cause temporary and localised increases in water turbidity. Within the turning basin, and along the pipeline route adjacent to Weed Reef, dredge plume dispersion was predicted to be very rapid due to the predominant high water currents in these areas. Although lower dispersion was predicted for the pipeline shore crossing area and the construction dock approach channel, elevated turbidity remained localised. Suspended sediment concentrations within the dredge plumes were predicted to fall to background levels within a radius of ~200 m from the shore crossing, and within a radius of ~700 m from the construction dock dredging (Figure 7.2.).

It was shown to be highly unlikely that water turbidity in the vicinity of the Channel Island coral communities would be elevated above background levels, as they were sufficiently distant (greater than 3 km) from the construction areas for any additional sediment to have settled from the water column prior to reaching Channel Island. The predominance of water flow to the south of Channel Island, along the main Middle Arm channel, rather than to the north of the island would further reduce the chance of turbid plumes impinging on these coral communities."

The ECNT requested further information on the ecologically important coral habitats nearby. "The ECNT is aware of the significant destruction of coral reefs for the construction of the East Arm Port Development Project, and questions the cumulative impact of destroying yet more coral communities. The lack of comprehensive mapping of the Harbour's coral resource and again the lack of a

management plan for Darwin Harbour makes it impossible to ensure that the protection of the coral communities will be ensured."

The recently published study by Wolstenholme et al. (1997) recorded 123 species of scleractinian (reef building) corals in Darwin Harbour. Most species occurred in the outer harbour seaward of a line between West Point and Fannie Bay; diversity is substantially reduced in the inner harbour. The three stations nearest Wickham Point had very limited coral diversity: Channel Island had 15 species, North Shell Island 13 and South Shell Island 12.

The study required three weeks of field time by a team of several divers and considerable effort by three highly trained scientists over the next year to analyse the results, identify the species, and write up the results. The level of effort required to completely survey the corals of Darwin Harbour is not warranted by the information which will be gained. Selection of stations for the coral survey was based on information on coral distributions developed by the Museums and Art Galleries of the Northern Territory over the previous two decades. The fact that eight of the twelve stations selected for examination were in the outer harbour is an indication of the relative paucity of corals in the inner harbour.

It is highly unlikely that the Phillips' marine construction programme will result in further destruction of coral communities given the relatively small volumes to be dredged and the short time spans over which dredging will occur. (Also refer to response to Section 8.3.2.3 of the Draft EIS.)

Finally, the selection of Wickham Point for the proposed LNG Plant is consistent with the Northern Territory Government objectives for future industrial development of the Port. The need for a comprehensive management plan for Darwin Harbour is a matter for government consideration.

7.3.2.1 Loss of archaeological sites and Aboriginal burial sites

Environment Australia asked for information on the likely composition, function and objectives of the Liaison Committee.

Phillips has committed to establish and work closely with a liaison committee which will include indigenous interests. It is anticipated that the liaison committee will consist of an equal number of Phillips' personnel and representatives of local indigenous interests. The liaison committee will be formed and begin its work prior to commencing construction on the LNG project. It will function as a principal point of contact between local indigenous interests and Phillips with regard to the plant site throughout construction and operation of the facility. It will provide a forum for recommendations, advice and problem resolution on matters relating to environmental protection, heritage site investigations, sacred site identification and protection, and economic opportunity. The committee will likely perform other tasks and address other issues as agreed among its members. The proceedings of the committee will be confidential.

Environment Australia mentioned that the Draft EIS notes that bulk samples will be taken of [archaeological] sites to be cleared. Measures to record such sites should be noted.

The NT Government asked that this section of the Draft EIS should be rephrased to fully incorporate the requirement for analysis of the archaeological remains as described in Recommendation 2, Section 6 of Appendix L.

It is Phillips' intention that the methods used to investigate and record any significant archaeological sites that will be affected by the project shall comply with Northern Territory Government requirements. For those sites that are expected to be impacted or destroyed during the development of the plant, Phillips undertakes that, prior to construction, appropriate approvals will be obtained. Bulk

samples of archaeological materials may be salvaged by interested parties from each of the middens which will be impacted. This material could then be analysed and sorted to determine accurately the range and relative frequency of different shell taxa in the deposit and so that samples of the shell can be submitted for radiocarbon dating (source: Section 6, Point 2 of Appendix L in Draft EIS).

Phillips has also undertaken to comply with established protocols in the unlikely event that a burial site is uncovered during construction, and has agreed to notify the relevant authorities including NT Police and the Aboriginal Areas Protection Authority.

It is Phillips' intent to use the Liaison Committee to assist in the management and protection of archaeological sites that may be located on Wickham Point.

7.3.2.3 Increased road traffic

Environment Australia noted that the Draft EIS indicates that the rock stockpile may vary from 2,000 to 8,000 tonnes. The supply of 2,000 tonnes every two to three days may require 20-30 truck loads per day. The final EIS should indicate the likelihood that more than 2,000 tonnes will be required every two to three days and the maximum number of daily truck movements that may be required.

As indicated in the response to Section 5.3.2.2 of the Draft EIS, the amount of rock armouring required is approximately 360,000 tonnes. Current plans are to begin stockpiling the majority of the rock 12 to 15 months prior to construction of the pipeline. As a result, there will now be a requirement for a maximum of 15 to 20 road train loads of 75 tonnes each per day operating about 12 hours/day, six days/week.

7.3.2.4 Construction workforce impacts

Environment Australia noted that the Draft EIS states "Phillips will endeavour to balance the economic benefits of the project between Indonesia and Australia to the maximum extent possible." Brief information on the rationale behind this and the most likely way this will be achieved should be provided.

The Bayu-Undan Field, on which the initial phases of the proposed Darwin LNG plant are based, is being developed in accordance with the Timor Gap Treaty. The degree to which the fiscal terms of the Treaty apply to processing operations located outside Area A of the Zone of Cooperation are the subject of continuing discussion within the governments of Australia and Indonesia.

For operations within Area A, the Treaty includes the following two provisions regarding economic benefits derived from petroleum resources. Firstly, developments should be "… aimed at achieving optimum commercial utilisation thereof and equal sharing between the two Contracting States of the benefits of the exploitation of petroleum resources as provided for in the Treaty." Secondly, there is generally to be a preference given to the use of goods and services produced in or provided by contractors operating out of Australia or Indonesia (considering competitive factors) and employment of nationals and permanent residents of Australia and Indonesia. At a recent meeting of the Timor Gap Ministerial Council, these general concepts were reaffirmed and it was agreed that a resolution of outstanding economic matters between the two nations is expected by March 1998. Phillips believes it is appropriate that the Darwin LNG project proceed within the spirit of that Treaty.

7.3.2.5 Include sketches from Appendix O into EIS

The ECNT requested an expansion of the section of the Draft EIS dealing with visual impact assessment, including a commitment to implement Recommendations from Appendix O, and the inclusion of several vantage point visual assessment sketches contained in Appendix O.

Section 7.3.2.5 of the Draft EIS provided a summary of the main findings of the visual impact assessment of the proposed development, conducted by landscape and environmental consultants Ecosystems. As occurred with other specialist studies conducted during the preparation of the Draft EIS, the full report on visual impact assessment was included as an appendix to keep the Draft EIS as concise as possible.

Phillips intends to adopt many mitigation measures to reduce the environmental impact of the project, including the thrust of the recommendations included in Appendix O. The following recommendations will be evaluated and implemented as far as practicable in the design and construction of the plant:

(1) undertake detailed site planning to define the limits of disturbance, the areas of existing vegetation that can be retained and protected and to take advantage of opportunities that may become available for minimising the visual impact of construction works;

(2) develop vegetation management, rehabilitation and landscape strategies as an integral part of the planning and detailed design of the facilities, to ensure wherever practically possible, that maximum advantage is taken of opportunities to reduce the visual impact of the development;

(3) detailed site planning will be undertaken to maximise the area of natural foreshore that can be conserved and protected, and to reinstate the natural shoreline wherever possible following completion of construction;

(4) consider the use of innovative designs and finishes (taking into account the purpose and safety requirements of plant facilities and associated infrastructure), with a view to establishing visual textures and patterns that will soften structural grids, hard edges and repetitive shapes;

(5) consider the use of forms which are sympathetic in proportion and shape to natural landforms (bearing in mind the functions and safety requirements of the facilities);

(6) consider the tonal values of surface finishes that are selected during detailed design of facilities and infrastructure, with the aim of approximating the tone of the immediate environment;

(7) consider the colour scheme of the plant on the basis of existing natural colour scheme of the local Wickham Point environment in order to harmonise with the local area and define the colours to be used throughout the plant.

Several of the vantage point sketches included in Appendix O of the Draft EIS are reproduced on pages 51 and 52 for information. It should be noted that the sketches have not been amended to reflect the new plant layout shown in Figures I.1 and I.2. The overall visual impact as presented in the sketches will not be materially affected by the changes to plant layout, due to the distance from the vantage points to the plant site and the scale of the drawing.

7.3.3.2 Heritage sites

SJ and MC requested the effects of marine construction activities on those shipwrecks which are not protected sites (listed in Section 6.4.6.2 above) be addressed. MC raises a concern that the SS

Ellengowan will be disturbed and damaged by the building of the proposed facility, particularly the pipeline shore crossing and jetty, and by shipping associated with the plant.

The potential for physical disturbance of these wrecks will be assessed following a re-survey of the pipeline route during the detail engineering phase of the project (see 8.2.2.5 below). Decisions can then be made to re-route the pipeline or to destroy/relocate the relic depending on its archaeological/historical significance. If the relics are considered significant and are to be left intact, appropriate management procedures (as outlined in Section 8.2.2.5 of the Draft EIS) will be followed to prevent any impacts upon them.

The wreck of the *SS Ellengowan* is considered distant enough from the construction activities to be safe from impact, but it will be buoyed to ensure its safety. The deep draughts of the vessels utilising the plant loadout facility during the operational phase of the project will prevent them from approaching the vicinity of the *SS Ellengowan*.

7.3.3.8 Conservation and National Estate values

Environment Australia expressed concern that "increased marine activity in the harbour may preclude dugong from visiting the area around Wickham Point. Seagrass beds are located off Mandorah and between Channel Island and the mainland. The final EIS should indicate whether these areas are feeding grounds for dugong, whether the dugong will be prevented from visiting these seagrass beds, and any adverse impact this may have on the dugong population."

As indicated in the Draft EIS, Bayliss (1986) made an aerial census of populations of dugongs (*Dugong dugon*) over large areas of the coastline of the Northern Territory. Details were not provided, but Darwin Harbour was shown as being a small part of a general area where dugongs occur in densities of 0.01 to 0.10 animals per square kilometre in protected areas. They are known to occur in East and Middle Arms except in small creeks.

The dugong population in Darwin Harbour is thus small, and no animals are known to specifically utilise the Wickham Point or Channel Island area. The LNG Plant will not affect access of the animals to the Mandorah area near the mouth of Darwin Harbour. Nor will access be precluded to the Channel Island seagrasses. The only expected affect is that they will remain away from the Wickham Point loading jetty and any vessels underway during the one to two ship movements per week.

COMPARATIVE ANALYSIS

Vantage Point 1

Stokes Hill Wharf - Distance From Site 7 km.

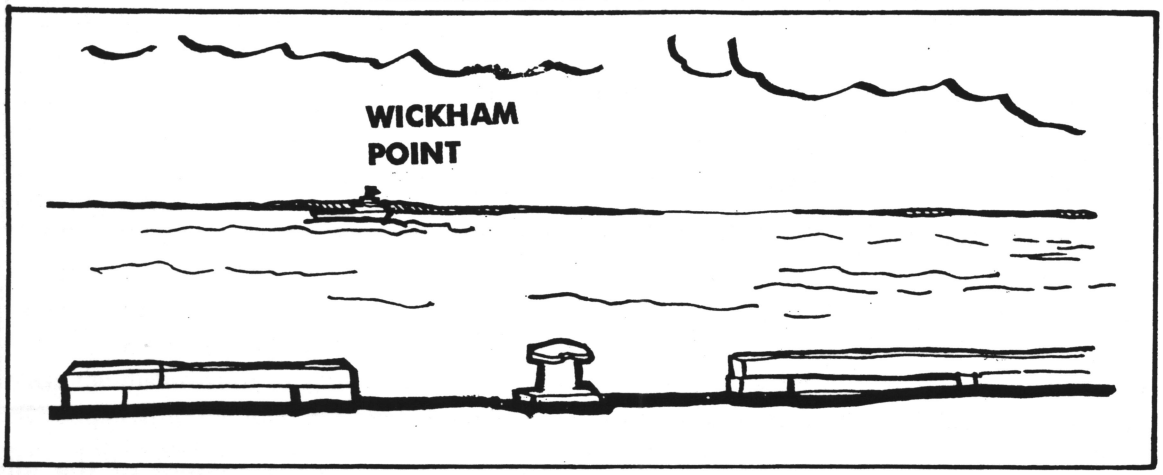


Figure 2: View from Stokes Hill Wharf before development of the site

Existing View - Visual Analysis

LINE	low horizontal lines
TEXTURE	predominant element is the variable texture of the water.
FORM	low elongated land forms
TONE	generally strong contrast between landform, water and sky. Contrast variable with conditions
COLOUR	dominant colours of the sea and skyscape with muted earth colours of the landform
SCALE	vast horizontal scale with considerable distance between prominent land features

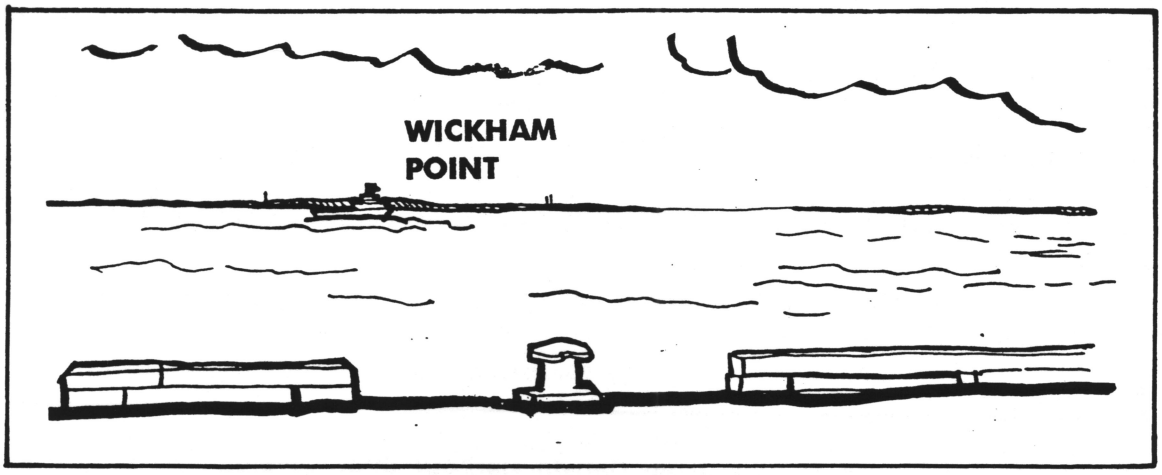


Figure 3: View from Stokes Hill Wharf after development of the site

Proposed Development - Visual Analysis

Visual analysis as for the existing view - no appreciable change

VISUAL IMPACT - NEGLIGIBLE

Vantage Point 2

Harbour View - Distance From Site 3 km

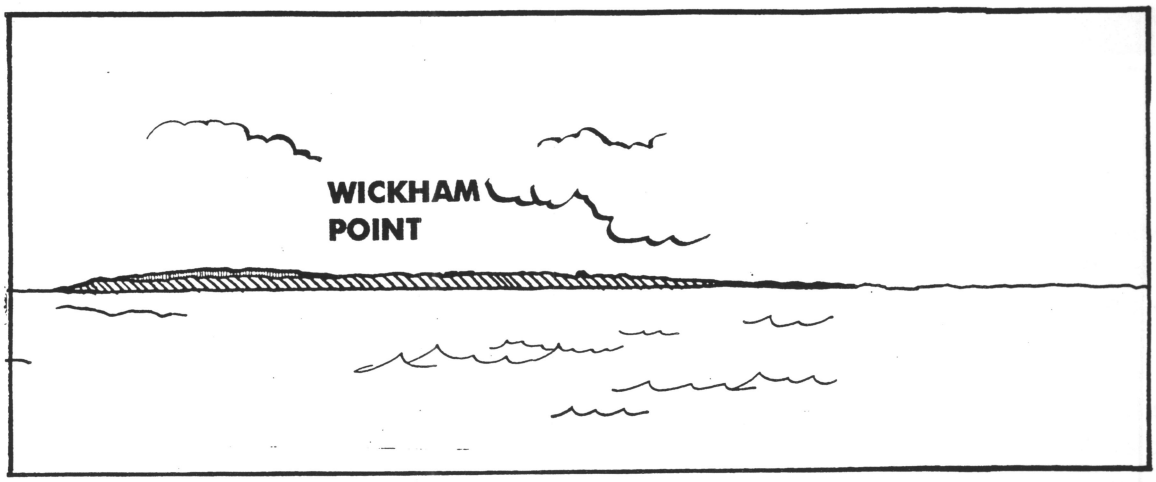


Figure 4: View from Darwin Harbour before development of the site

Existing View - Visual Analysis

LINE	flat horizon line with gently sloping landscape profiles
TEXTURE	dominant texture of waves, some vegetation texture visible
FORM	simple low landforms
TONE	generally strong contrast between landform, water and sky. Contrast variable with conditions.
COLOUR	dominant colours of the sea and skyscape with muted earth colours of the landform
SCALE	wide horizontal scale with little detail definition

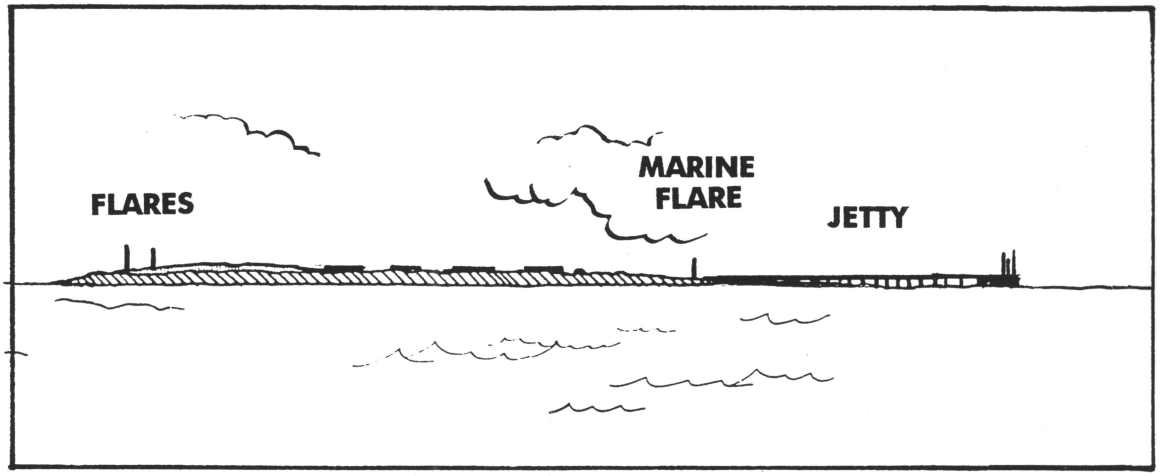


Figure 5: View from Darwin Harbour after development of the site

Proposed Development - Visual Analysis

LINE	flat horizon line with sloping landscape profile punctuated by vertical elements
TEXTURE	irregular vegetation texture contrasting regular texture of jetty piles
FORM	simple low forms, broken by vertical elements
SCALE	wide horizontal scale, broken by vertical elements.

VISUAL IMPACT - MINOR

PB commented that Darwin Harbour is a large sheltered harbour and is an unusually rich and diversified area of mangrove forest. The integrity of the harbour as a whole should not be compromised.

Throughout the Draft EIS, Phillips has recognised the conservation values of Darwin Harbour, particularly in terms of the abundance and diversity of mangroves (Section 6.3.3.2). The Draft EIS has also acknowledged that the development of the LNG plant will result in the permanent removal of vegetation from within the boundaries of the plant. Phillips has agreed to develop and implement an environmental management plan (EMP) to minimise disturbance to the local environment and to effectively manage surrounding areas of flora and fauna habitat within the lease that will not be directly impacted.

It was stated in the Draft EIS that construction of the plant and the access road (which is being designed and managed by the NT Government) will remove approximately 11.1 ha and 4.5 ha of mangroves respectively (Section 7.2.2.1 of the Draft EIS). The revised layout of the plant will increase the disturbance to approximately 11.9 ha. This was considered to be of minor significance when compared to the total area of mangrove habitat in the harbour (some 19,000 ha). Although the project will have some unavoidable impacts on the harbour mangroves it is considered that the integrity of the harbour as a whole will not be compromised by the loss of such a small portion of the vast area of mangroves available.

7.4.2 Atmospheric Emissions

Environment Australia commented that the discussion on page 7.26 of the Draft EIS refers to 'accepted guidelines' for stack emissions and ambient standards, but the guidelines used, or the basis for the standards referred to, is not altogether clear. This should be clarified.

The air quality guidelines used within the Draft EIS were presented in Table 7.3. These guidelines were drawn from a number of sources, with the current NHMRC guidelines being used in the Draft EIS.

