



GORGON
AUSTRALIAN GAS

ENVIRONMENTAL, SOCIAL AND ECONOMIC REVIEW of
THE GORGON GAS DEVELOPMENT
on BARROW ISLAND.

FEBRUARY 2003



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FOREWORD



On behalf of the Gorgon Venture, I am pleased to present this Environmental, Social and Economic Review (ESE Review) to assist the Western Australian Government's consideration of the restricted use of Barrow Island for the proposed Gorgon gas development.

Central to the commercial viability of the development of the Gorgon gas field is the restricted use of Barrow Island: an internationally significant nature reserve and the site of Australia's largest onshore operating oilfield. The Gorgon Venture recognises the importance of the conservation values of Barrow Island to the community and has only selected this location after an exhaustive study showed there are no economically viable and environmentally acceptable alternatives.

The gas fields discovered in the Gorgon area represent Australia's largest undeveloped gas resource. As custodian of this resource, the Gorgon Venture accepts responsibility for developing this important resource in a sustainable manner. A successful development will deliver substantial economic and social benefits to current and future generations of Australians, while also protecting the environmental values of the region and delivering net conservation benefits.

In addition, the development of the Gorgon gas field will unlock the vast Greater Gorgon area reserves, which currently represent over 40 trillion cubic feet of gas, equal to some 25 per cent of Australia's total known gas resources.

ChevronTexaco, operator of the Gorgon gas field, has been involved in existing operations on Barrow Island for over 40 years. The management of these operations is widely recognised as a showcase for the coexistence of an oilfield operation and the protection and maintenance of conservation values.

ChevronTexaco's successful environmental performance on Barrow Island gives us the confidence that gas from the Gorgon field can be developed on the island in a way that continues to protect the conservation values while delivering enormous economic, social and net conservation benefits to Western Australia and Australia.

I invite you to read this ESE Review and welcome your comments.

A handwritten signature in blue ink, consisting of several fluid, connected loops and strokes, representing the name Rhonda Zygoeki.

Rhonda Zygoeki

Managing Director

ChevronTexaco Australia Pty Ltd

INVITATION TO COMMENT

The Gorgon Joint Venture Participants - ChevronTexaco, Shell and ExxonMobil (the Gorgon Venture) – are seeking in-principle approval for the restricted use of Barrow Island to develop the Gorgon gas fields. The Gorgon gas development proposal includes establishing a gas processing facility within a limited area of Barrow Island. Prior to deciding whether to grant in-principle approval, the Government of Western Australia requires detailed information on the environmental, social, economic and strategic aspects of the proposed development.

At the request of the Government, the Western Australian Environmental Protection Authority (EPA) will provide advice on environmental matters. The Department of Mineral and Petroleum Resources (MPR) will provide advice on social, economic and strategic aspects of the proposed development. This will enable an integrated assessment of the proposal to be prepared for Government. The Conservation Commission of Western Australia, as the Authority holding the vesting of the Barrow Island Nature Reserve, will also provide advice to Government.

This Environmental, Social and Economic Review (ESE Review) was prepared by ChevronTexaco on behalf of the Gorgon Venture to provide the EPA and MPR with a high-level evaluation of the key issues associated with the proposed Gorgon gas development. These issues were identified through an extensive stakeholder consultation process and provision of guidelines by the MPR.

Prior to consideration by the EPA and MPR, the ESE Review is available for public comment as detailed below.

Availability of the ESE Review for Public Comment

This ESE Review is available for public comment from 10 February 2003 until 24 March 2003. Copies of the ESE Review can be obtained from ChevronTexaco by telephoning the Gorgon Health, Environmental and Safety Administration Assistant on 08 9216 4000 or emailing your request to gorgon.info@chevrontexaco.com. The document can also be viewed on the Gorgon Australian Gas website (www.gorgon.com.au).

The document is also available for viewing at the following locations:

Department of Environmental Protection Library Level 8, Westralia Square Building 141 St Georges Terrace Perth WA	Ashburton Shire Council Onslow Public Library Second Avenue Onslow WA
Department of Mineral and Petroleum Resources 1st Floor, 100 Plain Street East Perth WA	Karratha Community Library Millstream Road Karratha WA
Research & Information Centre Department of Mineral & Petroleum Resources 170 St Georges Terrace Perth WA	Battye Library Alexander Library Building 25 Francis Street Perth WA
Environment Australia Library John Gorton Building King Edward Terrace Parkes ACT	

Submission Process

Individuals and organisations are invited to submit comments on this ESE Review. A submission may comment on, provide information, and/or express opinions about the issues discussed in the ESE Review. It may also raise issues that you consider to have been overlooked in the ESE Review and/or suggest improvements to the conceptual development.

Reasons for conclusions stated in the submission should be stated clearly and supported by relevant data. The source of your information should also be included where applicable. Comments from the public will assist Government in making its decision.

The closing date for public submissions on this ESE Review is **24 March 2003**.

Submissions should be addressed to:

Mr Doug Betts
Department of Environmental Protection
Level 9, Westralia Square Building
141 St Georges Terrace
Perth WA 6000

Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*. They may also be quoted in full, or in part, in the EPA and MPR Bulletins and the Standing Interagency Committee of Chief Executive Officers' ESE appraisal package.

Submission Checklist

Comments should be in writing and:

- list points so that the issues raised are clear – where possible
- refer each point to the appropriate chapter and section in the ESE Review (e.g., Chapter 4, Section 4.2)
- keep discussion of different sections of the ESE Review distinct and separate
- include relevant, factual and supportive information with details of the source

Also, remember to:

- identify the development (i.e., the Gorgon gas development)
- provide your name, address and date of submission
- identify any special interest you have in the development (where relevant)
- indicate whether your submission is to be kept confidential

Further Information

Further information regarding the Gorgon gas development proposal can be obtained from the Gorgon Australian Gas website (www.gorgon.com.au), or by contacting Mr Peter Coghlan, Government and Public Affairs Manager, Gorgon Gas Development on 08 9216 4000.



ENVIRONMENTAL, SOCIAL AND ECONOMIC REVIEW EXPERT PANEL STATEMENT

Overview Comment

Since the discovery of the Gorgon gas reserves, the Gorgon participants have conducted extensive examinations of options for its commercial development and concluded that the viability of the venture depends on the restricted use of Barrow Island. Barrow Island is an A Class Nature Reserve. There has been a producing oil field on the island since the mid 1960s managed by ChevronTexaco or its predecessors with no apparent loss of nature conservation values.

In this context, the Expert Panel notes that the document contains commitments to:

- **Incorporation of sustainability principles** and criteria into all aspects of the project.
- **Protection of Environmental and Conservation Values** by development of a conservation agreement with CALM for the management of the Island, development of a single management system for the Island, limiting clearing to a maximum of 300 hectares, an enhanced rehabilitation program, establishing a foundation to provide net conservation benefits, enhancing the effective terrestrial quarantine system, developing a best practice marine quarantine system, and an improved waste management system; and minimising greenhouse emissions by energy efficiency, CO₂ re-injection, and minimisation of plant emissions.
- **Providing social benefits** by a best practice occupational health and safety system, a commitment to addressing fly-in fly-out social issues, a positive contribution to the West Australian community welfare and providing a catalytic role in community capacity building in the Pilbara.
- **Providing positive economic benefits** to Australia, Western Australia and the Pilbara.
- **Open and transparent processes** through annual reporting on all aspects of the project.

Noting these commitments by the Proponents, the Expert Panel is of the opinion that:

- the project is worthy of consideration by government; and
- the ESE Review addresses all issues critical to the Western Australian Government making an informed decision on whether to grant in-principle approval for the restricted use of Barrow Island.

Response to the Individual Terms of Reference:

In respect to the Terms of Reference for the Expert Panel, the Panel is of the opinion that:

- the ESE Review has been prepared in accordance with the ESE Review Scoping Document;
- all relevant issues have been addressed in an appropriate manner and to an adequate level of detail. Should the Government grant in principle restricted use of Barrow Island, the Panel notes that a detailed Environment Impact Assessment and other approvals processes must be carried out to provide additional levels of detailed information before the project could proceed; and
- the findings and conclusions of the Review are valid and justified and adequately describe the nature and impact of the proposal;

thus providing the information upon which the Government may make an in principle decision for the restricted use of Barrow Island.



The Hon Hendy Cowan



Dr Des Kelly



Dr Brian Robinson



Dr Denis Saunders



SUMMARY

The vast reservoirs of untapped natural gas found in the Greater Gorgon area off Western Australia's Pilbara coast contain in excess of 40 Tcf of gas, representing some 25 per cent of Australia's total known gas resources. Developing this world-class resource is a matter of national importance as it would secure Australia's position as a leading gas producer and provide a huge new source of wealth for both Australia and Western Australia.

Over the past 20 years, the Gorgon Joint Venture Participants have spent more than \$800 million on exploration, development and marketing to prepare the Gorgon area for ultimate development. During this time, a number of development options and potential gas processing locations have been evaluated. In the late 1990s, customers were sought based on a processing facility located on the Burrup Peninsula. However, the high cost of transporting gas to this mainland location made the project internationally uncompetitive. As a result of continued efforts to improve competitiveness, Barrow Island – both an internationally important nature reserve and Australia's largest operating onshore oilfield – has emerged as the development location that would enable gas from the Gorgon gas fields to be competitive in today's market.

The decision to seek the restricted use of Barrow Island for the Gorgon gas development has not been an easy one for the Gorgon Venture. It has been made only after exhausting all other development alternatives. The island has been a Class A Nature Reserve since 1910 and is one of the most important wildlife refuges in Australia. It is home to a rich suite of wildlife, some of which are listed as threatened. Preserving these conservation values are a critical aspect of this development proposal.

The key to unlocking the Greater Gorgon reserves is the development of the Gorgon field – one of the largest single gas fields ever discovered in Australia. Establishment of gas processing infrastructure on Barrow Island would provide a catalyst for the future development of other Greater Gorgon area fields. Gas would be processed at that facility and transported through a gas pipeline to shore, enabling large new competitive supplies of gas to be delivered to the mainland.

Although the development of Gorgon gas would bring significant benefits, the Gorgon gas field presents some unique challenges. With little associated liquid hydrocarbons, development costs must be kept to a minimum to maintain commercial viability. In addition, Gorgon gas contains a relatively high content of carbon dioxide (CO₂) which results in substantial treatment cost and relatively large potential greenhouse gas emissions.

Minimising the distance between the gas field and the onshore processing facility is critical to making the Gorgon gas development internationally competitive. Barrow Island is the nearest landfall to the Gorgon gas field and lies directly between the field and the mainland. Its use would minimise pipeline costs and eliminate the need for expensive offshore platforms. Siting a gas processing facility on Barrow Island is therefore central to commercial viability.

Significantly, Barrow Island would also provide a unique opportunity to re-inject reservoir CO₂ into saline reservoirs deep beneath the island. This, combined with current best practice in plant design, would make the development one of the most greenhouse gas efficient projects of its type in the world, and would assist Australia address international concerns regarding greenhouse gas emissions.

ChevronTexaco (formerly WAPET), the operator of both the oilfield and the proposed Gorgon gas development, is proud of its environmental reputation and performance on Barrow Island. The management of the island oilfield is widely recognised as an industry benchmark for the coexistence of petroleum development and biodiversity protection. These achievements have been realised over a period of 40 years, while producing 300 million barrels of oil, and give the Gorgon Venture confidence to seek restricted use of the island for the Gorgon gas development under the continued stewardship of ChevronTexaco.

The use of Barrow Island for the Gorgon gas development would represent a strategic long term transition from the production of oil to clean natural gas on the island. The oilfield - which has provided revenue to the State and Commonwealth of



SUMMARY

close to \$1 billion at present day value - has declining production and the current life expectancy is 15-20 years. As oilfield operations are decommissioned, the disturbance, which is dispersed over the southern part of the island, will be progressively rehabilitated. Total land clearance for the current oilfield operations and Gorgon gas processing, for which an area of no more than 300 hectares is being sought, would represent less than five per cent of the island.

As operator of both the oil and gas ventures, ChevronTexaco would continue to hold overall management responsibility for operational activities on the island and for operating in a manner that protects the conservation values of Barrow Island.

For the past 40 years, the oilfield operation has underpinned conservation best practice in managing quarantine and the protection of the island from unauthorised visits. Without this environmental stewardship of Barrow Island, Western Australia would have needed to contribute millions of dollars to provide the same level of protection to the island, or risk loss of conservation value.

The development on Barrow Island would not impair the conservation values of the island, nor would it alter its Class A Nature Reserve status. The development would be deliberately sited to avoid areas of particular conservation significance. Use of Barrow Island for gas processing would ensure continued stewardship and funding of the protection of the island's conservation values for decades to come. In addition, net conservation benefits would flow from the establishment of a Gorgon Environment Foundation. The Foundation would apply the knowledge and expertise gained from the conservation management of Barrow Island to the support of substantial projects that reflect the values of the island.

The Gorgon development would build on Australia's current standing as a secure and reliable source of both LNG and gas for industrial use by providing an additional strategic gas supply hub to the State. It would also provide another major competitive gas supply to Western Australia, encouraging the establishment of additional downstream processing in regional areas.

Between now and the mid-2020s, the Gorgon gas development would contribute about \$11 billion in investment expenditure at today's prices. Independent economic modelling indicates that \$17 billion in taxes and royalties would be provided over the life of the development, which would generate extra export income of \$2.5 billion annually. The development would stimulate 6000 jobs nationally, of which 1700 would be in the Western Australian workforce. It is estimated that more than 10 per cent of the construction and operational workforce could be sourced from the Pilbara region. This workforce would create flow-on economic benefits through spending in the region.

The Gorgon gas development would provide the impetus for the expansion of existing services and industries and attract a number of new ones. It would help underpin the development of new technologies and skills, for example in CO₂ sequestration and sub-sea technology, thereby creating regional capacity for future growth.

Western Australia's development has been underpinned by the resources sector for more than 100 years. During the past decade, this sector has been responsible for Western Australia's economic and employment growth being ahead of the rest of Australia. The Gorgon gas development would help to ensure that Western Australia maintains the high rate of economic growth and social benefits, such as low unemployment, that flow from a vigorous economy.

If in-principle approval for the restricted use of Barrow Island is granted, the Gorgon Venture is committed to undertaking all phases of the development in a safe, environmentally responsible and sustainable manner. As part of this commitment, the Gorgon Venture would work with all stakeholders to secure the success of the development. The Gorgon Venture is confident the development would provide substantial net economic, social and conservation benefits to both Western Australia and Australia.



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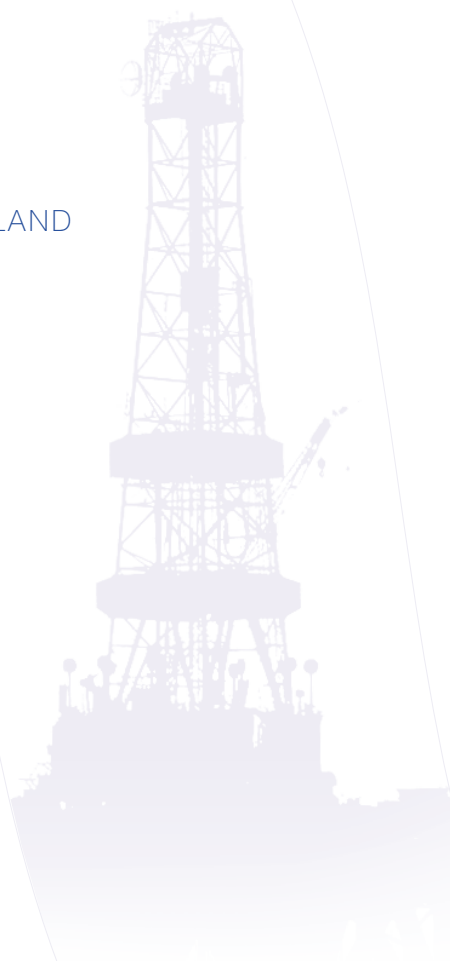


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INTRODUCTION

INTRODUCTION

The Gorgon area gas fields, situated approximately 130 km off the north-west coast of Western Australia, are amongst the largest natural gas fields ever discovered in Australia. ChevronTexaco is the operator of the Gorgon area gas fields and proposes to develop these fields with its joint venture partners, Shell and ExxonMobil (the Gorgon Venture).

Central to the commercial viability of the proposed development is the establishment of a gas processing facility on Barrow Island, which lies directly between the gas fields and the Australian mainland. Barrow Island has sustained one of Australia's most important onshore oilfields since 1967. The island is also a Class A Nature Reserve of international importance with unique conservation values.

This chapter introduces the Gorgon resource base, the Gorgon Venture and the process for seeking restricted use of Barrow Island for a gas processing facility.

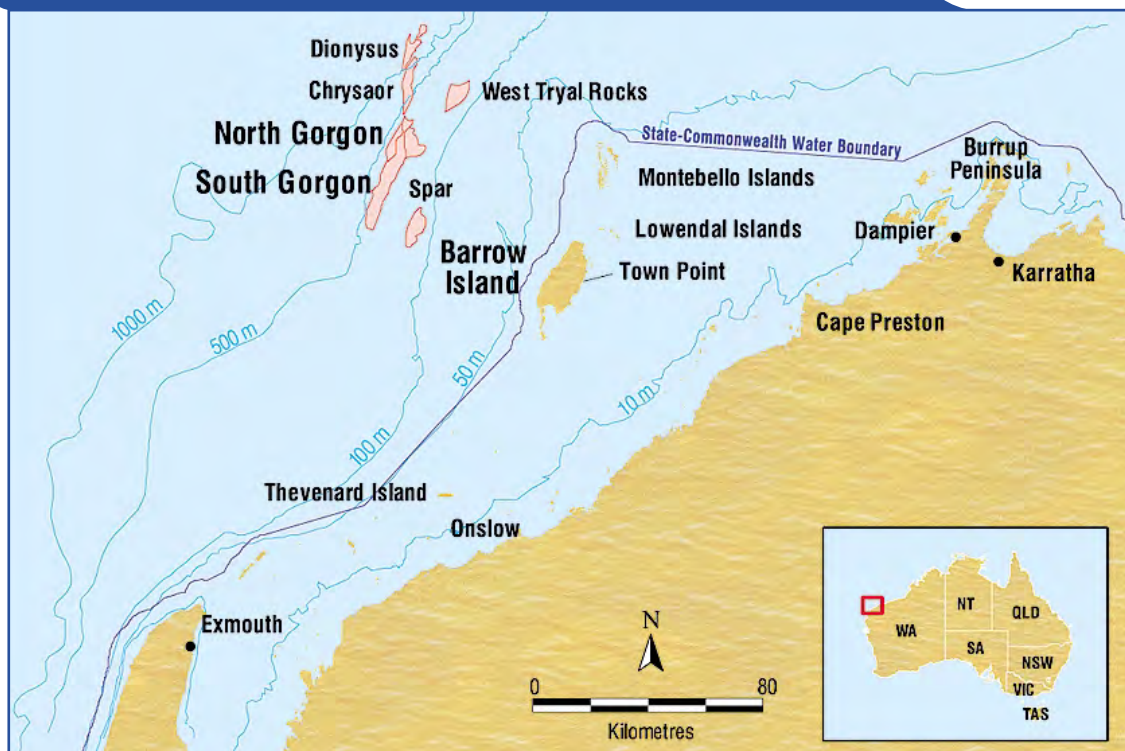
1.1 Background

The Gorgon area gas fields are situated approximately 130 km off the north-west coast of Western Australia (see figure 1-1).

For many years the Gorgon Venture has pursued a range of development and marketing options in order to secure a significant development. This history has led the Gorgon Venture to the preliminary

FIGURE 1-1

The Location of the Gorgon Gas Development



conclusion that a gas processing facility sited on Barrow Island could be the key to the commercial viability of the development.

In 2001, the Gorgon Venture approached the Western Australian Government regarding the possibility of locating a gas processing facility on Barrow Island. In a letter dated 20 November 2001, the Minister for State Development stated (Appendix 1):

"Against this background and without any guarantee of outcome, the Government is prepared to give consideration, after the relevant environmental, social, economic and strategic ramifications have been examined and the results made available, to the restricted use of Barrow in relation to the initial development of the Gorgon project, provided that there are net conservation benefits associated with the proposed development."

It was agreed that this information would be presented in the format of an Environmental, Social and Economic Review (ESE Review) and would be made available for public comment.

Current market opportunities identified by the Gorgon Venture indicate that the foundation development for Gorgon gas would most likely be a Liquefied Natural Gas (LNG) plant. However, the Gorgon Venture recognises that different gas processing opportunities could emerge, such as gas-to-liquids, dependent on market forces. The Gorgon gas

development would be contained within a proposed 300 ha limit.

For the purposes of the ESE assessment, LNG has been modelled as a reference case in this document for the type of development proposed on the island. Specific project details would be included in the normal environmental approvals process and regulatory and licence applications that would follow if the government gives in-principle approval to restricted use of Barrow Island.

1.2 Resource Base

The Greater Gorgon area contains an estimated gas resource in excess of 40 trillion cubic feet (Tcf), and is made up of two groupings of fields: the Gorgon area gas fields in the shallower water; and the deeper water fields which include the Io/Jansz fields located further offshore.

The Gorgon area contains certified gas reserves of 12.9 Tcf, and includes the Gorgon field, West Tryal Rocks, Spar, Chrysaor and Dionysus fields.

The Gorgon gas field is the largest field in this group, and one of the largest ever discovered in Australia.

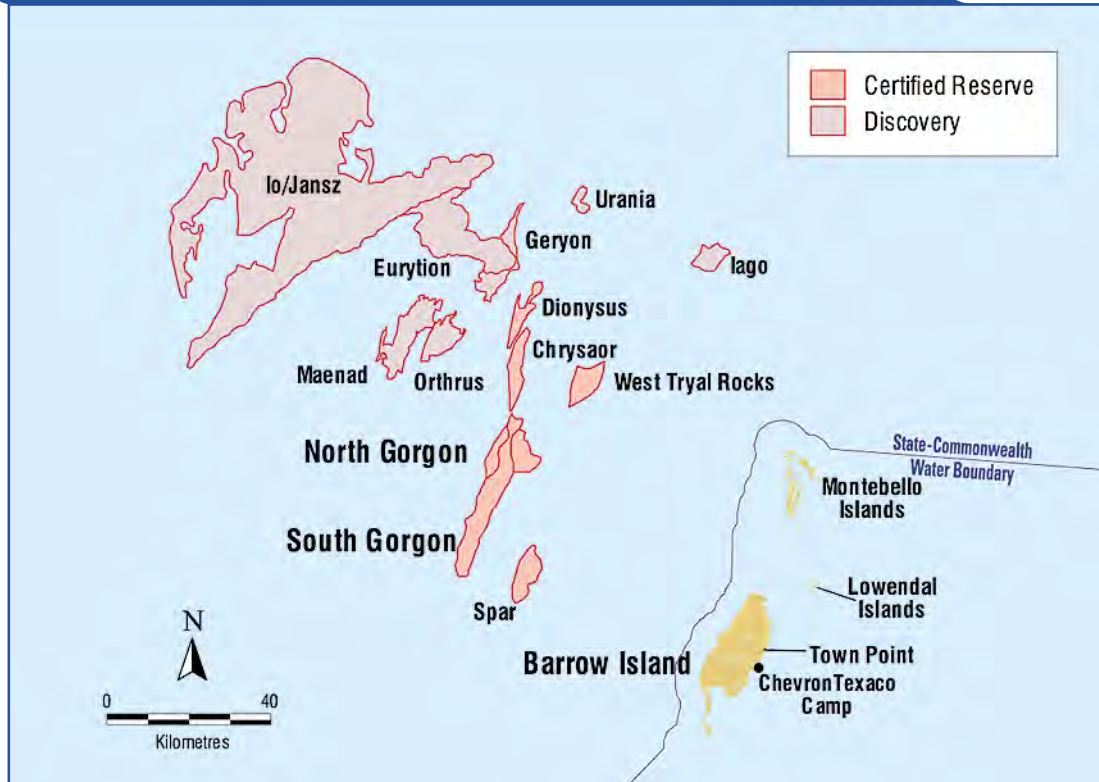
The key to unlocking the Greater Gorgon resource is the development of the Gorgon field. This field is the closest gas to land and the most ready for market (see Figure 1-2).



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FIGURE 1-2

The Gas Fields of the Greater Gorgon Area



1.3 Development Overview

The Gorgon field development plan is based on the installation of a sub-sea gathering system and a 70 km sub-sea pipeline to Barrow Island. A gas processing facility located on the central-east coast of Barrow Island would process the gas. Reservoir carbon dioxide would be removed and re-injected into deep saline reservoirs below the island. The liquid hydrocarbon product would then be transported by ship to international markets. Compressed domestic gas would be delivered via a sub-sea pipeline to the Western Australian mainland for use in the industrial and domestic gas markets.

The description of the development concept is provided in Chapter 5.

1.4 The Gorgon Venture

The Gorgon gas development is being pursued by an unincorporated joint venture consisting of three international energy companies: ChevronTexaco, Shell and ExxonMobil (the Gorgon Venture). ChevronTexaco, with a four-sevenths interest, is the operator of the Gorgon development on behalf of the Gorgon Venture, and is leading the marketing and development of Gorgon area gas. Shell has a two-sevenths interest and Exxon Mobil a one-seventh interest. ChevronTexaco is also the operator of the Barrow Island oil operation.

ChevronTexaco has been involved in the Australian energy industry since the 1950s, and is the fifth largest energy company in the world with over 53 000 employees in over 180

countries. ChevronTexaco and Shell are also participants in the North West Shelf Joint Venture project.

1.4.1 Participant Expertise

ChevronTexaco, Shell and ExxonMobil are leading companies in the global oil and gas industry with proven technical and management skills for safe, efficient and environmentally responsible development. ChevronTexaco's Health, Environment and Safety policy provides an example of the commitment to such development principles (Appendix 2).

The Gorgon Venture brings a wealth of international and domestic experience in oil and gas processing and LNG operations covering all aspects of the development, ranging from drilling to sub-sea production systems, offshore operations, gas plant operations, and product shipping. Between them, the Gorgon Venture participants are involved in eight other LNG projects that are currently operational or under construction. About three-quarters of the world production of LNG is produced by joint ventures involving participant companies from the Gorgon Venture.

The proposed offshore facilities configuration for the Gorgon gas development relies on sub-sea wells and production equipment. Sub-sea developments are commonplace, with over 1000 sub-sea wells completed worldwide, many in water much deeper (>1500 m) than the equipment proposed for the Gorgon gas development. The Gorgon Venture participants have substantial experience in sub-sea applications in areas as geographically diverse as the North Sea, the

Gulf of Mexico, South-East Asia and offshore West Africa.

The Gorgon Venture is committed to bringing the best technology and experience available from each of their organisations to ensure the resource would be successfully developed in an environmentally responsible manner under sustainable development principles.

1.4.2 Environmental Commitment and Responsibility

The Gorgon Venture believes that no new development should be established on Barrow Island unless it can be demonstrated it will be sustainable and continue to preserve the island's conservation values.

Best practice environmental management measures will be implemented in the planning, construction, operation and eventual decommissioning of the Gorgon gas development.

As operator of both the oil and gas ventures, ChevronTexaco would continue to hold overall management responsibility for operational activities on the island and for operating in a manner that protects the conservation values of Barrow Island. This includes coordinating enhanced quarantine management and rehabilitation programs.

1.4.3 Environmental Performance

ChevronTexaco has been involved in the oilfield operation on Barrow Island for over 40 years (see Box 1-1) and the other Gorgon Venture participants have been part of the Barrow Island venture for most of that time. Since 1967, nearly 300 million barrels of oil have

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been produced with the operation currently producing almost four million barrels of oil annually. Furthermore, ChevronTexaco has a demonstrated record of its global commitment to responsible and sustainable development of natural resources (see Appendix 3).

Barrow Island has been a Class A Nature Reserve since 1910 and is an internationally important conservation estate. Preserving this legacy has been an integral part of the oilfield operation.

BOX 1-1

ChevronTexaco and Barrow Island

In 1951, the Australian Motorists' Petrol Company (AMPOL) signed a preliminary joint venture agreement with Caltex to form a new oil and gas exploration company in Australia. Thus West Australian Petroleum Pty Ltd (WAPET) was established. Caltex, jointly owned by Chevron and Texaco, took an 80 per cent interest in WAPET and AMPOL held the remaining 20 per cent. After Shell joined the WAPET consortium in 1958, an extensive exploration and drilling program led to major discoveries. One of these was the Barrow Island oilfield.

Drilling commenced on the Barrow One well on 7 May 1964. In the first week of July 1964, the well produced flowing oil and newspaper headlines proclaimed 'WAPET GETS OIL'. Two years later, Barrow Island was declared a commercial oil discovery, Western Australia's first. Production began in April 1967 at over 8000 barrels of oil per day, peaking in 1971 at 50 000 barrels per day and in October 1992, the 250 millionth barrel of oil was produced.

Since 1967, more than 800 wells have been drilled, including more than 500 oil production wells, over 250 water injection wells, and various gas producer and water disposal wells. Oil is pumped to the surface using beam pumps in the majority of producing wells, the remaining wells using gas-lift or natural flow. Today, 455 wells are producing oil.

In February 2000, having supplied the senior management teams and technical advice to WAPET for most of its life, Chevron took over operatorship of the assets previously managed by WAPET. The majority of the WAPET staff now work for ChevronTexaco. Today ChevronTexaco continues the task of managing a producing oilfield on behalf of its partners Santos Offshore Pty Ltd and Mobil Australia Resources Company Pty Ltd. Personnel working and living on the island number from 150-200 and rotate in two-week shifts. By 2024, the expected life of the field, it is estimated that Barrow Island will have produced 360 million barrels of oil.



FIGURE 1-3

Oil Production Infrastructure on Barrow Island



INTRODUCTION

Barrow Island is Western Australia's second largest island, after Dirk Hartog Island. It is some 25 km long and 10 km wide, covering an area of approximately 234 km². Figure 1-4 provides an indication of the size of Barrow Island relative to Perth and surrounding suburbs.

ChevronTexaco's management of oil production activities on Barrow Island includes an environmental plan that contributes to the protection of the island's unique ecosystem. As a result, Barrow Island remains an important refuge for rare wildlife species and is free from introduced animals. Some of the wildlife

FIGURE 1-4

Relative Size of Barrow Island



species are endemic to the island and others are extinct, or near extinct, on the mainland. The management of ChevronTexaco's operations on Barrow Island is widely recognised as a model for coexistence of petroleum development and the protection of conservation values.

This success has been formally recognised by the receipt of a number of environmental awards and television coverage in renowned nature documentaries (see Box 1-2).

BOX 1-2

Recognition of ChevronTexaco's Environmental Performance on Barrow Island

Documentaries

ChevronTexaco's success in implementing a rigorous environmental management program on Barrow Island has been recognised in prestigious documentaries produced by the natural history units of the Australian Broadcasting Corporation (ABC) and the British Broadcasting Corporation (BBC).

Awards

ChevronTexaco's environmental performance has also been formally recognised through receipt of the following environmental awards:

- 2002 UK Institute of Petroleum Environmental Award for its Barrow Island Environmental Management and Protection Efforts
- 2002 World Oil – The Next Generation Health, Safety, Environment/Sustainable Development Award for Barrow Island Oilfield, Environmental Management and Protection (inaugural)
- 2001 Australian Petroleum Production and Exploration (APPEA) Environmental Award (inaugural)
- 2000 Golden Gecko Certificate of Merit for Barrow Island Coastal Care Group
- 1994 Australian Minerals and Energy Environment Foundation (AMEEF), Environmental Excellence Award – Organisation "for preservation of flora and fauna on Barrow Island during 30 years of oil exploration and production"
- 1994 Western Australian Department of Minerals and Energy (WA DME) Environmental Excellence in Petroleum Operations, Certificate of Merit for overall environmental management of seismic exploration on Barrow Island and Thevenard Island
- 1991 WA DME Environmental Excellence Award Petroleum Category (inaugural), Barrow Island application of innovative techniques

As a nature reserve, Barrow Island is vested in the Conservation Commission of Western Australia for the conservation of flora and fauna, and is managed by the Department of Conservation and Land Management (CALM).

1.4.4 Sustainability Principles

The Gorgon Venture recognises the importance of the attributes of Barrow Island for nature conservation and this is the context within which the Gorgon gas development needs to be considered. The Gorgon Venture aims to develop the Gorgon gas fields

consistent with key concepts of sustainable development. To this end, a set of ten development-specific sustainability principles was established and applied to the development proposal (see Box 1-3). The sustainability principles reflect the commercial, environmental, social, economic and strategic objectives of the development.

This ESE Review demonstrates how the proposed development would meet specific sustainability principles established for the Gorgon gas development and provide net conservation benefits. This review is detailed in Chapter 14.

BOX 1-3

Gorgon Gas Development Sustainability Principles

Clean Energy Supply	The development will meet Western Australian, Australian and international demands for competitive, clean energy sources. It will also enhance energy competition and security of supply in Australia.
Economic Benefit Delivery	Current and future economic growth in Australia will benefit from the development. It will foster economic growth and business development, generate government revenue, provide commercial returns to the Gorgon Venture and contribute to the wealth generated by Australia's natural resource base.
Biodiversity and Ecological Integrity Protection	The Gorgon gas development will not disrupt ecological structure and function, nor will it result in a loss of biological diversity on Barrow Island.
Social Equity and Community Well-being Enhancement	Communities will benefit from improved quality of life and well-being resulting from contributions of the Gorgon gas development such as creation of jobs.
Future Generations Commitment	The Gorgon gas development will meet the needs of the present generation and assist future generations to meet their needs.
Efficient Resource Use	International best practice and continual improvement principles will be applied to efficiently manage resources and wastes.
Precautionary Principle Application	Where there are threats of serious or irreversible damage, lack of full scientific certainty will not be used as a reason for postponing cost-effective measures to prevent environmental damage.
Community Respect and Safeguards	The Gorgon Venture will respect community values, community diversity and safeguard the well-being of public and workforce throughout the development.
Stakeholder Engagement	The Gorgon Venture will seek the views of stakeholders and take their interests into account throughout development of the Gorgon gas fields.
Accountability	The Gorgon Venture is committed to the highest standards of governance and accountability. It will report regularly to the community on the sustainability performance of the development.

1.5 ESE Document Scope and Content

As required by the Western Australian Government, this ESE Review documents the key findings of the environmental, social, economic and strategic studies and comments on the sustainability of the proposed development. It also explains how the development could deliver net conservation benefits.

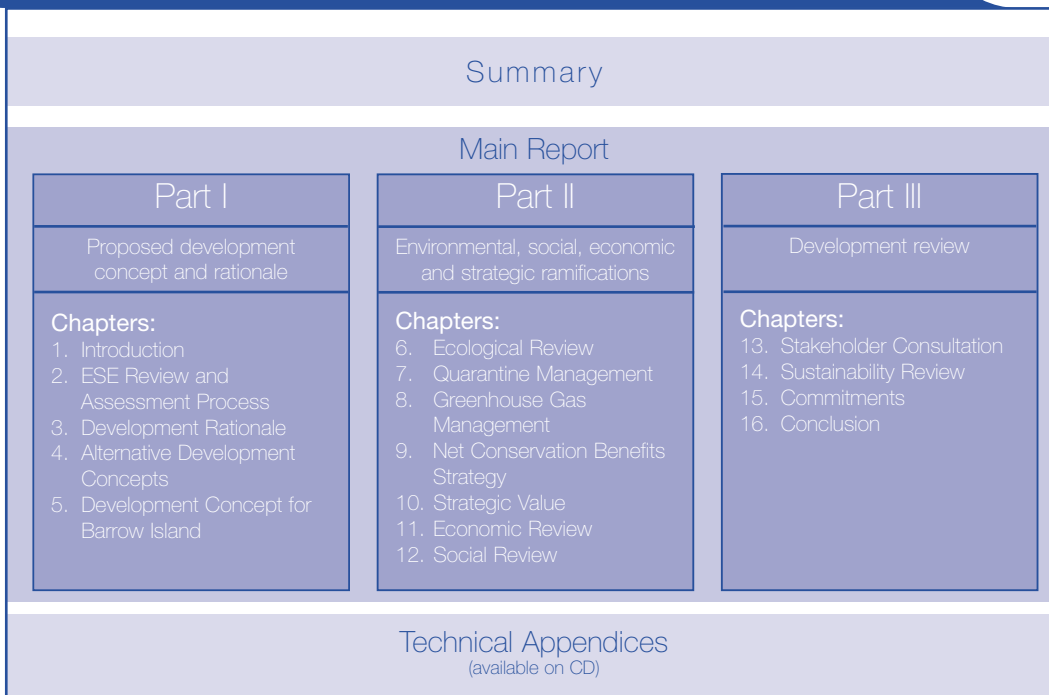
The ESE Review comprises a stand-alone summary document, the main report (this document) and a series of technical

appendices (available on CD). Within this structure, the main report is divided into three parts, as outlined in Figure 1-5.

The ESE Review process is designed to incorporate public comment on substantive matters relating to the restricted use of Barrow Island for a gas processing facility. The steps to making a submission are outlined in the front of this document in the section entitled "Invitation to Comment".

FIGURE 1-5

Structure of the ESE Review





ESE REVIEW AND ASSESSMENT PROCESS

The Gorgon Venture is seeking in-principle approval from the Western Australian Government for restricted use of Barrow Island to site a gas processing facility. The facility is a key component of the proposed development concept for the Gorgon gas fields.

In response, the Western Australian Government has requested that relevant information on the environmental, social, economic and strategic ramifications and net conservation benefits of the proposed development be presented to it in the format of an Environmental, Social and Economic Review (ESE Review). The government would then make a decision on whether to grant in-principle approval after receiving public comment and advice on the ESE Review from the Western Australian Environmental Protection Agency (EPA), the Department of Mineral and Petroleum Resources (MPR) and the Conservation Commission of Western Australia (Conservation Commission).

In order to receive in-principle approval, the ESE Review must demonstrate at a strategic level that the proposed Gorgon gas development can generate economic and social benefits for the Pilbara, Western Australia and Australia, provide net conservation benefits, and mitigate potential on-site environmental impacts. If in-principle approval is granted, a full Environmental Impact Assessment and other relevant government approvals would still be required by law before final approval for a specific development project could be considered. This Chapter presents the details of the ESE Review process.

2.1 ESE Review Framework

A strategic evaluation of the proposed Gorgon gas development would allow the Government of Western Australia to make an informed decision on whether to grant in-principle approval to the Gorgon Venture for restricted use of Barrow Island to site a gas processing facility.

Advice to the Gorgon Venture in November 2001 from the Western Australian Minister for State Development stated that the government would be prepared to consider the restricted use of Barrow Island after relevant environmental, social, economic and strategic ramifications were examined and net conservation benefits were demonstrated.

This advice is consistent with the recommendations of a recent review of the project development approvals system in Western Australia, which suggested that proponent development applications for major projects should include a sustainability statement that addresses the economic, social and environmental impacts of the project (Independent Review Committee 2002).

The Western Australian Government has made a firm commitment to sustainable development and recently released a consultation draft of the State Sustainability Strategy outlining a proposed Sustainability Assessment Framework. Meeting this commitment under the new framework requires project proponents to consider a wider range of economic and social issues, in addition to the impact to, and ongoing management of, the environment.

In Western Australia, the *Environmental Protection Act 1986* (EP Act) provides well-established, effective processes to evaluate the environmental acceptability of a development proposal. Under Part IV of the EP Act, the EPA is responsible for providing advice on the environmental protection aspects of any development proposal or scheme. However, as the EP Act is restricted to consideration of only physical impacts on the environment and the consequential impacts on society, the EPA can only give limited consideration to social and economic issues (Independent Review Committee 2002). It is the role of MPR to provide advice on strategic, social and economic impacts.

2.2 Approach to the ESE Review

In consultation with the Gorgon Venture, the Western Australian Government developed a process to assess the environmental, social, economic and strategic issues associated with the Gorgon gas development. The process is designed to fulfil the requirements of all stakeholders. The ESE Review process, as summarised in Figure 2-1, essentially mirrors Part IV of the EP Act with regard to requirements for public comment and government agency advice and recommendations to government.

2.2.1 Scoping Phase

Relevant environmental, social and economic factors requiring review related to the proposed development were identified in the scoping phase of the ESE Review process; and compiled as “The Gorgon Gas Development ESE Review Scoping Document” (see: www.gorgon.com.au) (Technical Appendix A, see enclosed CD).

Scoping of the relevant benefits and impacts was completed by:

- developing a proposed scope of work to address environmental impacts and benefits (as incorporated into the ESE Review Scoping Document)
- developing guidelines for the social, economic and strategic evaluation of the development by MPR
www.mpr.wa.gov.au/majproj/html/Gorgon.htm (Technical Appendix B)
- integrating social, economic and strategic guidelines; and preparing an environmental scope of work (the ESE Review Scoping Document)
- reviewing environmental impacts and benefits of the ESE Review Scoping Document and endorsement by the EPA
- making the ESE Review Scoping Document publicly available in July 2002

The Gorgon Venture consulted with stakeholders throughout the scoping phase of the ESE Review.

2.2.2 Stakeholder Consultation

The ESE Review process was established following discussions with a large number of stakeholders (see Chapter 13 for full description).

The stakeholders consulted include:

- State and Commonwealth Ministers
- Members of Parliament and their advisers
- State and Commonwealth government agencies
- local government representatives
- industry and regional development groups
- conservation organisations
- local and regional community groups
- Indigenous groups



- employees and contractors
- research centres, including universities
- potential customers and suppliers
- media and general public

The primary objectives of stakeholder consultation conducted to date were to: provide an overview of, and obtain feedback on, the proposed development; encourage stakeholder participation in the ESE Review process; identify key issues and sensitivities; and incorporate feedback into development plans and the ESE Review (see Chapter 13). The Gorgon Venture will continue to meet with these stakeholders and obtain feedback throughout the ESE process.

2.3 Process for Investigation of Relevant Factors

Critical environmental, social, economic and strategic factors associated with the proposed Gorgon gas development were identified in consultation with stakeholders, and investigated for the ESE Review by the Gorgon Venture with input from specialist consultants (see Box 2-1).

Factors addressed by the Gorgon Venture in the ESE Review include:

- preventing accidental introductions of exotic plants, animals and diseases
- minimising vegetation/habitat loss/disturbance
- reducing disturbance to fauna by light or noise
- protecting wildlife health
- avoiding impacts to marine fauna
- mitigating modifications to water currents
- preparing against accidental spills (e.g., oil spills)

- reducing greenhouse gas emissions
- generating economic development and employment opportunities
- protecting cultural heritage sites
- maximising regional education and training opportunities
- securing the supply of clean gas to Western Australia and Australia
- improving domestic gas competitiveness
- increasing demand for local business services
- providing significant revenue to government
- identifying a development site that is commercially viable and meets technical, environmental and social criteria
- developing the Gorgon gas fields in a sustainable manner
- ensuring a publicly transparent assessment process

In addressing these factors, the Gorgon Venture Participants applied their knowledge and experience accumulated from years of field operations and management where appropriate. In particular, ChevronTexaco has over 40 years of flora and fauna survey data resulting from its management of oil operations on Barrow Island. Where data and knowledge were lacking, specialist consultants were commissioned to conduct specific studies as outlined in Box 2-1.

Investigations and assessment were conducted at the level consistent with the in-principle approval being sought. The Gorgon Venture considers that the issues most critical to this ESE Review are those that directly relate to restricted use of Barrow Island to site a gas processing facility. The Review contains less information on technical matters that are largely independent of location or unrelated to a Barrow Island development.

BOX 2-1**Specialist Studies Specifically Commissioned for the ESE Review**

Study	Study Specialist
State and national economic impacts	Access Economics
Social, strategic and market assessment	ACIL Tasman
Terrestrial flora	Astron Environmental
Terrestrial fauna	Bamford Consulting Ecologists
Subterranean fauna	Biota Environmental Services
Marine and intertidal environments	Bowman Bishaw Gorham
Migratory birds	Chris Surman, Ornithological Expert
Net conservation benefits strategy	Frank Batini, Conservation Adviser
Quarantine management	Macro-Environmental and ChevronTexaco
Sea turtle ecology	Pendoley Environmental
Cultural heritage	Quartermaine Consultants
Terrestrial molluscan fauna	Shirley Slack-Smith, Western Australian Museum
Regional site assessment	URS Australia

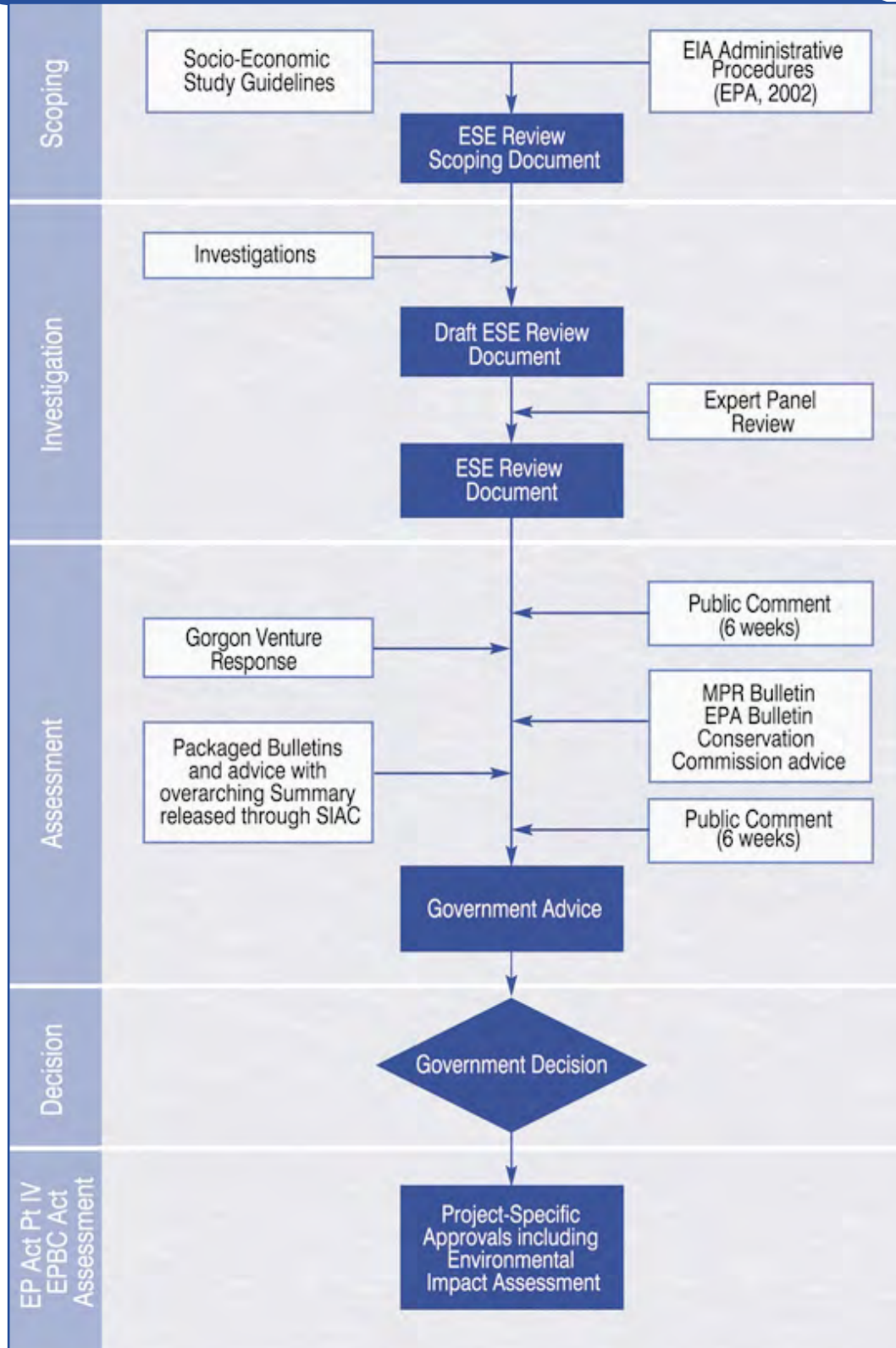
The Gorgon Venture believes the ESE Review addresses all issues critical to the Western Australian Government making an informed decision on whether to grant in-principle approval for restricted use of Barrow Island.

In broad terms, the process to complete the ESE Review document involved:

- Review and consideration of a range of internal Gorgon Venture studies, prepared over recent years, on technical, engineering and commercial aspects of the proposed development.
- Completion of specialist studies to determine and broadly quantify potential impacts and benefits associated with the proposed development (see Box 2-1).
- Development of possible strategies to mitigate (and possibly offset) adverse impacts and improve potential benefits (see Chapters 6, 7, 8, 9, 11 and 12).
- Development of a net conservation benefits strategy for the development (see Chapter 9).
- Consultation with stakeholders by the Gorgon Venture and consultants (see Chapter 13).
- Development, review and refinement of sustainability principles and criteria (see Chapter 14).
- Integration of environmental, social, economic and strategic issues within a sustainability framework (see Chapter 14)
- Review by an Expert Panel of the ESE Review findings and conclusions to ensure that the investigations satisfy the requirements of the ESE Review Scoping Document and to provide advice on whether the findings and conclusions of the ESE Review are valid and justified. The panel was a small group of experts with an appropriate mix of knowledge and experience to address the breadth of issues canvassed in the ESE Review (see Box 2-2). Membership of the panel was determined in consultation with the EPA and MPR. The report by the Expert Panel is provided in Appendix 4.
- Production and distribution of the ESE Review for government agency and public comment.

FIGURE 2-1

Summary of the ESE Review and Assessment Process



Expert Panel Members and Expertise

Expert Panel Member	Expertise
The Hon Hendy Cowan, Chair	Mr Cowan is a former Deputy Premier of Western Australia (1993-2001), holding the portfolios of Commerce and Trade, Small Business and Regional Development. He retains an active interest in the research and development capacity of Western Australia through a company Directorship and association with Murdoch University and Edith Cowan University.
Dr Des Kelly AM, FTS, BE (Hons), PhD, FIE	Dr Kelly is a former Chief Executive Officer of the Department of Minerals and Energy (1980-1992) and Department of Resources Development (1993-1999) of the Western Australian Government. He has worked extensively on establishing major resource developments and associated infrastructure in Western Australia. In 1992, he was made a Member in the General Division of the Order of Australia (AM) in acknowledgement of his contribution and service to the mining industry.
Dr Brian Robinson BSc (Hons), PhD	Dr Robinson is a corporate sustainability adviser with Richard Oliver International, Chairman of the Victorian Environmental Assessment Council and Chairman of Greenfleet Australia. He was Chairman of EPA Victoria from 1986-2002 and has been actively involved at state, national and international levels of environmental management for more than 30 years.
Dr Denis Saunders BSc (Hons), PhD	Dr Saunders is a landscape ecologist and conservation ecologist with over 30 years experience and a former CSIRO Chief Research Scientist. His interests include the integration of nature conservation with agricultural production in a total landscape management approach, and the conservation of biodiversity in agricultural landscapes.

2.4 Review, Comment and Assessment

Consideration of the ESE Review of the proposed Gorgon gas development is being coordinated by the Standing Interagency Committee of Chief Executive Officers (SIAC). For over two years SIAC has advised the Minister for State Development on whole of government strategic and approvals matters relating to major resource development projects. Members of SIAC represent the Western Australian Government agencies with responsibility for project assessment and decision-making.

SIAC comprises core representation by the:

- Department of Land Administration
- Department of Treasury and Finance
- Environmental Protection Authority
- Department of Environment, Water and Catchment Protection
- Department of Planning and Infrastructure
- Department of Indigenous Affairs
- Department of Mineral and Petroleum Resources (acting as the secretariat to SIAC)

For this ESE Review, SIAC membership also includes representation from the Department of the Premier and Cabinet, the Department of Conservation and Land Management (CALM) and the Conservation Commission of Western Australia (Conservation Commission). Other relevant agencies are invited to participate as appropriate to coordinate specific project approvals or issues.

MPR will provide advice on the social, economic and strategic aspects of the proposed development concept. The EPA will provide advice on environmental matters,

high-level management commitments and net conservation benefits. Government will also be advised by the Conservation Commission on nature conservation matters relating to the proposed development.

In addition to ongoing stakeholder consultation, two public comment periods, both six weeks in duration, will ensure that the public is fully informed of the proposed development and have adequate opportunity to provide feedback. The first period allows the public to comment on the ESE Review and for the Gorgon Venture to respond. The second period allows the public to comment on government agency advice on the proposed development, prior to the Western Australian Government making an in-principle decision.

Public comment on the ESE Review document is important because if the Western Australian Government grants in-principle approval, it would have indicated its support for the restricted use of Barrow Island subject to the assessment of technical matters that would be addressed in an Environmental Impact Assessment (EIA) and other relevant approvals.

Assessment of the ESE Review, public submissions and the Gorgon Venture's response to submissions involves the following steps:

- Advice from the EPA on the environmental impacts and benefits under the provisions of Section 16(e) of the EP Act – documented as a Bulletin.
- Advice from MPR on the social, economic and strategic matters (parallel to the EPA's Section 16(e) environmental assessment) – documented as a Bulletin. (MPR's advice includes evaluation from MPR's multifaceted independent panel with relevant eminence and expertise).

- Independent advice from the Conservation Commission to the Minister for Environment on conservation matters.
- Packaging of the Bulletins and Conservation Commission's advice for public release under SIAC's supervision – with an overarching Environmental, Social and Economic appraisal summary report.

The Environmental, Social and Economic appraisal package will then be available for a second six-week period of public comment before being considered by the Western Australian Government.

2.5 Government Decision

Before deciding whether to grant in-principle approval to the Gorgon Venture for restricted use of Barrow Island, the Western Australian Government will consider the Environmental, Social and Economic appraisal package and any other documentation and advice it considers relevant.

If in-principle approval is granted, the Gorgon Venture must then apply for formal approvals. Typical approvals required include: production and pipeline licences, Foreign Investment Review Board approval, marine licences, a major hazard control plan, a safety case, land tenure – and approval of a specific development project under Part IV of the EP Act. The timing of a development-specific EIA would be determined by the timetable for development of the Gorgon gas fields. As the scope of an EIA is more detailed than an ESE Review, this ESE Review document would be used as input into the development-specific EIA.

The need for a separate assessment process under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) will be determined in consultation with the Western Australian and Commonwealth Governments. Western Australia's environmental assessment process was accredited by the Commonwealth Environment Minister in August 2002. The bilateral agreement is intended to minimise duplication between Commonwealth and Western Australian environmental assessment processes and ensure that assessment of proposed developments occur in a timely and efficient manner. As a result, actions that are likely to have a significant impact on a matter of national environmental significance can be assessed under the Western Australian process. The Western Australian Government will provide the Commonwealth Environment Minister with an assessment report as the Minister remains responsible for approving actions under the agreement.

If the ESE Review process results in the Western Australian Government granting in-principle approval to establish a gas processing facility on Barrow Island, the Gorgon Venture would then have the surety required to proceed with the technical and commercial investigations necessary to develop the Gorgon gas fields.





DEVELOPMENT RATIONALE

The vast reservoirs of untapped natural gas found in the Greater Gorgon area off Western Australia's Pilbara coast are a world-class energy resource. Developing the resource is a matter of national importance as it would secure Australia's position as a leading gas producer and provide a huge additional source of wealth and energy for the country and the State.

There is a growing demand for energy in the Asia-Pacific region and the Australian domestic gas market. There is a projected shortfall in energy supply in Western Australia. The Gorgon development would help to meet that demand and provide another strategic gas supply hub for the State. It would help build on Australia's standing as a reliable gas supplier to Asia and ensure the availability of long-term, competitive supplies of natural gas to the State.

The development of the Gorgon gas resource is consistent with government objectives and policy. The State and Commonwealth Governments both identify the resource industry as key to economic growth and actively encourage the development of the nation's resources.

There is a window of opportunity for Australia to secure this gas development. A short delay now could result in a long delay in the ultimate development as gas supplies in competing countries move forward to fill the projected increase in demand.

3.1 Meeting the Need for Clean Energy

Heightened environmental awareness and increasing community demand for environmental protection are driving Australia and Asia-Pacific countries towards the increasing use of natural gas. Natural gas offers a range of benefits over traditional fossil fuels such as coal and oil, including:

- lower greenhouse gas emissions
- higher efficiency in electricity generation
- lower particulate emissions
- generally lower sulfur and nitrous oxide emissions
- no residual wastes

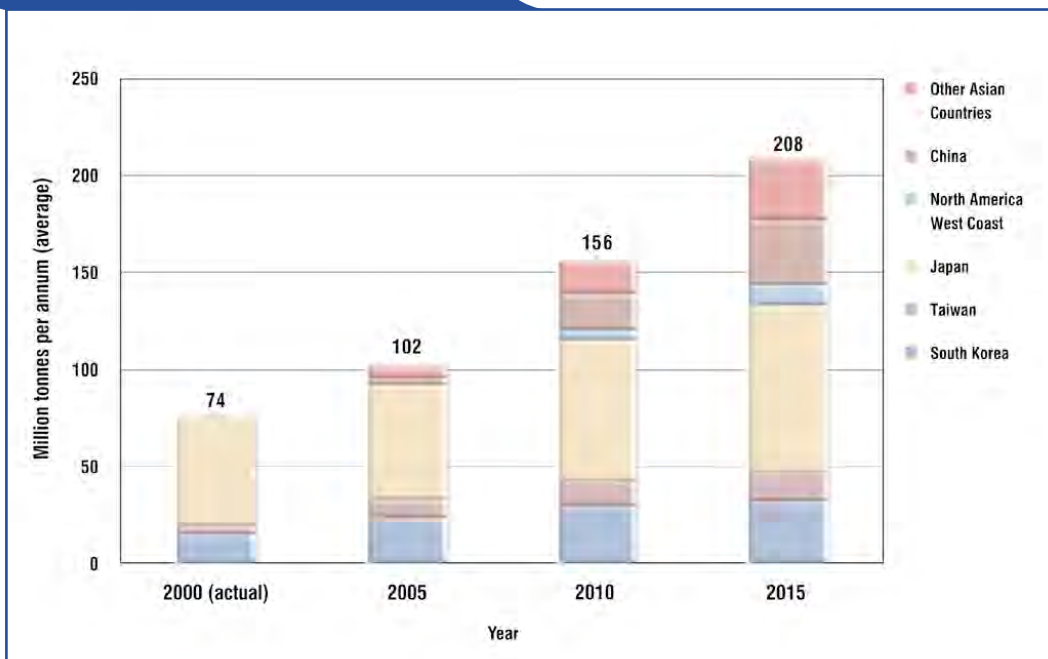
To proceed, the Gorgon Venture needs to secure a foundation customer able to commit to take a sufficiently large volume of gas on a long-term basis to underwrite the commercial viability of the development.

3.1.1 Projected LNG Demand

The Asia-Pacific market for Liquefied Natural Gas (LNG) is well established. Specialist consultant reports commissioned by the Gorgon Venture have projected strong demand growth for LNG during the next decade due to:

- greater demand for clean fuels to address air pollution problems
- lower prices and more flexible contract terms from competitive pressure in the LNG market
- lower demand for nuclear power due to social and regulatory issues

Figure 3-1 illustrates the forecast growth in LNG demand in the Asia-Pacific region. Current demand is around 80 million tonnes per annum (MTPA) and is forecast to more than double by 2015.

FIGURE 3-1**Asia-Pacific LNG Demand**

Source: ACIL Tasman

The existing LNG markets of South Korea, Japan and Taiwan are expected to continue to comprise the bulk of the demand in this region. The emerging markets in the west coast of North America, China and other Asian countries will also add significant opportunities.

Australia's key competition for this new demand comes mainly from Qatar, Indonesia, Malaysia and Russia. Figure 3-2 depicts the cost of supply of LNG from the Gorgon gas development to northern Asia expressed as a ratio of this cost of supply. Although Middle Eastern suppliers are likely to have lower production costs, Australia's proximity to the Asia-Pacific market provides the Gorgon Venture with transport cost advantages.

The Gorgon Venture is confident of its ability to competitively supply LNG to the Asia-Pacific market. Development of a gas processing facility on Barrow Island is a key element of

that competitiveness as it would provide the lowest gas delivery costs to a liquefaction plant.

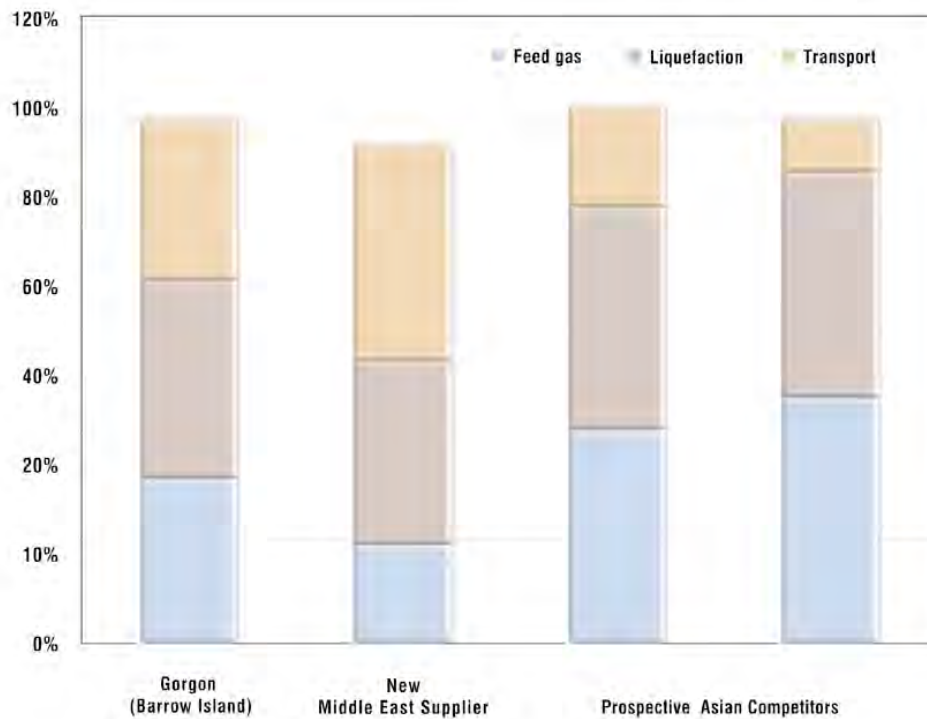
In addition to competitive costs, potential customers for LNG from the Gorgon gas development place value in the:

- low sovereign risk and political stability of Australia
- strength of the Gorgon Venture with companies that have a proven track record in the LNG business
- extensive and proven gas reserves
- direct participation that the joint venture could offer

The Gorgon Venture believes that a Gorgon LNG development on Barrow Island will be competitive and will secure a share of the growing LNG market in Asia and North America.

FIGURE 3-2

Competitiveness of the Gorgon Gas Development in the Asia-Pacific LNG Market



Source: ACIL Tasman

3.1.2 Projected Western Australian Domestic Gas Demand

The Western Australian gas market can benefit greatly from the addition of another major gas supply to fill a continuing growth in demand. Without the introduction of gas from the Gorgon gas fields, industrial growth in the State, for example in mineral processing or gas-to-liquids (GTL) conversion, could be stifled.

The sources of supply to Western Australian customers without gas from the Gorgon gas fields are illustrated in Figure 3-3. The figure shows the estimated sources of production associated with existing supply contracts (excluding LNG) as well as future contracts and spot sales. The modelling predicts a

supply gap caused partly by the decline in existing production and by an increase in demand which could be filled by the Gorgon gas development.

This demand gap is comprised of potential new industrial and domestic gas projects, such as minerals processing projects. The modelling includes a range of potential projects for the Pilbara region.

Figure 3-4 summarises the effect of the Gorgon gas development in terms of increasing supply to the Western Australian market. Following the introduction of gas from the Gorgon gas fields to the domestic market (assumed for this modelling work to occur in the year 2012) the total uptake of natural gas in Western Australia will increase by around

Gas Market Modelling

The Western Australian gas market has been studied extensively for the Gorgon Venture by ACIL Tasman using a gas market supply and demand model (GasMark). This model contains public domain data which have been verified and augmented by both ACIL Tasman and the Gorgon Venture.

The data presented in this report are based on the base demand case which assumes moderate growth in existing loads and the commencement of selected large industrial users. There are a number of potential projects that could represent this load including methanol and other industrial chemical production and downstream processing plants. The forecast includes the development of NWS LNG Trains 4 and 5 and Gorgon LNG. This demand case is consistent with the current (2002) Australian Bureau of Agricultural and Resource Economics (ABARE) forecast and also with internal Gorgon Venture market forecasts.

On the supply side, it is assumed that the NWS Project increases capacity in the short-to medium-term to complement other gas suppliers including Harriet, East Spar, Griffin, Perth Basin, Tubridgi and an unspecified new gas supplier(s) in the Carnarvon Basin area. Current contracts are preserved and extensions anticipated where appropriate. The model incorporates public data estimates on reserves, production capacity and delivery points and ACIL Tasman views on pricing.

The operation of the model is to match uncontracted supply and demand based on price. This is demonstrated in the results where supply/demand “gaps” open up when there is no supplier offering gas in the market at a price which is low enough to meet any customers’ requirements.

60 PJ/a initially, with the incremental supply rising to more than 110 PJ/a after ten years.

The modelling demonstrates that the Gorgon gas development does not cause significant displacement or deferral of gas production from other sources.

The Gorgon Venture believes that gas from the Gorgon gas fields can be competitive in the market if an initial project is secured on Barrow Island and a connection to the mainland market is subsequently established.

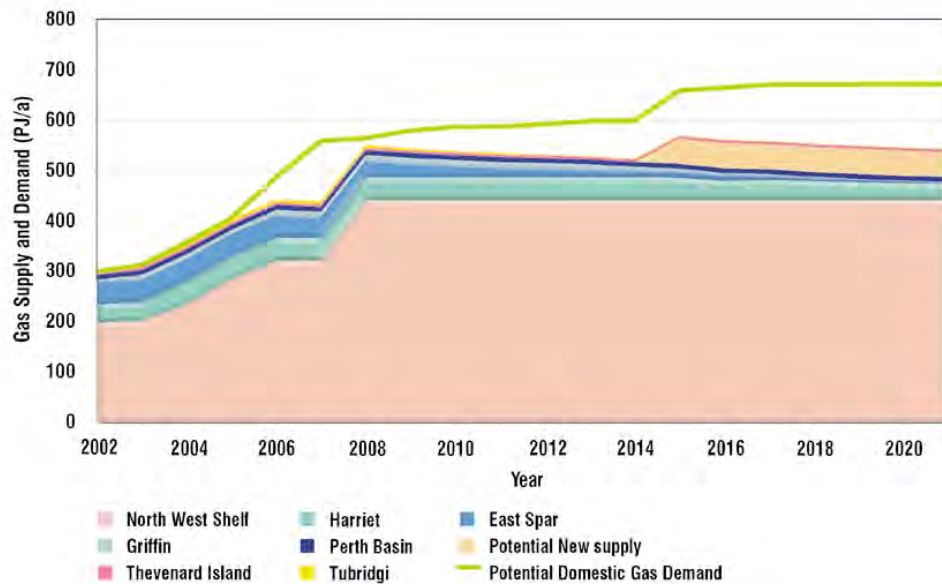
3.1.3 Other Potential Demand

The assumptions used in the modelling in relation to the future gas demand are deliberately conservative. This means that actual demand has the potential to greatly exceed the forecasts.

A number of very large-scale potential developments were not included in the preceding forecasts. The GTL projects are the largest of these potential customers. GTL refers to the conversion of natural gas

FIGURE 3-3

WA Gas Demand and Supply without the Gorgon Gas Development (excluding LNG)



Source: ACIL Tasman

into high-value commodity liquid fuels (including methanol, dimethyl ether (DME), and middle distillates – including diesel), specialty chemicals and waxes.

Competition for Australia to capture these projects is high. Some competing countries can provide gas at very low prices due to low development costs, large reserves, the need to eliminate flaring and other factors. Nevertheless, Australia can be competitive in attracting these projects given that sovereign risk factors are important in making overall investment decisions.

The Gorgon gas development would bring an additional large scale supplier to the market, increasing competition, and increasing the likelihood that Australia can capture one or more of these large-scale projects.

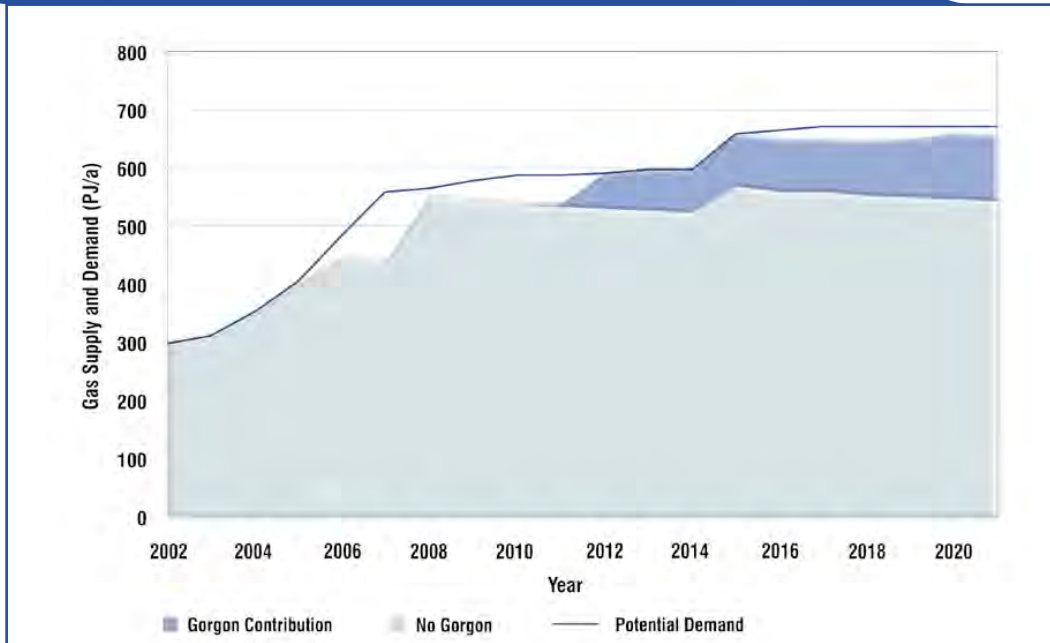
3.2 The Ability of the Development to Meet the Demand

The Gorgon gas resource is significant among Australia's major gas discoveries, as summarised in Table 3-1. The gas resource is the largest uncommitted resource in the country, is relatively close to infrastructure and has been:

- Well defined with extensive drilling and seismic coverage and reserve certification from an internationally recognised consultant (Netherland, Sewell and Associates Inc)
- Extensively marketed, with strong customer interest both for LNG and domestic gas. The Gorgon Venture has been in the LNG and Western Australian domestic gas markets for some time with established offices in Perth, Seoul, Beijing, Singapore and San Francisco actively marketing Gorgon gas.

FIGURE 3-4

Comparison of Gas Supply and Demand, with and without the Gorgon Gas Development



- Extensively studied with a mature and competitive development concept identified. The Gorgon Venture has been building an engineering database for some years and, over the last year, has been actively engaged in concept engineering with a team of over 50 professionals.

With a gas processing facility located on Barrow Island, the Gorgon gas development can be competitive in both the LNG, industrial and domestic gas markets and is well placed to capture a share of the projected demand.

3.3 Government Objectives and Policy

Development of the Gorgon gas resource is consistent with government policy. The State and Commonwealth Governments both identify the resources industry as key to economic growth and have programs to actively encourage the development of hydrocarbon resources.

Agencies such as Invest Australia in the Commonwealth and the Office of Major Projects in the State have mandates to facilitate investment and "...add value to major resources projects by providing assistance with access to land and infrastructure and in understanding and working through Government's approval processes needed to bring a project to fruition." (Department of Mineral and Petroleum Resources Western Australia 2002). The Gorgon development's Major Project Facilitation status with Invest Australia is a demonstration of Commonwealth Government commitment to the development.

The Commonwealth Government's LNG Action Agenda (Department of Industry, Science and Resources 2000) specifically addresses the LNG industry as "...a candidate for an Action Agenda because of the substantial contribution it makes to the Australian economy, and its ability to boost Australia's trade performance

DEVELOPMENT RATIONALE

TABLE 3-1

Comparison of Large Australian Gas Resources

	Gas resource	Size (90% probability)	Location
Producing Fields	North West Shelf Project	16 300 PJ	Offshore north-west Western Australia
	Gippsland Basin	6100 PJ	Offshore eastern Victoria
	Cooper–Eromanga Basins	3000 PJ	North-east South Australia and south-west Queensland
Undeveloped Fields	Greater Gorgon area	24 100 PJ	70 km north-west of Barrow Island, Western Australia
	Gorgon area only	17 200 PJ*	
	Brecknock–Scott Reef	12 100 PJ	350 km north-west of Broome, Western Australia
	Sunrise	9200 PJ	400 km north of Darwin, Northern Territory
	Evans Shoal	6500 PJ	300 km north of Darwin, Northern Territory
	Scarborough	4500 PJ	270 km west of Onslow, Western Australia
	Bayu–Undan	3400 PJ	450 km north of Darwin, Northern Territory

Sources: WA Department of Mineral and Petroleum Resources 2002; Office of Territory Development 2002.

* Derived from WA MPR figure of 602 Gm³ at 90 per cent probability

and national investment.” The Action Agenda is an extensive document which sets out a vision for the industry whereby Australia captures a significant amount of the new business in the Asia–Pacific region. The Action Agenda recognises the breadth of benefits that the industry provides to the nation and the strength of support that the Commonwealth

Government has expressed in its actions and in other policy documents such as “Minerals and Petroleum Resources Policy Statement” (Department of Industry, Science and Resources 1998) and the “Investing for Growth” Statement (Department of Industry, Science and Resources 1998).

3.4 The Timing of the Development

The Gorgon Venture believes there is a market window of opportunity for deliveries of gas from the Gorgon gas fields to commence in the 2008 to 2010 timeframe. This timing is specifically to meet the currently identified LNG and industrial gas market opportunities. A delay in this schedule risks:

- losing the identified LNG market opportunities to one of the overseas competitors and/or
- industrial gas customers investing elsewhere or not eventuating due to the lack of available gas

Short delays now, accompanied by a loss of potential customers' confidence in the development, could result in a long delay before the Gorgon gas resource is developed.

3.5 Conclusions

The Gorgon gas resource is being developed to meet a need for clean energy in the Asia-Pacific region, industrial gas markets and the Western Australian domestic gas market. The development is well placed to meet that demand and can be competitive in these markets with a gas processing facility on Barrow Island. State and Commonwealth Government policy support is an important driver to pursue the development now. Timing of the development is important as a short delay now could result in a long delay in the ultimate execution of the development.





ALTERNATIVE DEVELOPMENT CONCEPTS

The Gorgon Venture recognises that selecting the correct location for the gas processing facility is crucial to the successful application of the development's sustainability principles and fundamental to the acceptability of the development. Extensive consultation has confirmed that it is also a key issue for government and community stakeholders.

For many years, the Gorgon Venture has pursued a range of development and marketing options in order to secure a successful development. This history led the Gorgon Venture to the preliminary conclusion that a gas processing facility site on Barrow Island could be the key to the commercial viability of the development. The Gorgon Venture subsequently undertook a systematic regional assessment to determine if that preliminary conclusion was valid. The assessment demonstrated that in addition to being critical to commercial viability, a Barrow Island site can also meet necessary technical, environmental and social criteria.

Significantly, the island also provides a unique opportunity to re-inject reservoir carbon dioxide at a location in close proximity to the gas processing facility, thus minimising costs. This would allow the Gorgon gas development to be one of the most greenhouse efficient projects of its type in the world.

This chapter outlines the development concept, location and site selection processes. It explains why the Gorgon gas development needs to be located on Barrow Island and why a Town Point site is favoured over other areas on the island. The chapter concludes with a summary of the opportunities that would be lost if the Gorgon gas development did not proceed at this time.

4.1 Background

As outlined below, alternative concepts have been considered for development and commercialisation of the Gorgon gas fields over the last ten years. The current development concept is based on the results and experience gained from the many engineering, commercial and environmental studies conducted over this time.

4.1.1 Early Development Concepts

Initial concepts were primarily focused on a large, conventional Liquefied Natural Gas (LNG) facility on the mainland and included a two-train LNG development based on the

Burru Peninsula. This concept attempted to optimise economies of scale and synergies with adjacent infrastructure on the Burru Peninsula. However, the concept was costly and therefore proved to be uncompetitive in the LNG market. This lack of international competitiveness along with changes in the LNG market led to termination in 1998 of the Gorgon Venture's LNG marketing for the Burru Peninsula proposal.

Since 1998, the Gorgon Venture has actively sought a domestic gas customer base sufficient to underwrite development of the Gorgon gas fields. In addition, the LNG market has grown and volumes are being sought in new and existing Asia-Pacific LNG buying

countries. Studies and preliminary engineering on alternative concepts to establish a commercially competitive Gorgon gas development have continued during this time.

Some fundamental building blocks are crucial to the development of the Gorgon gas fields. In particular, any proposed project must effectively address the following challenges:

- Fields in deep water – gas produced will be from the deepest water (220 m) ever produced off the coast of Western Australia.
- CO₂ – gas from the Gorgon gas field contains up to 14 mol% carbon dioxide, a feature which requires additional investment in materials and equipment and raises potential greenhouse gas concerns.
- Liquid yield – while the Gorgon field contains high quality reservoirs and is very productive, the gas contains a very low proportion of liquid hydrocarbon (such as oil or condensate). As a result, the project does not have the advantage of being able to generate a large revenue from the sale of valuable liquids.
- Topography at field location – the nature of the topography at the Gorgon field location (see Figure 4-1) is such that it is difficult to utilise any form of bottom-founded structure (such as a platform) to produce the reservoirs. Use of sub-sea production facilities is therefore a key feature of the proposed development concept.

- Development size – the development must be of sufficient size to underwrite the initial investment, but not so large that the market cannot absorb the output within a reasonable timeframe.

The above challenges reinforce the need to minimise costs by, for example, reducing the distance between the gas fields and the gas processing facility.

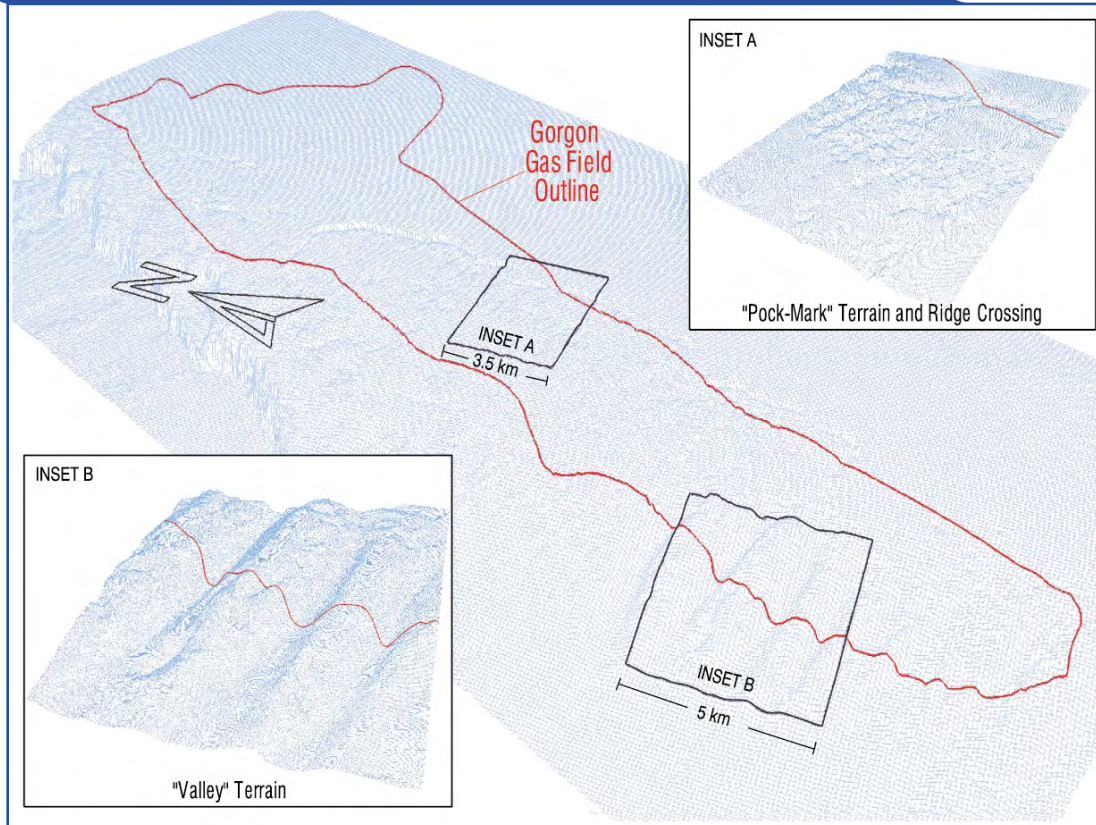
As previously described, the Gorgon Venture has pursued a range of development and marketing options in an effort to secure an initial development, including extensive development and marketing assessments for a variety of locations on the mainland, from the Burrup Peninsula to Exmouth, as well as offshore and island-based concepts.

This history led the Gorgon Venture to the preliminary conclusion that a gas processing facility site on Barrow Island could be the key to the commercial viability of the development. The Gorgon Venture subsequently undertook a systematic regional assessment to determine if that preliminary conclusion was valid.



FIGURE 4-1

Seabed Terrain of the Gorgon Gas Field



4.1.2 Current Development Concept

Current market opportunities identified by the Gorgon Venture indicate that the initial development for Gorgon gas would most likely be an LNG plant. The Gorgon Venture recognises that different gas processing opportunities could emerge, such as gas-to-liquids, dependent on market forces. However, LNG has been modelled as the reference case for the type of development proposed.

The Gorgon gas development reference case includes a gas processing facility that can produce LNG for the international market and also industrial and domestic gas for the Western Australian market. LNG plants are typically built in 'trains' of processing capacity.

A train size of up to five million tonnes per annum (MTPA) is currently viewed as providing a good balance of technical efficiency and market capacity. Market assessment indicates that the LNG market is capable of absorbing 5 MTPA from the Gorgon gas development before 2010 and 10 MTPA from around 2012.

The current Gorgon gas development concept involves wells and pipelines for gas production, and delivery to the gas processing facility and an export pipeline to deliver gas to the domestic market. However it is the location and suitability of the gas processing facility itself that is the fundamental factor which drives the overall competitiveness of the development. The following sections present the systematic process used to identify and evaluate potential development locations which

confirms Barrow Island as the preferred location for the Gorgon gas processing facilities.

4.2 Assessment of Regional Locations

Identification and assessment of possible development locations was conducted using a systematic screening process involving a series of steps.

Two stages of assessment were used to identify possible development locations. The first stage involved a regional assessment of development requirements and constraints to identify possible development locations using a multi-criteria analysis. The outcome of this process was a short-list of locations that were then subject to a second stage of assessment which included preliminary

engineering studies and an assessment of commercial competitiveness.

The process involved a logical and sequenced approach that allowed progression from a broad area of interest to a specific location within which specific development sites could be identified. This process, the actions taken at each step and the locations assessed are highlighted in Figure 4-4.

4.2.1 Key Requirements and Constraints for a Gas Processing Facility

The suitability of possible development locations is affected by a range of broad technical/cost, environmental and social requirements, benefits or constraints. Those requirements and constraints considered most important to the suitability of possible development locations are listed in Table 4-1.

TABLE 4-1

Key Requirements and Constraints for a Gas Processing Facility

Requirement/Constraint	Parameter	Rationale
Technical/Cost		
• Proximity to Gorgon gas field	Facility to be located within 200 km of Gorgon gas fields.	Cost of large diameter gas supply pipelines become increasingly prohibitive beyond 200 km from the Gorgon gas fields.
• Sufficient available area	At least 300 ha of land available for development.	300 ha required to accommodate required plant, infrastructure and construction needs safely.
• Proximity to coastline	Processing facility to be located within 10 km of coastline.	Allows the cooled liquefied gas to be piped to export ships. Plant to ship pipeline length and costs will be reduced by minimising distance of the plant site from the shipping berth.
• Proximity to deep water	Deep water within 5 km of adjacent coastline.	Keeps dredging/jetty requirements within reasonable limits.

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Requirement/ Constraint	Parameter	Rationale
Technical/Cost		
Sheltered water	Docking facilities must be located within sheltered, navigable waters.	Allows safe berthing of LNG carriers and loading of product.
Slope	Less than five per cent slope at plant location.	Keeps earthworks disturbance during construction within reasonable limits.
Elevation	At least 5 m – Australian Height Datum (AHD).	Site must be elevated to avoid storm surge flooding.
Proximity to existing infrastructure	Preference for locations with existing infrastructure.	Development costs and associated impacts will be minimised if the development is located close to existing infrastructure.
Pipeline crossings	Avoid crossing existing sub-sea pipelines.	Increases cost and risk of development.
Environment		
Mangroves	No development within 200 m of mangrove habitat.	Important habitat and key primary producers.
Declared rare flora	1 km exclusion zone in areas where declared rare flora species are present.	Important species avoided for protection.
Fauna species and habitats	Avoid protected species and habitats. Small islands of less than 1000 ha to be avoided.	Important species and habitat avoided for protection. Small islands avoided as they have less capacity for habitat loss.
Conservation reserves	National and Marine Parks and other conservation reserves to be avoided where practicable.	Conservation reserves established for protection of flora, fauna and habitats.
Saline coastal flats	Avoid saline coastal flats.	Considered to have moderate habitat value, but extensive coverage in the region.
Water courses	No development within 100 m proximity of watercourses.	Construction on or near watercourses has the potential to disrupt natural drainage patterns, leading to erosion and loss of habitat.
Groundwater reserves	No development in areas where prescribed groundwater reserves exist.	Risk of contamination of groundwater from development.

Requirement/ Constraint	Parameter	Rationale
Social		
• Settlements	No development within 3 km of settlements.	Development close to a settlement is considered unacceptable and counter to fundamental planning principles. Consideration of amenity, visual impact, pollution potential, disturbance and health and safety risks.
• Tourism and recreation reserves	No development within 3 km of tourism and recreation reserves or specific attractions or venues.	Consideration of amenity and landscape values.
• Aboriginal heritage sites	No development within 500 m of Aboriginal heritage sites.	Protection required by legislation and require buffer to adequately protect sites.
• Native Title claims	Avoid development in areas subject to Native Title claims where practicable.	Conflicting land use and potential for protracted and complex negotiation and compensation.
• Mineral deposits	Development to avoid mineral deposits.	Preference that development should not sterilise a mineral resource.
• Mining tenements	Avoid development in areas subject to mining tenements.	Conflicting land use and compensation requirements.
• Pearling leases	No development within 2 km of areas covered by pearling leases.	Potential for marine activities to disrupt pearling activities.

4.2.2 Analysis of Regional Data

Each of the development requirements and constraints listed in Table 4-1 were assigned a weighting that reflected their relative importance. The area within 200 km radius of the Gorgon gas fields was divided into 500 x 500 m grid squares and each square was assigned a score which reflected the level of constraint it possessed when requirements

and associated weightings were considered. A Geographic Information System (GIS)-based model was used to analyse this data to identify areas that broadly met the development requirements and constraints.

The regional location assessment study was conducted by URS Australia and is included in-full in Technical Appendix C (see enclosed CD).

4.2.3 Possible Locations

The GIS-based regional analysis identified the following list of possible development locations (see Figure 4-2):

- Montebello Islands
- Thevenard Island (central portion)
- Barrow Island
- Maitland Estate/West Intercourse Island
- Holden Point (Burrup Peninsula)
- Exmouth South (Exmouth Peninsula)
- West Intercourse Island
- Cape Preston

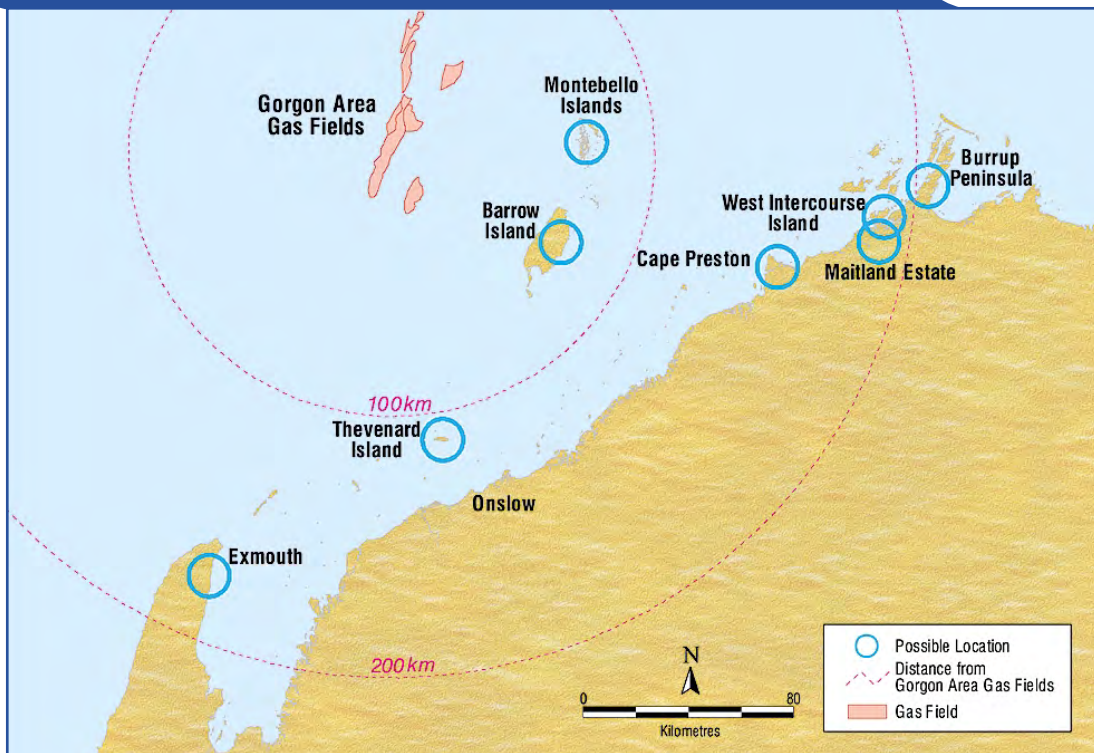
A preliminary screening was undertaken and unsuitable locations excluded or combined. The Maitland Estate location was initially screened out because of its unacceptable distance from the coast. However, because

Maitland Estate is a formally designated industrial zone with few significant environmental or social constraints it was considered in combination with the nearby West Intercourse Island as a combined location – Maitland Estate/West Intercourse Island. (West Intercourse Island offers a potentially suitable ship-loading point). West Intercourse Island was also retained as a possible stand-alone location.

Large areas of the Pilbara coastline were not considered suitable for development due to the presence of significant environmental values along the coastal fringe. This is reflected in extensive areas of saline coastal flats and mangroves, places on the Register of the National Estate, Conservation and Land Management (CALM) estate and proposed reserves. The mainland coastline from southern Exmouth Gulf to Cape Preston is also

FIGURE 4-2

Possible Locations for a Gas Processing Facility



characterised by extensive areas of shallow water which further inhibit development along this stretch of coastline.

Cape Preston is effectively unavailable as a possible development location as all usable land at the location is designated for an approved mineral processing development. In addition, there is no significant cost advantage over a Burrup Peninsula location. Cape Preston was therefore excluded.

4.2.4 Comparison of Key Attributes of Possible Locations

The key attributes of the remaining possible locations are compared in Table 4-2. The comparison reflects the suitability of the possible sites as measured against the key development requirements and constraints. A qualitative comparison of the suitability of each short-listed location is also presented in Figure 4-3.



TABLE 4-2

Comparison of Key Attributes for Possible Locations

Constraints	Possible Locations						West Intercourse Island
	Montebello Islands (Trimouille Island)	Thevenard Island	Barrow Island	Maitland Estate/West Intercourse Island	Burru Peninsula (Holden Point)	Exmouth	
Technical/Cost							
• Pipeline distance to Gorgon gas field	Approx. 90 km	Approx. 120 km	Approx. 70 km	Approx. 250 km	Approx. 230 km	Approx. 200 km	Approx. 200 km
• Sufficient available area	Area available for development is extremely restricted	Area available for development is limited	Sufficient area available for development requirements	Sufficient area available for development requirements	Sufficient area available for development requirements	Sufficient area available for development requirements	Sufficient area available for development requirements
• Proximity to coastline	Immediately adjacent to coast	Immediately adjacent to coast	Immediately adjacent to coast	Maitland Estate 10 km inland, coastal access via West	Intercourse Island Immediately adjacent to coast	Coastal	Immediately adjacent to coast
• Proximity to deep water	Good access to deep water	Good access to deep water	Moderate access to deep water	Moderate access to deep water	Moderate access to deep water	Moderate access to deep water	Moderate access to deep water
• Sheltered water	Limited sheltered waters	Limited sheltered waters	Sheltered waters	Sheltered waters	Sheltered waters	Sheltered waters	Sheltered waters
• Slope	Stable soils and minimal amount of earthworks required	Stable soils and minimal amount of earthworks required	Stable soils and minimal amount of earthworks required	ME- stable soils with a minimal amount of earthworks required WII- moderate geotechnical conditions	Difficult geotechnical conditions at site	Stable soils and minimum earthworks required	Moderate geotechnical conditions

Constraints	Possible Locations						
	Montebello Islands (Trimouille Island)	Thevenard Island	Barrow Island	Maitland Estate/West Intercourse Island	Burru Peninsula (Holden Point)	Exmouth	West Intercourse Island
• Elevation	No elevation constraints	No elevation constraints	No elevation constraints	ME low lying site WII - no elevation constraints	No elevation constraints	No elevation constraints	No elevation constraints
• Proximity to existing infrastructure	No existing infrastructure	Adjacent to existing oilfield infrastructure	Adjacent to existing oilfield infrastructure	No existing infrastructure at site. Good regional infrastructure	Site is adjacent to the NWS LNG development. Good regional infrastructure	No infrastructure at site. Good regional infrastructure	No existing infrastructure. Good regional infrastructure
• Pipeline crossings	No	No	Yes	Yes	Yes	No	Yes
Environment							
• Mangroves	No mangroves	No mangroves	Relatively few areas of mangroves	WII - surrounded by mangroves	No mangroves	No mangroves	Surrounded by mangroves
• Declared rare flora	Locality has relatively few significant flora	Locality has relatively few significant flora	Locality has relatively few significant flora	Locality has relatively few significant flora	Locality has relatively few significant flora	Locality has relatively few significant flora	Locality has relatively few significant flora
• Fauna species and habitats	Locality has relatively few significant terrestrial fauna and habitats High marine environmental and habitat values	Locality has relatively few significant terrestrial fauna and habitats High marine environmental and habitat values	High ecological values Several fauna that are endemic to Barrow Island High marine environmental and	habitat values Locality has relatively few significant terrestrial fauna and habitats Presence of seasonal wading and water birds	Locality has relatively few significant fauna and habitats	Locality has relatively few significant fauna and habitats High marine environmental and habitat values	Locality has relatively few significant fauna and habitats

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Constraints		Possible Locations						
		Montebello Islands (Trimouille Island)	Thevenard Island	Barrow Island	Maitland Estate/West Intercourse Island	Burrup Peninsula (Holden Point)	Exmouth	West Intercourse Island
- Conservation reserves - Saline coastal flats - Watercourses - Groundwater reserves		Class A Conservation Park Surrounding waters considered for a Marine Park	Class C Nature Reserve	Class A Nature Reserve Surrounding waters considered for a Marine Management Area	None	None	Close proximity of loading jetty to Ningaloo Marine Park	None
		No saline coastal flats	No saline coastal flats	No saline coastal flats	WII surrounded by tidal mudflats	No saline coastal flats	No saline coastal flats	Surrounded by tidal mudflats
		No watercourses	No watercourses	Watercourses exist (intermittent)	Watercourses exist	Watercourses exist	Watercourses exist	Limited numbers of watercourses exist
		No prescribed groundwater reserves	None	None	None	None	Prescribed groundwater reserve exists	None
Social								
- Settlements - Tourism and recreation reserves, attractions or activities	No settlements	Small tourist resort accommodation	No settlements	Relatively close to Dampier	Relatively close to Dampier	Relatively close to existing settlements and major highway	Relatively close to Dampier	
	Existing recreational boating and yachting activity. Islands support increasing tourism	Existing recreational boat and yachting activity. Island also supports tourism	No tourism or recreation	No tourism or recreation	Area used extensively for recreation and tourism	High regional tourism activity and high tourism industry growth potential	No island tourism or recreation Nearby recreational fishing occurs	

Constraints	Possible Locations						
	Montebello Islands (Trimouille Island)	Thevenard Island	Barrow Island	Maitland Estate/West Intercourse Island	Burru Peninsula (Holden Point)	Exmouth	West Intercourse Island
Aboriginal heritage sites	Relatively few Aboriginal heritage sites exist	One Aboriginal heritage site	Relatively few registered Aboriginal heritage sites	Many Aboriginal heritage sites recorded	High occurrence of Aboriginal heritage sites	Aboriginal heritage sites in general area	High occurrence of Aboriginal heritage sites
Native title claims	No native title claims	Native title claim exists	No native title claims	Native title claims settled	Native title claims settled	Native title claim exists	Native title claims settled
Mineral deposits	No mineral deposits	No mineral deposits	No mineral deposits	No mineral deposits	No mineral deposits	No mineral deposits	No mineral deposits
Mining tenements	No mining tenements	No mining tenements	No mining tenements	No mining tenements	No mining tenements	Some mining tenements	No mining tenements
Pearling leases	Several existing pearling leases in adjacent waters	Pearling leases	Pearling lease in adjacent waters on east coast of island	No pearling leases in adjacent waters	No pearling leases in adjacent waters	No pearling leases in adjacent waters	No pearling leases in adjacent waters

FIGURE 4-3

Summary of Location Comparison

Level of Constraint	Montebello Islands	Thevenard Island	Barrow Island	Maitland Estate/West Intercourse Island	Burrup Peninsula	Exmouth Peninsula	West Intercourse Island
Environmental	●	●	●	●	●	●	●
Social	●	●	●	●	●	●	●
Technical / Cost	●	●	●	●	●	●	●
Combined	●	●	●	●	●	●	●
Level of Constraint	Low		Medium/Low		Medium	Medium/High	High

Figure 4-3 clearly illustrates that of the seven possible development locations, Barrow Island and Thevenard Island best meet the development requirements and constraints. The key attributes of each location are outlined below:

- Barrow Island – is relatively close to the Gorgon gas fields, existing industry infrastructure, deep water for shipping access and a potential site for re-injection of CO₂. Barrow Island is also unconstrained by social factors such as settlements, recreation, tourism or other industry use. The major constraining factor associated with Barrow Island is its status as a Class A Nature Reserve of significant conservation value.
- Thevenard Island – contains some existing oil industry infrastructure, is a moderate distance from the Gorgon gas fields and provides good access to the coast and deep water. This location is also relatively unconstrained environmentally, although the island is surrounded by a rich marine environment and is designated as a Class C Nature Reserve. Disadvantages of this location include limited available area for development and potential impacts to recreational fishers, boat users and tourists, all of which visit the island and its waters.

A further constraint is the lack of sheltered waters and hence difficulty in establishing an operational ship-loading facility.

4.2.5 Assessment of Commercial Competitiveness

An assessment of the expected commercial competitiveness of the concept development alternative for each of the possible locations assisted the Gorgon Venture to further compare the locations. A key determinant of this competitiveness is the cost associated with the construction and operation of the gas processing facility and associated infrastructure. Estimation of such costs, with the necessary confidence, requires considerable preliminary design and engineering work. This involved examining in more detail the technical issues dealt with broadly in the URS assessment, supplemented with additional design criteria. Prior to this work the Gorgon Venture reviewed all the possible site locations and screened their attributes. The following two locations were excluded from the competitiveness assessment:

- **Exmouth South** was excluded because, as indicated in Table 4-2 and Figure 4-3, it possessed high environmental, social and technical/cost constraints. It was considered highly unlikely to be viewed more favourably following detailed analysis.
- **West Intercourse Island** was excluded as a separate location because it was included as an integral part of the Maitland Estate/ West Intercourse Island concept, the island being used for storage and jetty facilities due to its proximity to deep water. Also for the purposes of the competitiveness assessment, it did not offer any significant advantages as a stand alone option over the nearby Burrup Peninsula or Maitland Estate/West Intercourse Island concepts.

The Montebello Islands were also initially excluded due to their lack of usable land and history as a nuclear weapons test site. Within the Montebello Islands only two islands exist which could support any significant infrastructure. Neither has sufficient land available to safely accommodate the Gorgon gas development's 300 ha plant, infrastructure and accommodation requirements:

- **Trimouille Island** (450 ha) does not meet the basic 300 ha site requirement with a usable area of less than 100 ha identified.
- **Hermite Island** (950 ha) does not meet the basic 300 ha site requirement. It is such a convoluted shape that it does not provide sufficient contiguous consolidated area for practical planning and establishment of a gas processing facility.

In addition to the above issues, the Montebello Islands were the location of nuclear weapon testing in 1952 and 1956 and elevated radiation levels are still found in some parts of the islands. Disturbance of surface soils through construction on Trimouille Island may result in an increase in radiation levels on the ground. A Gorgon gas development on Trimouille Island will subject its workforce to

potential long-term exposure to radiation and consequently expose the development to the related commercial and legal risks. Stakeholder engagement has confirmed that this would be a serious industrial relations issue.

The connection of all of the Montebello Islands to nuclear weapon testing would also expose the development to negative public and customer perceptions, negatively impacting upon the ability of the development to attract and retain customers.

The lack of usable land on either of the islands and the Montebello Islands' history as a nuclear weapons test site are the key reasons why they have been rejected as a potential site to locate gas processing facilities.

This assessment leaves the following short-listed locations for comparison:

- Thevenard Island (Central Portion)
- Barrow Island
- Maitland Estate/West Intercourse Island
- Burrup Peninsula

Table 4-3 lists the components of the development concept that have the greatest impact on the cost of construction and operation of each of the short-listed sites. The two Montebello Islands have also been included at the request of a number of stakeholders although they are not short-listed sites.

Extensive work beginning in 1997 identified that the only feasible site for re-injection of reservoir CO₂ for Gorgon gas was the Dupuy reservoir beneath Barrow Island (see Chapter 8 Greenhouse Gas Management). Disposal of reservoir CO₂ is considered to be a critical issue for a number of stakeholders. Therefore the cost to deliver CO₂ from each short-listed location to Barrow Island is included in the comparison.

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TABLE 4-3

Comparison of Key Cost Driver Components

Key Cost Attributes	Short-listed Locations				Included on request	
	Thevenard Island	Barrow Island	Maitland Estate/West Intercourse Island	Burrup Peninsula	Montebello Islands Trimouille	Montebello Islands Hermite
Gas Pipeline Length	120 km	72 km	250 km	230 km	93 km	115 km
Offshore Platform	Required	Not Required	Required	Required	Not Required	Not Required
Jetty Length	1.1 km	3.9 km	1.1 km	0.5 km	0.5 km	2.9 km
Distance from Coast	0.1 km	0.7 km	12.1 km	0.1 km	0.2 km	0.1 km
Volume of Dredging	0.86 million m ³ soft soils / sand	6.9 million m ³ soft soils / sand	6.7 million m ³ hard soils / rock	7.8 million m ³ hard soils / rock	0.75 million m ³ soft soils / sand	2.94 million m ³ soft soils / sand
Extent of earthworks	1.4 million m ³ soft soils / sand	1.4 million m ³ soft soils / sand	1.4 million m ³ soft soils / sand	1.7 million m ³ hard soils / rock	1.4 million m ³ soft soils / sand	1.7 million m ³ soft soils / sand
CO ₂ Pipeline Length	115 km	14 km	165 km	200 km	40 km	30 km
Relative Cost, Millions	+ \$500	Reference Point	+ \$1100	+ \$1000	+ \$70	+ \$300
Useable Land (300 ha available)	Yes	Yes	Yes	Yes	No	No

The cost constraints associated with the mainland locations, Burrup and Maitland Estate/West Intercourse Island mean that the development would prove highly uncompetitive. The failure to secure a customer for a Burrup Peninsula-based development in 1998 supports this conclusion (see Section 4.1.1). These locations were therefore rejected.

Thevenard Island remains as the only potential location for the gas processing facility other

than Barrow Island. However, it is still a significantly more expensive option than Barrow Island, its status as a Class C Nature Reserve also requires stringent quarantine restrictions, the LNG loading operations are in less sheltered waters, and the operating costs are higher for boat and helicopter transfer of personnel from Barrow Island or Onslow.

Furthermore, unlike Barrow Island, it is located well south of the Greater Gorgon area reserves

and most existing gas infrastructure, which would limit its utility as a strategic gas hub.

Finally, cost analysis has shown that a development on Thevenard Island would incur a \$500 million increase in relative cost over the Barrow Island option. Direct marketing to prospective large-scale domestic gas customers has previously demonstrated Thevenard Island for such a development to be uncompetitive.

The following chart (Figure 4-4) summarises the location selection process and highlights the results at each stage of the assessment.

Preferred Location

As a result of detailed analysis, location assessment processes and competitiveness assessments, Barrow Island was identified as the only acceptable location where the development would be commercially competitive. A summary of the outcomes of these assessments is presented in Figure 4-5. The investigations demonstrate that as the preferred location for the gas processing facility, Barrow Island has the following attributes or benefits:

- It is the closest landfall to the Gorgon gas field, thus reducing the length of high-grade corrosion-resistant pipe and avoiding the need for an offshore platform at start-up. This becomes increasingly important as the deep water fields further west are brought into production. A more distant site would require excessively long feed gas pipelines and may result in the fields never being economically viable.
- It provides safe access to relatively sheltered water.
- Access to deep water for LNG carriers can be provided economically, with an acceptable level of dredging and length.

- Environmental impacts to the Class A Nature Reserve can be effectively managed and kept to within acceptable limits (see Chapter 6).
- A relatively flat, adequately elevated site of 300 ha can be accommodated without significant adverse impacts to sensitive vegetation or fauna habitats.
- It avoids impacts to residential areas and industrial or commercial land users, as well as tourism and recreational areas, mineral deposits and mining tenements, Aboriginal heritage sites and existing native title claims.
- It provides a unique opportunity and cost effective means to re-inject reservoir CO₂ as the processing facility and injection site would be in close proximity.
- It is close to existing infrastructure for transport of domestic gas to the mainland.
- It provides an opportunity to enhance the existing oilfield by eliminating flaring, since associated gas can be processed in the Gorgon gas processing facility.
- It contains established logistics infrastructure (e.g., airfield, accommodation, communications).

The Gorgon Venture considers that this systematic regional site assessment has reaffirmed the results of five years of concept screening and has established that Barrow Island currently represents the only commercially viable development option.

The following section provides an assessment of cost estimates for alternative development sites on Barrow Island.

ALTERNATIVE DEVELOPMENT CONCEPTS

FIGURE 4-4

Location Selection Process

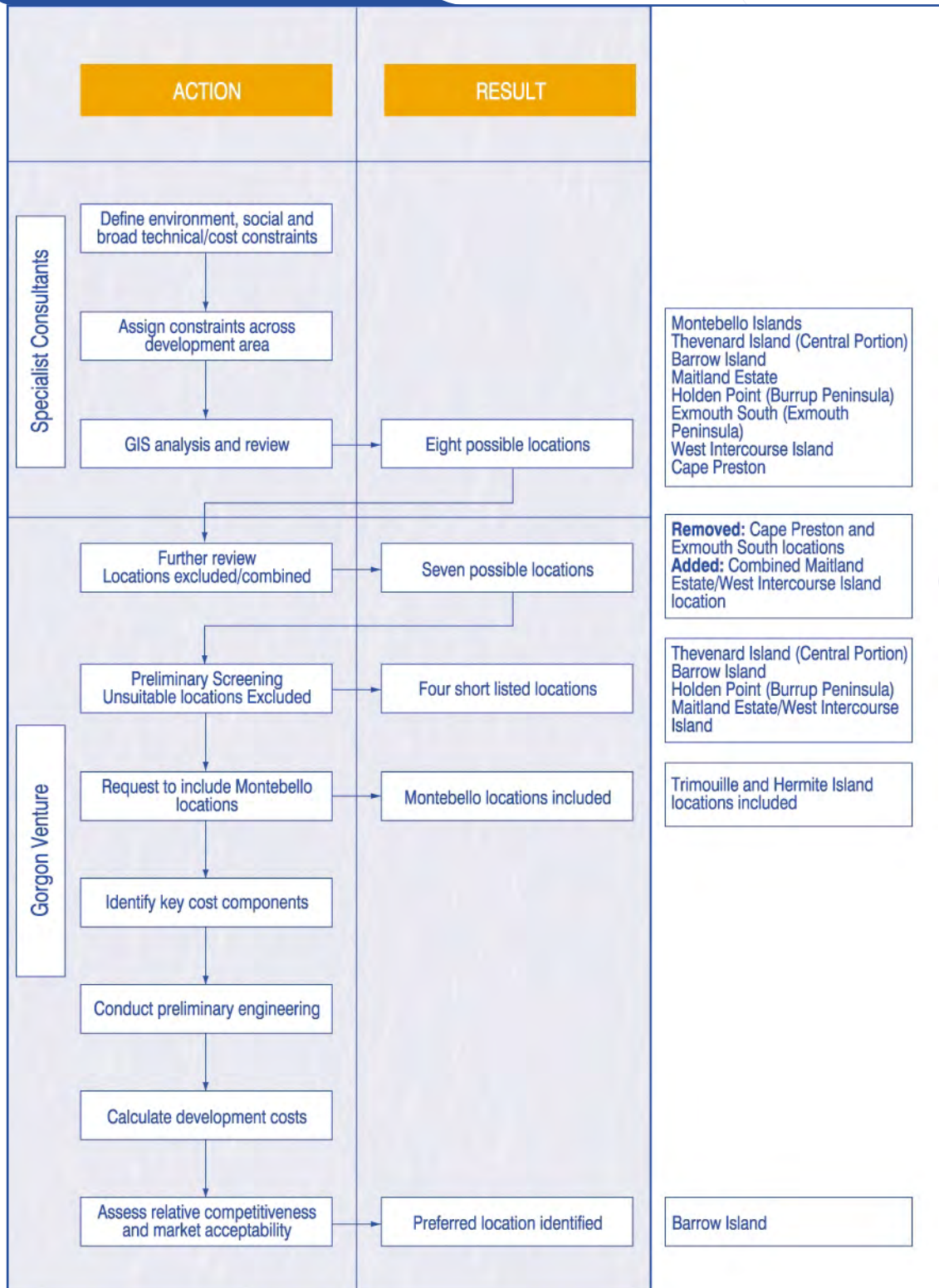
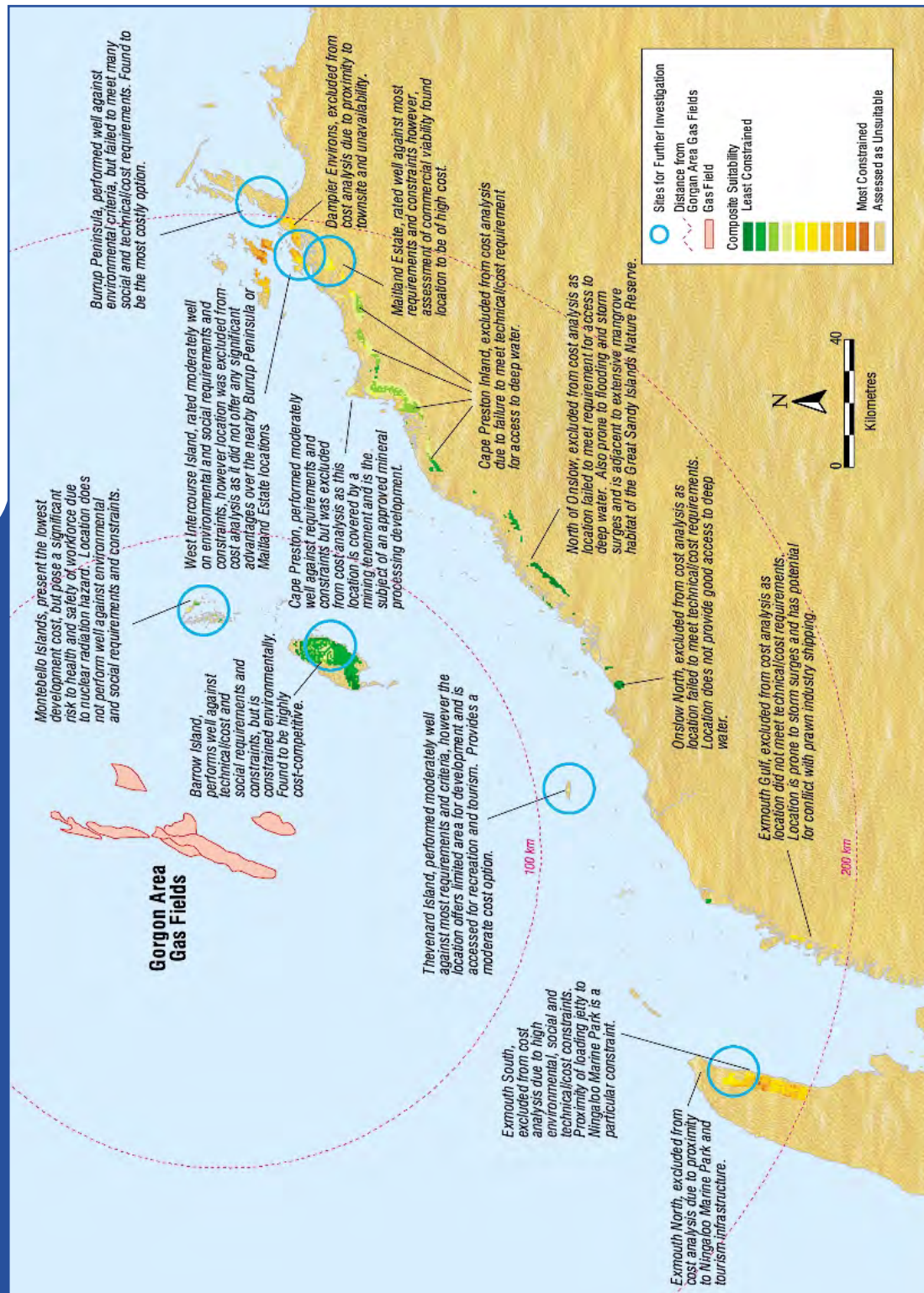


FIGURE 4-5

Summary of Results of the Location Assessments



4.3 Assessment of Barrow Island Sites

Selection of a preferred site on Barrow Island is based on the LNG development reference case with two 5 MTPA trains, and includes allowance for a controlled area within which construction materials can be stored and construction accommodation established. The site selection also takes into account the potential for future growth in the LNG market, and the capability to meet projected Western Australian domestic gas demand.

The Gorgon Venture recognises the importance of selecting the most appropriate site on Barrow Island for the gas processing facility. The conservation values of the island, as broadly discussed in Chapters 1 and 6, are not evenly distributed; particularly the sensitivity of vegetation associations and fauna habitats. Some areas have greater value and require an even higher degree of protection. These values would be a major factor in determining the site for the gas processing facility. In addition, there are a range of technical, operational and cost-related issues that must be considered in the selection of a site that will be safe, practical and allow the development to remain economically viable.

To address these issues the Gorgon Venture has assessed potential sites on Barrow Island

in some detail. This work has provided greater confidence that an acceptable site could be found on Barrow Island and serves as a basis for the review of the issues outlined in Part II of this ESE Review. The work identified Town Point, on the central-east coast of Barrow Island, as the preferred site for the gas processing facility. Should in-principle approval for restricted use of Barrow Island be granted, further site selection and refinement would be undertaken as part of the detailed engineering studies and public environmental impact assessment processes. The site selection process is therefore preliminary and this section should be reviewed in this context.

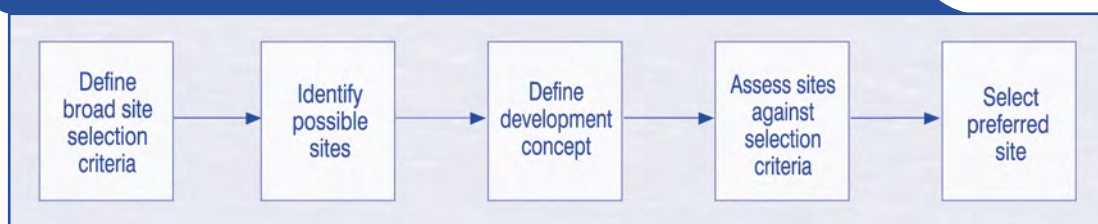
The approach adopted by the Gorgon Venture involved a series of steps that allowed potential sites to be systematically identified and assessed, prior to the selection of a preferred site (see Figure 4-6).

4.3.1 Broad Selection Criteria

A gas processing facility on Barrow Island would involve plant and equipment to receive and treat the incoming gas, then either liquefy and store it prior to loading onto tankers or compress the gas into the export pipeline to the mainland. The facility and associated land-based infrastructure would utilise no more than 300 ha. (See Chapter 5 for greater detail of the development concept).

FIGURE 4-6

Simplified Steps in the Site Selection Process



Broad selection criteria applied were:

- marine operability for LNG carriers approaching and berthing
- constructability of gas processing facilities
- safety
- environmental impact
- cost

Figure 4-7 shows areas of greater environmental sensitivity on Barrow Island and gives an indication of water depths.

4.3.2 Possible Sites

The Gorgon Venture identified six areas on Barrow Island that met the broad criteria outlined above: Latitude and Town Points on the east coast, Surf Point on the north-east corner, Flacourt Bay and The Chair on the west coast and Bandicoot Bay in the south of Barrow Island (Figure 4-7). The characteristics of each area are described below.

Latitude Point and Town Point

The Latitude Point and Town Point sites are both on the east coast of Barrow Island, which offers more sheltered waters for ship berthing than the west coast. The sites are geologically stable and are on relatively flat terrain. The sites are close to existing operations and either involve, or are close to, areas that have been previously utilised by oil operations. The feed gas pipeline to a facility would cross the island from Flacourt Bay on the west coast. To enable access to deep water, the Latitude Point site would require a 2-km jetty connecting a loading platform and a 4-km long dredged approach channel. The Town Point site would require a 4-km jetty and a 2-km dredged approach channel.¹

Surf Point

Surf Point is located on the north-east corner of Barrow Island and offers a sheltered environment for ship berthing. Deep water is relatively close to shore. Potential sites are heavily restricted due to the presence of sensitive vegetation associations and sandy, unstable soils. The north of the island is also relatively undisturbed and is the furthest point on the island from the existing oil operations. The onshore section of the feed gas pipeline between the shore crossing and the facility would be relatively short. The site would require a 2-km jetty connecting a loading platform to the shore and a 4-km-long approach channel with dredging at isolated areas along its length.

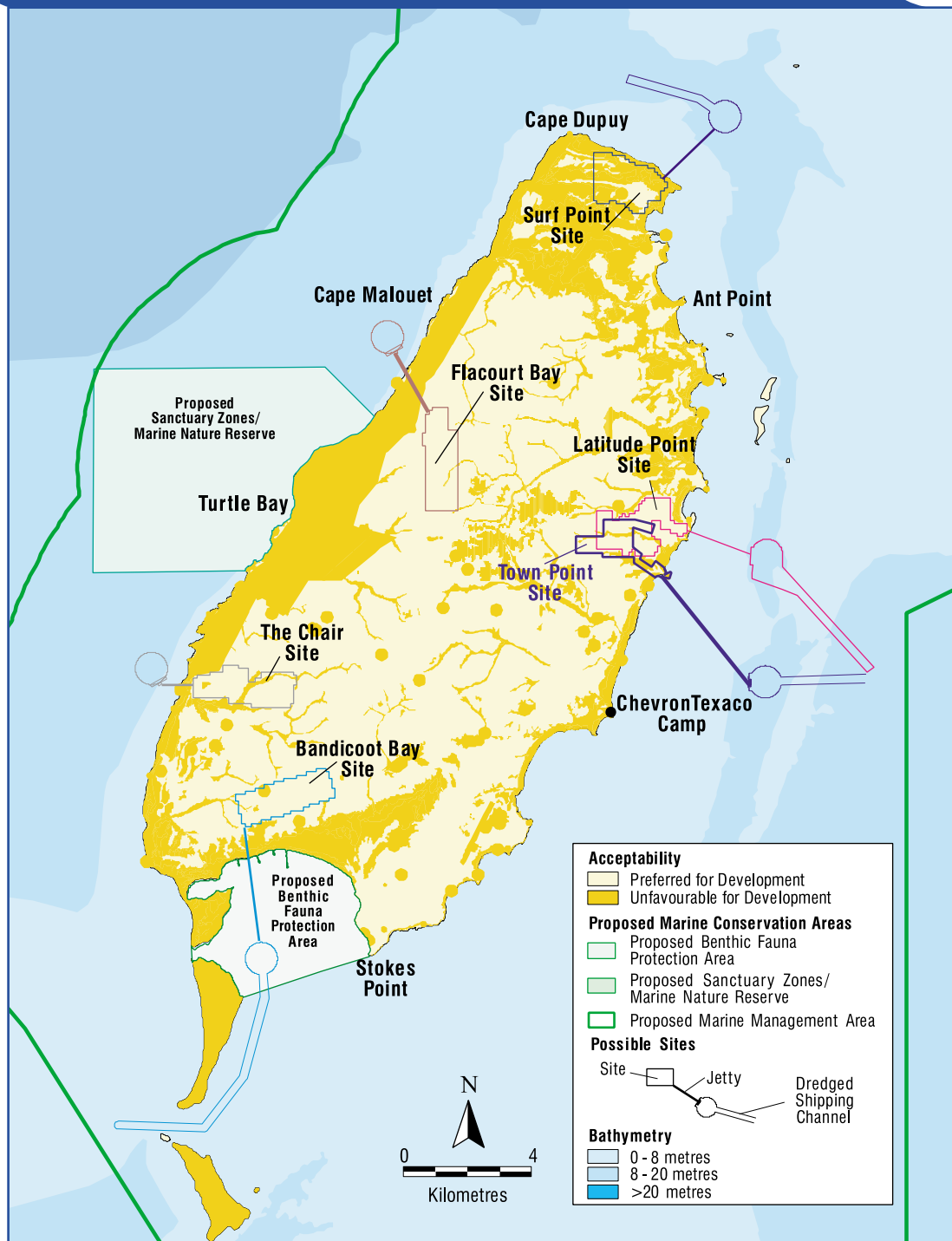
Flacourt Bay and The Chair

The Flacourt Bay and The Chair sites are located on the west side of Barrow Island which offers access to deep water close to the shoreline and allows the plant site to be located closer to the landfall of the feed gas pipeline. It does however place the marine terminal operations in a more severe swell wave climate adversely affecting port availability for unprotected jetty sites. The terrain is relatively flat and stable in structure. These sites are adjacent to the sensitive rock wallaby habitat on the west coast. Flacourt Bay site would require a 700-m breakwater and a 1-km jetty connecting a loading platform to shore. The Chair site would also involve a jetty of approximately 1 km. Neither site would require dredging.

¹ As the development options are conceptual at this stage, all measurements are approximations. Figures have been kept as rounded numbers at this stage.

FIGURE 4-7

Possible Sites for the Gas Processing Facility on Barrow Island



Bandicoot Bay

The south of Barrow Island offers no access to deepwater close to shoreline. The Bandicoot Bay site is located within the existing oil operations in an area of relatively flat topography away from significant vegetation associations and terrestrial fauna habitats. The site would require a 3-km jetty connecting the loading platform to the site and a 9-km dredged approach channel.

4.3.3 Refined Development Concepts

Once the general areas on the island that met the broad site selection criteria had been identified, preliminary engineering studies were conducted to confirm that the plant and equipment could be located in a manner that would avoid significant impacts to environmental values. The studies also provided greater detail to the conceptual design and layout to enable the preliminary cost calculations and comparison of safety and practicality of operations that would be required as part of the next step in the site selection process. The studies considered a common concept for the gas processing facility in terms of plant, equipment and processes. The differences in environmental impacts, safety, operations practicality and cost were therefore directly related to the differing attributes of the sites themselves and those components related to LNG tanker loading.

Early in the screening process The Chair and the Bandicoot Bay sites were rejected based

on these key criteria. In particular, the marine components of The Chair site would be exposed to severe ocean conditions. The steeply shelving sea floor and significant cyclone wave loading in this area mean that a breakwater shelter would be prohibitively expensive. The Bandicoot Bay site would require an exceptionally large amount of dredging. This would not only impose unacceptable construction and maintenance costs, but also would pose safety hazards for shipping and impact on areas important for marine benthic fauna and migratory birds.

Comparison of Alternative Sites

The engineering studies refined the development concepts sufficiently to allow the characteristics of each site to be compared. The environmental, technical and economic aspects of each site are summarised in Table 4-4.

4.3.4 The Preferred Site

The Gorgon Venture concluded that Town Point would be the preferred site for the gas processing facility at this stage as it was considered to best meet the selection criteria. That is, even though development at this site would be the most expensive (incurring costs in the order of \$180 million more than at Surf Point), the Town Point Site would present a significantly lower level of environmental impact and offer safe and practical marine operating conditions.



ALTERNATIVE DEVELOPMENT CONCEPTS

TABLE 4-4

Summary of Site Characteristics

Site/Concept	Town Point	Latitude Point	Flacourt Bay	Surf Point
Relative Cost	Reference Point	- \$60 million	- \$130 million	- \$180 million
Environmental	- Facility would be located close to the area of existing oil operations - Facility would avoid bettong habitat and restricted vegetation associations - Marine channel dredging is distant from coral accumulations - The jetty and MOF would be located on a rocky point reducing impacts to adjacent beaches - Feed gas pipeline would cross rock wallaby habitat	- Facility would be located close to the area of existing oil operations - Restricted vegetation associations would be largely avoided - The jetty and MOF would be located on rocky point reducing impacts to adjacent beaches - Facility would be close to and partially surround bettong habitat - Feed gas pipeline would cross rock wallaby habitat - Dredged turning basin and channel are adjacent to coral accumulations	- Facility would be located adjacent to the area of existing oil operations - Restricted vegetation associations would be easily avoided - Construction and operation of breakwater and jetty would be adjacent to an important turtle nesting beach at Flacourt Bay and in close proximity to the proposed marine protection area - MOF/Jetty access corridor crosses important rock wallaby habitat	- Facility would be located distant from areas of existing oil operations - Facility would directly impact large areas of restricted vegetation associations - The sandy soils of the low dune areas are relatively fragile and would be prone to erosion once disturbed - Feed gas pipeline would avoid rock wallaby habitat, but would cross areas of restricted vegetation associations
Technical	- Stable soils and minimal amount of earthworks required at site - Good coastal access for jetty and MOF via rocky outcrop at Town Point - Adjacent to existing oilfield infrastructure - Moderate access to deep water via jetty (3.9 km) and dredged channel (2.3 km) - Impact of nearshore currents on marine operations to be verified but likely to be moderate	- Stable soils and minimal amount of earthworks required at site - Good coastal access for jetty and MOF via rocky outcrops at Latitude and Town Point respectively - Adjacent to existing oilfield infrastructure - Moderate access to deep water via jetty (2.0 km) and dredged channel (4.3 km) - Adjacent to existing oilfield infrastructure - Strong nearshore currents in the natural channel running down the east side of the island will impact marine operations and increase the probability of regular maintenance dredging	- Stable soils and minimal amount of earthworks required at site - Poor coastal access for jetty and MOF requires significant earthworks in corridor through coastal cliffs and gullies. Could be reduced by relocating MOF to opposite side of island if roads across island are upgraded - Good access to deep water via 1.4 km jetty - Marine berth must be protected from significant swell by construction of a large breakwater, although vessel approach and pilot transfer are still vulnerable	- Relatively unstable soils and moderate amount of earthworks required at site - Moderate coastal access for jetty and MOF through dunes to low rocky coastline - Good access to deep water via jetty (2.0 km) and dredged channel (1.9 km) - Strong nearshore currents in the natural channel running down the east side of the island will impact marine operations and increase the probability of regular maintenance dredging - The East Spar and Wonnich pipelines would need to be relocated to allow construction of the dredged channel

* Note: "Relative Cost" relates to those components of the development concept that vary between sites. That is, these are not total construction costs.

4.4 The Option to Defer or Not Develop

The alternative exists to defer or not develop Gorgon area gas. Not developing Gorgon area gas would result in a lost opportunity to capture the economic, social, strategic and net conservation benefits described throughout this document. It also does not support government legislation and policy objectives to expeditiously develop the nation's resources.

The impact of a decision to defer the development will result in a deferral or potential loss of the benefits described herein. For example, Australia competes with other countries including Indonesia, Malaysia, Russia and Qatar in winning new LNG contracts in Asia. Market opportunities only periodically become available and if won by other countries become lost to Australia. A short delay in the project can therefore result in a long delay in achieving the benefits.

A deferral could also result in a long-term impairment of economic growth if exploration activity for new gas resources is deferred or cancelled due to slow development of existing discoveries.

4.5 Conclusions

Following years of marketing and concept development work, substantiated by a systematic and a rigorous selection process, the Town Point site on Barrow Island was identified as the preferred site for the Gorgon gas development.

The assessment determined that in addition to being critical to commercial viability a Barrow Island site can also meet the necessary technical environmental and social requirements and constraints, and provides a unique opportunity to re-inject reservoir CO₂. On Barrow Island, Town Point presents an acceptable economic solution while significantly improving the environmental outcome over other sites.

The option to defer or not develop the resource results in a significantly less favourable outcome for Western Australia, Australia and the Pilbara when environmental, economic, social and strategic factors are considered.



GORGON GAS DEVELOPMENT CONCEPT

The Gorgon gas development concept involves sub-sea production facilities, tied back to a gas processing facility located on Barrow Island. Potential products, such as Liquefied Natural Gas (LNG) and condensate would be exported by ship, with the domestic gas being supplied to the mainland via an export pipeline.

A range of potential Barrow Island sites met the broad criteria for the gas processing facility. However, at this early stage of development, Town Point is the preferred site as it presents the best solution considering engineering, operational, economic and environmental criteria.

A gas processing facility on Barrow Island would be designed, built and operated in a manner that protects the important environmental values of the island and the surrounding marine areas.

Current market opportunities identified by the Gorgon Venture indicate that the initial development for Gorgon gas would most likely be an LNG development. The concept described in this chapter, used to support the assessment undertaken in Part II of this document, is based on gas processing facilities to produce LNG and domestic gas.

The development outlined in this chapter is conceptual. Detailed engineering and design studies would be conducted if in-principle approval is granted. This chapter indicates the type, nature and scale of infrastructure, workforce and activities that could be expected and focuses on those aspects of the development that have environmental, social, economic or strategic implications. While the engineering details of this development are in their early stages, the concept has evolved from detailed technical studies and screening work conducted over the past decade.

5.1 Overview

The Gorgon gas development will require a range of infrastructure to extract and transport natural gas from the Gorgon gas field to Barrow Island for processing and delivery to domestic and international markets.

The development allows for three distinct components (see Figure 5-1):

- Town Point Gas Processing Facility
– located on Barrow Island.
- Offshore Infrastructure
– for the production and transport of gas from the Gorgon area gas fields to Barrow Island.

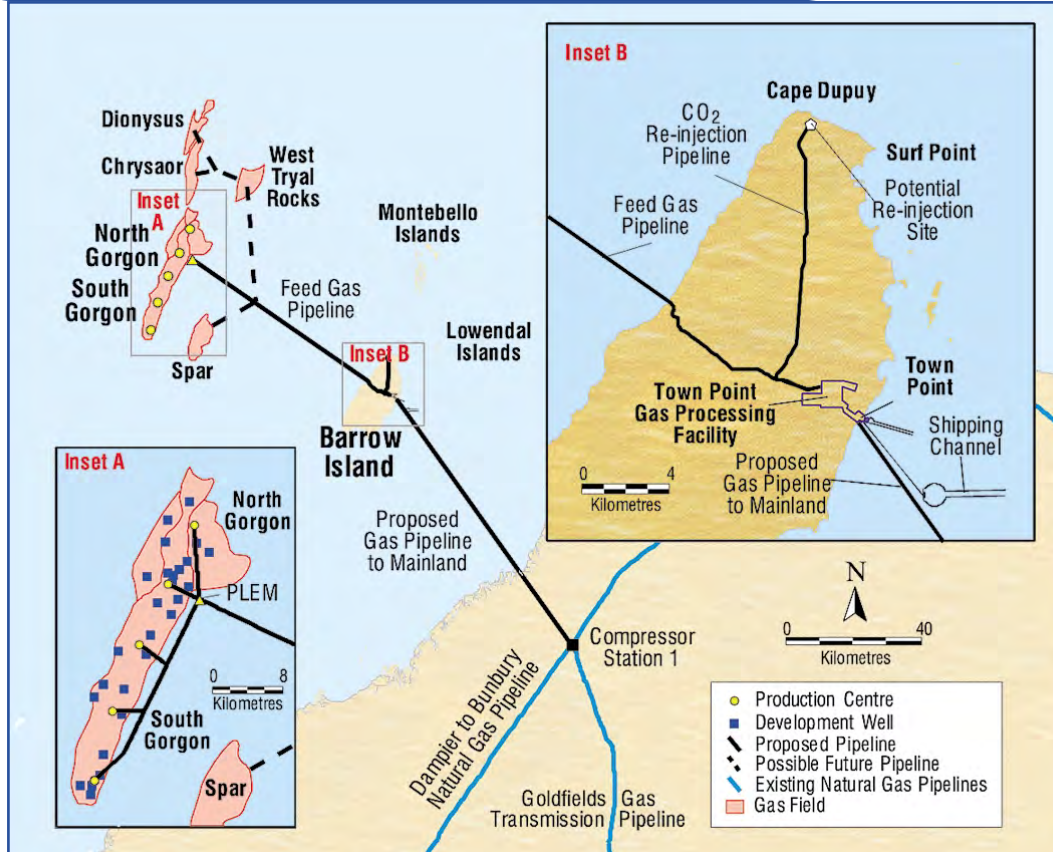
- Domestic Gas Infrastructure
– a proposed gas pipeline to the mainland from Barrow Island.

Approval to proceed with either the entire LNG and domestic gas development used as the reference case, or individual portions of it, is dependant on successfully securing a market.

The processing facility would occupy an area at Town Point on the central-east coast of Barrow Island. In addition, a range of associated infrastructure would be required on the island and in the adjacent marine area including: administration and accommodation facilities, materials lay-down area, materials

FIGURE 5-1

Proposed Gorgon Gas Development



offloading facility, feed gas pipeline and conventional product loading jetty. The total area occupied by the processing facility and associated infrastructure would be no more than 300 ha.

The preferred offshore development concept is the utilisation of sub-sea facilities. A sub-sea development was selected as it offered the best economic, environmental and safety solution by eliminating the need for offshore platform based facilities.

The Gorgon gas development will also be designed to allow the future addition of a pipeline to the mainland.

The Gorgon Venture is committed to designing and constructing a world-class development with best-in-class environmental performance and a competitive cost of supply. To achieve this, the design of a Barrow Island gas processing facility is driven by principles such as:

- minimising impact on the surrounding environment by avoiding areas of high conservation value
- minimising vegetation clearance
- minimising discharges to the environment
- high thermal efficiency minimising the use of resources
- adopting technologies which reduce emissions and minimise environmental impact

All necessary regulatory requirements such as licences, environmental approvals, and health and safety requirements would be met by the development as part of the planning, design, construction and operation of the gas processing facility.

The purpose of this chapter is to define the major elements of a gas processing facility at Town Point. The development described here has been used as the basis to assess the implications and define management strategies that are presented in Part II of this document.

5.2 Town Point Gas Processing Facility

The gas processing facility would be located at Town Point on the central-east coast of Barrow Island (Figure 5-1).

The final site selection and layout will depend on environmental, engineering, cultural and economic considerations. The cleared footprint for the facility and associated infrastructure would be minimised and would seek to utilise existing areas of disturbance where possible. Standard earthmoving equipment and limited blasting will be used to prepare the site for the facility.

The gas processing facility would be designed for continuous operation, supervised by on-site operations staff working on a shift roster. Major maintenance will be executed in short duration campaigns, typically on an annual basis. Plant safety and environmental protection will be an integral part of the facility design with automated systems for process containment and controlled shutdown in the event of any operational upset.

The conceptual facility layout is shown in Figure 5-2.

5.2.1 Footprint

The estimated footprint area was based on an initial conceptual layout for the proposed facilities. This included allowance for any potential disturbance between each of the plant components (such as the area between the administration buildings and the LNG trains), estimates of areas required for the construction camp, lay-down area, pipeline corridors, extension of existing common facilities (such as roads and the airport) and for future expansion of the foundation gas processing plant.

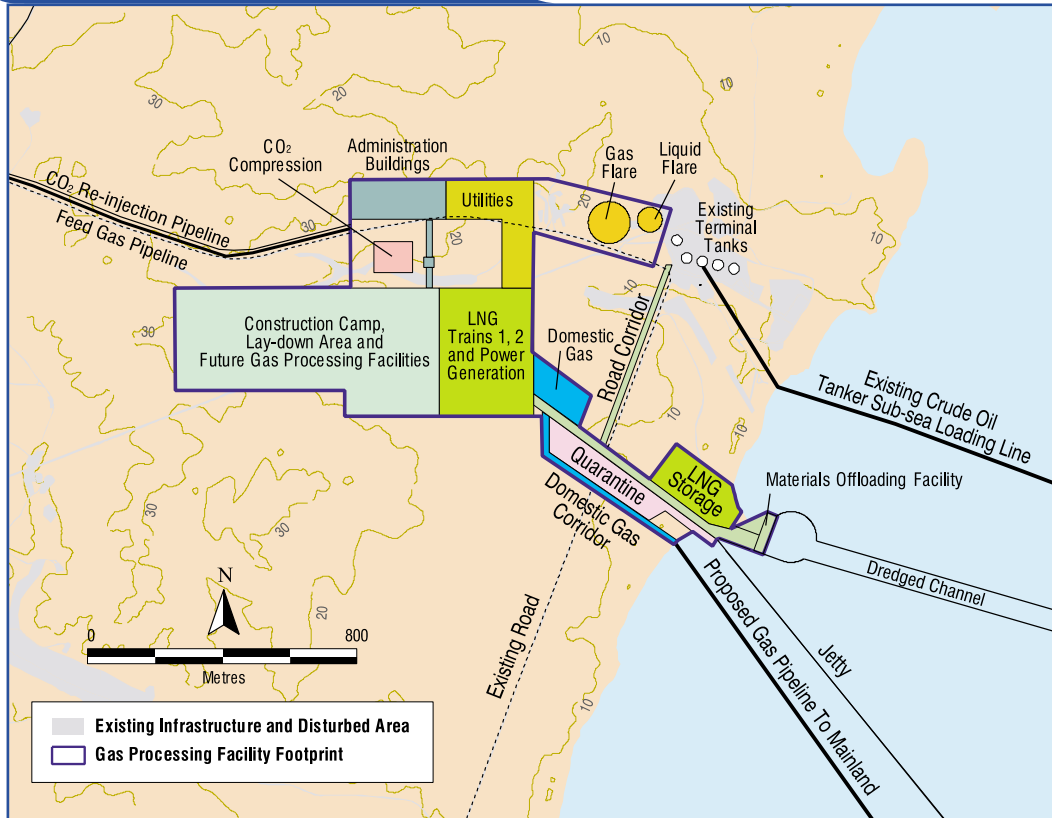
The eventual area to be cleared for the gas processing facility and associated infrastructure would be no more than 300 ha. This area consists of the main plant site, lay-down areas, temporary accommodation for the construction workforce, pipeline corridors across the island and any expansion of common infrastructure on Barrow Island, such as roads to support the Gorgon gas development. Areas within the footprint would be cleared only as required for development and wherever practicable the cleared area will be minimised.

5.2.2 Gas Processing

The development of the gas processing facility would occur in different phases based on market demand. This has been assumed to be achieved via the construction of one LNG train with a nominal capacity of five million tonnes per annum (MTPA) and a second similar capacity train as soon as there is sufficient

FIGURE 5-2

Conceptual Facility Layout



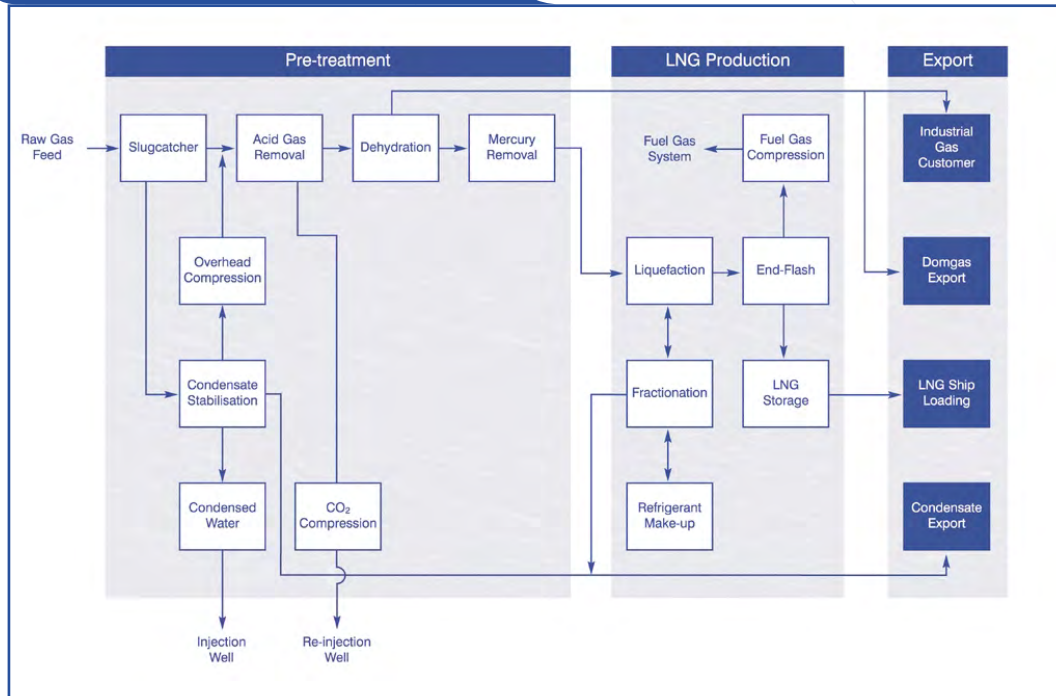
market demand (anticipated to be within a few years of the first train). Additional gas processing facilities eventually developed within the limit of the 300 ha area would be designed, constructed and operated in accordance with the commitments set out in this document and subsequent regulatory approvals.

The gas processing facilities described below are based on potential LNG processes that are being considered. The final process that is selected may differ from that presented here, but the anticipated environmental implications would be consistent with the described concepts.

The gas processing facility would separate gas and condensate (light oil) received from the Gorgon gas fields. After separation from the gas, the condensate will be stabilised prior to shipping to market. The gas component of the stream will then be treated to remove carbon dioxide (CO₂), hydrogen sulfide (H₂S), trace amounts of mercury (Hg) and water vapour. At this point the gas can be either liquefied for export as LNG, compressed and exported as domestic gas (once the domestic gas export pipeline is installed) or utilised as feed gas for other gas processing facilities. The gas facility is shown schematically in Figure 5-3 with LNG as the foundation development. The stages of processing are outlined below.

FIGURE 5-3

Typical Gas Facility Process



Pre-treatment

The first stage of the gas processing facility involves removal of condensate and condensed water from raw feed gas in a slug-catcher. The feed gas is then stripped of CO₂ in an "acid gas" removal process. The CO₂ (with minor levels of H₂S and hydrocarbons) would be re-injected into saline reservoirs 2000 m below Barrow Island to avoid emission of greenhouse gases to the atmosphere (see Chapter 8, Greenhouse Gas Management). The CO₂ separation technology would be selected to ensure that the quantity of hydrocarbons including any benzene, toluene, ethyl-benzene and xylene (BTEX) captured and re-injected with the CO₂ is minimised.

Feed gas then enters a dehydration unit where water vapour is removed from the gas to below one part per million of volume. This prevents ice from forming in any downstream cryogenic

equipment. At this point the gas can be utilised as feed gas for an LNG liquefaction facility, domestic gas facility or other gas processing facility, with only slight differences in required specifications (such as the concentration of inert gases). Domestic gas would be compressed for export to the mainland.

The final step prior to liquefaction is to remove any mercury. This prevents elemental mercury from causing degradation of the aluminium used in the main cryogenic heat exchanger (MCHE). The carbon absorbent in the mercury removal beds would be returned to the supplier for regeneration and capture of any mercury.

LNG Production

The treated gas is liquefied and sub-cooled to approximately -150°C in the MCHE and is thereafter referred to as Liquefied Natural Gas (LNG). Any heavy liquid hydrocarbons (C₅⁺) are

removed just prior to liquefaction by a 'scrubbing' column and fed to the fractionation unit.

A mixed refrigerant cooling cycle (of ethane, propane, nitrogen and methane) would most likely be used as the cooling medium for the MCHE. Mixed refrigerant vapours are compressed and then condensed using air-coolers eliminating the need for water cooling. This has a substantial environmental benefit.

The fractionation unit receives liquids from the liquefaction unit. The fractionation unit consists of three distillation columns that separate gases as ethane (C₂), propane (C₃), butane (C₄), and pentane and heavier products (C₅⁺). Some of the ethane (C₂) and propane (C₃) will be stored to serve as make-up for the mixed refrigerant. The remainder of the gas streams are re-injected into the LNG. Heavier products (C₅⁺) would be exported as condensate.

Prior to storage for export, the LNG is "flashed" down to atmospheric pressure. Flashing chills the LNG to approximately -161°C to stabilise it as a liquid for storage at atmospheric pressure. Flashed gas would also be utilised as fuel gas for development facilities.

Domestic Gas

Compressed domestic gas would be exported via a sub-sea pipeline connected to the Western Australian domestic gas pipeline network.

Condensate

Condensate would be separated from feed gas during initial pre-treatment and fractionation. Condensate is then stabilised via further removal of water and dissolved gas. It is currently envisaged that condensate would be exported through facilities associated with the existing Barrow Island oilfield operations.

5.2.3 Associated Facilities

A mix of permanent and temporary facilities, located at the Town Point gas processing facility, would be required during the construction and operation of the development.

Materials Offloading Facility

A Materials Offloading Facility (MOF), suitable for crane, fork-lifts and heavy transport trailers, would be needed to receive equipment required for construction of the gas processing facility. The MOF would be designed to handle large modules in the range of 500 to 2000 tonnes and will be capable of "over the side" and "roll-on roll-off" operations. The equipment and prefabricated modules are likely to be delivered to Barrow Island on large ocean-going vessels which will be subject to strict quarantine procedures.

The MOF would be located immediately off the headland at Town Point and connected to the gas processing facility area by a heavy haulage road. A dedicated quarantine facility would be located along this heavy haulage road as near as possible to the MOF (Figure 5-2). Vessels would utilise a dredged shipping channel to access the MOF in all tide conditions (Figure 5-4).

The MOF channel would be dredged to a sufficient depth and width to allow safe passage of heavy lift/transport barges (approximately 6.5 m deep and 60 m wide). A turning basin of approximately 100 m and an exclusion zone would be required at the MOF. The channel route alignment should be as straight as possible and include navigation aids. Depending on the final design of the channel, the volume of dredged material could be in the order of 1.4 million m³.



The MOF facilities could also incorporate berthing and marine facilities for vessels associated with ongoing Barrow Island operations, such as tugs and pilot boats.

LNG Storage Tanks

LNG produced from a 5 MTPA train is likely to necessitate storage capacity of 200 000 m³. This volume of storage can be provided as either two 100 000-m³ tanks (approximately 50 m high and 75 m in diameter), or as a single tank of approximately 200 000 m³ capacity. Additional storage would be required for further LNG trains. The tanks would incorporate vapour recovery systems to capture any LNG vapour that boils off.

The tanks would be built on a flat area near the loading jetty and would be designed to withstand cyclonic wind forces and impact from debris.

Product Shipping and Loading

LNG occupies about 1/600th of the volume for the same weight of natural gas. Due to the massive reduction in volume when natural gas is turned into LNG, it is able to be loaded into dedicated tankers in large quantities and transported to markets around the world. LNG is colourless, odourless, non-corrosive and non-toxic, hence it can be safely transported by ship. During loading, vapour forced out of the LNG carrier tanks will be recovered.

A sheltered deepwater berth (15 m water depth) would be needed to enable LNG loading using conventional jetty and loading arms. The current plan is for the jetty to be built out to a dredged channel which would be located at the 10 m water depth contour approximately 4 km offshore from Town Point. A 2.3 km access channel would be dredged

to approximately 15 m deep and would include a 1000 m turning circle adjacent to the jetty. Dredging of the channel is expected to generate approximately 5.5 million m³ of dredge spoil (Figure 5-4).

The Gorgon Venture is continuing to study several different options for loading of LNG carriers. The final design would accommodate a variety of medium and large LNG carriers (potentially up to 200 000 m³).

Flare System

Gas processing facility flare systems collect and dispose of hydrocarbons released during start-up, shutdown, upset and emergency conditions. The height of flare for the Gorgon gas development will depend on the final facility layout and flare structure location, but is expected to be approximately 120 m.