PB suggested that:

(i) the proposed LNG development at Wickham Point would add considerable pollution, including greenhouse gases and heat, to the area. As it would be in close proximity to urban areas, this may result in adverse health, social and environmental effects;

(ii) climatic and atmospheric conditions in the Darwin area are conducive to the formation of ozone and photochemical smog from the emissions. This would have negative health (respiratory) and environmental consequences;

(iii) in the air dispersion modelling, concentrations were given at ground level whereas atmospheric concentrations would be much higher especially above the stack. In addition, concentrations were given as averages when prevailing winds may cause higher concentrations in certain areas. Carbon dioxide, methane and heat were not modelled. Fugitive emissions of methane may also occur;

(iv) with the plant operating continuously, emissions will have a limited capacity for dispersing over time;

(v) an independent assessment of ambient air quality should be made;

(vi) greenhouse gas emissions from the plant have the potential to cause local climate change and an increase in temperature in the Darwin region.

The following response is presented according to the issues raised in PB's submission.

Pollution and gaseous emissions

Carbon dioxide and methane were not modelled to predict the ambient concentrations in the vicinity of the proposed LNG plant. These emissions are generally considered to be of global importance in relation to the enhanced greenhouse gas effect, however, as far as can be determined, there are no ambient standards or guidelines for carbon dioxide.

While the heat emitted from the plant (including the flares) may result in localised increases in temperature in close proximity to the flare, the natural dispersion of the emissions will result in a rapid decrease in this temperature.

The maximum ground level concentrations presented within the Draft EIS were for ground level as the ambient standards/guidelines all refer to ground level concentrations. The maximum concentrations of pollutants in the emissions occur at the point of discharge and these concentrations decrease as the plume is dispersed. Concentrations at elevated receptors are likely to be higher than at ground level with the maximum concentrations occurring at the plume centreline.

The air dispersion modelling was undertaken using a complete year of site specific one hour averaged meteorological data. Therefore, the modelling presented in the Draft EIS does include the effects of variations in the wind patterns that occur in the region.

The plant will operate on a continuous basis as this results in better process control which minimises the emissions expected. Gases such as nitrogen dioxide and carbon dioxide are heavier than air (which contains these gases), however the emissions are initially emitted at elevated temperatures which actually makes them lighter than the surrounding air. Further, the small concentrations of these gases in the majority of the emissions in combination with normal atmospheric turbulence ensures that these gases are well mixed and disperse rapidly.

The proposed LNG plant is for a capacity of 3 MTPA. Preliminary air dispersion modelling has been undertaken for a 9 MTPA plant. Although the composition of the feed gas for the 9 MTPA plant is unknown, it was assumed to be the same and the emissions were assumed to be proportionally higher. Results are presented in Appendix 4 of this Supplement. In any event, any proposals by Phillips to expand the size of the proposed plant to 9 MTPA will require further formal environmental assessment as outlined in the Northern Territory Environmental Assessment Act.

The EIS has been prepared by Phillips to present sufficient information to allow the regulatory authorities, public and any other organisation the opportunity to review the work that has been undertaken. As part of their review, the regulatory authorities normally assess the emissions information, meteorological information, modelling approach, and the acceptability of the predicted concentrations resulting from the plant. The modelling has been undertaken using conservative assumptions and the predicted ground level concentrations are well below the relevant ambient standards and guidelines.

The fugitive emissions of methane and other gases are quantified in Table 5.6 of the Draft EIS. These methane emissions have been accounted for within the greenhouse gas emissions.

As stated earlier, the air dispersion modelling has been undertaken using one year of 1-hour averaged meteorological data for Darwin. Therefore, the effects of variable wind speeds and wind directions has been accounted for within the modelling.

The diameters of the flares used in the modelling and reported in Table 7.2 of the Draft EIS are the 'effective' diameters and were calculated based on an approved methodology (as stated in the note at the bottom of Table 7.2). The effective diameter, temperature and exit velocity are calculated to enable the air dispersion model to simulate the effect of the combustion of the flared gases at the top of the flare stack. The actual physical diameter of the flare stack at its exit will be considerably smaller than the 'effective' diameter used in the modelling.

Greenhouse gases

It is not correct to state that the greenhouse gases released from the proposed LNG plant will have a significant effect on global warming. It is estimated that the proposed LNG plant will result in a 0.3% increase in the total mass of greenhouse gases emitted in Australia in 1994. The EIS stated that this was considered to be a large emission of carbon dioxide. However, on a global scale it has been estimated that Australia emits approximately 1.5% of the global carbon dioxide emissions. Therefore, the proposed LNG plant will represent a 0.0045% increase in the global emissions of carbon dioxide. Such a small increase is not expected to result in a significant effect on the global environment.

Nor is it true that the proposed plant will produce excessive quantities of carbon dioxide. As stated earlier, Phillips recognises that the project will emit a large quantity of carbon dioxide, but the plant has been designed to maximise its energy efficiency and minimise its emissions. It should be noted that approximately 40% of the emissions of carbon dioxide from the proposed plant occur naturally in the natural gas supplied to the plant.

The carbon dioxide emitted from the proposed LNG plant will disperse into the environment and will not "blanket the region".

The emissions of methane have been accounted for within the total equivalent emissions of carbon dioxide estimated within the EIS.

Photochemical smog

The submission provides an interesting but somewhat misleading and inaccurate description of photochemical smog formation. The two reactions described within the submission do occur however, the submission neglects to recognise that the nitric oxide (NO) and ozone (O_3) formed by these reactions are extremely reactive and recombine to form nitrogen dioxide (NO_2) and oxygen (O_2). In simple terms, the formation of photochemical smog becomes a problem when reactive organic compounds (ROCs) upset the equilibrium of the two equations by reacting with, and utilising NO, thereby resulting in the a situation where O_3 is not consumed by the NO. In the case of the proposed plant there are no significant sources of ROCs in the area (other than those emitted by vehicles from the population of Darwin) and as such the emissions of oxides of nitrogen (NO_x) from the proposed plant are not expected to contribute significantly to the development of a photochemical smog problem in Darwin.

The current NHMRC ambient criteria for O_3 are 210µg/m^3 for a 1-hour average and 170µg/m^3 for a 4-hour average which are well below the concentrations of 300 to 500µg/m^3 discussed in the submission. It is not expected that the proposed plant will contribute significantly to any exceedence of these criteria given the current emissions in the region.

Thermal pollution

The discrepancy in the heat rating between Table 5.4 of the EIS and Table 2(a) of Appendix F of the EIS is a typographical error made when translating the table from the Bechtel report (Appendix F) into the EIS.

The air dispersion modelling indicates that that the plumes emitted from the proposed plant will be diluted by 1,000 times within tens of metres of the source and by more than 10,000 times within a few hundred metres from the source. If we assume, conservatively, that all of the emissions are discharged at a temperature of 815K into an ambient environment with a temperature of 35°C then conservation of energy indicates that the following ambient temperatures would be expected downwind of the plant:

Dilution Factor	Final Temperature (°C)
1,000	35.19
5,000	35.04
10,000	35.02

The above illustrates, in a simple manner, that any increases in temperature due to the heat emitted from the plant are expected to be extremely localised and very small even using very conservative assumptions.

The NT Government commented: Table 7.3 - the source of the ambient standards referenced in this table should be identified. Why is the 1-hour prediction of SO2 listed as NA?

The National Environment Protection Council (NEPC) has released a discussion draft for ambient air quality standards. Predicted ground level concentrations should be compared with these standards (recognising that they are not yet endorsed by NEPC).

Considering the predicted emissions, it is likely that some will require reporting to the National Pollutant Inventory which is expected to be established in 1998.

The lack of commitment to ambient air quality monitoring is not satisfactory. A draft monitoring plan must be submitted as part of the EIS. The plan can then be finalised through licensing in order to confirm the predictions of the modelling and provide appropriate accountability (particularly since a US dispersion model was used). Where appropriate, emissions monitoring should be undertaken to complement ambient monitoring. Monitoring should go beyond nitrogen dioxide and include the major air quality emissions.

The prediction of the 1-hour average ground level concentrations of sulphur dioxide was overlooked in the air dispersion modelling exercise. Primarily this was the result of the fact that the emissions of sulphur dioxide from the proposed LNG plant are expected to be very minor since the inlet feed gas has virtually no sulphur. The results of the one hour sulphur dioxide modelling showed the predicted maximum ground level concentrate to be 0.3 $\mu g/m^3$ or 0.000113 ppm which is well below the AEC standard of 0.2 ppm.

At the time that the EIS was being prepared the NEPC draft discussion paper was not in wide circulation. In any event, the air quality standards generally recommended by the NEPC draft discussion paper are similar to the standards adopted for use in this study.

Phillips intends to produce an emissions inventory to enable the emissions presented within the Draft EIS to be confirmed. It is expected that this inventory would meet the NPI requirements when these are formalised.

The modelling results presented in the Draft EIS showed that the maximum predicted ambient concentrations of the major pollutants emitted from the proposed LNG plant were well below the existing and proposed ambient standards. The proposed LNG plant's emissions were estimated from various literature sources and are likely to be conservative (i.e. over estimated). As stated above, Phillips intends to produce an emissions inventory which can be used to check the accuracy of the emissions information used within the EIS. Should the emission inventory demonstrate that the proposed plants emissions used in the modelling are similar or less than those used in the EIS, then

there would appear to be little purpose in undertaking an ambient monitoring programme to measure the impact of the emissions from the proposed plant.

The air dispersion modelling of the emissions from the proposed plant was conducted using one of the US EPA's regulatory models, known as the Industrial Source Complex Model Version 3 - Short Term (ISCST3). The ISCST3 model is one of the most frequently used regulatory models used around the world and has formed the basis of many other models. The Victorian EPA's AUSPLUME regulatory model (commonly used by other State and Territory regulatory authorities within Australia) is based on an earlier version of the ISCST3 model. As a direct result of the wide scale nature of its use (both globally and different source configurations) the ISCST model is regularly updated and its performance closely scrutinised. The ISCST3 model currently represents one of the best Gaussian Steady State air dispersion models available. Other air dispersion models, such as the recently released AUSPUFF model (largely derived from the US EPA model CALPUFF), are available for more complex modelling scenarios. However, it should be noted that in many situations the additional surface and upper air meteorological data required by these advanced models are not available. It is the Project study team's opinion that the use of the ISCST3 model is suitable and appropriate for modelling the emissions from the proposed plant.

7.4.2.1 General

The NT Government asked if any of the predicted ground level concentrations of air emissions are likely to affect surrounding vegetation.

GANT noted that the comment was made that the discharge of atmospheric pollutants (carbon dioxide, nitrogen oxide, volatile organic carbons, sulphur dioxide) can have innate potential for interfering with adaptive mangrove physiology, increasing stress. GANT would encourage implementation of any and all means to reduce the volumes of atmospheric pollutants released.

Table 7.3 of the Draft EIS presented the results of air emission modelling for a 3 MTPA plant (one train) and Appendix 4 of this Supplement shows the predicted air emissions for the expanded three train plant. For the single train scenario, the maximum ground level concentrations for all pollutants are expected to be below accepted guidelines. For the three train plant one hour concentrations of NOx (nitrogen oxides, specifically nitrogen dioxide) are the only emissions shown through modelling to exceed ANZECC limits. This is therefore the only pollutant considered to be of potential concern in terms of vegetation impacts. As discussed in Appendix 4, actual emissions of NOx from both the 3 MTPA and 9 MTPA plants are expected to be significantly less than current projections based upon conservative emissions factors. These emissions will be confirmed and additional modelling will be conducted before proceeding with the 9 MTPA facility to assure that ambient concentrations of NOx are below applicable standards.

Considerable research has been carried out on the effect of various atmospheric pollutants on vegetation, however, this research has been based on vegetation species not present on Wickham Point or in the Top End region in general. Investigations have not revealed any surveys of vegetation in the Darwin region concerning sensitivity of species to air pollution.

In general terms, it is known that nitrogen oxides can affect plants in different ways, depending on exposure. There is evidence that low dosages of NOx (i.e. below toxicity thresholds) may stimulate growth, but this effect may not be beneficial (may increase susceptibility to insect attack). Variable results have been achieved using north American and European tree and grass species, leading to the conclusion that "response of plants to pollution by nitrogen oxides is species dependent (or even variety dependent) as well as dose-dependent" (World Health Organisation 1987).

7.4.2.3 Greenhouse gas emissions

Environment Australia noted that it would be useful if data on actual greenhouse emissions were included for each source of emission, as well as the percentages quoted. The Draft EIS states that removal of carbon dioxide at the offshore facility, and reinjection, is not feasible. The Commonwealth strongly supports any measures to reduce greenhouse emissions and this aspect requires further discussion. The EIS should clearly explain why it is not feasible and include relative costings. It would be helpful if there was some discussion of the use of reinjection in other countries. The EIS should also include comment on current international best practice for minimising $C0_2$ emissions.

ECNT requested implementation of CO_2 reduction technology.

Carbon dioxide represents 6% of the current Bayu-Undan feed gas composition to the LNG plant. Early in the design of this project, Phillips considered the economic benefits of removal of the carbon dioxide at the platform instead of onshore at the LNG plant. This review indicated the removal of the carbon dioxide would reduce the amount of gas to be transported to the plant, but the volume reduction was not significant enough to allow a reduction, and associated costs savings, in pipeline size. The study also indicated the initial cost of the offshore equipment, and the yearly expense to operate and maintain this equipment, was higher than an onshore installation. Consequently, a decision was reached not to consider CO_2 removal at the offshore production facility.

There have been situations in other production regions where the volume of carbon dioxide in a produced gas stream is of such a high percentage that its removal could result in a reduction in pipeline size and therefore provide an economic justification to remove the carbon dioxide offshore. An example of this application may be the proposed Natuna LNG project in Indonesia where carbon dioxide makes up 70% of the gas produced. There are also applications where carbon dioxide removal is preferred offshore to reduce the corrosiveness of the gas and therefore its impact on the pipeline integrity. However, for the Bayu-Undan project, water removal will be required offshore for LPG processing, therefore the corrosiveness of the gas is reduced and further reduction in corrosiveness through carbon dioxide removal cannot be justified based upon economic considerations.

Phillips has also performed a preliminary review of the well logs and reservoir structure depth maps of the Bayu-Undan field in an attempt to identify subsea structures that could be used for carbon dioxide re-injection. There have not been any structures identified from this review above the main gas-bearing reservoir that could accept the injection of carbon dioxide without a potential risk of a poor seal relative to the subsea surface or potential communication with other reservoir structures. There may be some potential for injection into separated structures that are adjacent to the main Bayu-Undan field at the reservoir level, although such structures would probably be at least 10 km from potential platform sites. There is also no information available to indicate whether suitable subsurface structures exist onshore for this same purpose. Because of the uncertainty of identifying a suitable structure, and the potential risks to this structure of seal loss or communication between reservoir structures, reinjection of the carbon dioxides into a subsurface structure was not considered a viable option.

The carbon dioxide removed from the gas is not the major source of carbon dioxide emission from the LNG liquefaction process. The majority of the carbon dioxide released during the process comes from the gas turbines as a result of fuel gas combustion. The Phillips process utilises a fuel efficient design which minimises the CO_2 emissions. Presently, Phillips is unaware of any other LNG plants capturing and using CO_2 for any purpose. As mentioned above, a suitable injection zone has not been identified. Phillips has looked at the option of using CO_2 contained in the natural gas feed for methanol production, but the process is very energy intensive and the volume of CO_2 produced is too small to make the process economically feasible.

The NT Government noted that the Draft EIS acknowledges that the LNG Plant will release a high volume of the greenhouse gas, CO_2 at a time when the Commonwealth Government is committed to stabilising greenhouse gas emissions. While there is adequate discussion of the intended measures to minimise CO_2 emissions and a reasonable comparison between LNG as a fuel and other more damaging fuels, it is recommended that Phillips contact the Greenhouse Challenge Office of the Federal Government. The Greenhouse Challenge is a voluntary cooperative agreement program in which Commonwealth and industry members work together to reduce greenhouse gas emissions. A cooperative agreement would usually include: an inventory of emissions; opportunities for abating greenhouse gas emissions in the organisation; a greenhouse gas mitigation action plan; regular monitoring and reporting of performance; and independent performance verification.

Can the 4,695 tonnes/day CO_2 be utilised for the production of methanol or any other products?

Phillips has designed its plant to maximise the project's energy efficiency and will continue to investigate ways of further improving this through the design and operational phases. The Greenhouse Challenge Office will be contacted by Phillips to discuss mechanisms for reducing greenhouse gas emissions. Phillips intends to produce an inventory of its greenhouse gas emissions and its energy efficiency.

Presently methanol is manufactured by methane reforming followed by methanol synthesis. In this process, methane gas is reacted over a catalyst to form hydrogen and carbon monoxide, which are then converted to methanol. Carbon dioxide is not used directly, but must be reacted with some of the hydrogen from the methane to form more carbon monoxide. There is no other commercially viable process for making methanol that would allow the use of the carbon dioxide contained in the feed gas and released during the LNG liquefaction process.

Worldwide there is considerable research into methods for utilising carbon dioxide in an economic and energy efficient manner. A major obstacle in this research is carbon dioxide's energy state. Carbon dioxide is a stable compound and therefore requires considerable energy to convert it to a form that can be utilised in other processes. This energy requirement is a major obstacle preventing the uses of carbon dioxide, as available from processes such as LNG liquefaction, from being a feedstock to a commercially viable process.

7.4.4 Wastewater Discharges

The NT Government commented that it is proposed to discharge treated sewage into the harbour from the loading facility. What level of treatment will be given to sewage? Has there been consideration given to other methods and timing of treated sewage disposal such as discharging through the mangroves or at ebb tides? The EIS should evaluate the different disposal systems to determine what would be the least environmentally damaging. In addition, consideration should be given to recycling as much wastewater (especially sewage) as possible on-site to minimise discharge to the harbour (e.g. irrigation water).

Sewage will undergo primary and secondary treatment. Phillips recognises the suggestions from the NT Government for not disposing treated effluent from the plant into the harbour. The present plan is for treated wastewater to be discharged from the loading jetty. However, Phillips will investigate the possibility of using treated wastewater for irrigation at the plant or discharge through the mangroves in lieu of discharge off the jetty. This decision will be based on wastewater quality and costs being acceptable, and agreement by the NT Government.

The NT Government requested information on the type of sewage treatment to be used on the laybarge.

Wastewater discharged from the laybarge will be fully treated sewage using a marine sanitation unit in compliance with international shipping regulations. Generally these systems macerate the deposits to a liquid that passes through a retention screen and is then treated with a dilute chlorine solution before being discharged overboard. A holding tank (usually 24 hours of use) is fitted in order to use the system when doing repairs or when the barge is in an area which does not allow any overboard discharge at all.

7.4.5 Rainfall Runoff Discharges

Environment Australia noted that modern industrial plants usually include arrangements to collect and treat the 'first flush' of stormwater runoff from the site as this is likely to contain most of the contaminants. The EPG believes that such an approach is justified for this proposal.

The LNG plant will be a relatively clean facility and has been designed to minimise environmental effects. All potentially contaminated stormwater leaving the process areas of the plant site will be routed through the CPI separator to ensure any oil is removed. Therefore, construction of ponds necessary for treatment of the first flush that would require additional clearing of land is not required.

Uncontaminated stormwater will be diverted to outfall areas designed to prevent erosion.

7.4.6 Solid and Semi-liquid Waste Disposal

The NT Government suggested that interstate disposal and treatment options should be investigated for wastes that cannot go into a municipal landfill.

Refer to response to Section 5.4.5.3 of the Draft EIS in this Supplement.

7.4.7 Ballast Water Discharge Effects

The NT Government suggested that a risk assessment study be undertaken pertaining to the potential introduction of marine pests through ballast water discharge within Darwin Harbour. They further recommended an on-going monitoring program as part of the environmental management of the project.

The information presented in Section 7.4.7 of the Draft EIS appears to require clarification. As stated in Section 6.3.2 of the Draft EIS, the marine fauna of northern Australia is part of the vast Indo-West Pacific biogeographical province (shown in Figure 6.12). The pattern of gross water movement off northern Australia has been examined by hydrological and satellite imagery studies by the CSIRO. These studies have shown the dominant feature to be a south-westerly flow of water from the Western Pacific region, through the Indonesian Archipelago and into the tropical sector of the eastern Indian Ocean (see Figure 5 of Appendix D in the Draft EIS).

The mid-ocean re-ballasting of vessels, as mentioned by DLPE, would ensure that the only organisms transferred into Darwin Harbour via ballast water would be pelagic species or planktonic larvae. As the primary Asian-Pacific markets are anticipated to be Japan, South Korea and Taiwan, re-ballasting will most likely take place within the Western Pacific region. Given the connectivity, due to the prevailing water currents, between the re-ballasting areas and northern Australian waters, it is considered that these species or larvae would already have had the opportunity to become naturally established within Darwin Harbour over a period of thousands of years.

Furthermore, the long history of trade links between Darwin and south-east Asian ports means there has already been a long period of ballast water discharge in the vicinity of Darwin Harbour. If conditions were suitable for non-endemic species to become established, this would already have occurred. The introduction of new species into the harbour via LNG vessels is therefore highly unlikely. Furthermore, as stated in Section 8.2.3.4 of the Draft EIS, Phillips will ensure that all vessels serving the Darwin LNG plant follow the IMO and AQIS guidelines for ballast water discharge at sea prior to entering port, effectively removing the risk of marine pest introductions.