Ancillary Buildings

The gas processing facility would incorporate a number of ancillary buildings for control, administration, engineering and support services. Most buildings would be located in the general vicinity of the processing plant. The layout and location of these buildings will be determined during the detailed design phase.

Construction Accommodation

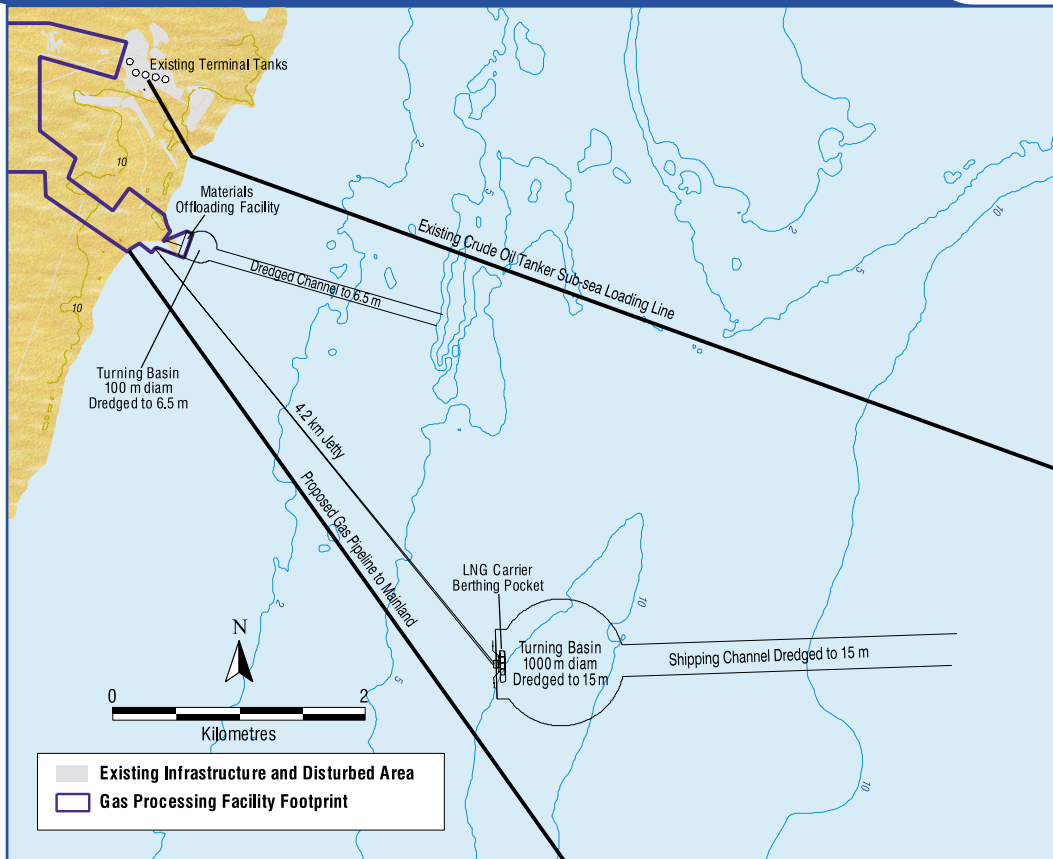
The construction workforce would be accommodated in temporary accommodation facilities within the gas processing plant site at Town Point. The accommodation would be self-contained including all recreation facilities for personnel.

Permanent Accommodation

The operations workforce would most likely be accommodated at the existing Barrow Island

FIGURE 5-4

Materials Offloading Facility and Jetty Location



operations facilities. Any cleared area required for either the expansion of these accommodation facilities or construction of any new facilities would be included within the 300 ha limit.

Stormwater Management

Stormwater run-off from hard-stand and plant areas would be collected and treated prior to disposal. It is anticipated that stormwater would be discharged into the natural drainage system following the collection and treatment of 'first flush' water during storm events, such as cyclones.

Effluent Management

Routine liquid-waste streams from the gas processing facility would not be discharged to sea. All process water and domestic effluents

will be collected and treated. The disposal method has yet to be determined, but is likely to involve use of the existing Barrow Island oil production operations water re-injection system.

Emissions to Atmosphere

Emissions of nitrogen oxides would be minimised by the use of Low-NO_x burners in all gas turbines. Emissions of sulfur oxides are expected to be low. As 75 per cent of fuel gas would be sourced from treated 'end-flash' gas that has negligible sulfur content. Initial sulfur levels in the raw feed gas would also be very low. Any hydrogen sulfide in the raw feed gas would be removed along with CO₂ in the 'acid gas' removal process and re-injected into the Dupuy saline reservoir. There would be no continuous hydrocarbon vents or emissions.

Power and Water Supply

Power for operations is likely to be generated by gas turbines located in the gas processing plant. Power from alternative sources would be required during construction.

A desalinisation plant would be installed to provide the proposed development with adequate supplies of potable, demineralised, condensate make-up (if steam is required) and fire-fighting water.

Access Roads

Existing roads would be utilised where possible. Some new roads would be constructed within the gas processing plant to provide vehicular access to various parts of the facility and MOF.

Where possible, existing tracks would be used to access the onshore pipeline easement for regular visual inspections. Any temporary access tracks required during construction would be rehabilitated.

Airstrip

It is planned that the existing airstrip on Barrow Island would be utilised to service both the construction and operations phases of the development.

Communications

Control and instrumentation equipment associated with the gas processing facility would be located within the plant area. Emergency shut-down systems would be linked between the facility, sub-sea gas gathering system and other operational facilities.

Details of control systems will be finalised during future engineering design studies. The systems may require equipment such as cables co-located with the incoming pipeline, or radio masts for telemetry links.

Mainland Support Facilities

Logistical support facilities would be required for both offshore and Barrow Island operations. A supply base would be established on the mainland to allow for berthing, loading and fuelling of support vessels and sub-sea intervention vessels, storage of construction materials, and offloading of sea deliveries material. It would also serve as a quarantine management area, where comprehensive quarantine procedures would be implemented prior to despatch of any materials or vessels to Barrow Island (see Chapter 7, Quarantine Management).

5.3 Offshore Infrastructure

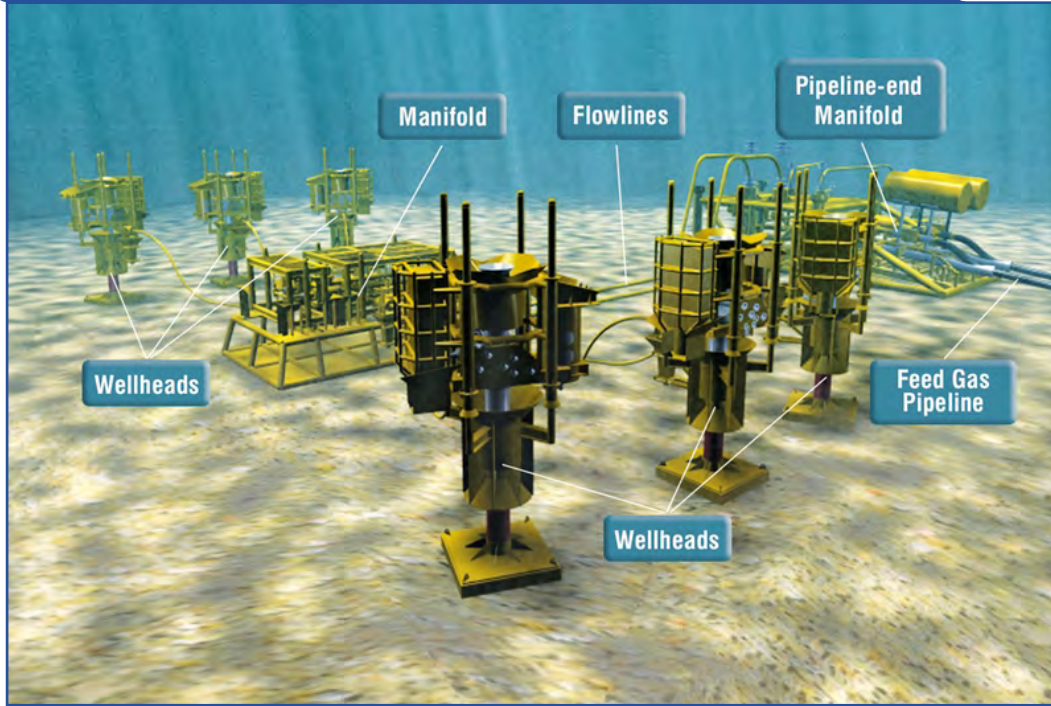
5.3.1 Sub-sea Gas Gathering System

The sub-sea gas gathering system would be located on the sea floor at the Gorgon gas fields 70 km west of Barrow Island (see Figure 5-1).

Water depths at the Gorgon gas fields are in the order of 200 m. The key components of the sub-sea gathering system include: conventional development wells, sub-sea wellhead trees, cluster manifolds, pipeline end-manifolds and flowlines (see Figure 5-5). All sub-sea equipment from the wells through to pipeline-end manifolds would be constructed from corrosion-resistant alloys.

FIGURE 5-5

Schematic Sub-sea Development Concept



Normal operation of the wells and sub-sea facilities would be remotely controlled from the gas processing facility on Barrow Island.

Requirements for offshore support, such as the provision of construction materials and maintenance, would be provided from a mainland support facility. This will ensure that offshore construction and maintenance does not impact upon Barrow Island. Remotely operated vehicles, offshore work vessels and semi-submersible drilling rigs would be used for inspection and maintenance of the sub-sea system.

Development Wells

It is anticipated that between 20 and 30 wells would be drilled in the Gorgon area gas fields over a 30-year period. The number of development wells and timing of construction will depend on future gas demand. Wells would be drilled in campaigns to optimise the efficiency of rig operations and minimise

mobilisation/de-mobilisation costs. Offshore support during the drilling campaign would be from an onshore support base located on the mainland.

Sub-sea Trees

Sub-sea trees (wellheads and associated pipework and controls) would be located on the ocean floor, and would be connected to cluster manifolds via flowlines. Sub-sea trees are usually installed by the drilling rig following well installation.

Cluster Manifolds

Well fluids from up to six wells would flow to cluster manifolds that will also be located on the ocean floor. These cluster manifolds would be designed and built so that they can be installed by a drilling or construction vessel.

Pipeline-end Manifolds

Pipeline-end manifolds (PLEMs) would combine the fluids from a number of cluster manifolds before directing the product through the feed gas pipeline to the gas processing facility.

Flowlines

Flowlines of various sizes would connect sub-sea trees to cluster manifolds and PLEMs. To maximise the efficiency of installation operations, it is likely that the initial flowlines would be installed by the same pipe-lay barge employed to install the feed gas pipeline to Barrow Island.

5.3.2 Feed Gas Pipeline

The feed gas pipeline would deliver gas/wellstream fluids from the Gorgon gas field sub-sea gas gathering system to the gas processing facility on Barrow Island.

Figure 5-1 shows the proposed pipeline route. The feed gas pipeline would be approximately 70 km long. The final 9 km of the pipeline would travel across Barrow Island.

The anticipated pipeline diameter would be in the range of 660–915 mm and will operate at a nominal pressure of 15 MPa. The operating pressure and diameter may vary based on the finalised design requirements.

The feed gas pipeline would be a welded, high-strength steel pipeline designed to incorporate the most recent available data and recommended practices and comply with relevant Australian and International Standards.

The integrity and safe operation of the pipeline would be assured by compliance with Australian Standard AS 2885.4 and development and implementation of a development-specific management plan. External inspection/survey of the operating pipeline would be undertaken to verify any deviation from design parameters. Corrosion of the pipeline, both internal and external, would be minimised and managed by a combination of design, anti-corrosion coatings and materials such that the integrity is not at risk.

Offshore Section

The offshore section of the pipeline would be installed on the seabed, possibly via a pipe-lay vessel supported from the mainland. The offshore pipeline route has been evaluated to determine construction requirements. Various methods could be used to stabilise the pipeline, such as trenching into the seabed by ploughing or dredging and/or installing concrete mattresses, rock bolting and rock berms. These measures will protect the pipeline from disturbance due to storm waves and currents and potential impact from ships' anchors and other objects. The final design of the stabilisation and protection methods would be determined after detailed risk analysis and consultation with stakeholders.

Shore Crossing

The shore approach and proposed crossing location has been evaluated as the one which minimises impact on important marine habitats. Detailed site investigations would be performed to provide comprehensive data on

Shore Crossing at Flacourt Bay



environmental implications of the shore crossing and most appropriate design and construction methodology. The range of construction options that are being considered for the shore crossing include conventional excavation and burial methods, and directional drilling. The final method would be selected to minimise environmental disturbance while also meeting a range of safety and engineering requirements. The proposed shore crossing site near Flacourt Bay is shown in Figure 5-6 and Plate 5-1.

Onshore Section

The onshore section of the feed gas pipeline would be designed to minimise environmental impact such as impediment of fauna movement and soil and vegetation disturbance across the pipeline route.

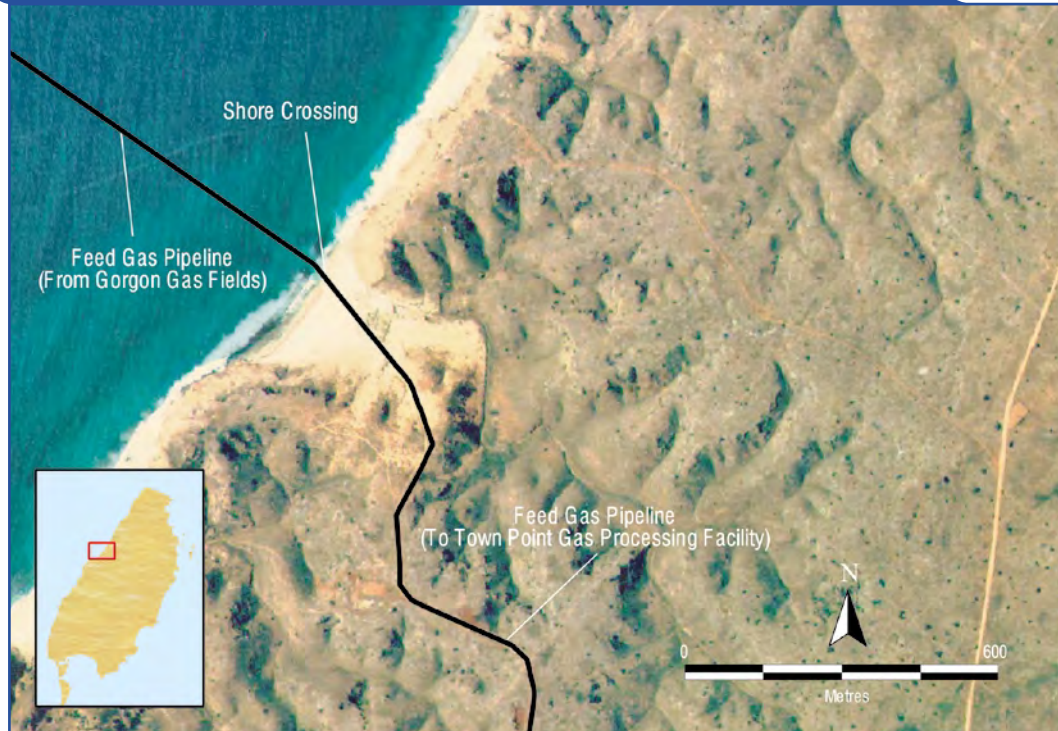
The feed gas pipeline would be constructed within a maximum easement of 30 m in width with occasional turning-circles for long vehicles. Most of the pipeline easement would be rehabilitated and serviced by existing roads.

5.4 Domestic Gas Infrastructure

5.4.1 Pipeline to Mainland

The Gorgon Venture is currently assessing several alternatives for gas delivery to the mainland. This could involve construction of a new large diameter pipeline to the mainland. This pipeline would be in the order of 80 km in length and would tie-in to the existing mainland pipeline network, possibly at Compressor Station Number 1. Alternatively, processed gas could be delivered to the State gas transmission pipeline network by connecting into existing pipeline infrastructure in the vicinity of Barrow Island (Figure 5-1).

Any new gas pipelines would be constructed in accordance with relevant Australian and International Standards as for the feed gas pipeline. Prior to operation they would be leak tested and pressurised to confirm their integrity. During normal operations the pipelines would operate at high pressure (approximately 10 MPa).

FIGURE 5-6**Proposed Flacourt Bay Shoreline Crossing – Barrow Island**

5.5 Workforce

A peak workforce of approximately 2200 personnel may be required for construction on the island. Construction techniques such as modularisation are being explored which may reduce personnel requirements to 1700 at peak construction. According to current estimates, 150 personnel would be required on the island for operations. Table 5-1 summarises the peak construction workforce.

In addition to the workforce presented in Table 5-1, several hundred personnel would be required for offshore construction. It is anticipated that the majority of the offshore work would be completed prior to reaching the peak employment levels. Offshore construction personnel will not be accommodated on Barrow Island.

5.5.1 Construction

Local services, labour and provisions would be used where practicable during construction of equipment and facilities associated with the Gorgon gas development.

All offshore construction personnel would be accommodated on offshore vessels at their worksite. A small contingent of personnel (10 to 20 persons) would be required on the mainland for logistical support (e.g., barge supplies and crew transfers).

The construction crews for the onshore sections of the pipelines on Barrow Island would be accommodated at the temporary accommodation facilities within the gas processing facility site. Accommodation requirements would be minimised by fly-in fly-

out work schedules and personnel will return to their point of hire as soon as their work is complete.

The majority of the construction work force would be housed in the temporary accommodation facilities on Barrow Island during their field roster. The facilities would be located within the gas processing facility site area to reduce environmental impacts from transportation. Buses may be used to transport personnel, where required, to and from the accommodation facilities to the workplace as required.

Chapter 6 contains an additional description of anticipated workforce control to reduce environmental impact.

5.5.2 Operation

During normal plant facility operations, it is estimated that approximately 150 workers would be required on site. These personnel would mostly be ChevronTexaco employees. Accommodation is likely to be provided in the existing operations camp location.

5.6 CO₂ Removal and Re-injection Facilities

Carbon dioxide separation and compression utilities would be integrated into the gas processing facility. A pipeline would be required to transport compressed CO₂ to re-injection wells which would be located at the northern end of Barrow Island (see Chapter 8, Greenhouse Gas Management). Construction would be undertaken in a similar manner and timeline as the onshore section of the feed gas pipeline.

5.7 Decommissioning

The current design life for the gas processing facility is 30 years, but may be extended. All facilities would be designed to facilitate eventual decommissioning. The time of decommissioning is unknown at this stage, however decommissioning will only occur after it is considered that there is no further economic use for the facilities associated with the development.

TABLE 5-1

Peak Workforce Size

Phase	On Barrow Island	Mainland Support (Off Barrow Island)	Off Barrow Island (Leave)
Construction Phase	2200	300	400
Operational Phase	150	300	150

The decommissioning of all offshore facilities are covered by International Maritime Organisation (IMO) resolutions, the Commonwealth *Environment Protection (Sea Dumping) Act 1981* (which implements the IMO's *London Convention 1972*) and the Commonwealth *Petroleum (Submerged Lands) Act 1967*.

The pipeline will also be covered by the Western Australian *Petroleum (Submerged Lands) Act 1982* and the *Petroleum Pipelines Act 1969*. The requirements of all these legislative instruments will be met. The main considerations of the above regulations are that safety of navigation is ensured, that marine pollution is prevented and controlled, and that the marine environment is protected.

Decommissioning of onshore facilities will also be conducted in accordance with legislative requirements. It is expected that decommissioning would include removal of above-ground structures including the feed gas pipeline and plant facilities. A detailed decommissioning plan would be submitted to relevant authorities for approval prior to implementation.

As the life of the proposed Gorgon gas development is expected to be in excess of 30 years, there will be changes to decommissioning procedures and regulatory requirements that incorporate advances in technology and information. At the time of decommissioning, further studies, such as a life-cycle analysis, will be conducted to determine the most appropriate decommissioning procedures to prevent or minimise all potential adverse environmental effects to the greatest extent practicable.

5.8 Development Schedule

The Gorgon gas development would be implemented as per the following three phases:

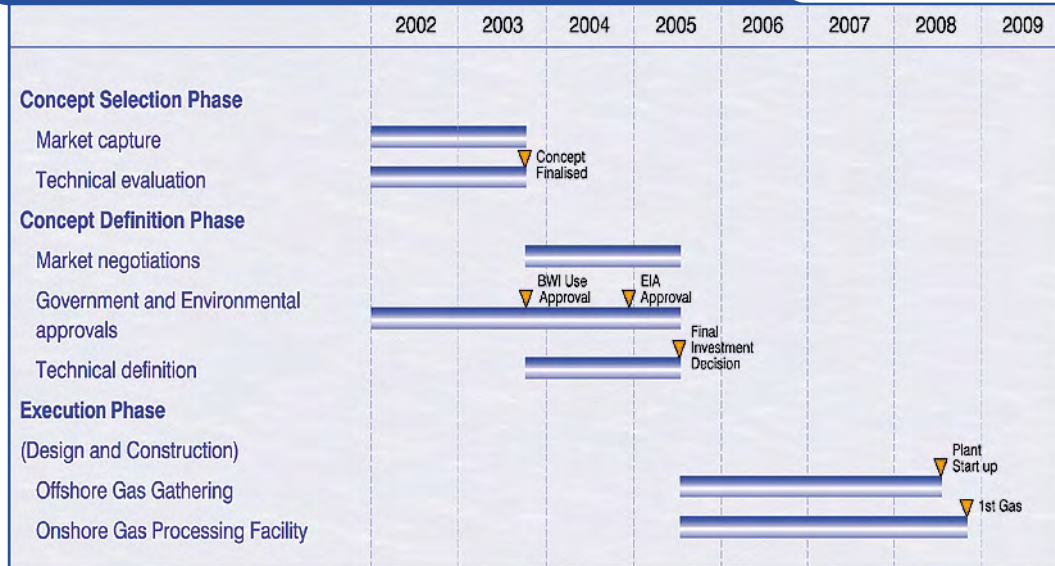
1. Concept selection phase – includes securing the market for Gorgon gas, in-principle approval for use of Barrow Island and further technical work on the development concepts.
2. Concept definition phase – would include negotiation with potential customers, government and environmental approvals for a specific development and technical refinement of the development concept.
3. Execution phase – includes the detailed design, procurement, construction and commissioning of the gas processing facility.

An indicative strategic schedule for the development is shown in Figure 5-7. The schedule for the gas pipeline to the mainland depends on securing a domestic gas market. For the purposes of economic analysis it has been assumed to be operational by 2012.

Field development work is scheduled to commence as early as mid-2005 with the aim of being ready for start-up in 2008. The field would have a life of up to 30 years with additional future opportunities extending the production life of the Town Point gas processing facility beyond that time.

FIGURE 5-7

Indicative Development Schedule





ECOLOGICAL REVIEW

6

Barrow Island is an important refuge for rare wildlife species and is free from introduced animals. Some of the wildlife species are endemic to the island and others are extinct, or near extinct, on the mainland.

ChevronTexaco has been actively involved with oilfield operations on Barrow Island for over 40 years, during which time it has demonstrated a clear commitment to protecting the conservation values of this world-class nature reserve. Throughout this period ChevronTexaco has acquired invaluable knowledge of the island's conservation values, and of management of oilfield activities within a Class A Nature Reserve. On this basis and with expansion of an environmental management program, ChevronTexaco as operator of the Gorgon gas development, seeks restricted use to Barrow Island in a manner that continues to maintain the island's biodiversity and conservation values.

As detailed throughout this chapter, adverse development impacts to important wildlife habitats, restricted vegetation types, and marine habitats with conservation significance can be successfully prevented. Best practice management options that would minimise or prevent any impact on conservation values are also presented, and a formal Conservation Agreement between the Department of Conservation and Land Management and the Gorgon Venture is proposed.

This chapter demonstrates that the Gorgon Venture would apply principles of sustainable development in that the development would not disrupt the ecological structure and function of Barrow Island. More specifically, it would not affect marine areas that have particular conservation significance; not affect rare flora, and be extremely unlikely to threaten the survival or genetic diversity of any flora or fauna on Barrow Island. This would be achieved in part by strict management of the areas of disturbance, with the commitment that the development would occupy an area not more than 300 ha for the life of the development.

In addition, as operator of both the oil and gas ventures on the island, ChevronTexaco would seek to coordinate between the ventures on an enhanced rehabilitation program to progressively reduce the total operational footprint over time. As detailed previously in this report, the preferred site for the gas processing facility is located at Town Point on the east coast of Barrow Island. Assessment of possible impacts of the proposed development to marine and terrestrial environments is discussed contingent upon the development of the Town Point site.

6.1 Marine Environment

The marine environment around Barrow Island is comprised of diverse habitats and fauna that are characteristic of the Pilbara Offshore bioregion (Osborne *et al.* 2000). Intertidal mangroves, sand and mud flats, coral communities and macroalgae beds are the most important in terms of productivity. Seagrass can occur on sheltered sand bottom areas, however there are no extensive areas of dense seagrass known around Barrow Island.

Two marine habitats at Barrow Island have been identified as having regional conservation significance (Wilson *et al.* 1994), namely:

- the coral community at Biggada Reef, off the western coast of Barrow Island
- the extensive intertidal mud and sand flats within Bandicoot Bay, at the south of the island

Western Australian Government planning for the proposed Barrow–Montebello Islands Marine Conservation Reserve has recognised the importance of these areas and they are likely to be afforded a higher level of protection within the reserve. Other waters around Barrow Island are likely to be proposed as marine management areas – a classification that recognises both conservation and societal or economic values.

Barrow Island marine fauna are regionally widespread. However, the island's subtidal and intertidal habitats support locally important populations of certain species that have high conservation value, including marine mammals, sea turtles and seabirds.

Specific investigations were undertaken by independent, specialist ecologists (see Chapter 2) to identify and record the key marine resources in the Barrow Island area that may be affected by the Gorgon gas development. These resources were reviewed in terms of their relative importance to the island's ecological function and conservation values. The results of these studies, summarised in Section 6.1.1, indicate that the proposed Gorgon gas development would not affect marine areas that have particular conservation significance.

6.1.1 Key Values

Benthic Habitats

The main benthic habitats around Barrow Island include:

- rocky shores, intertidal limestone reef platforms and offshore reefs
- intertidal mud and sand flats
- mangroves
- sandy beaches
- coral communities
- subtidal limestone pavement with sand, silt or rubble veneers supporting macroalgae and sparse seagrass

Subtidal pavement, exposed or overlain with silt/sand/rubble and with attached algae and invertebrates (Plate 6-1), is the most widespread benthic habitat in the area (Osborne *et al.* 2000), (Technical Appendix D – see enclosed CD for details of marine and intertidal environmental surveys).

6

PLATE 6-1

Limestone Pavement with Sand Veneer and Attached Algae and Invertebrates

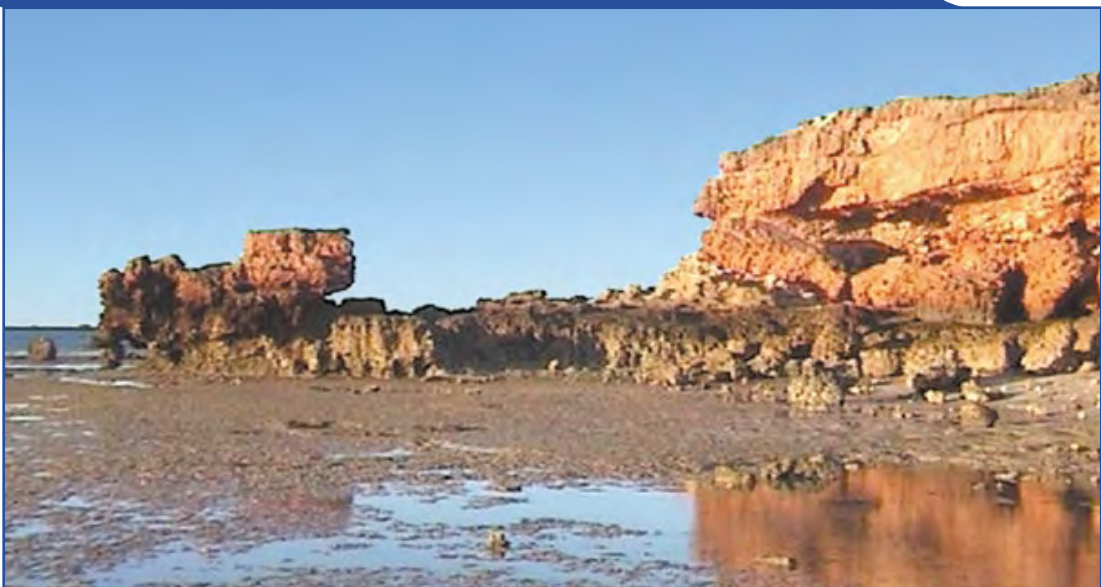


Intertidal reef platforms and mud and sand flats are well developed along the east coast of Barrow Island (Plate 6-2) as well as in the south in and around Bandicoot Bay (Plate 6-3).

The intertidal flats support highly abundant and diverse invertebrate communities and provide important habitat for numerous species of fish and seabirds, including transequatorial migratory waders.

PLATE 6-2

Intertidal Reef Platform North of Latitude Point



Extensive Intertidal Reef Platform at Bandicoot Bay

Sandy beaches occur on both the east and west coasts of Barrow Island. The beaches typically extend between areas of rocky headlands (Plate 6-4). They tend to be relatively narrow and contains very few species, but comprise important habitat for nesting sea turtles and seabirds.

Mangroves are not found in abundance at Barrow Island. Nevertheless, Barrow Island's mangrove communities are highly productive and well developed relative to other nearby islands.

Coral communities consist of mainly patchy or fringing reefs located on deeper margins of offshore reefs or intertidal platforms. The most significant coral reef occurs at Biggada Reef on the west coast, but there are also several isolated coral communities on the east coast of the island, including Dugong Reef off the south-east coast (Plate 6-5).

Infrastructure for the proposed Gorgon gas development would occur at two specific locations at Barrow Island: Flacourt Bay on the west coast (Plate 6-4), where the gas feed pipeline would arrive; and the intertidal and subtidal areas adjacent to Town Point on the east coast (Plate 6-6), where a materials offloading facility (MOF) and jetty would be constructed. A dredged turning circle and jetty head for product shipping would also be located offshore from this site.

East Coast

The marine environment surrounding the coastal and marine components of the proposed development on the east coast includes: the southern end of the Lowendal Shelf; the deeper water passage between Barrow Island and the shelf; and submerged pavement reef and emergent intertidal reef adjacent to the east coast.

PLATE 6-4

Sandy Beaches Interspersed Between Rocky Headlands at Flacourt Bay



The major benthic habitats in the area are shown in Figure 6-1, and comprise:

- bare sand
- shallow limestone pavement reef with macroalgae
- deeper limestone pavement reef with filter-feeding invertebrates
- coral bombores and reef

The subtidal benthos of the area is dominated by limestone pavement, covered with sand veneers of varying depth or attached macroalgal and filter-feeding invertebrate communities (Plate 6-1). Bare sands overlie the limestone pavement in many parts of the area, with increased rubble on exposed pavement in areas subject to stronger water currents. Areas of exposed rock in shallower waters are generally dominated by brown macroalgae, particularly *Sargassum* (Plate 6-7).

PLATE 6-5

Coral Community at Dugong Reef



In deeper areas, filter-feeders such as gorgonians, sponges and soft corals predominate. This habitat is typical of much of the seafloor throughout the Barrow–Montebello–Lowendal Island complex and is widespread off the east coast of Barrow Island.

Surveys identified that there are some corals of significance in the vicinity of proposed marine infrastructure. Coral communities of high regional conservation value occur on the south-western perimeter of the Lowendal Shelf, approximately two kilometres from Town Point and 3.5 km north of the proposed liquefied natural gas (LNG) offloading facility (Figure 6-1). The coral reef in this area includes extensive and well developed staghorn and tabular *Acropora* colonies in shallower waters, with large coral bomboras in deeper water along the edge of the shelf (Plate 6-8 and 6-9).

Significant patches of coral bomboras occur in the vicinity of the proposed jetty and MOF access channel. Bomboras range up to several metres in height.

The intertidal habitats adjacent to the Town Point site are widespread along most of the east coast. The intertidal zone is dominated by a limestone platform that extends approximately 100 m to 200 m offshore (Plate 6-10). Occasional pools and areas of sand veneer occur across the platform. The pavement is essentially bare, particularly in the upper intertidal zone, but supports more abundant epibiota where the platform slopes into deeper water. Pavement rock pools support sparse assemblages of seagrasses, isolated corals, macroalgae and invertebrates.

Undercut rocky platforms occur above the pavement reef and typically support oyster-dominated communities. These platforms form notch habitat and minor cliffs at Latitude Point and Town Point (Plate 6-11). Narrow sandy beaches occur in the upper intertidal to supratidal zone between the Latitude and Town Point headlands.

PLATE 6-6

Aerial View of Intertidal and Shallow Subtidal Habitats at Town Point

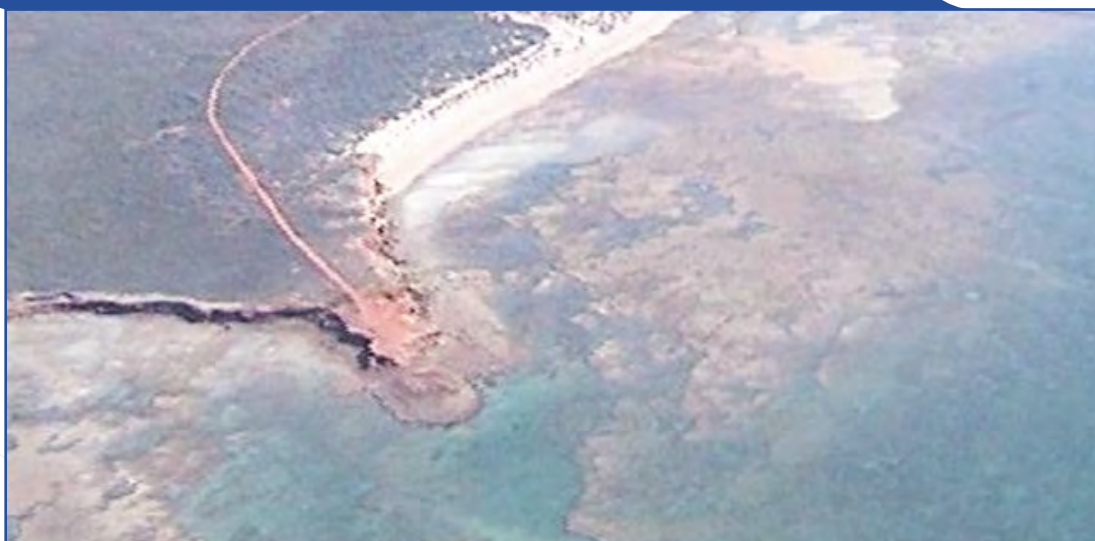
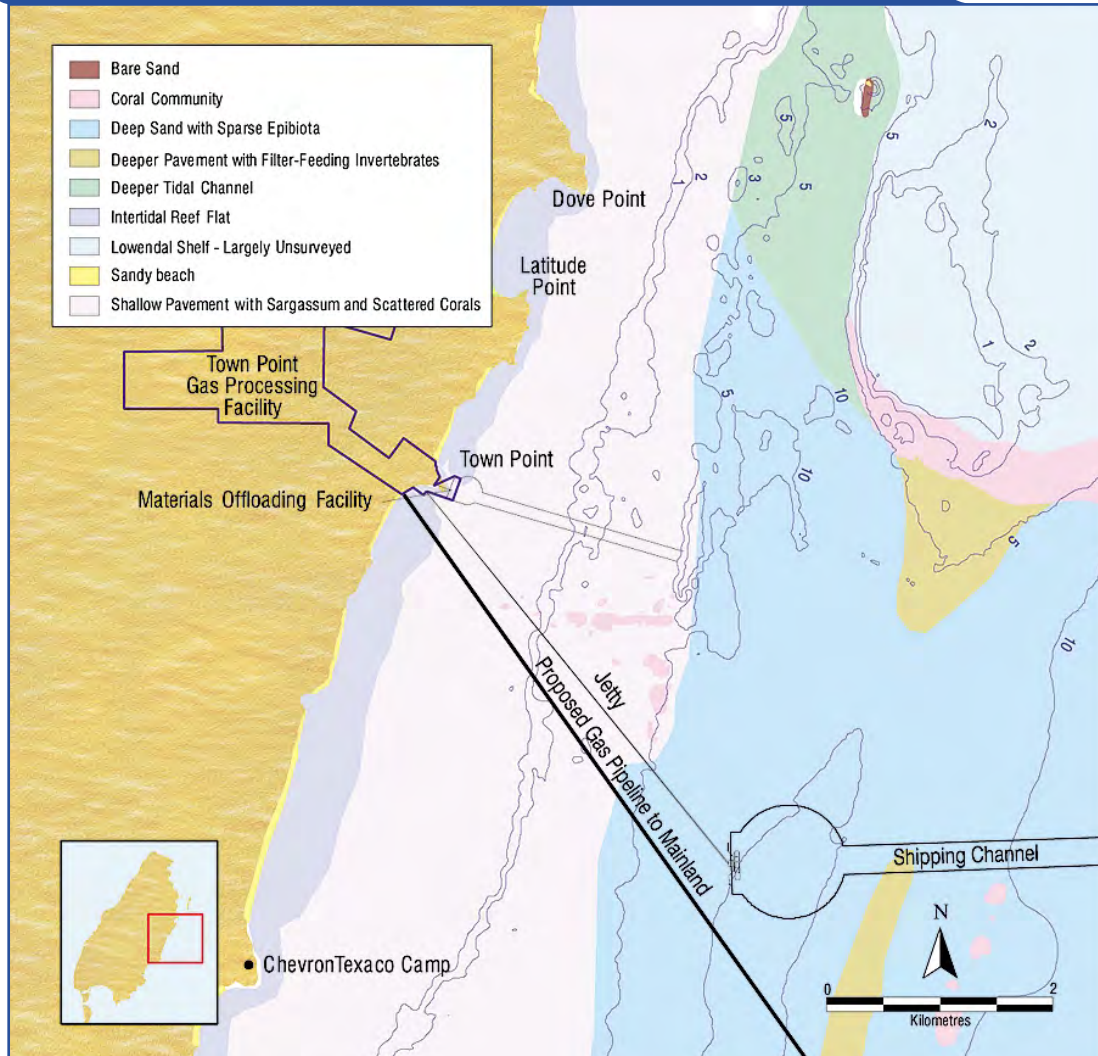


FIGURE 6-1

Marine and Intertidal Habitats Near Town Point



West Coast

The seabed in the vicinity of the proposed offshore pipeline corridor at Flacourt Bay is characterised by bare sand habitats and areas of exposed limestone pavement close to the beach (Plate 6-1).

The sandy substrates of the area support a very sparse epibiotic assemblage and are mainly bare.

Closer to the beach, the limestone pavement is exposed and supports a sparse cover of turfing brown and red macroalgae with small isolated corals. Areas of exposed pavement in

deeper waters are characterised by a low to medium density of sponges, sea whips, gorgonians, small corals such as *Turbinaria*, the calcifying alga *Halimeda* and brown macroalgae, such as *Sargassum* (Plate 6-7).

There are no coral communities in the area of the pipeline corridor; the nearest coral reef being located at Biggada Reef, which extends south from the southern end of Flacourt Bay (Figure 6-2). The northern end of Biggada Reef is made up of rocky pavement with scattered corals. Coral communities become more developed in the southern sectors of Biggada Reef.

FIGURE 6-2

Marine and Intertidal Habitats Near Flacourt Bay

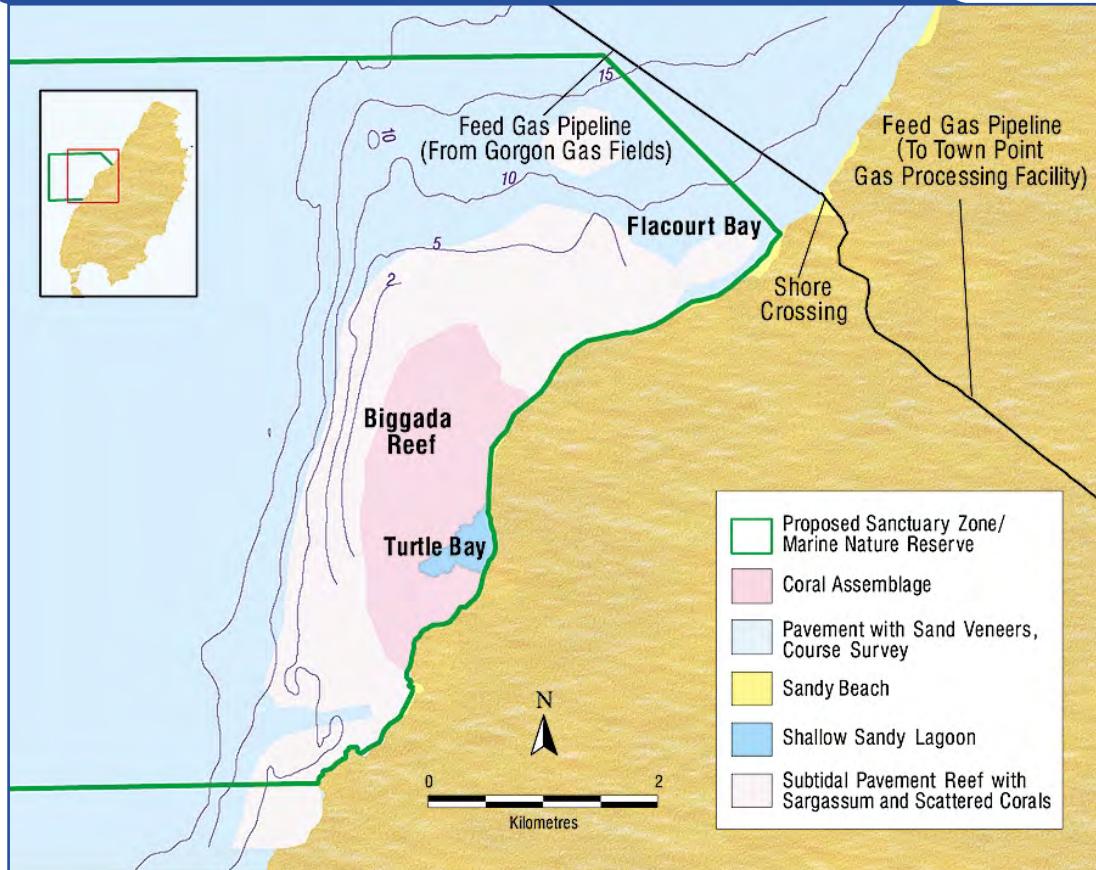


PLATE 6-7

Seafloor Colonised by the Alga *Sargassum*



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PLATE 6-8

Tabular and Branching *Acropora* Community on South-Western Perimeter of the Lowendal Shelf



Marine Mammals

Whales, dolphins and dugongs occur in waters around Barrow Island. Seven species of whale have been sighted in the Barrow–Montebello Islands area (Osborne *et al.* 2000), one of

which, the humpback, is listed as a threatened species under both the Western Australian *Wildlife Conservation Act 1950* and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

PLATE 6-9

Coral Bombora on South-Western Perimeter of the Lowendal Shelf



Humpback whales (*Megaptera novaeangliae*) pass through the region during their annual winter (June to October) migrations between Antarctic waters and the Kimberley and are likely to be the most common cetacean species in the area. The bulk of the humpback migration occurs in deeper (>20 m) waters to the west of Barrow Island and north of the Montebello Islands (Jenner *et al.* 2001).

Other whale species that have been observed in the region probably occur only as vagrant transients. These include the short-finned pilot whale (*Globicephala macrorhynchus*), false killer whale (*Pseudorca crassidens*), killer whale (*Orcinus orca*), Bryde's whale (*Balaenoptera edeni*), minke whale (*Balaenoptera acutorostrata*) and sperm whale (*Physeter macrocephalus*).

The shallow waters associated with the proposed east coast development area are unlikely to represent important habitat to any of these species of whales, although humpbacks have been sighted in the tidal channel along the north-eastern coastline of Barrow Island. Other species of whales may pass the area on occasion.

The Gorgon gas field is located in waters of over 200 m depth to the north-west of Barrow Island. The gas delivery line would extend from the field to the west coast of Barrow Island. Humpback whales seasonally pass this area. Other species of whale are also likely to occur, at least on occasions, in these deeper offshore waters.

PLATE 6-10

Intertidal Reef Platform Adjacent to Town Point



Dolphins found in the area include bottlenose dolphins (*Tursiops truncatus*), common dolphins (*Delphinus delphis*) and striped dolphins (*Stenella coeruleoalba*), the latter more common in deeper offshore waters. None of these species is listed as threatened.

Dugongs (*Dugong dugon*) are listed as threatened under the EPBC Act and on Schedule 4 (Other Specially Protected Fauna) of the Western Australian *Wildlife Conservation Act 1950*. The regional dugong population is estimated to number 2000 to 3000 animals (Prince *et al.* 2001; Prince 1986).

Dugongs have been recorded in areas on the east coast adjacent to the proposed marine infrastructure, however the habitats that

predominate in these areas are unlikely to have significance for breeding or feeding activity of this species.

Sea Turtles

Three of the four species of marine turtles (i.e., green, flatback and hawksbill) that occur in the area are known to nest on beaches of Barrow Island during summer (Prince 1990). All have State and Commonwealth conservation significance as threatened and/or migratory species. The regional sea turtle population is estimated to be over 49 000 animals (Prince *et al.* 2001).

Green turtles (*Chelonia mydas*), the most abundant turtle species in northern Western Australian waters, nest in large numbers on all

PLATE 6-11

Notched Intertidal Rock Face at Latitude Point



of the beaches along the western coast of Barrow Island. This species nests on most sandy beaches in the region, with other major rookeries at North West Cape, the Muiron Islands, Serrurier Island and in the Dampier Archipelago (Prince 1990). Although the most important Western Australian green turtle rookeries are on the Lacapède Islands further north, the west coast Barrow Island rookery has regional significance.

The sandy beaches along the east coast of Barrow Island are an important rookery for flatback turtles (*Natator depressus*). Flatback turtles are the second most abundant species in northern Western Australian waters (Pendoley 1997). Important Pilbara rookeries have been identified at Munda Station, Cape Thouin and Port Hedland on the mainland. Flatbacks are also commonly found nesting on islands in the Montebello and Lowendal Island groups.

Low numbers of hawksbill turtles (*Eretmochelys imbricata*) nest within the Barrow, Lowendal and Montebello Island groups, with more important rookeries occurring at Rosemary Island in the Dampier Archipelago.

At Barrow Island, hawksbill nesting occurs at low densities on the beaches of both the west and east coasts.

Turtle nesting activity on beaches adjacent to the proposed development infrastructure at Flacourt Bay and Town Point is similar to that of other beaches on the west and east coasts of Barrow Island.

Turtle nesting on the small sandy beach at Flacourt Bay on the west coast involves mainly green turtles, with the intensity of activity ranging from one to fifty nesting attempts per night during the breeding season.

This level of activity is representative of the nesting effort that occurs generally along the west coast beaches. The beach at Flacourt Bay is approximately 300 m long and represents approximately one per cent of the potential turtle nesting habitat on the Barrow Island west coast.

Turtle nesting on east coast beaches is dominated by flatback turtles. Research data collected from 1998 to 2002 at Terminal Beach, which extends approximately 550 m between Latitude Point and Town Point, has recorded flatback turtle nesting activity ranging from one to forty nesting attempts per night (Pendoley pers. comm. 2002). This is similar to the level of nesting activity recorded on beaches immediately south. Nesting effort may increase on beaches further north along the east coast (Pendoley pers. comm. 2002).

Sea turtle courtship, mating and nesting at Barrow Island occurs primarily between September and February. Most females will nest several times during this period, with resting (inter-nesting) occurring in the coastal waters between egg laying. Peak nesting activity for green and flatback turtles usually occurs between late November and January. Young turtles hatch approximately six to eight weeks after eggs are laid and hatchlings leave nesting beaches through to the end of April.

In addition to the presence of breeding turtles during summer, there are resident green turtles that remain at Barrow Island during the winter. These turtles feed around Barrow Island and migrate to other areas to breed. Feeding aggregations of green turtles have been reported from the shallow areas along the west coast of Barrow Island, and also around Dugong Reef and the Barrow Shoals to the south.

The habitat types present in the area off the east coast of Barrow Island that would be affected by the proposed development are unlikely to have any particular importance for feeding by turtles. No feeding aggregations of turtles have been reported from this area.

In light of these surveys, the Gorgon gas development on Barrow Island would pose a low risk to turtle reproductive success in the vicinity of infrastructure, and would be highly unlikely to have any significant effect on turtle populations.

Seabirds

Barrow Island's maritime avifauna consists of at least 53 species, including 21 species of migratory waders, six resident shorebirds, eight resident seabirds and 17 regularly visiting seabirds (Sedgwick 1978; WAPET 1989; Ninnox 1997). Within the context of the Barrow–Montebello Islands area, Barrow Island supports a similar number of wader species as the Lowendal Group (20) but more than the Montebello Islands (14). In contrast, Barrow Island has substantially fewer breeding seabirds (8) than both the Lowendal and Montebello Islands (12 each), (Technical Appendix E).

There are no threatened species of seabird on Barrow Island and none of the migratory species are restricted to the island. Twenty-one of the migratory waders and 11 seabirds are covered by international agreements and therefore recorded on the migratory species lists under the EPBC Act.

The intertidal zone adjacent to the Town Point site provides foraging habitat for a range of seabirds, including migratory waders. This area is characterised by a limestone reef-flat generally extending between 100 m to 200 m

offshore (Figure 6-1). Narrow sandy beaches extending between rocky headlands adjacent to the proposed development site, as well as to the north and south, and are likely to provide nesting sites for various seabirds, particularly the sooty oystercatcher (*Haematopus fuliginosus ophthalmicus*), pied oystercatcher (*H. longirostris*), Caspian tern (*Sterna caspia*), red-capped plover (*Charadrius ruficapillus*) and osprey (*Pandion haliaetus*). However, similar habitats occur along much of the east coast and the area does not contain the extensive sand and mud flats found further south, most notably in Bandicoot Bay. Flacourt Bay on the west coast does not provide significant seabird habitat.

6.1.2 Potential Impacts and Management

The potential for the Gorgon gas development to impact upon the marine environment is associated with:

- direct or indirect loss or modification of habitat as a result of the coastal infrastructure construction
- indirect impacts to marine life during construction, particularly as a result of increases in light, noise and turbidity levels
- indirect impacts to marine life during operations, associated with facility lighting and vessel movements
- possible introduction of invasive species via ballast water or hull fouling
- vessel or plant discharges to the marine environment
- incidents

Each point is addressed specifically below.

Habitat Modification or Loss as a Result of Marine Infrastructure

Selection of the rocky headland at Town Point

as the site for the MOF and jetty, associated with the proposed gas processing facility, deliberately avoided marine areas of conservation or biological production significance (refer to Chapter 4 regarding the site selection process).

The MOF would not extend substantially beyond the existing headland at Town Point (Figure 6-1) and would be appropriately sited and designed to minimise possible effects to longshore sediment transport. The MOF would not directly impact any sandy beaches that are used for flatback turtle nesting or have particular significance to seabirds. The 100 to 150 m length of intertidal area that would be occupied by the inshore part of the proposed jetty, the MOF and access channel is typical of the limestone platforms that occur over extensive areas of the east coast. It does not support any marine communities of conservation significance. The area currently provides foraging habitat for seabirds. However the size of the area of potential impact associated with the proposed infrastructure relative to the extent of this habitat along the east coast is low and significant impacts to any species of seabird are unlikely.

The jetty would be an open pile structure. Subtidal areas in the vicinity of the jetty and associated shipping channel do not support significant seagrass communities. However, there are some patches of coral bombores in the area. The marine infrastructure would be located to avoid direct impact to the coral. The seafloor of these areas is characterised by limestone pavement with sand veneers and/or attached macroalgae-dominated communities. They are widespread throughout the region and Barrow Island, do not comprise important feeding grounds for flatback turtles, and are

unlikely to be of particular significance to other fauna of conservation significance.

Based on observations at the existing pipeline that has been in place since 1967, sediment movement along this coast appears to be limited. Therefore, the jetty and MOF are unlikely to result in significant accretion or erosion of adjacent beaches or intertidal areas.

Flatback turtles are known to nest on beaches adjacent to coastal infrastructure elsewhere (WAPET 1992) and the proposed MOF and jetty are unlikely to directly affect the turtle breeding that occurs on Terminal Beach or on the beach south of Town Point.

The pipeline(s) would be buried below the beach at the Flacourt Bay shore crossing by either trenching or directional drilling. Consequently, there would be no long-term reduction in availability of seabird or turtle nesting or feeding habitat. It is likely that the constructed facilities would provide additional roosting habitat for seabirds.

Indirect Impacts to Marine Life During Construction

As detailed in the following section, the potential for indirect effects to marine fauna or habitats in the vicinity of the infrastructure during construction is primarily related to:

- turbidity associated with dredging activity, pipeline trenching and spoil disposal
- noise and light emissions
- vessel, vehicle or personnel presence in habitats of importance to species with conservation significance



Turbidity

Dredging has the potential to adversely affect epibenthic communities, primarily as a result of increased sediment deposition and water turbidity (decreased light penetration).

(Epibenthic communities live on the surface of bottom sediments in a water body.)

The marine habitats of Barrow Island that are most sensitive to the effects of dredging are scleractinian (reef-building) corals and, to a lesser extent, macrophytes (large marine plants).

The turbidity plumes associated with dredging generally extend between 0.5 to 1.5 km downcurrent of operations, depending on prevailing currents. Sedimentation generally only affects marine biota within 100 m of dredging activity and impacts can be mitigated through management measures such as scheduling of dredging to avoid periods of heightened coral sensitivity and installation of sediment curtains (Woodside 1997; WMC 1995). Turbidity dissipates rapidly once dredging activity has ceased, consequently potential impacts from dredging would be temporary and localised.

There are no significant seagrass communities in the vicinity of areas that would be dredged. The nearest coral reef with regional conservation significance is located approximately 3.5 km and 2 km from the shipping channel and MOF access channel, respectively (Figure 6-1). The risk of significant impacts to these corals is low. There are patches of coral bombores in the vicinity of the MOF access channel however the risk of impacts to these bombores is manageable. Best practice management to minimise disturbance, including scheduling of dredging activity to avoid periods of heightened coral

sensitivity in summer and/or prevailing currents and installation of sediment curtains would further reduce effects.

Stabilisation of pipelines in Flacourt Bay may involve trenching which would generate turbidity. However, the temporal and areal scale of a turbidity plume associated with trenching is considerably lower than that for dredging and, given the lack of sensitive resources in the area of the proposed pipeline alignment, is unlikely to result in significant environmental impact.

Some dredged material may be used as fill when constructing the MOF or other components of the development. However, it is likely that the majority of dredge spoil (up to approximately 7 million m³) would be disposed within a designated spoil ground. Preliminary investigations of potential spoil grounds reveal there are extensive areas of macroalgal habitat in close proximity to the proposed dredged area. Such areas present viable options for dredge spoil grounds given they are widely represented habitats. Determination of the exact locations of dredge spoil grounds would be negotiated with relevant agencies and form part of any subsequent development application process.

The environmental effects of spoil disposal include burial of the existing substrate in the spoil ground(s) and elevated suspended sediment levels during disposal. Spoil disposal requires a permit under the *Environment Protection (Sea Dumping) Act 1981*, which requires *inter alia*, investigations of the physical and biological characteristics of the spoil ground, the effects of disposal at the location and confirmation that the spoil would not remobilise. When located appropriately,

spoil dredge grounds are usually recolonised rapidly by pre-existing seafloor communities and have little effect on regional environmental values.

Light and Noise

Light and noise associated with construction of the jetty and MOF have the potential to affect adversely the marine fauna in the area, particularly sea turtles and seabirds.

Construction of the Flacourt Bay pipeline shore crossing, the MOF including dredging of the access channel and the nearshore portion of the jetty, would be managed to avoid the peak turtle breeding and migratory seabird seasons. Any construction operations on the plant site during the peak nesting season that would require lighting levels likely to affect turtles on adjacent beaches would be restricted to daylight hours only. Therefore, the risk of significant effects on turtle breeding or migratory seabird activity in areas adjacent to the proposed development is low.

Noise associated with construction of coastal facilities outside of the peak turtle breeding and migratory seabird periods is likely to temporarily disturb seabirds using adjacent areas. In some areas of the channel, underwater blasting may be required. The shock-wave associated with underwater blasting, as well as the noise generated by vessels and dredges have the potential to locally impact upon fauna during construction.

Implementation of routine management measures, including the use of warning shots, marine fauna watches and standby vessels to “shepherd” fauna away from the affected area, would reduce the risk of significant impacts from blasting. Areas adjacent to the proposed

marine infrastructure do not comprise important habitat to whales, dugongs or other species of conservation significance. Effects on seabirds may be limited to short-term displacement to similar habitat in adjacent areas. During peak seabird breeding and turtle nesting periods, no vehicle or machinery access to beaches would be permitted by the Gorgon Venture.

Construction Disturbance

The potential for visual or vibratory disturbance to seabirds or turtles (or their eggs) in areas adjacent to the construction works is low. Construction vehicle, machinery and personnel access to the supratidal areas on beaches adjacent to the Town Point site would not be permitted by the Gorgon Venture in nesting seasons during construction. Further, no substantive earthworks or other activity that could generate significant vibration levels on beaches would occur during peak turtle nesting periods at the gas processing facility site.

Vessel activity during construction of the pipeline shore crossing at Flacourt Bay may result in some disturbance to turtle feeding activity in intertidal and shallow subtidal zones. However, this is a short-term effect and the scale of impact, relative to the extent of similar habitat along the west coast, is very low.

Indirect Impacts to Marine Life During Operations

Lighting

Once constructed, the gas processing facility would operate 24 hours per day and would require adequate lighting to operate safely. The jetty and MOF would also need to be lit when loading/offloading operations occur at night. During the summer turtle breeding

season, light-spill or glow from the plant site, jetty or MOF would have the potential to disorient female turtles that traverse the beach for egg laying and hatchlings that use light cues to reach the ocean. Lighting also has the potential to affect seabirds. Light-spill over water adjacent to the jetty may increase the availability of food to silver gulls, with flow-on effects to other bird species.

A number of studies have identified successful measures to reduce the effects of lighting in urban or industrial developments on marine life, particularly turtle breeding activity (e.g., Witherington and Martin 1996). These measures would be incorporated into the Gorgon gas development as appropriate. Specific management measures that would be implemented to minimise potential effects of lighting from Gorgon gas development operations would include:

- Flaring would not occur during normal plant operations, however a pilot light would operate continuously.
- The plant would be set back from the coast, behind 6-10 m high coastal dunes.
- Lighting on the plant site would be the minimum necessary to fulfil operational and safety requirements, and the jetty and MOF would not be permanently lit.
- To the extent practicable, MOF or jetty operations during the flatback turtle breeding season would be scheduled during daylight hours. When night time operations are unavoidable, lighting would be restricted to the essential area and minimum period required to complete the operation.
- Facility layout will incorporate line of sight studies to ensure that light-spill to coastal areas is minimised by design considerations.

- Low and/or shielded lighting would be maximised and turtle-sensitive light sources (e.g., low-pressure sodium vapour) would be used wherever practicable. Lighting on the jetty would be directional, downcast and shielded.

Implementation of these management measures would result in a low risk of effects from normal operations extending beyond the immediate vicinity of the facility. Operational effects associated with the facility are likely to be localised and would not be significant from a Barrow Island or regional perspective. The beach (Terminal Beach) and intertidal areas adjacent to the proposed Town Point site represent approximately two per cent of the available nesting habitat and an even lower proportion of the seabird-foraging habitat along the east coast of Barrow Island. The risk of significant impact to seabirds or turtle reproductive success, at either local (Barrow Island) or regional levels, is low.

Flaring would be required in the event that component failure or maintenance disrupts normal operations and gas has to be vented to avoid over pressurisation and its associated safety risks. If this occurs at night, the flare may be visible over an extensive area and, if coincident with breeding activity, may adversely affect turtles or seabirds.

In general, flaring is unlikely to be required over a period of more than a few hours at any time. Any requirement to flare gas during maintenance or start-up operations for the Gorgon gas development would be scheduled to occur during daylight hours or outside the sensitive periods for local fauna, wherever practicable. Therefore, the frequency at which flaring would occur at night during the peak turtle nesting or seabird breeding periods is

expected to be relatively low and unlikely to affect significant numbers of the regional populations of any species.

Vessel Movements

Vessel traffic associated with product export or the import of materials via the MOF has the potential to increase:

- sediment re-suspension in the turning basin and to a lesser extent the access channel
- the risk of collision or disturbance to fauna from vessel movements

There are no seagrass or other highly turbidity-sensitive benthic communities within immediate proximity of the ship/barge access channels. There are some patches of coral bombores in the area of the access channel. However, it is considered that the risk of significant impact due to sediment re-suspension is negligible.

Increased vessel movements through the area would increase the risk of collision or disturbance to fauna. The vessels involved would not be navigating at high speed and mobile fauna would generally hear and avoid approaching vessels. The marine fauna of the area have widespread regional distributions and the scale of effect of vessel disturbance would be localised. The risk of significant effect on any species in the area is very low.

Introduction of Invasive Species

The increase in vessel traffic associated with construction and, more particularly, operations of the proposed Gorgon gas development presents the risk of introducing invasive species via ballast water discharge or vessel hull fouling. Estimates of vessel visits to Barrow Island suggest an increase in tanker loadings from one to ten per month during the

operational phase. Such an increase in vessel traffic implies a need for stringent control of risks associated with vessel movements.

The risk of invasive species being translocated in ballast water or on vessel hulls is largely dependent on the port(s) of origin and waters through which vessels navigate, combined with the efficacy of quarantine management practices.

Ballast water discharges are generally managed in accordance with Australian Quarantine and Inspection Service (AQIS) requirements. The Gorgon Venture would maintain AQIS standards at a minimum, and progress to more comprehensive standards adopted from international best practice on the basis of risk assessment that a vessel is carrying organisms of concern in its ballast tanks.

Hull fouling on marine vessels is usually controlled through the application of specific paint treatments to vessel hulls. These applications would be in compliance with the International Maritime Organisations standards regarding anti-fouling treatments and in particular the advice on use of tributyltin (TBT).

Impacts from an accidental introduction of an invasive marine species into the waters adjacent to the proposed Gorgon gas development would be dependent on the characteristics of the species involved. Establishment of an invasive ecological analogue, or a species that displaced one or more native species through competition or predation, could pose a high risk of significant effect to the local marine environment.

The environmental resources that are present at proposed sites for shipping infrastructure do not suggest any heightened risk at Barrow Island relative to the majority of the North West Shelf (NWS) or broader bioregion.

Nevertheless, project planning would assume a high risk and appropriate management would be developed and made contractually binding on vessels servicing the facility. The LNG fleet and/or other vessels associated with Gorgon gas development product export are expected to be of modern design and capable of achieving internationally recognised best practice in ballast water and hull-fouling management.

Vessel or Plant Discharges to the Marine Environment

The LNG plant, including associated accommodation facilities, would be designed to prevent waste discharge to the marine environment.

Vessel discharges in the waters at Barrow Island (and elsewhere in Western Australia) are subject to State and Commonwealth legislation and international agreements to control any potential occurrences of water pollution. Discharge of oily bilge water would not be permitted by the Gorgon Venture and discharge of domestic wastes to the ocean, including sewage and putrescibles, would be prohibited within 12 nautical miles of land.

The location of shipping berth(s) for the Gorgon gas development would be over three kilometres offshore and would not comprise enclosed waters. The increase to existing regional vessel traffic levels associated with the Gorgon gas development is unlikely to have a significant affect on Barrow Island's water quality.

Marine Spills

The potential for significant impact to the marine environment from an incident primarily relates to a spill of liquid hydrocarbons.

There are three main potential sources of accidental release of hydrocarbons to the marine environment associated with the proposed gas processing plant:

- the pipelines from the plant to the tanker berths
- the tanker loading facilities
- shipping

Possible liquid export products from the Gorgon gas development include LNG and condensate. Other likely sources include work vessels, LNG ships and work barges that would have bunkers of diesel on board.

The offshore Pilbara region is a major petroleum production province. Over the last 35 years, 1000 tanker loadings have occurred and nearly 300 million barrels of crude oil have been exported without incident from the ChevronTexaco operated facilities on the east coast of Barrow Island. Detailed planning is in place to reduce the risk of a significant spill. Substantial oil spill response capacity is also maintained at the Port of Dampier and the islands on the North West Shelf, including Barrow Island, to minimise environmental impacts if an incident occurs.

If LNG were accidentally released to the environment, it would rapidly return to a gaseous state – limiting the temporal and spatial potential for a slick to impact on marine resources. Seabirds and other air-breathing marine fauna within the trajectory of a spill plume may be adversely affected by the gas. However, broad-scale impacts to the Barrow

Island marine environment, the proposed Barrow–Montebello Islands marine management area, or the regional marine environment are very unlikely.

The environmental effects of a spill of condensate or diesel are dependent on a range of variables, particularly the volume of the spill, the prevailing weather conditions and the timing of the incident relative to life-cycle events of sensitive species (e.g., turtle nesting periods). In general, spills of light oil, such as condensate and diesel, are characterised by acute toxicity but low persistence. Consequently, the areal extent and potential for chronic effects from a spill of these oils are low, but impacts on resources in the area affected could be high. The widespread regional or broader distributions of marine wildlife vulnerable to the effects of an oil spill, including those with high conservation significance, lowers the potential for impacts on population viability.

Rigorous monitoring and emergency shutdown valves and procedures mean that the volumes of condensate/diesel that could be lost from an incident involving the pipeline or tanker loading facilities are relatively low. Oil spill response resources would be locally available (at Barrow Island) to further reduce the area of effect.

The potential environmental impacts from a large spill as the result of a major shipping incident may vary from low to severe – depending on prevailing weather and sea conditions. Under the worst case scenario, an incident close to shore in which a large volume of condensate or diesel was lost could result in widespread damage to intertidal and shallow water habitats. The east coast of Barrow

Island includes low energy environments, such as mangroves and intertidal sand and mud flats, where recovery from acute impacts may be hindered by hydrocarbons becoming entrained in the sediments. The east coast also supports seasonally high breeding and/or feeding activity by regionally important populations of marine fauna.

The risk of a worst case scenario is extremely low. It would require a tanker grounding or collision to occur close to shore and result in the simultaneous loss of the contents from several tanks, during tide and weather conditions that would entrain the resulting slick into areas that support sensitive environmental resources.

The Gorgon Venture would incorporate comprehensive quantitative risk assessment and risk reduction measures into the planning, design and implementation phases of the proposed development. Strict requirements would be placed on the design, condition and operations of vessels servicing the development. The existing ChevronTexaco Oil Spill Contingency Plan for Barrow Island operations would be reviewed, and expanded as appropriate to: incorporate the Gorgon gas development; fulfil Australian Maritime Safety Authority (AMSA) requirements; and meet the satisfaction of the Western Australian Department of Mineral and Petroleum Resources (MPR) and the National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substances (NATPLAN) State Committee.

6.2 Terrestrial Environment

Barrow Island lies within the Pilbara bioregion and is a geological extension of the Cape

Range Peninsula. The terrestrial flora and fauna assemblages therefore show affinities to those of the Peninsula.

Rising sea levels separated Barrow Island from the mainland approximately 8000 years ago. That physical separation and stringent access and quarantine controls for the oilfield development on Barrow Island have protected its wildlife from the predators, competitors and diseases that accompanied European settlement of the mainland. The persistence of a number of native species that have become extinct or whose populations have declined on mainland Australia is central to the environmental values of Barrow Island and its importance as a conservation reserve.

The terrestrial environment of Barrow Island has generally been well documented (Box 6-1). To augment the available information and place the environmental values of the development area into both a Barrow Island and broader context, specific investigations of the proposed plant site, pipeline corridor and

environs were undertaken. These are summarised and discussed in Section 6.2.

6.2.1 Existing Land Clearance on Barrow Island

The current oilfield footprint is principally over the central-southern half of Barrow Island, although all areas of the island have at some time over the past 40 years been subject to seismic exploration. There are a number of isolated wells in the north-west of the island and a road network linking the wells, processing areas, accommodation, barge landing and the airstrip. Narrow roads or tracks also lead to a number of beaches on the island. Within the existing oilfield there is also a network of flowlines that connect the wells to the separator stations and the central processing facility. These lines are laid directly onto the surface and the vegetation is not cleared from under or around such lines. Figure 6-3 provides an overview of the oilfield infrastructure footprint on Barrow Island.

BOX 6-1

Knowledge of the Barrow Island Environment

Numerous research projects have been undertaken on Barrow Island with the support of WAPET and ChevronTexaco over the past four decades. An outline of such projects is presented in Appendix 5. The available literature describes biological inventory surveys in marine, intertidal, terrestrial and subterranean environments, fauna population monitoring programs and research into fauna ecology, fauna physiology and genetics, monitoring of revegetation sites, palaeontological surveys, archaeological surveys and soil, geotechnical and groundwater studies.

Comprehensive overviews of the Barrow Island terrestrial and marine environments are included in the island's Interim Management Guidelines (Department of Conservation and Land Management 1999) and in the Barrow Island Oilfield Environmental Reviews (WAPET, 1989; 1992). A broader Barrow-Montebello Islands perspective is provided in Osborne *et al.* (2000) and regional marine habitat mapping is maintained in the CALM GIS database. Details of ongoing environmental monitoring programs and studies at Barrow Island are provided in the annual environmental reports produced for the oilfield. Specific aspects of the environment are described in greater detail in the numerous reports by government agencies, academic institutions and environmental consultants.

FIGURE 6-3

Footprint of Oilfield Operations on Barrow Island

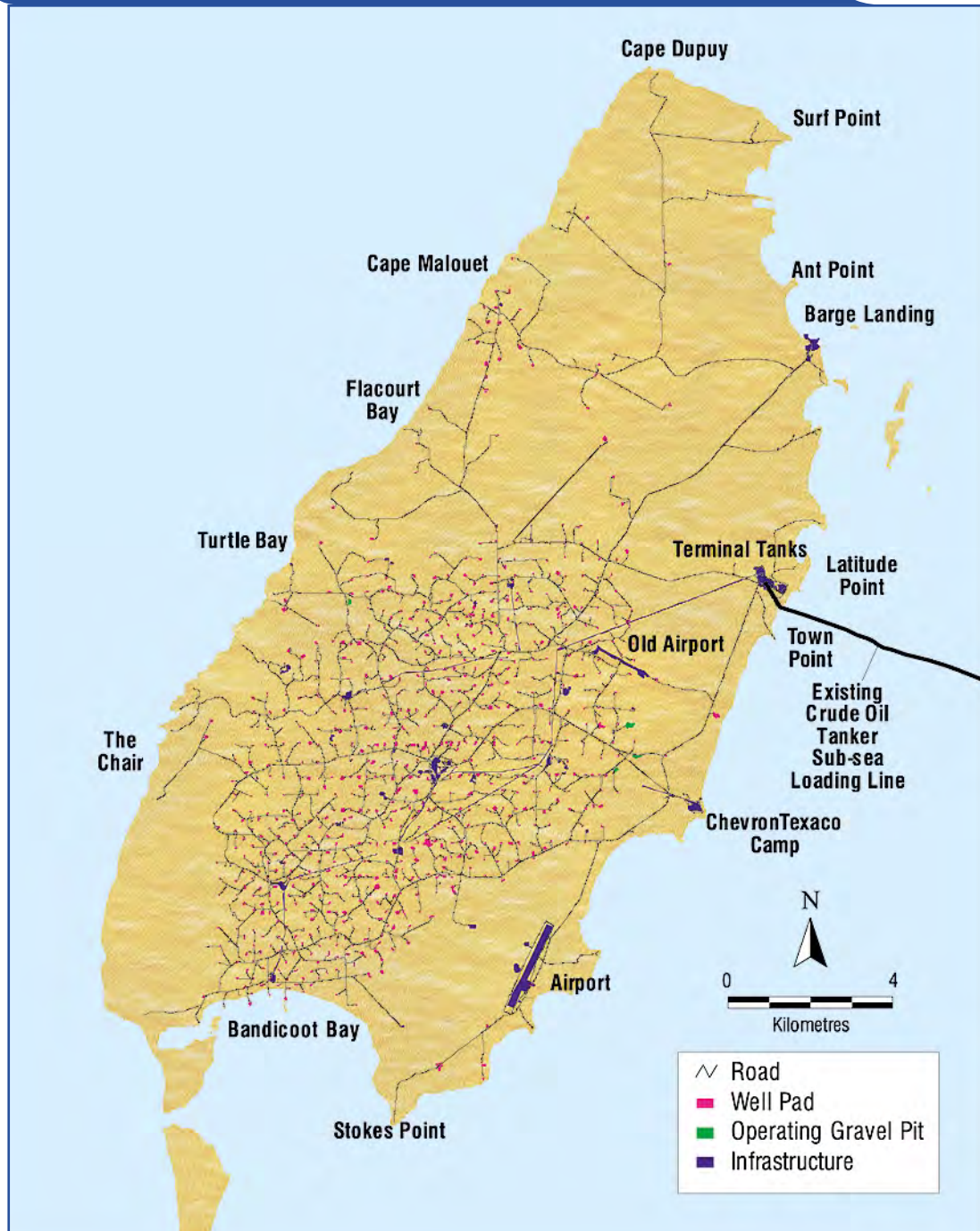


TABLE 6-1

Area of Cleared Vegetation on Barrow Island (2001)

Description of Area	Area hectares (ha)	Area per cent (%)
Total area of Barrow Island:	23 567	
Area cleared for roads	284	1.21
Area cleared for wells	220	0.93
Area of gravel pits	5	0.02
Area cleared for infrastructure	139	0.59
Area cleared since 1998	9	0.04
Cleared area (current at end of 2001)	657	2.79

ChevronTexaco undertook a survey in 2002 to determine the area of cleared vegetation on Barrow Island. Spatial data were sourced from high quality 1998 aerial photography and earlier drawings of roads, well sites and facilities. Analysis was conducted with the aid of a Geographic Information System (GIS). Results of this work (amended to include data to end of 2001) are presented in Table 6-1.

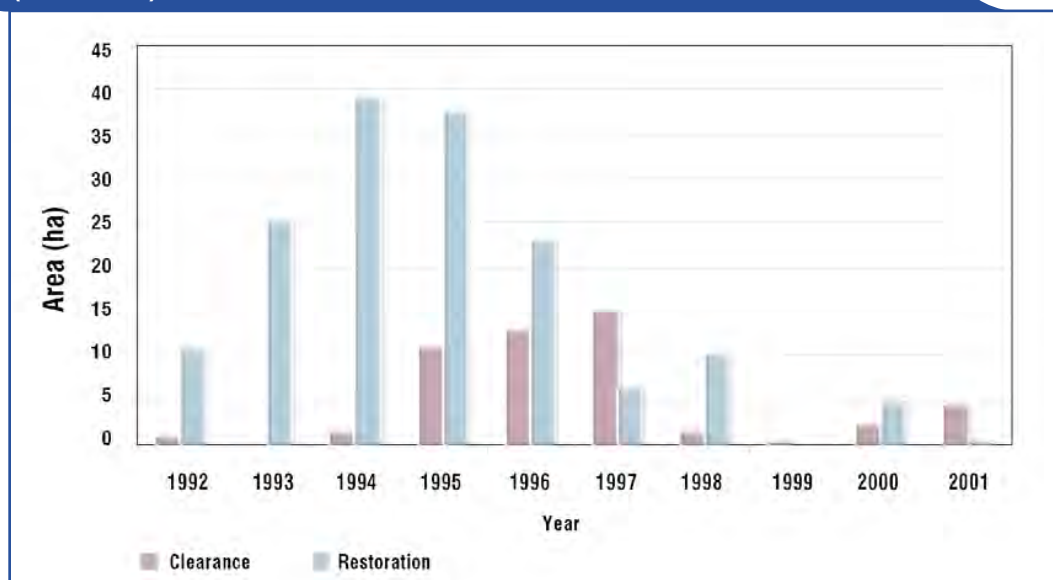
Not included in the above figures are previously

disturbed areas which have now been rehabilitated or are in the process of being rehabilitated, which total approximately 410 ha.

Rehabilitation is progressively applied to affected areas with some areas already successfully rehabilitated, and other areas designated for, or currently undergoing rehabilitation. The predominance of rehabilitation works relative to land clearance on the island is depicted in Figure 6-4.

FIGURE 6-4

Total Area of Clearance and Restoration Works, Barrow Island, (1992-2001)



The Gorgon Venture commits to disturb no more than 300 ha on Barrow Island or 1.27 per cent of the total island area.

This proposed development area, plus the current cleared area of 657 ha, represents 957 ha or 4.06 per cent of total island area.

As operator of both the oil and gas ventures on the island, ChevronTexaco would seek to coordinate between the ventures on an enhanced rehabilitation program to progressively reduce the total operational footprint over time.

6.2.2 Key Values

Vegetation and Flora

The Barrow Island flora has been studied in detail since oilfield activities commenced in the 1960s. A total of 250 plant species have been recorded on the island to date.

The floral assemblages are dominated by spinifex grasslands (*Triodia* sp.) (Plate 6-12) with scattered acacia and melaleuca shrubs. The flora of Barrow Island is typical of the arid Pilbara region (Eremaean Botanical Province) (Beard 1980), but has geological and floral affinities with the Cape Range area on the mainland (Trudgen 1989; Mattiske Consulting 1997), particularly in coastal areas.

PLATE 6-12

Spinifex (*Triodia* sp.) Grasslands



The vegetation on Barrow Island was classified into eight major vegetation units by Buckley (1983) which have been refined into 34 plant formations based on major landforms, soil type and species composition (Mattiske and Associates 1993). These plant formations were mapped and included in the ChevronTexaco GIS for Barrow Island in 1997 (Figure 6-5). (Details of vegetation and flora surveys specific to the proposed development are provided in Technical Appendix F).

No rare flora, as listed in the *Commonwealth Wildlife Conservation (Rare Flora) Notice 1999 (Wildlife Conservation Act 1950)* or the EPBC Act, are known to occur on Barrow Island. One species, *Corchorus interstans* (Plate 6-13) is currently listed on CALM's Declared Rare and Priority Flora List (January 2000) as a Priority 3 species (taxa which are known from several

populations, at least some of which are not believed to be under immediate threat). *Corchorus interstans* is widespread on Barrow Island and has also been collected from the Exmouth area.

The vegetation of the Town Point site (Plate 6-14) is dominated by hummock grasslands of *Triodia wiseana*. Pockets of *Melaleuca cardiophylla* occur amongst the *T. wiseana* on the low, undulating limestone hills in the western sector of the site, with a greater variety of emergent shrubs present on hillsides and valley slopes. Lower lying areas tend to support mixed hummock grasslands of *T. wiseana* and *T. angusta*, with the latter becoming dominant in the drainage line that intersects the site, as well as on the flats behind coastal areas. Sparse or isolated stands of *Hakea lorea*, *Ficus* spp. and *Acacia* spp. are also present in these areas.

PLATE 6-13

***Corchorus interstans*, a Priority 3 Species on CALM's Declared Rare and Priority Flora List is Found on Barrow Island**



Spinifex (*Triodia* sp.) Grasslands in Vicinity of Proposed Plant Site



Based on the Matiske vegetation mapping, there are five distinct vegetation units within the Town Point site. All are well represented elsewhere on Barrow Island. The vegetation survey undertaken by Astron Environmental in August 2002 indicates that at least 25 vegetation associations occur within these units. Further study of some of these associations would be required to confirm their distributions on the island, and to correct discrepancies in the current formation level mapping of the site.

Corchorus interstans, and three other plant species (*Dysphania kalpari*, *Abutilon otocarpum* and *Euphorbia* sp. A) that are known only from a few records elsewhere on the island, were recorded at the Town Point site. *Hakea lorea*, identified by Matiske and

Associates (1993) as "Needing Special Attention" because it was "geographically or habitat restricted and/or requiring further research to determine its status" was also recorded. This species is widespread in scattered populations across the central parts of the island. The landforms and soils present in the Terminal Tanks area are typical of the central to southern parts of the island and it is unlikely that any flora or vegetation associations would be restricted to the site.

The proposed pipeline route traverses nine distinct vegetation units as described by Matiske and Associates (1993). Twelve vegetation associations were recorded during the field survey. None are restricted to the pipeline corridor.

FIGURE 6-5

Barrow Island Vegetation Units

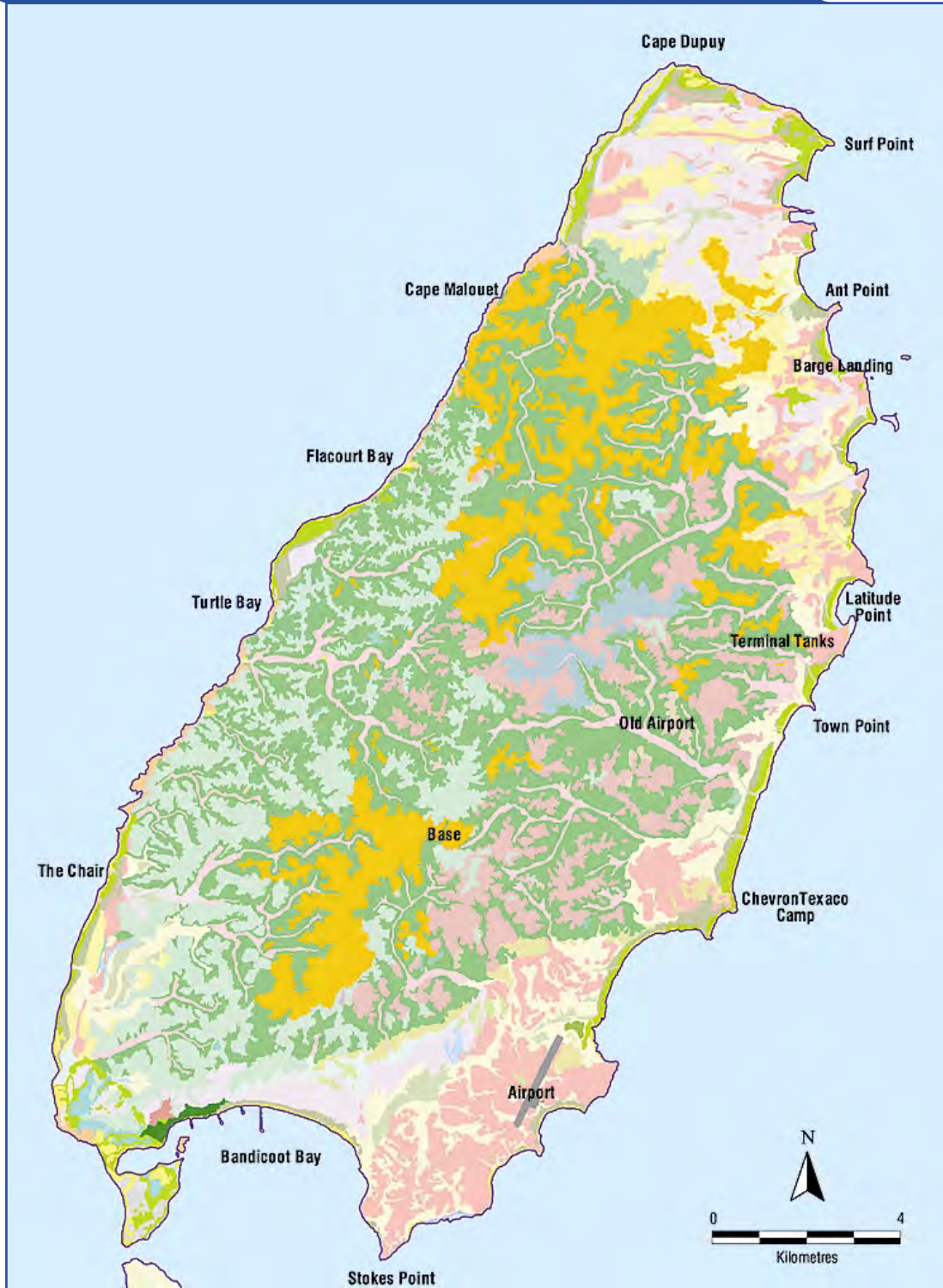


FIGURE 6-5

Barrow Island Vegetation Units (Key)

- BS Bare sand
- C1 Coastal complex dominated by *Spinifex longifolius* on white fore-dunes; including Coastal Complex of *Ipomoea pes-caprae* ssp. *brasilensis* and *Spinifex longifolius* on strand line foredunes
- C2 Open Shrub of *Acacia coriacea* - *Rhagodia preissii* ssp. *obovata* - *Olearia dampieri* ssp. *dampieri* on elevated dunes on fringes of island
- C3 Hummock Grassland of *Triodia pungens* with dense shrubs including *Acacia bivenosa* on back-slopes of fore-dunes
- C4 Mixed Hummock Grassland of *Triodia angusta* - *Triodia pungens* with dense shrubs including *Acacia bivenosa* on back slopes of fore-dunes
- C5 Low Mixed Shrubland of *Frankenia pauciflora* and *Hedyotis crouchiana* on exposed cliff faces around edge of island
- C6 Hummock Grassland of *Triodia pungens* with dense pockets of *Melaleuca cardiophylla* on sandy valley systems in south-western corner of island
- C7 Hummock Grassland of *Triodia pungens* with dense pockets of *Olearia dampieri* ssp. *dampieri* on sandy soils behind fore-dunes in south-western corner of island
- D1 Mixed Hummock Grassland of *Triodia angusta* with pockets of dense shrubs along major creek-lines
- D2 Hummock Grassland of *Triodia angusta* along minor creek-lines and drainage lines
- D3 Hummock Grassland of *Triodia angusta* along minor creek-lines with emergent *Santalum murrayanum*
- F1 Hummock Grassland of *Triodia angusta* on red earth flats and drainage lines
- F2 Hummock Grassland of *Triodia angusta* with emergent *Acacia synchronicia* on red earth flat
- F3 Hummock Grassland of *Triodia angusta* with emergent shrubs of *Gossypium robinsonii* on red earth flats
- F4 Hummock Grassland of *Triodia angusta* - *Triodia* ssp. with emergent pockets of *Erythrina versperillio* on flats
- F5 Mixed Hummock Grassland of *Triodia pungens* - *Triodia angusta* on fringes of main red earth flats and drainage lines.
- F6 Hummock Grassland of *Triodia pungens* on slopes of escarpments on fringes of red earth flats
- F7 Hummock Grassland of *Triodia pungens* - *Triodia angusta* - *Triodia wiseana* on slopes of escarpments on fringes of red earth flats
- L1 Hummock Grassland of *Triodia wiseana* with *Ficus platypoda* var. *platypoda* on central limestone ridges
- L2 Hummock Grassland of *Triodia wiseana* with *Ficus virens* var. *virens* on escarpments on west coast and southern edge of limestone ridges
- L3 Hummock Grassland of *Triodia wiseana* with low mixed shrubs including *Acacia gregorii* on limestone ridges
- L4 Hummock Grassland of *Triodia wiseana* with dense emergent shrubs of *Acacia pyrifolia*, *Acacia gregorii* and *Petalostylis labicheoides* on limestone ridges
- L5 Hummock Grassland of *Triodia wiseana* with emergent *Hakea suberea* on limestone ridges
- L6 Hummock Grassland of *Triodia wiseana* with emergent *Grevillea pyramidalis* on limestone ridges
- L7 Hummock Grassland of *Triodia wiseana* with dense pockets of *Melaleuca cardiophylla* on limestone ridges
- L8 Hummock Grassland of *Triodia wiseana* with pockets of *Eucalyptus patellaris* on limestone ridges
- L9 Hummock Grassland of *Triodia wiseana* - *Triodia angusta* with emergent *Sarcostemma viminali* spp. *australe* and *Ficus platypoda* var. *platypoda* on coastal limestone flats and low ridges with localised pockets of *Frankenia pauciflora*
- L10 Hummock Grassland of *Triodia pungens* - *Triodia angusta* with emergent *Hakea suberea* on exposed small limestone hills on southern coastal area
- M1 Aquatic Complex supporting strands of *Avicennia marina* and *Ruppia maritima* on the fringes of the island
- S1 Mixed Herbfield and Grassland of *Eragrostis xerophila*, *Eriachne flaccida* and *Sporobolus virginicus* on clay-pans
- S2 Mixed Herbfields with *Streptoglossa bubakii* and *Pterocaulon sphacelatum* on fringes of tidal Halophytic areas and flood channels on clay soils near coast
- T1 Halophytic Complex dominated by *Habsarcia halocnemoides* and *Halosarcia indica* on tidal flats
- T2 Mixed Chenopod and Halophytic Complex with low *Frankenia pauciflora* shrubs on high tide areas usually associated with strands of *Avicennia marina*
- V1 Hummock Grassland of *Triodia wiseana* with mixed emergent shrub species on valley slopes
- V2 Hummock Grassland of *Triodia wiseana* with *Pentalepis trichodermoides* on southern escarpment
- Airport

Terrestrial Fauna

Mammals

Barrow Island is one of Australia's most important mammal conservation areas, supporting fourteen species of terrestrial mammal. Six of these species are included on Schedule 1 of the Western Australian *Wildlife Conservation Act 1950* and/or listed as vulnerable on the threatened species list of the EPBC Act. These are:

- Boodie or burrowing bettong (*Bettongia lesueur*)
- Barrow Island golden bandicoot (*Isoodon auratus barrowensis*)
- Spectacled hare-wallaby (*Lagorchestes conspicillatus conspicillatus*)

- Barrow Island euro (*Macropus robustus isabellinus*)
- Black-flanked rock-wallaby (*Petrogale lateralis lateralis*)
- Barrow Island mouse or moolboo (*Pseudomys nanus ferculinus*)

While these species are afforded legislative protection because of the status of their distributions at a State or Commonwealth level, all except the rock-wallaby have secure populations on Barrow Island. Full details of specialist surveys of terrestrial vertebrate fauna in relation to the proposed development are provided in Technical Appendix G.

PLATE 6-15

A Barrow Island White-Winged Fairy-Wren Nest



PLATE 6-16

**Barrow Island Euro (*Macropus robustus isabellinus*)
Sheltering under Spinifex**



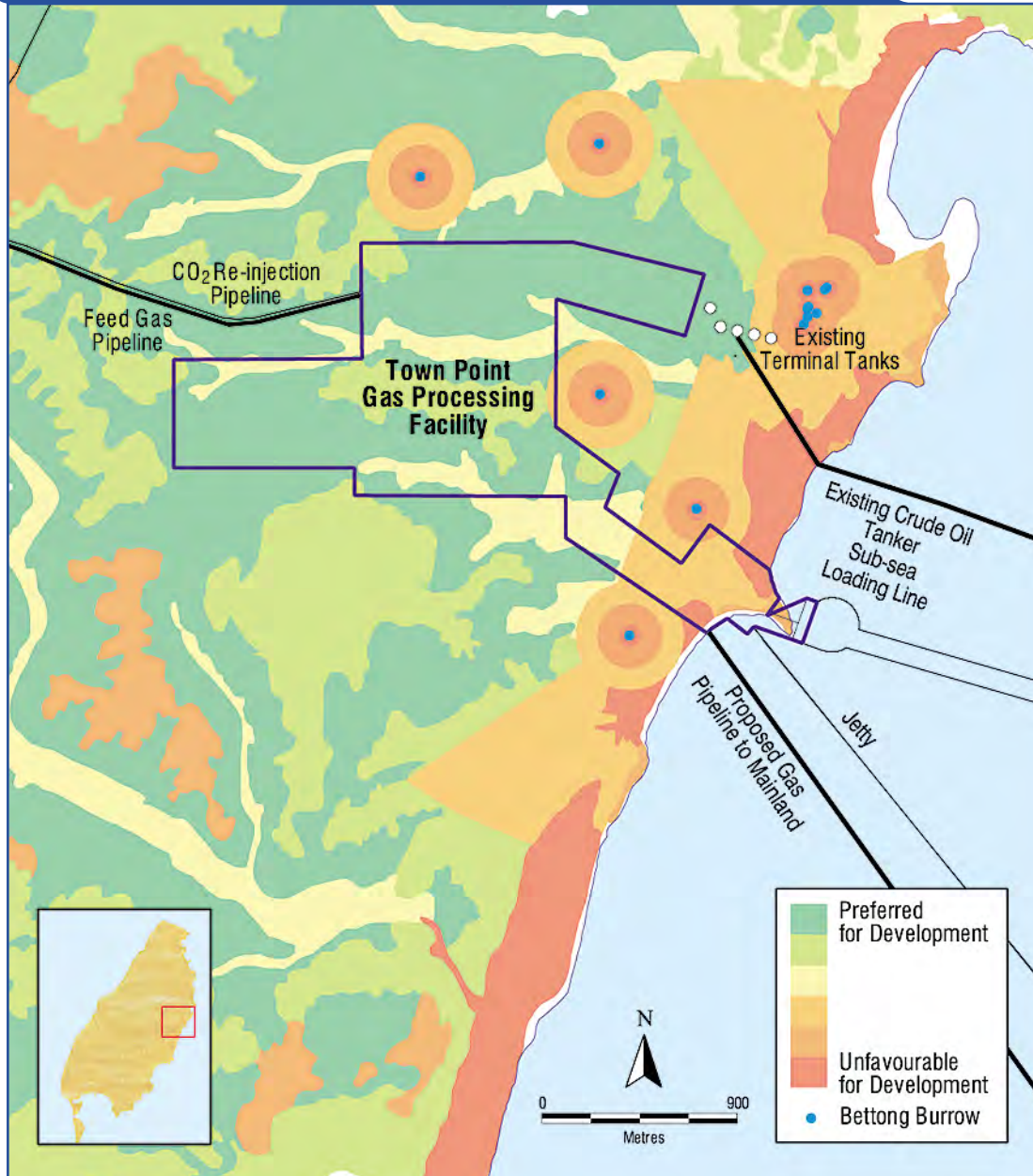
Burrowing bettongs, hare-wallabies, Barrow Island mice, euros and bandicoots are widespread and abundant on Barrow Island (Osborne *et al.* 2000; Short *et al.* 1989). It is estimated that there are 1500-1800 euros, 50 000-120 000 bandicoots, 9000 hare-wallabies, 5000 bettongs and 125-160 rock-wallabies on Barrow Island. All use structural shelters to avoid heat stress. Bandicoots, hare-wallabies, Barrow Island mice and euros rely on the dense vegetation, rock piles and/or other forms of shelter that are available in diverse habitats across the island (Plate 6-16). However, bettongs construct burrows under limestone cap rock, generally in association with particular vegetation types (Plate 6-17). Therefore, suitable locations for bettong burrows may be more restricted on the island, placing high conservation value on

existing burrows. The proposed development area was therefore selected specifically to avoid the bettong burrows in the vicinity of the Town Point site (Figure 6-6).

Black-flanked rock-wallabies are the mammal species with the smallest population and most restricted distribution on the island. These wallabies are largely restricted to rock piles, cliffs and caves along the west coast of the island and number approximately 150 animals (Strahan 1995). The Town Point plant site is distant (ca. 8 km) from the habitat of this species and the western-most section (approximately 1 km) of the gas feed pipeline is the only component of the proposed development that would traverse the eroded west coast gorges that comprise rock-wallaby habitat.

FIGURE 6-6

Favourable¹ Locations for the Town Point Site



¹ Locations assessed for suitability of development on basis of vegetation sensitivity and location of high-conservation value bettong burrows.

Birds

Fifty-three species of landbird have been recorded on Barrow Island. Most of these are considered to be vagrants and also occur on the adjacent mainland. Sedgwick (1978) recognised only 23 species as residents or regular migrants to the island. One threatened

species of bird, the white-winged fairy-wren (*Malurus leucopterus edouardi*), is widespread on Barrow Island. All other resident or regular visitor species are well represented on the adjacent mainland.

The Barrow Island white-winged fairy-wren is an endemic race that is listed as Vulnerable under the Western Australian *Wildlife Conservation Act 1950* and the EPBC Act. It is the second most abundant bird that breeds on the island (Pruett-Jones and O'Donnell, in press). It builds characteristic domed nests lined with dry grass blades approximately 0.5 m above the ground in *Melaleuca cardiophylla* and other shrubs, and in dense *Triodia* hummocks (Plate 6-15).

M. leucopterus edouardi is most abundant in the upland areas of Barrow Island, but also occurs at lower densities in fore-dunes and red dunes (Pruett-Jones and Tarvin 2001). It was recorded in the development area in numbers (0.6 birds/ha) typical for Barrow Island in general (0.08 to 1.75 birds/ha), although certain areas of taller and/or denser vegetation, particularly shrubs to the south of the main plant site, were found to support slightly higher densities.

Reptiles and Amphibians

The reptilian assemblage on Barrow Island, comprising 43 species, is generally a subset of the fauna of the adjacent mainland. One lizard sub-species (the skink *Ctenotus pantherinus acripes*) is endemic and the blind snake *Ramphotyphlops longissimus* is a species endemic to Barrow Island. *Ramphotyphlops longissimus* is listed by CALM as a Priority 2 (i.e., taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands) species, but none of the terrestrial reptiles are listed as threatened species in Western Australia or under the EPBC Act.

The only frog species (*Cyclorana maini*) on Barrow Island is widespread in the adjacent Pilbara.

PLATE 6-17

The Boodie or Burrowing Bettong (*Bettongia lesueur*) Digs Warrens Under Limestone Cap Rock



Native Molluscs

The terrestrial native mollusc fauna of Barrow Island has not been systematically investigated. Opportunistic collections have previously recorded two species of land snail, *Quistrachia barrowensis* (Solem 1997) and *Rhagada* sp.

A survey to investigate the land snail populations at several locations on Barrow Island, including the proposed Town Point site, was undertaken by the Western Australian Museum in August 2002 (Technical Appendix H). Survey key findings of the relevance to the proposed development are:

- The plant site does not appear to comprise native mollusc habitats that are unique on Barrow Island.
- The land snail fauna recorded from the development area is typical of that in all areas surveyed, and is numerically dominated by members of the family Camaenidae (*Rhagada* sp. and *Quistrachia barrowensis*). Three species of the family Pupillidae were also recorded.
- All three species of pupillids recorded from the development area have widespread distributions on the mainland, but one, and possibly both, species of cameanid may be endemic to Barrow Island.
- None of the species recorded are restricted to the proposed gas processing facility site.

Subterranean Fauna

The subterranean fauna of Barrow Island has been relatively well studied, with the Western Australian Museum conducting at least seven sampling surveys over the last decade to support taxonomic, distribution and ecosystem function research. Four species of troglobitic (cave dwelling) fauna and 24 species of stygofauna (obligate underground aquatic fauna) have been described from Barrow Island to date.

Twelve of the 28 species of subterranean fauna known on Barrow Island (nine crustaceans, one millipede, one micro-whip scorpion and a fish (blind gudgeon) are listed under the *Wildlife Conservation Act 1950*. The blind gudgeon (*Milyeringa veritas*) is also listed as threatened (vulnerable) under the EPBC Act.

The subterranean fauna recorded on Barrow Island extended the known distributions of some species previously only recorded from the Cape Range Peninsula; and described several species apparently endemic to the island. Fauna common to both areas include the larger stygofauna, such as the shrimp (*Stygiocaris stylifera*) and the blind gudgeon (*Milyeringa veritas*). The cave eel (*Ophisternon candidum*), which has similar conservation significance, is known to occur in sympatry with *M. veritas* at Cape Range Peninsula and may also occur at Barrow Island, but has not been recorded to date.

The distribution of subterranean fauna across Barrow Island remains to be established definitively. Due to the inherent difficulties in accessing subterranean areas, the majority of subterranean fauna recorded from the Island, particularly stygofauna, has been found within the oilfield, where anode, abstraction or monitoring bores provide access for subsurface sampling. Consequently, the recorded distributions of many of the subterranean fauna on Barrow Island may reflect the access for sampling more than the actual distributions.

Based on the known characteristics of the groundwater and karst formations, it is likely that subterranean fauna, particularly stygofauna, would be represented over most, if not all, of Barrow Island. Wells where

stygo fauna were found are shown in Figure 6-7. Stygo fauna in general are widespread over the island, but some species may have restricted distributions.

The Town Point development area is located on relatively low-lying land adjacent to the east coast, where the depth of groundwater and extent of limestone above the water-table is limited. Bore logs indicate that the limestone is karstic immediately above and below the water-table (Bradbury 2002). However, seismic and geotechnical data suggests that the area does not comprise extensive karst. No caves have been recorded in the area and field investigations suggest an absence of fissures or other surface expressions of cavernous formations.

Stygo fauna sampling was undertaken within and outside the proposed development site in August 2002 (Technical Appendix I). The survey recorded a stygo faunal assemblage of relatively low species richness and abundance within the development area compared to other locations on Barrow Island. Five of the

18 sites sampled within the proposed plant site contained stygo fauna.

Other key outcomes of the sampling include:

- Twelve stygo fauna taxa were recorded from the groundwater below the plant site, with the assemblage dominated by copepods and amphipods (Plate 6-18), and including three previously undescribed species.
- No species listed as threatened were recorded on the site.
- Eight of the twelve taxa found on the site were also recorded in other areas, suggesting the saturated karst below the site is not geologically isolated (Humphreys pers. comm.) 2002.

The Schedule 1 species *Nedsia hulbertii* has previously been recorded from the Town Point area (Humphreys 2001), but is not restricted to the site. Bradbury (2002) recently reported the holotype of another member of this genus, *N. chevronii*, from a bore on the site. This species has not been described from elsewhere on the island. However, the apparent lack of geological isolation in the karst at the site and the fact that *N. chevronii* occurs in sympatry with *N. hulbertii*, which has a wide distribution, suggests that it may have a broader distribution.

PLATE 6-18

Amphipoda: *Nedsia sculptilis*



FIGURE 6-7

Location of Wells Where Stygofauna Were Present



6.2.3 Potential Impacts and Management

Terrestrial Vegetation and Fauna

Terrestrial vegetation and fauna on Barrow Island, as described in preceding sections, could be impacted upon by the proposed development through:

- introduction of invasive species
- direct removal of vegetation/fauna habitat within plant and pipeline disturbance areas
- disturbance to vegetation/fauna and habitat in adjacent areas from emissions/activity during construction and operation of the facility
- protracted changes to the natural fire regime of the island

Accidental Introduction of Invasive Species

Construction of a gas processing facility could create a pathway for the introduction of weeds and/or feral animals through the transport of people, materials and machinery to Barrow Island. Many of the fauna species with conservation significance on the island are extinct or in decline on the mainland and/or other islands due to the introduction of invasive species.

The success of ChevronTexaco's quarantine program applied to oilfield operations on Barrow Island demonstrates that this risk is manageable. Barrow Island's ecosystem remains essentially unaffected by invasive species despite over 35 years of oilfield operations with over 10 000 cargo transfers.

The scale of the construction program for the LNG plant requires intensified, project-specific quarantine protocols to be developed in consultation with CALM and other stakeholders. This task has commenced and would continue as part of the Environmental Impact Assessment (EIA) process if in-principle

approval is granted for restricted use of Barrow Island. The risk of an invasive species being transferred and becoming established on Barrow Island would be low through the implementation of appropriate point-source controls, combined with measures to detect, monitor and eradicate introduced species on the island. Quarantine management measures are discussed more fully in Chapter 7, Quarantine Management.

Development Area

Rehabilitation of the development area would be carried out following ultimate decommissioning of the facility. Such rehabilitation is likely to result in many of the existing communities regenerating. At this stage however, there remains some uncertainty as to whether the existing communities could return to the exact pre-disturbance state.

The implications of the possible loss of existing vegetation and habitat types within the development area to the ecological function of Barrow Island and regional conservation values is dependent on the extent of their distributions across the island and other areas. Further investigation of vegetation at the proposed facility site at the "vegetation association" level is required to definitively establish the broader island distribution patterns.

Broad-scale vegetation mapping in the ChevronTexaco GIS database (Figure 6-5) provides an indication of the extent of the potential impact on vegetation types at an island level. Based on the Matiske and Associates (1993) unit descriptions, the areal extent of disturbance to any vegetation type on Barrow Island is provided in Table 6-2. The area of potential disturbance to each vegetation unit at the proposed Town Point site on Barrow Island is shown in Table 6-3.

TABLE 6-2

Areal Disturbance of Barrow Island Vegetation Units

Vegetation Type	Vegetation Type Area (hectares)	Total Disturbed Area (hectares)	Disturbed Area (per cent of total) %
BS	81.8	0.1	0.1
C1	257.4	1.2	0.5
C2	535.2	5.0	0.9
C3	414.0	12.0	2.9
C4	69.6	0.4	0.6
C5	205.4	2.6	1.3
C6	14.2	0.6	3.9
C7	38.2	2.2	5.7
D1	37.1	0.4	1.1
D2	1096.7	238.0	21.7
D3	0.6	0.1	8.7
F1	1567.2	43.4	2.8
F2	9.0	0.2	2.2
F3	36.9	0.8	2.1
F4	42.2	0.2	0.6
F5	1374.3	40.5	2.9
F6	137.5	16.3	11.9
F7	856.2	4.5	0.5
L1	2727.8	84.8	3.1
L2	19.6	1.7	8.7
L3	2782.5	90.3	3.2
L4	322.7	17.2	5.3
L5	105.7	3.6	3.4
L6	93.7	1.0	1.0
L7	1583.4	51.8	3.3
L8	8.8	0.1	1.3
L9	1747.3	38.2	2.2
L10	47.5	3.5	7.3
M1	23.9	0.0	0.0
S1	192.2	1.9	1.0
S2	0.9	0.0	4.5
T1	12.2	0.1	0.5
T3	3.6	0.0	0.0
V1	6822.9	335.8	4.9
V2	144.6	14.6	10.1
Unclassified	0.3	0.0	3.2
Airport (Cleared)	39.7	36.4	91.8
Total	23452.9	1049.3	4.5

* Refer to Figure 6-5 for Key

TABLE 6-3**Area of Potential Disturbance to Each Vegetation Unit at Proposed Town Point Site on Barrow Island**

Vegetation Unit	Description	Total Area on Barrow Island (ha)	Area on Town Point Site (ha)	Per cent of Town Point Area (%)
D2	Hummock Grassland of <i>Triodia angusta</i> along minor creek-lines and drainage lines	1096.7	17.7	1.6
F1	Hummock Grassland of <i>Triodia angusta</i> on red earth flats and drainage lines	1567.2	10.5	0.7
L3	Hummock Grassland of <i>Triodia wiseana</i> with low mixed shrubs including <i>Acacia gregorii</i> on limestone ridges	2782.5	21.5	0.8
L7	Hummock Grassland of <i>Triodia wiseana</i> with dense pockets of <i>Melaleuca cardiophylla</i> on limestone ridges	1583.4	96.8	6.1
V1	Hummock Grassland of <i>Triodia wiseana</i> with mixed emergent shrub species on valley slopes	6822.9	153.5	2.2

No rare flora would be affected by the facility and it is extremely unlikely the development would threaten the survival or genetic diversity of any plants on Barrow Island. The Priority species *Corchorus interstans* that occurs at the proposed site is widely distributed across the island, and elsewhere, and is known to regenerate following disturbance (Astron Environmental 2002). Further botanical surveys would be undertaken during an EIA to confirm whether any species of potentially restricted distribution, which occur in areas that would be disturbed by the development, are represented in secure populations outside the development area. Further botanical surveys can also contribute to more detailed design and layout of the gas processing facility to avoid or minimise effects on plants with a locally restricted distribution because the facility would comprise a number of discrete

components, rather than a single disturbance area.

The fauna habitats in the areas associated with the proposed development are typical of much of Barrow Island. The proposed plant site at Town Point has been specifically located to avoid direct disturbance to bettong burrows or other features with particular significance as fauna habitat. There are no fauna habitats unique to the site and the area does not comprise habitat critical to the survival of species.

All of the fauna species recorded at the proposed development site have widespread distributions across Barrow Island and have persisted during more than 35 years of oilfield operations. CALM's annual monitoring program shows no impacts on mammal



populations as a result of the existing level of disturbance (Osborne *et al.* 2000; Morris *et al.* 2001). Previous studies of the relative abundance and condition of rare mammals within and outside the oilfield also indicate that it “appears to have had no deleterious effect on the populations of any of the species surveyed” (Short *et al.* 1989). Barrow Island fauna and flora are therefore unlikely to face any significant impact from this small increase in areal disturbance.

Appropriate design considerations applied during the detailed project planning phase would reduce the potential effects to fauna movements. Design considerations would include incorporating undisturbed corridors within the Town Point plant site and raising the pipelines that would traverse the island on trestles to ensure that animals can pass underneath. The proposed pipeline corridor generally follows existing roads and seismic tracks to minimise disturbance. No bettong burrows or other habitats of particular significance would be impacted upon during pipeline construction.

The western-most section of the gas feed pipeline would traverse the gorges behind Flacourt Bay that support rock-wallabies. Strict management requirements would be placed on this section of the pipeline to minimise potential impacts to rock-wallaby habitat. Alternative methods of installing the pipeline through this area, such as directional drilling, would also be investigated during detailed project planning, in addition to other strategies to reduce potential impacts.

In the event that a traditional pipeline construction approach is adopted, a reduced (<30 m) construction corridor width would be enforced. Consequently, the potential extent of affect from construction of the pipeline would involve less than 0.2 per cent of the rock-wallaby habitat on the island.

Experience with other infrastructure within the Barrow Island oilfield suggests that the structural shelter provided by the installed pipeline and its supports would be utilised by rock-wallabies and other fauna (Plate 6-19). This would contribute to an offset of habitat loss associated with the ground disturbance from pipeline installation.

Construction and Operations Activity

Construction and operation of a gas processing facility has the potential for offsite impacts to vegetation and fauna through:

- light and noise emissions
- construction access in areas outside the development area
- indirect impacts associated with the construction and operations workforce

All construction wastes would be handled in accordance with a specific waste management plan for the proposed development and would include removal from the island for appropriate mainland recycling or disposal. Waste volumes would be minimised in accordance with the principles of the ChevronTexaco Health, Environment and Safety Policy (see Appendix 2).

Air emissions from the gas processing facility are expected to be low and would not pose a significant risk to wildlife or result in acute or chronic impacts to wildlife health.

The gas processing facility will be designed and operated to minimise emissions and to facilitate adequate dispersion to avoid harmful concentrations. Emissions of nitrogen oxides would be minimised by the use of Low-NO_x burners in all gas turbines. The potential for significant emissions of oxides of sulfur (SO_x) is low as sulfur levels in the raw feed gas are very low. Nevertheless any significant SO_x emissions would be avoided by sourcing 75 per cent of fuel gas from treated 'flashed' gas. Any hydrogen sulfide would be removed along with CO₂ in the "acid gas" removal process and re-injected into the Dupuy saline reservoir. There will be no continuous hydrocarbon vents or emissions. Air emission standards would be reviewed in the next phase of the development engineering and the fauna health aspects of air emissions would be further addressed.

Light and Noise Emissions

Light and noise emissions associated with the proposed development have the potential for temporary and/or localised disturbance to fauna, particularly during the construction phase. This phase would include earthworks to level the plant component sites.

The requirement for cut and fill operations have been reduced through the site selection process and excavation would be minimised to the extent practicable. Blasting is likely to be

required in some areas, although it would be avoided wherever possible. The limited extent of excavation would reduce any requirement for extensive or prolonged blasting activity.

Lighting for construction operations would be directional, downcast and shielded to reduce light-spill into adjacent areas. If pipeline construction is required through the rock-wallaby habitat on the west coast, construction operations would be limited to daylight hours. A similar constraint would be placed on any activity near turtle and seabird nesting areas during the breeding season.

With these management measures, any effects would be limited to areas close to the construction area. The ecological consequences of temporary and localised disruption of fauna behavioural patterns from increased noise and light levels during construction are expected to be low. Terrestrial fauna in the areas subject to disturbance are abundant on Barrow Island and breed throughout the year. Possible short-term behavioural disturbance is unlikely to have any effect on the feeding or reproductive success of the island's fauna populations.

Operation of a gas processing facility would not require extensive external lighting and light-spill to adjacent areas would be very low. Considerably higher light-spill would occur during emergency flaring, but would be a relatively infrequent and short-term (less than three hours) occurrence. The specific lighting management strategies that would be implemented to avoid impacts on breeding

seabirds and turtles (Section 6.1.2) would also reduce possible effects on adjacent terrestrial fauna. Noise emissions from the facility would be low but noisier than the existing oilfield operations. The island's fauna, including threatened species, appear to have readily acclimatised to oilfield operations and are little affected by ongoing sources of low-level noise. This situation is expected to be the same for the gas processing plant.

Offsite Construction Disturbance

All disturbance from construction, including clearing of laydown areas, would be included within the 300 ha development area. To the extent practicable, the project development would be planned so that areas of construction disturbance are restricted to areas that would ultimately be occupied by infrastructure. Any areas impacted by construction within the proposed development site, but not required for the future facility, would be rehabilitated.

Indirect Workforce Impacts

Construction would be phased over 3–15 years dependent on market demand for Gorgon gas. An on-island construction workforce of up to 2200 personnel is estimated, which would reduce during the operations phase to a maximum of 150 people on the island.

During the initial stages of the development, the majority of the construction workforce would be housed in temporary facilities in the development site. Later stages of development may require a temporary facility

within another area of existing disturbance (e.g., old airport). The permanent accommodation facilities would not increase the total area of ground disturbance of the project.

Potential impacts upon the environment from the construction and operations workforce therefore relate to:

- effects from domestic waste discharge
- incidental impacts to fauna (e.g., vehicle collision)
- increased recreational pressures (e.g., fishing)

Disposal of all domestic waste would be managed such that there would be no effect on the Barrow Island ecosystem. Waste, including wastewater, would not be discharged to the marine environment or groundwater aquifer. The disposal method for wastewater, including domestic effluent and operation-produced water, has yet to be determined. It is likely that after collection and treatment it would be, with agreement of the oilfield venture, added to their deep well (>1000 m) re-injection waste stream. Approximately 750 kL per day of produced formation water is currently re-injected to the geologically isolated Flacourt Formation below Barrow Island. The additional volume of wastewater associated with the Gorgon gas development would be negligible. All solid domestic wastes would be removed from Barrow Island for appropriate recycling or disposal at a licensed mainland facility.

Oilfield Infrastructure is Often Utilised by Island Fauna

Vehicle movements, particularly at and following dusk, pose a risk to Barrow Island's fauna. In general, larger construction vehicles tend to travel at sufficiently low speed that the risks to fauna are low. Vehicles transporting personnel to and from the development area, particularly during construction operations, represent a greater risk of impacting upon fauna.

The establishment of accommodation within, or in close proximity to, the gas processing facility would minimise any increase in traffic on the island associated with the development. Consequently, the risk of significant impacts upon fauna populations is low. Strict restrictions would be placed on hours of vehicle use and speed limits to ensure risks to

fauna remain as low as practicable. Buses, rather than personal vehicles, would be used to transport personnel to and from the construction camp to the workplace where possible.

The Gorgon Venture is also assessing ways to schedule construction so as to minimise the numbers of personnel on the island at one time and reducing the required space for laydown areas.

The construction workforce would be managed in accordance with industry practice for “offshore sites”. General management guidelines would include:

- no alcohol
- no hunting, including the use of firearms
- no fishing, including spear fishing and shell collecting
- no pets
- no private vehicles or boats
- all recreational facilities would be provided in the camp
- only approved and supervised conservation-related activities would be allowed outside of the camp after working hours (e.g., bird and turtle tagging)
- camp would be contained via a perimeter fence
- multi-language inductions and educational materials prior to arrival at the island

LNG operations personnel would be required by the Gorgon Venture to comply with the recreational access regulations that have been developed by ChevronTexaco for the Barrow Island oilfield operations personnel.

Subterranean Fauna

Construction of the proposed LNG plant would not require dewatering and the development would not use groundwater utilised by subterranean fauna. Consequently, potential effects to subterranean fauna primarily relate to:

- changes to surface hydrology from the plant area
- impacts on fauna and/or habitat from construction operations
- potential subterranean contamination associated with a liquid hydrocarbon spill/leak

Surface Hydrology

Elements of the plant that involve the installation of impermeable hard-stand would locally modify groundwater recharge patterns, possibly affecting water and nutrient inputs to underlying subterranean systems.

The plant would not involve a single area of disturbance, but would comprise a number of separate facilities, interspersed with open and unsurfaced areas. Therefore, changes to recharge patterns would be likely to be very localised and could be largely mitigated through appropriate plant design and stormwater management strategies. Stormwater run-off from hard-stand and plant areas would be collected and treated prior to disposal. It is anticipated such stormwater would be discharged into the existing natural drainage system following the collection and treatment of ‘first flush’ water associated with rainfall events.

Groundwater migration or recharge from adjacent areas would tend to diminish the significance of local changes to surface hydrology, particularly given the apparent lack of geological isolation at the site. There is also

some evidence that subterranean systems on the island are driven by chemotrophic rather than surface energy (Humphreys 2001). This would also serve to buffer local ecosystems.

As the subterranean fauna of the plant site are likely to be represented elsewhere on Barrow Island, the risk that minor effects to local communities from changes to surface drainage patterns would significantly impact Barrow Island's subterranean fauna is very low.

Construction Effects

Excavation during construction has the potential to directly impact upon troglobitic (cave dwelling) fauna or karst areas that provide them habitat. Physical vibration associated with earthworks on the site, particularly the shock-wave associated with any blasting, could also affect subterranean fauna and/or habitat.

The excavation required to level plant areas would be relatively shallow (<10 m). Cavernous areas are known to occur over extensive areas of Barrow Island and the possible scale of effect to the island's potential troglobitic habitat is low. However, there are no known caves or cave dwelling species in the proposed development area.

Direct effects to subterranean fauna may occur from the shock-waves associated with blasting. This and other sources of vibration might also affect the integrity of small fissures or crevices in the karst that represent habitat to subterranean fauna.

The plant area is unlikely to have particular significance for troglobitic fauna and the stygofauna assemblage of the site is dominated by copepods and amphipods,

comprising species that are generally well represented elsewhere on Barrow Island. The susceptibility of stygofauna to the shock-waves associated with blasting is unknown. However, experience with other aquatic species suggests that invertebrates are little affected by explosive shock-waves (Swan *et al.* 1994). It is therefore unlikely that the potential effects of construction activity on the Town Point site would present a significant risk to subterranean fauna populations on Barrow Island.

The western-most portion of the gas pipeline route would pass through an area of potentially more developed karst and subterranean fauna habitat. The exact alignment of the pipeline through this area would be determined on the basis of detailed geotechnical and technical feasibility assessments, to ensure the corridor, including the possible directional drilling of the shoreline crossing, does not intersect significant cavernous formations.

Contamination

Areas on the plant where liquid hydrocarbons are processed or stored would have impermeable hardstand, closed drainage systems, and bunded areas. The pipeline corridor would be selected to avoid any cave openings and the pipelines would be located above ground. Monitoring and contingency response procedures and resources would be developed for the project to ensure the risk of leaks or spills affecting the environment is minimised.

The risk of a spill/leak of liquid hydrocarbons of sufficient volume to contaminate subterranean habitat being released undetected from the plant or the pipelines is very low.

Suppressed Natural Fire Regime

Fire is acknowledged as a legitimate element of the terrestrial ecology of Barrow Island. The natural fire regime of the island has been suppressed over the last 40 years as a result of fire control measures associated with existing oilfield operations where there is an unacceptable risk to the facility and associated infrastructure. The Gorgon Venture would extend the suppressed fire regime on the island for reasons of safety of personnel and risk to infrastructure.

However, fire can be regarded as a legitimate tool for the management of conservation values on nature reserves. To that end, any proposal to develop fire management options for Barrow Island would need agreement between ChevronTexaco and the relevant agencies in order to achieve the right balance between conservation values, and risk to personnel and equipment. Mobile fire fighting equipment would be kept on site to respond to any occurrences.

6.3 Conservation Agreement

The Gorgon Venture acknowledges the important role of CALM in the ongoing management of the conservation values of Barrow Island. In order to optimise the collective body of knowledge and expertise specific to Barrow Island, the Gorgon Venture would seek to work co-operatively with CALM in order to conserve the ecological structure and function of the island. To that end, the Gorgon Venture would enter into a formal Conservation Agreement with CALM, which would provide the framework for management decisions concerning the Barrow Island environment, provide a mechanism for

adequate resources of CALM activities on the island, and provide an ongoing vehicle to undertake research on the island.

6.4 Conclusions

The ecological impacts that could result from the development of a gas processing facility on Barrow Island have been assessed by independent, specialist ecologists using a qualitative risk assessment process. Review of that work shows that the proposed development would not result in significant adverse impacts to important wildlife habitats, restricted vegetation types, and marine areas that have conservation significance.

Loss of species, populations or genetic diversity on Barrow Island through impacts beyond the plant site are not considered to be high risk and can be avoided through the adoption and implementation of strict environmental mitigation and management measures. Key measures include: location and design of the gas processing facility to avoid threatened species, significant habitat, and restricted vegetation communities; use of international best practice pipeline construction methods to avoid direct disturbance to significant fauna habitat; further detailed geotechnical assessments to avoid significant cavernous formations; management of workforce activities; and movement and use of appropriate technology to reduce light-spill.

The Gorgon Venture is committed to undertaking all phases of the development in an environmentally responsible and sustainable manner. ChevronTexaco's strong environmental performance on Barrow Island to date demonstrates that it is possible to successfully implement internationally recognised best practice management measures and maintain ecological integrity.



QUARANTINE MANAGEMENT

QUARANTINE MANAGEMENT

A quarantine program was first introduced on Barrow Island in the mid-1960s in acknowledgement of the world-class conservation values of the island. This quarantine program has set the benchmark for offshore island petroleum operations in Australia and overseas, and is recognised for its excellence in environmental management.

As operator of the existing oilfield and the proposed Gorgon gas development, ChevronTexaco views quarantine as paramount to the protection of Barrow Island's conservation values. The applied quarantine management, procedures, and restricted access have effectively prevented the establishment of invasive species on Barrow Island.

In order to maintain this quarantine record in the event the Gorgon gas development proceeds on Barrow Island, the Gorgon Venture would expand and enhance existing quarantine management procedures in order to control any increase in quarantine risk associated with the development.

ChevronTexaco, in its role as operator of both the Barrow Island oilfield and Gorgon gas development, would continue to provide overall management responsibility for operational activities on the island. This would include coordinating between the ventures on an enhanced quarantine program.

Ongoing success in quarantine management will require the continuous pursuit of improvements in reducing point of source risks, in increasing detection and eradication success and in integrating quarantine into every aspect of the proposed gas development.

7.1 Background

Environmental quarantine procedures were first introduced to Barrow Island by the West Australian Petroleum consortium (WAPET) in the mid-1960s. Since then, quarantine management procedures have been continually adjusted, refined and adapted as knowledge and understanding of risk species and processes has increased.

Stringent access and quarantine controls associated with oil field development and operation on Barrow Island have largely prevented the establishment of invasive species. This is despite there having been

more than 10 000 cargo landings by sea as well as regular movements of personnel to and from the island by air over the past 40 years.

To maintain this record, the Gorgon Venture has commenced work on further expanding and enhancing the existing quarantine program to cover the Gorgon gas development. Review of current procedures has commenced and has involved a workshop and consultation with the Department of Conservation and Land Management (CALM), Australian Quarantine and Inspection Service (AQIS), the Department of Environmental Protection (DEP), Commonwealth Scientific and Industrial Research Organisation (CSIRO), and

ChevronTexaco personnel who have specialist expertise in quarantine management on Barrow Island. Quarantine issues have also been discussed with the Conservation Commission of Western Australia and the Environmental Protection Authority (EPA) during site visits to Barrow Island.

7.2 Historical and Existing Presence of Invasive Species

Success in preventing the establishment of invasive species on Barrow Island means that on the limited number of occasions when invasive species have reached the island, they were detected and eradicated, or were

controlled and limited to highly restricted distributions (see Box 7-1).

There are currently no known invasive fauna on Barrow Island. Records indicate that there are currently four weed species on the island (see Box 7-1). These species are restricted to areas surrounding the airport and camp facilities and are subject to an intensive monitoring and weed eradication program. None of these plant species have invaded areas of native vegetation or threaten to alter ecological processes on the island.

BOX 7-1

Historical and Existing Presence of Invasive Species

Limited invasive fauna species have been recorded on Barrow Island. Although the black rat (*Rattus rattus*) has a relatively long history of association with the island, most other species have had a much shorter association, in some cases only a matter of a few hours. No introduced fauna presently occur on Barrow Island.

The black rat is thought to have been introduced to Barrow Island by pearlers in the latter part of the nineteenth century. Cooperative eradication programs between ChevronTexaco and CALM throughout the 1990s resulted in complete removal of the black rat from Barrow Island by 1998.

The house mouse (*Mus musculus*) was introduced to Barrow Island via food cargoes in 1965 but was eradicated using trapping and poisoning. Two subsequent introductions occurred and again coordinated CALM – ChevronTexaco eradication programs were successful.

One cat was inadvertently transported to the island in freight. This animal was located during unloading and destroyed. Similarly, a dog escaped from an aircraft at Barrow Island airport, but was promptly recaptured. To prevent such occurrences, animals are no longer carried on flights which land on Barrow Island.

A hive of European bees was accidentally brought onto the island in 1995 on the chassis of a vehicle. Upon discovery the hive was destroyed and the bees exterminated. A follow-up trapping program failed to reveal the presence of further bees.

Twelve weed species have been recorded on Barrow Island over the past 40 years, comprising eight environmental weeds and four deliberately introduced plant species. Unlike deliberately introduced species, environmental weeds can become established in areas of native vegetation and alter ecological processes. Introduced plant species are those species that had been approved for deliberate introduction to Barrow Island to moderate the human environment and include various mainland eucalypts and couch grass. Deliberately introduced species are restricted to the area surrounding the accommodation facilities.

Of the eight environmental weed species recorded on Barrow Island, only buffel grass (*Cenchrus ciliaris*), spiked malvastrum (*Malvastrum americanum*), black berry nightshade (*Solanum nigrum*) and sowthistle (*Sonchus oleraceus*) remain on the island. These species have highly restricted distributions on the island, with only a handful of individual plants recorded in some cases. Each of these species is currently subject to an intensive monitoring and weed eradication program.

7.3 Quarantine Management

The Gorgon Venture aims to prevent the introduction of all invasive plant and animal species to Barrow Island through enforcement of effective quarantine procedures.

Current environmental quarantine procedures for existing oil operations on Barrow Island are documented in ChevronTexaco's Health, Environment and Safety Standards Manual (Document No. EHS-NA-002, Section 14). These procedures are currently being reviewed and would be adapted and applied to the Gorgon gas development.

Maintenance of high quarantine standards throughout all phases of the Gorgon gas development on Barrow Island will be achieved by:

- integrating consideration of quarantine management into all aspects of the development from design, to contracting, purchasing and transportation

- minimising the risk of inadvertent transfer of plants and animals with transport of materials, machinery or personnel
- maximising the likelihood of detecting and eradicating invasive species
- ensuring that contingency plans to respond to all potential breaches of quarantine are developed
- monitoring the effectiveness of quarantine management processes
- incorporating and improving procedures from ongoing quarantine experience

7.3.1 Key Aspects of Quarantine Management

The current Barrow Island quarantine management program comprises a number of interrelated management activities, the core of which is workforce education and awareness (see Figure 7-1). Each of the components of quarantine management is discussed below.

FIGURE 7-1

Inter-related Aspects of Quarantine Management



Education and Awareness

The success of the quarantine management program on Barrow Island is founded on the ownership of, and participation in, the quarantine program by all employees and contractors. Continued success of quarantine management of the Gorgon gas development will also rely on the continued education, awareness, motivation and vigilance of personnel involved in all stages of the development.

Education and awareness of the importance of quarantine, as well as knowledge of responsibilities and procedures, is achieved through a number of processes. These include inductions, specific job training and promotion of general environmental awareness.

Personnel travelling to Barrow Island for work are required to participate in an induction that emphasises the special significance of Barrow Island as a Class A Nature Reserve; the critical importance of preventing the introduction of invasive species; and their responsibilities for quarantine management. Personnel who have responsibilities for activities that can influence the prevention of introducing invasive species are provided with specific training on quarantine protection methods. For example, quarantine training is provided to Toll Energy personnel who provide logistical support to the Barrow Island oilfield operation.

BOX 7-2

Quarantine Awareness Poster



Both island-based and supply depot personnel are given presentations on quarantine procedures and their importance to the continuing health of the Barrow Island ecosystem. Environmental awareness training for Barrow Island personnel is conducted regularly as a formal training package. Quarantine awareness posters (see Box 7-2), aimed at heightening awareness of potential quarantine breaches, are also placed strategically at numerous locations on Barrow Island, in the ChevronTexaco Perth office and at supply depot facilities.

The Gorgon Venture intends to enhance the training program for inspecting all goods transported to Barrow Island, and will work cooperatively with a variety of agencies including AQIS to implement best practice in this area.

Design and Planning

Integrating quarantine considerations into the design and planning of the Gorgon gas development will avoid or greatly reduce the potential of introducing invasive species to Barrow Island. Examples of how quarantine management can be integrated into design and planning include:

- selection of materials that reduce the potential for invasive species to be taken on at the point of origin
- selection of project processes, such as the type of construction method, to limit the frequency of vector movements
- design and planning of transfer operations to minimise the potential for invasive species to survive transport to Barrow Island
- consideration of environmental variables, particularly seasonal variability, in planning the timing of key project activities

Contracts and Purchasing

Contractors and sub-contractors will play a substantial role in all phases of the Gorgon gas development, especially construction.

Quarantine management processes must be equally applied to contractor operations with their involvement. Currently, all contracts for Barrow Island operations include the condition that quarantine management requirements are met. This condition will also apply to contracts for the construction and operation of the Gorgon gas development.

A variety of mechanisms can be used to ensure that contractors apply the desired level of quarantine management processes. These mechanisms fall into two broad categories: incentives to encourage good practices; and penalties to discourage bad practices. Penalties for non-compliance are severe and include dismissal of personnel and cancellation of contracts.

Incentives for contractors to encourage good quarantine practices can include financial, training, reputation enhancement, awareness and education on the importance of quarantine for Barrow Island. Currently ChevronTexaco extends the same environmental induction and awareness program to all staff and contractors visiting the island. If construction and operation of the Gorgon gas development proceeds, each main contracting company that could affect the integrity of quarantine procedures would receive additional training that emphasises the importance of quarantine in protecting the conservation values of Barrow Island.

Quarantine Procedures

Experience from Barrow Island and other

quarantine management programs worldwide demonstrate that the best quarantine outcomes are achieved when procedures are vector-based rather than species-based. That is, rather than focus on managing particular species, procedures are implemented with the primary purpose of ensuring that the vectors of transport (e.g., pathways of transport such as goods, vehicles and equipment) are clean and free of invasive species. In developing vector-based quarantine procedures, it is best to develop procedures at the smallest practicable scale.

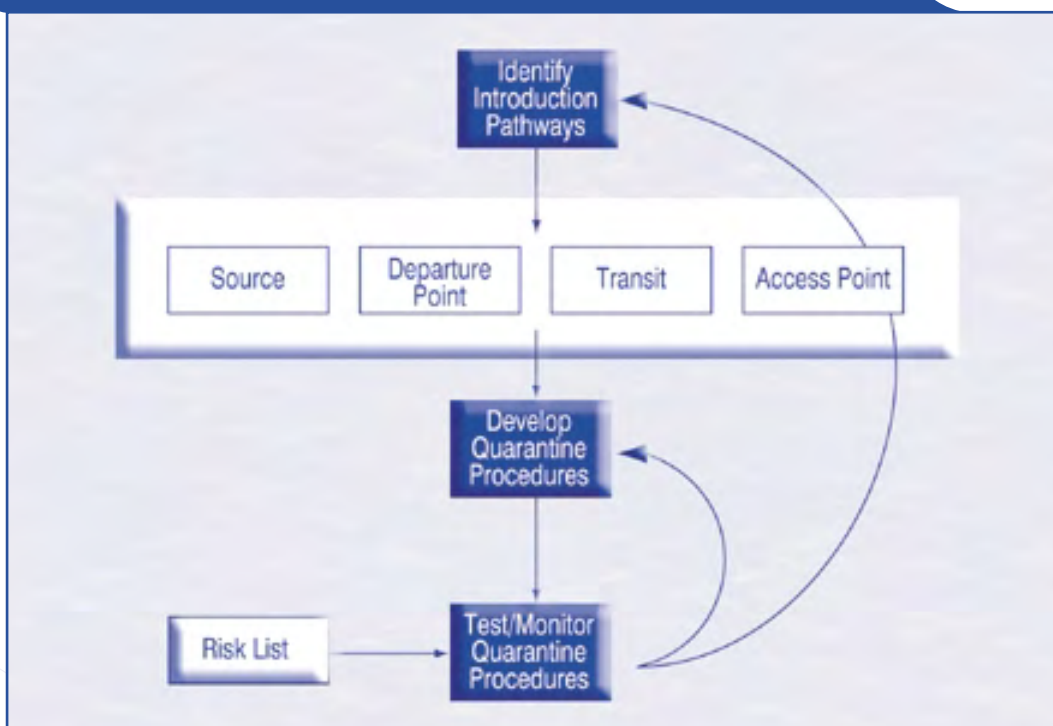
Potential transport vectors of invasive species to Barrow Island during the Gorgon gas development include vehicles, machinery and equipment, pallets, containers, imported accommodation units, large modules (from domestic and overseas), aggregate, people

and materials such as pipe and steel plate. These vectors were identified by reference to experience gained through almost 40 years of operations on Barrow Island. The vectors identified are similar to those for existing oilfield operations according to results from a workshop with DEP, CALM and AQIS and consideration of the likely logistical requirements associated with construction and operation of the development.

The process by which quarantine procedures have been, and will continue to be, developed for Barrow Island oilfield operations and the Gorgon gas development are illustrated in Figure 7-2.

FIGURE 7-2

Process for Development of Quarantine Procedures



Measures required as a minimum to prevent the introduction of foreign species to Barrow Island within the current ChevronTexaco quarantine procedures include:

- internal and external inspection for signs of earth, seeds, webs, eggs, vegetation, vermin or other pests
- wash-down of all equipment prior to transport
- inspection of container integrity
- testing of flour trays
- isolation and baiting
- fumigation of used accommodation or contaminated goods
- clear labelling of clearances
- recording of quarantine treatment in the Freight Management System and the Cargo Manifest
- reporting of potential presence of vermin or any foreign species
- implementation of preventative measures for avoidance of contamination by local vermin at supply bases and on barges
- clearance before unloading and visual monitoring during unloading at Barrow Island
- routine and incident monitoring and reporting
- auditing

ChevronTexaco's Weed Control Guidelines provide information on invasive flora species that have been identified as high risk for Barrow Island. The guidelines describe in detail the procedures to be applied for eradicating invasive flora from the island. These procedures would be incorporated into quarantine procedures for the Gorgon gas development.

In 1994, an Introduced Animal Contingency Plan was prepared after two domestic mice

were trapped in equipment transported from Thevenard Island to Barrow Island. The Plan provides procedures for a rapid response to contain and eradicate non-indigenous species accidentally introduced to the island. It also includes notification procedures and provides guidelines for personnel to contain and eradicate recently introduced species to Barrow Island. The Plan was designed such that actions will be effective and appropriate for the situation, will give a high degree of confidence that an introduced species is contained and eradicated, and will have minimal impact on native animals. This contingency plan would also be incorporated into quarantine management for the proposed development.

Monitoring

The effectiveness of quarantine management processes is presently monitored at all functional levels. If a gas processing facility is constructed on Barrow Island, quarantine monitoring will be implemented at all stages of development, construction and operation.

At the management level, monitoring also encompasses periodically auditing the effectiveness of management systems, such as contracts and purchasing and incident reporting procedures. Incident reporting procedures are monitored to ensure that all incidents, and potential incidents, are reported and appropriately investigated. Quarantine procedures are monitored to ensure that adequate resources (including personnel, training and finances) have been allocated to allow procedures to be properly implemented.

The quarantine program is subject to regular audit, review and improvement, as well as frequent initiatives to maintain personnel

awareness and vigilance. Audits target compliance with the formal quarantine procedures and include inspections of premises, operations and record keeping, as well as interviews with staff. Independent auditors are involved in the process and representatives from CALM have participated in audits.

At the procedural level, monitoring involves checks for invasive species at the point of origin and logistics bases, and on vectors of transport during transit to and arrival at Barrow Island. The Gorgon Venture will prepare detailed procedures for quarantine inspection based on existing proven Barrow Island oilfield procedures. The procedures are vector-based and focus on ensuring that vectors are free of invasive species.

If a gas processing facility is built on Barrow Island, ecological monitoring will be carried out through planned environmental monitoring and opportunistic observation – as is currently done for oil operations on the island.

Cooperation from the entire workforce as observers to detect the presence of invasive species significantly increases the effectiveness of monitoring. To further enhance this effectiveness, awareness programs are conducted and information is posted at strategic sites on Barrow Island and shore-based facilities.

Planned ecological monitoring currently occurs on an annual basis. If a gas processing facility is constructed, the timing and scope of the monitoring would be adjusted to reflect the scale of activity and the associated risk potential. Monitoring programs would be developed with input from regulatory agencies and a technical expert group.

Contingency Plans

Any breach of the quarantine procedure is currently reported through the ChevronTexaco Incident Reporting System – whether an introduction of an invasive species has occurred or not. The priority is to respond to the incident and then investigate the cause. The system provides for information gathering, determination of the sequence of events and causal factors, identification of corrective actions, and identification of responsibilities and time frames for the implementation of those actions.

A breach that results in the actual introduction of an invasive species is treated as an emergency response. It also highlights the importance that ChevronTexaco places on quarantine. This ensures that causes and remedial actions are considered with high priority during the annual review of environmental performance. All required corrective actions are tracked to ensure implementation as required.

The Introduced Animal Contingency Plan (explained above) provides procedures for a rapid response to contain and eradicate any invasive species accidentally introduced to Barrow Island. It includes notification procedures, individual responsibilities, an on-site action plan, immediate actions, planned responses and a resource list.

7.3.2 Identifying Potential Invasive Species

If an invasive species reaches Barrow Island, it would only become established if it possesses characteristics that allow it to survive and flourish. Survival depends on a range of factors including the adaptive ability of the



species, presence of an ecological niche, predator–prey dynamics, competitive ability and the prevailing physical conditions existing at the time of introduction (Lonsdale 1999). Thus, it is difficult to predict which species could survive if introduced to Barrow Island.

The best indication of whether or not a species could successfully survive and colonise Barrow Island is to identify whether it has a history of invading similar areas (IUCN 2000). However, caution must be applied in adopting this approach. Failure to colonise an area in the past does not necessarily mean that a species would fail to colonise the same area in future. Several government agencies including AQIS, Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Western Australian Department of Agriculture have compiled lists of species with known invasive potential. If the proposed development proceeds, a working list of species with high invasion and colonisation potential for Barrow Island will be prepared from these lists and from knowledge of species that have an invasive history on the adjacent mainland and nearby islands.

A list of invasive species with risk potential would provide a mechanism to test and refine the efficiency of quarantine procedures for each of the pathways by which an invasive species could reach Barrow Island.

7.3.3 Managing Pathways of Introduction

As Barrow Island is approximately 60 km from the mainland, invasive species can only be introduced if they are transported. There are a limited number of pathways to Barrow Island that would be associated with the proposed

Gorgon gas development. These are:

- barge landing/support vessel jetty
- airstrip
- loading jetty

As the barge landing and airstrip are utilised in existing oilfield operations and have been subject to strict quarantine procedures for almost 40 years, it is possible to draw on previous experience in devising quarantine procedures for these pathways of introduction.

Quarantine management would be applied to each pathway and at all stages of a development from design to decommissioning (including contingency planning). For each pathway, quarantine management planning must consider how to:

- avoid quarantine risk through design, planning or contracts
- avoid taking on invasive species at the departure point
- treat vectors during transit to remove invasive species
- inspect and contain on arrival

Barge Landing/Materials Offloading Facility

The barge landing and support vessel jetty will be used to offload materials to the island and backload equipment and waste to the mainland. Invasive species could be introduced through these pathways by being carried onboard the vessels, or with cargo and goods carried by the vessels; by other non-Gorgon Venture vessels utilising the jetty; or by people (as vectors). Marine invasive species could be introduced by vessels (e.g., fouling organisms) and from release of ballast water.

Increased vessel activity at Barrow Island particularly during a construction phase,

presents a significant increase in opportunity for the introduction of invasive species to the island. Estimates of vessel visits to Barrow Island suggest an increase in barge visits from one or two a week to approximately four to six a day during the peak of construction, and tanker loadings from one to ten per month during the operational phase. This is the same scale of increase that occurred during the

construction of the Saladin facility on Thevenard Island, which is also subject to quarantine. The manner in which this increased quarantine risk would be managed is discussed in Section 7.4.

The main management control options for the barge landing/materials offloading facility (mof) are outlined in Table 7-1.

TABLE 7-1

Barge Landing/Material Offloading Facility Quarantine Management Controls

Quarantine Goal	Management Control Options
Avoidance of quarantine risk through design, planning or contracts.	- Contractual requirements for quarantine in the provision of goods and materials. - Vessels that are waiting to be inspected, or have been rejected, will be required to remain at an offshore anchorage to minimise the potential for invasive species to reach the island. - No waste materials of any type to be transported to, or accepted onto, Barrow Island.
Avoidance of taking on invasive species at the departure point.	- Inspection of goods and materials prior to departure using the quarantine procedures. - Tracking of goods and materials using a "certificate of cleanliness", or similar system, to identify items that have been inspected. - Sterile area for temporary storage prior to departure for the island.
Treatment of vectors during transit to remove invasive species.	- Baits on vessels and in containers. - Fumigation of selected containers. - Trapping of fauna species.
Inspection and containment on arrival.	- Clearly identified Beach Master with responsibility to accept/reject vessels. - Sterile area for receiving materials and equipment that is separate from other works areas. - Secondary containment surrounding the sterile area, such as vermin-proof fencing, to restrict the dispersal of any invasive species that may be introduced to the island.

QUARANTINE MANAGEMENT

Airstrip

Fixed-wing aircraft and helicopters will use the airstrip primarily for transporting personnel to and from Barrow Island. A relatively small amount of material will be transported by air. The risks associated with this potential pathway of introduction are: a high density of invasive species, particularly weeds, at mainland departure points, hand-carried loads that may avoid quarantine inspection (e.g., tool-boxes), invasive species carried on aircraft, and people inadvertently acting as vectors.

Estimates of aircraft landings at Barrow Island under the Gorgon development imply an increase from the current four landings per week to a possible 21 landings per week. Such an increase in scale of activity represents an increase in the risk of a quarantine breach. An overview of a proposed quarantine response to this increased risk is provided in Section 7.4

The main management control options for air movements are outlined in Table 7-2.

TABLE 7-2

Airstrip Quarantine Management Controls

Quarantine Goal	Management Control Options
Avoidance of quarantine risk through design, planning or contracts.	- Contractual quarantine requirements for personnel travelling to Barrow Island and the aircraft provider companies. - Flights carrying animals will not be allowed to land at Barrow Island except in emergency conditions. - No waste materials of any type are to be transported to, or accepted onto, Barrow Island.
Avoidance of taking on invasive species at the departure point.	- Maintain sterile departure point. - Manage weeds at departure points on the mainland and nearby islands to minimise the potential for invasive species to be transported to Barrow Island. - Inspection of boots and socks of personnel, etc. at departure point. - Awareness video at induction.
Inspection and containment on arrival.	- Clearly identified Airport Master with responsibility to accept/reject loads. - Sterile transit area and hardened surrounding area to restrict dispersal and inhibit potential for weed species to become established. - Aircraft wash down is to occur in defined areas with drainage to trap any dislodged invasive species or propagules. - Monitoring program around Barrow Island airstrip.

LNG Load-out Jetty

Invasive species could be introduced to Barrow Island across the load-out jetty that may service both dedicated and non-dedicated Liquefied Natural Gas (LNG) tankers. The main risks associated with this pathway of introduction are invasive species carried onboard the vessels and marine

invasive species, including fouling organisms and organisms carried in ballast tanks.

The main management control options for the proposed LNG load-out jetty are outlined in Table 7-3.

TABLE 7-3

LNG Load-out Jetty Quarantine Management Controls

Quarantine Goal	Management Control Options
Avoidance of quarantine risk through design, planning or contracts.	- Contractual quarantine requirements imposed on tanker companies. - Vessel vetting procedures. - No waste materials of any type are to be accepted onto Barrow Island from the tankers. - No pets on dedicated tankers. - Jetty is to be designed to minimise the potential for introduction of invasive species onto Barrow Island, examples of design changes could include: - Dolphin moorings to keep the tankers a distance off the edge of the jetty rather than laying alongside. - Drawbridge(s) or cattle grids at points along the jetty to prevent movement of invasive species along the jetty. - Refuges strategically located along the jetty to trap invasive species and to prevent Barrow Island species getting out to the jetty head.
Avoidance of taking on invasive species at the departure point.	- Sterile departure point. - Apply best practice ballast water requirements.
Treatment of vectors during transit to remove invasive species.	Treat vectors during transit to remove invasive species using baits and traps.
Inspection and containment on arrival.	- Clearly identified Jetty Master with responsibility to accept/reject tankers. - Collars on ropes and piping to prevent invasive species gaining access to the jetty. - Secondary containment, such as vermin-proof fencing, around the land end of jetty to restrict dispersal of invasive species onto Barrow Island.

7.3.4 Quarantine Aspects of Emergency Response

Prudent planning takes into account potential and foreseeable emergency events. Emergencies that could occur on Barrow Island as a result of construction and operation of a gas processing facility include: fires, medical emergencies, accidents, aircraft crashes and quarantine breaches. All of these emergency situations could occur during existing oilfield operations. Consequently, existing oilfield emergency procedures are directly applicable to the construction and operation of the proposed Gorgon gas development.

Responding to an emergency situation on Barrow Island could pose a risk to quarantine if pressure to respond demands additional equipment and personnel be transported to the island with lesser quarantine priority.

The approach to emergency situations lies primarily with the integration of quarantine objectives into the development of emergency response procedures. Management control options include:

- pre-inspection of off-island emergency response resources to identify resources with the least potential for the introduction of invasive species
- inclusion of quarantine considerations in drills undertaken to test and train personnel in emergency response
- maximisation of the capabilities of on-island response as far as practicable to avoid the potential for introducing invasive species
- preparation of pre-defined separate quarantine procedures for life-threatening emergencies

7.4 Current and Proposed Quarantine Management

As operator of the Barrow Island oilfield, ChevronTexaco has in place a comprehensive environmental quarantine program designed specifically to address any quarantine risk to the island (Technical Appendix J).

In the event the Gorgon gas development on Barrow Island proceeds, the heightened level of people and material movements on the island would present an increase in the risk of a breach of quarantine. In acknowledgement of such a risk, the Gorgon Venture proposes to enhance existing quarantine procedures with a broad range of more intensive measures intended to preserve the integrity of the quarantine program.

ChevronTexaco, in its role as operator of both the Barrow Island oilfield and Gorgon gas development, would continue to provide overall management responsibility for operational activities on the island. This would include coordinating between the ventures on an enhanced quarantine program.

A summary of current and potential additional quarantine practices associated with the proposed Gorgon gas development is provided below. Under the expanded quarantine program a total of 37 individual quarantine practices could be implemented. The Gorgon Venture commits to working with the oilfield venture and various government agencies to design and implement the necessary level of quarantine protection for the Gorgon gas development.

The Gorgon Venture would therefore block the introduction of invasive species to Barrow

Island, and would continue to monitor the effectiveness of quarantine procedures and implement eradication measures to meet ecological integrity objectives.

Current Quarantine Procedures

ChevronTexaco currently has in place a range of quarantine procedures, which include:

- auditing
- barges baited and monitored
- clear labelling of clearances
- clearance before unloading and visual monitoring during unloading at Barrow Island
- fumigation of used accommodation or contaminated goods
- implementation of preventive measures for avoidance of contamination by local vermin at supply bases and on barges
- inclusion in all contracts that involve field work or material moving to field
- inspection of container integrity
- internal and external inspection for signs of earth, seeds, webs, eggs, vegetation, vermin or other pests
- isolation and baiting
- monitoring and contingency plans
- quarantine treatment for all material is tracked on manifests
- recording of quarantine treatment in the Freight Management System and the Cargo Manifest
- reporting of potential presence of vermin or any foreign species
- routine and incident monitoring and reporting
- single company accountability for quarantine
- testing of flour trays
- wash-down of all equipment prior to transport
- workforce education and training

Potential Additional Quarantine Practices

Potential additional quarantine practices that could be adopted for the Gorgon gas development include:

- addressing large modules such as main cryogenic heat exchanger
- agreeing procedures with AQIS for packages and modules coming from overseas
- baiting all tanker loading associated vessels (line handling vessels and tugs) and maintaining them free of invasive species
- baiting and maintaining refuges on Jetty, MOF and in quarantine area
- including contractual requirement for quarantine for each tanker berthing
- keeping clean and baited a dedicated wash bay on the mainland
- double fencing of a sterile area on Barrow designated as "quarantine area" for last check before release on to plant site
- increasing emphasis on detection of invertebrates as invasive species
- producing multilingual quarantine awareness information
- preventing waste material from vessels being brought onto Barrow Island
- preventing weeds and seeds arriving with personnel travelling to Barrow Island
- including quarantine positions in construction organisation
- implementing quarantine requirements for all vessels moving between the mainland supply base and Barrow Island
- reviewing of Australian Defence Force quarantine procedures
- upgrading audit and monitoring programs to reflect increased scale of movement
- upgrading procedures in conjunction with CALM for the movement of quarry material to the island



- upgrading procedures to deal with large packaged machinery such as motors, control systems, etc
- suppressing weeds in the immediate surrounds of the departure points on the mainland

7.5 Effectiveness of Quarantine Management to Date

ChevronTexaco recently received the U.K. Institute of Petroleum Environment Award for its environmental management and protection efforts on Barrow Island. This is the third award that ChevronTexaco's quarantine program on Barrow Island has received in the last 18 months. The company also received the inaugural APPEA Environment Award and the World Oil Award for Sustainable Development (see Chapter 1).