However, Phillips is aware through discussions with the Darwin Port Authority that the Authority will soon be implementing its own monitoring programme for introduced organisms as part of a nation-wide initiative by AQIS and the Association of Australian Ports and Marine Authorities (AAPMA). Phillips will contribute to this monitoring programme and, if still considered necessary, will also undertake a risk assessment of its shipping operations.

7.4.10 Shipping Movements

The NT Government asked that consideration be given to impacts from wave wash on the shoreline structures and vegetation of Wickham Point."

As indicated in the Draft EIS, Darwin Harbour has a strong tidal regime with a maximum of 8 m tides which generate strong currents. Byrne (1988) summarised data on the hydrodynamics and coastal processes of Darwin Harbour, with particular reference to the area of Fannie Bay and Cullen Bay. He concluded the wave climate is mild except for cyclones. Waves are typically less than 0.5 m with periods of two to five seconds, though they can be up to 3 to 3.5 m during cyclones. Natural forces thus contribute considerable water movement within the harbour.

Mangroves are the vegetation at Wickham Point which could be affected by wave action generated by vessel movements to or from Wickham Point. The trees occur in the mid to upper portions of the intertidal region and could thus only be affected during the high portion of the tidal cycle. Two features will effectively ameliorate erosion in the mangroves caused by vessel movement at the Middle Arm loading jetty. Firstly, the jetty will extend approximately 1.6 km from shore, allowing considerable distance for the dissipation of any waves generated. Secondly, the LNG vessels and attendant tugs will be manoeuvring at very low speeds, and will not generate significant wave action.

Once construction of the Plant has been completed, the construction dock on East Arm will be used infrequently by small boats. In the unlikely event that shoreline erosion becomes a problem, speed limits can be imposed. However, there is no indication that existing port traffic is causing erosion of mangrove trees in the vicinity of existing wharves and facilities.

7.5.1.3 Visual impacts

Environment Australia commented that it would be more useful to indicate the number of times per month the wet and dry gas flares are likely to operate, rather than the length of time for the year, given that that figure is low. Further information should be provided on the likely frequency of flaring at

night, and the visual impacts of this. Further information should also be provided on the likely colour scheme for prominent features of the plant.

The NT Government noted that there is little detail of the flare emissions with respect to their likely size and appearance. This aspect of the operation is not addressed in Appendix O. Given that the impact on visual amenity is a matter to be taken into account under the Planning Act, flare emissions should be investigated prior to any development approval.

The plant will have three separate flare systems. Two of the flare systems, identified as the wet gas and dry gas flares, are for emergency flaring. Because these events are not scheduled, the time of day a flare event will occur cannot be quantified. When a flaring event does occur, operational interaction to control this flaring will begin immediately, therefore any flaring events should be short-lived. The third flare would primarily be used during ship loading and it is likely that some of this flaring will occur at night.

The visual impact of flaring will be a multicoloured flame. The height of this flame will be dependent upon the final flare system design selected to address the concern of the impact of the flares on air traffic.

The colour scheme for the plant will take into consideration the natural colour scheme of the environment at Wickham Point and the impacts these colours can have on the plant process. Because the plant utilises cold fluids in the LNG liquefaction process, heat absorption from the surrounding environment can affect the efficiency of the process. For this reason, large surfaces that contain cold process fluids are typically painted lighter colours to minimise this heat absorption. It will be Phillips intent to balance the need to minimise heat absorption with the need to use a natural colour scheme that blends in with the colours of the natural environment.

PB noted that the visage of the proposed industrial site will be evident from many parts of Darwin. This will destroy the aesthetic quality of Darwin Harbour and is not acceptable.

As part of the EIS an assessment was conducted of the existing visual environment at Wickham Point and the expected visual setting following construction of the plant. The study included a comparative analysis of several views of the proposed development site with and without the plant, from a number of vantage points around Darwin harbour.

The results of the visual assessment were presented in Appendix O of the Draft EIS and a summary of the conclusions of the assessment were presented in Section 7.3.2.5 of the Draft EIS. Several of the sketches made from the vantage points have been re-presented in this Supplement in response to Section 7.3.2.5 of the Draft EIS.

It has been concluded from the visual impact assessment that:

- the visual impact of the development will be greatest during the construction phase of the project;
- there is not a great deal that can be done to mitigate the visual impact of construction activities;
- visual impact will be greatest within 500 m of Wickham Point.

Several recommendations have been made on measures to soften the visual impact of the plant, including minimisation of foreshore disturbance, rehabilitation of areas no longer needed for construction or operation activities, sensitive selection of colours, tones and textures (consistent with the function and safety requirements of the facilities in question). These recommendations will be evaluated and implemented as far as practicable in the design and construction of the plant.

Strategies to reduce visual impacts are listed in this Supplement in the response to Section 7.3.2.5 of the Draft EIS above.

7.5.1.5 Effects on other harbour and coastal users

Environment Australia believes that Phillips should commit to consultation with fishing interests to ensure that the presence of the pipeline will be compatible with fishing activities.

As noted in Section 7.5.1.5 of the Draft EIS, the attraction of fish to subsea pipelines elsewhere in northern Australian waters (e.g. Dampier, WA) has led to them becoming favoured fishing locations. Within Darwin Harbour, artificial reef habitats comprising ship and aircraft wrecks have long been popular fishing spots. In addition, the Amateur Fisherman's Association of the NT, the Darwin Sub Aqua Club, the Department of Primary Industry and Fisheries (DPIF) and the Darwin Port Authority have strategically located several derelict vessels within the harbour to further enhance fishing opportunities (DPIF undated - *Darwin's Artificial Reefs*). There is no reason to believe that the 25 km expanse of armoured pipeline within the harbour will not also be highly compatible with fishing activities.

Phillips will consult with the Amateur Fishermen's Association and the Professional Fishermen's Association to discuss the proposed pipeline construction schedule and associated fishing issues.

7.6.2 Pipeline Leakage or Rupture

Environment Australia noted that it would be useful to provide an estimate of likely worst case releases in the event of a major rupture (presumably this would relate to the volume and pressure of gas in the pipeline, and the time taken for shutdown at the offshore facility).

In the unlikely case of a large leak, including breaking of the pipeline, the on-line leak detection system would discover the problem immediately for locations within 50 - 100 km of either end of the pipeline. To discover problems near the mid-point of the pipeline, it would take 10 to 15 minutes for the pressure wave to travel to the nearest end point and the initiation of an immediate shutdown of gas supplies from the field.

For practical purposes, pipeline isolation valves are provided only at the pipeline inlet at Bayu-Undan and the outlet at the Wickham Point landfall of the pipeline.

Depending on the water depth and related external pressure at the break point, depressurisation of the pipeline would occur and, for an assumed average pipeline pressure of 10 MPa (Mega Pascal) 10 to 15 MSm^3 (mega standard cubic metre) of natural gas could escape.

AHC requested further discussion on the impacts of a diesel fuel spill (during pipeline construction) or pipeline rupture on marine fauna and flora.

Details on the potential impacts of a diesel fuel spill are given in Section 4.3.2 of Appendix D of the Draft EIS.

The evaporation rate of diesel under typical Timor Sea conditions is such that approximately 50% of any spill will evaporate within six hours. After 40 hours, only 20 - 30% of the heavier hydrocarbons would remain (Kagi et al. 1988).

While diesel is toxic to marine organisms, spills will undergo rapid evaporative loss in the warm tropical waters, resulting in short-lived slicks (72-96 hours for a 500 m^3 spill). In addition, diesel oils tend not to form emulsions at the temperatures found in the Timor Sea, so slick dissipation and evaporation rates will not be inhibited (LDM 1997). Potential effects of hydrocarbon spills are

limited to short term effects in the proximity of the slick. The effects include the risk of oiling birds, turtles and marine mammals, with little risk posed to fish or benthic communities.

It is impossible to accurately predict the potential effects of diesel spills in marine fauna for many reasons, not the least of which is the lack of published information. Small spills of diesel regularly occur throughout most of Australia's tropical ports and no significant adverse impact has been reported to occur.

In the event of a pipeline rupture, the rapid dissipation of gas within the water column, and its immediate dispersal into the atmosphere from the sea surface, means there is little potential for any marine flora or fauna to be impacted. Rapid turbulent dilution and evaporation of the minor (<1%) condensate fraction similarly minimises the potential for impacts on marine biota.

ECNT enquired whether military exercise mishaps are considered a potential cause of pipeline rupture.

The discussion in Section 7.6.2 above is generic for all pipeline leakage or rupture and not specific to any particular causes. As stated in the response to Section 4.4 of the Draft EIS, the current pipeline route is outside the military exercise area.

7.6.4 Product Spill on Plant Site

Environment Australia recommended that spills of contaminants should be mapped so that problems of any residual site contamination can be addressed during the decommissioning process.

Proposed spill management procedures are such that residual contamination should not develop. However, Phillips will record the occurrence and location of significant spill events.

7.6.5 Plant Process Upset

Environment Australia noted that it is indicated that consultations concerning the impact of plant process upset on pilots overflying the plant during such an event are currently underway between the proponent and Darwin airport authorities. The final EIS should provide an update on the consultations and outline any potential impacts that have been identified.

Refer to response to Section 5.4.3.3 of the Draft EIS.

ENVIRONMENTAL MANAGEMENT (Section 8 of Draft EIS)

8.2 PRELIMINARY ENVIRONMENTAL MANAGEMENT PLAN

Environment Australia suggested that other elements which should be addressed in the construction and operation EMPs include fire prevention and protection of remnant vegetation in the 'island' of dry rainforest. This may include measures such as speed limits, littering controls and clean-up, active control of weeds and feral animals, etc."

The 'central' island of Figure 4.2 in the Draft EIS will be traversed by the access road (Section 6.3.3). It is in an area to be managed by the Northern Territory Government, and is outside the perimeter fence of the LNG Plant. Phillips will provide whatever assistance it can to the government in managing the area. (Refer to response to Section 6.3.3 for further comment.)

8.2.2.1 Plant site and access road construction

Environment Australia noted that regular and frequent sightings of feral pests will be reported to the NT Parks and Wildlife Commission. Further information should be provided to specify what constitutes regular and frequent and whether this will be determined in consultation with the Commission.

The details of the feral animal control programme will be finalised during the preparation of the environmental management plan for the plant. However, it is intended that the advice of Parks and Wildlife Commission personnel will be obtained during development of the programme and that the occurrence of sightings will be reported to the Commission regularly at a yet to be decided frequency.

The NT Government noted that the slash and burn technique outlined in the Draft EIS is not favoured in a draft policy document being developed by the Department of Transport and Works, entitled "Fire Management and Weed Control on Roadside Reserves".

Phillips will cooperate with NT Government authorities in implementing fire management and weed control on sections of the access road and other areas of the plant site for which the company is responsible. Phillips will also aim to utilise the most cost effective measures for managing fire and weeds, which meet Government requirements.

(i) Control of weeds and plant pathogens

ECNT noted that, while the proposal to establish washdown areas for plant and equipment to minimise weed infestations is supported, the Draft EIS does not outline disposal measures for water and other materials collected from the washdown areas

For the construction phase of the project, all equipment entering the plant will be required by contract to be clean and free of debris. However, in the event that equipment arrives at the site and requires further cleaning, a washdown area will be provided near the construction dock. Plans are to use a portion of the area designated for the spill impoundment area using an impermeable lined impoundment. Water and debris from the washdown areas will be treated on-site in accordance with applicable guidelines and regulations, or transported off-site for treatment.

(iii) Soil erosion control

The NT Government noted that seven stormwater outfalls are planned for the site. Several impacts may arise from these outfalls: water run-off may interfere with the natural drainage in the mangrove habitats and cause soil erosion: a shift in species composition: change in the mangrove habitat and creation of biting insect habitats. Stormwater outfalls should be designed to follow natural contours and seasonal waterways.

Plans of proposed drain construction, erosion prevention structures and specific end points should be approved by THS to ensure that additional mosquito breeding sites are not created.

Potentially contaminated stormwater within the process area will be collected and treated before release to the environment. Clean stormwater will be gathered via stormwater collection systems as outlined in the Draft EIS. The systems will be designed and constructed to control discharge velocities and minimise soil erosion through use of measures proven to be effective in the local environment. In addition, discharge points will be located within regularly flushed tidal areas (i.e. below 3.7 AHD), using natural drainage channels as far as practical. Care will also be taken to avoid

the creation of depressions and obstructions to water movement during construction activities associated with the drains and access corridors. Phillips understands that poorly planned and inadequately controlled discharge of freshwater can lead to changes in species and the build-up of grasses and other vegetation which can impede drainage through mangroves, creating new mosquito breeding areas.

The construction of drains designed and constructed for mosquito control purposes can lead to obvious local environmental impacts, such as clearing associated with the discharge drains; however, the more significant long-term effects to vegetation, including species change and the introduction of weeds, and human health issues associated with increased mosquito numbers, are minimised or avoided. Phillips will utilise the document *Construction Practice Near Tidal Areas in the Northern Territory, Guidelines to Prevent Mosquito Breeding* referenced in the Draft EIS, and will consult with the Medical Entomology Branch, Territory Health Services.

(iv) Management of acid soil

The NT Government noted that the Draft EIS identifies that there is possibility of acid sulphate soil being dredged. Though it states that there is enough calcareous material in the dredged sediments to neutralise its acidity. The report justifies this comment with results from ANC and NAPP tests. While these tests show that there is enough ANC, previous experience with acid sulphate soils indicate that dredged acidic sediments remain highly acidic in retention pond situations. Is the $CaCO_3$ in a form available for acid neutralisation? On-going tests should be undertaken, including complete column testing to look for accelerated acid production.

PB commented that acid leachate may have adverse effects on the mangrove habitats and invertebrate organisms in the discharge area and impacted areas may take years to regenerate. Further, groundwater may possibly be affected by the acid-water infiltration. These problems should be addressed with an indication of the monitoring programs that will be undertaken. Any monitoring should take place during dredging and road construction and a contingency plan should be prepared prior to commencement of construction activities."

Phillips and its contractors are well aware of the management problems associated with potentially acid sulphate soils, and the issue was addressed comprehensively in the Draft EIS [Section 7.2.2.2 (iii) and (iv)]. To this end, Phillips intends to minimise the amount of mangrove mud disturbed by plant construction (e.g. the mud in the vicinity of the flare will be left in situ except where foundations for the flare are required). Where mangrove muds must be removed, they will be stored in a basin adjacent to the construction dock and seaward of the mangroves. A management plan for acid soils will be prepared as part of the Environmental Management Programme during the detailed design phase, and disposal requirements will be finalised once the preferred dredging and spoil disposal option has been selected (refer Section I.8 of this Supplement).

Phillips recognises that further detail is required on the proposed dredging and spoil disposal activities, and commits to providing that detail and obtaining separate environmental approval as required for these works prior to construction.

(v) Biting insect management

The NT Government suggested that the general clean up of artificial containers around the shore line is an additional measure of removing potential mosquito breeding sites to those identified in Section 8.2.2.1(v).

A variety of hand held, back pack and vehicle mounted machines are available for fogging. Fogging operations are not restricted to confirmed outbreaks of malaria. Precautionary fogging is carried out by THS to prevent the transmission and outbreaks of malaria.

Phillips will undertake a range of practical measures to manage mosquitoes and other biting insects. Site management will ensure that containers and equipment capable of storing water are either stored under cover or are regularly inspected and emptied of water. Other debris and containers in the vicinity of the site will also be removed.

As stated above, Phillips will consult with the Territory Health Services regarding mosquito control operations including fogging. (See also the response to Section 8.2.3.1 of the Draft EIS in this Supplement.)

(vi) Heritage sites management

The NT Government drew attention to the reference in Section 7.3.2.1 to burials. While burials are unlikely to be located on the site, the proponent and construction contractors need to be aware of protocols regarding the identification of skeletal remains and should obtain advice from Aboriginal Areas Protection Authority on this matter. All remains, including those discovered accidentally must be reported to the Chief Executive Officer of the Aboriginal Areas Protection Authority.

Phillips is aware of its obligations regarding the discovery of burial sites in construction areas at Wickham Point and will follow all applicable statutory standards regarding their notification, recording and protection (Section 7.3.2.1 of the Draft EIS). In addition to its statutory responsibilities, Phillips will also utilise the Liaison committee to fulfil this obligation to appropriately manage any discovered sites. (Refer also to the response to Section 7.3.2.1 of the Draft EIS in this Supplement.)

(vii) Protection of Ecological Values

The NT Government suggested that, in order to compensate for the loss and degradation of this significant habitat, and to prevent further loss, it is suggested that Phillips be responsible for the management and protection of the central island, where it is acknowledged that good quality dry rainforest vegetation also occurs. As recognised in the Draft EIS, the risk to the central island through indirect affects of the proposal is an issue to be addressed. By including the central island in the proposal and requiring on-going management of fires, weeds and feral animals, this larger patch of dry rainforest may increase in value. In addition, including this area of dry rainforest in the overall management of the site will afford some protection for a habitat that has declined considerably in the Darwin region in recent years.

Phillips will undertake to manage the area within the boundaries of the LNG plant property in an environmentally responsible manner. Details of environmental management undertakings are outlined in the preliminary EMP contained in this Supplement to the Draft EIS. These management commitments will be further developed in the EMP for the project. Phillips will work cooperatively with the NT Government in any management programme that might be developed for the central island area.

8.2.2.3 Plant site waste management

ECNT suggested disposal of oil and wastes at a commercial products site.

Refer to response to Section 5.4.5.3 of the Draft EIS in this Supplement.

The NT Government has requested that the wastewater discharge parameters/substances to be monitored are included in the final EIS.

The proposed parameters/substances to be monitored are listed in Table 5.7 (page III.17 of this Supplement). These parameters will be finalised in consultation with the NT DLPE. In addition, an ICPMS scan of trace elements will be conducted, as recommended by DLPE, to identify all likely contaminants.

8.2.2.4 Dredging and use of spoil

The NT Government asked that, if it eventuates that the dredge spoil disposal cannot be used elsewhere, what is the proposed rehabilitation plan (noting that this material will be highly saline and difficult to stabilise).

ECNT considered that more information on the expected life of the temporary reclamation area, monitoring of this area, rehabilitation and end use of spoil should be incorporated into the final EIS."

Please refer to Section I.8 of this Supplement.

8.2.2.5 Pipeline construction

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The NT Government and SJ recommended that a full survey for shipwrecks and aircraft wrecks be undertaken along the pipeline route, with DLPE also recommending surveys within the turning basin and at the construction dock. They recommend the use of side scan sonar, magnetometer and differential GPS, with any discovered sites surveyed and documented by trained professional archaeologists.

During the detailed engineering phase, the pipeline route will be re-surveyed using sidescan sonar, magnetometer and differential GPS. Any sites discovered during this survey will be brought to the attention of trained professional archaeologists at the Northern Territory Museum for management advice.

The locations of the wreck sites listed in the submissions, and of other known wreck sites, will be considered in relation to the final pipeline alignment within Darwin Harbour. Those in the vicinity of the pipeline will be clearly marked by buoys to avoid any possibility of damage during pipelaying operations.

8.2.3.1 Plant site management

Environment Australia suggested that some comment on the possible use of fogging on non-target species is warranted. Information on the potential impacts of the reduction in insect populations on other fauna is also required.

Fogging for mosquitoes can have an adverse effect on some fauna species, both directly through poisoning, and indirectly through reduction in a food source (insects). Vertebrate species most

affected would include small reptiles, such as geckoes. Malathion or Biomesrethrin have low mammalian toxicity and would probably be used in fogging operations. Because of the potential for impacts on non-target species, fogging will be undertaken only when absolutely necessary under strict controls and in localised areas. Fogging is not planned for biting midge control.

8.3 MONITORING PROGRAMME

Environment Australia commented that monitoring of the 'temporary' reclamation area may be required, particularly if the spoil cannot be sold and the site must be rehabilitated.

Please refer to Section I.8 of this Supplement.

8.3.2.1 Weeds and feral animals

Environment Australia commented that, given the potential for rapid weed growth during the wet season, the proposed three year interval between surveys of weeds and feral animals at Wickham Point may not be sufficient.

The NT Government commented that quantitative rather than qualitative surveys may be required to determine the baseline of weeds and feral animals. Any sightings of feral cats or other feral animals should be reported to the Parks and Wildlife Commission, rather than just regular sightings.

Weed species were recorded as part of the flora survey, but no quantitative data on density, abundance and/or species composition were recorded.

Very few weed species were recorded in dense rainforest patches with a continuous canopy. Competition for light is so intense at ground level that very few rivals can gain access to the necessary light and space to establish. With the development of a road corridor, gaps in the continuous canopy will be created. This may well facilitate the invasion of weeds by providing them with opportunities for light and space that were not present in the undisturbed forest with a continuous canopy.

A number of representative sites will be established in the various vegetation communities adjacent to the plant site, and quantitative weed surveys will be carried out. These will establish the baseline distributions of the weed species, their relative densities and abundance across the various plant communities.