Since its discovery in 1964, the oilfield has yielded almost 300 million barrels of crude oil. Over 400 producing wells require continuous logistical support by barge and plane which has resulted in more than 10 000 cargo landings since the inception of the oilfield. Today, Barrow Island retains its conservation significance despite those shipments having included hundreds of thousands of separate items that each poses a risk of introducing invasive plants and animals.

A deep sense of employee pride, ownership and accountability in ChevronTexaco staff and contractors contribute to Barrow Island's status as vermin-free even after four decades of oil operations. In the absence of regulatory requirements mandating the quarantining of material going to Barrow Island – and commencing well before the passage of environmental legislation in Australia – the

ChevronTexaco program provides a benchmark for industry and sets a worldwide standard for offshore island petroleum operations.

7.6 Conclusions

ChevronTexaco has a comprehensive and rigorous quarantine management program in place for existing oilfield operations on Barrow Island. This program has been highly successful in protecting the integrity of Barrow Island's ecology and conservation values. To ensure that this record continues, the Gorgon Venture has commenced work on further expanding and improving the existing quarantine program to cover the Gorgon gas development.

If the Gorgon Venture receives approval to develop a gas processing facility on Barrow Island, its biodiversity and ecological integrity will continue to be protected through the integration of quarantine management into every aspect of the Gorgon gas development. This will be achieved through the pursuit of improvements that will reduce the risk of introducing invasive species and further increase the success of detection and eradication.



GREENHOUSE GAS MANAGEMENT

The Gorgon Venture is committed to the responsible management of greenhouse gas emissions. This ongoing commitment is reflected in the greenhouse gas management strategy – developed specifically for the proposed development of the Gorgon gas fields.

The strategy is based on the reference case of a liquefied natural gas (LNG) development. Total life-cycle emissions of greenhouse gases – spanning from gas production through to LNG consumption – are markedly lower per unit of energy consumed than traditional fossil fuels such as coal or fuel oil. Using oil for power generation in Asia would create approximately 84 per cent more greenhouse gas emissions than using LNG to produce the same quantity of electricity and 94 per cent more greenhouse gas emissions if coal was used. The use of natural gas will assist the Gorgon Venture customers meet their greenhouse emission reduction targets.

Integration of the greenhouse gas management strategy into the gas processing facility design – from the early conceptual design phase to plant operation – means that the LNG production facility proposed for Barrow Island would be the most greenhouse gas efficient facility of its kind in the Asia-Pacific region, and one of the most efficient in the world. The design of the facility would incorporate best practices in thermal and greenhouse gas efficiency. The current design concept for Barrow Island would emit approximately a quarter of the greenhouse gases, per tonne of LNG produced, compared to the initial 1995 design concept.

As explained in this chapter, greenhouse gas management for the Gorgon gas development incorporates innovative, internationally recognised best practice techniques, design improvements that increase greenhouse gas efficiency, and discussions with relevant government and industry groups. The strategy also features a plan to re-inject reservoir carbon dioxide (CO₂) into saline reservoirs beneath Barrow Island, unless it is technically infeasible or cost-prohibitive. All of the studies undertaken to date by the Gorgon Venture indicate that re-injection is technically feasible.

Re-injection could avoid approximately 4.2 million tonnes of CO₂ emissions per annum based on two 5 million tonnes per annum (MTPA) LNG trains. It would avoid a further 0.6 MTPA of CO₂ emissions from a 300 terajoules per day (TJ/d) domestic gas supply.

Development of knowledge and technology for re-injecting CO₂ as part of the Gorgon gas development would make Australia a world leader in this field. The Gorgon Venture has developed a strong working relationship with Australian researchers to ensure this knowledge would be shared and utilised in Australia.

8.1 Background – The Enhanced Greenhouse Effect

The “greenhouse effect” in Earth’s atmosphere is a natural process. It occurs as a result of a range of gases absorbing radiant energy from Earth and reflecting some of that energy back to Earth’s surface to produce a warming effect. This process, dominated by water vapour, maintains the atmosphere at a temperature suitable for life on Earth.

Human activities, such as combustion of fossil fuels, release greenhouse gases (principally carbon dioxide, methane and nitrous oxide). Consequently, atmospheric concentrations of anthropogenic greenhouse gases have increased substantially over the past 200 years: CO₂ has risen by 31 per cent; methane by 151 per cent; and nitrous oxide by 17 per cent (IPCC 2001). Each gas has a different potential impact on atmospheric heat absorption (see Box 8-1).

These increases have raised concerns that the natural warming effect will be “enhanced” by a greater concentration of gases absorbing and re-radiating energy. The “enhanced greenhouse effect” could result in global climate change. The predicted impacts of global climate change are significant and wide-ranging. They include:

- change in global temperature, rainfall and wind patterns
- shifts in climate zones
- reduction of polar ice-caps
- rise in sea level

Concern by the international community about global climate change has resulted in actions

designed to reduce greenhouse gas emissions.

The United Nations Framework Convention on Climate Change and the Kyoto Protocol, for example, aim to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent interference with the climate system. Some national governments have implemented policies that reflect the Protocol’s aims and their own national circumstances.

In recognition of scientific, government and public concern about the “enhanced greenhouse effect” resulting from human activities, the Gorgon Venture has devised a plan to mitigate greenhouse gas emissions from the proposed Gorgon gas development.

8.2 Government and Industry Response to Greenhouse Gas Emissions

Commonwealth Government Policy

The National Greenhouse Strategy, launched in 1998, provides a strategic framework for advancing Australia’s domestic greenhouse management response. The forward strategy against global climate change comprises four primary objectives (Kemp 2002). These objectives are:

- Australia will strive for an effective global response to climate change
- Australia will position itself to maintain a strong and internationally competitive economy with a lower emissions signature
- domestic policy settings will balance flexibility and certainty, and emphasise cost-effectiveness
- Australia will anticipate adaptation needs

Within this context, the Commonwealth Government is committed to continuing development and investment in domestic programs that will meet the target agreed in the Kyoto Protocol to the United Nations Framework Convention on Climate Change. Australia's target is to limit greenhouse gas emissions to 108 per cent of 1990 levels over the period 2008–2012.

Western Australian Government Policy

The Western Australian Government is developing a comprehensive greenhouse strategy that is based on the four strategic directions listed below (EPA 2002).

- Adaptation strategies to reduce vulnerability of human activities and natural systems to changes in climate and weather.

BOX 8-1

Relative Global Warming Potential of Greenhouse Gases

Each greenhouse gas has a different ability to affect the atmospheric heat balance, which depends on their concentrations, relative abilities to absorb energy, and lifetimes in the atmosphere. To provide a means of standardising the relative impacts of emissions of various greenhouse gases, a global warming potential (GWP) was developed to describe the contribution of each gas relative to an equal quantity of carbon dioxide. GWPs developed by the Intergovernmental Panel on Climate Change (IPCC) are listed below.

Global Warming Potential for Primary Greenhouse Gases (AGO 2002a)

Greenhouse Gas	Formula	Relative GWP (100 year)
Carbon dioxide	CO ₂	1
Methane	CH ₄	21
Nitrous oxide	N ₂ O	310
Perfluorocarbons	-	6500–11 900
Hydrofluorocarbons	-	12–12 000
Sulphur hexafluoride	SF ₆	23 900

Note: GWP (100 year) is the cumulative effect relative to CO₂ of other greenhouse gases over 100 years.

Based on the assessment by the IPCC, the global warming impact of methane is 21 times greater than the impact of CO₂ on a weight-for-weight basis.

The mass of the particular gaseous emission can be multiplied by the GWP to express the emission as “CO₂ equivalents” (CO₂e). Consequently the combustion of methane or volatile organic compounds to form CO₂ reduces their greenhouse impact.

- Emissions reduction strategies to protect Western Australia's quality of life and economic development while reducing greenhouse gas emissions through better energy efficiency, industry re-engineering and restructuring, renewable energy sources, and improved land management and other practices.
- Carbon-sink promotion, by revegetation and other processes that promote the absorption and storage of carbon dioxide from the atmosphere, to increase the amount of carbon stored in the Western Australian landscape.
- New industry development to increase the contribution to the Western Australian economy of "greenhouse-friendly" goods and services that take maximum advantage of new opportunities in response to climate change.

The Western Australian Environmental Protection Authority (EPA) has released its Guidance Statement for Minimising Greenhouse Gas Emissions (EPA 2002). The guidance statement provides advice on new or expanding projects and requires proponents to consider how to:

- estimate and benchmark greenhouse gas emissions
- minimise greenhouse gas emissions
- sequester carbon
- minimise emissions over the life of a project
- provide benefits on a national or global scale

LNG Action Agenda

The LNG Action Agenda (Department of Industry, Science and Resources 2000) identified greenhouse gas emissions as one of the major issues confronting the LNG industry in Australia. The LNG Action Agenda identified actions for both industry and governments to both meet Australia's greenhouse

commitments and maintain the international competitiveness of the Australian LNG industry (see Box 8-2).

ChevronTexaco's Position on Global Climate Change

In recognition of community and government concerns over the potential impacts of anthropogenic greenhouse gas emissions, ChevronTexaco – the operator of the Gorgon gas development – is committed to the effective management of greenhouse gas. A four-fold plan of action was developed to respond to climate change concerns (see Box 8-3).

Internationally, ChevronTexaco has many projects and technologies that are being developed to increase energy efficiency and reduce greenhouse emissions across the globe. Box 8-4 outlines some of the international activities undertaken by ChevronTexaco.

BOX 8-2

LNG Action Agenda

The LNG Action Agenda aims to identify and remove impediments to growth of the LNG industry; and to identify and capitalise on opportunities.

The national greenhouse policy was identified as one of the key issues that could impede growth. As a result, several actions were proposed for both the Commonwealth Government and industry.

Major actions on greenhouse gas emissions proposed for the LNG industry, as it works towards maximising the commercial development of Australia's gas resources, include:

- continuing to have Greenhouse Challenge Agreements for all current and future LNG projects
- applying the best economically available technology to greenhouse gas management
- managing greenhouse gas emissions in line with Greenhouse Challenge Agreements, government approvals and corporate policies
- maintaining an inventory of greenhouse gas emissions, and measures taken to abate greenhouse gas emissions
- providing advice to government on competitiveness issues associated with the introduction of any greenhouse gas management proposals, and how best to account for verified emission reductions that have occurred prior to that time
- funding at an appropriate level, research applicable to the industry on greenhouse gas abatement opportunities
- investigating sink-enhancement opportunities

Major actions proposed for the Commonwealth Government include:

- promoting LNG as a greenhouse-beneficial fuel
- avoiding greenhouse policies and measures that distort investment decisions between particular LNG projects and locations
- pledging that future greenhouse gas abatement policies and measures will promote cost-effective actions that minimise the burden for business and community, so the LNG industry can remain competitive (endorsed by the Western Australian Government)
- involving industry in all phases of greenhouse policy strategies that impact on their business
- avoiding greenhouse gas abatement policies that unduly limit access to the most cost-effective greenhouse gas mitigation options

ChevronTexaco's Position on Global Climate Change

ChevronTexaco is a global company providing energy and chemical products and services vital to the growth of the world's economies. Our core values include a commitment to protecting the safety and health of people and the environment. This commitment is a critical component of the value we deliver to our stockholders, customers, government partners and employees.

In addition to contributing to economic growth, the use of fossil fuels to meet the world's energy needs has contributed to an increase in "greenhouse" gases – mainly carbon dioxide and methane – in the Earth's atmosphere. Concern is growing that this increase is leading to climate change with adverse effects on the environment. ChevronTexaco recognises the increasing public and government concerns about global climate change and integrates these concerns into our business decisions. ChevronTexaco works proactively with governments and others to create environmentally, technically and economically sound solutions for responsible growth.

ChevronTexaco is responding to the concern about climate change with a four-fold plan of action. We are:

Reducing emissions of greenhouse gases and increasing energy efficiency: Our goal is to reduce emissions per unit output from operations. We inventory our emissions and use innovative technologies to continually improve the energy efficiency of our existing operations, new projects and products. We are incorporating greenhouse gas emission assessments into our capital project evaluations.

Investing in research, development and improved technology: We invest in research to: improve understanding of global climate change; to identify mitigation strategies; and to improve the cost-effectiveness of mitigation technology. We develop and apply cost-effective technologies that reduce the carbon emissions of producing, delivering and consuming its products.

Pursuing business opportunities in promising innovative energy technologies: Its research and business units are actively evaluating and investing in advanced energy technologies that have the potential of being commercially viable and beneficial to the environment.

Supporting flexible and economically sound policies and mechanisms that protect the environment: We respect the varied views of partner nations on this complex issue. We assist government policy development and decision-making on energy issues and participate constructively in dialogue with a broad range of stakeholders on this complex challenge. We support the development and use of international mechanisms such as Emissions Trading, Clean Development Mechanism and Joint Implementation, which provide flexible, market-based, economically sound means to reduce emissions.

BOX 8-4

Activities Undertaken Internationally that Demonstrate Chevron Texaco's Approach to Reducing Greenhouse Gas Emissions

- Establishment of an auditable greenhouse gas emissions inventory and baseline for the entire corporation using software developed by ChevronTexaco known as the ChevronTexaco System Analysis for Greenhouse Gas Emissions and Energy Assessment (SANGEA™). This will be utilised for creating a greenhouse gas emission inventory for the Gorgon gas development.
- Sharing best practices across the corporation in greenhouse gas management, energy and process efficiency improvements, and technology innovations.
- Plans to construct a natural gas pipeline connecting Nigeria with Benin, Togo and Ghana. This project could reduce greenhouse gas emissions by 100 million metric tonnes of carbon dioxide (CO₂) over its 20-year life.
- In Thailand, ChevronTexaco is a partner in a new 700 MW power plant, which will use natural gas instead of the more common high-sulfur coal to generate power.
- Developing fuel cells as alternatives to conventional internal combustion engines including the installation of 200 KW fuel cell operating on natural gas at ChevronTexaco's head office in San Ramon, California.
- ChevronTexaco's gasification technology converts coal, petroleum coke, heavy oil and refinery wastes into clean synthetic gas, which can produce electricity, chemicals and industrial gases including hydrogen. The process isolates CO₂ and allows it to be captured more easily. The ChevronTexaco gasification technology accounts for 55 per cent of global gasification efforts, and dozens of ChevronTexaco-owned or licensed gasification plants are operating or in various stages of development and construction.
- Chevron Energy Solutions (CES) was established in 2000 to deliver customised, cost-reducing energy solutions to commercial and industrial businesses and institutions.

Within Australia, ChevronTexaco has a history of proactive greenhouse gas management on its Barrow and Thevenard Island operations and in its association with regulators and other stakeholders (see Box 8-5). This includes ChevronTexaco's investment and participation in Australian and international research and development projects on technologies to capture and geologically sequester CO₂.

As an operator of oil and gas developments within Australia, ChevronTexaco contributes to greenhouse policy discussions at all levels of government. ChevronTexaco is providing

comment to the Western Australian Government on the development of the State Greenhouse Policy and was a member of the industry review panel for the EPA Guidance Statement for Minimising Greenhouse Gas Emissions.

The Gorgon Venture has integrated a greenhouse gas management strategy into decision-making and the concept selection process for the proposed Gorgon gas development (see Box 8-6). The strategy is aligned with Commonwealth and State policy for greenhouse gas emissions.

The concept presented in this document for developing the Gorgon gas fields is designed to emit significantly lower amounts of carbon dioxide per tonne of LNG produced, compared to earlier design concepts and other existing, or planned, Australian LNG facilities.

Greenhouse Challenge Cooperative Agreement

All Australian operating facilities that ChevronTexaco has an interest in are signatories to an Australian Greenhouse Office

BOX 8-5

Activities Undertaken in Australia that Demonstrate Chevron Texaco's Approach to Reducing Greenhouse Gas Emissions

- Conducting a trial planting of 65 ha of maritime pine with the Forest Products Commission to assess the potential for CO₂ sequestration. This trial enables ChevronTexaco and the Gorgon Venture to increase their understanding and familiarity of forestry issues such as carbon sequestration including carbon rights, costs and plantation management issues.
- ChevronTexaco, Shell and the Gorgon Venture are founding partners of the GEODISC program, which is part of the Australian Petroleum Cooperative Research Centre. This program is investigating potential geological sequestration opportunities for carbon dioxide and related issues for Australia. It commenced in 1999 for a four-year period. Over this time, ChevronTexaco, Shell and the Gorgon Venture have actively participated in technical and steering committees as well as contributing over \$1.2 million in financial support and a considerable contribution of 'in kind' support of time, data and resources.
- ChevronTexaco has made a substantial commitment to the CO₂ Cooperative Research Centre (CO₂CRC). This will continue the work of the GEODISC program and include additional research on CO₂ capture opportunities. The program will commence in 2003 and continue for seven years. It is intended that the CO₂CRC will develop or utilise a demonstration or pilot CO₂ re-injection program. ChevronTexaco and Shell have committed over \$3.5 million in direct support and will also provide 'in kind' support of time, data and resources. ChevronTexaco is an active participant in the organisation and steering of the CO₂CRC.
- Constructive participation with the State and Commonwealth Governments in the development of various policies on greenhouse gas emissions. This includes formal submissions, workshop participation and membership in review committees.
- Preparation of annual greenhouse inventories and forecasts since 1995 for all of our operating assets which are submitted annually to the Australian Greenhouse Office via the Greenhouse Challenge Program and to the ChevronTexaco inventory system (SANGA™).
- Ensuring all of our operating assets are covered by a Greenhouse Challenge Cooperative Agreement, either directly or under the APPEA Cooperative Agreement.
- Resources dedicated to the management of greenhouse gas issues for the Gorgon gas development and our other operating assets.
- Development and implementation of a comprehensive Greenhouse Gas Management Strategy and Management Plan for the Gorgon gas development.

BOX 8-6

Gorgon Development Greenhouse Gas Management Strategy

The Gorgon Development Greenhouse Gas Management Strategy for a Barrow Island development is to:

- Demonstrate via life-cycle analysis that a Gorgon gas development and LNG export result in a net reduction in global greenhouse gas emissions relative to other fossil fuel alternatives.
- Design the production facilities to incorporate current best practices in thermal efficiency and greenhouse gas emission control where practicable.
- Develop a project to re-inject the removed reservoir CO₂ into the Barrow Island Dupuy saline reservoir, unless it is technically infeasible or cost-prohibitive. This will involve:
 - pursuing a stepwise process to: develop a reservoir CO₂ re-injection project, demonstrate technical feasibility, and ensure that costs to the project are not excessive
 - selling treated gas to meet domestic gas customer requirements and re-inject the removed reservoir CO₂
 - commencing re-injection as soon as practicable after the processing facilities commissioning and start-up process
 - implementing re-injection of reservoir CO₂ by installing a single train of injection equipment, sized for the full volume of reservoir CO₂
- Investigate potential synergies with existing Barrow Island operations and implement measures that minimise greenhouse gas emissions and enable full use of associated gas production where practicable.
- Pursue projects and opportunities which provide net conservation benefits and enhance greenhouse gas removal from the atmosphere.
- Continue existing funding for greenhouse gas-related research and development projects such as CRC and technological research.
- Review options for funding additional value-added research and development or demonstration projects.
- Pursue potential opportunities for external sale or use of separated reservoir CO₂ as a chemical feedstock or enhanced oil recovery agent.
- Develop a contingency plan that could provide a partial offset for reservoir CO₂ if a sequestration project proves infeasible. Options may include:
 - maturing alternative re-injection sites that could be developed in the future such as a depleted gas reservoir
 - creation of emission reductions or offsets external to the Gorgon gas development
 - sequestration opportunities such as forestry
 - additional research funding
- Meet the commitments within the LNG Action Agenda including the revision of the existing Gorgon Greenhouse Challenge Cooperative Agreement.
- Continue to advocate increased use of gas-based fuels, in preference to more carbon-intensive options, to reduce greenhouse emissions.
- Participate constructively in the development of greenhouse policy at both the State and Commonwealth level.

(AGO) Greenhouse Challenge Agreement. Greenhouse Challenge Agreements are voluntary agreements between the AGO of the Commonwealth Government and individual companies or industry organisations (e.g., APPEA) to abate greenhouse gas emissions and provide annual emission inventories. The agreements provide a framework for emission reporting and actions to reduce emissions below the business as usual emissions.

The Gorgon Venture's history of proactive greenhouse gas management is exemplified by the completion of a Greenhouse Challenge Agreement for the proposed development in November 1998. This was the first Greenhouse Challenge Agreement for a project that was still in the design stage (i.e., prior to operations).

The Gorgon Venture is committed to modifying and updating the existing agreement to reflect the proposed development concept should in-principle approval for a Gorgon gas development on Barrow Island be granted. This is in keeping with industry's commitment within the LNG Action Agenda (Department of Industry, Science and Resources 2000).

8.3 Life-Cycle Benefits of LNG

Strategies for reducing greenhouse gas emissions have focused on combustion of fossil fuels for energy because it is one of the most significant contributors to the increase in atmospheric CO₂ concentrations. Natural gas as domestic gas or LNG produces less greenhouse gas emissions per unit of energy consumed (i.e., has a lower carbon intensity) than other traditional fossil fuels such as coal or fuel oil. Thus, greater utilisation of natural gas for power generation can reduce the quantity of greenhouse emissions per unit of energy produced.

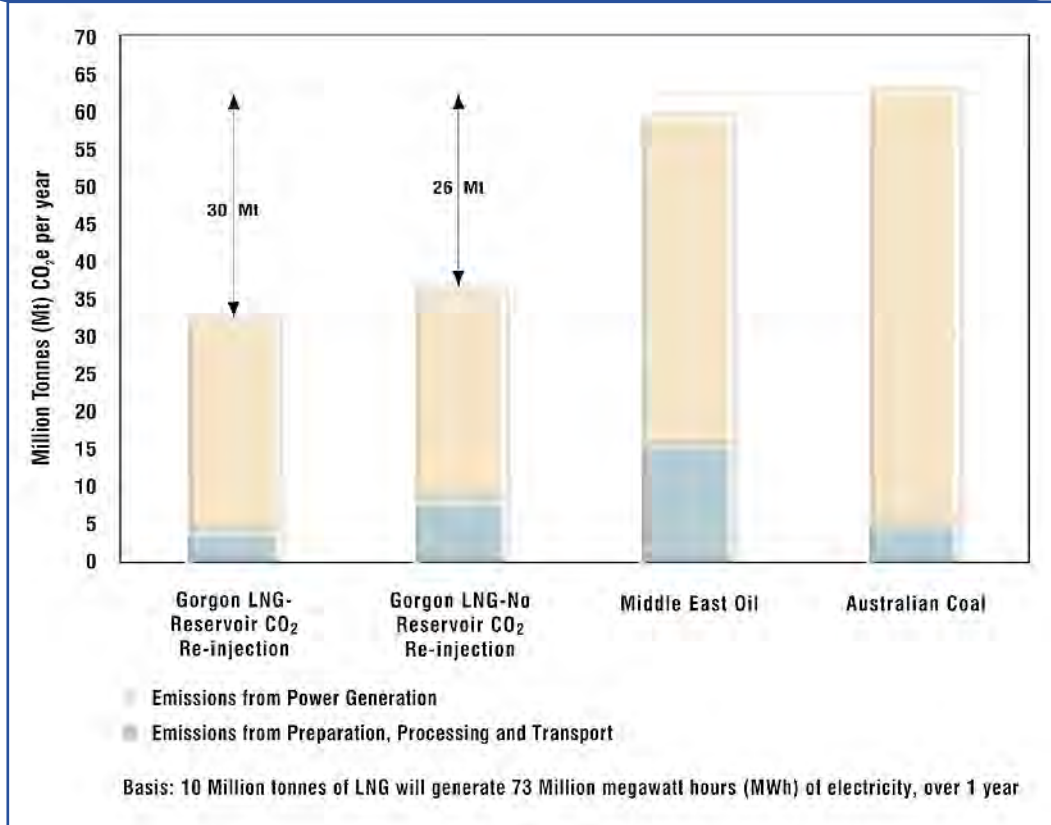
The demand for electricity continues to increase in both the developing and developed world. Currently, this demand is primarily met by coal, oil, natural gas or nuclear power. Renewable energy sources emit less CO₂ than these energy sources, but will not be sufficient to meet demand unless renewable energy technologies improve and become more economically feasible. It is widely accepted that when balancing issues such as long-term waste management (nuclear) with greenhouse gas and pollutant emissions (fossil fuels), the use of natural gas will have the lowest environmental impact.

When comparing the greenhouse gas impacts of different energy sources, the entire process from production through to consumption should be considered. This approach is referred to as "life-cycle greenhouse analysis". It includes emissions relating to the extraction, processing and distribution, as well as the combustion of the fuel by the end-user. As such, it represents the true greenhouse gas impact of a fuel.

When the total life-cycle emissions of various fossil fuels are compared, the total greenhouse gas emissions of natural gas are considerably less than coal or fuel oil. This makes natural gas one of the cleanest sources of fossil fuel energy. For example, the United Kingdom reduced its greenhouse gas emissions from power plants by 29 per cent between 1990 and 1999 despite a 16 per cent increase in electricity consumption. This decrease was largely due to a switch in primary electricity generating fuel from coal to natural gas (Department for Environment, Food and Rural Affairs 2001). An additional benefit of the combustion of natural gas or LNG, instead

FIGURE 8-1

Comparison of Life-Cycle Greenhouse Gas Emissions for Gorgon Gas (with & without re-injection) & Standard Fuels for Electrical Power Generation in Asia



of traditional fossil fuels, is that it results in lower levels of emissions such as sulfur oxides, particulates and nitrogen oxides. This can improve local and regional air quality with a corresponding decrease in potential health impacts.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) conducted studies for the Gorgon Venture to quantify the life-cycle advantages of LNG over coal and oil (CSIRO 1996). These studies showed that for generation of electricity in Asia, the production and use of 10 MTPA of Gorgon LNG would result in life-cycle emissions of 32 million tonnes of CO₂ equivalents¹. This compares to 59 million tonnes of CO₂ equivalents (i.e., 84

per cent more emissions) for fuel oil and 62 million tonnes of CO₂ equivalents (i.e., 94 per cent more emissions) for coal (see Figure 8-1).

As shown in Figure 8-1, compared to the use of conventional fossil fuel alternatives, the development of an LNG processing facility with a 10 MTPA capacity on Barrow Island, with reservoir CO₂ re-injection into the saline reservoir below, could provide a global benefit in avoided emissions of up to 30 million tonnes of CO₂ equivalents. Without reservoir CO₂ re-injection, production of LNG from Gorgon gas would still provide a potential global benefit of up to 26 million tonnes of CO₂ equivalents. Currently, there is no internationally accepted mechanism under the Kyoto Protocol to

¹ Gorgon LNG greenhouse gas efficiency for production has been updated from the 1996 study to reflect efficiency improvements in the design and increased LNG production.

provide a credit to Australia for this net global benefit in reduced greenhouse emissions because LNG production emits CO₂.

Figure 8-1 also shows that the combustion of LNG for power generation (or other uses) is the largest contributor to the total life-cycle greenhouse impact (87 per cent).

8.4 Greenhouse Gas Management

The Gorgon Venture is committed to implementing the current best practices in greenhouse gas management when developing the Gorgon gas fields. This is reflected in the Gorgon Greenhouse Gas Management Strategy (see Box 8-6) in which the major commitments are to:

- Incorporate current best practices in thermal efficiency and greenhouse gas emission control where practicable.
- Re-inject separated reservoir CO₂ (see Section 8.8).
- Investigate potential synergies with existing Barrow Island operations to identify and implement measures that could reduce greenhouse gas emissions (i.e., the use of gas associated from oil production within the proposed Gorgon gas processing facility to minimise flaring).
- Pursue projects and opportunities which provide net conservation benefits and enhance greenhouse gas sequestration from the atmosphere.
- Continue the existing commitment to greenhouse gas-related research and development.
- Pursue potential opportunities for external sale or use of separated reservoir CO₂ as a chemical feedstock or enhanced oil recovery agent.

The Dupuy saline reservoir under Barrow Island presents a unique opportunity to re-inject

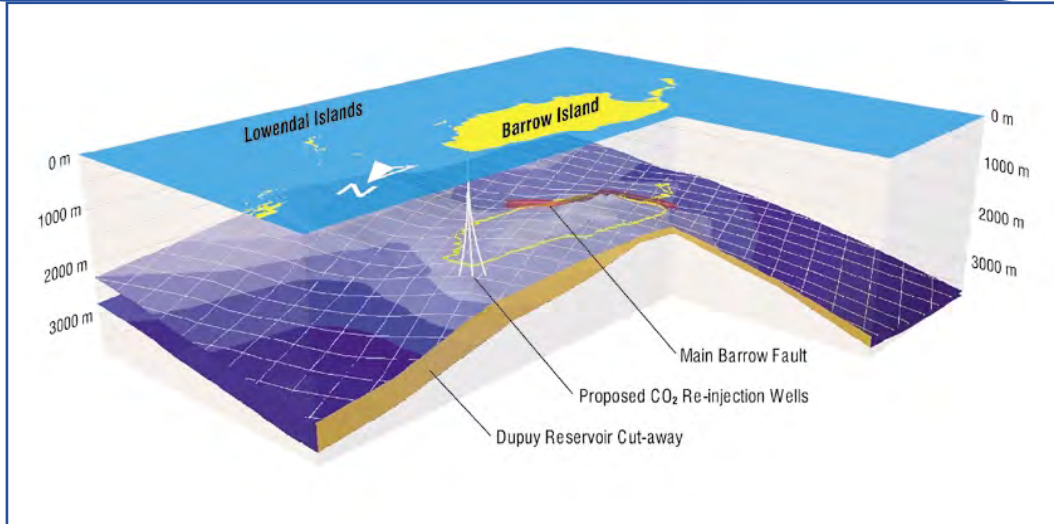
reservoir CO₂ and reduce greenhouse gas emissions. Figure 8-2 presents a three-dimensional view of the Dupuy reservoir (with the top of the formation located 2100 m below Barrow Island) and the potential re-injection well locations. The view is looking southwards towards the island (and mainland).

A re-injection facility to sequester CO₂ beneath Barrow Island would be sized to accommodate the full stream of separated reservoir CO₂. Re-injection would commence as soon as practicable after the gas processing facilities commissioning and start-up process. Studies undertaken to date indicate that the re-injection is technically feasible. However, as the re-injection project is a “first-of-a-kind”, there is a degree of technical and commercial risk for the Gorgon Venture. Section 8.8 describes the potential risks and management strategies that would be implemented to minimise these risks. The Gorgon Venture would also ensure that the facilities are designed to the same high engineering standards as the remainder of the LNG facilities to ensure safe operation and reliability.

The Gorgon Venture’s willingness to develop the knowledge and technology required to re-inject reservoir CO₂ reflects its genuine commitment to extend greenhouse gas management beyond current best practices. It will further improve life-cycle greenhouse gas emissions for LNG. If the proposed development of the Gorgon gas fields proceeds, re-injection of reservoir CO₂ would demonstrate the long-term feasibility of sequestering CO₂ on a large scale.

FIGURE 8-2

Three Dimensional Representation of the Dupuy Reservoir



8.4.1 Gorgon Greenhouse Gas Management Planning

Over the last decade the Gorgon Venture has undertaken a significant amount of work on the management of greenhouse gas emissions, including reservoir CO₂ re-injection, engineering design improvements and investigation of external greenhouse gas offsets. Current and future work will continue to develop and build on this knowledge.

To guide this process, several documents have been, and will be, produced to assist in the development, implementation and communication of the greenhouse gas management commitments and actions for the proposed development. These documents include:

- Gorgon Development Greenhouse Gas Management Strategy – this forms the basis of the Gorgon Venture's commitment to greenhouse gas management for the development (see Box 8-6).
- Environmental, Social and Economic Review (this document).
- Greenhouse Gas Management Plan – this document would outline the actions that

would be undertaken through the design, installation, commissioning and operation of the Gorgon gas development based on the Greenhouse Gas Management Strategy.

- Greenhouse Challenge Cooperative Agreement – would define the actions and commitments for a Gorgon gas development based on the Greenhouse Gas Management Strategy and Management Plan.
- Greenhouse commitments within the Environmental Impact Assessment would be developed and submitted to the Government if in-principle approval for restricted use of Barrow Island is granted. This would include more details on estimated greenhouse gas emissions and control techniques.

8.4.2 Management of Major Emissions Sources

Greenhouse gas emissions from LNG production are predominately CO₂, although some facilities can emit significant quantities of methane. CO₂ is primarily emitted from the combustion of natural gas (as fuel used to

generate power) and from the removal of the naturally occurring reservoir CO₂ in the natural gas. The major sources of greenhouse gas emissions from a typical LNG facility are related to:

- CO₂ removal system
- power system for gas compression
- electrical power generation
- flaring or venting
- fugitive emissions

The Gorgon gas development is currently at the conceptual design stage of development. As engineering and design work proceeds, detailed strategies for reducing all sources of greenhouse gas emissions will be refined and implemented. Such strategies will be based on the greenhouse design principles for each major greenhouse gas emissions source as outlined below.

Reservoir CO₂

Natural gas reservoirs contain naturally occurring levels of CO₂ that need to be removed before the gas can be liquefied. This removal is necessary as the CO₂ would freeze in the LNG process, blocking the processing equipment. The Gorgon Venture is approaching the management of this naturally occurring reservoir CO₂ in two ways.

Firstly, reservoir CO₂ would be re-injected if the gas processing facility is sited on Barrow Island (see Section 8.8 for further details). This would capture both the separated reservoir CO₂ and any remaining hydrocarbons that may be captured in the CO₂ separation process. All existing LNG production facilities in the world currently vent this reservoir CO₂ to the atmosphere (see Box 8-7).

Secondly, the CO₂ separation technology would be selected to ensure that the quantity of hydrocarbons captured with the CO₂ is as low as practicable.

Power Production

A significant portion of the greenhouse gas emissions from an LNG facility is due to the combustion of natural gas to provide electrical and motive power. The majority of this energy is utilised to power the refrigeration equipment in the liquefaction stage of an LNG facility. Greenhouse gases from the gas turbines are primarily emitted as a low concentration CO₂ stream in the exhaust gases (mostly nitrogen). The greenhouse gas emissions from power production are primarily determined by the combustion efficiency of the gas turbines and the energy efficiency of the process, in particular the liquefaction stage of the process.

Electrical power generation would primarily be provided by large gas turbines. Motive power would be provided by either direct-drive gas turbines or electric motors. Greenhouse gas emissions efficiency will be a significant criterion in the selection and design of the power production facilities (electrical and motive). The Gorgon Venture would utilise cogeneration technology within the power generation system. This system would recover waste heat from the gas turbine exhausts where practicable within the constraints of the process requirements. This will ensure an efficient use of energy and minimise greenhouse gas emissions.

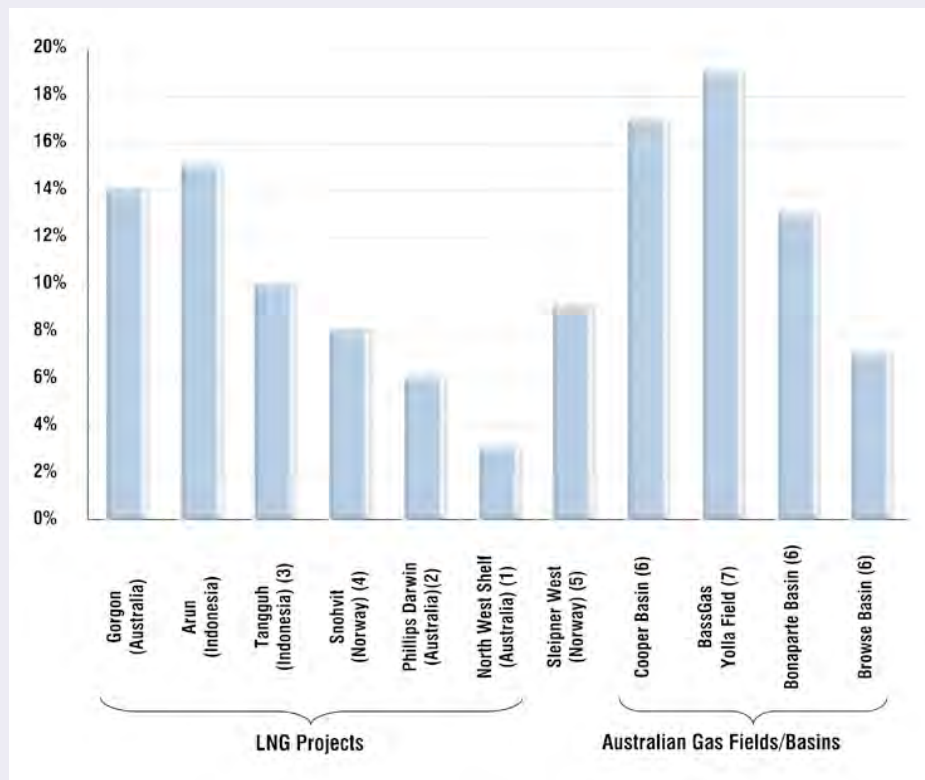
Due to the low concentration of CO₂ in the exhaust gases, it is currently considered infeasible to capture and re-inject this CO₂. The Gorgon Venture is currently investing in

BOX 8-7

Management of Reservoir CO₂ for a Typical LNG Plant

The reservoir CO₂ content varies dramatically between gas fields around the world. The Gorgon reservoirs have a naturally occurring CO₂ content of approximately 14 mol%. The following graph presents reservoir CO₂ concentrations from Australia and around the world.

Reservoir CO₂ Content



- 1 Woodside 1998
- 2 URS Australia 2002
- 3 http://www.bp.com/location_rep/indonesia/tangguh_project/enviro.asp
- 4 <http://www.snohvit.com/STATOILCOM/snohvit/svg02699.nsf?OpenDatabase&lang=en>
- 5 <http://www.ieagreen.org.uk/sacshome.htm>
- 6 Bradshaw 2002
- 7 Origin Energy 2002-12-05

The quantity of greenhouse gas emissions due to the removal of reservoir CO₂ is primarily determined by the natural CO₂ content of the reservoir gas. Current standard practice by all operating LNG facilities worldwide is to vent this CO₂ to the atmosphere as a concentrated stream.

research into technologies based on this concept including the CO₂CRC and the CO₂ Capture Project (see Section 8.8.2).

Process Efficiency

Process efficiency will be the major driver for determining the quantity of power that is required as either electrical, mechanical or heat energy. The management of energy through the gas production facility, LNG facility and supporting utilities will be an integral part of the design process and greenhouse gas management. Energy optimisation is an important part of the ChevronTexaco Project Development and Execution Process (CPDEP) and Value Improvement Practices (VIP) and will be applied throughout the execution of the proposed development. For example, the selection criteria for the liquefaction technology and refrigerant will include greenhouse gas emissions and energy efficiency. Other considerations in technology selection include cost, reliability, operability, environmental factors and other technical requirements.

Locating the gas processing facility on Barrow Island would permit the use of a sub-sea gas production system. This would further reduce greenhouse gas emissions by eliminating the need for offshore gas processing, compression, and power generation facilities.

Flaring and Venting

To minimise the risk to personnel and the plant in the event of process upsets, flaring is used as a safety measure to release gases from high pressure vessels rather than venting. The primary greenhouse gas emitted during flaring is CO₂ as a product of combustion.

Where practicable and without compromising the safety of the plant and personnel, all significant continuous flaring or venting sources will be eliminated. Waste gases from LNG loading and boil-off would be recovered back into the process.

Greenhouse emissions from flaring due to emergencies, process upsets, plant start-up and shutdown are expected to be very small relative to the total annual greenhouse emissions. These would be minimised where possible during the design and operation of the facilities.

The design would incorporate a high efficiency flare to minimise the portion of unburnt hydrocarbon to as low as reasonably practicable. This would minimise the emission of gases such as methane that have a high global warming potential.

Fugitive Emissions

Major sources of potential fugitive emissions include volatilisation from storage and loading of products, compressor seals and component leaks (e.g., valves, flanges and pumps). The use of the latest engineering practices has significantly reduced the level of fugitive emissions from gas plants. Historically, compressor seals have been a significant source of fugitive emissions from gas processing facilities. The proposed Gorgon gas development would utilise dry compressor seals that virtually eliminate fugitive emissions from this source. Vapour recovery on storage and loading facilities would be utilised where practicable. Selection of equipment would include consideration of the potential for fugitive emissions.

8.4.3 External Offsets

In addition to reducing greenhouse gas emissions by reservoir CO₂ re-injection and efficient design, the Gorgon Venture would consider external emission offset options as follows:

- Investigating opportunities to further reduce greenhouse gas emissions from existing projects managed by the Australian operations of ChevronTexaco. This includes potential synergies with the Barrow Island oil production operations such as the increased utilisation of associated gas to reduce flaring and enable the production of high gas-oil ratio wells.
- Continuation of the maritime pine plantation trial in the Moora region. This trial is being utilised by the Gorgon Venture to sequester CO₂ and increase the familiarity and understanding of biomass sequestration techniques.

8.5 Expected Emissions from a Barrow Island Gas Facility

According to the Gorgon Venture's assessment, the LNG facility proposed for Barrow Island would be the most greenhouse gas efficient LNG facility in the Asia-Pacific region and one of the most efficient in the world. This level of performance will be achieved through the integration of the greenhouse gas management strategy into the facility design from the early conceptual design stage through to plant operation.

The greenhouse gas emission estimates presented in this document are based on two

5-MTPA LNG trains along with a 300-TJ/d domestic gas supply. The phasing of each LNG train and the domestic gas supply will remain unclear until sufficient customer commitments have been obtained to justify project implementation. It has been assumed for the purposes of this analysis that production commences in late 2007 and would ramp-up over five years.

An LNG facility with a capacity of 10 MTPA on Barrow Island is expected to emit approximately 3.2 MTPA of CO₂ equivalents. This relatively low level of emissions would be achieved by:

- implementation of a comprehensive Greenhouse Gas Strategy and Management Plan
- design of a highly efficient LNG facility
- re-injection of the separated reservoir CO₂

Implementation of the above measures by the Gorgon Venture represents a financial commitment that extends beyond current best practices. This level of commitment reduces the competitive advantage of the Gorgon gas development relative to its competitors due to the expenditure on greenhouse gas management.

The level of greenhouse gas emissions from a domestic gas plant that is integrated into the Gorgon gas development is estimated to be relatively low. That is, for a 300-TJ/d domestic gas supply (to Compressor Station 1 on the Dampier to Bunbury Natural Gas Pipeline) (DBNGP) 0.1 MTPA CO₂ equivalents would be emitted. The major sources of these emissions are related to reservoir CO₂ removal and

re-injection, and compression to meet the required supply pressure at Compressor Station 1. As discussed in relation to the LNG development (Section 8.4), greenhouse gas emissions from a domestic gas plant would be managed by:

- implementing a comprehensive Greenhouse Gas Strategy and Management Plan
- designing of an efficient facility
- maximising synergies with the LNG facility
- re-injecting separated reservoir CO₂

The combined LNG and domestic gas facility is estimated to emit approximately 3.3 MTPA of CO₂ equivalents. Without reservoir CO₂ re-injection the estimated level of emissions for the LNG and domestic gas plant would be 8.1 MTPA of CO₂ equivalents. Table 8-1 summarises the emissions for an LNG and domestic gas facility based on a typical year.

Figure 8-3 presents an indicative emissions profile for a two-train LNG development with a 300-TJ/d domestic gas supply on Barrow Island over 30 years. The actual emissions profile would be dependent on the final development concept and timing of the development stages. The emissions profile was developed assuming normal operations, reservoir CO₂ re-injection and no changes in greenhouse gas efficiency over the life of the proposed development.

The greenhouse emissions from the development would almost be completely CO₂. Methane emissions would be relatively minor due to the implementation of the commitments outlined in Section 8.4.2. The contribution of nitrous oxide emissions from combustion will have a very minor impact on total greenhouse gas emissions. Application of the emission

TABLE 8-1

Summary Table of CO₂ Emissions (MTPA)

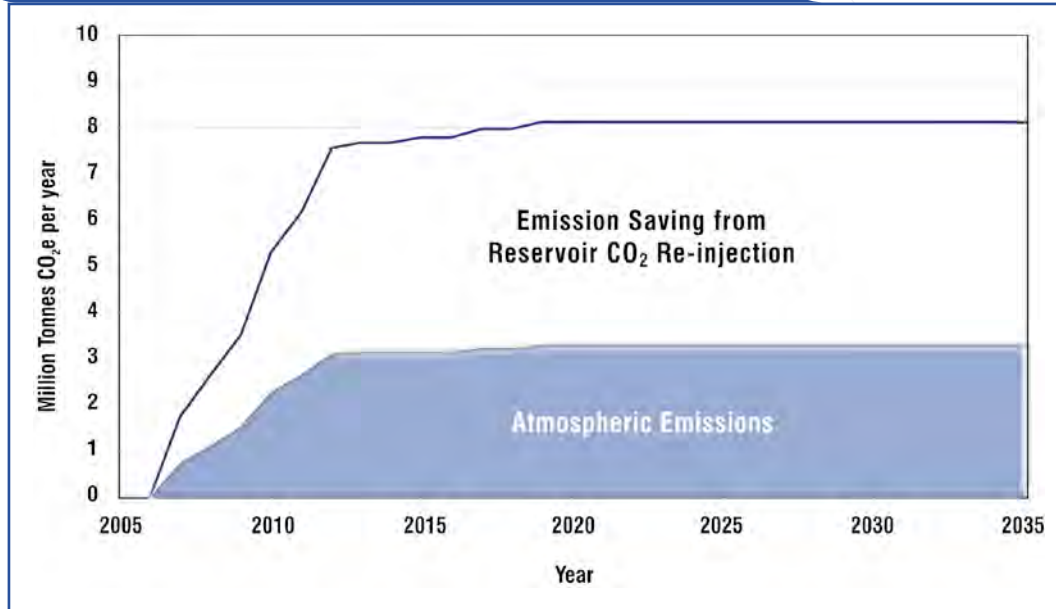
	LNG Facility	Domestic Gas Facility	Total
CO ₂ emitted ¹	3.2	0.1	3.3
Emissions avoided due to reservoir CO ₂ re-injection ²	4.2	0.6	4.8
Total (CO ₂ emission without re-injection)	7.4	0.7	8.1

¹ Includes emissions from the CO₂ re-injection compressor

² Avoided emissions equals re-injected volumes minus emissions related to the CO₂ re-injection compressor

FIGURE 8-3

Estimated Greenhouse Gas Emissions



estimate methodology of APPEA shows that the greenhouse gas contribution of nitrous oxide is approximately two per cent of the CO₂ emissions from gas turbines (APPEA 2001). It is anticipated that the Gorgon gas development would not emit any perfluorocarbons, hydrofluorocarbons or sulfur hexafluoride.

The estimated annual emissions from the Gorgon gas development would cause a slight increase in Australia's annual greenhouse gas emissions of approximately 0.7 per cent. This compares to potential global greenhouse gas emissions of 30 million tonnes of CO₂ equivalents being avoided each year. This in turn equates to approximately six per cent of Australia's 1990 baseline. Table 8-2 presents the potential Gorgon gas development emissions relative to Australia's 1990 and 2000 baseline emissions.

Table 8-3 presents the same information relative to Western Australia's 1990 and 1995 emissions.

8.6 Continuous Improvements

The greenhouse gas efficiency of the current Gorgon gas development concept is approximately four times the efficiency of the earlier 1995 concepts. Figure 8-4 outlines the improvements that have been made. During this period there has been a sustained effort to reduce greenhouse gas emissions as part of the Gorgon Venture's ongoing commitment to an environmentally responsible development. Some of the major improvements that have been made in the concept selection and LNG train design to reduce greenhouse gas emissions include:

- better liquefaction and turbine technology (ongoing)
- utilisation of waste heat recovery (1997 design)
- unmanned remote offshore hub (1999 design)
- sub-sea completion (no offshore compression for initial phases of the development) (2002 design)

TABLE 8-2**Predicted Greenhouse Emissions Relative to Australia's 1990 and 2000 Baseline**

	Million Tonnes of CO ₂ e per Annum	Percentage increase relative to the 1990 Baseline %
Australia's 1990 Baseline Emissions ^{1,2}	503.3	-
Australia's 2000 Emission ^{1,2}	535.3	6.3
Gorgon Gas Development with Re-injection of Reservoir CO ₂	3.3	0.7
Gorgon Gas Development without Re-injection of Reservoir CO ₂	8.1	1.6

¹ Based on the UNFCCC accounting method

² From Australia's Third National Communication on Climate Change (Australian Greenhouse Office 2002b)

- re-injection of reservoir CO₂ (2002 design with re-injection)

The Gorgon Venture will continue to review opportunities to reduce emissions in the design. Improvements in the efficiency of power generation and liquefaction facilities, which represent the majority of the emissions from the current design, hold the greatest potential for any further reductions. However any significant reductions in greenhouse gas emissions from these sources would require a substantial

change in the efficiency of these technologies.

Once the LNG facility is operational, the primary focus for greenhouse gas management will be on operating efficiency by improving plant optimisation and control. The Gorgon Venture will continue to consider and review potential technologies that could reduce greenhouse gas emissions from the development, particularly for new or replacement equipment. Opportunities to further reduce greenhouse gas emissions

TABLE 8-3**Predicted Greenhouse Emissions Relative to Western Australia's 1990 and 1995 Baseline**

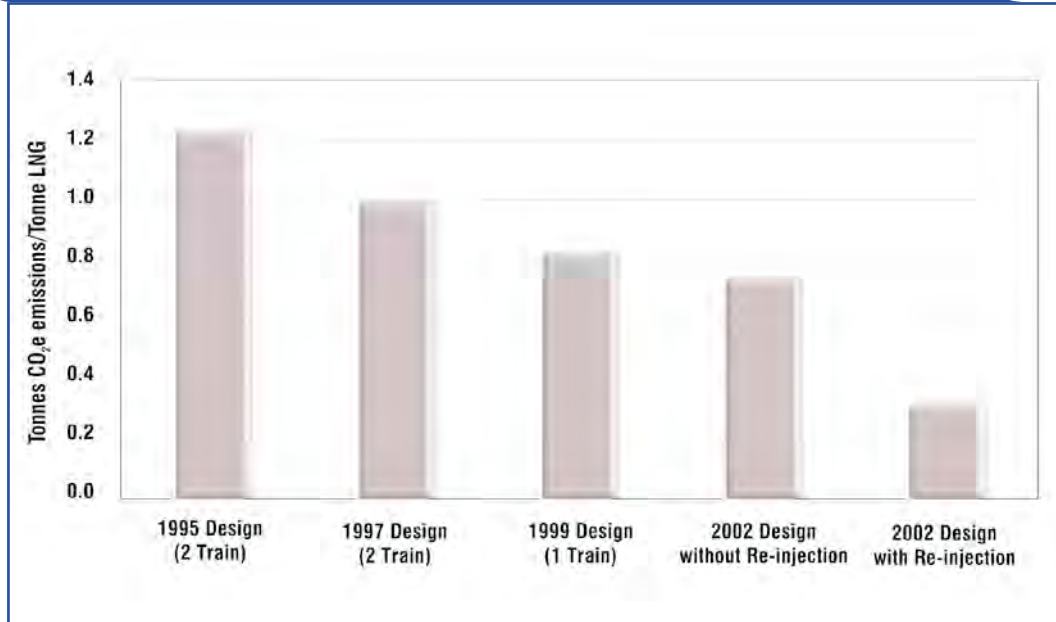
	Million Tonnes of CO ₂ e per Annum	Percentage increase relative to the 1990 Baseline %
Western Australia's 1990 Baseline Emissions ^{1,2}	42.5	-
Western Australia's 1995 Emission ^{1,2}	49.3	16
Gorgon Gas Development with Re-injection of Reservoir CO ₂	3.3	7.7
Gorgon Gas Development without Re-injection of Reservoir CO ₂	8.1	19

¹ Excludes land use changes

² EPA 2002

FIGURE 8-4

LNG Production — Improvements in Greenhouse Gas Emissions



may be limited as the cost of retrofitting equipment on an LNG train is significantly greater than incorporating it into a new design.

8.7 Comparative Greenhouse Gas Emissions of the Gorgon Gas Development

The estimated greenhouse gas emissions performance for a gas processing facility based on Barrow Island indicate that it would be the most greenhouse gas efficient facility of its type in the Asia-Pacific region (see Figure 8-5). The figure compares the estimated greenhouse gas emissions performance, per tonne of LNG produced, of the planned Phillips Darwin LNG facility (URS 2002), the existing North West Shelf LNG Trains 1–3 and the new Train 4 operated by Woodside Petroleum (Woodside 1998).

Both the North West Shelf project and Phillips Darwin LNG project have offshore platforms that supply gas to the LNG facilities. Emissions from these platforms have not been included in

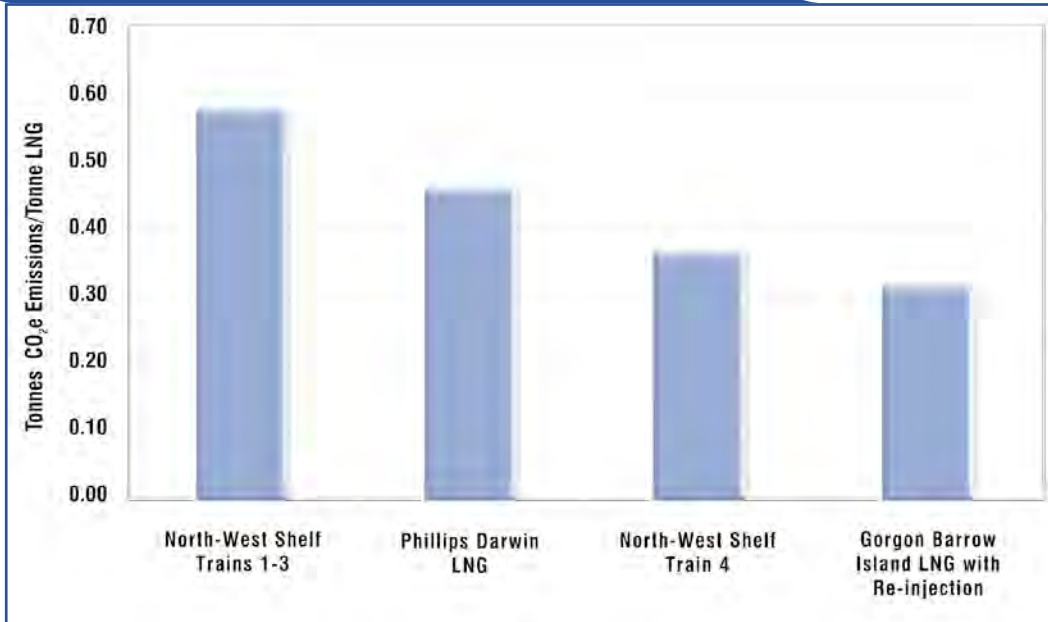
the greenhouse gas efficiencies presented in Figure 8-5. A Gorgon gas development on Barrow Island would utilise a sub-sea production system eliminating any offshore emissions during initial operations. Therefore the greenhouse gas emissions per tonne of LNG for the Gorgon gas development includes emissions from the well to the LNG carrier, not just from the LNG facility.

Statoil, a Norwegian Oil and Gas company, also intend to re-inject reservoir CO₂ in their proposed Snøhvit LNG facility on the north coast of Norway. The Snøhvit LNG facility is likely to have a lower level of greenhouse emissions per unit of LNG production than Gorgon due to several natural advantages that translate to a lower level of emissions. These advantages include:

- Significantly lower reservoir CO₂ content (5–8 mol%) which reduces the quantity of CO₂ that needs to be removed and re-injected. This reduces energy requirements and greenhouse gas emissions.

FIGURE 8-5

Greenhouse Efficiency of Australian LNG Facilities



- Significantly colder ambient temperatures which improve the efficiency of the cooling facilities and the gas turbines.

8.8 Reservoir CO₂ Sequestration

Re-injecting reservoir CO₂ into a saline reservoir below Barrow Island has the potential to sequester significant volumes of CO₂ and therefore reduce potential greenhouse gas emissions.

8.8.1 International Experience

Re-injection of Gorgon reservoir CO₂ into a saline reservoir for GHG management will be a first for Australia, and one of only a handful of such schemes worldwide.

However, ChevronTexaco has extensive experience in design, construction and successful operation of projects involving re-injection of substantial volumes of CO₂ into subsurface formations (see Box 8-8).

ChevronTexaco's largest current CO₂ injection operation is the Rangely Weber Sand Unit in western Colorado, in the USA. Rangely is the largest oilfield in the US Rocky Mountain area and is the third largest CO₂ enhanced oil recovery operation in the world. Injection of CO₂ for enhanced recovery began in 1986. Today this operation injects approximately three million tonnes of CO₂ per annum into sandstone formations at a depth of about 1800 m. The CO₂ is compressed to 150 bar (2150 psi), dehydrated and then injected using a network of wells. The CO₂ supply for this enhanced oil recovery project is transported to Rangely via a CO₂ pipeline, which was built and is operated by ChevronTexaco. Since beginning this project, over 19 million tonnes of CO₂ have been sequestered.

BOX 8-8

International CO₂ Re-injection Experience

ChevronTexaco pioneered large scale re-injection of CO₂ into oil production reservoirs as a technique to enhance oil production rates and increase the percentage of reserves commercially recovered. Starting in 1972 ChevronTexaco began injecting CO₂ into the giant Kelly-Snyder field, in the Permian Basin of Texas. This CO₂ was recovered from natural gas processing plants, compressed to supercritical pressure and transported by pipeline 270 km for re-injection at a depth of about 2000 m.

In the years since, ChevronTexaco has conducted pilot tests involving CO₂ re-injection or installed CO₂ enhanced oil recovery projects at a series of oil fields in the western USA, including the Rangely Weber Sand Unit (1986), Kingdom Abo Field (1987), North Ward Estes Field (1989), Mabee Unit (1992), Sundown Slaughter Unit (1994), J.T. McElroy Lease (1995), Goldsmith San Andres Unit (1996), Central Vacuum Unit (1997), Aneth Unit (~1998), and Vacuum Grayburg San Andres Unit (2001). Today, ChevronTexaco's North American exploration and production company operates six CO₂ injection projects. In addition, ChevronTexaco has a working interest in 11 non-operated CO₂ injection projects, two of which are the world's largest – the Seminole Unit and the Denver Unit.

In addition to this experience with CO₂ enhanced oil recovery projects, ChevronTexaco also has operated systems designed to inject mixtures of CO₂ and hydrogen sulfide into subsurface formations to reduce atmospheric emissions. ChevronTexaco's producing operations in Canada was one of the first to use this technique, referred to as 'acid gas injection', to dispose of hydrogen sulfide and CO₂ separated from natural gas streams, while minimising sulfur emissions.

Acid gas injection typically involves compressing the mixed acid gas to pressures of up to 130 bar (1900 psi), dehydrating the gas and injecting it into a saline formation other than the source oil or gas field. ChevronTexaco's Canadian subsidiaries have successfully operated four such acid gas injection projects since 1990, with 21 years of cumulative experience. The CO₂ content in the injected gas is up to 88 mol%.

Both Shell and ExxonMobil – the other two Gorgon Venture participants – also have experience in the operation of CO₂ re-injection based on enhanced oil recovery projects. ExxonMobil also is a joint venturer in the Sleipner project, the only large scale CO₂ geological sequestration operation currently underway (one million tonnes per annum). Sleipner is located in the Norwegian sector of the North Sea.

8.8.2 Geological Sequestration Research and Development

Research is currently being conducted around the world to investigate the viability of geological sequestration of CO₂ to reduce

greenhouse gas emissions. The four primary goals of this work are to:

1. Develop reservoir management practices that lower the cost of storage and ensure reservoir integrity.
2. Demonstrate the environmental acceptability of the process.
3. Understand the behaviour and gain assurance on the predictability of sequestered CO₂.
4. Develop reliable monitoring, verification and mitigation technology for CO₂ sequestration.

ChevronTexaco is actively involved in several projects that are investigating geological sequestration (see Table 8-4). Participation

in these programs is expected to contribute to the success of planning and executing reservoir CO₂ re-injection into the Barrow Island saline reservoir.

Further information on these programs is available on the world wide web from:

1. www.apcrc.com.au/Programs/geodisc_res.html
2. www.co2captureproject.com
3. www.ieagreen.org.uk/weyburn.htm
4. esd.lbl.gov/GEOSEQ

ChevronTexaco has a strong working relationship with GEODISC and the new CO₂CRC involving financial, policy and technical commitments. The Gorgon Venture plans to maximise the transfer of re-injection knowledge between the proposed development and the GEODISC and CO₂CRC programs. In this way, Australia would establish itself as a leader in geological sequestration of CO₂.

The Gorgon Venture would also utilise information through links with the Saline Aquifer CO₂ Storage (SACS) project which was set up to monitor and research the storage of CO₂ for the Sleipner project (www.ieagreen.org.uk/sacshome.htm). The Gorgon Venture has links with the SACS project through ExxonMobil (which is a Joint Venture participant in both the Gorgon gas development and the Sleipner development); and with GEODISC which is technically reviewing SACS work.

The Gorgon Venture organised an international forum on geological carbon dioxide sequestration in Perth in 1998, which included discussion on the Gorgon gas development re-injection concept. The forum included speakers and participants from the oil and gas industry,

the Australian Greenhouse Office, the Department of Mineral and Petroleum Resources, Environment Australia and numerous researchers from the CSIRO, the Netherlands Institute of Applied Geoscience, the British Geological Survey, the Alberta Research Council and the Massachusetts Institute of Technology (MIT).

8.8.3 Identification of Re-injection Sites

The Gorgon Venture has carried out several studies to identify a suitable site to re-inject reservoir CO₂. Screening studies undertaken since 1992 have identified several sites with re-injection potential. The region considered is shown in Figure 8-6.

Sites considered suitable for CO₂ re-injection included saline reservoirs, depleted gas reservoirs and other formations that meet the general requirements for subsurface disposal of CO₂. The criteria for selection are outlined as follows:

- The top of the reservoir for re-injection must be at least 800 m deep. At this depth the CO₂ will be in a dense, supercritical (liquid like) state under normal geothermal conditions.
- The reservoir system will provide containment of the CO₂.
- The reservoir must have sufficient porosity and permeability to handle the re-injection rates for the CO₂ volumes required. The Gorgon gas development requires a single site, or multiple sites near to each other, capable of taking approximately 250 million standard cubic feet per day (MMscf/d) and a total volume of approximately 2.5 Tcf or more. This would allow all the reservoir CO₂ produced from the proposed Gorgon development to be sequestered (e.g., from a 10 MTPA LNG facility producing for 30 years).

TABLE 8-4

Research and Development Projects for Geological Sequestration of CO₂

Program Name	Program Location	Description
GEODISC ¹	Australia	The GEODISC program is designed to address key technical, commercial and environmental issues associated with geological sequestration of CO ₂ in Australia. This program is part of the Australian Petroleum Cooperative Research Centre (APCRC).
Cooperative Research Centre for Greenhouse Gas Technologies (CO ₂ CRC)	Australia	The CO ₂ CRC will continue and extend the work of GEODISC. The aim of the program is to develop CO ₂ capture and sequestration technologies.
CO ₂ Capture Project ²	International	Major international program aimed at reducing the cost of CO ₂ capture from combustion sources and the development of methods for safely storing CO ₂ underground.
Weyburn Project ³	United States / Canada	Monitoring of the sequestered CO ₂ in geological reservoirs for enhanced oil recovery in the Weyburn field.
GEO-SEQ ⁴	United States / Canada	Is a public-private research and development partnership that will deliver the technology and information needed to enable the application of safe and cost-effective methods for geological sequestration.

- The reservoir must have the capacity to accept the volume of CO₂ being re-injected without build-up of pressures to conditions where safety or the integrity of the reservoir seals would be compromised.
- The re-injection site should be close to the CO₂ source to minimise costs, transportation issues, and increase greenhouse efficiency.
- The re-injection of CO₂ should not prevent the exploration and production of hydrocarbon resources from reservoirs within the area.

A total of eight locations were evaluated for their re-injection potential. These are shown in Figure 8-7.

Table 8-5 outlines the major advantages and disadvantages for each location that was evaluated and comments on their suitability. Seven additional areas were also considered, but determined unsuitable and eliminated from further consideration. These included:

- Exmouth area
- Canning Basin
- Barrow Island – Windalia formation
- Wandoo
- Barrow Group offshore
- Burrup Peninsula area
- North Rankin

These locations were excluded from further consideration due to reasons including risk to currently producing oil or gas fields, distance from potential gas processing facilities sites, and a lack of suitable CO₂ re-injection reservoirs.

The review of sites concluded that the Barrow Island – Dupuy saline reservoir, West Tryal Rocks and the Gorgon gas reservoirs offer the best opportunities to re-inject reservoir CO₂.

Among those sites, the Barrow Island – Dupuy saline reservoir was identified as the best reservoir for CO₂ re-injection as it would be available when

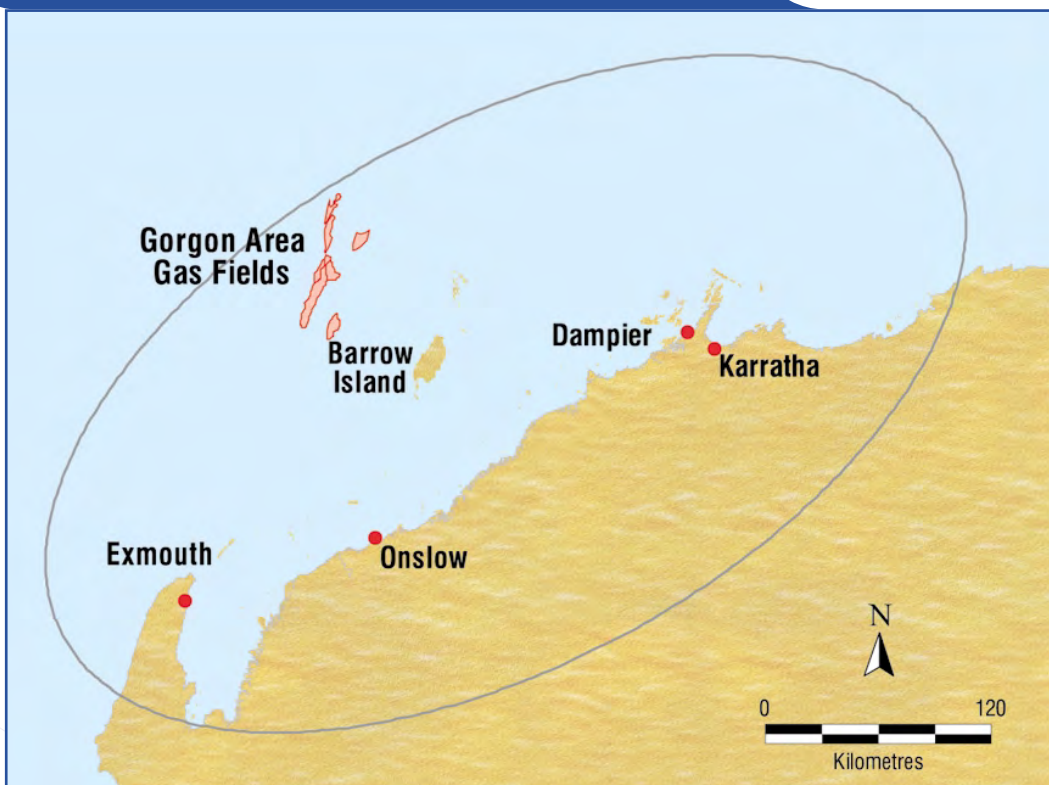
production from Gorgon gas fields commence. Some of the major factors that make the Dupuy saline reservoir the best option, and Barrow Island itself the only suitable location, include:

- The depth and “thinning up-dip” provide the most favourable technical conditions for re-injection (see Figure 8-2 and 8-9).
- There is little or no potential to jeopardise current or future production of hydrocarbons.
- Re-injection wells that penetrate into the Dupuy reservoir would allow access to other saline reservoirs (Flacourt and Malouet) as mitigation/upside options.
- The reservoir would be available for re-injection when gas production commences.
- The reservoir is large and deep enough to accept the proposed CO₂ volumes.
- The Dupuy saline reservoir is accessible from Barrow Island – removing the need for sub-sea wells and offshore platforms, reducing the risk and cost, and making re-injection more practicable.
- The location under a land mass (Barrow Island) and the existing oilfield provides increased geological data and monitoring opportunities to improve knowledge of the behaviour of re-injected CO₂.

Recent stakeholder discussions have raised the issue of utilising shallow reservoirs under the Montebello Islands as a potential re-injection site. The Gorgon Venture has assessed this opportunity and do not consider it to be a viable re-injection site at this time.

FIGURE 8-6

Region of Investigation



The Montebello's region has poor seismic quality due to the reef effects. This results in significant uncertainties with the reservoir sand geometry, fault traps and unknown hydrocarbon pools. Injection of CO₂ into the Montebello's region could result in the CO₂ migrating up-dip towards nearby producing reservoirs.

8.8.4 Barrow Island Reservoir CO₂ Re-injection Concept

The location of a gas processing facility on Barrow Island provides a unique opportunity to re-inject the reservoir CO₂ removed from Gorgon gas. By having the re-injection site and gas facility both located on Barrow Island, the need for an offshore compression/re-injection platform and pipeline are eliminated. This minimises the capital and operating costs for

the proposed development and increases the probability that reservoir CO₂ re-injection will not be cost-prohibitive. In addition the CO₂ separation and compression utilities can be integrated into the gas processing facilities optimising the use of support utilities (eliminating duplication) and reducing energy needs and therefore greenhouse gas emissions.

Figure 8-8 illustrates the reservoir CO₂ re-injection concept. The reservoir CO₂ is removed from the incoming gas stream (following condensate and water removal) in a CO₂ absorber column using a solvent-based process. The removed CO₂ is then stripped from the solvent, dehydrated and compressed to a pressure suitable for re-injection into the Dupuy saline reservoir. Following compression to approximately 240 bar (3500 psi), the CO₂ is

FIGURE 8-7

Potential Re-injection Locations

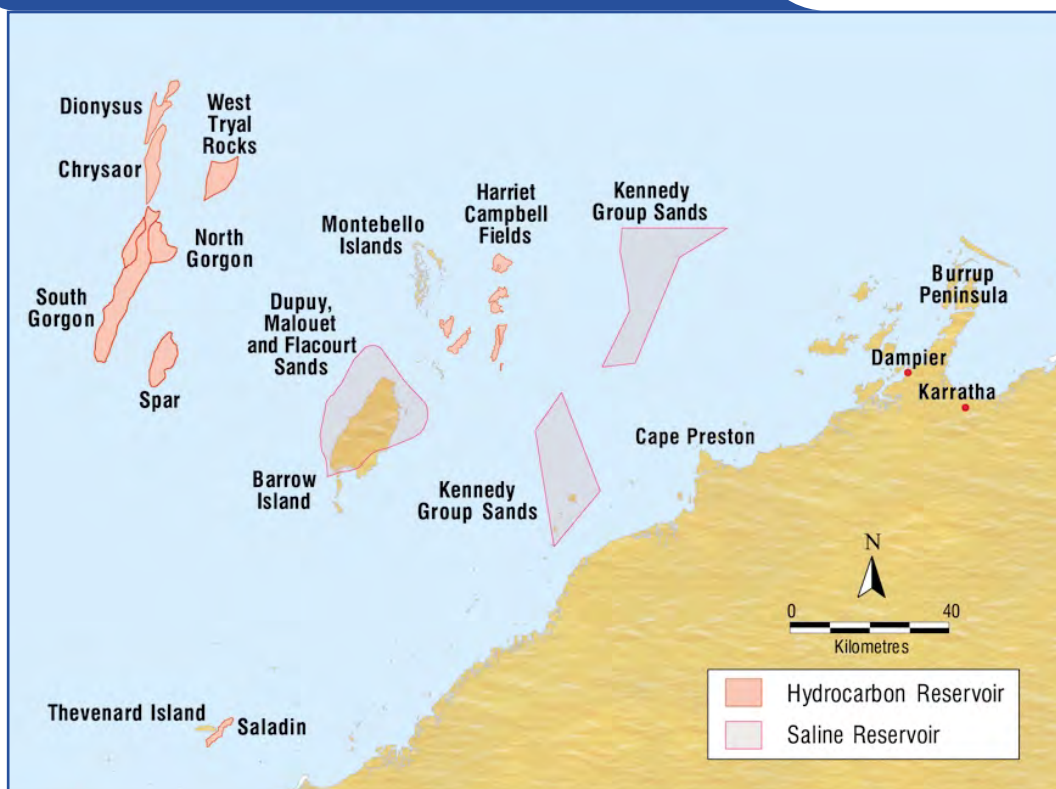
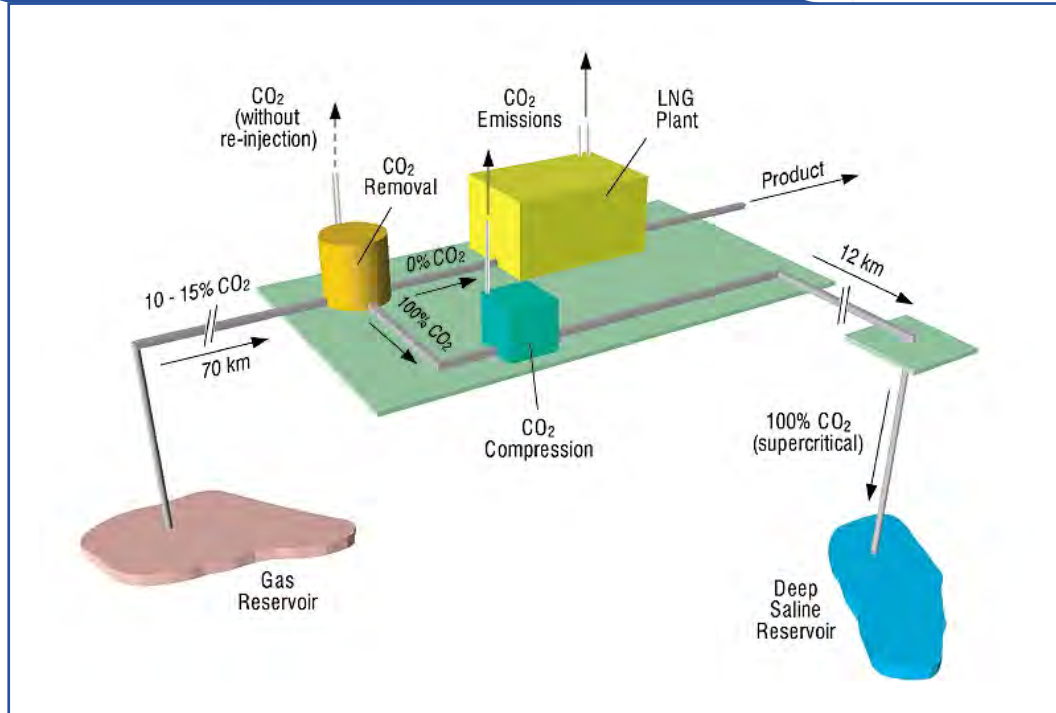


TABLE 8-5
Potential Re-injection Locations

Location	Approximate Distance to Plant Site (km)	Capacity to Accept Anticipated CO ₂ Volumes	Risk to Potential Hydrocarbon Production	Cost	Comments
West Tryal Rocks	75 km	Yes	Yes (gas)	Very High	Would not be available until the reservoir was depleted
North Gorgon	75 km	Yes	Yes (gas)	Very High	Would not be available until the reservoir was depleted
South Gorgon	75 km	Yes	Yes (gas)	Very High	Would not be available until the reservoir was depleted
Spar	60 km	No	Yes (gas)	Very High	Insufficient capacity
Barrow Island Dupuy Sands / Saline Reservoir	12 km	Yes	No	Medium	- Barrow Fault is known to be sealed at the Windalia Formation (reservoir for Barrow Island oilfield) but could pose a leak risk if Dupuy reservoir pressure increase is excessive - Greater depth favour the Dupuy over the shallower Flacourt and Malouet targets
Barrow Island, Flacourt and Malouet Sands	12 km	Yes	No	Medium	- Possible targets, though considered less favourable than the Dupuy because shallower and exhibit greater dip northwards - Barrow Fault is known to be sealed at the Windalia Formation (reservoir for Barrow Island oilfield) but could pose a leak risk if Flacourt or Malouet reservoir pressure increase is excessive
Kennedy Group Sands	45–70 km	Yes	No	Very High	- High degree of uncertainty due to limited data - Significant cost to obtain sufficient data - Further data may show that the reservoir is not suitable
Harriet – Campbell Group of Fields	35 km	No	Yes (oil and gas)	High	- Insufficient capacity - Not operated or owned by any of the Gorgon Venture participants - Would not be available until the reservoir was depleted
Saladin (Thevenard Island)	90 km	No	Yes (oil and gas)	High	Insufficient capacity

FIGURE 8-8

Barrow Island Reservoir CO₂ Re-injection Concept



in a supercritical state. In this state, the CO₂ density is similar to a very light liquid and it has a viscosity similar to a gas. The supercritical CO₂ is then transported by pipeline to where it is injected via several onshore injection wells into the Dupuy saline reservoir. The top of the Dupuy saline reservoir is located approximately 2100 m below Barrow Island. It is approximately 500 m thick at the northern end of Barrow Island and is overlain with a thick shale cap-rock seal. The Barrow Island fault intersects the saline reservoir at the southern end of the Barrow Island. This fault provides a seal to the oil and gas production reservoirs located above the Dupuy saline reservoir. Figure 8-9 shows a cross-section of the Dupuy saline reservoir. This cross-section runs along the axis of the island as indicated on Figure 8-10.

Several features of the Dupuy Saline reservoir that are conducive to CO₂ sequestration make it the preferred site for reservoir CO₂ re-injection. The CO₂ would be injected at depths of between 2700 to 3000 metres into a gently sloping (upwards) reservoir. The pressure in the reservoir

will cause the injected CO₂ to behave as a super critical fluid with behaviour being more liquid-like which will reduce the density difference between the CO₂ and the saline water. Based on the solubility of CO₂ at reservoir conditions, the size of the Dupuy Saline reservoir theoretically has the capacity to dissolve many times the actual re-injection volumes.

Based on computer modelling, it is possible to describe the predicted behaviour of the CO₂ after re-injection into the reservoir. Initially, injected CO₂ will mix with formation water. A fraction will dissolve rapidly, while the balance will coalesce as a separate CO₂ phase. A fraction of the CO₂ would migrate slowly up the slope of the reservoir due to gravity (buoyancy) forces. The natural geology of the Dupuy has strong layering with smaller shale barriers that provide resistance to vertical movement. As a result, the CO₂ (phase) will move vertically, but also flatten horizontally during injection. Further vertical movement is restricted by the cap rock that separates the Dupuy saline reservoir from the formation above.

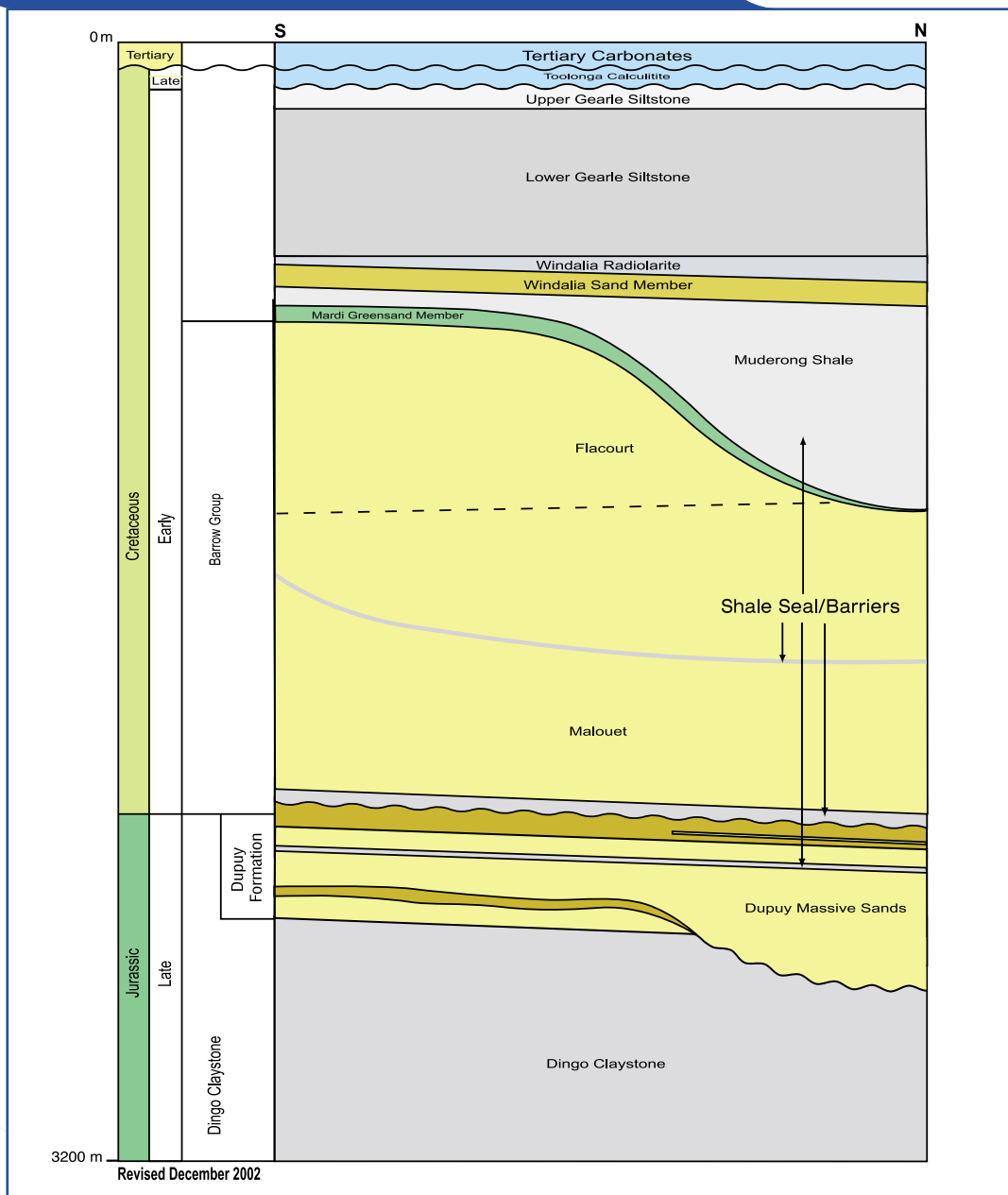
Over longer time periods, approximately 15 to 30 per cent of the CO₂ will dissolve in the saline water, while a further 15 to 30 per cent will be trapped near the re-injection site. The remaining CO₂ will continue to move slowly and continue to repeat the dissolution and trapping process. The modelling predicts that it

will take at least several thousand years for the remaining CO₂ to move 10 to 15 km up the slope of the reservoir.

It is anticipated that the re-injection wells would be located near the northern end of Barrow Island to maximise the potential sequestration

FIGURE 8-9

Cross-Section of the Dupuy Reservoir



capacity of the reservoir, while minimising potential costs by utilising onshore wells. Figure 8-10 shows the potential location of the re-injection well in relation to the gas processing facilities.

FIGURE 8-10

Location Map of Reservoir CO₂ Re-injection Facilities

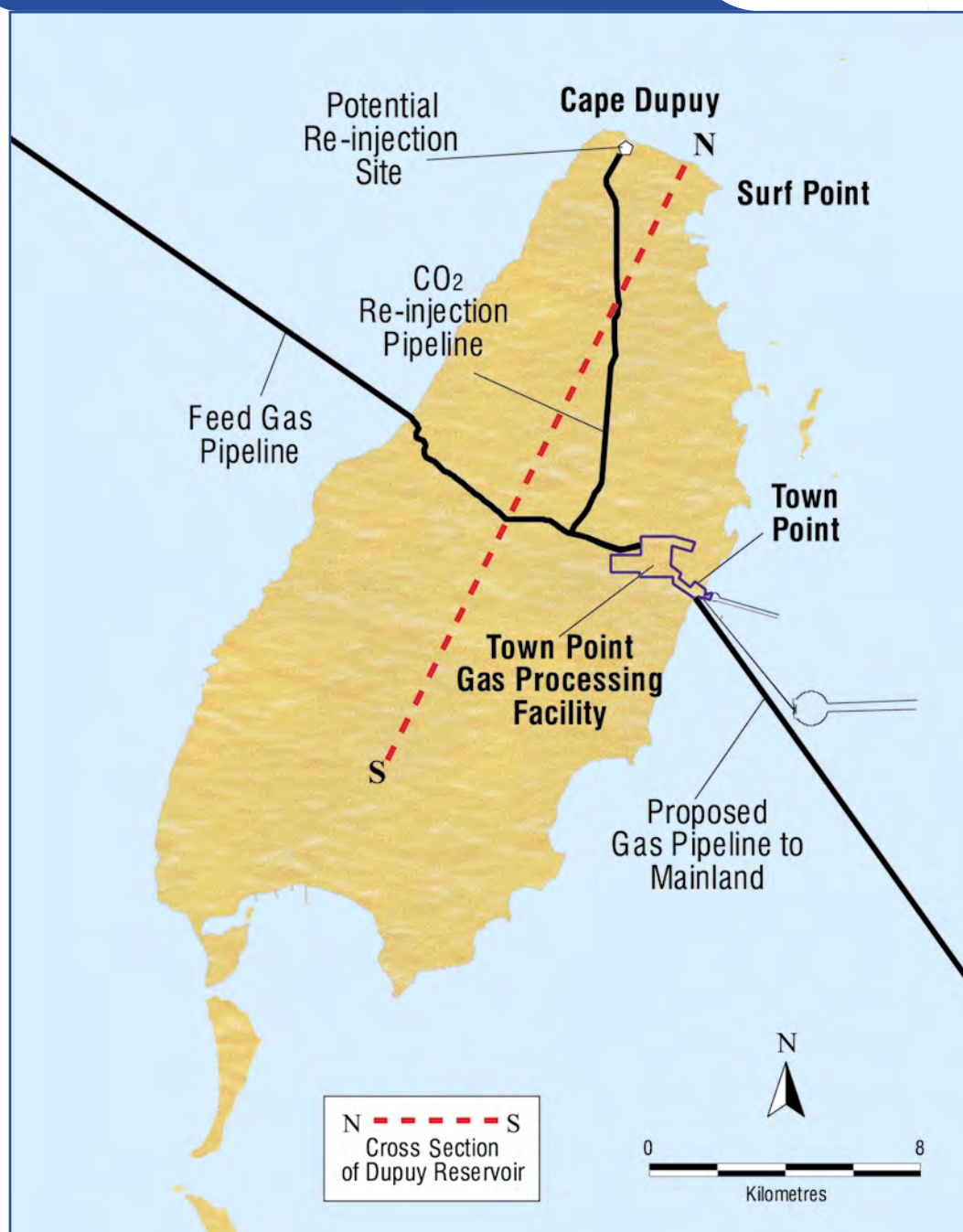
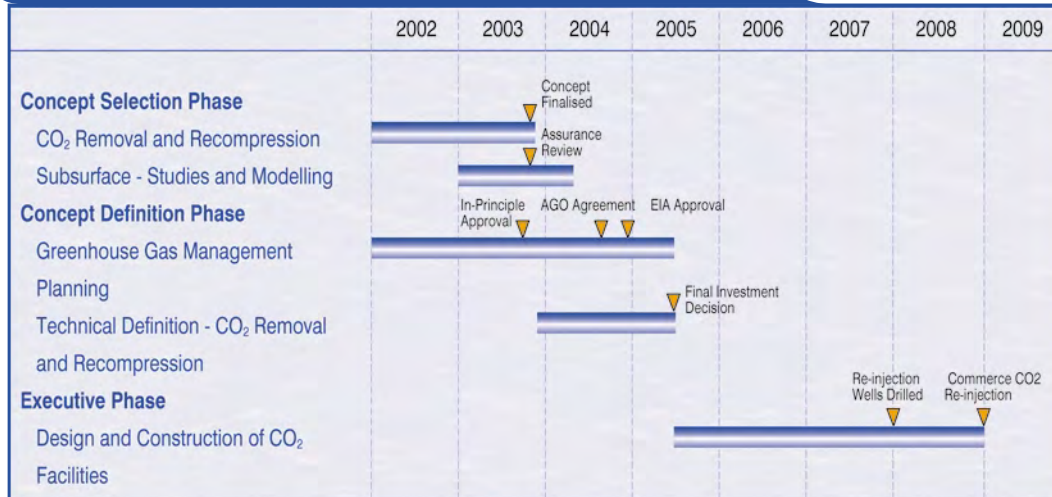


FIGURE 8-11

Indicative CO₂ Re-injection Schedule



To ensure efficient use of resources, re-injection would be implemented using a single train of injection equipment sized to handle the expected rate of reservoir CO₂ removed from the incoming gas stream to the gas processing facility and domestic gas plant. The system would be designed and operated in line with good oilfield practice for high-pressure injection. Limited venting would be required for the purposes of maintenance and re-injection equipment downtime or reservoir constraints. Gas production would continue as normal during equipment maintenance since the amount of CO₂ emitted would be minimal. Where practicable, maintenance would be scheduled to minimise potential greenhouse emissions.

The Gorgon Venture is incorporating the reservoir CO₂ re-injection facilities into the design of the main gas processing facilities. As the re-injection facilities are integral to the gas processing facility, re-injection will commence as soon as practicable after the processing facilities commissioning and start-up process.

Figure 8-11 shows the indicative project schedule for the implementation of the reservoir CO₂ re-injection project.

8.8.5 Monitoring

Monitoring of the behaviour of CO₂ injected into the subsurface is an important priority for a successful geological sequestration project. Consequently a suite of techniques will be deployed to monitor the re-injected CO₂ within the Dupuy saline reservoir. The main requirements for a monitoring program have been identified by various bodies (e.g., SACS 2000) and are summarised below:

- verify net quantity CO₂ sequestered
- interaction with dynamic reservoir simulations for history matching
- validate sequestration mechanism
- determine efficiency that available reservoir capacity has been utilised
- optimise injection process (with respect to energy efficient operations)

- demonstrate that CO₂ is retained in formation in which it was injected

The selection of monitoring techniques will include an assessment of impact on Barrow Island. In general, down-hole seismic and down-hole monitoring techniques will be preferred to minimise any environmental impacts. Any minor vegetation clearance required for monitoring wells will meet the commitments within this document.

8.8.6 Technical Feasibility of Reservoir CO₂ Re-injection

All studies undertaken to date by the Gorgon Venture indicate that re-injection into the Dupuy saline reservoir is feasible. However due to the difficult nature of predicting behaviours within subsurface structures, it is not possible to obtain absolute technical certainty on the feasibility of reservoir CO₂ re-injection. The Gorgon Venture is therefore implementing a work program to provide the confidence required by the Gorgon Venture and regulatory bodies.

Technical feasibility is defined as the ability to re-inject CO₂ in a manner that has acceptable safety, environmental and reservoir risks based on an assessment by the Gorgon Venture and relevant regulatory bodies. The technical assurance process would be the same as for the LNG facility design and the gas reservoir development.

The Gorgon Venture will work with the government and its agencies to obtain all necessary approvals for the re-injection of the reservoir CO₂.

Based on previous injection experience of the Gorgon Venture and the technical studies completed to date there is a high level of confidence that the re-injection facilities can be

designed to operate successfully. There is sufficient information available on the properties of the Dupuy saline reservoir to provide confidence that it is possible to achieve the desired CO₂ re-injection rates into the reservoir using a reasonable number of wells. The design, cost and drilling techniques required to complete these wells are also understood.

Uncertainties with respect to the technical feasibility of the re-injection project relate to the long-term behaviour of the CO₂ within the reservoir. The Dupuy saline reservoir was selected on the basis that it offered the best solution to minimise these concerns.

The Gorgon Venture has determined where additional assurance on the reservoir behaviour is required. The work identified is similar to what would be expected for any oilfield or gas field development. This detailed step-by-step work program is designed to: confirm the feasibility of reservoir CO₂ re-injection into the Dupuy saline reservoir; and reduce uncertainties to acceptable limits. The major items identified for study include:

- detailed regional mapping to better define the extent and size of the Dupuy reservoir system
- down-hole static pressure measurements to confirm the hydraulic separation of the Dupuy saline reservoir from the formations above such as the Malouet and Flacourt reservoir systems
- use existing reservoir core samples to study mineralogy and CO₂ dissolution effects
- consider obtaining extra core information to augment existing data sets
- detailed work to improve understanding of the sealing behaviour of the main Barrow Fault
- detailed subsurface computer modelling of CO₂ re-injection with presentation of the results to government and regulatory bodies

- involve acknowledged experts and Department of Mineral and Petroleum Resources specialists who actively research and monitor the state of regional reservoir systems
- identify suitable surveillance and monitoring strategies and determine key early signs of potential improvements to injection or warnings of deterioration in re-inject ability or containment
- determine any additional data requirements

8.8.7 Economic Impact of Reservoir CO₂ Re-injection

Development of a project to re-inject reservoir CO₂ represents a major financial commitment to greenhouse gas management by the Gorgon Venture. This commitment is a significant step beyond current Australian and international standards for greenhouse gas management.

The Gorgon Venture's commitment to re-injection is of a similar magnitude to the Commonwealth Government's Greenhouse Gas Abatement Program (\$400 million allocated over 12 years). Currently, the estimated capital costs for removing reservoir CO₂ from the natural gas is approximately \$400 million based on two 5-MTPA LNG trains. The CO₂ re-injection system including compression, pipeline and wells would require a further capital expenditure of approximately \$300 – \$400 million. In addition, there would be operating costs for CO₂ removal, re-injection and monitoring.

The commitment to reservoir CO₂ re-injection would impose significant additional costs to the Gorgon gas development compared to competing developments. No other Asia-Pacific LNG projects are re-injecting reservoir CO₂, even though several have reservoir CO₂ content of 10–15 mol%.

If the gas processing facility is located somewhere other than Barrow Island, the cost of reservoir CO₂ re-injection would significantly increase – making it potentially an impracticable greenhouse gas management option. Locating the gas processing facility on Barrow Island ensures these costs are minimised, enabling the Gorgon Venture to make the commitment to pursue reservoir CO₂ re-injection.

8.8.8 Contingency Plan

The Gorgon Venture considers that reservoir CO₂ re-injection is a feasible greenhouse gas management option based on studies completed to date and therefore have committed to designing and constructing the necessary CO₂ handling facilities. However given the developmental nature of reservoir CO₂ re-injection, it is still prudent to develop a contingency plan.

If in-principle approval for restricted access to Barrow Island is granted, the contingency plan would be fully developed as part of the Greenhouse Gas Management Plan prior to the completion of an Environmental Impact Assessment and during the detailed design phase. The plan would examine options to partially offset reservoir CO₂ emissions.

Prior to implementing the contingency plan, every reasonable effort would be made to successfully re-inject reservoir CO₂. These efforts may include:

- modification of operational procedures
- modification of equipment
- upgrades of technology where necessary
- continued investment into research and development into geological sequestration and incorporation of the results into the design

- review the potential of extending CO₂ injection into other saline reservoirs on Barrow Island (notably the shallower Flacourt and Malouet)

In the unlikely event that reservoir CO₂ re-injection cannot be successfully implemented for the Barrow Island reservoirs, the contingency plan would consider:

- conversion of nearby oil and gas reservoirs to re-injection as they reach the end of their production lives
- additional research funding into greenhouse gas management options
- assistance to other operations to reduce their existing emissions
- utilisation of carbon sequestration options such as forestry and revegetation

The selection of options to be included in the contingency plan will be based on: consideration of technical risks; the impact of additional cost on commercial viability; the competitive position of the development; and greenhouse gas efficiency.

8.9 Conclusions

The Gorgon Venture's Greenhouse Gas Management Strategy commits the proposed development to go beyond current Australian and International practice for the management of greenhouse gas emissions.

Barrow Island provides a unique opportunity to re-inject reservoir CO₂ into saline reservoirs deep beneath the island. This, combined with current best practice in plant design, would make the development one of the most greenhouse gas efficient projects of its type in the world, and would assist Australia in addressing international concerns on greenhouse gas emissions.

Studies completed to date indicate that Barrow Island is the only site for a gas processing facility that would allow re-injection of reservoir CO₂ while maintaining an internationally cost-competitive development. The Gorgon Venture is implementing a work program to provide increased confidence in the technical and commercial feasibility of re-injection.

Implementing a reservoir CO₂ re-injection project on Barrow Island would avoid over four million tonnes of CO₂ emissions per annum, based on two 5-MTPA LNG trains; and in excess of half a million tonnes of CO₂ for a 300 TJ/d domestic gas supply.

Development of knowledge and technology for re-injecting CO₂ as part of the Gorgon gas development would make Australia a world leader in this field. The Gorgon Venture has developed a strong working relationship with Australian researchers to ensure this knowledge would be shared and utilised in Australia.



NET CONSERVATION BENEFITS STRATEGY

The Gorgon Venture is committed to implementing a comprehensive net conservation benefits program that will clearly enhance Western Australia's conservation estate and provide wide-ranging, long-term environmental benefits to the community.

The Gorgon Venture plans to establish the "Gorgon Environment Foundation" to coordinate a range of significant conservation programs that would deliver net conservation benefits to Western Australia. These commitments to be applied on Barrow Island.

The Gorgon Venture would play a pivotal role in the community-based Foundation that could fund and oversee a diverse range of programs reflecting the conservation values of Barrow Island. The Foundation would improve the conservation values of selected areas in the region as well as undertaking research and education projects based on marine and terrestrial conservation. The work of the Gorgon Environment Foundation would complement the Gorgon Venture's proposed best practice environmental management procedures for development on Barrow Island by delivering net conservation benefits from the Gorgon gas development.

This chapter outlines the Gorgon Venture's plans to develop and implement such a strategy. It provides background to the concept of net conservation benefits, outlines a proposed process for development of the strategy and the funding of projects, and describes the types of projects and programs that the Gorgon Venture considers could deliver net conservation benefits as a result of the proposed development.

9.1 The Need for Net Conservation Benefits

Barrow Island is a Class A Nature Reserve and an important part of the conservation estate of Western Australia. Through its long association with the island, ChevronTexaco has developed a sound understanding of the importance and sensitivity of the Barrow Island environment (see Box 9-1).

ChevronTexaco has a strong environmental record on Barrow Island. ChevronTexaco's operations on Barrow Island are widely recognised as a model for coexistence of petroleum development and the protection of biodiversity. This is the result of a rigorous and

effective environmental management program that has been developed over time. In developing the Gorgon gas fields, and in particular, in establishing a gas processing facility on Barrow Island, ChevronTexaco, as operator of the Gorgon Venture, is committed to further building its expertise in environmental management on Barrow Island and adopting best practice management procedures to minimise adverse environmental impacts (see Chapter 6, Ecological Review).

In addition to employing best practice environmental management, the Gorgon Venture, by implementing the Gorgon gas development, would deliver long-term net conservation benefits to the State.

Key Conservation Values of Barrow Island

Barrow Island possesses a range of conservation values including:

- Its status as an island which supports many unique fauna species and a high level of biodiversity.
- The suite of native marsupials which are found on Barrow Island, many of which also used to occur on the mainland but have been substantially reduced in numbers or eliminated by introduced predators or other factors such as competition and habitat alteration.
- The absence of introduced fauna species.
- The potential for Barrow Island marsupial populations to act as a source for controlled re-introductions to other areas.
- The rich marine environment which surrounds Barrow Island and its various components (e.g., coral reefs, intertidal flats, marine mammals and turtles).
- Barrow Island's importance as a staging area for migratory birds.
- The varied subterranean fauna components found in the limestone cave systems and their affinities and differences to populations on the mainland.

This approach is consistent with the direction from the Minister for State Development who has advised that for the Western Australian Government to consider the restricted use of to Barrow Island, there would have to be net conservation benefits associated with the proposed development.

9.2 The Basis of a Net Conservation Benefits Strategy

The concept of net conservation benefits may have been introduced into the assessment of development projects in Western Australia in the mid-1980s (see Box 9-2).

Initial projects involved land exchanges (that is, the addition of new areas of land to the conservation estate to compensate for development impacts within park areas). However, this is only one mechanism to pursue net conservation benefits and such

exchanges are not necessarily appropriate in all cases. As an example, the purchase of 300 ha of land elsewhere by the Gorgon Venture is unlikely to be considered an adequate replacement for 300 ha on Barrow Island. The Gorgon Venture considers enhancement of the conservation estate alone is a narrow definition of net conservation benefits and that benefits can also include conservation programs, education and research.

BOX 9-2

Background to Net Conservation Benefits in Western Australia

The concept of net conservation benefits may well have been first introduced into the assessment of development projects in Western Australia during the tenure of the Labor Government in the mid-1980s. However it is now well accepted by the Environmental Protection Authority and Department of Conservation and Land Management. The Labor Government faced the dilemma of deciding how to deal with pre-existing discoveries of mineral resources (iron ore, uranium, mineral sands, diatomaceous earth) estimated to be worth \$3–3.5 billion, located in four National Parks. A fifth National Park was already being mined for limestone. After much discussion, and the issuing of a policy “Balancing the Scales”, a decision was made to excise the prospective ore bodies from the National Parks and provide net conservation benefits and biodiversity conservation, by the permanent addition of areas to the Conservation Estate that were considered to be equivalent in ecological terms. Some of these areas were Unallocated Crown Land, others were areas of private land offered as a suitable land swap. In one case, the land exchange was not completed by the end of the government’s term, but was finalised with the support of the succeeding Coalition Government.

9.2.1 Consultation

The Gorgon Venture consulted with a broad range of stakeholders to obtain an understanding of the issues, options, projects and processes that may contribute to a successful net conservation benefits strategy. Organisations and individuals consulted include:

- Conservation Commission of Western Australia
- Department of Conservation and Land Management
- Environmental Protection Authority
- Department of Mineral and Petroleum Resources
- Management of King’s Park (Botanic Gardens and Parks Authority)
- Management of Perth Zoo (Zoological Gardens Board)
- Rottnest Island Authority
- Western Australian Museum
- non-government organisations (NGOs) with a conservation focus such as the Conservation Council of Western Australia and World Wide Fund for Nature

- individuals with relevant expertise, such as Harry Butler

A range of views were expressed by stakeholders and many useful suggestions were made and ideas canvassed.

9.2.2 Recognising Values for Attention

A common view held by many of those consulted, and one strongly supported by the Gorgon Venture, is that any net conservation benefits projects or programs should be related to the conservation values of Barrow Island, although projects and programs would not necessarily have to occur on the island. There are many worthy environmental causes but the Gorgon Venture should recognise its responsibility to address the values of Barrow Island that may be affected by the proposed development. Those values listed in Box 9-1 were confirmed during the consultation program and are examples of priorities for consideration in a net conservation benefits strategy.

Other attributes worthy of consideration are the key environmental problems that face land managers throughout Western Australia. The *State of the Environment Report* identifies 22 key State and regional environmental issues for Western Australia (State of the Environment Reference Group 1998). Issues of highest priority for government and community action that have a direct link to Barrow Island and the Gorgon gas development include the maintenance of biodiversity and marine protection issues.

9.2.3 Possible Projects and Programs

Consultation with key stakeholders identified a diverse range of potential net conservation benefits projects. These varied in scale, duration and focus and involved management actions, research, survey, capital expenditure or education and awareness. Examples of suggested projects include:

- sponsoring the rehabilitation and restocking of another island
- establishing a research and education centre on Barrow Island
- controlling foxes on mainland beaches in the Pilbara region to protect turtle nests and hatchlings
- establishing a Centre for Excellence to coordinate research into subterranean fauna of the Pilbara region
- providing financial support to existing community or youth-based conservation programs
- sponsoring undergraduate and doctorate research
- funding breeding programs for endangered native species
- conducting a long-term survey program for migratory birds

- funding education and awareness programs at King's Park, Rottnest Island or the Perth Zoo

If the Gorgon gas development proceeds on Barrow Island, the Gorgon Venture would fund the establishment of the Gorgon Environment Foundation to coordinate the Net Conservation Benefits Program (see Section 9.3). ChevronTexaco, as operator, would coordinate funding approval, development selection and implementation.

The Gorgon Venture is ready to start the work of establishing the Foundation and identify a number of specific projects that have the potential to deliver net conservation benefits.

9.3 Process for Achieving Net Conservation Benefits

Net conservation benefits would be delivered through a range of projects and programs coordinated by the Gorgon Environment Foundation. The Foundation would be responsible for identifying and selecting potential projects, allocating funds and managing budgets, establishing partnerships between beneficiaries of the development and overseeing the effective implementation of the net conservation benefits strategy.

9.3.1 The Gorgon Environment Foundation

The Gorgon Environment Foundation board of management could include representatives from the Gorgon Venture, government departments and/or agencies, academia, a State non-government organisation (NGO) and a national NGO. Executive support for the Foundation would be provided by the Gorgon

Venture. The application, selection and reporting processes would be designed to minimise bureaucracy, but should provide for opportunities for innovative ideas to be considered in the future. The actual membership, selection criteria and number of panellists would be determined by the Gorgon Venture and relevant State Ministers.

9.3.2 Identifying Potential Projects and Programs

Possible developments and programs would be identified by a range of means. These may include nomination by the Gorgon Venture, government agencies, special interest groups, academic institutions and the general community. The Foundation may call for applications or nominations. Strong consideration would be given to a significant icon project that could deliver an enduring conservation outcome.

9.3.3 Criteria for Selecting Projects and Programs

The Foundation would select projects based on an agreed set of criteria. Criteria used to evaluate the ability of possible projects to achieve net conservation benefits may include the following:

- Projects should relate to the conservation values of Barrow Island and have strategic significance.
- Projects should involve a mix of activities on Barrow Island and in the region. Those with State and international benefits could also be considered.
- Project scopes should be broad and inclusive.

- Projects should provide long-term conservation benefits.
- Projects should deliver multiple benefits where possible, such as capacity building of organisations and community development.
- Proposals should be visible and have a low risk of failure.
- The projects could include both high-cost proposals as well as more modest ones.
- Projects should avoid duplication with existing projects and established funding bodies.
- Projects that stimulate a partnership approach to funding and implementation should be favoured.
- Long-term projects should become financially self-supporting.
- Awareness and education projects should seek to enhance public attitudes and behaviour with respect to nature conservation.

9.3.4 Funding

The Gorgon Venture is committed to provide funding to commence the Foundation's activities after the project has been sanctioned, an amount expected to exceed \$10 million.

9.3.5 A Partnership Approach

The success of a net conservation benefits program is reliant on the formation of strong partnerships between the Gorgon Venture, industry, government, State and Commonwealth departments, agencies, conservation organisations, the community and academic institutions. Partnerships would allow for the direct contribution of State and Commonwealth funds as well as funds from industry and academia, thereby creating a

leverage effect that, together with the Gorgon Venture funding, could provide sustainable funding for proposals.

The Gorgon Venture and other industry partners could provide logistical and practical support for field programs as well as direct funding. Government, academic or other organisations could provide personnel, support systems, access to existing intellectual property and direct funding support. Community groups might provide, ideas or other inputs.

9.3.6 Mechanisms for Implementation

In order to effectively implement a long-term proposal that provides net conservation benefits, adequate mechanisms need to be established to ensure the required continuity of purpose and governance for the funds and their proper expenditure. These could be:

- provisions in a State Agreement Act
- the establishment of a Trust Fund and Trustees
- the establishment of Bonds, or
- establishment of a Contract between the parties

9.4 Conclusions

If the proposed Gorgon gas development proceeds, the Gorgon Venture is committed to implementing a comprehensive net conservation benefits program that will clearly enhance Western Australia's conservation estate and provide wide-ranging, long-term conservation benefits to the community. Through the establishment of the Gorgon Environment Foundation and the formation of partnerships with government and the community, the Gorgon Venture would contribute to world-class conservation programs relevant to the conservation values of Barrow Island.



STRATEGIC VALUE

The Gorgon gas development offers significant strategic value to both Western Australia and Australia by increasing security of supply and competition, adding value throughout the Western Australian economy and providing opportunities for Australian industry participation and regional business development.

Development of the Gorgon gas field could be a catalyst to further development of the Greater Gorgon area gas resource which would multiply the benefits of the initial development.

10.1 Promoting Security of Gas Supply

10.1.1 Western Australian Domestic Gas

A number of pillars of the Western Australian economy depend upon secure supplies of natural gas including:

- the City of Perth and regional centres
- gas-fired power generation
- LNG exports
- alumina processing
- iron ore processing
- nickel processing
- mineral sands processing

Some 60 per cent of domestic gas is supplied from the North West Shelf Gas Project making Western Australia critically dependent on the security of one project. The bulk of industry in Western Australia is also dependent on connection to this source via the Dampier to Bunbury Natural Gas Pipeline (DBNGP).

The establishment of a foundation Gorgon gas development would facilitate the introduction of Gorgon gas to the mainland domestic gas market and substantially enhance supply security for the State by:

- providing an additional major gas source for Western Australia

- underpinning the gas reserves available to expand gas-related industries in the State
- supporting the expansion of gas pipeline infrastructure from the Pilbara region to the south-west of Western Australia
- potentially supporting further extensions of the state pipeline grid, bringing gas to areas not yet served with gas supplies

The Gorgon Venture is committed to working with customers and government agencies to develop domestic gas opportunities for Western Australia and establish a physical connection to the mainland transmission network in order to enhance the security of domestic gas supplies.

10.1.2 Extension to the National Gas Grid

The establishment of Gorgon gas in the Western Australian domestic market provides the opportunity to connect the extensive gas reserves off the north-west coast of Western Australia to east coast markets, given a suitable competitive environment. The substantial strategic benefits could include:

- additional competition in the market
- providing alternative supply options to strategic gas reserves in the Gippsland and Cooper basins
- added value from possible minerals processing along the route

The timing and extent of any opportunity for a transcontinental pipeline to supply Gorgon gas to east coast markets will be dependent upon the availability of alternative sources of gas in the region. The Gorgon Venture contracted ACIL Tasman to analyse the supply of Gorgon gas within the eastern Australian market under three alternative supply scenarios reflecting different outcomes with the PNG Gas Project and Timor Sea projects.

Figure 10-2 depicts a scenario where PNG Gas Project moves forward but Timor Sea gas is not connected to the market. This scenario highlights a significant potential supply gap in these markets next decade.

Gorgon gas delivered via a transcontinental pipeline has the potential to make a significant

contribution to the security of regional gas supply in eastern Australia, including satisfying market demand in New South Wales (Sydney and Newcastle), South Australia (Adelaide and Whyalla) and Victoria.

Given that there is a considerable degree of uncertainty regarding gas supply (e.g., related to discoveries in existing fields and the timing and extent of supply from new sources such as Timor Sea, PNG and coal seam methane) it is not possible to accurately predict timing of a transcontinental pipeline. However, the modelling demonstrates that under plausible assumptions about future gas supply alternatives, there would be a role for Gorgon gas to service eastern Australian demand in the foreseeable future.

FIGURE 10-1

Existing Natural Gas Transmission Pipelines

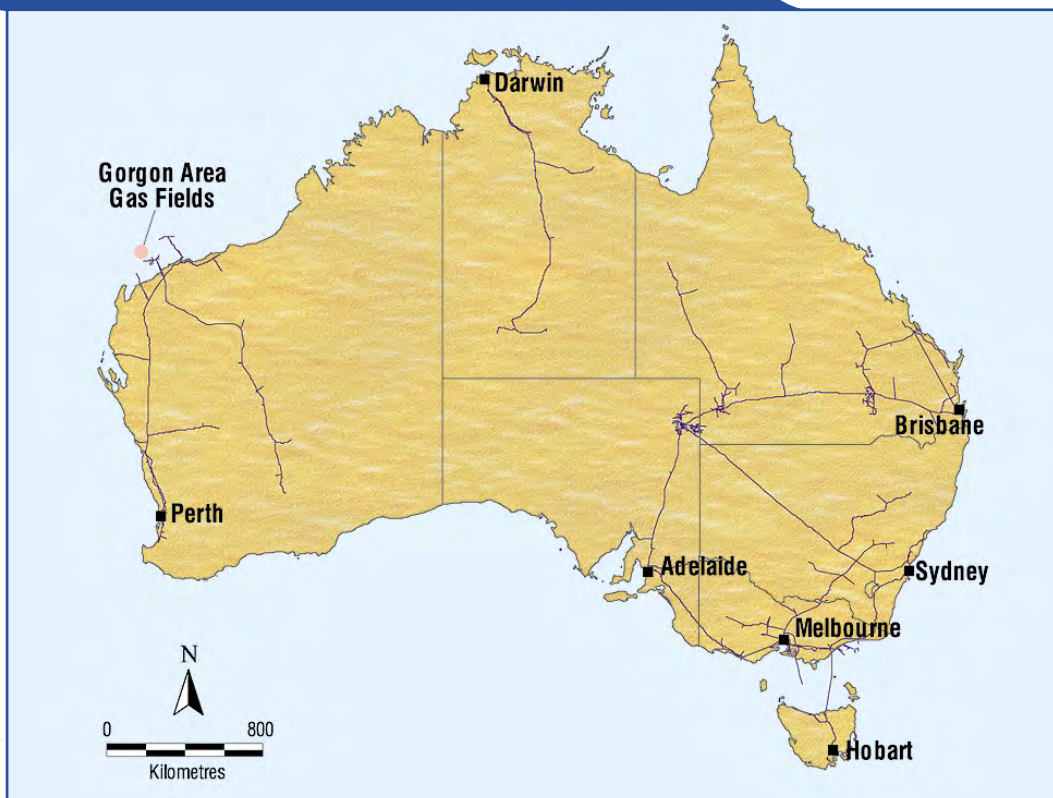
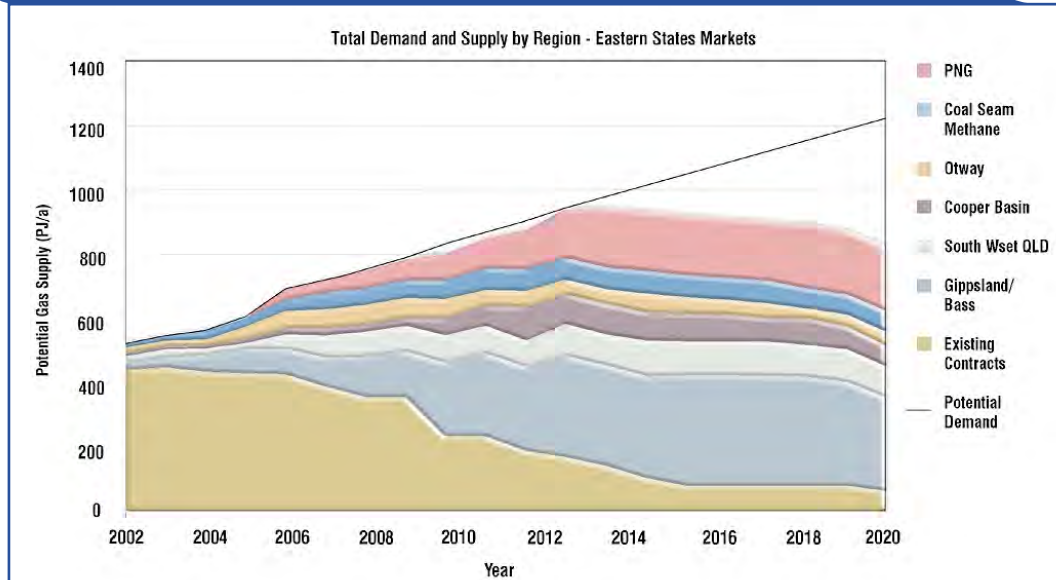


FIGURE 10-2

Gorgon Gas Potential Supply into Eastern Australia via Transcontinental Pipeline (no Timor Sea Connection to Eastern States)



Source: ACIL Tasman

10.1.3 LNG Supply

Australia currently has solid international standing as a major supplier in the Liquefied Natural Gas (LNG) market as evidenced by the recent North West Shelf Project LNG contract with China and the project's long-standing relationship with Japan. The Gorgon development could both benefit from and enhance Australia's reputation in this market.

The Gorgon gas development would improve supply security for Australian LNG export. The high reliability of the Australian LNG industry is important to existing and potential customers. As sales grow and markets diversify, the importance of this reliability continues to increase and would be enhanced with the availability of this new, independent source.

Although the Gorgon gas development would be independent from other projects with different customers and contractual arrangements, there could be opportunities to collaborate to further enhance supply security.

For example, spare capacity, subject to commercial arrangements, could be used to meet supply shortfalls during unplanned shutdowns or other plant upsets. In this way, the reputation of reliability of supply of LNG from Australia could be maintained and enhanced in the future.

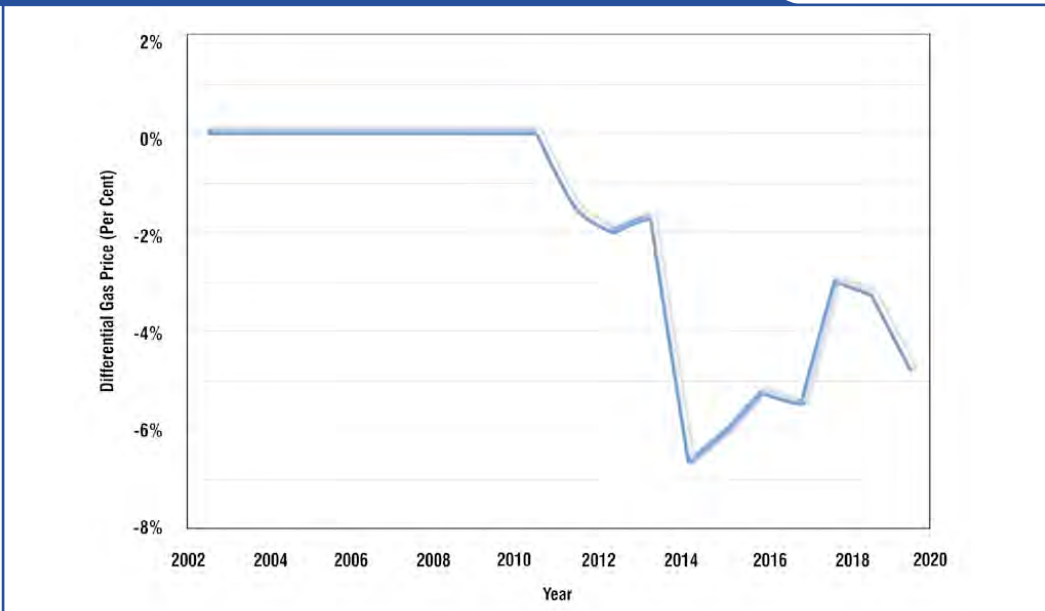
10.2 Gas Market Competition

The impact that the Gorgon gas development could have on gas price in the Western Australian market was assessed as an extension of the modelling presented in Chapter 3.

The contribution of the Gorgon gas development to enhancing gas market competition has important implications for the continued international competitiveness of the Western Australian economy. The additional availability of gas in Western Australia will bring benefits to customers from the downward pressure on delivered gas prices.

FIGURE 10-3

Reduction in Delivered Gas Prices with Gorgon Gas



Source: ACIL Tasman

Modelling conducted for the Gorgon Venture predicts that the increased competition associated with the introduction of a major new gas supply will reduce delivered gas prices to domestic gas consumers on a state-wide basis by between two per cent and seven per cent over a ten-year period, versus pricing without an additional major gas supplier (see Figure 10-3).

These predicted price reductions are particularly significant for industrial development in the South-West and Goldfields regions, which have great potential for expansion in minerals processing and energy-intensive production of metals. For example:

- In the South-West, more competitive gas supplies may stimulate further expansion of alumina and titanium pigment production
- Gas-fired electricity generation (both stand-alone and co-generation), together with the introduction of a fully competitive electricity market, will play an important part in achieving electricity prices which are competitive for energy-intensive processing such as aluminium smelting

- Further development of laterite nickel processing and other industries in the Goldfields–Esperance region would be enhanced by more competitive gas supplies

10.3 Future Expansion Opportunities

Development of the Gorgon gas field as envisaged in this review would provide the economic, strategic and social benefits presented and is a stepping stone to development of the totality of the Greater Gorgon area gas resource. The volume of gas in the Greater Gorgon area is sufficient to support additional LNG trains or large scale clean fuel gas-to-liquids (GTL) developments in the future. The additional gas processing facilities may be located either on the mainland or within the area set aside on Barrow Island. Although the economic effects of such an expansion have not been modelled, there are clear market advantages and considerable economic, strategic and environmental benefits.

Competitive economic and market factors would determine the pace and extent of any such future developments.

The Gorgon Venture is acutely aware of the need to restrict activities on Barrow Island to the smallest practicable footprint. Consistent with this strategy, the Gorgon Venture proposes to limit all future expansion to within the proposed 300 ha footprint (see Chapter 5).

10.4 Energy Self-Sufficiency

A Gorgon gas development can enhance Australia's energy self-sufficiency. Our current self-sufficiency for oil is declining due to a reduction in production from the Bass Strait, Timor Sea, North West Shelf and Cooper Basin oilfields. Although activity continues across Australia to explore for more oil, there have been no world-class discoveries in recent years. However, Australian undeveloped gas resources have continued to be increased by huge, world-class discoveries such as Chrysaor (1994), Dionysus (1997), Geryon (1999) and Io/Jansz (2000). Drilling for gas is continuing in the region.

As oil imports increase, Australia's net energy export balance can be maintained through development of its vast gas resources and increased energy exports via LNG and other energy-based products such as GTL. Development of the Greater Gorgon area gas fields provides an opportunity to supply gas to a new GTL industry in Australia. International competition in this market is high, particularly in countries (such as Qatar) which offer substantial support to projects that monetise their virtually limitless gas supplies.

Nevertheless, an Australian GTL industry supplied by Greater Gorgon area gas could be viable given Australia's low sovereign risk and the appropriate support from government.

10.5 Capacity Building

The Gorgon gas development presents many capacity building opportunities with significant flow-on effects in the Western Australian economy.

10.5.1 Technology and Skills Transfer

Leading-edge, but proven, technologies will be employed throughout the Gorgon gas development. These include:

- research and development of the first CO₂ re-injection facility in Australia with, most likely, the highest capacity in the world
- development of one of the largest sub-sea installations in the world
- one of the largest corrosion-resistant, alloy, sub-sea gas pipelines in the world

Opportunities will arise for transfer of some of these technologies to other industry participants. Where technologies are proprietary, contractors will gain experience in applying them. The capacities of contractors and the skills of their employees will be enhanced as a result of working on the development. These capacities and skills can then be utilised on other projects in Australia and overseas.

With respect to the utilisation of technology to sequester greenhouse gas, Australia is currently creating world-class research results through the GEODISC program and its extension to the CO₂ Cooperative Research

Centre. This could be extended into practice through the Gorgon gas development. The development could provide important critical mass in Western Australia to stimulate research and development in other areas such as petroleum production, health and safety, gas processing technologies, sub-sea technology and environmental management.

10.5.2 Development of Petroleum Service Hub

Growth of the petroleum industry in north-western Australia has stimulated strong growth in the petroleum service sector of Western Australia, which parallels the growth in the mining services sector. The petroleum service sector supplies a wide range of services including: exploration, engineering, equipment, training, education, environment, economic, community relations and legal.

Service firms have developed the capacity to not only compete with overseas companies for work in Australia, but also to win work increasingly throughout the Asia-Pacific region. As a result, Western Australia is developing a reputation as a regional petroleum service hub.

The Gorgon gas development will provide further scope for service firms to expand and develop their capabilities as well as ensuring continuity of business as activity on current projects reduces. The experience gained through this development will enhance the ability of those firms to win similar work in other countries. In this way, the Gorgon gas development will contribute to Western Australia developing as a petroleum service hub.

PLATE 10-1

Australian Marine Complex



10.6 Opportunities for Australian Industry Participation

A development as large as the Gorgon gas development will provide opportunities for national, State and regional businesses. The significance of such opportunities has already been demonstrated by other major resource development projects.

10.6.1 Australian Industry Participation

The Gorgon gas development will actively support Australian industry participation as a core business policy. The Gorgon Venture's policy on Australian industry participation is contained in Appendix 6 and includes:

- provision of full, fair and reasonable opportunity for Australian industry to supply goods and services to the project
- extensive use of the Industrial Supplies Office resources to identify, engage and facilitate local suppliers
- timely and extensive briefing sessions for local suppliers
- full life-cycle evaluation of tenders
- establishment of a supplier diversity program

Implementation of this policy would be formalised through the execution of an Australian industry participation plan and will constitute a major commitment by the Gorgon Venture to sourcing regional, Western Australian and Australian suppliers as much as commercially possible. To fulfil this commitment, the project team will build relationships with organisations such as:

- the Industrial Supplies Office
- relevant State government departments, such as the Department of Industry and Technology, including the Office of Aboriginal Economic Development

- local and State chambers of commerce
- local and national union peak bodies
- the Australian Marine Complex – Cockburn Sound, Western Australia (Plate 10-1)
- regional Indigenous and small business development organisations, such as the Pilbara Development Commission, the Pilbara Area Consultative Committee and the Karratha Business Enterprise Centre

These relationships will be established early and developed over the years between preliminary engineering studies and completion of the construction phase. The policies will continue to be applied in the operational phase of the project and work will continue with suppliers whose capabilities have been enhanced during construction.

Achieving a high level of local content depends on successful execution of the Australian industry participation policy. Particularly critical is the adoption of these principles by any major engineer-procure-construct contractors that are engaged by the Gorgon Venture for the development.

Specific areas where a high degree of Australian industry participation can be achieved include site preparation and development, civil works and installation. Other areas such as major equipment and instrumentation may have less Australian content, but where local industry does participate in these areas, there is a high degree of technology transfer and capability added.

The current estimate for the initial capital cost of the gas processing facility is approximately \$6 billion. Preliminary estimates show that achievable Australian industry participation will be substantial based on the Gorgon Venture's

assessment of available contractors. Based on the North West Shelf experience, about two-thirds of this could be spent on goods, services and labour from Australia (see Box 10-1).

Some of Australia's leading engineering companies, who built their capabilities working on Western Australian resource projects, are now working on design projects for offshore oil and gas developments for ChevronTexaco and other operators in Thailand, China, Indonesia, Pakistan, Bangladesh and Vietnam. This demonstrates the capacity building that large resource projects can bring to local businesses.

10.6.2 Regional Opportunities

The Gorgon Venture expects to source a proportion of its goods and services from regional Western Australia. Despite the difficulty at this stage of accurately estimating the scale of regional content, the following list briefly outlines the potential regional supply opportunities:

- site development activities
- marine support activities
- construction of the jetty and jetty head if constructed off-site within regional Western Australia
- construction of prefabricated and modular buildings
- supply of construction materials (sand, aggregate, rock, etc.) from regions within reasonable proximity to Barrow Island

BOX 10-1

Lessons from the North West Shelf Gas Project

The North West Shelf Project has been the most important resource development in Western Australia and holds important lessons for predicting the impact on State and regional businesses of the Gorgon gas development.

Murray (1991) estimates that 72 per cent (\$6.3 billion) of the LNG phase of the NWS Project was spent in Australia on Australian labour, goods and services. Clements and Greig (1994) reviewed the contracts let for the onshore components of Phase II of the development (LNG trains 1 and 2) and found that of the \$3 billion total contract value, 66 per cent was sourced in Western Australia, seven per cent in the eastern states and 27 per cent from overseas.

Many Australian businesses were exposed to new technologies via the implementation of the North West Shelf Project. As a result, the oil and gas engineering capability in Australia, particularly in Western Australia, has advanced significantly and they are capable of participating more fully in future developments both locally and overseas. For example, the design team for the North West Shelf offshore platform was initially located in England, with the work concluded in Perth.

- construction of pre-cast concrete
- supply of building, furnishing and fit-out materials
- erection and maintenance of construction camp
- supplying and operating cranes
- supply of security, catering, cleaning and quarantine services

10.7 Conclusions

The Gorgon gas development would provide a range of long-term strategic benefits at national, State, and regional levels. Australia would benefit from a new major competitive and more secure gas supply for the next phase of energy-intensive industry development and power generation.

The Gorgon gas development would promote energy security and competition in Western Australia as well as creating value-adding

manufacturing opportunities in the form of LNG and industrial gas developments, such as GTL, for domestic and export markets. National supply security and competition would be further enhanced if construction of a transcontinental pipeline proceeds.

Development of the Gorgon gas field could lead to further development of the Greater Gorgon area gas resource with an extension and expansion of the benefits of the initial development.

The Gorgon Venture is making a solid commitment to Australian industry participation through direct actions and leveraging partnerships with organisations such as the Industrial Supplies Office.

The background is a deep blue with a complex, abstract pattern. In the upper right corner, there is a semi-circular, globe-like structure with a grid of lines, resembling a celestial sphere or a map projection. From the left side, numerous bright, diagonal light rays or streaks of white and light blue extend towards the center, creating a sense of depth and movement. The overall texture is fluid and organic, with various shades of blue and white creating a dynamic visual field.

ECONOMIC REVIEW

Development of the Gorgon gas fields will provide national, State, and regional economic benefits by increasing general economic growth, sustaining regional development and increasing competition in domestic gas markets. Economic modelling predicts that the investment phase of the development would result in a peak increase of 15 500 in employment driven by the \$6 billion initial investment by the Gorgon Venture.

During the operations phase, gross domestic product (GDP) would increase by an average of \$3.6 billion per year as a direct result of the Gorgon gas development. This is predicted to sustain over 6000 jobs on average through the decades of operation of the development.

The Gorgon gas development would substantially increase government revenues both through the direct payment of taxes by the Gorgon Venture participants and the workers and businesses associated with the development.

General economic growth would provide flow-on benefits for business, employment and government revenues. As the location of the development, Western Australia would benefit significantly from this growth. The Pilbara region would benefit from sustained regional development through increased demand for goods and services that would stimulate business development and employment opportunities.

11.1 The Economy of Western Australia

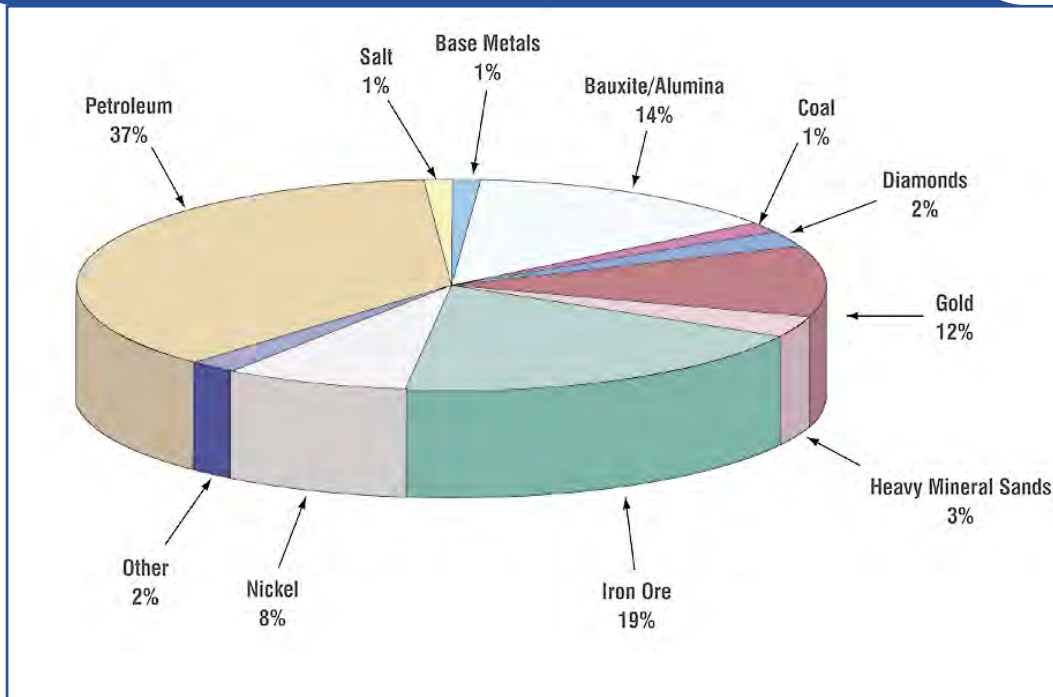
Western Australia has a moderately diverse economy, but is dominated by the resources sector, and to a lesser extent, the agriculture sector. As such it is very export-oriented and different to the Australian economy as a whole. The primary generator of economic growth is the resource sector which provides nearly one-third (Department of Mineral and Petroleum Resources 2003) of Western Australia's Gross State Product (GSP), mainly through export income as well as downstream manufacturing and processing. In 2001 The Department of Mineral and Petroleum Resources reported that this sector accounted for 70 per cent of Western Australia's exports and 56 per cent of new investment in the State.

The sector is also a strong contributor to the State Government's finances through payroll tax and royalties. Whilst the mineral and energy sector clearly dominates the Western Australian economy, it is not a large direct employer. However, it does create jobs downstream in the minerals processing, manufacturing and service sectors. The largest employer in Western Australia is the services sector, which provides jobs for two-thirds of the workforce.

Figure 11-1 shows the value of each of Western Australia's resource products. Petroleum (including natural gas) is Western Australia's most valuable product, accounting for more than one-third of the value of mineral and energy production in the State. This is followed by iron ore, which accounts for just under 20 per cent.

FIGURE 11-1

Western Australian Resource Production 2001 – A\$27.2 billion



Source: Department of Mineral and Petroleum Resources

The relative value of the agricultural sector remains significant, but continues to decline despite being the State's second largest export sector. In 2001, it contributed around four per cent to GSP. Other major contributors to GSP are the government sector and the property finance sector.

Resources and agriculture have provided Western Australia with a healthy, but sometimes variable economic base. Reliance on the export market for commodities means that the economy is vulnerable to fluctuations in world demand and prices for those goods. Nevertheless, the diversity of Western Australia's resource base helps to protect it somewhat from the variability in individual commodity prices. For example, Western Australia produces some 50 minerals of which gold, diamonds, iron ore, nickel and mineral sands all account for a significant share of global production.

The value of commodity exports continues to grow. During the past decade, the value of commodity exports has increased by an average of 10 per cent per annum to reach \$34 855 million in 2000-01 (Western Australia Chamber of Commerce and Industry 2002). During the past decade, Western Australia has recorded the fastest growth of any of the states. GSP has averaged growth of 3.8 per cent a year, compared to the national Gross Domestic Product (GDP), that has average growth of 3.2 per cent (*ibid*). The mineral and energy sector played a key role in driving this performance through a strong export sector.

During 2001 and 2002, growth in demand has been accompanied by a recovery in business investment. Investment associated with the North West Shelf Expansion Project accounted for much of this investment and will continue to do so, at least until 2004, when the project becomes fully operational.

Other key drivers of economic growth in Western Australia during 2001 included the housing sector. Fuelled by low interest rates and the Commonwealth Government's subsidy for first homebuyers, the residential housing market is estimated to have accounted for 25 per cent of the growth in State Final Demand in the last two quarters of 2001 (*ibid*).

11.2 The Economy of the Pilbara

As the Gorgon gas reserves are off the Pilbara coastline, the development would further enhance that region's economy. The dominant industry in the Pilbara is the mineral and energy sector, and in particular the iron ore and petroleum industries, including natural gas. Gold and salt are also important industries in the region. Until the 1970s, the pastoral industry was the mainstay of the Pilbara. Whilst it is still an important employer (especially for Indigenous people) and export earner, its relative significance has declined as the mineral and energy sector expands and new industries such as tourism grow in importance.

The unemployment rate in the Pilbara is lower than the rest of the State. This is primarily due to major resource projects providing employment opportunities. The cost of living, however, is around 13 per cent higher than the Perth metropolitan area (Department of Local Government and Regional Development 2001).

11.2.1 Minerals and Energy

The Pilbara is considered as Western Australia's premier resource region, contributing over half of the value of the State's total mineral and energy production. It is rich in a number of mineral and petroleum resources including iron ore, gold, salt, oil and gas and

boasts a good infrastructure to support these industries. Figure 11-2 shows the current major mineral and petroleum projects in Western Australia. There is a concentration of major developments in the Pilbara region with petroleum and iron ore developments holding the greatest share of total developments. Table 11-1 summarises the current planned and proposed resource projects in the Pilbara.

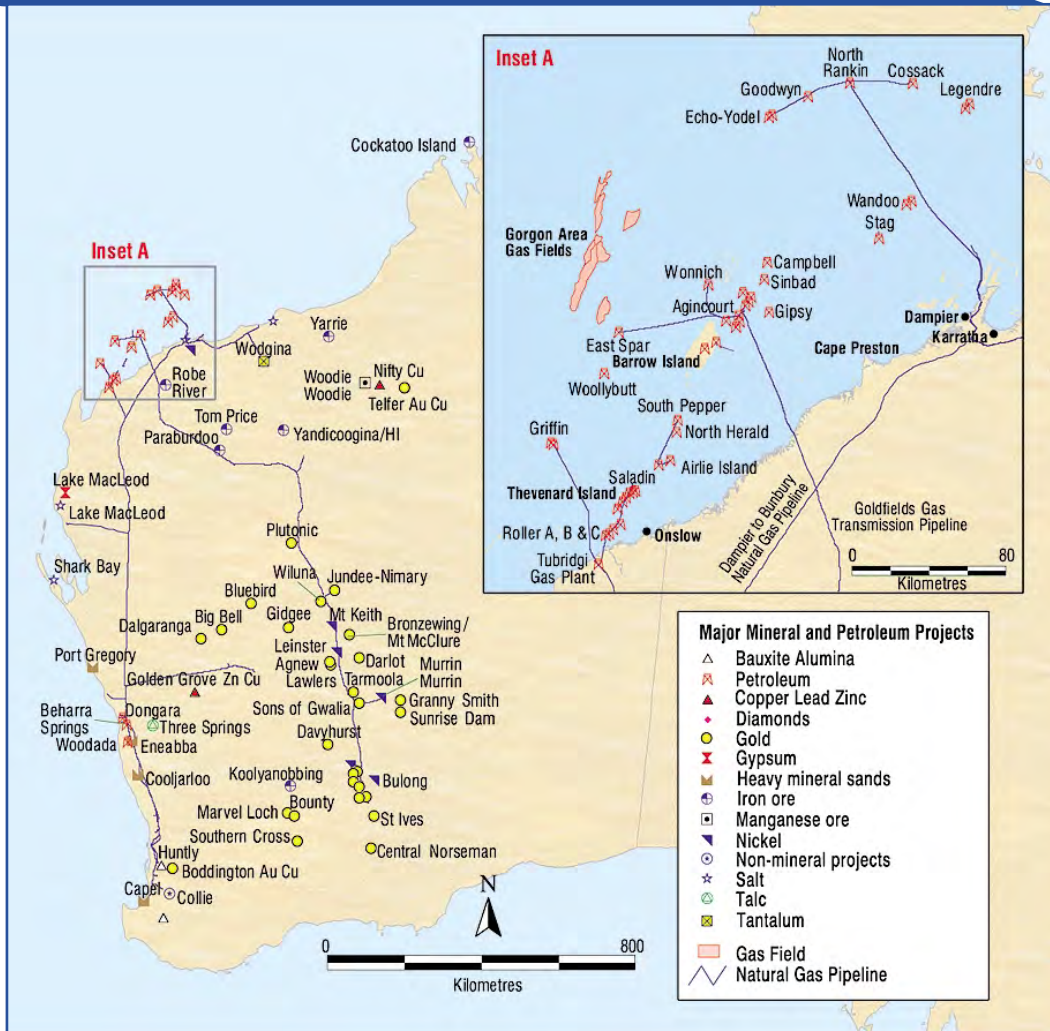
Despite these developments, the Pilbara is still considered as one of the most prospective and under-explored parts of the State for a large range of commodities (Department of Resource Development 2000), which suggests that there is a good potential for sustained future economic development in the region.

11.2.2 Agriculture and Fishing

The major land use in the Pilbara is pastoral. The pastoral industry was one of the first industries in the region and continues to play an important economic role, although diminished in both nominal and relative terms. The Pilbara Development Commission estimates that in 2001 there were 209 000 cattle and 87 000 sheep in the region. In 2001, around 62 000 cattle and 8000 sheep were exported (Pilbara Development Commission 2002). Significant quantities of wool are also produced in the Pilbara. A number of pastoral properties are owned by mining companies, which purchased them in the 1960s and 1970s to provide security of access to mineral deposits. These are usually managed as commercial pastoral properties within a framework of sustainable land management.

FIGURE 11-2

Major Mineral and Petroleum Projects in Western Australia



Source: Department of Mineral and Petroleum Resources

The three major commercial fisheries in the Pilbara region are the Nickol Bay Fishery, the Onslow Prawn Fishery and the Pilbara Fin Fish Trawl Fishery. Diving for and farming pearl oysters is also carried out. Established fishing operations are located at Onslow, Dampier, Point Samson and Port Hedland. The total catch for the region in the 1999–2000 season was 3356 tonnes valued at an estimated

\$18.6 million. While the fishing industry in the Pilbara is small compared to other regions, the total value of the catch has grown nearly fourfold since 1990–1991.

Recreational fishing is also an important activity in the region with some 70 000 anglers per year generating one million fishing days in the north coast bioregion (Department of Fisheries 2002).

TABLE 11-1

Planned and Proposed Minerals and Energy Projects in the Pilbara

Project	Project Value (\$ Millions)	Direct Employment	
		Construction	Permanent
Gas			
LNG Train-4 and trunkline	2 400	2000	70
LNG Train-5	1 600	2000	70
Gorgon 2 Train LNG	6 000	2900	600
	10 000		
Petrochemicals			
Dampier Nitrogen ammonia-urea plant	900	1000	130
Burrup Fertilisers ammonia plant	630	500	60
Japan DME – dimethyl-ether plant	1000	1000	150
GTL Resources methanol plant	610	600	60
Methanex methanol plant	2000	1000	150
Sasol-Chevron gas-to-liquids plant	2400	2500	200
	7540		
Iron and Steel			
Mining Area C iron ore mine and infrastructure	1000	500	200
Hope Downs iron ore mine	1050	500	300
Fortescue (Cape Preston) mine and HBI plant	3000	5000	1050
	5050		
Other			
Telfer gold mine expansion	1000	1500	810
Port Hedland manganese dioxide project	136	500	115
Port upgrades (Dampier and Port Hedland)	25	50	10
Sundry other projects	3000	1500	300
	4161		
TOTAL VALUE OF PROJECTS	26 751		
EMPLOYMENT TOTALS		23 050	4275

Source: Department of Mineral and Petroleum Resources (modified by ChevronTexaco)

11.2.3 Tourism

Tourism is a small but valuable and increasing contributor to the economy of the Pilbara region. The industry provides good opportunities for new businesses and for Indigenous businesses. It is a significant employer.

The Pilbara has experienced a growth in tourist numbers over the past few years and is the sixth most visited region out of the 11 regions in Western Australia. In 2000–2001 there were 330 000 visitors to the Pilbara who each stayed on average over four nights (Pilbara Development Commission 2002).

Most tourism activities are centred on nature-based tourism, with the major attractions in the region including Karijini National Park, Millstream–Chichester National Park and the Dampier Archipelago. There are good opportunities for cultural-based tourism. Industrial tourism is also popular at sites such as the Mount Newman iron ore mine and North West Shelf LNG plant.

11.3 The Economy of the Perth Region

The dominance of the natural resources sector in Western Australia means that the sector is also a major driver of the Perth economy. Perth hosts major offices of most large mineral and petroleum companies that operate in the State, many of which are Australian or Asia-Pacific headquarters.

The service industry also plays a pivotal role in the economy of Perth. The resource service sector is particularly strong. Tourism has grown rapidly since Fremantle hosted the America's Cup in 1987. Education is a major industry in Perth, which has five universities, and hosts many thousands of international secondary and tertiary students, and trainees.

The port of Fremantle is Western Australia's major general cargo port with a total trade value of about \$12 billion annually (Fremantle Port Authority 2000). East and South-East Asia are the major trading regions for the Fremantle Port. The major exports are grain, alumina, refined petroleum, refined nickel, silica sands, animal feeds, sheep, scrap metal, mineral sands and wool.

In comparison to other regional centres in Australia, Perth is a small economy and as such does not have the infrastructure to support traditional industries such as complex manufacturing. However, as the number of resource developments in the State increases, there is an opportunity to develop manufacturing infrastructure to cater to their needs.

The Australian Marine Complex in Cockburn Sound, south of Fremantle, is a significant addition to this infrastructure. The resources service sector is also expected to develop further, both via growth of the mineral and petroleum industries in Australia, and through growth in exports of services to these industries in other countries.



11.4 Economic Analysis

The economic benefits from developing the Gorgon area gas fields have Australian, State and regional dimensions. The benefits come in the form of:

- general economic growth, which has flow-on benefits across the community through businesses, workers (some of whom might otherwise be unemployed) and government revenues
- sustaining regional development
- increased competition in domestic gas markets

To evaluate the potential benefits from developing the Gorgon gas field, the Gorgon Venture commissioned extensive analysis by Access Economics and ACIL Tasman. The assumptions and methodology are outlined in Box 3-1 in the Development Rationale Chapter 3, also Box 11-1 and Technical Appendix K (see enclosed CD), "National and Western Australian Economic Impacts of the Gorgon Gas Supply and LNG Projects by Access Economics".

11.4.1 National and State Economic Growth

The Gorgon development will make a major contribution to Australian and State economic growth by:

- Contributing some \$11 billion of investment expenditure (at today's prices) between now and the mid-2020s (note: approximately \$6 billion is spent in the initial construction phase of the project with the rest being additional capital to fully utilise the Gorgon gas fields, for example: compression facilities).

- Generating net exports averaging in excess of \$2 billion annually (at today's prices) over the period from 2012 to 2030.
- Permanently adding around 6000 to national employment, 1700 of which would be in Western Australia.
- Contributing company tax and Petroleum Resources Rent Tax (PRRT) payments totalling \$17 billion (at today's prices) over the life of the project. In net present value terms this amounts to \$7 billion at a five per cent real discount rate.

In the model, the best measures of the project's overall impact on economic welfare are the:

- increase in annual flows of private consumption and public sector final expenditures that it allows
- increase in public and private sector wealth at the end of the simulation period

As modelled, in net present value terms, the impact is mainly on the private sector. At a real discount rate of five per cent, the project improves Australian economic welfare by an estimated \$24 billion (net present value in 2002).

National Economic Growth

Modelling shows that the Gorgon gas development would generate substantial positive economic benefits to the nation.

These benefits are driven by the export income that the development produces, the amount of money spent in the local economy and the taxes paid by the participants, businesses and individuals (see Figure 11-3).

Macroeconomic Modelling Assumptions

As detailed in Technical Appendix K, Access Economics conducted an assessment of the Australian and Western Australian economic and budgetary impacts of the Gorgon gas development. These analyses employed the following scenario for input into the macroeconomic models:

- 10 million tonnes per year (two trains) of LNG supply into the Asia-Pacific region/area.
- 110 PJ per year of supply into the Western Australian domestic gas market of which about half goes into a new export-based industrial gas project (e.g. methanol, ammonia or similar) and half goes into supplementing the Western Australian domestic gas market.
- The modelling horizon extends to 2030. This takes into account most of the Gorgon area reserves but does not extend into other Greater Gorgon Area resources.

The assumed LNG start-up of 2007 in the modelling has been subsequently adjusted to 2008 in current project schedules. This one-year adjustment does not have a material effect on the interpretation of the data.

The analysis is based on standard modelling practice, comparing two long-term simulations of the Australian and Western Australian economies based on Access Economics' assumptions about trends in major economic variables with and without the Gorgon gas development. Importantly, they represent a potential outcome rather than an exact forecast of the long-term behaviour of the economy. The modelling performed is deliberately conservative and reflects accepted best practice in this area.

During the initial investment phase
(from 2003 to 2009):

- As investment reaches its peak in 2006, GDP would increase by about \$1.5 billion (at today's prices), and total employment by up to 15 500. Private consumption increases by about \$750 million, reflecting higher wage incomes.
- Higher aggregate demand leads to a \$1.7 billion increase in imports in 2006, and \$1.6 billion deterioration in the trade balance (at today's prices). This is financed by capital inflows from the project's investors.