Feral animal populations are currently low in the area, probably amounting to only a few individuals. Pigs and feral cats are the main issues, because pigs can cause habitat damage, especially to mangrove margins and freshwater sources during the wet season and cats are predatory and have the potential to disturb birds such as the Beach Stone-curlew.

Quantitative surveys of feral animals will be conducted prior to construction commencing, and will be conducted periodically thereafter. Surveys will aim to identify numbers, species and locations of feral animals in the area. The frequency of surveys will be determined in consultation with the Parks and Wildlife Commission, but will be reviewed annually depending on results. Survey results will be supplemented by incidental sightings made by site employees, which will be maintained on the site environmental database. All sightings of feral animals will be promptly reported to the Parks and Wildlife Commission, with details of location, species and numbers.

Phillips has undertaken to monitor the spread of weeds from disturbed areas into adjacent areas of undisturbed habitat and to record and report sightings of feral animals. Weeds will be removed and

feral animals will be trapped, on the advice of the Parks and Wildlife Commission and other relevant government agencies. Procedures outlined in the Draft Policy on Weed Management in NT Road Reserves will be implemented, where appropriate, for internal roads and laydown areas within the plant site and Phillips will cooperate with the Department of Transport and Works and the Department of Primary Industries and Fisheries in any joint efforts to control weeds.

The NT Government requested that the effect of the access road on the surrounding vegetation should be monitored following its construction.

As outlined above in the response to Section 4.5 of the Draft EIS, the NT Government has assumed responsibility for the design and construction oversight of a new road from the Channel Island Road to the plant site boundary. The road will be owned and managed by the Government, and will be a public road. The NT Government will therefore be responsible for any monitoring programmes associated with the road. Phillips has undertaken to carry out specific monitoring programmes for weeds and feral animals within the LNG plant lease area and the details of these programmes will be developed during preparation of an EMP, which will be subject to government approval.

8.3.2.2 Biting Insect Control

The NT Government recommended that a baseline biting insect monitoring programme be developed in conjunction with the THS with the program to commence after the access road has been completed. In relation to biting insect management, it was suggested that the education of the workforce about biting insects would be facilitated by a baseline monitoring programme.

From discussions with the Medical Entomology Branch, Territory Health Services, during the preparation of the Draft EIS Phillips Petroleum was aware of the practical difficulties of obtaining detailed site specific data about the biting insect population and the likely extent of biting midge and mosquito problems during the construction and operation of the plant. It was also realised that the preliminary survey undertaken by MEB (Appendix J of Draft EIS) at Wickham Point in February 1997 would not be sufficient to address the biting insect issue. At the time of the preliminary survey the site experienced heavy rain, local flooding and strong winds and trapping revealed low numbers of biting midges and mosquitoes.

Phillips agrees that further monitoring will be needed and has undertaken to conduct baseline monitoring studies following construction of the access road to the site. The road will enable MEB personnel to identify the most suitable locations for traps and will provide access to the area. The monitoring programme will be developed in consultation with the MEB.

8.3.2.3 Pipeline shore crossing

The AHC has noted that while the EIS states that management arrangements should protect the Channel Island reefs, consideration should be given to:

- *management and monitoring of increased sediment levels from pipeline construction, soil erosion, dredging and shipping activity; and*
- *the need as recommended in Appendix H to avoid interruption to the strong tidal flows which at present keep the Channel Island reefs relatively free of sediments.*

A detailed commitment is given in the Draft EIS (Section 8.3.2.3) to undertake discussions with appropriate authorities, such as the NT DLPE and the Heritage Commission, aimed at protecting the Channel Island coral assemblage. The section further states "It is anticipated that such a programme will require the proponent to establish a baseline description of selected population characteristics prior to construction proceeding." Further commitments are provided to examine the actual turbid water plume during dredging to determine whether the corals may be affected, and if they are affected to institute a reactive monitoring programme.

Environment Australia commented that the Draft EIS notes that the proponent will design a monitoring program and establish a baseline description of selected coral population characteristics prior to construction proceeding.

Environment Australia further noted that the Draft EIS states "it is anticipated that a baseline description of the coral community at this site will be obtained prior to commencement of dredging the approach channel to the construction dock" and queries the word anticipated as the survey is required to later assess any changes which might have occurred. The baseline survey is also necessary to minimise the potential impact of the dredging.

Hanley Caswell and Associates (1997) have recently concluded a two year study of the effects of the development of the East Arm Port. The report concludes that "properly managed dredging programs in the Harbour can be undertaken with a minimum of impact". No impact on corals was attributed to increased turbidity or other problems associated with dredging. The inner harbour is a marginal environment for corals. The corals which occur in the inner portion of the harbour undergo substantial fluctuation in population characteristics as a result of natural phenomena such as low spring tides and the wet season runoff. As such, these communities are relatively young, having low species diversity and being comprised mainly of small corals that have recently recruited into the area. Such communities tend to be ephemeral in nature and do not contribute significantly to the overall productivity of the harbour ecosystem..

Effort spent monitoring such communities is wasted because their natural high level of dynamism makes it very difficult to differentiate between changes caused by nature and those caused by man. Furthermore, if such communities suffer mortality regularly in response to natural phenomena, mortality caused by human-induced disturbance is of limited concern as long as the original substrate is not altered and the potential for recruitment of coral planulae to a disturbed site is maintained.

The potential for incremental losses of corals in the harbour as a result of a variety of projects is acknowledged as a concern. However, it should be considered in the context of natural processes in the harbour. Phillips is committed to undertaking the dredging programme and other construction activities in an environmentally sensitive manner to minimise as far as is reasonably possible any loss of corals, particularly in the Channel Island area. As part of this commitment, a predredging survey of the corals of the Wickham Point area will be undertaken to provide a baseline against which any future changes can be assessed.

The NLC submission suggests "there should be monitoring of waters in the vicinity of the operating dredge."

During the development of the EIS, a detailed analysis was undertaken of the potential effects of the turbid water plumes resulting from dredging. Adverse impacts may arise from:

- light attenuation;
- sediment smothering of biota;
- release of contaminants; and
- oxygen depletion of the water column.

A sampling programme was undertaken in the area to be dredged for the turning basin to determine whether there were any contaminants present and the levels of oxygen loss which could be expected from the dredging. The results of these studies are presented in Section 7.2.3.3 in the Draft EIS. The low levels of contaminants present and the lack of a significant predicted effect on oxygen levels mean they do not require further investigation. It is therefore not proposed to monitor waters in the vicinity of the operating dredge. The only monitoring considered necessary is that required to ensure the protection of the heritage listed Channel Island coral reefs.

Section 8.3.2.3 of the Draft EIS provides a strategy for monitoring the turbidity plume and any potential effect on the Channel Island corals.

8.3.2.5 Spoil reclamation stilling basin and overflow

Environment Australia noted that the Draft EIS states that a 'reactive monitoring programme will be undertaken at the commencement of spoil disposal to ensure that the spoil reclamation pond/stilling basin and return water overflow do in fact work as designed'. Further information should be presented on the likely impacts if the spoil disposal infrastructure does not work as designed."

GANT supports the progressive intent to rehabilitate cleared or disturbed areas not required for operations, and minimal removal of vegetation and soil erosion. However, the dumping of dredge spoils in a "temporary reclamation" of saline coastal flats poses a threat unless appropriate adequate precautions are taken to avoid overflow into adjacent mangrove communities, particularly during the wet season.

Phillips recognises the potential management problems associated with a temporary reclamation pond located on the salt flats of Wickham Point and would prefer to avoid the need for such a pond. Reference to Section I.8 of this Supplement indicates that further investigations will be undertaken by Phillips during the detailed design phase of the dredging aimed at finding a suitable alternative.

8.3.2.7 Atmospheric emissions

The NT Government requested ambient air monitoring.

Phillips believes that the predicted maximum ground level concentrations of the major pollutants are well below the relevant ambient standards and guidelines. As such, it is considered that ambient air quality monitoring cannot be justified on the basis of these predicted impacts. Phillips would participate in a broadly subscribed regional monitoring programme with defined objectives and monitoring plan.

8.3.2.9 Contaminants in Marine Environment

The NT Government suggested additional baseline data to be collected:

- *hydrocarbon levels in sediments and biota near Wickham Point;*
- *tributyltin (TBT) in the area;*
- *presence of heavy metals in marine biota in the Wickham Point area;*
- *metals in turning basin sediments to also include uranium, radium, arsenic and selenium;*

The Northern Territory Government has brought to Phillip's attention the fact that uranium, radium and arsenic occur naturally in the soils of the area. The information suggested above will be collected during the baseline monitoring programme to establish conditions existing before construction commences in the harbour.

8.3.2.10 Request for risk assessment study of ballast water

The NT Government submission agrees the risk of introduction of foreign species through ballast water is small but requests a risk assessment study of ballast water.

Refer to response to Section 7.4.7 of the Draft EIS.

8.3.2.11 Request for monitoring access road effects on mangroves

The NT Government requested that the effects of the access road on the surrounding vegetation should be monitored following its construction, and remedial action undertaken if necessary.

As indicated earlier in this document, responsibility for design, construction oversight, management and monitoring of the access road will now be the responsibility of the NT Government.

The ECNT requested that drainage or erosion measures used in mangrove areas be natural (earth banks, hale bales, contouring) rather than engineering solutions (culverts, etc). They request the use of monitoring programs to ensure the health of mangrove habitats and mudflats.

The NLC requested monitoring of tidal movements and vegetation along the access road to ensure there is no erosion or impact on vegetation.

Section 7.2.2.1(v) of the Draft EIS frankly discusses the potential problems which could be posed for mangroves as a result of drainage modifications caused by the construction of the access road and works around the plant site. A commitment is provided in Section 7.2.2.1(v) in the Draft EIS to refine the alignment of the access road to minimise effects on drainage patterns.

As indicated above in the response to Section 4.5 of the Draft EIS, while Phillips may contribute to the costs of the access road, actual construction oversight and ownership, along with any monitoring, will be the responsibility of the Northern Territory Government. However, as part of its construction and operations management plan, Phillips will initiate a rapid assessment mangrove monitoring programme based on visual inspection of mangroves adjacent to the plant site. The purpose of this programme will be to test the prediction that mangrove productivity adjacent to the plant perimeter will not be adversely affected in the long term by the operations of the plant.

8.5 Emergency Response Manuals

The NT Government queried whether there is a contingency plan for diesel spills on the laybarge.

An Oil Spill Contingency Plan will be required for use by the pipeline contractor which will include the laybarge.

Cyclone emergency response plan

The NT Government requested that a cyclone and storm surge emergency response plan should be developed for the plant during the design phase.

Phillips will prepare a written emergency plan for the pipeline, plant and marine terminal to cover the conceivable emergency situations that could occur. This plan will not only address situations that occur within the operating facilities, it will also address those situations offsite that could impact these facilities. It will be Phillips' intent to liaise with the appropriate civil and port authorities in development of the overall facility emergency plan. This external liaison will facilitate the development and continual review of the plan and procedures, provide for joint participation in training and emergency exercises, and develop effective and rapid communications and response in a real emergency.

It is recognised that Civil and Port authorities already have their own plans in place for dealing with harbour and cyclonic emergencies and it will be Phillips' intent to liaise with authorities to ensure mutual compatibility between plans. Phillips is aware of the inherently destructive nature of a storm surge and cyclonic type winds. Design work performed to date has taken these issues into consideration relative to plant elevation and structural design. During the detailed design of the facilities, these issues will be revisited to ensure the final design has considered these forces. The emergency plan will address when and how the plant will be shut down to respond to an emergency of this type, personnel responsibility in this process, personnel evacuation in an emergency, and where personnel shall seek shelter in an emergency.

Phillips has held several meetings with Port and Naval authorities to discuss the nature of our project and to address safety concerns that have been expressed as this project is interfaced with the existing infrastructure and operations in the harbour. Issues such as pipeline routing, LNG tanker pilotage, pilot training, berthing simulations, spill response coordination, cyclone emergency plans, naval anchoring locations, and naval exercise activities, to name a few, have been discussed. Presently both the Port and Naval authorities are in agreement with the pipeline routing and LNG tanker navigation route that is proposed for this project. Phillips will continue a dialogue with authorities throughout the design, construction and operation of the facilities with the intent of resolving any safety concerns that arise. Appendix P of the Draft EIS further discusses this liaison with Port, Civil and Naval authorities throughout this project.

8.5.1 Risk Assessment Study

PB suggested zero risk to life from LNG explosion.

No plant can be designed to zero risk. However, risk will be evaluated during design in order to minimise risk and potential hazards to the public.

ECNT asked for a more comprehensive risk assessment from explosion.

Phillips has confirmed that the information supplied to the ECNT regarding the alleged LNG explosions was in fact not related to LNG production. The explosion at Flixborough was a

cyclohexane vapour cloud explosion and the ship fire was an LPG fire. As mentioned in the initial response, the LNG industry has an excellent safety record.

The preliminary Hazard and Risk Assessment presented in Appendix P of the Draft EIS discusses hazards associated with LNG and LPG plants as well as shipping. Phillips has committed to perform a systematic risk assessment for the LNG facility as required under the Major Hazards Facilities legislation. This includes such things as the Hazop review during the detailed design phase of the project.

As such, a more comprehensive risk assessment in relation to spills and explosions will be done at that stage.

8.5.6 Pipeline Rupture Contingency Plan

AHC requested further discussion on a risk assessment of diesel fuel spills occurring during (pipeline) construction and of rupture of the pipeline once operating.

A risk assessment addressing these and other issues is required as a condition of the pipeline licence and will be done prior to final issuance of the licence.

8.6 PROJECT DECOMMISSIONING ALTERNATIVES

The NT Government queried whether there has been any consideration of other uses or methods of disposal for the pipeline once the project is decommissioned.

There are no other viable options to decommissioning the pipeline other than emptying, cleaning and removing cathodic protection. Any other available option would be more destructive to the established marine environment than leaving it in place.

III.2 SUBMISSIONS ON APPENDICES TO DRAFT EIS, VOLUMES 2 AND 3

III.2.1 Appendix C - Process Design Alternatives

The following comments are provided by Environment Australia against the relevant section of Appendix C.

1.1 LIQUEFACTION SYSTEM

The discussion concentrates on the success of the system used at Phillips' Kenai plant. Climatic differences between Alaska and Darwin could hardly be more extreme. Further justification of the use of this system in a tropical setting is required, including discussion of specific process modifications that may be needed, any additional discharges to the environment and general environmental impacts.

The Phillips Optimized Cascade Process is well suited for use in the more tropical climate of Darwin as well as the cooler climate of Kenai Alaska. The impact of the climatic temperature difference between Darwin and Kenai are primarily reflected in the type and amount of the cooling medium selected for the specific location. Because of the lower humidity and readily available water source, a

cooling tower was the preferred cooling medium for use at Kenai. In Darwin, with the higher humidity and less readily available water source, air fin cooling is the preferred cooling method. The use of air fins reduces the volume of wastewater to be discharged from the plant. The Atlantic LNG Plant, now under construction in Trinidad, has a similar climatic condition to Darwin and for the Phillips Optimized Cascade liquefaction process, air fin cooling will be utilised.

The horsepower, and the resulting emissions, required to produce equivalent LNG volumes is higher at Darwin than at Kenai due to the warmer climate, This horsepower issue would apply to any LNG process used at these two locations. The emissions from the plant have been discussed in the Draft EIS and this supplement.

1.2 COOLING SYSTEMS

Air fin cooling will produce a considerable thermal plume. This may affect overflying aircraft and birds. Some discussion of the magnitude of the plume and its potential impacts is needed. This issue does not appear to have been addressed in Appendix F.

The air dispersion modelling results indicate that plumes emitted from the proposed plant will be diluted by 1,000 times within tens of metres of the source and by more than 10,000 times within a few hundred metres from the source. Any increases in temperature due to the heat emitted from the plant are expected to be extremely localised and very small even using very conservative assumptions. Therefore minimal impact is expected on overflying aircraft and birds.

This same rationale can be used for the heat emitted from the air fins whose exit temperature is much less than the 815° K used in the explanation above.

1.4 SHIP VAPOUR HANDLING

Ships are to be loaded with LNG on a weekly basis. If the LNG plant is expanded, this frequency will increase. There may thus be justification for the installation of sufficient compressor capacity to recover vapours produced during loading. Further discussion of the economic basis of the current proposal is needed.

The use of an additional boil off vapour compressor has been evaluated for both the single train and expanded plant. The results indicate this additional compression is not economical. As this project moves forward, the economics of this option will continue to be reviewed and implemented if so justified.

The flaring rate associated with ship loading is a function of ship size and loading rates and will not increase if the plant is expanded from 3-9 MTPA. However, the frequency of flaring will increase as the number of ships increase to transport higher LNG production.

1.6 HEAVY HYDROCARBON REMOVAL

Comment is needed on the volumes of hydrocarbon that will be removed, disposal methods and potential environmental impacts.

Heavy hydrocarbons that are removed from the inlet gas stream is the condensate product stream. The anticipated volume of this stream is approximately 400 tonnes/day as stated in Figure 5.14 of the Draft EIS. Since this is product, there is no disposal or potential impacts to be addressed.

III.2.2 Appendix D - Bayu-Undan to Darwin Gas Pipeline

NB: Appendix D addresses the offshore 470 km of pipeline only. The section of pipeline within Darwin Harbour is assessed in the main EIS.

The following comments were provided mainly by DEST. Some comments were also provided by ECNT and these are indicated.

2.2.3 Pipeline Geometry

Explain the potential impacts of pipeline movement, particularly in relation to movement and settlement of any ballast material or any concrete weight coating.

As indicated in Section 2.2.3 of Appendix D, the pipeline wall thickness (21.7 mm) was selected to eliminate the possibility of pipeline buckling (i.e. movement). The concrete weight coating will cover the entire surface of the pipe, and will not be subject to movement or settlement.

Movement and settlement of ballast material may result in small extensions of the areas impacted by initial rock placement. In these areas, soft silty and sandy sediments (widespread along the pipeline route) will be covered with hard substrate. As discussed in Section 4.5.2 of Appendix D, the environmental effect of this change is not considered deleterious.

Indicate the volumes of rock armour and aggregate for concrete, with the source of the material identified and comment on the likely impacts of demand in relation to supply for other regional construction projects.

The amount of concrete weight coating and rock required for pipeline construction will only be known after detail design and actual construction are completed. However, based on current information, indicative estimates are approximately 50,000 m^3 of concrete weight coating, and 360,000 tonnes of rock for support and protection of the pipeline.

A study has shown that local reserves of quartzite and granite rock are well in excess of the current estimate of the 360,000 tonnes potentially required for the pipeline project. Quartzite could be sourced from up to three quarries near Darwin (one currently active and two under development) and granite could be sourced from a quarry where reserves are probably >10 million tonnes (Mt Bundey). The proposed Darwin to Alice Springs railway was identified as a potentially competing regional construction project which would not exhaust granite reserves but may tie-up quarry facilities.

2.3 PIPELINE ROUTE

Indicate the problems related to unsupported spans, steep gradients etc., including discussion of the impacts on bottom sediments, corals and benthos from vortices induced by pipeline interaction with currents.

As indicated in Section 2.4 of Appendix D, vortex induced vibrations within the pipeline will be avoided by the placement of rock to reduce span lengths to within limits acceptable under the design codes and standards listed in Section 2.2.1 of Appendix D. As indicated in Section 2.3 of Appendix D, local rerouting of the pipeline will be undertaken to avoid any steep gradients with the potential to affect pipeline stability.

Some localised accretion and erosion of sediments is anticipated in the immediate vicinity of the pipeline. Any impacts of vortices on the sparse corals and other benthos near the pipeline will be highly localised and will not lead to regionally significant changes in the abundance, diversity or distribution of these biota.

Discuss impacts on the seabed environment from laying the pipeline.

These impacts are discussed in the relevant sections (4.3.1 and 4.3.2) of Appendix D.

2.4 CONSTRUCTION, INSTALLATION AND STABILISATION

Discuss the impacts of hydrotest water discharge, which DEST calculates to be ~185,000 m^3.

Further to the discussion in Section 4.3.2 of Appendix D:

Only minimum dosages of oxygen scavenger (e.g. sodium sulfite) and an organic biocide will be added to prevent corrosion of the internal pipe surface. Ecotoxicity of the additives will be addressed as part of the application to discharge hydrotest waters under the Petroleum (Submerged Lands) Act.

During displacement of hydrotest water from the field end of the pipeline, the water will be sprayed high into the air to maximise the re-introduction of oxygen as it falls into the surrounding waters, thereby minimising the potential for any adverse impacts.

Discuss the methods of preparing the pipeline route and their impacts.

Preparation of the pipeline route prior to the actual laying of the pipeline will be limited as much as possible through route optimisation efforts during the detail engineering phase of the project. Rock filling, rather than blasting, will be employed across areas of rough terrain and hard substrate near the Bayu-Undan field. Epibenthic fauna will be smothered by the rock fill, which will subsequently be recolonised by similar fauna.

Ploughing is likely to be used to install the pipeline through the areas of soft sand waves near the entrance to Darwin Harbour. Lateral movement of the already-mobile sand substrate will not adversely affect the biota present.

Comment on the likely effects of erosion/accretion impacts along the pipeline, especially in relation to unsupported spans.

In areas along the route where erosion or accretion is expected, the bottom of the pipeline will be installed below the existing seafloor, to a level where sediments are suitably stable to support the pipeline. This will prevent the formation of unsupported spans by erosion. Accretion of sandy sediments over the pipeline will not affect pipeline integrity. Following severe storm activity, sub-sea inspection of the pipeline will be performed to confirm the stability of the pipeline and, if required, maintenance work will be initiated.

2.6 OPERATIONAL PHASE

Explain visual inspection techniques.

Submarine inspections of the pipeline external conditions will be undertaken by remotely operated vehicle (ROV) or by divers.

Will isolating valves only be present at the ends of the pipeline? If so, will the total content of the pipeline be lost in the case of a leak or rupture?

Isolation valves will be provided only at the pipeline inlet (at Bayu-Undan) and outlet (at the Wickham Point landfall). Reliable remote interline isolation valves are not available for offshore gas pipelines.

Primary leak detection will be provided by an on-line leak detection system which will use operating data (inlet and outlet pressures, temperatures and flow rates) to continuously compare actual versus simulated pipeline pressure changes and mass flow balance differences. Pipeline rupture would initiate immediate shutdown of gas supplies from the field. The pipeline would be depressurised at the onshore plant to enable evacuation of the pipeline inventory in a controlled manner, thereby minimising the volume of gas released to the marine environment. For an assumed average pipeline pressure of 10 MPa, approximately 10-15 MSm^3 of gas could be released.

4.3.1 Seafloor Modifications

Refer to the impacts of induced vortices and of the demand for rock ballast/armour.

Refer to responses in Sections 2.2.3 and 2.3 above.

4.3.2 Water Quality Impacts

Is there an implicit assumption that there cannot be a major oil spill from pipeline laying operations?

No. An oil spill contingency plan will be required for use by the pipeline contractor, which will include the laybarge.

ECNT requested further information on the scale of potential impacts on

a) the local fauna and seabed;
b) the ecologically important mangrove and coral habitats close by, and
c) the adjacent Tropical Indo-Pacific biogeographic province,

from a pipeline leakage or rupture, using several accident scenarios.

As discussed in Section 4.5.1 of Appendix D, small leaks (e.g. from minor pipeline damage or corrosion) would result in small volume releases of gas, with minimal condensate release. These leaks would be unlikely to be environmentally damaging even if undetected for long periods, due to the rapid dissolution of gas within the water column.

In the event of pipeline rupture, raw gas containing <1% condensate would be released into the marine environment (see Section 2.6 response above). The buoyancy of the gas would preclude any impacts on the seabed, except in the immediate vicinity of the leak. Turbulent mixing within the water column, and rapid evaporation (6-12 hours) at the sea surface, would minimise any impacts on local fauna. Mangrove and coral habitats are >5 km distant at the entrance to Darwin Harbour and >50 km distant from the pipeline route outside of the harbour and therefore most unlikely to be adversely affected by a rupture. The Tropical Indo-Pacific biogeographic province encompasses a huge area of tropical ocean and, consequently, a regional-scale impact would not result from a pipeline leakage.

4.4.2 Commercial Fishing Activities

If the pipeline will inhibit potential fisheries activities within its vicinity, indicate consultations that have been held, or are proposed to be held with fisheries industries representatives.

Information provided by the Australian Fisheries Management Authority (Figure 9 in Appendix D) showed fishing effort within the Northern Prawn Fishery was low in the vicinity of the pipeline. As indicated in Section 4.6 of Appendix D, the concrete weight coating surrounding the pipeline will afford sufficient protection from fishing gear impacts, and it is unlikely that fisheries activities will be inhibited. The other fisheries employ fishing gear which will not contact the pipeline, and the weight coating will also provide sufficient protection against anchor damage.

Commercial fishing operators will be notified of temporary access restrictions in the vicinity of the laybarge during construction activities through Notifications to Mariners.

5.2.2 Construction Management

Discharge quality guidelines for the hydrotest water should be given.

The guidelines will be set by the Department of Minerals and Energy, under the Petroleum (Submerged Lands) Act, and will be pertinent to the components of the specific additives selected, which are undetermined at this stage. Since the discharge of hydrotest water will occur within the Zone of Cooperation between Australia and Indonesia, the requirements of the Joint Authority will also be addressed.

5.4 PROJECT DECOMMISSIONING

ECNT request further information on the effects on the seabed and marine fauna from erosion of the cathodic protection system and deterioration of the pipeline following the project's operational phase.

The cathodic protection system will conform to design code DnV RP B401 and will not adversely affect the marine environment during or following the operational phase of the pipeline.

Both the cathodic protection system and the pipeline itself will deteriorate slowly, especially in the low-oxygen environment of the deeper areas and where the pipeline is buried. Water currents will disperse the slowly-released oxidation products, thereby preventing the accumulation of significant concentrations of metals within the seafloor sediments or marine biota.

III.2.3 Appendix P - Hazards and Risks Assessment

Comments were received on this appendix from both the Northern Territory DLPE and the Environment Protection Group, Environment Australia. The responsibility for hazard and risk management rests with Northern Territory agencies.

The Northern Territory Environment Protection Division requested additional information in regards to the Preliminary Hazard and Risk Assessment based upon a review of Appendix P undertaken by Keith Collins of the Western Australian Department of Environmental Protection.

The issue of land required for a fully developed LNG plant and a land use plan for Wickham Point, be determined on an urgent basis, as this will affect public utilisation of the area.

Figure A 4.2 in Appendix 4 of this Supplement shows the area required for a LNG plant with three trains. The Phillips process has a smaller foot print than other LNG processes. As such, the area available on Wickham Point is sufficient for expansion to 3 trains or 9 MTPA.

Preliminary Risk Assessments, both ecological and public, be conducted to determine the acceptability of the LNG plant located at Wickham Point. In regards to Mr. Collins' second recommendation, the EPD requested "…additional information regarding risk assessment, particularly in terms of public access areas and fires, should be provided in the Final EIS." in lieu of an entirely new risk assessment.

One of the prime considerations in the selection of a suitable location for a LNG or LPG facility is the possible hazards which may be posed to the adjacent residential population and to other users of neighbouring land. It is widely acknowledged that the location selected for a LNG facility is the principal determinant of the hazard which has to be managed during its operation.

Applicable codes (like NFPA 59A) define the design basis for various accident scenarios. Hazards resulting from these accidents must be contained within the plant boundary or within an area subject to land use restrictions, usually referred to as an "exclusion zone". A LNG facility which complies with design code requirements such as NFPA 59A, does not present a hazard to public access areas outside the exclusion zone.

While the codes define the accident scenarios which result in the largest expected LNG hazards, the Proponent has considered other worst case accidents, even those that are highly improbable. The design of the plant takes these outcomes into consideration.

The maximum fire heat intensity exclusion zone are provided in the Section 4 of the Preliminary Hazard and Risk Assessment Report found in Appendix P of the Draft EIS. Based on the spill detection and automatic shutdown system included in the design of the proposed facility, it is expected that such a spill could be terminated in less than 60 seconds. Nevertheless, the design incorporates the more conservative 10-minute spill criteria as outlined in NFPA 59A. For consistency with the LNG release scenarios, the 10-minute spill criteria was used for LPG as well.

The thermal radiation protection distances for the worst case accidents were calculated to be:

Thermal Radiation Protection Distances for Facility Siting

Fuel	Description of Event	Impounding Area	Dimensions of Pool Surface (m)	Distances (m) from Center of Impoundment to Specified Radiant Heat Flux		
				5 kW/m^2	9 kW/m^2	30 kW/m^2
LNG	Full tank spill	Outer tank	66 dia.	250	210	145
LPG	Roof failure	Inner tank	57 dia.	210	175	120
LPG	Full tank spill	Remote	143 x 143 x 4	520	430	290
Condensate	Roof failure	Tank	55 dia.	90	60	*
Condensate	Full tank spill	Large, flat	100 x 125 x 2	150	110	*

* This Flux was not reached.

The flammable mixture dispersion distances for spills described in the codes are as follows:

Flammable Mixture Dispersion for Design Spills

Case	Description of Spill Impounding Area	Release Rate (m^3/hr)	Release Duration (min)	Distance (m)
1	LNG spill into 25 x 25 x 4 m high density concrete sump	15,000	10	375
1a	LNG spill into 50 x 50 x 1 m high density concrete sump	15,000	10	475
2	Propane spill into 20 x 20 x 1 m high density concrete sump	2,250	10	250
3	Butane spill into 20 x 20 x 1 m high density concrete sump	2,250	10	208
4	Condensate spill into 100 x 125 m soil dyke	2,250	60	365

A LNG release in the liquefaction plant larger than that defined in the code is a very remote possibility. In order to obtain a spill of greater magnitude, multiple failures would be required. The general pipe joint failure rate is about 1×10^{-6}, while isolation valve failure or sensor failure frequencies are about 1×10^{-4} (US Nuclear Regulatory Commission, 1973). Therefore, the combined frequency of pipe failure followed by isolation failure is about 1×10^{-10}. This exceedingly low expected failure frequency precludes from consideration any spill accident larger than that defined by the code.

LNG Storage Tank Releases

The LNG storage tanks proposed for facility are double containment tanks with "over-the-top" loading and withdrawal connections. Each tank will comprise an inner container fabricated from 9% nickel-steel surrounded by approximately 1 m of perlite insulation, contained within an outer concrete wall lined with steel. There are no sidewall penetrations through either the primary or secondary containment systems. Therefore, the LNG release scenario described in the code is the same as given in the above table.

Another accident that should be considered is a fire over the entire surface of the liquid in the tank. In postulating this accident, it is implicitly assumed that the tank roof fails and immediate ignition occurs. Failure of the tank roof could occur only as a result of excessive pressure or vacuum in the tank, violent impact on the outside of the tank roof by an aircraft or other object, or earthquake. The probability of occurring such an event is in the order of 1×10^{-6} failure per year.

In the event of roof failure without immediate ignition of the vaporised LNG, a flammable vapour cloud could spread beyond the facility boundaries. This accident scenario is not considered credible due to many power and instrument lines on the tank roof which would be damaged in a roof failure and which would ignite the vapour. The thermal exclusion zone for the proposed storage tanks is approximately 200 m from the fire center. The storage tanks will be spaced so that a fire on one tank does not propagate to the other. Thus, a major accident like this will be contained within the plant boundaries and will not affect the general public.

If immediate ignition does not occur and the flammable vapour cloud travels to its maximum downwind distance without ignition, the total hazard zone extends about 1800 m from the tank center, for the worst atmospheric conditions. However, the probability of this event is so low as to preclude its consideration in the establishment of exclusion zones.

LPG Storage Release

LPG tanks are double-walled, single containment tanks. Internal pumps will be used and all liquid and vapour connections will pass through the dome of each tank. LPG tanks do not have a "design" spill defined as do LNG tanks. The maximum ship loading rate for LPG products is expected to be 1,500 m^3/hr. A "severed line" accident scenario would allow liquid to be released at a rate higher than 1,500 m^3/hr due to reduction in backpressure. Assuming a 50% pump runup due to decreased backpressure, a spill rate of 2,250 m^3/hr for a ten minute period has been selected as the LPG design spill. This corresponds to a spill volume of 375 m^3. This could be contained in a sump with dimensions of 20 x 20 x 1 m.

Therefore, for a "design spill" of 375 m^3, the thermal radiation distance from the center of the sump will be 210 m. For a catastrophic failure (full tank spill), the LPG will overflow from the sump to the remote impoundment basin and the thermal radiation distance will be 520 m (from the center of the impoundment). Similarly, the flammable mixture dispersion zones for a 10 minute design spill would be 250 m.

Conclusions

The purpose of the specific accident scenarios outlined by code is to provide information so that the plant can be designed without posing a significant risk to the public. Applicable codes require that the exclusion zone surrounding the storage tanks and spill containment basins be sufficiently large that the general public could not be affected.

An LNG storage tank fire (involving roof failure) would be a danger to people within about 200 m from the tank center, but it would not endanger the adjacent tank. An unignited vapour cloud created by an LNG transfer line rupture would cause a potential hazard to an area about 500 m to 600 m from the spill. Similarly for LPG, the thermal radiation distance for a full tank spill is approximately 520 m.

Property fencelines will be established to keep the public out of the exclusion zones as defined by the applicable codes. Therefore, design basis accidents will present minimal risk to the general public. The worst case accident used for calculating the required exclusion zone is a 10-minute spill from the large diameter loading line into impounding system, without ignition. If a 50 m x 50 m x 1 m perlite concrete basin is assumed, the exclusion zone will have to extend 475 m from the center of the basin. Thus, the required exclusion zones are within the proposed area to be acquired and accidental fire will not affect the general public for the LNG and LPG releases described above.

Full Quantitative Risk Assessments (QRA) looking at onsite, offsite and ecological risks, would need to be conducted as the plant design progresses.

From the risks identified in the QRA, a Safety Report and Management System be developed and committed to by the Proponent in accordance with the Worksafe Standard for the 'Control Of Major Hazard Facilities.

Phillips will perform a systematic risk assessment on the facility in accordance with the Worksafe Australia Standard for the " Control of Major Hazard Facilities" The LNG facility will also establish, implement, and maintain a documented safety management system as defined by this Standard.

An Environmental Management System (to AS 14000) be developed and committed to by the Operator.

Phillips is committed to the development of an Environmental Management Plan (EMP), as outlined in the guidelines for an EIS, that will minimise the potentially adverse environmental effects of this project. The EMP will include the following practices:

- establish management and monitoring plans which will ensure that actual and potential adverse effects associated with the construction, operations, and decommissioning phases of the project are minimised;

- seek continual improvement in environmental protection through the establishment of effective management systems;

- conduct environmental reviews for compliance to the EMP, all relevant environmental legislation and regulations, and with other requirements that Phillips subscribes; and

- establish and maintain communications on environmental issues with concerned groups and regulatory agencies.

The NT Government also requested information on the effect of lightning strikes on power supply.

The plant has been designed to minimise the effect that lightning can have on plant operations. A major feature of this design is the installation of a lightning avoidance system which should result in the complete elimination of strikes to the facility. In addition, the plant will use different electrical buses and redundant circuits to specific electrical equipment to reduce the possibility that complete power supply will be lost to this equipment in the event of conductor damage. The overall plant is also served by four separate gas turbine generators and one stand-by diesel generator. If one gas turbine generator is damaged, the other three will still allow the plant to operate normally.

Environment Australia made a number of comments on Appendix P, most of which have been addressed in the response to the NT Government.

The EIS should provide a clear list of further studies and documents to be prepared on hazard and risk issues.

As a minimum, the following studies will be conducted and the following documents will be prepared during the detailed engineering phase of the project.

1. **HAZOP: Hazard and Operability Study:** A critical review of Process and Instrumentation Diagrams will be conducted for "what if" analysis of the scenarios rising from failure of valves and controls or other upset conditions. Whilst HAZOPs are conducted for hazard identification and management purposes, they are also useful for pollution control purposes. This effort will be

done during the detailed engineering phase of the project. The Engineering Contractor will be responsible for conducting the HAZOP and an independent team of specialists will do the comparing.

2. **Quantitative Risk Assessment (QRA):** The principal elements of the QRA will include:

   - Review of risk/accident scenarios (hazard identification);
   - Assessment of initiating event frequencies;
   - Consequence assessment on general basis; and
   - Evaluation of severity of consequences and their impact.

   The QRA is usually conducted by a third party consultant (hired by the primary EPC contractor) specialised in Hazard and Risk Assessment of LNG facilities. The QRA will be conducted after completion of HAZOP in the detailed engineering phase of the project. As a result of HAZOP studies, the QRA usually indicates that the plant will be much safer than was determined in the preliminary risk assessment because of the conservative assumptions required to be used for the preliminary risk assessment. The relevant public authority (Work Health Authority) will be consulted for certain specific risk issues such as application of risk criteria, cumulative risk, buffer zones, etc. during the preparation of the QRA.

3. **Safety Report:** A detailed Safety Report for the onshore facilities per requirements of the Worksafe Australia Standard "Control of Major Hazard Facilities" will be prepared after the completion of HAZOP and the QRA. This effort will be done prior to operation of the plant. Phillips will consult with the relevant public authority (Work Health Authority) for determining and agreeing on the presentation, format and detail required for the safety report. Similarly a periodic consultation with the public authority will be conducted during the preparation of the Safety Report. Consultation with other public authorities such as the Port Authority, RAN, and the Airport Authority will be conducted on specific issues.

4. **Safety Case:** For offshore facilities and subsea pipeline, a Safety Case will be prepared. The primary engineering and construction contractor will be responsible for the preparation of the Safety Case. This report will be prepared simultaneously with the Safety Report, prior to operation of the plant and pipeline. As described above the public authorities will be consulted before and during the preparation of the report.

5. **Construction Safety and Health Plan:** A detailed plan depicting procedures to be followed for occupational safety and health of construction force during the construction of the facility. The primary construction contractor will be responsible for preparing this report. This plan will be prepared in the early part of the detailed engineering and well before the start of the construction. The relevant public authority (Work Health Authority) will be consulted for determining and agreeing on the presentation, format and detail required for the safety and health report. Similarly a periodic consultation with the public authority will be conducted during the preparation of the Construction safety and health report. Subcontractors and employees will be consulted through appropriate consultative mechanisms in order to promote the safe construction and operation of the facility.

6. **Construction Environmental Control Plan:** A detailed plan for addressing environmental issues and procedures for mitigation of spills will be prepared prior to the start of construction. The primary contractor's organisation will be responsible for the preparation of this plan. Consultation with the DLPE will be conducted for determining the format and detail required for the protection of the environment during the construction of the plant.

7. **Emergency Plans:** Emergency Plans for operation of the facility per requirements of the Worksafe Australia Standard "Control of Major Hazard Facilities" will be prepared. This will

also include loading facilities, LNG tankers, oil spills and pipeline rupture . The relevant public authority (Work Health Authority) will be consulted for determining and agreeing on the presentation, format and detail required for the preparation of the Emergency Plans. Emergency services will be consulted to formulate and to agree on off-site emergency plan for action outside the facility. Also the community and Channel Island Power Plant personnel will be consulted during the preparation of off-site emergency plans. These plans will be prepared by Phillips before the operation of the plant.

8. **Port Emergency Plan:** Phillips will work closely with the Darwin Port Authority and the Royal Australian Navy for the development of this plan. The plan will be prepared before the operation of the plant during the detailed engineering phase of the project.

IV. ENVIRONMENTAL MANAGEMENT

IV.1 INTRODUCTION

An Environmental Management Plan (EMP) will be developed for the LNG plant and pipeline. An EMP outlines specific management responses by the proponent to environmental impacts and issues identified during the assessment process, as a result of input by the proponent, the public and government reviewers. An EMP is therefore a means of both documenting and auditing environmental management commitments made by the proponent

An EMP provides a detailed plan of action to assist in the avoidance or mitigation of identified adverse impacts, and to assist in the management of beneficial impacts, where appropriate. Persons or positions (e.g. environmental officer, site engineer) responsible for implementing the management action also need to be identified, to ensure accountability. Monitoring tasks may need to be developed as part of the management strategy to provide feedback on the adequacy of management and to enable changes to be made to management approaches if necessary.

An EMP needs to be designed to meet the specific requirements of the project as presented in the final design and following the conclusion of the EIA process. However, the EIS is required by government to be undertaken early in the project life and inevitably, there will be refinements and changes to the project during and following completion of assessment.

The following EMP should therefore be considered as a preliminary document which will be developed and refined to meet the ultimate needs of the project for sound environmental management. It is based on the Preliminary EMP presented in Section 8 of the Draft EIS, but has been modified to accommodate changes to the plan plus new commitments made by Phillips in this supplement.

IV.1.1 Objectives

A detailed EMP will be developed for the project, following the completion of environmental assessment and finalisation of project design. The overall objectives of the EMP will be to establish management and monitoring plans which ensure that actual and potential impacts associated with the construction, operation and decommissioning phases of the pipeline and LNG plant are minimised, and that compliance with all relevant environmental regulations is achieved.

The specific objectives of the EMP are to provide a planned structure which will:

- ensure that construction activities are undertaken in an appropriate manner and that impacts on the environment are minimised and monitored;
- ensure that impacts associated with the operating phase of the development are minimised and monitored; and
- minimise the risk of potential effects from unexpected incidents, such as oil spills and ensure that appropriate contingency plans are in place in the event of such incidents.

The EMP will identify the timing and scope of individual components of the environmental management plan, and serves as a compliance document - recording the progress of management commitments and their conformity with requirements set by authorities and expectations of the public.

IV.1.2 Proponent's Commitments and Environmental Policy

Phillips addresses environmental management through a corporate Health, Environment and Safety (HES) Management System. The HES Management System helps to ensure that health, environment and safety are incorporated into every aspect of the company's business. The four main components of the System are the HES Policy, which defines the Company's commitment to being a responsible corporate citizen; the Process for Safety and Environmental Excellence, which provides the structure for implementing the policy; Plans and Objectives, set by business units and staff to continuously improve HES performance; and Measuring Progress, a rigorous review and auditing system that is designed to ensure that the policy is implemented and that all facilities are in compliance with applicable laws and regulations.