During full operation (from 2015 to 2030):

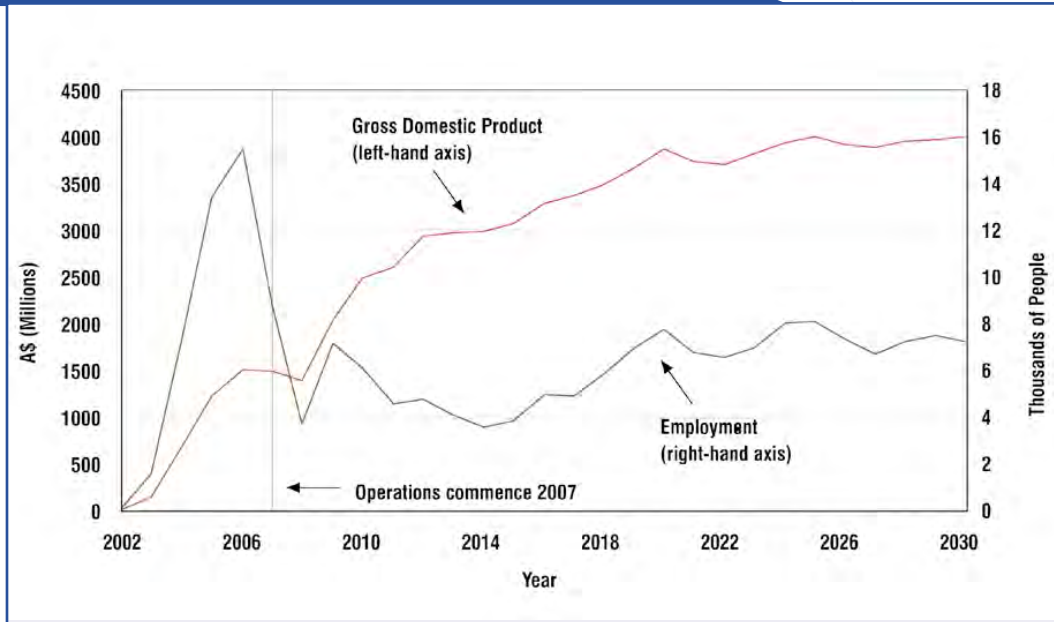
- There is a substantial increase in GDP and net exports, due to the income directly and

indirectly generated by the project. There is some offsetting outflow of income to pay dividends to the project's owners. However, the project's overall impact on the balance of payments is strongly positive.

- The real exchange rate increases, leading to an improvement in the competitiveness of imports relative to domestic production. Imports stay high, bringing the current account back towards balance. The imports flow mainly into higher private consumption.
- The project raises government revenues which the modelling assumes allows a cut in personal income taxes as a government response. Higher consumer demand reflects in higher imports, but also an increase in Australian production and employment.

FIGURE 11-3

National GDP and Employment Benefits



Source: National and WA Economic Impacts of the Gorgon Gas Supply and LNG Projects, Access Economics 2002

- Between 2012 and 2030, annual GDP is on average 0.25 per cent – some \$3.6 billion (at today's prices) – above the level without the project. Private consumption increases by nearly \$1.8 billion. Employment is up, on average, by over 6000.

Western Australian Economic Growth

The Western Australian macroeconomic benefits broadly follow the national results, with some differences. Output and expenditures for the Gorgon gas development occur mainly in Western Australia.

The development provides a substantial boost to Western Australian business investment over the period till 2009, with further investment continuing until the mid-2020s (see Figure 11-4). The estimated response of Western Australian business investment tracks closely that of the development, but is slightly higher over the entire period, indicating additional investment in capacity building.

As expenditure on the initial investment phase reaches its peak in 2006, Gross State Product (GSP) increases by about \$650 million (at today's prices), and total employment by almost 8000 (see Chapter 8). Private consumption increases by \$200 million, reflecting higher wage incomes.

Once the development begins operation, the direct benefits include a substantial contribution to GSP and merchandise exports. The development also has direct impacts on Western Australia through increased employment, payment of payroll tax and expenditure on intermediate inputs. However, unlike the situation during the investment phase, these are not the main source of benefit to the State. The main benefits are:

- An improvement of over \$4 billion in Western Australian economic welfare over the life of the development.

- Between 2015 and 2030, annual GSP is on average some \$2.9 billion (at today's prices) above the level in a world without the development. The percentage increase is over two per cent in 2012.
- Private consumption is on average some \$240 million higher over the period from 2012 to 2030. On average it is 0.25 per cent higher than it would be without the development.
- Western Australian employment is up, on average, by about 1700 over this period. The increase in the State's employment is partly met by increased labour supply from the existing population – and partly by a small increase in interstate migration.

In percentage terms, the project has a much larger impact on the Western Australian economy than on the national economy. The peak impact on the GSP (at about 2.2 per cent) is well above the corresponding impact on GDP (0.25 per cent).

11.4.2 Regional Development

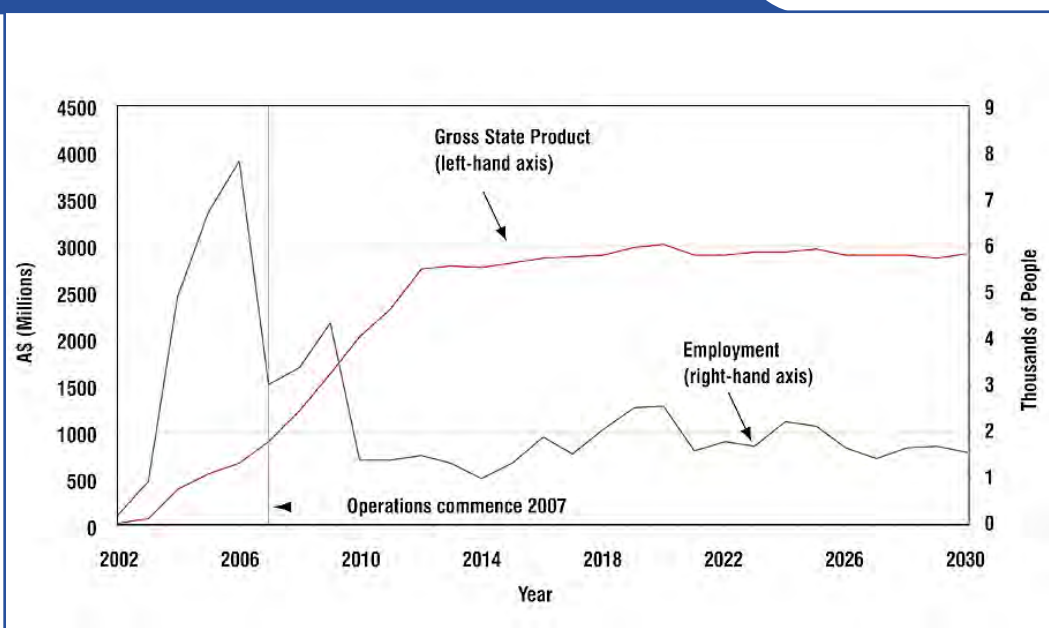
The Pilbara region can benefit significantly from this development. The extent to which the economy of the Pilbara region benefits from the proposed Gorgon development is a function of the percentage of:

- goods and services required for the construction and maintenance of the development that is sourced from the region
- the workforce sourced from the region
- the workforce sourced from outside of the region, but who relocate to the region

It is estimated that more than 10 per cent of the construction and operational workforce could be sourced from the Pilbara region. This workforce would create flow-on economic benefits through spending in the region.

FIGURE 11-4

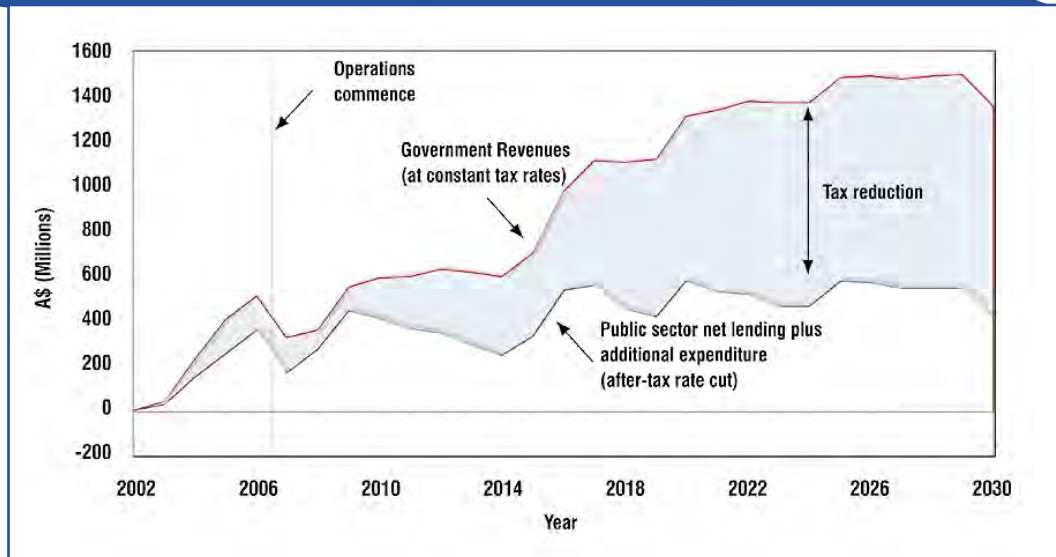
Western Australia GSP and Employment Benefits



Source: National and WA Economic Impacts of the Gorgon Gas Supply and LNG Projects, Access Economics 2002

FIGURE 11-5

Government Revenue Associated with the Gorgon Gas Development



Source: National and WA Economic Impacts of the Gorgon Gas Supply and LNG Projects, Access Economics 2002

The biggest economic impact will come from the amount of goods and services required for the development that are purchased in the region. At present, the Pilbara Region has insufficient capacity to manufacture suitable plant and equipment and to supply major construction services to support the Gorgon gas development. It is expected that most of these requirements will be met by companies located in Perth, the rest of Australia and overseas. However, there are potential opportunities for Pilbara-based companies to supply a share of these goods and services. These could include general logistics provision, site development, provision of elements of ship-berthing facilities, project buildings, construction materials and services, pre-cast concrete, erection and maintenance of the construction camp, and supply of general services.

During the operation phase of the development, supply base and general logistical activities will add to the economic

and social welfare of the Pilbara Region. These activities would add to the general level of activity in the region and allow further capacity building in local businesses.

11.4.3 Gas Market Analysis

The Gorgon gas development will benefit existing and new industrial, commercial and residential gas users by improving the availability of gas over the long term. In addition, by exerting downward pressure on delivered gas prices in the domestic market in Western Australia, the Gorgon development will enhance the competitiveness of gas-consuming industries by reducing costs.

The results of the specialist gas market modelling were incorporated into the macroeconomic modelling reported above and discussed in Chapters 3 and 10.

11.4.4 Government Revenue

Specialist studies conducted by Access Economics indicate that the Gorgon gas development would add substantial revenue to public sector finances, particularly at the Commonwealth level.

In response to these increased revenues and economic growth, governments may increase expenditures, and reduce the average personal income tax rate to keep the ratio of public debt to GDP from falling too rapidly. These income tax reductions, in turn, stimulate further growth.

The impact on government revenues, with and without the income tax reduction is illustrated in Figure 11-5. The shaded portion of the chart shows the dollar value of the income tax reduction that the public sector is able to provide (rather than accumulating higher Budget surpluses).

Commonwealth Government Revenue

The Commonwealth receives company tax and PRRT payments from the project's investors. Commonwealth tax receipts also benefit from the overall increase in economic activity and Commonwealth expenditures also rise in an expanding economy.

The Gorgon gas development would make estimated PRRT and company tax payments to the Commonwealth totalling \$17 billion in nominal terms (\$7 billion expressed as a net present value at a five per cent real discount rate). This additional economic activity generates a further \$2 billion (net present value at five per cent discount rate) in revenue for the Commonwealth. The net present value of overall Commonwealth budget gains are estimated at over \$9 billion.

In response to these increased budget revenues, it has been assumed for modelling purposes that the Commonwealth would respond with a reduction in income tax rates. These tax cuts are estimated to be worth \$6 billion (net present value at five per cent discount rate). The remaining budget revenues are used to fund government services, including health and education. Other outcomes would occur for different assumptions. For example, if the Commonwealth chose to re-invest all of this income in capital works, this would have a corresponding outcome in terms of job creation, import/export balance and GDP increase.

State Government Revenue

The Gorgon development has only modest direct impacts on Western Australian public sector finances. The main impact on revenue is the additional payroll tax generated from employment associated with the development. On the expenditure side, it is assumed that there are no State Government subsidies. There is also no requirement for development-specific investment in infrastructure by State authorities.

Indirect effects are more substantial, where the modelling predicts that the development causes increases in both revenues and expenditures. As production levels out, the project's national economic impacts flow through in the form of higher consumption expenditure and GST revenues.

Overall, revenue grows by \$980 million (in current dollars) over the life of the project and current expenditures are estimated to increase by \$820 million.

Local Government Revenue

Local government in the Pilbara is expected to receive increased revenue resulting from the economic activity and additional dwellings constructed in the region associated with the Gorgon gas development. The quantum of this revenue cannot be estimated at this time.

The siting of gas processing facilities on Barrow Island means that the development will not call on local government for significant increases in services. Required services are likely to be in user-pays areas such as passenger transits at Karratha airport.

11.5 Local Content

Over the 30-year life of the Gorgon gas project, the proponents are expected to invest over \$11 billion in upstream gas field development, LNG value-adding manufacturing plant and domestic gas infrastructure. Operating expenditure over the same period of time is estimated to be over \$5 billion. This could act as a substantial catalyst to the Pilbara region.

For both the investment and operating phase of the development, there are expected to be opportunities for Australian suppliers to deliver a significant proportion of the labour, goods and services required. The Gorgon Venture's Australian Industry Participation Policy is outlined in Chapter 10 and attached as Appendix 6.

In addition to the opportunities flowing to businesses and workers that could be directly involved with the project, there are benefits to other businesses and workers throughout the economy. Table 11-2 shows the modelled increase in output in various sectors of the Western Australia economy that result from the increase in economic activity generated by the Gorgon gas development.

While the Gorgon gas development mostly benefits directly related activities, there are also significant benefits for agrifood industries, general manufacture, and business and consumer services.

11.6 Expansion of the Development

Expansion of the development to utilise the Greater Gorgon Area gas fields would result in further benefits for the nation, State and region. As outlined in Chapter 10 (Strategic Value), market factors could allow expansion beyond the two LNG trains modelled, significant additional domestic and industrial gas production and delivery to the eastern states of Australia through a transcontinental pipeline. Expansion would capitalise on the infrastructure established for the foundation development and the capacity already developed in the national, State and regional economies. The benefits associated with this potential have not been quantified but would be substantial.

TABLE 11-2**Increased Output by Sector in Western Australia Generated by the Gorgon Gas Development**

	2002-06	2007-15	2016-20	2021-25	2026-30
	% share of WA output deviation				
Agrifood	2.9%	1.8%	2.2%	2.9%	3.5%
Resources	6.4%	4.8%	5.9%	8.9%	11.7%
Gorgon JV project	0.0%	65.8%	61.7%	50.6%	40.5%
Manufacturing	9.4%	1.8%	1.7%	2.0%	2.4%
Construction	25.2%	4.5%	4.4%	5.2%	6.1%
Logistics	25.2%	7.0%	7.5%	9.2%	10.8%
Business	21.8%	5.8%	6.2%	7.6%	8.7%
Ownership of dwellings	0.8%	2.1%	2.7%	3.6%	4.4%
Consumer services	8.3%	6.4%	7.7%	10.1%	12.1%
Total	100%	100%	100%	100%	100%

Source: Access Economics

11.7 Conclusions

Economic modelling predicts substantial economic benefits at the national and State level. Western Australia is expected to benefit significantly from this economic growth. General economic growth from the development would provide flow-on benefits for business, employment and government revenues. The development would contribute to the development of the Pilbara region by job creation and business development and capacity building. Further expansion of the development would continue to build on these benefits.

Between now and the mid-2020s, the Gorgon gas development would contribute about \$11 billion in investment expenditure at today's prices. Independent economic modelling indicates that \$17 billion in taxes and royalties

would be provided over the life of the development, which would generate extra export income of \$2.5 billion annually.

The development would stimulate 6000 jobs nationally, of which 1700 would be in the Western Australian workforce. It is estimated that more than 10 per cent of the construction and operational workforce could be sourced from the Pilbara region. This workforce would create flow-on economic benefits through spending in the region.

The Gorgon gas development would provide the impetus for the expansion of existing services and industries and attract a number of new ones. It would help underpin the development of new technologies and skills, for example in CO₂ sequestration and sub-sea technology, thereby creating regional capacity for future growth.



SOCIAL REVIEW

Western Australia's development has been underpinned by the resource sector for more than 100 years. During the past decade, the sector has been responsible for Western Australia's economic and employment growth being ahead of the rest of Australia. The Gorgon gas development would help to ensure that Western Australia maintains the high rate of economic growth and social benefits, such as low unemployment, that flow from a vigorous economy. Establishment of the initial infrastructure on Barrow Island would provide a catalyst for the future development of the Greater Gorgon Area fields, bringing a significant expansion and extension of the benefits.

Increased economic growth would lead to new employment opportunities, increased government revenues and consequent capacity to provide community services, and a rise in the spending power of the State's population. Direct benefits from construction and operation of the project would include new, highly-skilled jobs and opportunities for Western Australian businesses.

The Pilbara region would benefit from increases in the number and range of jobs, and from the growth of regional businesses. In particular, Indigenous employment and business development would be stimulated by the development. The Gorgon gas development would also stimulate growth of several Pilbara towns.

The supply of large competitive supplies of gas from the Gorgon gas fields would stimulate further industrial development in the Pilbara and other regions throughout Western Australia. New and expanded industries would in turn provide additional employment and business opportunities.

The design, construction and maintenance of the Gorgon gas development would provide many opportunities for technology transfer to Western Australian businesses and capacity building that would enable them to service other resource and industrial projects in the State.

The Gorgon Venture, in partnership with other stakeholders, would take action to maximise the benefits for Western Australia and the Pilbara region. Such stakeholders include government, business groups and Indigenous organisations. Any increase in the demand for social infrastructure would be managed through cooperative action between the Gorgon Venture and government so that social amenity is not adversely affected by the development.

This chapter presents an assessment of the benefits and potential impacts of the Gorgon gas development, in the context of the social settings of the Pilbara and Western Australia. The chapter also proposes management measures to maximise benefits and mitigate impacts.

12.1 Background and Approach

Consultants ACIL Tasman undertook the assessment of social impacts and benefits in light of the *Guidelines for the Social, Economic and Strategic Evaluation of the Gorgon Gas Development Proposal* issued by the Department of Mineral and Petroleum Resources in May 2002. They are set out in Technical Appendix L (see enclosed CD). The guidelines identify the factors and issues to be considered and the objective of the assessment, and suggested scopes of work to be undertaken to assess each factor and propose responses. These factors and issues are:

- demographics (impact of workforce and contractors on relevant settlements)
- government policy and legislation (extent to which the proposal meets current policies and in particular furthers development policies)
- livelihood and lifestyle impacts (changes to people's way of life, sources of income, opportunities for development)
- social infrastructure (demand for schools, hospitals, roads, health services, law and order, and recreation)
- native title, cultural heritage and Indigenous communities
- work practices applying to construction and operation of the development
- health and safety of the workforce and the wider community
- changes to the conservation estate and societal amenity in that estate
- social and societal comparison of alternative locations for the development (see Chapter 4)

These factors and issues were initially examined by conducting an economic and social literature review that profiled the

demographics and other characteristics of the communities in the Pilbara. The review also identified government institutions and businesses in terms of their likely interest in the development and their ability to service the development and the flow-on demands it would create.

Preliminary execution plans of the development concept provided the basis to assess the likely social implications. This concept includes the supply of 10 MTPA (two trains) of LNG into the Asia-Pacific region and 110 PJ/a of supply into the Western Australian domestic gas market. The horizon for the economic modelling extends to 2030. This takes into account most of the Gorgon gas field resource but does not extend into other Greater Gorgon Area resources.

The consultants and the Gorgon Venture met with community, business and government leaders in the Shires of Ashburton and Roebourne, and in Perth. Field visits to Barrow Island were made as well as to existing developments on the Burrup Peninsula, the proposed Maitland Industrial Estate and Karratha, Dampier, Roebourne and Onslow. Consultation processes are discussed in detail in Chapter 13.

The issues identified through the research and consultation process were assessed for the likely effects on the social status quo and in particular, their social impacts on areas potentially affected by the development. Recommendations for management responses were then developed taking into account the outcomes of the assessment and consultation.



12.2 The Study Areas

The study areas for the social assessment are the western part of the Pilbara region encompassing the Shires of Roebourne and Ashburton, and the Perth region. Other parts of Western Australia would also benefit directly and indirectly from the development. Summary information on the population and demographics of the study areas is provided in the following sections. More details are contained in Appendix L.

12.2.1 The Pilbara Region

The Pilbara is one of ten statistical and planning regions in Western Australia. The region is made up of four local government areas: The Shires of Ashburton, East Pilbara and Roebourne, and the Town of Port Hedland. The 2001 Census recorded 42 700 people

living in the Pilbara region of which 5700 or 13 per cent are Indigenous people. The majority of the population lives in coastal communities.

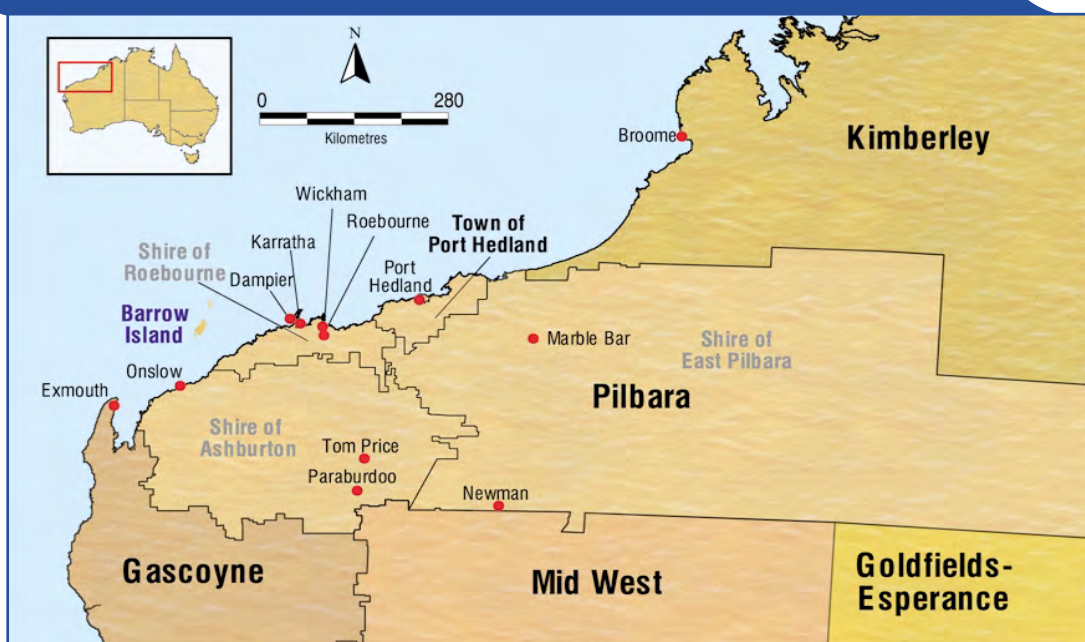
The Shire of Roebourne, an area of approximately 15 000 square kilometres, includes the towns of Karratha, Dampier, Roebourne and Wickham.

The Shire of Ashburton covers an area of about 105 000 km² and includes the townships of Tom Price, Paraburdoo and Onslow, plus several Aboriginal communities.

The current population of the towns expected to be most affected by the development is as follows: Karratha 10 800, Dampier 1500, Onslow 800 and Roebourne 950 (ABS Census 2001).

FIGURE 12-1

The Pilbara Region Showing Local Government Authority Boundaries and Towns



Source: Regional Development Council of WA

The population of Barrow Island comprises about 100 oilfield workers. All these workers are employed on a 14-day-on, 14-day-off rotation. Most live in the Perth region. There are no permanent residents on Barrow Island.

12.2.2 The Perth Region

As the capital city of Western Australia, Perth is the hub of business and finance in the State. Its 1 400 000 people make up 72 per cent of Western Australia's population, reflecting both its role as an economic and employment centre, and the city's attractiveness as a place of residence.

12.2.3 Other Regions of Western Australia

The Gorgon gas development is expected to result in social benefits for regions other than Perth and the Pilbara – depending on the extent to which the development sources people, goods and services from these regions. For example, some of the workforce may be drawn from the South-West region, centring on Bunbury, which may also be the source of engineering and other services. The Mid West region and Geraldton in particular could also service the development, especially in the construction phase.

12.3 Demographic Effects of the Development

Economic modelling of the effects of the development on Western Australia indicates a peak increase in the State's workforce of 8000 during construction (see Chapter 11). This would result in temporary increases in the populations of Perth, the Pilbara and the South-West. In the Pilbara, the population

increase as a result of construction would principally be on Barrow Island, with smaller increases in Dampier, Karratha and Onslow.

The predicted long-term average increase in employment of 1700 would result in modest population increases in Perth and the Pilbara and would help to sustain the State's relatively high rate of population growth. The Australian Bureau of Statistics predicts this to be an average of 1.4 per cent a year.

Chapter 5 details the anticipated Gorgon workforce during construction and operations phases. In summary, construction would require a peak workforce of 2200 located on Barrow Island and offshore, with a further 300 on the mainland in the Pilbara and Perth. The operations phase of the project would utilise about 150 workers on Barrow Island, with 300 located on the mainland. Workforce numbers and locations would be determined with more precision as the project is designed in detail.

12.3.1 Demographics of the Pilbara Region

The Gorgon gas development would have a positive effect on the population and social amenity of Pilbara towns. This section discusses the current and expected population and demographics of the Pilbara and the expected effects of the Gorgon project.

Population Growth

The Western Australian Planning Commission predicts that the population of the Pilbara would grow by an average of 0.8 per cent per annum from 2001 to 2016 and then 0.4 per cent from 2016 to 2031. This equates to a population of 48 000 in 2016 and 51 100 by 2031. Actual growth will depend on the

number, size, location, type and timing of future resource projects in the region.

The Shire of Roebourne predicts that Karratha's population will grow by 1800 (17 per cent) to 12 600 by 2006, and Dampier by six per cent to 1600, while other towns in the Shire are expected to grow only marginally.

Most of the Gorgon gas development workforce would work on Barrow Island, which would experience an increase of approximately 2200 during construction and a long-term increase of about 150 in the operations phase. In the order of 200 workers could be engaged in the Pilbara region on offshore construction and onshore engineering and supply activities during construction.

From a statistical standpoint, the Pilbara's population could increase substantially during construction and marginally over the long term in the operations phase. This would in part depend on the status of other projects in the region. However, population increases in Pilbara towns as a result of the Gorgon gas development are expected to be modest, manageable and within current government expectations for growth. Increases are likely to occur in Karratha and Dampier, which would be the principal regional centres servicing the development. Onslow may also see a small increase in population. The employment rates in the towns of Onslow and Roebourne are expected to increase as a result of greater employment of Indigenous people, and these towns may see modest population increases.

The greatest impact on Pilbara communities would be felt during the construction phase of the Gorgon gas development. It is anticipated that Dampier would be the primary supply

base for construction both on Barrow Island and offshore. This is likely to necessitate development of new infrastructure at the port and would involve complex logistics and engineering activities. Large-scale marine operations would be required to service project construction. Onslow may be utilised as a secondary supply base.

The operational phase of the project would require a smaller workforce. It would create a demand for longer-term employees and a steady demand for services, and therefore long-term social benefits.

During the past three decades, the population of the Pilbara has grown, although it has also fluctuated in response to the phases of development and operation of major resource projects. The small and fluctuating population of the Pilbara has been identified as inhibiting the region's sustainability. The Gorgon gas development, together with other industrial developments that could feed off the supply of gas from the Gorgon gas fields, would create a greater critical mass of projects and employment, resulting in a more stable population and enhanced regional sustainability.

The beneficial effects of the Gorgon gas development in stimulating a sustained increase in population could be enhanced by:

- use of Dampier (and possibly Onslow to a lesser extent) as a supply base during construction and operation
- encouragement and facilitation of local suppliers to provide goods and services for construction and operation of the development
- effects of the Gorgon gas development and subsequent related projects creating a sustainable level of business activity for

more locally-based businesses to be established or expand to supply them

- regional fly-in fly-out operations in addition to fly-in fly-out from Perth and the use of Karratha and Dampier as residential towns (this would largely depend on the extent to which workers choose to live in Pilbara towns)

Population Profile

The underlying demographics of the Pilbara or the rest of Western Australia are unlikely to be changed by the development, as the workforce and additional population would comprise similar mixes to the current population. Pilbara demographics reflect the remoteness of the region and the dominance of the economy by the resource industry and are characterised by:

- a young population, with a median age of 28.7 years compared with 33.3 for the whole of Western Australia
- a high proportion (13 per cent) of Indigenous people, compared with less than two per cent in Western Australia as a whole
- a high proportion of people in the under-14 age group, but a relatively small proportion in the 15 to 24 age group
- smaller numbers of older people relative to the Western Australian average
- a male-dominated population, with the number of males in the Pilbara more than 10 per cent greater than the number of females, whereas there are equal numbers in Western Australia as a whole

The Gorgon gas development is expected to attract a Pilbara-based workforce with a demographic profile very similar to the current profile. The majority of the Gorgon workforce is likely to be young, especially during the construction phase. Once in operation, the development's workforce would comprise

highly-skilled and professional workers who tend to be older with several years of specialised training and on-the-job experience. This trend would be enhanced as the operation matured, with a workforce that is expected to be very stable, as is the experience with the North West Shelf project.

The proposed development would not affect the Indigenous population profile, but is likely to increase the employment rate of Indigenous people.

Past and current experience with resource projects indicates that the workforce available to be employed on the Gorgon gas development would be male-dominated, especially in trades and operator roles and during the construction phase. Female workers should increase as a proportion of the workforce during operation, although likely to remain in the minority.

The Gorgon Venture would implement a diversity program that would encourage and facilitate employment of Indigenous people and women. Such programs are consistent with the equal opportunity policies of the project operator, ChevronTexaco and its partners, and with government employment policy. The development's approach to Indigenous employment and training is discussed in Section 12.4.

12.3.2 Demographics of the Perth Region

The demographics of the Perth region reflect those of other Australian capital cities – ethnically diverse with a median age of about 34 years.

During construction, the Gorgon gas development would result in a temporary increase in Perth's population, due to the creation of a number of new jobs to support the development. Many of these jobs would be filled by temporary interstate migration or by workers from other construction projects moving on to the Gorgon gas development.

The operations phase of the project would result in a modest long-term increase in the Perth population as a result of interstate and overseas migrants filling some of the new jobs created by the development or to fill vacancies in other operations caused by local recruitment. Recruitment by the Gorgon gas development in its operations phase is expected to have only a small impact on the Western Australian labour market and should not lead to any flow-on costs to other employers.

The general skills profile of the population would increase due to the development's need for a highly-skilled workforce in professional, trades and operator disciplines.

12.4 Employment and Training

As detailed in Chapter 5, construction of the Gorgon gas development is expected to be in three phases starting in mid-2005. The first and second phases – sub-sea and pipeline development, and construction of a gas processing plant on Barrow Island – would take about three years to complete, with the construction of a gas pipeline to the mainland to follow. It is expected that at the peak of construction approximately 2200 people would be employed directly on Barrow Island, with another 300 at off-island locations such as Perth, Karratha and on offshore construction.

The remainder of the jobs would be generated by businesses supplying goods and services to the project, and indirectly as a result of increased economic activity.

If modular construction of elements of the project takes place in Perth or elsewhere in Western Australia, a significant number of workers could be located at these construction sites, and proportionally fewer on Barrow Island.

The operational phase would require a smaller, but still significant workforce of about 600. Around 150 would work on Barrow Island at any one time, with another 150 island workers on their rostered time off, plus an additional 300 off island workers based in Perth and the Pilbara.

Based on previous large-scale resource developments in Western Australia, it is expected that the construction workforce would be sourced from the Pilbara (about 11 per cent), Western Australia and the rest of Australia (88 per cent) and overseas (one per cent). If other major construction projects are underway at the same time – particularly in the Pilbara – these proportions may change, with fewer workers able to be recruited from the Pilbara and larger numbers recruited from interstate.

Workforce Recruitment

The Gorgon Venture would seek to employ a workforce sourced largely from Western Australia, including regional areas, and one that reflects the diversity of the Western Australian community. It would actively seek to employ workers from the Pilbara, women and Indigenous people. It plans to establish recruitment offices in both Karratha and Perth.

The Gorgon Venture would put in place similar requirements for contractors to give effect to its employment policies.

Workforce Training

The Gorgon gas development would provide a major opportunity for Western Australian workers to enhance their skills and be trained in new skills. Highly specialised skills would be required for offshore operations, and in operation and maintenance of the Barrow Island gas processing plant. During construction, a workforce with skills in complex engineering construction would be required. Filling these needs would require both recruitment of workers with existing skills and training of workers to enhance their skills or develop new ones. The skills required for project operation are high level and specialised. Operations workers – regardless of origin – would require substantial training.

Contractors engaged to construct the development would recruit both trained and less-experienced workers, and would implement training programs to ensure that there are enough workers with sufficient skills to construct the project safely, on time and on budget.

The Gorgon Venture would implement a comprehensive training program for operations workers, in conjunction with public and private sector training providers. Specialised programs in conjunction with the Western Pilbara College of TAFE could provide training in safety, quarantine procedures and nature conservation and rehabilitation. The Gorgon Venture would also implement professional development and performance management programs to foster ongoing development of its employees.

Achieving the objective of employing significant numbers of Indigenous people in the construction and operation workforce would require a targeted training and recruitment effort. Training would be implemented in association with employment, either directly by the Gorgon Venture, or by contractors.

Workforce Movements

The location of the development on Barrow Island would necessitate that the bulk of the construction and operation workforces would operate on a fly-in fly-out basis from both Perth and the Pilbara. Fly-in fly-out rosters are yet to be determined. The Gorgon Venture would fully examine the options for regional fly-in fly-out from the Pilbara in conjunction with State and local government agencies.

During construction, daily jet flights transporting personnel between Barrow Island and Perth would be required during peak construction periods. This would be in addition to the current average of 50 persons, each way, on four days a week to staff ChevronTexaco operations on Barrow and Thevenard Islands, and the Apache and BHP Billiton oil and gas operations nearby. Daily flights between Karratha and Barrow Island are also envisaged.

The airport infrastructure at Perth and Karratha is adequate to deal with the expected increase in aircraft and passenger movements, although quarantine procedures may require that some of the current inspection facilities and procedures in Perth be upgraded. Barrow Island airport infrastructure may also need to be modified to cater for an increased number of passengers. ChevronTexaco would arrange any required modifications to airport facilities in conjunction with airport operators and other users.



Social issues associated with fly-in fly-out are discussed in Section 12.6.5.

12.5 Government Policy and Legislation

The Gorgon gas development is consistent with the policies of the State and Commonwealth Governments relating to economic growth, regional and industry development, and social amenity. The development would enhance the achievement of policy goals. This section outlines these policies, relevant legislation and the implications of the development. Other policies relevant to the development – in particular land use, conservation, environment protection, and health and safety – are discussed in other chapters and sections within this chapter.

12.5.1 Regional Development Policies

The Western Australian and Commonwealth Governments both give a high priority to regional development and have implemented comprehensive programs covering all aspects of regional development – from business assistance to social services. The Pilbara is a priority area for the State Government. In December 2002, it released a draft Regional Policy Statement for Western Australia. The statement identifies four goal areas under the headings of governance, economic, social and environment.

The Gorgon gas development would make a positive contribution to regional development in the Pilbara and potentially to other regions through:

- the direct impact on regional economies through employment and spending with regional businesses

- the development's proposed industry participation program
- the delivery of another major supply of gas to Western Australia which would stimulate development of energy-intensive industries

The Gorgon Venture would work with Commonwealth, State and local government agencies to enhance the regional development benefits flowing from the development.

12.5.2 Industry Policy

The Gorgon gas development epitomises the type of strategic resources development that governments wish to attract. The State and Commonwealth Governments both recognise that continued economic growth based on industry and business development is essential for the economic and social well-being of Western Australia and the nation. A key element of their policies is to facilitate development of resources such as natural gas to enhance exports of energy products such as LNG and to stimulate development of other energy-intensive export industries through provision of competitive supplies of energy.

The Gorgon gas development could act as a stepping stone to the development of the Greater Gorgon Area gas fields. This would further position the Pilbara as a major energy province. The development of the Greater Gorgon Area gas fields would stimulate a diverse range of downstream industries and development of a petroleum service centre based in Western Australia and serving the Asian region.

Governments also wish to maximise the benefits of such developments through value adding and participation of Australian industry and workers. They have implemented a wide

range of policies and programs aimed at achieving industry development and Australian industry participation goals.

12.5.3 Indigenous Development Policies

The Gorgon gas development, as a major development in a regional area that has a large Indigenous population, would complement and enhance the efforts of government, particularly in helping communities work towards greater economic self-sufficiency.

State and Commonwealth Governments place a high priority on the social, cultural and economic development of Indigenous people and communities. Both have comprehensive policies on reconciliation and Indigenous development.

In June 2002, the Commonwealth and State Governments, and the Aboriginal and Torres Strait Islander Commission (ATSIC) agreed on key issues for a collaborative approach to improve economic and social outcomes for Indigenous people in Western Australia. Amongst the key needs identified were partnerships between Indigenous communities, government and the business sector.

The Gorgon gas development would work with government, Indigenous groups and other resource companies to contribute to the achievement of improved social and economic conditions for Indigenous people. This would include an Indigenous employment program with associated on-and-off-the-job training, and an Indigenous business development program.

While education and training schemes are yet to be designed, they would be implemented so as to complement existing schemes.

12.6 Livelihood and Lifestyle Effects of the Development

The Gorgon gas development would create substantial benefits for the livelihood and lifestyle of Western Australians. These benefits could be maximised through cooperative efforts between the Gorgon Venture, government and business and community stakeholders. There may also be some potential impacts that require management to ensure that the development does not have adverse effects.

12.6.1 Livelihood and Lifestyle in the Pilbara

As described earlier, the Gorgon gas development could be expected to lead to an increase in employment in the Pilbara and enhance the skills profile of the Pilbara workforce. The development would not only provide jobs directly, but also in these industries that support the development more indirectly in downstream industries that process minerals and petroleum products. As well, employment in other sectors could be expected to increase. These include the retail, health and education, transport and hospitality industries.

The Gorgon gas development would thus contribute to enhancing the diversity and quantity of employment opportunities in the Pilbara.

The major employment prospects in the Pilbara are for semi-skilled and skilled workers. As the magnitude of downstream mineral and petroleum processing increases and there is growth in industries that manufacture equipment and provide services for the construction and operation of resource

projects, there would be increasing demand for personnel who are more skilled. This would result in a steady increase in the general level of skills in the Pilbara community.

The Gorgon gas development would contribute to this enhancement of the workforce skills profile. As a technically complex operation, it would require high levels of skill amongst its workers.

The Gorgon gas development would enhance the lifestyle of the Pilbara through generating increases in the population and in economic activity, and in providing, through direct and indirect tax payments, increased resources to government to enable provision of services to Pilbara communities. The growth of communities as a result of the development would help to enhance the social amenity of Karratha, Dampier and Onslow. The development would not restrict the recreational pursuits of Pilbara residents.

12.6.2 Livelihood and Lifestyle in Perth

The Gorgon gas development would add to the number and range of employment opportunities in, and based out of Perth. The range of occupations of Perth residents is generally comparable to that of other state capitals. The location of Perth as the nearest major city to Western Australia's resource regions has, however, resulted in comparatively higher levels of employment in resource-related jobs. Many mineral and petroleum companies have major offices in Perth. Numerous engineering and service providers to the resource sector also have large operations in Perth. As a result, many people in Perth are employed in the mineral

and energy sector or those industries that support it such as construction, banking and finance, government services, education and training, and manufacturing.

The resource sector is a major contributor to Western Australia's and Perth's low unemployment rate relative to the rest of Australia. The Gorgon gas development would further strengthen the role that the resource sector plays in the economy of the Perth region. At the same time, it would act as a catalyst for the broadening of economic and employment opportunities through stimulation of the petroleum services sector. The development would enhance the Perth lifestyle through generation of such economic activity and employment, and attraction of numbers of interstate and overseas migrants.

The development would not restrict the recreational pursuits of Perth residents.

12.6.3 Community Development

In developing the Gorgon gas fields, the Gorgon Venture would seek to form partnerships with communities in which it operates and where its employees work and live. These include communities in the Pilbara, in Perth and potentially elsewhere in regional Western Australia. The Gorgon Venture would discuss with communities their needs and develop partnership programs that help to address these needs. These programs may include provision of employment, training and business development opportunities.

12.6.4 Opportunities for Regional Business

The Gorgon gas development would provide opportunities for businesses to service the developments directly as well as the activities that would support the project. Karratha offers the most comprehensive range of such service and would be likely to experience the largest increase in new residents and the largest requirement for businesses and services through direct, indirect and consequential demand.

There would be new business opportunities in those industries that support the mineral and energy sector such as catering, transport and light engineering. The larger population and increased economic activity would create new opportunities for small and medium business in the region.

Many Pilbara enterprises already receive considerable flow-on business from resource developments through the general economic stimulus that these projects have on the Pilbara. The Gorgon gas development could provide further opportunities for business.

The Gorgon Venture would work closely with Commonwealth and State Government programs designed to enhance business development in regional areas. The objective would be to facilitate the participation of regional businesses in the development through business capacity building, enhanced communication between businesses, the development and its contractors, and adoption of procurement policies that favour regional, small and Indigenous-owned businesses.

This could include a staged, integrated program to enable regional businesses to achieve internationally recognised quality standards which would assist them to participate in the Gorgon gas development as well as other resources and industrial projects.

12.6.5 Social Effects of Fly-In Fly-Out on Families

Fly-in fly-out commuting, while the preferred employment mode of many resource industry employees, could have some undesirable effects on families. Recent research by Edith Cowan University found that the children of fly-in fly-out employees showed no difference in psychological health and well-being when compared with children of fathers who do not work far from home (Sibbel 2002). The study found that mothers, however, tended to encounter problems associated with role definition within the family.

Resource companies have responded to concerns about family and employee welfare with programs to help improve communication and provide support for families. These programs include:

- provision of telephone facilities at site, including in some cases, mobile telephone coverage
- provision of information for families about projects, about workers' living arrangements and working arrangements
- provision of counselling and chaplaincy services at site
- provision of counselling and chaplaincy for families of workers in Perth
- site visits for family members



The Gorgon Venture would implement, within its employee assistance program, measures such as those above to help employees and their families deal with stresses associated with fly-in fly-out rosters, in conjunction with existing support services provided by government, religious organisations and community groups.

12.7 Social Infrastructure and Services

12.7.1 Social Infrastructure

The demand for additional social infrastructure in the Pilbara as a result of the Gorgon gas development is expected to be small. The expected population increases would not be large, and most existing infrastructure (except housing) is adequate to deal with such increases. Even if several other projects are under construction concurrent with the Gorgon development, most existing infrastructure would be adequate. Schools, health facilities, roads, shops, parks and sporting grounds in these towns are adequate to cope with a total permanent population of about 20 000, which is the projected population by 2010 under a medium growth scenario (Naralup Associates 1998). Housing issues in Karratha are discussed in Section 12.7.3.

Pilbara councils, however, are concerned about their capacity to maintain, replace and enhance community infrastructure due to its age and councils' limited revenue bases. The State Government has funded an audit of Pilbara infrastructure to be commissioned by the Pilbara Development Commission. The audit would produce assessments of community needs and current infrastructure to identify gaps in provision of services and the

cost of maintaining existing infrastructure. In this way, the State Government and Shire Councils should be able to determine the infrastructure needs of Pilbara towns and the long-term cost of provision, and provide adequate resources to maintain, renew and supplement infrastructure.

If greater numbers of Indigenous people join the workforce, the demand for community infrastructure in Roebourne may rise. In particular, there may be a need for additional education and training infrastructure in Roebourne. There may also be a need to supplement other infrastructure, such as transport to provide for Roebourne-sourced workforce movements; and for shopping and access to services in Karratha.

If Onslow is used as a base for construction supply activities, there is adequate infrastructure – except housing – to service a modest population increase. There is adequate single persons' accommodation in the town that, with some refurbishment, could accommodate the temporary workforce required. Construction of new houses would be required for any additional permanent population.

The Shire of Ashburton recently completed a major upgrade to the Onslow airport to enable all-weather and night operations by non-jet aircraft. This would assist rapid movement of people and goods to and from Onslow.

With or without the Gorgon gas development, the growing population of Perth and the rest of Western Australia would require additional infrastructure and services. Governments, utilities and other service providers are planning for this population increase and are

expected to continue to provide adequately for the population in both regional and metropolitan areas.

There is not likely to be a need for additional infrastructure or services in Perth beyond those that are already planned.

In the Pilbara, the Gorgon development is not expected on its own to lead to a need for substantial new social infrastructure, except for housing for the additional population, and the already-planned upgrading of education and training facilities. If several other projects are developed in the Pilbara within the next decade, some new infrastructure and upgrades may be needed. In any case, the continued development of social infrastructure would enhance the attractiveness of the Pilbara as a place to work and live, particularly for people with families.

The Gorgon Venture would work with all levels of government and other project developers to assess social infrastructure needs and how required infrastructure might be provided.

12.7.2 Community and Social Services

Private and government agencies provide a comprehensive range of community and social services to the Pilbara. Most services in the areas of education, social welfare, community groups, religion, sports and recreation are available. Karratha has the most comprehensive range of services. However, being relatively small communities in a remote region of Australia, these towns do not have the full range of services enjoyed by capital cities and large regional centres.

As with social infrastructure, services in Karratha and Dampier are generally adequate to cope with populations significantly larger than those anticipated as a result of the Gorgon gas development. Community leaders report that health, childcare, family support and other social services are adequate for the current population, and likely to remain so, with some supplementation, for the population increases expected as a result of any future resource development projects.

Services for Roebourne residents are adequate, although some services are only available in Karratha. Difficulties with transport for Roebourne people wishing to access such services can limit their practical access to these services.

Existing services in Onslow are limited as a result of the small population. A modest increase would not change demand sufficiently to warrant increased services under current government policies.

The Gorgon gas development is not expected to result in new demand for services that would require changes to current plans for their expansion.

12.7.3 Housing

The low availability and high cost of housing in the Pilbara is a major disincentive to people residing there and could limit the number of workers that the Gorgon gas development is able to recruit from the Pilbara. These housing issues are due to:

- high construction costs as dwellings need to be cyclone rated and because of freight costs of construction materials

- limited land availability due to native title issues
- low liquidity of houses for sale or rent due to large numbers being owned by resource companies and government, and because of demand due to an upturn in construction of resource projects

Dwelling purchase prices are up to 50 per cent higher than in Perth, and rental costs (as at October 2002) are up to double the cost of equivalent rental accommodation in Perth. Karratha business leaders report that rental costs have risen significantly during the past year in response to increased demand due to construction of Phase IV of the North West Shelf project.

For the Gorgon gas development, Karratha housing costs would be a significant determinant of how many potential employees may be available in Karratha or would be willing to relocate there. The State Government has reached agreement for access to land for housing to cater for the expected growth in population arising from new industrial development. This, together with continued investment in housing by the State Government and the private sector, should result in a supply-demand balance and reasonable housing prices, taking into account the high construction costs in the Pilbara.

Increased availability of housing would enhance the benefits that the Pilbara receives from the Gorgon gas development as more people choose to reside in the region. The Gorgon Venture would work with government and other project developers to assess the demand for housing and how such housing could be provided.

12.7.4 Education and Training

The Gorgon gas development would result in a small increase in demand for education and training in Pilbara towns. Generally, education and training infrastructure is adequate to cope with such an increase, as it has been designed to cater for a considerably larger population. However, if the region is to maximise its participation in the development, education and training offerings and outcomes would need to continue to improve – both to assist in making the region an attractive place for workers with families to live, and to prepare Pilbara young people for work.

The provision of quality education and training in the Pilbara has been identified as a key to the region's development and sustainability. The greatest demand for education is for pre-primary and primary aged children. Perception of a lack of diversity and quality of secondary education, however, is the most commonly cited reason that families either leave the Pilbara or decline to move there. Many families leave the Pilbara when their children reach high school age, or send their children to Perth for secondary education. This issue was raised frequently in consultations with community and business leaders. Principal concerns are with secondary school infrastructure and curriculum offerings.

In January 2003, the State Government announced plans for the co-location of Karratha Senior High School with the West Pilbara College of TAFE, and a campus of Curtin University of Technology. This would lead to a program allowing secondary students access to TAFE and university units during

their final year of high school, and to ease the transition between institutions. It would also allow curriculum offerings to be expanded and provide more choice for students.

A key to further economic and social development of the Indigenous population of the Pilbara is education. If Indigenous people are to participate in greater number in resource projects and in Pilbara service businesses, average education achievement levels need to increase.

The State Government, through the Department of Education, has a comprehensive program to improve education outcomes among Indigenous students. In 2002, the Department of Education established an annex of Karratha District High School at the Roebourne Primary School campus to try to improve attendance and retention rates of Aboriginal students. The school also includes a campus of the West Pilbara College of TAFE. Supported by industry, the Department of Education also works with local community committees to improve attendance rates.

The Department of Education, in conjunction with several resource companies in the region, offers an innovative program to identify, mentor and educate talented Aboriginal students in Roebourne. Up to 25 students per year participate in this program, which utilises a purpose-designed education centre in Karratha.

The Gorgon Venture would work with the State Government, education institutions to assess the education and training requirements of the development and to cooperate in designing programs that would meet these requirements.

The Gorgon Venture would also seek to support existing Indigenous education programs.

12.7.5 Health

Demand for health services would increase with the size of the Pilbara population. The provision of quality health services, as with education, are high on the list of priorities of Pilbara residents. Health services in Karratha are adequate for the current population and the Nickol Bay Hospital has enough capacity to cope with the expected medium-term increase in population in the Shire of Roebourne. The Wickham Hospital supplements it.

The Gorgon gas development is not expected to place demands on health services for the community that could not be met by incremental growth of existing services. The Gorgon Venture would discuss health service needs and provision with the State Government.

The development would, however, require medical care services on Barrow Island for the large number of workers during construction, first-aid care during operation, and access to an emergency medical response capability in the Pilbara. The Gorgon Venture would provide the Barrow Island first-aid and medical services. Current emergency response arrangements would also be enhanced.

12.8 Land Tenure

Land tenure is the legal mechanism by which the Gorgon Venture would, in the event of the government granting in-principle approval for restricted use of Barrow Island, secure the right to use a site on the island for an onshore plant and ancillary facilities.



Details of land tenure would need to be finalised following the granting of in-principle approval. The granting of tenure would also be subject to acceptance of an Environmental Impact Assessment (EIA) for a specific proposal. Some key elements expected to be included would be:

- tenure would not cancel or reduce the size of the Class A Nature Reserve
- the rights and operations of the existing tenants on Barrow Island (the Barrow Island oil production joint venture) would not be unduly prejudiced or interfered with
- the granting of tenure would involve a legislative process, that is, it would have to be passed by both houses of the Western Australian Parliament
- the terms of tenure would address CO₂ re-injection in a saline reservoir

12.9 Native Title Issues

There are no native title claims over Barrow Island or the surrounding waters. Barrow Island is a Class A Nature Reserve vested in the Conservation Commission of Western Australia. The island is also subject to Petroleum Lease L1H which was granted to West Australian Petroleum Pty Ltd in 1967 under the *Petroleum Act 1936* and is now held jointly by ChevronTexaco, ExxonMobil and Santos.

There are a number of native title claims that cover mainland areas and adjoining offshore waters along the West Pilbara coastline facing Barrow Island.

The Gorgon Venture would brief and consult with native title claimants regarding any parts of the development that may occur on claim areas.

12.10 Cultural Heritage

The following assessment shows that the Gorgon gas development would not impact on any sites of cultural heritage significance on Barrow Island. However, if the development proceeds, a cultural heritage management plan would be developed to ensure that known sites are protected. All activities would be managed to maintain the integrity of these sites and any sites discovered during construction or operation activities. Relevant employees would receive cultural heritage training.

Cultural heritage that may be affected falls into two categories: Indigenous and non-Indigenous. Barrow Island has thirteen registered Aboriginal heritage sites even though it has not been utilised by Indigenous populations, with the exception of minor pearling activities in the late 19th century, since it separated from the mainland at least 8000 years ago.

Sites of cultural heritage on the adjacent mainland that may be affected by the development would also be subject to a management plan. Any such sites would be identified during planning for the mainland components of the development.

With respect to Indigenous heritage, all objects, sites and areas of Aboriginal origin, or of significance to Aboriginal people, are protected under the Western Australian *Aboriginal Heritage Act 1972* (and amendments 1980 and 1995). The Gorgon Venture would comply with all provisions of this Act. Non-Indigenous heritage is covered by the *Heritage of Western Australia Act 1990*. The Gorgon Venture would also comply with this Act.

The Gorgon Venture would consult with relevant stakeholders, particularly Indigenous people, about protection of cultural heritage.

12.10.1 Sites on Barrow Island

To assess cultural heritage sites on Barrow Island, an archaeological investigation was conducted. It involved a search of the Department of Indigenous Affairs (DIA) Aboriginal Site Register, a study of previous research material and a review of previous archaeological survey work conducted on Barrow Island. The work was conducted by a qualified archaeologist with extensive field experience on Barrow Island who had conducted the previous archaeological work.

A 1994 survey of cultural heritage sites on Barrow Island, which is still relevant to the current investigation, was based on systematic and predictive sampling and included the area proposed for the Gorgon gas development. Field surveys involved pedestrian and vehicular transects that covered a 10 per cent sample area (i.e. 23.4 km² of a total area on Barrow Island of 234 sq km). The assessment of the cultural heritage issues on Barrow Island is primarily based on the findings of this survey work.

Most archaeologically sensitive areas on Barrow Island are in clay-pans and dunes. Under WAPET's and ChevronTexaco's environmental management programs, these areas have been excluded from oil operations on Barrow Island, thus avoiding impact to significant archaeological sites.

Field survey work shows that Aboriginal activity on Barrow Island was concentrated around the clay-pan areas. All sites were

recorded on the northern, southern, south-western and south-end plain areas.

The limestone uplands are particularly devoid of artefacts. These findings are consistent with the results of the predictive sampling model. It predicted that most sites would occur within the vicinity of potential water sources.

Twelve archaeological sites were recorded on Barrow Island during the 1994 field survey work (Figure 12-2). Six of these sites were previously located by WAPET personnel and six were located during the field survey. All sites were surface artefact scatters and most of the artefact scatters were recorded in full. Information on all sites was forwarded to the Department of Indigenous Affairs as required by legislation.

Based on the size and apparent complexity of their assemblages, together with the potential for stratified deposits at the clay-pan sites, a relatively small number of reasonably large artefact scatters at six field sites were considered to be of moderate archaeological significance. It is possible that the assemblages could provide information about regional settlement patterns and Aboriginal stone procurement and reduction practices. The presence of glass artefacts at two field sites poses questions about Aboriginal usage of Barrow Island during the pearling era. The scarcity of recorded sites on the island also elevates their significance.

Several small artefact scatters at five field sites were assessed as having low significance due to their small and undistinguished assemblages, which have a low potential to provide further archaeological information.

FIGURE 12-2

Archaeological Sites of Significance on Barrow Island



One field site was considered to be of high significance due to the presence of artefacts that are typical of Kimberley assemblages. For example, artefacts of bottle glass provide

a link between pearling activities of the late nineteenth century and the transport of Aboriginal people from the Kimberley region of the State.

The registered archaeological sites of Barrow Island are mostly associated with clay-pans or sand blow-outs (i.e., dunes). There are no sites near the area of the proposed Town Point gas facility or associated feed gas pipeline route.

Two sites are near the conceptual CO₂ re-injection pipeline and well facilities.

The former is situated in the dune blow-out at Cape Dupuy and the latter in the clay-pan area about three kilometres further south. Should the development proceed, the Gorgon Venture would position these facilities to avoid any impact upon these sites.

12.11 Work Practices

The Gorgon gas development operator, ChevronTexaco, places high value on the contribution of its employees and intends to have the Gorgon gas development recognised as best practice in relation to work practices and employee relations.

ChevronTexaco and its contractors would comply with the relevant State and Commonwealth legislation applying to the employment conditions, remuneration, entitlements and workers' compensation. Employees at the current Barrow Island and Thevenard Island operations are engaged under a federally-registered certified agreement under the Commonwealth *Workplace Relations Act 1996*. It is envisaged that this instrument would apply to the operational workforce for the Gorgon gas development.

For the construction phase of the development, it is expected that the project would also be regulated by a federal certified agreement, as is the norm for major construction projects in Western Australia.

The details of employee relations and work practice arrangements would be formulated within the above framework by the Gorgon Venture as planning proceeds for the development.

12.12 Health, Safety and Workplace Amenity

ChevronTexaco, as operator of the Gorgon gas development, aims to achieve world-class performance in health and safety. It would do this by implementing best practice programs and systems to protect those employed on the project as well as the wider community. These would be consistent with ChevronTexaco's corporate policy (The ChevronTexaco Way).

ChevronTexaco's goal is to be recognised and admired worldwide for safety, health and environmental excellence. The following principles and expectations guide the company's behaviour in relation to safety and health:

- **Leadership.** *Strive for world-class performance by institutionalising a rigorous system (Operational Excellence Management System) for managing safety, health and environmental affairs. Assess and manage risks to our employees, contractors, the public and the environment from our operations and products.*
- **Safety and Incident-Free Operations.** *Design, construct, operate, maintain and ultimately decommission our assets to prevent injury, illness and incidents.*
- **Compliance Assurance.** *Verify conformity with company policy and government regulations. Ensure that employees and contractors understand their safety, health and environmental responsibilities.*
- **Emergency Management.** *Prevention is a first priority, but be prepared for any emergency and mitigate any incident quickly and effectively*

ChevronTexaco would require the same high standards of health and safety management from its contractors.

12.12.1 Workplace Health and Safety Risks and Issues

The onshore workplace health and safety issues for the Gorgon gas development are similar to other gas processing operations in the world and are directly comparable to those at the North West Shelf project.

Offshore, the sub-sea development would reduce the safety hazards compared to offshore platform-based operations. The absence of a platform reduces the exposure of the workforce to risks associated with offshore helicopter travel and those associated with living on an offshore production platform such as fire and explosion. Similarly, exposure to health effects such as noise is averted. The use of sub-sea completion systems installed and maintained by remote operated vehicles (ROV) rather than divers also reduces the risk to personnel. These are the major hazards in offshore operations.

Project development would entail large-scale onshore and offshore construction activities, which provide some particular hazards and risks that need to be managed. The Pilbara and adjacent waters are subject to cyclones, typically between November and March. These pose a hazard to both facilities and workforce that would require a specific management plan.

The Gorgon Venture and the contractors it would engage have extensive experience in construction and operation of offshore and onshore petroleum production, processing and transport.

All organisations involved in the development would be required to have comprehensive systems to manage health and safety hazards and minimise risks. A safety case would be developed and a safety management system put into place for the development.

The onshore gas processing facility will be operated under a major hazard control plan. This plan will identify and mitigate risks and provide for emergency response measures such as for a gas leak or fire.

12.12.2 Health and Safety Legislation

Western Australia and the Commonwealth have a comprehensive but complex suite of safety legislation covering all aspects of the Gorgon gas development. The regulatory system has been designed and modified in recent years to make it consistent with a co-regulatory objective-based approach. Legislation that would apply to the development is administered by two departments within the State jurisdiction and by one within the Commonwealth.

Petroleum safety legislation for Western Australia (onshore areas and offshore coastal waters) is administered by the Department of Mineral and Petroleum Resources. Pipeline legislation is also administered by this department. The principal Acts are the *Petroleum Safety Act 1999*, the *Petroleum Pipelines Act 1969*, the *Petroleum Act 1967* and the *Petroleum (Submerged Lands) Act 1982*.

The Department of Consumer and Employment Protection, through Worksafe Western Australia, administers the *Occupational Safety and Health Act 1984*, which would apply to the proposed gas processing plant on Barrow Island. However, the Barrow Island operations would also be subject to the *Explosives and Dangerous Goods Act 1961* and *Dangerous Goods (Transport) Act 1998*, which are administered by the Department of Mineral and Petroleum Resources.

Petroleum safety in Commonwealth waters adjacent to Western Australia, is governed by the *Petroleum (Submerged Lands) Act 1967* and administered by the Western Australian Department of Mineral and Petroleum Resources under a Joint Authority arrangement as the Designated Authority.

12.12.3 Community Safety and Health

The Gorgon gas development would not pose any significant risks to community safety and health. Nevertheless, the operator, ChevronTexaco would apply the same level of rigor to identification of hazards to the community and management of any risks as it would in the workplace.

The Gorgon Venture also recognises that the community would wish to be assured that its operations do not pose significant risks to the safety and health of the public. It would therefore communicate to the community what it is doing to ensure that risks are managed and minimised. The proposed onshore gas pipeline would have similar characteristics to existing gas pipelines and would be subject to similar safety management practices.

12.12.4 Workplace Amenity

The principal location of the Gorgon gas development on Barrow Island would create some unique issues in relation to workforce management. Barrow Island is remote from the mainland, contains an operating oilfield and is a Class A Nature Reserve. Movement of workers outside their accommodation and workplaces therefore would need to be restricted. During construction, when a peak workforce of up to 2200 would be located on Barrow Island and others would be working offshore, maintaining workplace amenity would present some challenges.

Potential issues relating to workplace amenity include:

- In common with existing offshore operations, all workers would be on fly-in fly-out rosters from Perth or the Pilbara during both project construction and operation. They would be absent from their family and friends for extended periods.
- Workers on, or in transit through Barrow Island would be subject to strict quarantine procedures to ensure that no flora or fauna is introduced to, or removed from the island. This would include requirements for signed undertakings by workers upon employment, and bag searches when arriving and departing.
- During construction, movement of workers on Barrow Island would be restricted to accommodation areas, workplaces and designated recreation zones. Workers would not be permitted to move elsewhere on the island. During operation, restrictions on workforce movement would also be put in place.



- The operating environment, particularly during construction, would necessitate that the Gorgon gas development's workplaces are alcohol-free. The Gorgon Venture would also apply a strict alcohol and drug-testing regime to all workers, plus related workforce management practices.
- During summer months, the climate in the Pilbara is typically hot and humid, and can create an uncomfortable working environment and a need to manage heat-related stress.

ChevronTexaco policies on its people, and environment, health and safety are all relevant to workplace amenity. In formulation of management responses, the company would apply these policies.

The unique situation in which the Gorgon gas development would be undertaken and the implications for workplace amenity would require comprehensive management responses. These may include:

- Inductions for workers to ensure that they understand, agree and comply with conditions applying to employment.
- Monitoring of compliance with employment conditions through a comprehensive workforce management regime, including general supervision, bag searches to ensure that quarantine and alcohol-free conditions are maintained, and drug and alcohol testing.
- Provision of high standards of accommodation, catering and services for workers, including facilities for exercise and active and passive recreation.
- Implementation of fly-in fly-out rosters that provide for reasonable periods at work and at home.
- Workplace management and facilities that provide adequate sun and heat protection, management of heat-stress and rest periods.

- Provision of telephone facilities to enable workers to communicate readily with family and friends. These may be either or both public telephone-type facilities and a mobile telephone system, although restrictions on workplace use of mobile telephones would need to be enforced to manage hazards during construction and operation.
- Provision of pastoral care services for both workers and their families to assist them in managing stress due to absence and any family "crisis" situations.

12.13 Community Amenity and Conservation and Environmental Value

12.13.1 Conservation Amenity

The Gorgon Venture recognises that the community places a high value on the conservation amenity of Barrow Island. It would carefully manage any impacts on the amenity of the island to ensure that the conservation amenity is maintained and that the community is satisfied that the values that it ascribes to Barrow Island are not compromised. Research into the Barrow Island environment would continue and the Gorgon Environment Foundation would foster relevant research and conservation activities. Details of conservation management responses are contained in Chapters 6, 7 and 9.

The Gorgon Venture would continue to communicate with the community about the management regimes that it has in place and the conservation outcomes it achieves.

2.13.2 Community Recreational Amenity

The unique conservation values of Barrow Island necessitate that access is restricted to workers on the current oilfield and people who have a working interest in the island's scientific and conservation values. Under government management plans, the general community does not have access to the island. The Gorgon gas development would not result in additional restrictions on community access.

To ensure public and workforce safety, boating and shipping exclusion zones would be established around offshore construction activities, while during operation, exclusion zones would be put in place around ship-loading facilities and ships. Similar exclusion zones operate in relation to the North West Shelf project.

12.14 Conclusions

Assessment of the social effects of the Gorgon gas development reveals that it would deliver social benefits to the Pilbara, to Western Australia as a whole and to the Perth region in particular. These benefits would stem from:

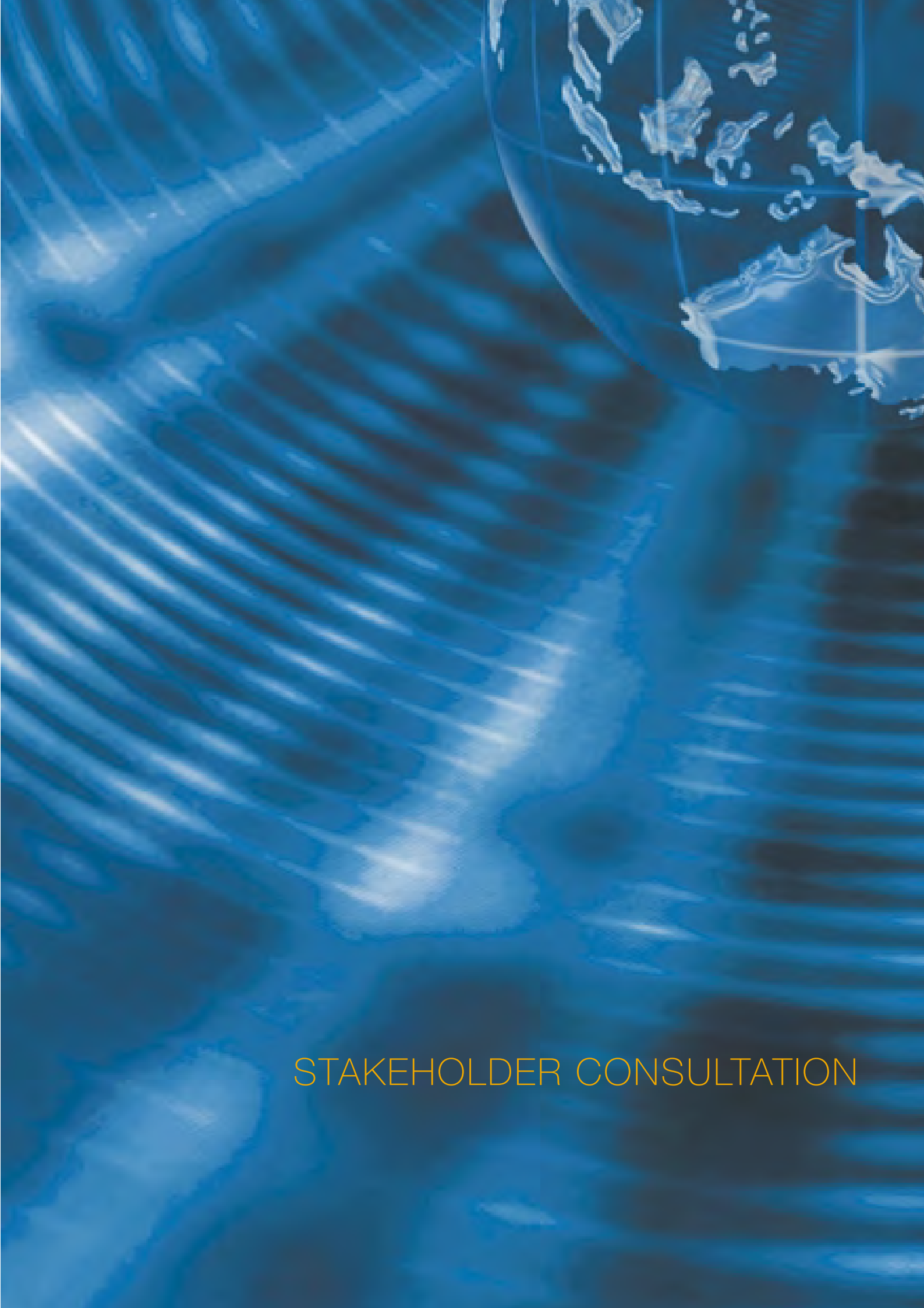
- the construction and operation of the development directly
- the stimulation it could provide greater gas-based industrial development in the Pilbara and other regions
- technology transfer and capacity building amongst local business that would help to further develop Western Australia as a petroleum services hub

Benefits include increased employment opportunities in the Pilbara and the rest of Western Australia, stimulation of regional development and population growth resulting in greater sustainability of regional communities, enhanced government services arising from economic growth and increased revenues, and greater community spending power. Regional businesses would be encouraged and assisted to participate in the development, and a program to employ Indigenous people would be implemented.

The Gorgon Venture, in partnership with other stakeholders, would take action to maximise the benefits for Western Australia and the Pilbara region. Such stakeholders include government, business groups and Indigenous organisations. Any increase in the demand for social infrastructure would be managed through cooperative action between the Gorgon Venture and government so that social amenity is not adversely affected by the development.

The Gorgon gas development could act as a stepping stone to the development of the Greater Gorgon area gas fields. This would further position the Pilbara as a major energy province. The development of the Greater Gorgon area gas fields would stimulate a diverse range of downstream industries in the region and the continued development of a petroleum service centre based in Western Australia.



The background is a deep blue with a complex, abstract pattern. In the upper right corner, a portion of a globe is visible, showing landmasses in a lighter blue. From the bottom left, a series of bright, white, diagonal light rays or streaks extend towards the center of the image, creating a sense of movement and depth. The overall effect is a high-tech, futuristic aesthetic.

STAKEHOLDER CONSULTATION

Comprehensive assessment of stakeholders' comments and questions about the proposed Gorgon gas development is critical to the success of the ESE Review process. As this requires the participation of both government and non-government stakeholders, the Gorgon Venture adopted a proactive approach to consultation throughout the lead-up and preparation of the ESE Review.

Engaging stakeholders also provided the Gorgon Venture with the opportunity to obtain valuable feedback and comment on the proposed development. It also clarified issues and sensitivities particular to the various stakeholder groups. The Gorgon Venture will continue to engage stakeholders and address comments and feedback throughout the ESE Review process.

As detailed in this chapter, there was general support for the ESE Review process and the level of public involvement in the process. Similarly, there was support for growth in the use of natural gas and the development of clean fuels. Development of the Gorgon gas reserves was also viewed as important, with stakeholders acknowledging both the direct and indirect economic benefits that the development could deliver. Some stakeholders, however, were opposed to further development on Barrow Island because of the significance of the conservation values.

13.1 Approach to Consultation

In the first half of 2001, the proponents of the Gorgon gas development initiated discussions with the Western Australian Government about the possibility of establishing a gas processing facility on Barrow Island. In November 2001, the Minister for State Development informed the Gorgon Venture that the State Government would consider the restricted use of the island, but only after an examination of the relevant environmental, social, economic and strategic ramifications. Throughout 2002, the proponents engaged with a broad range of government, industry and community stakeholders to discuss, at a strategic level, both the development proposal and the ESE Review process.

As explained in Chapter 2, the ESE Review process was developed to assess the proposed Gorgon gas development. In July 2002, the ESE Review Scoping Document was

publicly released followed by continued discussions with interested parties.

A wide range of organisations and key individuals have been consulted through briefing sessions, presentations, discussions and familiarisation tours to Barrow Island. The stakeholders are categorised in the following groups:

- State and Commonwealth Ministers
- Members of Parliament and their advisers
- State and Commonwealth government agencies
- local government representatives
- industry and regional development groups
- conservation organisations
- social groups
- local and regional community groups
- Indigenous groups
- employees and contractors
- research centres, including universities

- potential customers and suppliers
- media and general public

Discussion with stakeholders was a crucial element of the ESE Review process. It provided the Gorgon Venture with the opportunity to obtain valuable feedback and comment about the proposed development and the attitudes to the use of the island. It also clarified the issues and sensitivities of interest particular to the various stakeholder groups (see section 13.4).

The primary objectives of the stakeholder consultation conducted thus far were to:

- provide stakeholders with an overview of the proposed Gorgon gas development on Barrow Island
- outline the ESE Review process and encourage stakeholder participation in the process
- obtain feedback on the Gorgon gas development and identify key issues and sensitivities
- incorporate stakeholder feedback into development plans and the ESE Review

13.2 Key Stakeholders

13.2.1 State Ministers, Members of Parliament and Advisers

Briefings, meetings and discussions have been held primarily with members of Cabinet with direct portfolio responsibility and their key advisers. These include the:

- Premier
- Deputy Premier, Treasurer and Energy Minister
- Minister for State Development
- Minister for Heritage and the Environment

Several other Cabinet members have also been involved in discussions on the Gorgon gas development. The ESE Review Scoping

Document was distributed to Ministers with portfolio interests in the Gorgon gas development.

A number of briefings and discussions on the ESE Review process and the Gorgon gas development concept have been held for Members of Parliament from the Australian Labor Party, the Liberal Party, the National Party and the Greens WA.

The Premier, Deputy Premier, Minister for State Development, the Attorney General, Minister for Planning and Infrastructure, Member for Burrup and a number of Ministerial advisers visited the preferred development site on the island during a trip to the Pilbara for a Cabinet meeting in September 2002.

Several Ministerial advisers also visited Barrow Island as part of an Australian Petroleum Production Exploration Association of Australia (APPEA) sponsored tour of offshore oil and gas facilities in the State's north-west.

13.2.2 Commonwealth Ministers, Members of Parliament and Advisers

Meetings and discussions have been held predominantly with members of Cabinet with direct portfolio responsibility and their key advisers. These include the:

- Minister for Industry, Tourism and Resources
- Minister for Trade
- Minister for Heritage and the Environment

The Minister for Industry, Tourism and Resources and key members of his staff visited Barrow Island and were shown potential Gorgon gas development sites.



Advisers of other Commonwealth Government Ministers have been briefed on the Gorgon gas development. The Federal Opposition resource spokesperson has also been briefed on a number of occasions.

Presentations on the ESE Review process and the Gorgon gas development concept have been held for a number of Western Australian Federal Members of Parliament.

13.2.3 State Government Agencies

The Standing Inter-Agency Committee of Chief Executive Officers (SIAC) has a pivotal role in coordinating advice to State Cabinet on the ESE Review and assessment. For the ESE Review assessment, SIAC membership is made up of the heads of the:

- Department of Mineral and Petroleum Resources (MPR)
- Environmental Protection Authority (EPA)
- Department of Environmental Protection (DEP)
- Department of Land Administration (DOLA)
- Department for Planning and Infrastructure
- Department of Treasury and Finance
- Department of Conservation and Land Management (CALM)
- Policy Unit, Department of the Premier and Cabinet
- Conservation Commission of Western Australia
- Department of Indigenous Affairs (DIA)

SIAC has been involved in regular discussions on proposed plans for the Gorgon gas development and the ESE Review and assessment process. Senior representatives of the Gorgon Venture met SIAC members during their bi-monthly meetings to provide

updates on the development and obtain feedback from government agencies. Members of SIAC visited Barrow Island in November 2002 to examine possible Gorgon development sites. SIAC has a sub-committee of government officers working on the ESE Review process. Members of the sub-committee also toured Barrow Island.