In the EMP for the Wickham Point plant, Phillips will undertake:

- the adoption of best practice industry standards and guidelines applicable to the construction, operation and decommissioning of the pipeline and LNG plant;
- compliance with government regulations and all legal requirements;
- production and implementation of a safety manual and an emergency response manual, including an oil spill contingency plan, for the LNG plant and pipeline construction spread;
- monitoring to confirm the scale of potentially adverse environmental impacts;
- decommissioning the plant upon completion of operations; and
- rehabilitation of the plant site and infrastructure areas to a natural condition or as otherwise specified by legislative or regulatory requirements.

IV.1.3 Summary of EMP Components

This preliminary EMP comprises the following components:

- EMP document (including a Construction Management Plan and an Operations Management Plan);
- Environmental Monitoring Programme;
- Compliance Auditing and Reporting commitments;
- Outline of Emergency Response Manuals; and
- Outline of Decommissioning Proposals.

IV.2 PRELIMINARY ENVIRONMENTAL MANAGEMENT PLAN

IV.2.1 Components

The preliminary EMP will comprise both a Construction Management Plan and an Operations Management Plan. Both these plans will incorporate a number of subparts to cover the major activity experienced in each phase of development.

The Construction Management Plan will incorporate the following parts:

- Plant Site Construction;
- Workforce Management;
- Plant Site Waste Management;
- Dredging and Spoil Disposal Management;
- Pipeline Construction.

While Phillips may contribute to the construction costs, the design, construction oversight and maintenance of the Access Road will be the responsibility of the Northern Territory Government.

The Operations Management Plan will comprise the following components:

- Plant Site Management;
- Workforce Management;
- Plant Waste Management;
- Shiploading Management.

Table IV.1 summarises the objectives of each of the components listed above.

IV.2.2 Construction Management

Details on the objectives and tasks proposed for each of the major components is provided below.

IV.2.2.1 Plant site construction

As outlined in Section 7.2.2 of the Draft EIS, concerns associated with the clearing and levelling of the plant site include:

- the potential for the introduction of weeds and plant pathogens via machinery and equipment;
- the potential for introduction of feral animals;
- alteration of existing drainage patterns leading to soil erosion, sedimentation and off site water turbidity;
- potential occurrence of acid sulphate soils;
- the potential for the creation of conditions favourable for breeding of biting insects;
- the potential for disturbance of sites of specific heritage value;
- the potential for disturbance of ecological values of remnant vegetation by fire; and
- potential creation of construction noise and dust.

Management tasks that have been identified to mitigate these specific potential issues of concern are listed below.

(1) Control of weeds and plant pathogens

- **Washdown of all plant and equipment.** To prevent the introduction of weeds and plant pathogens, provisions for vehicle washdown will be included in construction contracts, and machinery will be checked on arrival to ensure that the requirements have been observed. Machinery and materials arriving on site without such clearance will be quarantined off-site pending washdown. A designated washdown area will be selected in consultation with weeds officers from the Department of Primary Industries and Fisheries (DPIF). Treatment will include hosing down of earthmoving equipment and vehicles, and the use of steam pressure spray for earthmoving equipment which retains soil or mud which is difficult to remove.

TABLE IV.1

SUMMARY OF COMPONENT TASKS OF PRELIMINARY ENVIRONMENTAL MANAGEMENT PLAN

CONSTRUCTION MANAGEMENT PLAN

Plant Site Construction	Workforce	Plant site Waste Management	Dredging and Spoil Disposal	Pipeline Constructions
• Control of weeds and plant pathogens • Control of feral animals • Control of soil erosion • Management of acid soils • Management of biting insects • Protection of heritage values: - heritage sites - Aboriginal sites • Protection of ecological values: - significant vegetation - significant fauna • Management of noise • Control of dust	• Accommodation • Transport to site • Induction • Training	• Dryland vegetation • Debris and leaf litter • Cleared mangroves • Marine muds • Excess fill • Spent oils • Domestic garbage • Domestic wastewater • Drums and Containers • Building Materials	• Further evaluation required prior to construction	• Shore crossing sediment characteristics and turbidity management • Protection of historic sites • Avoidance of sacred sites • Disruption to Mandorah services • Access and traffic restrictions • Notifications to mariners • Use of Naval Waters and Exercise Areas • Minimisation of disturbance to road traffic

OPERATIONS MANAGEMENT PLAN

Plant Site Management	Workforce	Waste Management	Shiploading Management
• Control of weeds • Control of feral animals • Control of biting insects • Resolution of concern re flare on airport approaches	• Induction • Training • Emergency response training and testing	• Atmospheric Environment - Confirm accuracy of modelling for NO_x - Greenhouse gas audit • Wastewater discharge - confirm quality and quantity of effluent - investigate alternatives to direct discharge to harbour waters • Solid and semi-liquid wastes - non-hazardous - hazardous	• Prohibition on hull cleaning of tankers • Prepare oil spill contingency plan • Maintain jetty corrosion protection at optimum performance • Adopt IMO and AQIS guidelines for deballasting at sea • Notify authorities and liaise with DPA and Navy

- **Notify authorities if major areas of weeds are found in the project area.** Wickham Point is relatively weed-free; however, the lantana weed is common throughout the dry rainforest. Weeds officers from DPIF will be consulted about the most effective precautions that should be taken to prevent the spread of lantana offsite, and to other areas on Wickham Point, and for appropriate action to be taken to dispose of cleared vegetation containing lantana or other weeds.

- **Park vehicles and plant in designated areas only.** To minimise the risk of spreading weeds to other areas on Wickham Point that will not be directly affected by the project, all earthmoving and other equipment will be parked in designated parking areas. (This will also minimise impacts from accidental fuel spills or leaking equipment). Vehicle parking areas will generally be located in borrow pits or previously disturbed areas.

- **Progressively rehabilitate areas.** All cleared or disturbed areas that are no longer required for construction or operational purposes will be stabilised to minimise re-establishment of weeds, as well as to reduce dust, and silt runoff from site. Much of the cleared area will be compacted and armoured with gravel and left exposed as a laydown area or future process area.

(2) Feral animal control

- **Notify authorities if feral animals are found in the project area**. Wickham Point is relatively free of feral animals because of the difficulties of access to the site at present. As a result, it supports breeding sites for a number of ground-dwelling birds (the Beach Stone-curlew and Orange Footed Scrubfowl), and viable populations of bandicoots and possums.

  Completion of the access road, however, will enable feral pests (cats, rats, pigs and dogs) to access Wickham Point more easily, particularly at night. In an effort to minimise reduction of Wickham Point's ecological values, staff will be encouraged to report any sightings of feral pests. The advice of the Parks and Wildlife Commission will be sought in developing the feral animal control programme, and the occurrence of sightings will be reported regularly to the Commission on a frequency yet to be decided. Officers will be assisted in their endeavours to eradicate periodic increases in numbers of feral pests.

(3) Soil erosion control

- **Minimise clearing.** An overriding objective for vegetation removal will be to ensure that only areas that are absolutely necessary for access, construction activities or associated purposes will be cleared. In temporary construction areas (e.g. temporary access corridors or temporary lay down areas), vegetation will be cleared at or above ground level leaving any intact rootstock which will not obstruct traffic or machinery. In some areas light vegetation (low shrubs and ground cover) may alternatively be rolled or flattened by machinery. This will serve to keep disturbance to a minimum and conserve topsoil and vegetative propagules.

  In areas requiring excavation, vegetation, including rootstock, will be removed and stockpiled in windrows for future use in rehabilitation of temporarily cleared areas. If the stockpiled vegetation is not required it could be chipped and used on site for landscaping. This will remove the need to import mulch to the site and thereby reduce the chance of weed introduction.

- **Drainage and erosion control works.** To reduce the potential of soil erosion and siltation of water resources, drainage and erosion control in disturbed areas will be undertaken by construction of banks or drains, use of temporary measures, such as hay bales, cultivation of compacted areas parallel to contours and restoration of vegetation. Drains will be designed for non-scour velocities. Culverts and drains will be designed to avoid erosion at inlet and outlet

points. Where necessary, drop structures will be installed at discharge points. Where surface runoff is redirected as a result of construction, appropriate water diversion banks and culverts will be installed.

All stockpiles and surcharge embankments will be sloped as needed to prevent ponding. Excavations will be sloped to a low point to allow pumping and eliminate saturation by ponding.

Potentially contaminated stormwater within the process area will be collected and treated before release to the environment. Clean stormwater will be gathered via stormwater collection systems as outlined in the Draft EIS. The systems will be designed and constructed to control discharge velocities and minimise soil erosion through use of measures proven to be effective in the local environment. In addition, discharge points will be located within regularly flushed tidal areas (i.e. below 3.7 AHD), using natural drainage channels as far as practical. Care will also be taken to avoid the creation of depressions and obstructions to water movement during construction activities associated with the drains and access corridors. Phillips understands that poorly planned and inadequately controlled discharge of freshwater can lead to changes in species and the build-up of grasses and other vegetation which can impede drainage through mangroves, creating new mosquito breeding areas.

Phillips will utilise the document *Construction Practice Near Tidal Areas in the Northern Territory, Guidelines to Prevent Mosquito Breeding* referenced in the Draft EIS, and will consult with the Medical Entomology Branch, Territory Health Services.

(4) Management of acid soil

It is possible that some PASS will be encountered in the marine flats or mangrove areas. This issue will require further investigation during detailed site investigations prior to construction. To avoid creation of acid soil conditions, it is proposed to:

- minimise disturbance of mangrove sediments where possible, i.e. in area of flare; and
- dispose of any excavated marine sediments that are found to be acid producing in an appropriate location as agreed with Northern Territory Government authorities.

If a PASS problem does develop, an Acid Sulphate Soil Management Plan and Monitoring Programme will be developed in consultation with DLPE Soil Conservation Officers.

(5) Biting insects management

Phillips recognises the significant health and life-style implications that mosquitoes and biting midges can have on the workforce at the Plant site. Phillips is therefore committed to minimising impacts that the plant construction will have on existing biting insect numbers and to controlling the effects of biting insects on the health and well being of site personnel through the following approved and environmentally sound protection measures:

- **Avoidance of the creation of new breeding areas.** In order to avoid the creation of potential breeding sites for biting insects, construction practises will follow the "Guidelines to Prevent Mosquito Breeding" prepared by P. Whelan for the Northern Territory Coastal Management Committee in June 1988. Some of the measures will include: borrow pits will not be created on flat-lying terrain within 2 km of residential areas; borrow pits and quarries will be graded where practicable to ensure free drainage; ponding of water will be avoided where practicable.

Particular attention will be paid to disturbance of salt flats where even small depressions can create breeding sites.

- **Removal of identified breeding sites.** There are a number of existing mosquito breeding sites, including poorly draining tidal retention areas, that can be rectified by engineering measures. Impeded drainage in these sites has resulted from the development of a sand bar which retains water at low tide. A short subsoil pipe through the sand bar, with appropriate erosion prevention structures at either end, may need to be installed to drain these sites.

  On other sites it may be necessary to fill shallow depressions or poorly draining areas during construction. Site management will ensure that containers and equipment capable of storing water are either stored under cover, or are regularly inspected and emptied of water. Other debris and containers in the vicinity of the site will also be removed. A general clean-up of artificial containers around the shoreline will also be undertaken in an effort to further remove potential for breeding.

Some areas may require larval control operations, in consultation with the Territory Health Service. The preferred control mechanism for most larval control situations will be *Bacillus thuringensis* var. *israelensis.*

- **Biting Midges.** *Culicoides ornatus* is likely to be a severe pest in at least the eastern half of the island, and possibly the entire island. They will be most numerous around August to December at the time of the full moon, and principally in the early evening and morning. Where possible this problem will be minimised by siting high use personnel areas, particularly those having evening and early morning activity, in the south-west section of the island. All personnel facilities will be screened or sealed from biting midge entry. As biting midges will penetrate normal insect screens, fans and air conditioning could be utilised to discourage biting midge entry to personnel facilities.

- **Adult mosquito and biting midge control.** Control of adult populations is not likely to be practical or effective under most circumstances. Control would need to be by aircraft, the insecticide would need to penetrate beneath dense mangrove canopy, large areas of treatment would be required, the insecticide of choice would be non-selective, and repeated application would have deleterious effects on many non-target animals. A variety of hand held, back pack and vehicle mounted machines are available for fogging. Precautionary fogging is carried out by THS to prevent the transmission and outbreaks of malaria.

  Except in emergency situations, e.g. in the event of a confirmed outbreak of malaria at the plant and under advice of the THS, it is not proposed to undertake adult biting insect control activities on the scale outlined above.

- **Education of workforce about insect pests.** As there will be times when personnel will be exposed to seasonal attack by either biting midges or mosquitoes, the company will incorporate advice on the pest and health issues, and methods of personal protection from biting insects into the induction procedures for new personnel at Wickham Point. Aspects of particular importance are an awareness of the potential for Ross River virus infection posed by salt marsh mosquito attack, and the protective clothing and repellent measures that may be necessary during periods of mosquito and biting midge attack. Phillips' experience in managing mosquito problems in other tropical regions may also assist in developing an understanding by the workforce of issues involved in biting insect protection.

(6) Protection of heritage values

In order to protect sensitive areas and sites of cultural/heritage value, the following strategies will be employed.

- **Protection of heritage sites.** Prior to the commencement of construction activities, Phillips will ensure that the appropriate authorisation has been received from the DLPE and AAPA. An archaeological sites register for the entire project (including a detailed map and photographic evidence) will be established in consultation with the Heritage Unit of DLPE. This register will be used to educate all construction and operations personnel of the location and significance of sign-posted "off limits" areas. If any new archaeological artefacts or historic sites are discovered, DLPE Heritage Unit will be notified as soon as practical.

- **Protection of Aboriginal significant sites.** Surveys of Wickham Point by anthropologists have not revealed the presence of any sacred sites, and an Authority Certificate has been issued by the AAPA (Appendix N). However, there is a possibility that Aboriginal graves may be located during construction activities. If any Aboriginal artefacts or apparent burial sites are uncovered, work on that particular site will be suspended and the appropriate authorities will be notified. If any sites of significance are located, a sacred sites register and a map of general protected (off limits) areas (where sites are located) will be prepared. This will be incorporated in the workforce induction program and will be used to educate all construction and operations personnel of the significance of the sacred sites to Aboriginal people. Protected areas will be sign posted. Consultations with the Larakia will occur on a regular basis through a liaison committee.

(7) Protection of Ecological Values

In order to protect the ecological values of the flora and fauna remaining adjacent to the plant site, the following strategies will be employed.

- **Protection of significant vegetation.** Areas of significant vegetation (both rainforest and mangroves) to be retained will be clearly marked by temporary fencing during the site development phase. Access into and through these areas by workers and machinery would reduce the ecological integrity of these areas and will be prohibited.

  The most effective protection will be afforded by management of fires and subsequent weed invasion of significant areas of vegetation at Wickham Point. The dry rainforest of the peninsula has not been burnt for several decades and this has resulted in an uncommon and valued vegetation association. Burning of this vegetation during the construction phase will be prohibited. Construction staff will be briefed about the impacts of fire and burning of sensitive areas. Fire fighting equipment will be available during construction to prevent fires spreading and all vehicles will be fitted with fire extinguishers. The site manager will be responsible for liaison with the local authorities (Northern Territory Bushfires Council and possibly Palmerston Fire Brigade) on severe fire hazard days.

  Phillips recognises that the island which occurs between Wickham Point and the mainland also supports large areas of good quality dry rainforest vegetation which is also at risk from fire and weeds as a result of improved access. Whilst this island is not Phillips' responsibility to manage, Phillips will cooperate with any Northern Territory Government initiative for management of the area.

- **Protection of fauna.** Firearms and traps will not be permitted and pets will be banned from the construction site. Fauna habitat will be protected as much as possible in areas surrounding the cleared plant site through the protection measures for areas of significant vegetation, as outlined

above. Some scrubfowl breeding mounds will be removed during clearing and site preparation works. Most mounds are located on cheniers away from the plant site and these will not be disturbed. The workforce induction program will alert construction workers to the presence of scrubfowl, wallabies and other native fauna in the area. Speed limits will be enforced to help protect fauna from motor vehicles and plant and equipment.

All open holes and pits will be covered where ever possible to prevent trapping and injury to fauna. All open pits will be inspected daily and any fauna trapped therein will be released.

(8) Noise management

The construction site on Wickham Point is located approximately 7 km across the harbour from Darwin City and 10 km from the nearest residential areas in Palmerston. Construction activities are unlikely to cause significant off-site disturbance. Environmental management measures to reduce impacts will include:

- all equipment will be fitted with adequate and approved noise control equipment and the construction site manager will ensure that noise control equipment is fully maintained and operational;
- construction activities will comply with noise abatement requirements under OH&S regulations;
- where possible, construction activities will be undertaken during daylight hours. Blasting will only occur during daylight hours;
- noise levels will be monitored on site and if any noise complaints are received the problem will be rectified if possible.

(9) Dust control

To reduce the potential for dust generation, stockpiles of topsoil and overburden will be smooth-rounded. Cleared areas used for traffic will be regularly sprayed with water to reduce dust generation and the speed of all vehicles on site will be controlled. Additionally, where practicable, progressive revegetation will be undertaken of areas no longer required for construction or support services.

IV.2.2.2 Management of construction workforce

Management of the large construction workforce is recognised as a major requirement of this project. As indicated earlier, it is not proposed to establish a construction camp on or near the site. It is anticipated that workers will be either bussed or ferried to the plant site from collection points around Darwin and Palmerston, thereby reducing effect on traffic congestion.

All workers and contractors will be put through an induction programme prior to gaining access to the construction site. The induction programme will educate the workforce about the special ecological, archaeological and anthropological values of Wickham Point and the need to respect and protect these values.

In particular, they will be trained to recognise problem weeds and feral animals and encouraged to report any sightings. Workers will be prohibited from entering signposted prohibited and “off limits” areas established to protect sensitive areas. The workforce will also be educated regarding the biting insect problem and means of protecting themselves against infection. Speed limits will be established

on site for safety reasons and to minimise dust generation. A bushfire response plan will be developed and the workforce trained in its application.

IV.2.2.3 Plant site waste management

Waste materials generated during construction of the LNG plant will be disposed of appropriately and in accordance with NT Government requirements. Disposal plans proposed for various wastes include:

- **Dryland vegetation.** Cleared vegetation will be stockpiled and used for rehabilitation. Respreading of vegetation on previously cleared areas that have been ripped or otherwise prepared for rehabilitation, provides sheltered conditions for native plant establishment as well as microhabitats for fauna recolonisation. If excess vegetation material is available, it may be chipped and used as mulch for landscaping on site. Stockpiled vegetation will only be burnt as a last resort.

- **Debris and leaf litter** from clearing operations may be utilised in rehabilitation or stockpiled for burning as soon as possible. All stripped material will be removed to the designated disposal areas in accordance with acceptable practices. It is not intended that plant debris and other non-putrescible organic matter will be required to be disposed of in a suitable landfill site.

- **Cleared mangroves** will be stored and used to assist in rehabilitation in suitable areas where practical. Unused mangrove material may be woodchipped and used in landscaping. Mangroves will be burnt only as a last resort.

- **Marine muds**, which may become acidic on exposure to air and rainwater, will be disposed of in accordance with guidelines agreed by the NTDLPE. The volume of marine muds needing such treatment is not known at present and will be investigated during the detailed design phase.

- **Excess fill** (if any) will be sold on the local market or provided to government.

- **Spent oils**, lubricants and collected oil will be recycled or disposed of properly through a licensed waste contractor. Waste oils from the Darwin area are currently disposed of in a lime kiln or distilled in a mobile treatment plant. Future management of waste oil and other hydrocarbons will be in accordance with the NT Government Waste Oil Management Plan.

- **Domestic garbage** will be collected by commercial contractor and disposed of at an approved landfill (either Shoal Bay or Palmerston Waste Disposal Facility)

- **Domestic/sanitary wastewater**. Either on-site septic toilets, or portable toilets, provided in appropriate numbers at convenient locations, will be used during the construction phase. The toilets may be obtained through a commercial contract which will include cleaning, disinfection and maintenance at regular intervals. Sanitary wastes will be collected and disposed of off-site on a regular basis. Disposal will be contracted to a local chemical toilet or sullage trucking firm that operates within statutory requirements. Selection of the preferred toilet option will be made in consultation with Territory Health Services.

- **Drums and containers** used for non hazardous materials will be recycled or disposed of in a local landfill, in accordance with NT Government requirements.

- **Building materials** will be disposed at an approved location such as the Palmerston Waste Disposal Facility. Recyclable waste such as scrap metals will be collected in a suitable disposal area and transported for commercial disposal if economically viable.

- **Hazardous materials**. At the LNG plant site, the primary contractor and subcontractors will be responsible for on-site handling and off-site disposal of hazardous materials/waste that may be generated due to construction and start-up activities.

  Phillips recognises the importance of handling all waste streams in an appropriate manner. Before any industrial type waste will leave the plant site, the disposal method and location will be reviewed to ensure that the method of disposal/treatment is appropriate.

  Phillips will review all proposals to bring chemicals onto the site, regardless of volume. The division of responsibilities for hazardous material/waste management between the contractor and Phillips is listed in Table IV.2.

Table IV.2

Responsibility for Hazardous Waste Management

Activity	Responsibility
Characterise the material/waste to decide if it is hazardous	Contractor, with input from Phillips as needed
Provide an acceptable container with label	Contractor/Subcontractor
Place waste materials in the container	Contractor/Subcontractor
Inspect the container weekly	Contractor/Phillips
Track the accumulation time for the waste	Contractor/Subcontractor
Prepare the required paperwork, including manifest	Contractor/Subcontractor
Haul the container to the disposal site	Contractor/Subcontractor

NB: In accordance with the Northern Territory Waste Management and Pollution Control Act, all contractors will be licensed.

IV.2.2.4 Dredging and spoil disposal

As outlined in Section I.8 of this Supplement, the Darwin Port Authority and Department of Transport and Works suggested that Phillips coordinate dredging activities with Northern Territory Government plans to dredge Stage 2 for East Arm Port, thereby sharing costs of dredge mobilisation. The agencies also offered to accept for disposal at East Arm Port reclamation, all suitable fill material generated by Phillips which was not required for the LNG plant site.

A preliminary geotechnical analysis of areas requiring dredging for the LNG project (refer Appendix 8) indicates that most of the spoil will be suitable as fill material. Phillips is supportive of both suggestions since they result in a potential cost saving and remove the need for a temporary reclamation area on the salt flats of Wickham Point.

Review of the dredging operations has resulted in two minor changes. One change will be to remove the entire ridge which occurs in part of the turning area to a depth of -13 m Chart Datum as suggested by the Darwin Port Authority. Recalculation of the amount of material to be moved (refer Appendix 8) indicates that some 150,000 m^3 of primarily meta siltstone will need to be dredged. During the detailed design stage, Phillips will investigate the cost/benefit and environmental consequences of a number of options for handling this spoil. The available options, in order of preference, are:

(1) relocate spoil to the East Arm Port reclamation area;
(2) sidecast spoil onto the floor of Middle Arm channel; or
(3) relocate spoil to a temporary reclamation area elsewhere on Wickham Point.

The second change involves the excavation of about 50,000 m^3 sand-gravel/silt-clay material (Appendix 8) from the construction dock approaches. The dredge proposed for use during Stage Two of the East Arm project will be too big to operate in such shallow waters. Options include:

- bringing in a smaller cutter suction dredge;
- using a clam shell grab dredge;
- constructing the channel by excavator at low tide;
- constructing the channel by barge-mounted excavator.

Depending on the option selected, there may still be a requirement for a temporary reclamation area on Wickham Point. Phillips recognises the difficulties associated with the area proposed for use in the Draft EIS and, as a result, has investigated alternatives (Appendix 8). More suitable disposal areas have been identified adjacent to the base of both the loading jetty and the construction jetty (Appendix 8).

As for the turning basin, further detailed appraisal is required before the preferred option can be selected. Phillips therefore commits to undertaking further detailed evaluation of all dredging/excavation/disposal options, and will seek further environmental approval for the option selected.

IV.2.2.5 Pipeline construction

The main concerns associated with construction of the pipeline occur within Darwin Harbour and include impacts arising from the shoreline crossing, the possible disturbance of WWII shipwrecks, interference with Aboriginal sacred sites, disruption of phone and power cable services between Darwin and the Cox Peninsula communities, and disruption of public use of the Harbour, including marine traffic, during construction. Another concern associated with construction of the pipeline relates to the effect of trucking the armour rock from quarries to stockpiles near the harbour. Management undertakings to mitigate these impacts will include:

- **Shore crossing.** Construction of the pipeline shore crossing will cause a localised increase in water turbidity. Hydrodynamic modelling indicates that the Channel Island coral community is unlikely to be adversely affected by the water turbidity created by this activity.

  However, the final location of the pipeline crossing and the construction technique have not been selected and the characteristics of the sediments to be trenched have not yet been confirmed. Once these unknowns are resolved, the potential for adverse effect on the Channel Island coral community will be re-evaluated and a management plan developed if necessary to protect these corals. If necessary, such a plan may include the undertaking of excavation works only during the falling tide, to ensure suspended matter is carried away from the coral community.

- **Protection of historic sites.** The locations of WWII wrecks *Meigs* and *Mauna Loa* are accurately known. The position of the wrecks plus the *SS Ellengowan* will be clearly marked by buoys to avoid any possibility of damage during the laying of the pipeline;

  A survey will be undertaken prior to finalisation of the pipeline route to determine the locations of additional wrecks, if any, along the proposed route in the harbour. Any sites discovered during

this survey will be brought to the attention of trained professional archaeologists at the Northern Territory Museum for management advice.

- **Sacred site avoidance.** The Authority Certificate issued by AAPA (Appendix N of the Draft EIS) shows the areas of significance to Aboriginal people that must not be entered or disturbed. These areas are to the west of the preferred pipeline route and will not be impacted. Authority Certificate conditions will be respected and activities that may impact upon known or possible sites will be coordinated with the plant/Larakia Liaison Committee.

- **Telecommunications and power supply impacts.** Phillips will liaise with Telstra and Northern Territory Government authorities regarding the temporary interruption of communication and electricity services to Mandorah.

- **Public access and marine traffic restrictions.** Access to parts of Wickham Point, notably the site of the construction dock and the loading jetty will be closed to the general public during construction and operation of the plant. It is not expected that construction activities *per se*, including the arrival and unloading of ships will have any significant impact on harbour users, above the normal requirements for harbour users to obey harbour and maritime rules on boat use. Any unusual, planned temporary interruptions to the activities of recreational fishermen, mariners and other users of the harbour will be notified to the Darwin Port Authority and advertised in the local media.

- **Notifications to mariners.** The approximate location and time period of construction activities associated with pipelaying will be notified to mariners through the appropriate channels.

- **Naval waters and exercise areas.** Military authorities will be involved in decisions affecting the final pipeline route through Darwin Harbour, including Middle Arm, and the timing of pipelay operations in the vicinity of the offshore military exercise area.

- **Road traffic disturbance.** Once the source of rock armour is finalised, Phillips will liaise with the Northern Territory Department of Transport and Works to plan a route and timing of truck movements to the Port which will minimise disturbance to peak hour commuters.

IV.2.3 Operations Management

The Operations Management Plan will comprise the following four components:

- plant site management;
- workforce management;
- wastes management; and
- shiploading management.

Details on the objectives and tasks proposed for each of the above components follows.

IV.2.3.1 Plant Site Management

Once construction is completed, the environmental objectives for the plant site area will reduce to protecting the ecological value of the remaining stands of dense rainforest and of Wickham Point in general as a habitat for wildlife. To this end, management plans introduced during the construction phase to control weeds, feral animals and bushfires will be continued during the operations phase. These plans have already been detailed in the Construction Management Plan and are not repeated here.

There will also be an ongoing requirement for control of biting insects because the plant site is located amongst mangroves and tidal creeks and biting insects will be present throughout the life of the plant. The extent of the biting insect problem will be managed to reduce its impact on the operations workforce.

The Medical Entomology Branch of the Territory Health Service shall be consulted if a biting insect problem develops. Monitoring biting insect numbers and investigation of control measures will be carried out in consultation with government authorities. Education of the operational workforce on the need to wear appropriate clothing to reduce skin exposure and the use of personal repellents, will be the main means of reducing the severity of the problem. Staff facilities will be screened and air conditioned or be equipped with fans to discourage biting midges. At times of greatest nuisance, limited ground fogging with an approved insecticide at the minimum recommended application rate may be necessary; however, use of insecticides to control biting insects will be kept to a minimum.

Concerns have been expressed regarding the plant's location on the southern flight path approach to Darwin Airport's north/south runway. Discussions aimed at resolving these concerns are currently ongoing between Phillips and the Civil Aviation Safety Authority. A number of options are available for resolution of these concerns. Phillips will resolve this issue prior to proceeding with final design of the plant site.

IV.2.3.2 Workforce management

An induction programme will be developed and implemented as part of operational workforce training. The programme will cover all aspects of health, safety and environment, including all undertakings identified in this EIS and government regulations relating to the operation of the LNG plant. The programme will pay specific attention to educating workers on the cultural and natural heritage values of the Wickham Point site, and reasons for the application of environmental management practices.

Emergency Response Manuals will be developed for the plant, and the workforce will be trained in their implementation and regularly tested to maintain necessary skills.

IV.2.3.3 Waste management

Waste management and disposal proposals have been described in Section 5 and assessed in Section 7 of the Draft EIS. Wastes will be managed in accordance with Northern Territory Government regulations, including the soon-to-be enacted Waste Management and Pollution Control legislation. For certain wastes, there may be a requirement to monitor the quantity and contaminant concentrations disposed off site.

(1) Atmospheric emissions

The air dispersion modelling results presented earlier indicate that no unacceptable air quality impacts resulting from the development of the LNG plant are expected. On the basis of these results, it is considered that an ambient air quality monitoring programme for the project is not required.

The major emission sources should be further quantified during commissioning and subsequent operations by periodic emissions testing programmes where these are considered appropriate. Any such monitoring programme would be expected to focus on nitrogen dioxide, the major pollutant associated with the operation of the facility.

In line with current Government policy on greenhouse gas emissions, an ongoing audit of the major greenhouse gases emitted from the LNG plant will be required to quantify the emissions of greenhouse gases, compare these to historical emissions and consider areas where they can be reduced.

(2) Wastewater discharges

It is considered unlikely that the wastewater discharge proposed for the end of the loading facility will cause adverse environmental effects. However, the performance of the CPI oil/water separator and the sanitary treatment plant will be confirmed by regular monitoring of the concentration of contaminants within the effluent stream. These data will enable verification of the accuracy of the assessment of no adverse effect.

Discussions with officers from various Northern Territory Government departments have indicated that the wastewater can probably be used for irrigation of landscaping at the plant site. Phillips will therefore investigate the possibility of using treated wastewater for irrigation at the plant or discharge through the mangroves in lieu of discharge off the jetty. This decision will be based on wastewater quality and cost being acceptable, and agreement by the Northern Territory government.

(3) Solid and semi-liquid wastes

The solid and semi-liquid wastes which will be disposed of at approved facilities off site include:

- oily sludge from the CPI separator;
- inorganic sludge from the demineralisation plant*;
- biological sludge from the aerobic digester sewage treatment plant*;
- waste lubricating oils;
- spent oils from the hot oil system;
- mercury removal carbon beds;
- molecular sieve waste *;
- ceramic balls *;
- cellulose and trash *; and
- domestic garbage *.

The wastes marked with an asterisk are all considered non-hazardous. Under the new NT Legislation, the remaining items are considered hazardous.

The exact destination and means of transport for these wastes has not yet been determined. Phillips is aware that the Northern Territory Government has recently enacted new Waste Management and Pollution Control legislation and commits to complying with any associated regulations. Phillips also has its own inhouse waste management procedures which ensure that the waste is handled by approved contractors and is disposed in approved facilities according to applicable regulations. Part of Phillips' waste management procedures includes waste minimisation guidelines used during the design of the LNG plant. The operations workforce will also be encouraged to look for opportunities to implement procedures.

IV.2.3.4 Shiploading management

Impact assessment of these operations indicated that there was a potential for:

- accumulation of heavy metals and TBT in sediments in waters adjacent to the facility;
- accumulation of sediment adjacent to the groyne. The groyne was not expected to cause any shoreline instability adjacent to Wickham Point;
- minor disturbance to recreational fishermen as a result of shipping movements and restricted access to exclusion zones; and
- minor spillage of condensate at the loading jetty.

Of the above potential impacts, the accumulation of heavy metals and TBT is of potential concern and will require regular monitoring to determine if concentrations in sediments exceed levels known to be toxic to marine biota.

Phillips will investigate means to reduce the potential for metal and TBT accumulation in sediments. Such management actions may include:

- prohibiting the use of hull cleaning machines on vessels moored at the loading facility;
- ensuring that the corrosion protection system on the jetty is maintained at optimum performance levels.

A major spillage of condensate at the jetty has the potential to cause extensive adverse impacts on nearby intertidal biota. A condensate spill contingency plan will be produced to minimise the scale of adverse impacts in such an unlikely eventuality (refer Section 8.5.5 of the Draft EIS).

Phillips will also ensure that all vessels serving the LNG plant follow the IMO and AQIS guidelines for ballast water discharge at sea before entering ports of call. Such action will further reduce the potential for introduction of foreign marine organisms to Darwin Harbour.

Shipping movements will be coordinated through the Darwin Port Authority to minimise disturbance to commercial shipping. Phillips will also liaise with the Royal Australian Navy in Darwin regarding mooring in and passage through the harbour military reserve.

IV.3 MONITORING PROGRAMME

IV.3.1 Introduction

A detailed Environmental Monitoring Programme will be produced and implemented. The aim of the programme will be to validate the main impact predictions regarding the project effects which have the potential to have an adverse impact on the environment. The monitoring programme will also ensure that potential environmental effects are minimised and that the facility complies with any regulations governing particular activities.

The following activities have been identified through the assessment of environmental effects as requiring monitoring:

(A) Construction Phase

- occurrence of weeds and feral animals on the plant site and in adjacent vegetation;
- occurrence of potential breeding sites for biting insects;
- extent of dispersion of water turbidity during shore crossing construction and water turbidity effects on corals at Channel Island heritage site as a result of pipeline shore crossing construction;
- dredging effects on corals of north-east Wickham Point;
- waste disposal quantification and destination;
- effect of construction activities on mangrove and rainforest vegetation adjacent to the cleared area.

(B) Operation Phase

- Occurrence of weeds and feral animals on plant site and adjacent vegetation;
- waste discharges:
  - atmospheric emissions
    - stack testing to confirm predictions regarding ground level concentrations of $NO_{x,}$,
    - Greenhouse gas audits;
  - wastewater discharges - effluent quantity and quality;
  - solid waste disposal quantification and designation;
- the effect of plant site operations on mangroves adjacent to the plant site;
- accumulation of heavy metals and TBT in sediments and selected molluscs in the vicinity of the shiploading facility;
- introduced marine organisms in ballast water.

IV.3.2 Proposed Scope of Monitoring Activity

The general scope of monitoring proposed for each of the above programmes is outlined below.

IV.3.2.1 Weeds and feral animals

Prior to construction commencing, a quantitative baseline characterisation will be obtained of the abundance of weeds and feral animals on selected portions of Wickham Point which will not be disturbed by construction activity.

Further surveys of weed and feral animal abundance in undisturbed parts of Wickham Point will be conducted at the end of the wet season each year.

Periodic surveys will be conducted thereafter at a frequency appropriate to the rate at which weeds occur and feral animals are observed during the operation phase, and as agreed with officers of DPIF and the Parks and Wildlife Commission.

IV.3.2.2 Biting insect control

As part of the induction process to the construction site, all workers will be advised of the importance of minimising potential for breeding of biting insects, and encouraged to report observations of potential breeding sites to site management. Phillips agrees that further monitoring will be needed and has undertaken to conduct monitoring studies following construction of the access road to the site. The road will enable MEB personnel to identify the most suitable locations for traps and will provide access to the area. The monitoring programme will be developed in consultation with the

MEB. A regular monitoring programme will be devised in consultation with THS officers, and the site will be thoroughly inspected at completion of the construction phase to determine if remedial works are required to reduce potential for insect breeding.

IV.3.2.3 Pipeline shore crossing

The coral community at Channel Island is a listed heritage site which is located some 3 km from the proposed pipeline shore crossing. This community, plus others located at other sites in Darwin Harbour, has been monitored since 1994 as part of an investigation into the effects of developing the East Arm Port (Hanley & Caswell 1995b, 1997). Discussions with appropriate authorities (NT DLPE and Heritage Commission) will be held to design a monitoring programme aimed at protecting this heritage listed assemblage. It is anticipated that such a programme will require the proponent to establish a baseline description of selected population characteristics prior to construction proceeding.

On commencement of construction, the spread of turbid water will be monitored and if, as indicated by the hydrodynamic modelling, turbid plumes do not extend as far as Channel Island, then no further monitoring of corals is proposed. However, if water turbidity does extend to the Channel Island coral community, a reactive monitoring programme will be implemented and, if sedimentation of corals is detected, the shore crossing construction programme will be modified to operate only on falling tides.

IV.3.2.4 North-east Wickham Point corals

This coral community has also been monitored since 1994 as part of the investigation into the effects of developing the East Arm Port (Hanley & Caswell 1995b, 1997). The NT DLPE will be consulted prior to designing a monitoring programme to determine the effects of excavating the approach channel to the construction dock. It is anticipated that a baseline description of the coral community at this location will also be obtained prior to commencement of excavating the approach channel to the construction dock. This survey will be repeated at completion of excavation to determine if the dredging activity caused any changes in population character.

IV.3.2.5 Mangroves adjacent the Plant Site

Phillips will initiate a rapid assessment mangrove monitoring programme in the Wickham Point area to test the prediction that mangrove productivity adjacent to the plant perimeter will not be adversely affected in the long term by plant operations. This programme will be based on regular visual inspection of mangroves adjacent to the plant site and qualitative assessment of their condition.

IV.3.2.6 Waste disposal

Phillips will monitor the quantity and quality of wastes produced and removed for off site disposal during both construction and operation phases, and will also monitor contractor compliance with disposal procedures and final destination of waste to ensure that waste is disposed as required by government regulations.

The data could provide a baseline against which the success of waste minimisation strategies can be judged.

IV.3.2.7 Atmospheric emissions

The assessment of environmental effects considered that an ambient air monitoring programme for the plant site was not required. However, it will be necessary to confirm the emission estimates by measuring the major emission sources of NO_x during commissioning and normal operation.

An ongoing audit of Greenhouse gas emissions will be conducted in accordance with current Commonwealth Government policy.

IV.3.2.8 Wastewater discharge

Depending on the outcome of further investigations to be conducted during the design stage, the treated sewage component of the wastewater discharge may be used to irrigate landscaping around the plant site and, as a result, only process wastewater may be discharged into the harbour. The volume and contaminant concentrations of both proposed wastewater discharges will be measured during the operation phase to confirm compliance with proposed discharge quality criteria.

The anticipated rapid dilution and dispersal of the effluent which is eventually discharged to the harbour will be confirmed by conducting a series of in-field effluent dispersion surveys under neap and spring tide conditions. These surveys will utilise fluorometers to track known concentrations of dye, thereby enabling calculation of dilution rates for the effluent.

IV.3.2.9 Metal accumulation offshore

A baseline quantification of selected metals (including uranium, arsenic and radium), TBT and TPH concentrations will be obtained from sediments and selected biota in the vicinity of the shiploading facility and the construction dock prior to construction proceeding. Subsequent monitoring will be conducted at a frequency appropriate for the site and as agreed with officers of the DLPE.

IV.3.2.10 Introduced marine organisms

Phillips will contribute to the Darwin Port Authority's proposed monitoring programme for introduced marine organisms and, if considered necessary by DPA and NTDLPE, will undertake a risk assessment of its shipping operations.

IV.4 COMPLIANCE AUDIT AND REPORTING

Phillips will be responsible for the regular audit and review of the LNG facility's environment and safety management. This will include both on-site auditing and review of performance reports. Additional onsite inspections and investigations will be undertaken in the event of significant environmental incidents. Plant management will participate in the audits and inspections and investigations. Plant management will also be responsible for regular review of the environmental performance of the site and site personnel, and for the reporting on the implementation of commitments made in the EMP. In particular, there will be:

- reports to the Departments of Mines & Energy and Lands, Planning & Environment as required;
- a triennial review of the EMP.

In addition, Phillips propose to conduct the following inhouse audits.

IV.4.1 Site Internal Environmental Audit

The site internal environmental audit enables site management to assess the environmental management of activities at a site. Environmental activities include all aspects of operations that result in emissions, effluent or wastes. This audit does not cover *management systems*, which is the subject of the separate Environmental Management Systems Audit, rather it covers the day-to-day management of environmental issues on site.

The audit involves checking against legislative obligations, environmental commitments and company best practice, compliance of various environmental management strategies for:

- noise;
- water;
- raw materials management;
- atmospheric emissions;
- waste management;
- wastewater controls;
- issues specific to offshore operations; and
- miscellaneous environmental issues.

IV.4.2 Environmental Management Systems Audit

The environmental management system audit assesses the implementation and operational success of the Environmental Management System (EMS) at the site. This is achieved by assessing the objectives, organisational structure, responsibilities, procedures, processes and resources available at the site. The EMS Audit is a systems assessment, rather than an audit of environmental compliance, which is assessed through the Site Internal Environmental Audit.

IV.5 EMERGENCY RESPONSE MANUALS

Phillips will prepare a written emergency plan for the pipeline, plant and marine terminal to cover the conceivable emergency situations that could occur. This plan will not only address situations that occur within the operating facilities, it will also address those situations offsite that could impact these facilities. It will be Phillips' intent to liaise with the appropriate civil and port authorities in development of the overall facility emergency plan. This external liaison will facilitate the development and continual review of the plan and procedures, provide for joint participation in training and emergency exercises, and develop effective and rapid communications and response in a real emergency.

It is recognised that civil and port authorities already have their own plans in place for dealing with harbour and cyclonic emergencies and it will be Phillips' intent to liaise with authorities to ensure mutual compatibility between the plans. Phillips is aware of the inherently destructive nature of a storm surge and cyclonic type winds. Design work performed to date has taken these issues into consideration relative to plant evaluation and structural design. During the detailed design of the facilities, these issues will be revisited to ensure the final design has considered these forces. The emergency plan will address when and how the plant will be shut down to respond to an emergency of this type, personnel responsibility in this process, personnel evacuation in an emergency, and where personnel shall seek shelter in an emergency.

IV.5.1 Risk Assessment Study

A preliminary hazard and risk assessment of the LNG plant has been prepared by Bechtel. The full document is included as Appendix P to the Draft EIS, and the most important sections summarised here. Phillips will prepare a Detailed Hazard and Risk Assessment of the project once final design is closer to completion.

The approach adopted to achieve a high standard of safety and a low hazard potential for the LNG plant is:

- measures will be included through siting, design, manufacture, construction, commissioning, and operation, to prevent incidents and accidental releases of hazardous materials which might result in a threat to the safety of people or property and to mitigate their consequences if such situations do occur;

- safety, reinforced by training, will be an integral part of the LNG plant, product loading terminal and shipping operations, and systematic reviews, assessments, and audits will be undertaken to ensure that the intended safety levels are achieved and maintained;

- safe operating procedures, based on the 27 years of safe operation at the Phillips Kenai LNG plant, will be developed and implemented;

- emergency procedures will be established in conjunction with the appropriate authorities and emergency services.

This philosophy will ensure that all necessary safety features are identified and specified in design of the LNG plant and associated infrastructure, and that safety of the workforce and members of the public are protected in the extremely unlikely event of a major accident occurring.

IV.5.2 Hazards Identification

The LNG plant will process, handle and store large inventories of LNG, LPG and condensate. The potential hazards associated with uncontrolled releases of flammable hydrocarbons are readily apparent, the principal types being: vapour clouds and fires; thermal radiation or flame impingement from jet or pool fires; vapour cloud explosions (VCEs); and boiling liquid expanding vapour explosions (BLEVES). The possibilities of such accidents are well understood and the design of the plant and other facilities will emphasise minimisation of the probability of an accident happening and mitigating an accident if it occurs.

If an accident does occur, it will be in one of five areas: the LNG plant; product loading facility; LNG carrier; an oil spill; or in the pipeline to the plant. Separate emergency response plans will be developed for each contingency.

At this stage in the development of the LNG plant, detailed emergency plans and procedures have not been formulated. These will be developed in conjunction with the appropriate civil and maritime authorities during detailed engineering to ensure that all the appropriate operational procedures are in place, and the necessary facilities available, before commissioning of the plant.

IV.5.3 LNG Plant Accident Response

A written site emergency plan will be produced to cover conceivable accident situations. The plan will clearly describe the emergency organisation of personnel. The responsibility for deciding when to implement an emergency plan will rest with the site manager, and a key dedicated person (probably the shift supervisor or equivalent) will be designated to coordinate on-site actions.

The emergency plan will comprise a document outlining possible hazards and detailing how each is to be dealt with. Procedures will cover communications, chains of command, marshalling of resources, specific personnel duties, incident control, evacuation, and liaison with external organisations and emergency services. It is recognised that it will not be possible to cover every conceivable eventuality in the emergency plan, and that the plan should therefore be flexible and provide clear guidance on information to be communicated when a situation develops.

The emergency plan will be supported by written emergency response manuals, relevant sections of which will be available to, and required reading for, all site personnel needing to work in hazardous plant areas, especially those likely to be directly involved in emergency response. The manuals will set down the procedures needed to implement the relevant part(s) of the emergency plan, and will be designed to provide instructions and advice to personnel involved in the response to an emergency on the actions to be taken.

A fundamental prerequisite to the smooth operation of emergency planning is familiarity achieved by thorough training. The normal operational training of site personnel will cover the immediate actions to be taken on detection of an incident in any plant area. Such training will include the use of ‘live’ exercises to simulate real emergency situations as closely as possible. The written plan and procedures, and particularly the effectiveness of communications, will be reviewed and updated in the light of the findings from these exercises.

IV.5.4 LNG Carrier Accident Response

Planning for emergencies on LNG carriers will be based on an understanding of the types of accident which could occur and their possible consequences, together with an effective system of communication. Written procedures will be developed in liaison with the Darwin Port Authority.

Emergency procedures for the LNG carriers will cover two situations: cases where the ship is at or near the LNG berth, and cases where the ship is at sea in the Beagle Gulf or in the approaches to the Darwin Port harbour area.

A particularly important aspect of the first situation will be the relationship between the shift supervisor of the LNG plant and the ship's master. Clear definitions of responsibilities will be provided in the emergency procedures. Instances where a ship should be disconnected and moved away from the site (to protect the ship from a site incident or vice-versa) will be defined. Both the site and ship operators will be able to initiate the emergency shut-down of LNG transfer, and each will have the ability to activate this through the hard-linking of ship and shore ESD systems.

In the second case (an LNG carrier at sea), the emergency response should not involve the LNG plant directly. However, the movement of LNG carriers in Beagle Gulf is of concern, and the development of emergency procedures will form part of the overall preparation for the LNG plant operation. Emergency plans for ships in Beagle Gulf will take account of existing plans for the area and wider procedures for LNG carriers at sea. It is likely that existing contingency plans for oil tankers in Beagle Gulf will cover many aspects of LNG carrier emergency planning. However, the specialised nature of LNG ships and their cargoes means some adaptation of the plans may be needed. Key elements of the plan will be: speed and effectiveness of response in the context of possible accident consequences; adequacy of resources; assured communications and flow of information; and constant control of incident response.

If an incident were to occur on a ship away from the LNG plant site, immediate action would be required by the ship's crew. Each LNG ship will have on board written procedures containing, as a minimum, general guidance on action to be taken to limit damage following an incident such as grounding, collision or fire. Ships operating in Beagle Gulf will also carry instructions relating to communication with port authorities if an incident occurs.

As with the on-site plan, ship emergency procedures will be reinforced by training and exercises, and will be continually reviewed and updated in consultation with the Darwin Port Authority.

IV.5.5 Oil Spill Contingency Plan - Darwin Port OSCP

The Darwin Port Authority has legal jurisdiction for dealing with oil spills in Darwin Harbour, and has developed a detailed Oil Spill Contingency Plan for the following purposes:

- to assess the potential for an oil spill within Darwin Harbour and to identify sources of spill threat;
- to create an effective notification and reporting system in the event of a spill;
- to outline practical and prompt response arrangements to halt the spillage and restrict its area of impact; and
- to remove and dispose of the pollutant and polluted waste.

The Oil Spill Contingency Plan recognises three levels of severity of oil spills:

- Tier 1. Small, local spills less than 10 tonnes. Such incidents are usually associated with ship transfer or bunkering operations at a jetty, pier or mooring, and around waterside storage tanks.

- Tier 2. Medium spills, local or at some distance from operational centres, 10 to 100 tonnes. These incidents are typically associated with shipping incidents in ports or harbours, estuaries, or coastal harbours, but could also come from pipelines, tank failures or nearshore production and exploration operations.

- Tier 3. Large spills, greater than 1000 tonnes. This covers major incidents, normally involving oil tankers or other large vessels having large amounts of bunker oil.

The Darwin Port Authority Oil Spill Contingency Plan covers all areas of the port area, including the waters adjacent to the proposed LNG plant. As such, the plan has priority. A supplementary plan, specific to the LNG plant, will be developed in consultation with the Darwin Port Authority. This Plan will detail the organisational responsibilities, actions, reporting requirements and resources to ensure effective and timely management of an oil spill for operations in the Darwin Harbour area. The Plan will interface with the Emergency Response Plan.

IV.5.6 Pipeline Rupture Contingency Plan

Precautions taken to minimise the risk of any leakage of gas from the pipeline will be:

- pipeline design in accordance with all applicable national and international design codes and standards;

- design of pipeline stabilisation to minimise risks of damage from any anticipated storm and cyclonic activities associated with a 100 year return period;

- cathodic protection of the pipeline to mitigate against external corrosion;

- provision of an internal corrosion allowance in the pipe wall thickness;

- routing of the pipeline so as to minimise the risk of damage from shipping and fishing activity;

- protection of the pipeline by combinations of concrete coating, rock dumping or trenching in all areas of the selected route where damage risk cannot be mitigated by rerouting;

- periodic external and internal inspections to ensure integrity of the pipeline is maintained.

This approach is consistent with the best practices currently implemented worldwide regarding subsea pipeline systems in environmentally sensitive areas.

A Pipeline Rupture Contingency Plan will be developed to cover emergency handling procedures in the event of a rupture of the pipeline. As with the above plans, the emphasis will be on prevention of an incident. Detailed plans and staff training will be in place to effectively handle a rupture, should one occur. Procedures will be detailed for notification of the public and of the appropriate authorities, as required by Northern Territory and Commonwealth Government laws.

IV.5.7 Emergency Response Management

Emergency response management will be provided by a small team of senior managers (the Control Committee) who in turn will direct all response activities through the Emergency Response Unit, Plant Security, Communications, Public Relations, Safety and Environmental Affairs, and Material Procurement Departments. Each of these departments will have specific responsibilities to perform in the event of an emergency.

IV.6 PROJECT DECOMMISSIONING

Once all resources are exhausted and no feed is available for the LNG plant, plant equipment and piping will be purged of hydrocarbons. Plant and office equipment will be sold where possible unless the facility is sold as is. Equipment that cannot be sold will be disassembled and sold as scrap or disposed of in accordance with current regulatory guidelines.

The plant site will be rehabilitated as deemed appropriate in consultation with the Northern Territory Government.

At the end of the project life, the pipeline will be purged of hydrocarbons internally, flooded with seawater and left on the seabed. It is anticipated that, after the anodes of the cathodic protection system erode, the pipeline will progressively deteriorate.

V. SUMMARY OF COMMITMENTS

V.1 INTRODUCTION

This section presents a summary of environmental management commitments made by Phillips.

V.2 ENVIRONMENTAL MANAGEMENT PLAN

A detailed Environmental Management Plan (EMP) will be developed for the project, following the completion and finalisation of project design. The overall objectives of the EMP will be to establish management and monitoring plans which ensure that actual and potential impacts associated with the construction, operation and decommissioning phases of the pipeline and LNG plant are minimised, and that compliance with all relevant environmental regulations is achieved.

The EMP will identify the timing and scope of individual components of the environmental management plan, and serves as a compliance document - recording the progress of management commitments and their conformity with requirements set by authorities and expectations of the public.

The preliminary EMP will comprise both a Construction Management Plan and an Operations Management Plan. A summary table of commitments follows, in which the proposed environmental management commitments pertaining to each of the proposed construction and operational activities are listed. The commitments are cross-referenced to the relevant section of the supplement to the Draft EIS, where further details are given.

V.3 ENVIRONMENTAL MONITORING PROGRAMME

A detailed Environmental Monitoring Programme will be produced and implemented. The aim of the programme will be to validate the main impact predictions regarding the project effects which have the potential to have an adverse impact on the environment. The monitoring programme will include the following:

- abundances of weeds and feral animals in undisturbed areas of Wickham Point;
- abundances of biting insects within the plant site;
- effects of dredging and excavation associated with construction of the loading facility turning basin, the pipeline shore crossing and the construction dock approach channel on the coral communities of Channel Island and North-east Wickham Point;
- productivity of mangroves adjacent 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, tributyltin and total petroleum hydrocarbons in marine sediments and selected marine biota in the vicinity of the ship-loading facility and construction dock; and

- contribution to the Darwin Port Authority's proposed monitoring programme for introduced marine organisms.

V.4 COMPLIANCE AUDIT AND REPORTING

Phillips will be responsible for the regular audit and review of the LNG facility's environmental and safety management programmes.

V.5 RISK ASSESSMENT STUDY

During the detailed design phase, Phillips will produce the following documents to address hazard and risk issues:

- Hazard and Operability Study (HAZOP);
- Quantitative Risk Assessment (QRA);
- Safety Report;
- Safety Case;
- Construction Safety and Health Plan;
- Construction Environmental Control Plan; and
- Emergency Response Plans.

V.6 EMERGENCY RESPONSE MANUALS

Phillips will prepare emergency plans for the pipeline, plant and marine terminal to cover the conceivable emergency situations that could occur. These plans will include:

- Plant Accident Response Plans (including a cyclone response plan);
- LNG Carrier Accident Response Plans;
- an Oil Spill Contingency Plan (to operate in conjunction with the Darwin Port Authority plan); and
- a Pipeline Rupture Contingency Plan.

Proposed Activity	Proposed Environmental Management Commitment	Supplement Section
Detailed Design Phase		
Pipeline alignment	Final alignment of the pipeline will be determined following consultation with all relevant government and non-government organisations.	Section III.1: 4.4
	Detailed seabed evaluations along the alignment will ensure the pipeline is routed to avoid environmentally sensitive areas, significant conservation and recreation areas, protected heritage sites, Aboriginal sacred sites, navigation lanes and mooring areas.	Section III.1: 4.4
	Requirements for pre-lay preparation works (e.g. rock filling, ploughing) will be minimised through route optimisation studies.	Section III.1: 5.3.2.1
Pipeline shore crossing, turning basin and construction dock approach channel	Detailed evaluation of all dredging, excavation and spoil disposal options will be undertaken, with further environmental approval sought if the preferred option is not practical. Phillips' preference is to avoid the need for a temporary reclamation area and will endeavour to coordinate dredging works with the Department of Transport and Works to enable the relocation of suitable fill material to East Arm Port.	Section IV.2.2.4
Plant site	The gas flare system will be designed to eliminate risk to routine air traffic. Approval for the preferred flare design will be sought from the appropriate Commonwealth and NT Government authorities.	Section III.1: 5.4.3.3
	An inventory of atmospheric emissions and project energy efficiency will be prepared. Mechanisms for reducing greenhouse gas emissions will be discussed with the Commonwealth Government's Greenhouse Challenge Office.	Section III.1: 7.4.2.3
	Alternatives to the direct discharge of wastewater into the harbour will be considered, including landscape irrigation and filtration of wastewater through mangroves. Approval for the preferred disposal option will be sought from the NT Government.	Section I.8 (iii)
	Design measures will be implemented where practical to minimise the potential visual impact of the development.	Section III.1: 7.3.2.5
Access Road	Matters relating to the planning, alignment and construction oversight of the access road are the responsibility of the NT Government.	Section III.1: 4.5

Proposed Activity	Proposed Environmental Management Commitment	Supplement Section
Construction Phase		
Pipeline alignment	The proposed pipeline alignment within Darwin Harbour will be surveyed in detail. Submerged material which may be of archaeological significance will be reported to the Maritime Heritage Unit of the MAGNT for management advice.	Section III.1: 4.4, 7.3.3.2, 8.2.2.5 Section IV.2.2.5
Pipelay operations	Submerged material of heritage significance will be buoyed to prevent disturbance during pipelay operations.	Section III.1: 8.2.2.5 Section IV.2.2.5
	Areas of significance to Aboriginal people will not be entered or disturbed without consultation.	Section IV.2.2.5
	Amateur and professional fishing associations will be consulted to discuss the proposed construction schedule.	Section III.1: 7.5.1.5
	Notifications to mariners will list the approximate locations and timing of pipelay operations.	Section IV.2.2.5
	Any unusual, planned temporary interruptions to the activities of recreational fishermen, mariners and other users of the harbour will be notified to the Darwin Port Authority and advertised in the local media.	Section IV.2.2.5
	The timing of pipelay operations in the vicinity of the offshore military exercise area will be determined in consultation with military authorities.	Section IV.2.2.5
	Phillips will liaise with Telstra and NT Government authorities regarding the temporary interruption of communication and electricity services to Mandorah.	Section IV.2.2.5
	Phillips will liaise with the Department of Transport and Works to plan the routing and timing of truck movements (associated with transport of rock armour to the port) so as to minimise disturbance to commuter traffic.	Section IV.2.2.5
Hydrotest of pipeline	Hydrotest water will be discharged offshore and will meet ZOCA water quality requirements.	Section III.1: 5.3.2.4
Pipeline shore crossing, turning basin and construction dock approach channel	Appropriate construction methods and timing will be adopted to minimise the potential for dispersion of turbid water plumes towards the Channel Island coral community.	Section IV.2.2.5
Ship-loading facilities and construction dock	No commitments during construction.	
Plant site construction	Phillips undertakes to manage the area within the boundaries of the LNG plant in an environmentally responsible manner and will cooperate with the NT Government in management programmes that may be developed for the central island of Middle Arm peninsula, through which the access road will pass.	Section III.1: 8.2.2.1 (vii)
	Introduction of weeds and plant pathogens will be prevented through vehicle washdown and inspection procedures, to be developed in conjunction with the Department of Primary industries and Fisheries.	Section IV.2.2.1 (1)

Proposed Activity	Proposed Environmental Management Commitment	Supplement Section
Plant site construction (cont'd)	A feral animal control programme will be developed on the basis of advice from the Parks and Wildlife Commission.	Section IV.2.2.1 (2)
	Potential soil erosion and siltation of water resources will be minimised by earthworks and by the design of drains and culverts.	Section IV.2.2.1 (3)
	The creation of acid soil conditions will be mitigated by minimising disturbance of mangrove sediments and by disposing of any marine sediments with the potential for acid generation in a government-approved location. If necessary, an Acid Sulphate Soil Management Plan will be developed in consultation with DLPE soil conservation officers.	Section IV.2.2.1 (4)
	Construction practices will be adopted which avoid the creation of new breeding areas for biting insects, and identified breeding sites will be removed.	Section IV.2.2.1 (5)
	Phillips will establish a liaison committee, which will include indigenous interests, to assist in the management and protection of any archaeological sites which may be discovered on Wickham Point.	Section III.1: 7.3.2.1
	An archaeological sites register will be established in consultation with the Heritage Unit of DLPE and will be updated if any new artefacts or historic sites are discovered.	Section IV.2.2.1 (6)
	If any sites of Aboriginal significance are discovered, the areas will be protected and the AAPA will be consulted.	Section IV.2.2.1 (6)
	Areas of significant vegetation (rainforest and mangroves) to be retained will be marked by temporary fencing, with access prohibited. Fire fighting equipment will be available.	Section IV.2.2.1 (7)
	Fauna habitat surrounding the plant site will be protected by fencing, with access prohibited.	Section IV.2.2.1 (7)
	Free movement of fauna will be maintained through retention of vegetation corridors to the south and west of the plant, and through the provision of culverts beneath the landward end of the ship-loading facility.	Section III.1: 7.3.2.5
	Construction activities will comply with noise abatement requirements and, where possible, will be undertaken during daylight hours. Blasting will only occur during daylight hours.	Section IV.2.2.1 (8)
	The potential for dust generation will be minimised by shaping of stockpiles, spraying of cleared areas with water and control of vehicle speeds.	Section IV.2.2.1 (9)
	Disposal of construction waste materials will be in accordance with NT Government requirements.	Section IV.2.2.3
	An induction programme will be implemented to educate appropriate workers and contractors about the ecological, archaeological and anthropological values of Wickham Point, and about the need to protect these values.	Section IV.2.2.2

Proposed Activity	Proposed Environmental Management Commitment	Supplement Section
Operational Phase		
Pipeline	Internal inspections of the pipeline will be performed at start-up and periodically thereafter. Inspections of the external condition of the pipeline will be routinely undertaken.	Section III.2.2: 2.6
Plant	Stack emissions will meet ambient air quality guidelines.	Section III.1: 7.4.2
	Improvements in project energy efficiency will be sought throughout the operational life of the plant.	Section III.1: 7.4.2.3
	Sewage will undergo primary and secondary treatment. An ICPMS scan for trace elements in wastewater will be conducted.	Section III.1: 7.4.4, 8.2.2.3
	All potentially contaminated stormwater leaving the process areas of the plant site will be routed through a CPI separator to ensure removal of any oil.	Section III.1: 7.4.5
	An induction programme for the operational workforce will cover all aspects of health, safety and the environment. It will educate workers on the cultural and natural heritage values of the plant site and on the reasons for the application of environmental management practices.	Section IV.2.3.2
	Emergency Response Manuals will be developed for the plant. The workforce will be trained in their implementation and regularly tested to maintain necessary skills.	Section IV.2.3.2
Shipping	Vessels serving the LNG plant will follow IMO and AQIS guidelines for ballast water discharge at sea, prior to entering Darwin Harbour. This will minimise the potential for introduction of foreign marine organisms.	Section IV.2.3.4
	Shipping movements will be coordinated through the Darwin Port Authority. Vessels will be escorted by tugs in the vicinity of the loading facility and will be under the control of a pilot within harbour waters, to ensure compliance with all procedures including maintenance of separation distances from other vessels.	Section III.1: 6.4.2.1 Section IV.2.3.4
Project Decommissioning	At the end of the project life, the plant and pipeline will be decommissioned in accordance with standard practice applicable at the time.	Section IV.6

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This document was produced by Ian LeProvost and Jill Regazzo of LeProvost Dames & Moore, Perth, Western Australia. Responses to the submissions have been provided by:

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- Ian LeProvost, Fred Wells and Ian Baxter of LeProvost Dames & Moore, Perth.
- Peter Wright of Dames & Moore, Canberra.
- Stan Bellgard, Keith Martin and Denis Ford of Dames & Moore, Darwin.
- Brian Bell of Dames & Moore, Perth.
- Warren Murgatroyd undertook further consultation with the Larakia people and produced Appendix 5.
- Bechtel provided further engineering description and produced the revised 3 MTPA plant site plan and the potential site plan for a 9 MTPA plant.

VII.2 CONSULTATION

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