MPR coordinated the preparation of guidelines for the socio-economic work in the ESE Review, liaising with a broad range of stakeholders, including relevant agencies and provided feedback to the Gorgon Venture. Likewise, with the release of the ESE Review Scoping Document, MPR coordinated discussions within government and provided feedback. Feedback was sought from all relevant portfolios. Apart from the agencies represented on SIAC, the Marine Parks and Reserves Authority, the Crown Solicitor's Office and the Office of Energy have indicated special interest or had an involvement in discussion on aspects of the development. The ESE Review Scoping Document was also distributed widely to State Government agencies.

Additionally, the Gorgon Venture has held briefings, updates and discussions directly with government agencies and boards with a central role in the management of Barrow Island, the Gorgon gas development and the ESE Review process. These agencies include the EPA, MPR, CALM, Conservation Commission, DEP, DPI, Department of Industry and Technology and the Policy Unit of the Department of the Premier and Cabinet, in particular the Sustainability Policy Unit (SPU). A number of briefings and discussions have been held with members of SPU and the Gorgon Venture has had close involvement in

the industry consultation phase of the development of the State Sustainability Strategy. Members of the Gorgon gas development team have also participated in SPU Sustainability Assessment Working Group meetings. Other agencies and advisory bodies who were briefed and provided feedback included Department of Fisheries, Western Australian Tourism Commission, WA Museum and the State Emergency Management Committee.

During 2002, regular contact was maintained with officers from CALM, EPA and MPR – the agencies most involved in the ESE Review process. Members of the EPA and Conservation Commission were also briefed at regular meetings and visited Barrow Island to examine the current oilfield operation and possible development locations.

Senior officers from several agencies visited Barrow Island to examine potential development sites.

13.2.4 Commonwealth Government Agencies

Throughout 2002, briefings, updates and discussions on the ESE Review process, Gorgon development plans and marketing development activities were held with officers of a number of Commonwealth agencies. They include:

- Department of Industry, Tourism and Resources
- Invest Australia
- Geoscience Australia
- Environment Australia
- Australian Greenhouse Office
- Department of Prime Minister and Cabinet
- Department of Foreign Affairs and Trade
- Australian Tax Office

While the ESE Review process is a State process, the Commonwealth Minister for the Environment has committed the Commonwealth to work closely with the Gorgon Venture and the Western Australian Government during the ESE Review process. Discussions were held at both senior and officer levels to ensure that Commonwealth agencies were aware of the development proposal and the work being undertaken as part of the ESE Review.

13.2.5 North West Regional Roadshow

In September 2002, representatives of the Gorgon Venture met and briefed key stakeholders in the State's north-west. Meetings included local government representatives, Indigenous groups, local and regional community groups and local Members of Parliament.

The visit was planned to coincide with the Pilbara Natural Advantages Conference, at which, as a conference sponsor, ChevronTexaco had a public display and distributed brochures detailing Gorgon gas development plans and the ESE Review process.

13.2.6 Local Government Representatives

Representatives of the two local government authorities that would be directly affected by a Gorgon gas development – the Shires of Ashburton and Roebourne – were briefed on proposals for the development, as was the Dampier Port Authority. Discussions were held as part of the regional roadshow to meet with and brief key stakeholders in the State's north-west.

13.2.7 Conservation Organisations

Representatives from a number of conservation organisations were consulted on the ESE Review process, the proposed Gorgon gas development concept and associated environmental issues. The Gorgon Venture briefed and received feedback from the Conservation Council of WA, the Marine and Coastal Communities Network, Greenpeace and the World Wide Fund For Nature (WWF) both at a State and national level. The Australian Conservation Foundation (ACF) was also briefed.

The Conservation Council distributed copies of the ESE Review Scoping Document to a number of its member organisations.

Members of the WWF visited Barrow Island to examine potential development sites and provided feedback on the environmental management practices currently employed and issues involved in a further development. A representative of WWF subsequently briefed representatives of the Gorgon Participants on key conservation issues WWF believed were associated with the proposal.

Harry Butler, a prominent conservationist with a long-standing association with Barrow Island, provided valuable feedback on the Gorgon gas development proposal. He was briefed on a number of occasions and he participated in the Conservation Commission visit to Barrow Island.

13.2.8 Local and Regional Community Groups

A number of local and regional community groups in the State's north-west were briefed on the proposed development plans.

Feedback was received from several groups and organisations including the Pilbara Development Commission, the Pilbara Area Consultative Committee, Karratha Business Enterprise Centre, and representatives of the Karratha and Districts Chamber of Commerce and Industry.

Meetings were held and feedback sought from the Western Australian Council of Social Service (WACOSS) and United Way.

13.2.9 Indigenous Groups

Meetings were held and feedback sought from a number of Indigenous organisations, including the Aboriginal and Torres Strait Islander Commission – South Hedland Regional Office, Office of Aboriginal Economic Development, Yamatji Land and Sea Council and Pilbara Aboriginal Chamber of Commerce.

13.2.10 Employees and Contractors

Employees and contractors of ChevronTexaco were regularly briefed on the proposed Gorgon gas development, through a series of internal announcements and news releases on the company's intranet site and via regular "townhall" meetings in Perth and on Barrow Island. A Gorgon noticeboard has also been established on Barrow Island for employees to obtain the latest news and information on the proposed development.

13.2.11 Potential Customers and Suppliers

Marketing activities are targeting potential gas customers in South Korea, China, Taiwan and the west coast of North America, as well as existing and new domestic gas customers in

Western Australia and the eastern states. Potential suppliers of a broad range of materials and services are also being briefed and preliminary discussions have commenced with the Industrial Supplies Office of Western Australia and the Department of Industry and Technology regarding supplier relationships.

13.2.12 The Media

On 28 June 2002, the Minister for State Development issued a media statement announcing details of the ESE Review process (Appendix 7). On the same day, Managing Director of ChevronTexaco Australia, Rhonda Zygocki, issued a statement on behalf of ChevronTexaco detailing plans to proceed with the ESE Review (Appendix 8). Since then, key members of the resources, business and political media at a State and national level have been briefed on the proposed Gorgon gas development and the ESE Review process.

Information and interviews with senior members of the Gorgon Venture development team were also provided, as requested, to journalists from international, national, State and regional media organisations that range from radio news to daily press, trade and industry publications.

A familiarisation visit to Barrow Island was conducted for representatives of the Australian Broadcasting Corporation, The West Australian, Dow Jones, Australian Associated Press, Business News, the Sunday Times and several freelance journalists.

Stories on the development and the ESE process have appeared in numerous international, national and State print and on-

line publications. ABC Radio has broadcast a number of items about the plans to develop Gorgon gas on Barrow Island.

13.2.13 General Public

Communication with the public has been centralised through a dedicated Gorgon gas development website – www.gorgon.com.au. The website is updated with the latest news announcements and contains information on background to the development and a copy of the ESE Review Scoping Document. An email address is also available on the website for general inquiries. The Gorgon Venture is committed to addressing the inquiries it receives.

The SES (strategic, economic and social) guidelines are also published on MPR's website (www.dme.wa.gov.au/majproj/html/Gorgon.htm) with an email address for feedback to the Gorgon Venture.

13.2.14 Industry

Briefings and presentations were given to key industry associations such as Australian Petroleum Production and Exploration Association (APPEA), Australian Pipeline Industry Association, Australian Gas Association, Australian Council for Infrastructure Development, and the West Australian Chamber of Commerce and Industry. A number of presentations were delivered at industry forums facilitated by APPEA, the American Chamber of Commerce, the Petroleum Club of Western Australia and at professional conferences.

Unions WA was also briefed on the development proposal.



13.2.15 Other Oil and Gas Companies

There are on-going discussions with oil and gas companies with interests in the area.

13.2.16 Universities

Meetings were held with The University of Western Australia, Murdoch University and Curtin University of Technology to investigate potential options to engage in research and development programs in the oil and gas industry in Western Australia.

13.2.17 Independent Review of State Government Stakeholder Consultation

An independent review found the consultations with Western Australian Government stakeholders to be extensive and well directed. It identified several additional stakeholders who, while not having a direct involvement in the issue of Barrow Island access, were likely to have an interest in the development of Gorgon gas. These stakeholders were subsequently included in the consultation process.

13.3 Distribution of the ESE Review Scoping Document

More than 150 copies of the ESE Review Scoping Document were distributed to stakeholders during 2002. The ESE Review document will be similarly distributed through direct mail and at meetings with stakeholders, as well as being included in presentations and made available for downloading on the Gorgon gas development website.

13.4 Issues Raised During Consultation

From the comprehensive consultation process,

a number of general and specific questions about the development of Gorgon gas were raised. These questions were categorised as strategic, environmental, social and economic, as summarised in the following tables. As outlined in the tables, and discussed in detail in the relevant chapters of this review, the Gorgon Venture has endeavoured to address each query.

The following list of each stakeholder group provides a brief summary of their key issues as identified from the consultation:

State and Commonwealth Ministers – issues included Barrow Island as a development location, development on a nature reserve, greenhouse gas emissions, net conservation benefits, habitat disturbance, regional development, gas-to-shore, land tenure, payment of royalties and local content.

State and Commonwealth Agencies – issues included Barrow Island as a development location, gas-to-shore, local content, social benefits, regional development, native title and cultural heritage, size of development footprint, net conservation benefits, greenhouse gas emissions and quarantine.

Local Government Representatives – local content, employment opportunities, impact of fly-in fly-out, benefits and training for local communities, and cost of social infrastructure.

Industry and Regional Development Groups – local content, ESE Review process, employment opportunities, regional development, importance of social benefits, cost of social infrastructure, business opportunities for local community and native title.

Conservation Organisations – Barrow Island as a development location, development on a nature reserve, ESE Review process, greenhouse gas emissions, quarantine, impact

on marine environment, stygofauna, habitat disturbance, endangered species, size of development footprint, size of workforce and net conservation benefits.

Local and Regional Community Groups – local content, employment opportunities, regional development, importance of social benefits, cost of social infrastructure, business opportunities for local community and native title.

Indigenous Groups – native title, cultural heritage management, employment and training opportunities and social benefits.

Employees and Contractors – employment opportunities and site location on Barrow Island.

Research centres, including Universities – net conservation benefits, benefits to “knowledge economy” and local content.

Social Groups – social benefits, cost of social infrastructure, size of workforce, impact of fly-in fly-out, local employment and training opportunities and health and safety.

TABLE 13-1

Environmental Issues and Concerns Raised by Stakeholders and the Gorgon Venture’s Response

Issue	Question Raised	Response
Greenhouse gas emissions	Is the disposal of Gorgon Gas CO ₂ content going to be responsibly managed?	The Gorgon Development Greenhouse Gas Strategy outlines a number of commitments to manage CO₂ emissions. Barrow Island also provides a unique opportunity to sequester CO₂ through re-injection of the reservoir CO₂. (Refer Chapter 8 – Greenhouse Gas Management)
	Are there going to be contingency arrangements if re-injection of CO ₂ from Gorgon gas proves technically infeasible?	The Gorgon Venture believes that reservoir CO₂ re-injection is currently a feasible option based on work to date. However, a contingency plan has been outlined in Chapter 8 and will be further developed prior to completion of the environmental impact assessment process and during the detailed design phase to provide a fall-back in the event that reservoir CO₂ re-injection ultimately proves infeasible. (Refer Chapter 8 – Greenhouse Gas Management)

Issue	Question Raised	Response
	Are other greenhouse gas options and offsets, beyond sequestration, being considered to provide benefits to the State?	The Gorgon Venture is committed to a range of options for CO₂ management including designing the production facilities to incorporate current best practices in thermal efficiency and greenhouse gas emission control. (Refer Chapter 8 – Greenhouse Gas Management)
Impact of re-injection	What impact would re-injection in the Dupuy reservoir have on reservoir pressure in nearby oilfield operation?	The Gorgon Venture does not consider that there will be an impact on nearby oil reservoirs. Initial studies on re-injection have indicated sufficient reservoir integrity. Liaison with MPR will continue to assess the behaviour of regional reservoir systems. (Refer Chapter 8 – Greenhouse Gas Management)
Quarantine	Could the level of industrial and workforce activity impact on the ability to guarantee quarantine measures on Barrow Island?	ChevronTexaco's environmental record on Barrow Island is well recognised internationally, no invasive species established or native species lost since oilfield operations commenced in 1964. The activities associated with the Gorgon development would increase the scale of the quarantine challenge. Stringent project-specific quarantine measures would be implemented throughout the construction phase and during operation of the development. (Refer Chapter 7 – Quarantine Management)
	Will construction of a jetty on Barrow Island increase quarantine risk?	The jetty is recognised as a key pathway of potential introduction of invasive species to Barrow Island. ChevronTexaco has commenced work on expanding and revising its existing quarantine program for Barrow Island and a number of quarantine management controls are being developed specifically for the jetty facility. (Refer Chapter 7 – Quarantine Management)
Impact on marine environment	Could the marine environment be threatened by shipping activity (e.g., ballast water)?	Adverse impacts to the marine environment would be avoided through the adoption and implementation of international best practice mitigation, management measures, such as designing and locating marine facilities to avoid significant marine areas and ballast water management. (Refer Chapters 4 – Alternatives Development Concepts, 5 – Development Concept for Barrow Island, 6 – Ecological Review, 7 – Quarantine Management)

Issue	Question Raised	Response
	Is there potential for significant environmental impacts (e.g. from dredging, construction of wharfage, transfer and transport of liquid hydrocarbons) within the proposed marine management area?	An extensive site selection process has led to location of development facilities to avoid significant or sensitive marine habitats. The Gorgon Venture would develop and implement a comprehensive environmental management plan to mitigate and/or manage potential environmental impacts to the marine environment. (Refer Chapter 6 – Ecological Review)
Stygofauna (subterranean aquatic fauna)	Will stygofauna be adversely impacted by the development?	Risks to stygofauna associated with the development were assessed as low by specialist, independent consultants. Stringent environmental management measures, such as location of plant site to avoid important habitat, would be implemented to minimise impacts to stygofauna. (Refer Chapter 6 – Ecological Review)
Habitat disturbance	Will construction and workforce activity impact on native fauna habitats?	Construction and workforce activity would be managed to ensure that significant fauna habitats are conserved. This would include establishment of restricted access areas and scheduling of works to minimise impacts to habitats during sensitive periods. (Refer Chapter 6 – Ecological Review)
Endangered species	Is the new development going to threaten the nationally and internationally significant fauna on Barrow Island?	ChevronTexaco has a very strong environmental record on Barrow Island, with no established invasive species or native species lost since oilfield operations commenced in 1964. The development would be designed and constructed to mitigate impacts to threatened fauna and their habitat. (Refer Chapter 6 – Ecological Review)
Site location on Barrow Island	Will development on Barrow Island be located within, and limited to, the current disturbance area on the island?	Although there will be some new vegetation clearance, the preferred development site is located adjacent to the existing tank farm and would maximise the use of previously disturbed areas. (Refer Chapters 4 – Alternatives Development Concepts, 5 – Development Concept for Barrow Island)

Issue	Question Raised	Response
Size of development footprint	Is 300 ha too large a proportion of the island for development and will associated environmental impacts be too great?	The current oilfield land clearance with the addition of the 300 ha would be less than five per cent clearance of the island. The Gorgon Venture considers that a development with a 300 ha limit would be sustainable and would not undermine the conservation values of the island. (Refer Chapters 4 – Alternatives Development Concepts, 5 – Development Concept for Barrow Island, 6 – Ecological Review)
Size of workforce	Could the workforce be too large to effectively manage associated environmental impacts?	During the construction period, workforce activity would be managed to ensure that environmental impacts were minimised. This would include measures such as the establishment of restricted access areas and scheduling of works to minimise impacts to habitats during sensitive periods. (Refer Chapters 5 –Development Concept on Barrow Island, 6 – Ecological Review)
Duration of construction period	Will the length of the construction period make it difficult to limit environmental impacts on the island?	Stringent workplace relations policies would be developed to minimise the impact of workforce activities on the environment. (Refer Chapter 12 – Social Review)
Net conservation benefits	Are net conservation benefits going to be significant and closely related to Barrow Island conservation values?	A net conservation benefit strategy has been developed. A process has been established for selection and implementation of projects that would provide net conservation benefits. One of the key criteria for evaluating potential net conservation benefits projects is that they should reflect key environmental values that are potentially impacted by development on Barrow Island. (Refer Chapter 9 – Net Conservation Benefit)
Nature reserve	Will Barrow Island, including any area set aside for a Gorgon development, remain a Class A Nature Reserve?	The proponents are proceeding on the basis that the status of the island would remain unchanged. (Refer Chapter 12 – Social Review)

TABLE 13-2**Strategic Issues and Questions Raised by Stakeholders and the Gorgon Venture's Response**

Issue	Question Raised	Response
Barrow Island as a development location	Are other locations, such as the Montebello Islands, Thevenard Island, the Burrup Peninsula or another mainland location a better option than Barrow Island for the development? Will the ESE Review comprehensively evaluate and assess alternative options?	Alternative gas processing facility sites have been thoroughly evaluated and assessed. Barrow Island access makes the proposed Gorgon gas development internationally competitive. Barrow Island also offers a unique opportunity to sequester CO₂ through re-injection of reservoir CO₂. (Refer Chapter 4 – Alternatives Development Concepts)
"Thin end of the wedge"	Will there be pressure for further industrial development on Barrow Island if access to Barrow Island is granted?	The Gorgon Venture would limit the gas processing operations on Barrow Island to an area of no more than 300 ha area and would not seek additional area. (Refer Chapter 5 – Development Concept on Barrow Island)
Development on a nature reserve	Could further development on Barrow Island conflict with its status as Class A Nature Reserve?	For 40 years, the oilfield and the nature reserve have successfully co-existed on Barrow Island. The Gorgon Venture is confident that the conservation values of Barrow Island would be protected through implementation of international best-practice environmental management measures. The Gorgon Venture is also committed to providing net conservation benefits if the development proceeds. (Refer Chapters 6 – Ecological Review, 7 – Quarantine Management, 9 – Net Conservation Benefit)
National security	How is the issue of national security being addressed by the Gorgon Venture?	The Gorgon Venture participants will continue to be involved in industry initiatives and work with the appropriate authorities on security issues.
Coordinated development of gas reserves	Is Government strategically developing the gas reserves off the Western Australian coast to ensure benefits are maximised for Western Australia?	Given the large volumes of gas offshore Western Australia, it is in the best interests of the State and nation to ensure access to the reserves. Commercialisation of gas reserves is expensive and driven by international market demand. Development would only proceed if a customer with a large-scale requirement for gas can be secured. (Refer Chapter 3 – Development Rationale)

Issue	Question Raised	Response
	Are gas reserves off Western Australia being developed in a sustainable manner?	The Gorgon Venture is committed to sustainable development. A set of specific sustainability principles and assessment criteria have been established and form the basis of a sustainability review of the Gorgon gas development concept. (Refer Chapter 14 – Sustainability Review)
The ESE Review process	Is the ESE Review publicly transparent and does it provide a statutory appeal mechanism?	The ESE Review process was established by the Western Australia State Government to provide an open and accountable process that encouraged involvement by all stakeholders. It includes two six-week periods for public comment. If in-principle approval is granted for the restricted use of Barrow Island, formal approval will still be required under the WA Environmental Protection Act and Commonwealth EPBC Act. (Refer Chapters 2 – ESE Review and Assessment Process, 13 – Stakeholder Consultation)
	Will pre-emptive or in-principle approval undermine the environmental assessment process?	The ESE Review process is an open and accountable process with two public comment periods, each of six weeks. Even if in-principle approval is granted, formal approval will then be required under the State EP Act and Commonwealth EPBC Act. (Refer Chapter 2 – ESE Review and Assessment Process)
	Is the ESE Review process setting an unrealistic precedent for other resource development projects?	The Western Australian Government is currently developing a sustainability policy to assess future projects of State significance within a sustainability assessment framework that takes into account social, economic and environmental impacts of proposed projects. The ESE Review process is appropriate for the scale of the Gorgon proposal and the issues it raises. (Refer Chapters 2 – ESE Review and Assessment Process, 14 – Sustainability Review)

Issue	Question Raised	Response
	Has there been an investigation and assessment of the acceptable limits to the development footprint, including an assessment of the total “ecological footprint”, of the existing Barrow Island oilfield operation?	The ecological footprint has been minimised. The additional 300 ha for the Gorgon development, together with the existing oilfield, would represent less than five per cent land clearance of the island. The Gorgon Venture believes this would not undermine conservation values of the island. (Refer Chapter 6 – Ecological Review)
	What criteria or terms of reference will be used by the State to assess the ESE Review, and will these be released publicly?	The Gorgon Venture has received guidelines from the Department of Mineral and Petroleum Resources. This issue has been forwarded to MPR. (Refer Chapter 2 – ESE Review and Assessment Process)

Table 13-3

Economic Issues and Concerns Raised by Stakeholders and the Gorgon Venture's Response

Issue	Question Raised	Response
Gas-to-shore	Will domestic gas be provided to the mainland to increase security of supply and competition in the domestic gas market?	Central to the Gorgon gas development concept is a gas processing facility to produce LNG and a domestic gas supply. Timing of domestic gas supply to the mainland will depend on securing a domestic market. (Refer Chapters 3 – Development Rationale, 5 – Development Concept on Barrow Island, 10 – Strategic Value)
Third party pipeline access	Will there be third party access to a gas pipeline built from Barrow Island to the mainland?	Third Party Access may need to be addressed in a State Agreement or relevant legislation. (Refer Chapter 5 – Development Concept on Barrow Island)
Local content	Are local businesses going to get an adequate share of the business flowing from the development?	The Gorgon gas development will actively support Australian industry participation as a core business policy. (Refer Chapter 10 – Strategic Value)

Issue	Question Raised	Response
Business opportunities for local communities	Is ChevronTexaco going to work with local businesses to provide contracting opportunities?	The Gorgon Venture will actively support Australian industry participation as a core business policy. It will work with government, regional business organisations and other resource companies to maximise opportunities for regional businesses in Pilbara and other regions. (Refer Chapters 10 – Strategic Value, 12 – Social Review)
Role of unions	Will unions be involved in employment negotiations and strategy?	A workplace relations strategy and program would be implemented as part of a specific project. (Refer Chapter 12 – Social Review)
Land tenure	Will there be single base tenure and sole proponent governance?	The tenure will not reduce the size of the Class A Nature Reserve. As operator of both the Gorgon gas development and Barrow Island oilfield, it is expected ChevronTexaco would retain overall management responsibility for island operations. (Refer Chapter 12 – Social Review)

Table 13-4

Social Issues and Concerns Raised by Stakeholders and the Gorgon Venture's Response

Issue	Question Raised	Response
Impact of fly-in fly-out	Will fly-in fly-out operations benefit local communities?	There is no permanent community on Barrow Island and it would be inappropriate to establish one on a Class A Nature Reserve. The Gorgon Venture is committed to ensuring that local communities would have opportunities to participate in the construction phase and supply of goods and services to the development. (Refer Chapters 11 – Economic Review, 12 – Social Review)
Benefits to local communities	Are local communities going to get an adequate share of the benefits flowing from the development?	The Gorgon gas development will actively support Australian industry participation as a core business policy. It will work with government, regional business organisations and other resource companies to maximise opportunities for regional businesses in Pilbara and other regions. (Refer Chapters 10 – Strategic Value, 12 – Social Review)

Issue	Question Raised	Response
Indigenous employment	Is the development going to provide opportunities for Indigenous training and employment?	The Gorgon Venture will provide opportunities for Indigenous people to work directly on the Gorgon gas development. To facilitate this process, the Gorgon Venture will participate in an Indigenous training and recruitment program in the Pilbara in partnership with Indigenous organisations, government and other companies. The Gorgon Venture will also implement a program to utilise Indigenous-owned businesses and foster their development. (Refer Chapter 12 – Social Review)
Cost of social infrastructure	Will there be investment in social infrastructure for the local community?	Social infrastructure requirements have been identified and assessed. Existing infrastructure is considered adequate, however, if additional infrastructure becomes necessary, the Gorgon Venture would examine how it could participate in its development. (Refer Chapter 12 – Social Review)
Local employment opportunities	Will there be opportunities for local employment?	The Gorgon Venture would seek to employ a construction and operation workforce predominantly from Western Australia, including regional areas. (Refer Chapter 12 – Social Review)
Training for local communities	Is the development going to provide training opportunities for local employment?	The Gorgon Venture would provide education and training to enable participation by Pilbara residents in the project's workforce. The Gorgon Venture will participate in an Indigenous training and recruitment program in the Pilbara in partnership with Indigenous organisations, government and other companies. (Refer Chapter 12 – Social Review)
Benefits to "Knowledge Economy"	Will the Gorgon gas development contribute to the "knowledge economy" through research and development activities in the resource sector?	The Gorgon development could benefit the Western Australian economy by building capacity in regional business, transfer of technology and skills, and further development of Western Australia as a major petroleum service, research and development centre. (Refer Chapter 10 – Strategic Value)
Importance of social benefits	Will social benefits and impacts be as well addressed as the economic and environmental aspects	Social impacts and benefits have been addressed in the ESE Review and considered along with environmental and economic aspects of the development. (Refer Chapter 12 – Social Review)

Issue	Question Raised	Response
Industrial tourism	Will there be opportunities for industrial tourism on Barrow Island?	Barrow Island is a Class A Nature Reserve. Any tourism initiatives would need to be developed in consultation with CALM and the Conservation Commission of Western Australia, and would need to be addressed as part of the project's implementation plan.
Native title and Indigenous heritage	Are potential native title and cultural heritage issues identified?	There are no native title claims over Barrow Island or the surrounding waters. The ESE Review includes a comprehensive assessment of cultural heritage issues relevant to the Gorgon gas development. (Refer Chapter 12 – Social Review)
Cultural heritage	What level of cultural heritage awareness training is planned for the proposed workforce?	Cultural Heritage Awareness training would be one of the elements, along with Health, Safety and the Environment, to be addressed in the induction process for the workforce. (Refer Chapter 12 – Social Review)
Social sustainability	What is ChevronTexaco's record of social sustainability in its other operations around the world?	ChevronTexaco has a successful history of developing partnerships with the community in its global operations.

As the Tables above indicate, the process of consultation with a broad range of stakeholders with different interests has provided the proponents with valuable input and feedback on the ESE Review process, the Gorgon gas development and the use of Barrow Island. It has led to a more complete understanding of stakeholder concerns and expectations. As a result, these issues are better addressed in the ESE Review.

13.5 Consultation Plan for ESE Review

The following processes will be used to disseminate the ESE Review and consult with stakeholders:

- distribution of the ESE Review to an extensive stakeholder list
- media statements, briefings and interviews
- provide the latest information on the Gorgon website, including the ESE Review, appendices and associated background material
- meetings and feedback sessions to discuss the ESE Review with State and Commonwealth government agencies
- meetings and feedback sessions with key stakeholders, environmental, community and interest groups
- roadshow presentations in key regional areas
- presentations at industry forums and conferences
- familiarisation trips to Barrow Island
- workshops

The Gorgon Venture will continue to meet with stakeholders, answer questions and seek feedback throughout the ESE Review process. There are two six-week public comment periods during the ESE Review process. The first public review period will provide stakeholders with an opportunity to provide formal input into the ESE Review and comment on its findings. The Gorgon Venture will then address these submissions. The second consultation period will give the public the opportunity to provide feedback on the agency bulletins and advice.

A comprehensive consultation plan has been developed to engage key stakeholders and obtain their feedback following the release of the ESE Review and through all stages of the development.

The objectives of the consultation plan are to:

- outline the proposed Gorgon gas development on Barrow Island and the associated economic, social and conservation benefits
- seek stakeholder feedback on the ESE Review document
- encourage stakeholder participation in the public submission process

The feedback gained from the stakeholder engagement will be used as an additional input to the submissions received through the formal public comment period and will assist the Gorgon Venture in formulating their responses and addressing the issues raised in these submissions.

13.6 Conclusions

There was general support for the concept of the ESE Review and the level of public involvement in the process, also for growth in the use of natural gas and the development of clean fuels. Development of the Gorgon gas reserves was also viewed as important, with stakeholders acknowledging both the direct and indirect economic and social benefits that the development could deliver.

There were a number of stakeholders opposed to further development on Barrow Island. Concerns included protecting the Class A Nature Reserve status, the impact on the habitat, fauna and the marine environment, quarantine during the construction, greenhouse gas emissions, securing gas supplies for Western Australia, and ensuring the ESE Review process was transparent and appropriate. Concerns raised by stakeholders have been addressed in the ESE Review and the Gorgon Venture will continue to work to address further stakeholder concerns.

There has been considerable support and encouragement for the application of sustainability principles by the Gorgon Venture.





SUSTAINABILITY REVIEW

In a progressive step toward formally assessing the sustainability of the proposed Gorgon gas development, the Western Australian Government in consultation with the Gorgon Venture developed the Environmental, Social and Economic Review process. The ESE Review integrates the environmental, social, economic and strategic considerations associated with the Gorgon gas development for assessment by the Western Australian Government. This process is a first in Western Australia and one of the few sustainability assessment processes documented internationally for a specific development.

The Gorgon Venture is committed to sustainable development and has established a set of specific sustainability principles and assessment criteria for the proposed Gorgon gas development. These are based on widely accepted sustainability principles and the key concerns raised by the stakeholders consulted about the proposed development.

The sustainability review presented in this Chapter demonstrates that the proposed Gorgon gas development concept meets the principles of sustainable development, is consistent with the direction of the State, and would provide economic, social and environmental benefits to the Pilbara, Western Australia and Australia.

14.1 The Concept of Sustainability

Various definitions for the concept of sustainable development have emerged over the last three decades. In 1987, the Brundtland Report, *Our Common Future*, triggered worldwide debate on the issue of sustainable development by defining it as:

“...development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Consideration of the needs of future generations highlights that development requires a long-term view with balance between short and long-term goals.

The concept of sustainable development progressed rapidly after first publication of

the Brundtland Report. In 1992, the United Nations Conference on Environment and Development (commonly referred to as the Earth Summit) in Rio de Janeiro produced a global strategy, known as *Agenda 21*, to achieve sustainable development. More than 178 governments, including Australia, endorsed the strategy. A wide variety of groups also embraced the concept including businesses, various levels of government and international organisations such as the World Bank – albeit with their own particular interpretation. Despite wide diversity in the definition and interpretation of the concept of sustainability, the core objectives remain the same. These objectives are to:

- enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations

- value and protect the environment
- ensure natural resources are developed without compromising the ability of future generations to meet their needs
- consider the economic, social and environmental implications of decisions and actions in an integrated way

In 1989, the Australian Government initiated public discussion on a proposal to develop a *National Strategy for Ecologically Sustainable Development* (NSESD). The discussion was extensive and involved consultation and negotiations between key interest groups from industry, the community, conservation groups, scientific organisations and all levels of government. The process extended over a period of two years from 1990 to the end of 1992. All three tiers of government in Australia adopted the NSESD in December 1992 at a meeting of the Heads of Government of each jurisdiction (Council of Australian Governments 1992).

Since 1992, sustainable development objectives have been incorporated increasingly into the policies and programs of Australian governments. The current Western Australian Government, elected in February 2001, made a strong commitment to sustainability and developed a sustainability strategy titled *“Focus on the future: The Western Australian State Sustainability Strategy”* (Department of the Premier and Cabinet 2002a). The Strategy defines sustainability as:

“Meeting the needs of current and future generations through simultaneous environmental, social and economic improvement.”

This definition reflects the widely accepted view that integrating environmental, social and economic development objectives is the key to achieving sustainable development (Devuyst 1999; Organisation for Economic Cooperation and Development (OECD) 2001).

The Western Australian Government established a Sustainability Policy Unit within the Department of the Premier and Cabinet to coordinate development of the State Sustainability Strategy. The process to develop the Strategy engaged government departments, the community and business (Department of the Premier and Cabinet 2002b). A consultation paper was released in December 2001 to assist interested individuals and groups to prepare written submissions on the Strategy. The draft State Sustainability Strategy was released for further public comment in September 2002.

14.2 Sustainability Review and the Gorgon Gas Development

Development of the Gorgon gas field offers substantial economic and social benefits at national, state and regional levels. However, its remoteness and the need to construct a gas processing facility on Barrow Island present commercial, technical and environmental challenges.

In a letter dated 20 November 2001, the Western Australian Minister for State Development advised the Gorgon Venture that the Government is prepared to consider the restricted use of Barrow Island for the initial development of the Gorgon gas field after



relevant environmental, social, economic and strategic concerns were reviewed and the results made publicly available.

In Western Australia, there are well-established, effective processes for evaluating the environmental acceptability of a development proposal through the *Environmental Protection Act 1986* (EP Act).

However, there is no formal, transparent process to assess the relationship between the environmental, social and economic costs and benefits of significant development proposals. The ESE Review process was therefore established for the Gorgon gas development to provide an appropriate process and reporting structure.

During the development of the ESE Review process, both the Gorgon Venture and the Western Australian Government recognised that the process should consider simultaneously the environmental, social, economic and strategic implications of the proposed development. Review of those implications would equate to a review of the sustainability of the proposed development.

In a demonstration of its commitment to sustainable development, the Western Australian Government recently released a consultation draft of "The Western Australian State Sustainability Strategy" that outlines a proposed Sustainability Framework. Formal adoption of a sustainability assessment process under this framework would be a significant step forward in implementing the concept of sustainability to resource development projects in Western Australia.

This process is consistent with the Keating Review of the Western Australian project development approvals system. That Review recommended that development proponents be required to develop a sustainability statement that addresses the economic, social and environmental impacts of a project (Independent Review Committee 2002).

The Gorgon gas development concept will be the first proposed resource development subjected to a sustainability review process in Western Australia.

14.3 The Gorgon Venture Approach to Sustainability

While there is widespread acceptance of the need to achieve sustainable development objectives, there is no consensus on the approach to monitoring and assessing performance in achieving these objectives (Hardi and Zdan 1997). As a consequence, there is currently no standard or generally accepted method or system of assessing the sustainability of development proposals or existing operations.

The Western Australian Government and the Gorgon Venture therefore worked together and agreed that a review of the sustainability of the proposed Gorgon gas development must be:

- acceptable to a wide range of stakeholders
- specific to the Gorgon gas development
- relatively simple and easy to apply compared to other assessment models
- consistent with current Western Australian, Australian and international sustainability strategies

The Gorgon Venture recognises that the area of interest is a Class A Nature Reserve which has been set aside to protect an array of plants and animal species which have been impacted upon by various activities on the mainland. It is within this context that the sustainability of Gorgon gas development needs to be considered.

The Gorgon Venture's approach to sustainability recognises the status and purpose of Barrow Island as a Class A Nature Reserve and has used this as a focal point in its consultation with stakeholders on environmental, social and economic issues (see Chapter 13).

This consultation provided important feedback and comment on the Gorgon gas development concept. It also identified particular issues and sensitivities of various stakeholder groups. As a result, the Gorgon Venture was able to incorporate stakeholder feedback into development plans and the ESE Review document generally. The Gorgon Venture believes that the Gorgon gas development sustainability principles and criteria also incorporate the key interests and concerns of stakeholders that were raised during the consultation process.

The Gorgon Venture adopted a principle-based methodology and established a set of development-specific principles and criteria to test the sustainability of the proposed development concept. This approach is similar to that developed for the mining industry in North America by the International Institute for Sustainable Development (Mining Minerals and Sustainable Development 2002).

Establishment of the Gorgon gas development sustainability principles and criteria involved three key steps:

1. Establishment of development-specific sustainability principles that are acceptable to stakeholders; and are consistent with the core objectives and values of sustainable development.
2. Development of assessment criteria that reflect all the requirements of each sustainability principle.
3. Development of measurement statements which allow an evaluation of whether the development concept meets the assessment criteria.

The result is a three-tiered review process with ten principles and associated criteria and measurement statements.



14.4 Sustainability Principles

In addition to outlining the key requirements for achieving sustainability, the Gorgon gas development sustainability principles and criteria cover the fundamental environmental, social and economic considerations required to comprehensively review the sustainability of the development. The Gorgon gas development sustainability principles, outlined in Box 14-1, are based on the:

- guiding principles of the Western Australian Government's Draft Sustainability Strategy (Western Australian Department of the Premier and Cabinet 2002a)
- core objectives and principles of the Australian Government's National Strategy for Ecologically Sustainable Development (Ecologically Sustainable Development Steering Committee 1992)
- objectives of the OECD's Environmental Strategy for the First Decade of the 21st century (OECD 2001)
- Bellagio Principles (Hardi and Zdan 1997)¹

¹ Set IISD principles which serve as guidelines for the choice and design of sustainability indicators

BOX 14-1

Gorgon Sustainability Principles

Clean Energy Supply	The development will meet Western Australian, Australian and international demands for competitive, clean energy sources. It will also enhance energy competition and security of supply in Australia.
Economic Benefit Delivery	Current and future economic growth in Australia will benefit from the development. It will foster economic growth and business development, generate government revenue, provide commercial returns to the Gorgon Venture and contribute to the wealth generated by Australia's natural resource base.
Biodiversity and Ecological Integrity Protection	The Gorgon gas development will not disrupt ecological structure and function, nor will it result in a loss of biological diversity on Barrow Island.
Social Equity and Community Well being Enhancement	Communities will benefit from improved quality of life and well-being resulting from contributions of the Gorgon gas development such as creation of jobs.
Future Generations Commitment	The Gorgon gas development will meet the needs of the present generation and assist future generations to meet their needs.
Efficient Resource Use	International best practice and continual improvement principles will be applied to efficiently manage resources and wastes.
Precautionary Principle Application	Where there are threats of serious or irreversible damage, lack of full scientific certainty will not be used as a reason for postponing cost-effective measures to prevent environmental damage.
Community Respect and Safeguards	The Gorgon Venture will respect community values, community diversity and safeguard the well-being of the public and workforce throughout the development.
Stakeholder Engagement	The Gorgon Venture will seek the views of stakeholders and take their interests into account throughout development of the Gorgon gas fields.
Accountability	The Gorgon Venture is committed to the highest standards of governance and accountability. It will report regularly to the community on the sustainability performance of the development.

The Gorgon gas development principles reflect the values and tenets of sustainability that the Western Australian Government's principles encompass. Principles specifically applicable to a large gas development were adopted, with some modification.

14.5 Sustainability Criteria

The sustainability criteria outline specific requirements that the development must meet in order to be consistent with the Gorgon gas

development sustainability principles (see below). Following each criterion is a measurement statement that outlines how the Gorgon Venture will meet the requirements. Each of these statements is based on the findings of the environmental, social and economic studies that are presented in Part II of this ESE Review.

Principle 1 – Clean Energy Supply

The development will meet Western Australian, Australian and international demands for competitive, clean energy sources. It will also enhance energy competition and security of supply in Australia.

Sustainability Criterion 1.1: Market Demand for Energy

The Gorgon gas development will supply clean gas energy to Western Australian, Australian and international markets.

International gas supply: The development will supply LNG on a world-scale and produce gas for the next generation of gas-based industries. The development will access expanding energy markets throughout the world, particularly in the Asia-Pacific region.

State and national supply: The development will add a major supply of gas to Western Australia, and potentially to the eastern-state markets. It will meet demand for competitively priced gas for the next phase of major industrial development.

Sustainability Criterion 1.2: Competition

The Gorgon gas development will increase gas availability and competition in the Australian market. This will enhance Australia's international competitiveness.

Increased competition in the gas market: Modelling indicates that on a state-wide basis over 10 years, the development would reduce delivered prices to Western Australian domestic gas consumers by between two and seven per cent from prices expected without the development.

Sustainability Criterion 1.3: Security of Supply

The Gorgon gas development will provide an additional major gas supply hub, connected to substantial reserves for gas supply in Western Australia.

Alternative supply: The development will deliver an alternative major source of gas for export industries and domestic use.

Additional gas transmission infrastructure: The Gorgon gas reserves are sufficient to support the expansion of gas pipeline infrastructure from the Pilbara region to the south-west of Western Australia.

Principle 2 – Economic Benefit Delivery

Current and future economic growth in Australia will benefit from the development. It will foster economic growth and business development, generate government revenue, provide commercial returns to the Gorgon Venture and contribute to the wealth generated by Australia's natural resource base.

Sustainability Criterion 2.1: Economic Growth

The Gorgon gas development will measurably enhance the economies of Australia, Western Australia and the Pilbara in both the short and long-term.

Contribution to economic growth: The development will make a major contribution to national and state economic growth including: direct contribution of approximately \$11 billion in investment expenditure over the next twenty years, and increased Gross State Product and Gross Domestic Product of \$650 million and \$1.5 billion respectively by 2006.

Benefits to the Pilbara: The development will maximise regional, social and economic benefits by direct investment and leverage of existing programs in the Pilbara region to strategically build capacity and partnerships in regional business.

Sustainability Criterion 2.2: Profitability

The Gorgon gas development will create profitable investment opportunities for the Gorgon Venture and for other industrial gas projects in Australia that depend on gas as a feedstock.

Commercial returns: The development will deliver commercial returns to the Gorgon Venture on a long-term basis. It will also enhance Australia's reputation as an attractive and secure country for capital investment.

Competitive gas: The development will provide a competitive gas supply that will underpin the viability of other industrial gas developments.

Sustainability Criterion 2.3: Government Revenues

The Gorgon gas development will generate substantial revenues to the Western Australian and Commonwealth Governments.

Commonwealth revenue: Estimated government revenues will include Commonwealth resource and company tax payments of \$17 billion in nominal terms over the life of the development. The Commonwealth will receive a further \$2 billion from additional economic activity generated by the development.

State revenue: The main impact on revenue will come from additional net payroll tax generated from employment associated with the development. Overall, state revenue will grow by \$160 million (in current dollars) over the life of the development.

Local government revenue: As a result of development, local government in the Pilbara is expected to receive increased revenue from increased industrial development, economic activity and additional dwellings constructed in the region.

Sustainability Criterion 2.4: Business Development

The Gorgon gas development will encourage the development of new value-adding industries and will stimulate growth of a diverse range of businesses that service it directly and indirectly.

Industry growth: The development will stimulate a range of industries that rely on the availability of abundant, competitive supplies of gas. New technologies from the development will also stimulate capacity-building.

Local content: The Gorgon Venture will provide full, fair and reasonable opportunity for Australian industry to supply goods and services to the development. There are expected to be opportunities for Western Australian suppliers to deliver a significant proportion of the labour, goods and services required.

Principle 2 Cont.

Diversification: The development will stimulate diversification in businesses that service it directly and indirectly. This will occur through promotion and support of: increased business capacity and skills; adoption of new technologies and research and development in petroleum production; gas processing; and environmental management.

Principle 3 – Biodiversity and Ecological Integrity Protection of Barrow Island

The Gorgon gas development will not disrupt ecological structure and function, nor will it result in a loss of biological diversity on Barrow Island.

Sustainability Criterion 3.1: Maintenance of Biodiversity

The Gorgon gas development will not result in the loss of genetic diversity, populations, native species, or ecosystems on Barrow Island, or the surrounding marine environment. It will also avoid the introduction of invasive species – including pathogens.

Biodiversity protection: The Gorgon Venture is confident that the loss of genetic diversity, populations, native species and ecosystems can be avoided through the adoption and implementation of specific monitoring, mitigation and management measures. Measures include: location and design of the gas processing facility to avoid threatened species, significant habitat and restricted vegetation communities, and use of best practice pipeline construction methods to avoid direct disturbance to significant fauna habitat.

Quarantine: Stringent quarantine measures will be implemented to prevent the introduction of exotic plants, animals or pathogens to Barrow Island and the surrounding marine environment. Key aspects of the quarantine management program include: education, awareness and accountability; enhancement of a management plan for the preparation and shipment of goods, personnel and modules to Barrow Island; continual dedicated monitoring and reporting procedures for quarantine; and implementation of an emergency response plan if a breach is identified on Barrow Island.

Sustainability Criterion 3.2: Development Area

The Gorgon gas development will not clear more than 300 ha of land on Barrow Island.

No net increase in cleared land: The Gorgon gas development will occupy an area no more than 300 ha of Barrow Island. The Gorgon Venture will manage the development to minimise increasing the overall area of cleared land on the island by: ensuring that, wherever possible, infrastructure is sited in pre-existing cleared or disturbed areas; and ensuring that retention of uncleared areas of land within the plant site and along the pipeline corridor are maximised wherever practicable.

Sustainability Criterion 3.3: Protected or Restricted Communities

The Gorgon gas development will not adversely impact on restricted vegetation communities or significant marine habitats.

Mitigation and management: Adverse impacts to restricted vegetation communities and significant marine habitats can be avoided through the adoption and implementation of appropriate mitigation and management measures. Measures include: locating the MOF and jetty to avoid marine areas of particular productivity or conservation significance, designing the MOF and jetty to minimise possible effects to longshore sediment transport, and conducting detailed botanical surveys to avoid areas of important/restricted vegetation communities.

Site location and layout: The gas processing facility site was selected to minimise impact on restricted communities. This site can also incorporate undisturbed corridors that will allow fauna to move through the site.

Principle 4 – Social Equity and Community Well-being Enhancement

Communities will benefit from improved quality of life and well-being resulting from contributions of the Gorgon gas development such as creation of jobs.

Sustainability Criterion 4.1: Shared Benefit

The Gorgon gas development will benefit investors, the development workforce, the Australian people, the Western Australian and Australian Governments and development customers.

Many beneficiaries: The development will have many beneficiaries: the Gorgon Venture will receive commercial returns; the development workforce will benefit from increased employment opportunities, increased income and skills transfer; the Australian people will benefit through increased security of gas supply, greater competition and lower energy prices; the Western Australian and Australian Governments will receive direct revenues; and gas customers will benefit from increased security of supply and lower energy prices.

Sustainability Criterion 4.2: Indigenous Australian Community

The Gorgon gas development will benefit the Indigenous Australian community through direct engagement in employment and business opportunities.

Training and recruitment: The Gorgon Venture will implement an Indigenous training and recruitment program. It will provide appropriate training, support and other opportunities; and engage Indigenous Australian businesses that cater to the resource sector.

Participation in development programs: The Gorgon Venture will actively seek opportunities to participate in and support government Indigenous development programs, particularly programs that focus on development of partnerships which provide improved economic and social outcomes for Indigenous Australians throughout the Pilbara region.

Sustainability Criterion 4.3: Job Creation

The Gorgon gas development will create significant direct and indirect short and long-term employment opportunities for local, state and national workforces.

Direct employment: Approximately 2900 people will be employed on the Gorgon gas development at the peak of construction. In addition, approximately 600 employees will be required for operation of the development (both on and off the island), with additional personnel employed in Perth and other locations. It is estimated that more than 10 per cent of the workforce will be sourced from the Pilbara.

Associated employment: It is estimated that an additional 6000 people will be employed in Australia as a result of the wealth generated by the development in other areas of the economy – 1700 of these jobs will be in Western Australia.

Sustainability Criterion 4.4: Community Well-being

Community well-being will be sustained by effective identification and management of potential impacts on people's way of life, their culture or their communities.

Management of social impacts: The Gorgon Venture will actively seek to address impacts to the community through measures such as: providing an employee and family support program; consulting with communities to identify their needs; and providing high standards of accommodation, catering and services for workers.

Social investment: The development will act as a catalyst to provide, in partnership with the Government, regional education, training and employment opportunities.

Principle 5 – Future Generations Commitment

The Gorgon gas development will meet the needs of the present generation and assist future generations to meet their needs.

Sustainability Criterion 5.1: Future Needs

The Gorgon gas development will contribute to the ability of future generations to meet their economic and technological needs.

Long-term benefits: The development will result in numerous long-term benefits to the community including: development of new gas-based industries, enhancement of the petroleum industry service sector, transition to cleaner fuels, and economic benefits which span several decades.

Sustainability Criterion 5.2: Technology and Expertise

The Gorgon gas development will stimulate research and development, potentially leading to new technology and enhanced expertise.

Research and development opportunities: The development provides an opportunity for Western Australia and the Pilbara region to enhance research and development in areas such as petroleum production, sub-sea technology, gas processing, and develop a centre of excellence for geological sequestration and environmental management.

Technology transfer: The development will employ leading-edge technology giving the opportunity for technology transfer to, and capacity building in, local enterprises.

Sustainability Criterion 5.3: Acceptable Legacy

The Gorgon gas development will result in beneficial legacies, such as net conservation benefits, and will avoid legacies that may burden future generations.

Beyond best practice: The Gorgon Venture is committed to achieving the highest standards of performance in all aspects of the planning, design, construction and operation of the development. The values, business strategies and field operations of the Gorgon Venture would reflect the highest possible standards, based on a long history of going beyond local requirements to protect people and the environment.

Commitment to rehabilitate: The Gorgon Venture will progressively rehabilitate areas of Barrow Island and the surrounding marine environment which are affected by the development.



Principle 6 – Efficient Resource Use

International best practice and continual improvement principles will be applied to manage resources and wastes efficiently.

Sustainability Criterion 6.1: Energy Efficiency

The development will be designed and operated at a level of efficiency which is best practice among comparable plants in the world. It will also seek opportunities for continuous improvement.

Efficient design and operation: The management of energy through the LNG processing plant and supporting utilities will be an integral part of the design process and operation of the development. Selection of technology and equipment during detailed design will take into account energy efficiency and greenhouse gas emissions.

Plant optimisation and control: The Gorgon Venture will continue to review opportunities to improve the efficiency of the plant throughout operations. Once the LNG processing plant is operational, day-to-day management will focus on achieving the highest levels of efficiency possible through plant optimisation and control.

Sustainability Criterion 6.2: Recovery Efficiency

The development will utilise best practice to optimise recovery of natural gas and associated liquid hydrocarbons from the underground reservoirs and to maximise efficiency in the production and transportation of those resources to the market.

Best practice and technology: The Gorgon Venture will adopt best practice recovery techniques and advanced technology to optimise recovery efficiency and extend the economic life of the development.

Sustainability Criterion 6.3: Waste and Emissions Management

The Gorgon Venture will adopt international best practice management of wastes and emissions.

Best practice management: The Gorgon Venture is committed to adopting and implementing current international best practice management waste and emission measures for all aspects of the Gorgon gas development and would seek further opportunities for waste and emissions reductions throughout the life of the development.

Principle 7 – Precautionary Principle Application

Where there are threats of serious or irreversible damage, lack of full scientific certainty will not be used as a reason for postponing cost-effective measures to prevent environmental damage.

Sustainability Criterion 7.1: Best Practice Management

The Gorgon Venture will adopt best practice management for planning, construction, operation and decommissioning of the development, including the implementation of a comprehensive greenhouse gas management plan.

Environmental management system: A specific Gorgon gas development Environmental Management System (EMS) will be developed for construction, operation and decommissioning. The EMS will be the key tool in managing potential impacts and risks and ensuring that environmental responsibilities are fulfilled in a manner that reflects best practice environmental management.

Greenhouse gas management plan: The LNG facility on Barrow Island will be the most greenhouse gas efficient LNG plant in the Asia-Pacific region and one of the most efficient in the world. This will be achieved through the implementation of a comprehensive greenhouse gas management plan by the Gorgon Venture.

Sustainability Criterion 7.2: Research

The Gorgon Venture will initiate, participate in and support, scientific research programs regarding issues relevant to the development.

Stimulus for research and development: The Gorgon gas development will provide a stimulus for the establishment of a range of strategic research programs. Research will be initiated and supported primarily through programs such as the net conservation benefits program and the greenhouse gas management plan.

Sustainability Criterion 7.3: Monitoring

The Gorgon Venture will monitor potential adverse effects of the Gorgon gas development and strive to minimise these effects.

Monitoring program: A comprehensive environmental inspection, monitoring and auditing program will be undertaken to assess and record whether construction and operation activities are delivering the expected outcomes. These processes shall ensure that construction and operation activities are undertaken in a manner that is in keeping with the Gorgon Venture commitment to best practice management.

Sustainability Criterion 7.4: Risk Assessment, Risk Management and Emergency Preparedness

Best practice risk assessment, risk management and subsequent emergency response procedures will be in place and regularly tested for all activities which have the potential to cause environmental harm or threaten the safety of the workforce or the public.

Risk assessment: Thorough risk assessments will be undertaken to ensure that all risks and hazards associated with construction and operation are identified, assessed and appropriately managed.

Emergency response: A Gorgon gas development emergency management and response system will be developed and implemented. The system will reflect best practice procedures and will guide preventative management and prescribe actions to minimise the impacts of accidents or incidents in the case of an emergency.

Principle 8 – Community Respect and Safeguards

The Gorgon Venture will respect community values, community diversity and safeguard the well-being of the public and workforce throughout the development.

Sustainability Criterion 8.1: Health and Safety

The Gorgon Venture will implement a world-class safety system that will protect public health and safety, strive for incident-free operations to prevent injuries, illnesses and accidents to personnel.

Best practice health and safety: The Gorgon Venture will implement best practice health and safety policies and practices in constructing and operating the Gorgon gas development. ChevronTexaco's existing systems will be adapted to the Gorgon gas development.

Sustainability Criterion 8.2: Cultural Heritage

No sites of archaeological or cultural significance will be adversely impacted by the development.

Cultural heritage plan: The Gorgon Venture is confident that no sites of archeological significance will be adversely impacted by the proposed gas development on Barrow Island. The Gorgon Venture will develop and implement a cultural heritage plan to ensure that known sites are avoided and that appropriate measures are in place to protect previously unidentified sites that may be discovered during construction or operation activities.

Sustainability Criterion 8.3: Diversity

The Gorgon Venture goal is to reflect the diversity of the Western Australian community in its workforce.

A workforce that reflects the community: It is the Gorgon Venture's goal to achieve a level of diversity in the Gorgon gas development workforce that reflects the Western Australian community. This will be achieved through continuation of its equal opportunity employment policy, establishment of an Indigenous training and recruitment program, and establishment of recruitment offices in Perth and Karratha to encourage recruitment of Pilbara and Western Australian-based workers.

Sustainability Criterion 8.4: Net Conservation Benefits

The development will clearly result in overall net conservation benefits that are valued by the community.

Gorgon Environment Foundation: The Gorgon Venture plans to establish the Gorgon Environment Foundation to coordinate a range of significant conservation programs that will deliver wide-ranging, long-term net conservation benefits to the community.

Principle 9 – Stakeholder Engagement

The Gorgon Venture will seek the views of stakeholders and take their interests into account throughout development of the Gorgon gas fields.

Sustainability Criterion 9.1: Broad Consultation

Stakeholder views will be sought and their values and interests will be taken into account.

Ongoing stakeholder participation: The Gorgon Venture has a proactive approach to consultation. The Gorgon Venture has consulted with a broad range of stakeholders throughout the development of the ESE Review and will continue to seek stakeholder feedback throughout construction and operation of the development.

Working with stakeholders: The Gorgon Venture will integrate stakeholder feedback and opinion in performance assessments.

Sustainability Criterion 9.2: Openness and Transparency

All members of the community will have adequate opportunity to obtain information about the Gorgon gas development and its potential effects; and provide comment to decision-makers throughout planning, construction and operation of the development.

Ongoing consultation: The Gorgon Venture will continue to meet with stakeholders and provide briefing materials and updates. Members of the community will also have opportunities to obtain information about the development during construction and operation via published materials and the Gorgon website.

Public exhibition and feedback: There are two public comment periods in the ESE Review process. The first is a six-week public review period during which all stakeholders have the opportunity to provide formal input into the ESE Review and comment on its findings. The second consultation period, also of six weeks, will give the public the opportunity to provide feedback on government agency advice on the proposed development.



Principle 10 – Accountability

The Gorgon Venture is committed to the highest standards of governance and accountability. It will report regularly to the community on the sustainability performance of the development.

Sustainability Criterion 10.1: Governance and Accountability

As operator of the Gorgon Venture, ChevronTexaco will meet the highest standards of governance and accountability.

The ChevronTexaco Way: ChevronTexaco, as operator, states in “The ChevronTexaco Way” that the company will: respect the law, conduct business in a socially responsible and ethical manner, meet the highest ethical standards in all business dealings and take responsibility for its actions, welcome scrutiny and hold itself accountable.

Sustainability Criterion 10.2: Reporting

The development’s social, economic and environmental performance will be reported to the community at least annually.

Annual sustainability report: The Gorgon Venture will produce an annual sustainability report for the Gorgon gas development. The report will be available to the public.

Regular ongoing reporting: The Gorgon Venture will report regularly to the community on topical issues as they arise through its website and in the media.

14.6 Conclusion

The Gorgon Venture is demonstrably committed to sustainable development and is resolved to successfully meeting each of the ten Gorgon gas development sustainability principles. Under the assessment criteria for each sustainability principle, the Gorgon gas development concept is in alignment with the Western Australian Government’s definition of sustainable development (see Section 14.1).

The Gorgon Venture’s approach to sustainable development goes beyond review of separate environmental, economic and social development implications by instead considering these factors within a single

sustainability framework. This sustainability framework is an integral part of the Gorgon gas development concept and the Gorgon Venture’s way of doing business.

The Gorgon Venture is of the view that a gas processing facility can be accommodated on Barrow Island and that the development will deliver social and economic benefits to the region, Western Australia and Australia without compromising in any manner the nature conservation values of the island. Indeed, the Gorgon Venture would provide net conservation benefits to Western Australia.



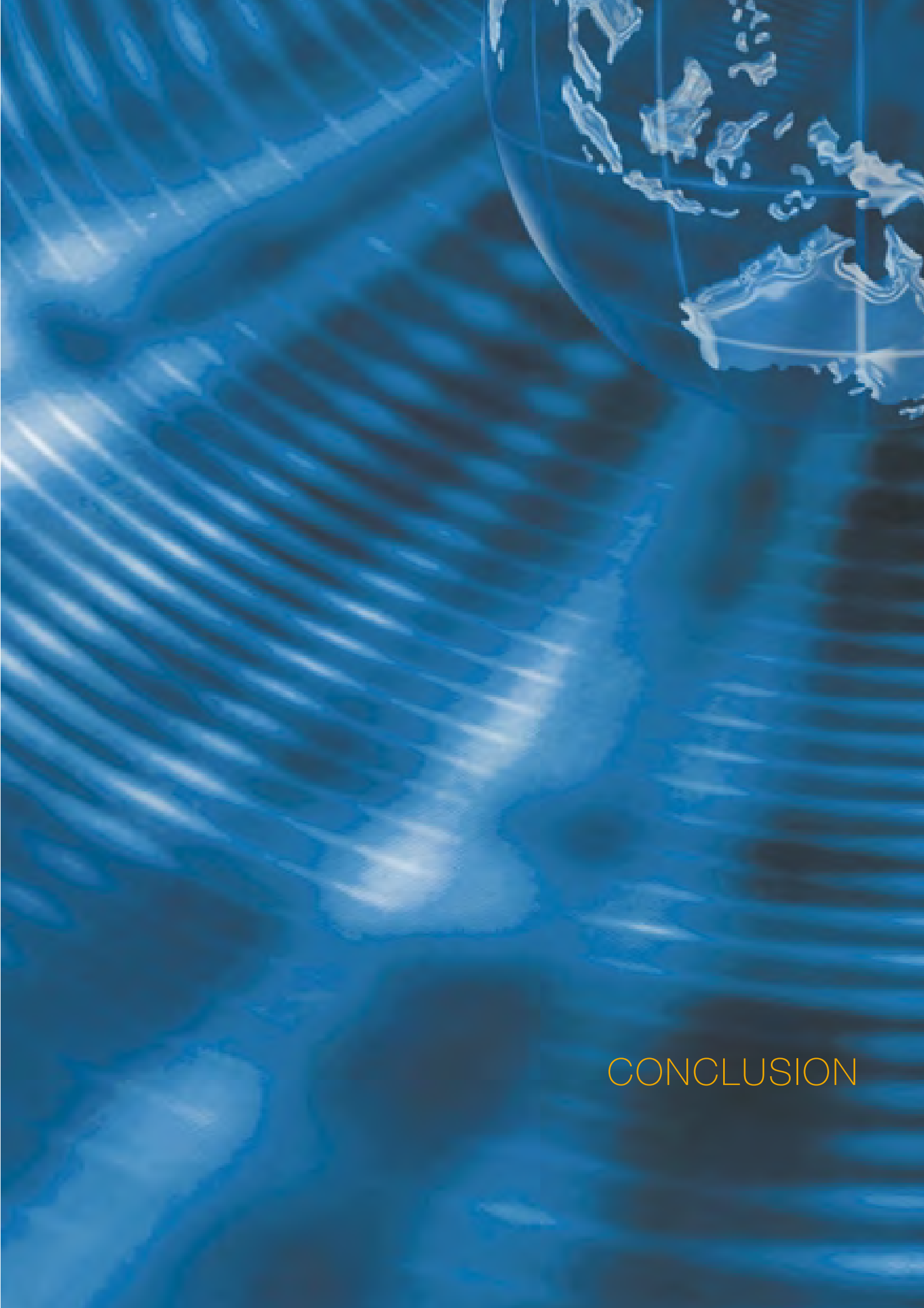
COMMITMENTS

This ESE Review has identified a range of potential environmental, social, economic and strategic issues that would need to be appropriately addressed, should the Gorgon gas development proceed on Barrow Island. To address these issues the Gorgon Venture is prepared to enter into the following commitments.

1. The Gorgon Venture would limit the new **area of development** including that of the gas processing plant, pipelines and associated infrastructure such that it would occupy an area not more than 300 ha or approximately 1.3 per cent of Barrow Island, for the life of the development.
2. The Gorgon Venture is committed to the preparation and implementation of a comprehensive management plan that would account for known and potential **ecological impacts**, and would outline management options to mitigate risk.
3. The Gorgon Venture would seek to enter into a formal **Conservation Agreement** with CALM which would provide the framework for management decisions concerning the Barrow Island environment, provide a mechanism for adequate resources of CALM activities on the island, and provide an ongoing vehicle to undertake research on the island.
4. The Gorgon Venture would build on existing ChevronTexaco **quarantine management** procedures and develop stringent measures to prevent the introduction of invasive species to Barrow Island.
5. ChevronTexaco, in its role as operator of both the Barrow Island oilfield and the Gorgon gas development, would continue to provide **overall management responsibility** for operational activities on the island.
6. The Gorgon Venture would plan for re-injection of reservoir CO₂ and implement current best practices in **greenhouse gas management** which would involve adopting best practices in thermally efficient plant design, preparing a Greenhouse Gas Management Plan, updating the Greenhouse Challenge Cooperative Agreement, and continuing to support research and development in greenhouse gas abatement.
7. The Gorgon Venture would establish and fund the "Gorgon Environment Foundation" to develop and employ a range of strategies and projects intended to deliver **net conservation benefits** to Western Australia reflecting the conservation values of Barrow Island. This includes a funding commitment which is expected to exceed \$10 million.
8. The Gorgon Venture is committed to working with customers and government agencies to develop domestic gas opportunities for Western Australia and establish a **physical gas supply connection** to the mainland transmission network in order to enhance the security of domestic gas supplies on a schedule to be agreed with the State Government.
9. The Gorgon Venture would actively support **Australian industry participation** as a core business policy and would implement an Australian industry participation plan.

10. The Gorgon Venture would seek to **employ a workforce** sourced largely from Western Australia, including regional areas, and one that reflects the diversity of the Western Australian community.
11. The Gorgon Venture would work with the State Government and educational institutions to assess the **education and training** requirements of the development and to cooperate in designing programs that would meet these requirements.
12. The Gorgon Venture would work closely with Commonwealth and State Government programs designed to enhance **business development in regional areas**, facilitate the participation of regional businesses in the development, enhance communication with business and contractors, and adopt procurement policies that provide opportunities for regional businesses.
13. The Gorgon Venture would work with government, Indigenous groups and other resource companies to contribute to employment and business development opportunities for **Indigenous people**.
14. ChevronTexaco, as operator of the Gorgon gas development, aims to achieve world-class performance in **health and safety**. Best practice programs and systems to protect those employed on the project as well as the wider community would be implemented.
15. The Gorgon Venture would maintain open and accountable processes through all stages of the development that encourages **stakeholder engagement** in relation to the Gorgon gas development.
16. The Gorgon Venture would comply with all **legislation** relevant to the proposed gas development on Barrow Island.
17. The Gorgon Venture would prepare and implement a **sustainable development** program specific to the proposed Gorgon gas development on Barrow Island that would meet the requirements of the sustainability criteria outlined in the ESE Review.





CONCLUSION

The Gorgon Venture has provided the information in this Economic, Social and Environmental Review to enable the Western Australian Government's consideration of the possible restricted use of Barrow Island for the proposed Gorgon gas development.

The Gorgon Venture recognises the importance of the conservation values of Barrow Island to the community and has only selected this location after exhaustive study and evaluation work showed there are no economically viable and environmentally acceptable alternatives.

A specific site on Barrow Island has been identified which can provide the necessary area for the gas processing facility without compromising the environmental values of the island. The area to be used for gas processing would be limited to 300 ha, and the restricted use of Barrow Island would not alter the status of the Class A Nature Reserve covering the entire island.

The ecological impacts that could result from the development of a gas processing facility on Barrow Island have been assessed by independent, specialist ecologists using a qualitative risk assessment process. Review of that work shows that the proposed development would not result in significant adverse impacts to important wildlife habitats, restricted vegetation types, or marine areas with unique conservation significance.

A significant benefit of Barrow Island is that it provides a unique opportunity to permanently dispose of reservoir CO₂. While subject to further evaluation and confirmation, such a re-injection program would enable Gorgon to be one of the most greenhouse efficient projects of its kind in the world.

The development would provide some 6000 jobs throughout Australia, of which 1700 jobs would be in Western Australia. Over the life of the development, there would be \$11 billion in new investment and \$17 billion in State and Commonwealth taxes and royalties. Annually, Gross Domestic Product (GDP) would be increased by \$3.6 billion and projected exports by \$2.5 billion.

The development would benefit local communities through small business development and training opportunities in the Pilbara region. The development would also provide for technology transfer, capability-building and would provide Indigenous employment and training opportunities.

If the development proceeds, the Gorgon Venture is committed to implementing a comprehensive net conservation benefits program that would enhance Western Australia's conservation estate and provide wide-ranging, long-term conservation benefits to the community. The Gorgon Venture has proposed the establishment of the Gorgon Environment Foundation to secure these benefits.

The development of the Gorgon field will be a catalyst for the further development of the Greater Gorgon area gas resource. This would multiply the benefits of the initial development described in this document. The development would provide a second strategic gas supply hub and another major competitive gas supply to Western Australia, encouraging the establishment of additional downstream processing in regional areas.

The option to defer or not develop the resource results in a significantly less favourable outcome for Western Australia, Australia and

the Pilbara when environmental, economic, social and strategic factors are considered.

This report has been reviewed by an Expert Panel which has concluded that the investigations satisfy the requirements of the ESE Review Scoping Document and that the findings and conclusions of the ESE Review are valid and justified.

As required by the State, this ESE Review demonstrates at a strategic level that the proposed Gorgon Gas development on Barrow Island would be sustainable. The development would provide net economic, social and conservation benefits while mitigating onsite impacts.

Way Forward

Before deciding whether to grant in-principle approval to the Gorgon Venture for restricted use of Barrow Island, the Western Australian Government will consider agency advice, public comment and any other documentation and advice it considers relevant.

If in-principle approval is granted, the Gorgon Venture would be able to continue with the marketing, engineering, environmental and commercial investigations necessary to develop the Gorgon gas fields. In-principle approval would also provide the commercial confidence required for the Gorgon Venture to enter into binding commercial arrangements with potential customers.

Once customer commitments have been achieved, application would be made for formal approval of a specific development project under Part IV of the Western Australian *Environmental Protection Act 1986*. Additional or related approvals would also be required under a range of other legislation.



The background is a deep blue gradient. In the upper right corner, there is a semi-circular, wireframe-like globe showing continents. From the lower left, a series of bright, parallel light rays or beams of light extend towards the center and right side of the image, creating a sense of depth and movement. The overall aesthetic is futuristic and technological.

ACKNOWLEDGEMENTS

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Preparation of this ESE Review was a combined effort led by the Gorgon Australian Gas team working in-house at ChevronTexaco. A range of specialist consultants provided information and support for the document where required.

Gorgon Australian Gas Team

The Gorgon gas development ESE Review team included:

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Gorgon Australian Gas Team

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John McLaughlin	Commercial Manager	Shell
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Study	Company
Conservation Consultant	Harry Butler
Cultural Heritage	Quartermaine Consultants
Economic Impacts	Access Economics
Economic, Social and Strategic Assessment	ACIL Tasman
Land Snail Survey	WA Museum
Marine Ecology	Bowman Bishaw Gorham
Net Conservation Benefit Strategy	Frank Batini
Quarantine Management	Macro-Environmental
Regional Location Assessment	URS Australia
Sea Bird Ecology	Astron Environmental
Stygofauna Survey	Biota Environmental Sciences
Terrestrial Fauna	Bamford Consulting Ecologists
Terrestrial Flora	Astron Environmental

Technical Support

Person	Contribution	Company
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Peter Doig	Field Coordinator	Expertest
Kim Kay	Document Production	BKAYDesign
Linda Lamb	Logistics	ChevronTexaco

Special thanks to the many other individuals who made valuable contributions to the preparation of this document.



GLOSSARY

GLOSSARY

Glossary

Acid gas	Typically a mixture of hydrogen sulfide (H ₂ S) and carbon dioxide (CO ₂).
Anthropogenic	Affected by, or relating to, human beings.
Bar	Measurement of pressure equivalent to 10 newtons per square centimetre (1 bar is the approximate atmospheric pressure at the Earth's surface).
Barrel of oil	A volume of 159 litres of oil.
Benthic	Living in or utilising the bank or bed surface of water bodies.
Billion	One thousand million.
Biodiversity	Level of biological diversity in the environment. It is defined in the EPBC Act as: <i>"the variability among living organisms from all sources (including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part) and includes: (a) diversity within species and between species; and (b) diversity of ecosystems."</i>
Biota	The sum of all living organisms of an ecosystem, or of a defined area or period.
Bombora	A coral structure that rises to, but does not break the surface.
Carbon dioxide equivalents	A metric measure used to compare various greenhouse gases based upon their global warming potential.
Cathodic protection	Application of an electrical current to the pipeline exterior to prevent the electrochemical process of corrosion occurring.
Cetacean	Whale and dolphin species.
Class A Nature Reserve	A reserve classified as a class A reserve under section 42 of the <i>Land Administration Act 1997</i> (WA).
Emissions	Substances being released to the environment.
Epibenthic	Epibenthic organisms are the taxa that live on or immediately above the sediment surface of the sea bed.
Epibiota	Animal or plant life living on the surface of other plants or animals.
Gas-to-liquids (GTL)	Liquid products developed from gas, such as diesel or methanol.
Geotechnical	Relating to the engineering study of subsurface soils; involves specialised drilling or sampling for soil analysis and testing.
Gorgon area	Includes the Gorgon gas field, West Tryal Rocks, Spar, Chrysaor and Dionysus gas fields.
Gorgon gas field	Includes North and South Gorgon gas fields.

Glossary (Cont.)

Gorgon Venture	An unincorporated joint venture consisting of three energy companies: ChevronTexaco, Shell and ExxonMobil. ChevronTexaco is the operator.
Gorgonians	Sea fans, closely related to soft corals. Plant-like in shape, grow in large fans with many branches, each bearing numerous tiny polyps. In the phylum cnidaria.
Greater Gorgon area	Includes two groupings of gas fields: the Gorgon area gas fields in the shallower water; and the deeper water gas fields which include the Io/Jansz fields located further offshore.
Gross Domestic Product (GDP)	A measurement in dollar terms of aggregate goods and services produced within a particular economy over a year and excluding income earned outside the country. Considered one of the main yardsticks of the health and vitality of the particular economy.
Gross State Product (GSP)	GSP is defined equivalently to Gross domestic product (GDP) but refers to production within a state or territory rather than to the nation as a whole.
Groundwater	Underground water contained within a saturated zone or rock.
Habitat	The place or type of site in which an organism naturally occurs.
Hydrocarbons	Substances composed only of hydrogen and carbon.
Hydrostatic testing (or hydrotesting)	A means to check the pipeline for strength and leaks prior to operation, in which the pipeline is filled with water and the pressure increased and monitored under controlled conditions.
Intertidal	The area of land lying between the high and the low water marks.
Invasive species	A species occurring in an area outside its historically known natural range as a result of intentional or accidental dispersal by human activities.
Invertebrate	Lacking a spinal column (e.g., shellfish, jellyfish, sponges, corals).
Joint Authority	The Joint Authority consists of relevant State and Commonwealth agency representatives involved in granting of petroleum offshore pipeline and production licences.
Karst	A region composed of limestone or dolomite and characterised by underground drainage systems, sinkholes and gorges.

GLOSSARY

Glossary (Cont.)

Life-cycle assessment	Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.
Macroalgae	Large algae, commonly referred to as "sea-weed".
Permeability	Capacity of a material for transmitting fluids.
Pollutant	A chemical that may reduce the quality of the environment.
Potable water	Drinkable water.
Priority flora	Threatened species that are included on the Priority Species List under the <i>Wildlife Conservation Act 1950</i> (WA). Information on these species is poorly known and requires further monitoring to be considered as "Rare flora".
Rare flora	Protected species under the <i>Wildlife Conservation Act 1950</i> (WA) that are considered to be in danger of extinction, rare or otherwise in need of special protection.
Reservoir CO₂	The CO ₂ that occurs naturally within a natural gas reservoir.
Reverse osmosis	Water purification by forcing it under pressure through a membrane which is impermeable to the impurities (salt).
Stygofauna	Small, aquatic groundwater and cave-dwelling animals.
Sub-sea	Below the surface of the sea.
Sub-sea trees	A sub-sea system of valves and fittings assembled on the sea bed above the well gas well to control the flow of hydrocarbons and other fluids from a completed well.
Subterranean	Growing or living beneath the ground.
Subtidal	Waters below the low tide mark.
Supercritical	Above a certain temperature (critical temperature) and pressure (critical pressure), the gas becomes a fluid in an intermediate phase between gas and liquid. Such a fluid is called a supercritical fluid.
Supratidal	That part of a tidal flat that is infrequently inundated.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
Taxa	Any of the groups into which living things are formally classified by the scientific community, such as species.
Turbidity	Interference with the passage of light through water caused by suspended matter.

The background is a deep blue with a complex, abstract pattern. In the upper right corner, there is a semi-circular, globe-like structure with a grid of lines, resembling a celestial sphere or a map projection. From the left side, numerous bright, diagonal light rays or streaks of white and light blue extend across the frame, creating a sense of depth and movement. The overall texture is fluid and organic, with various shades of blue and white creating a dynamic visual field.

ABBREVIATIONS

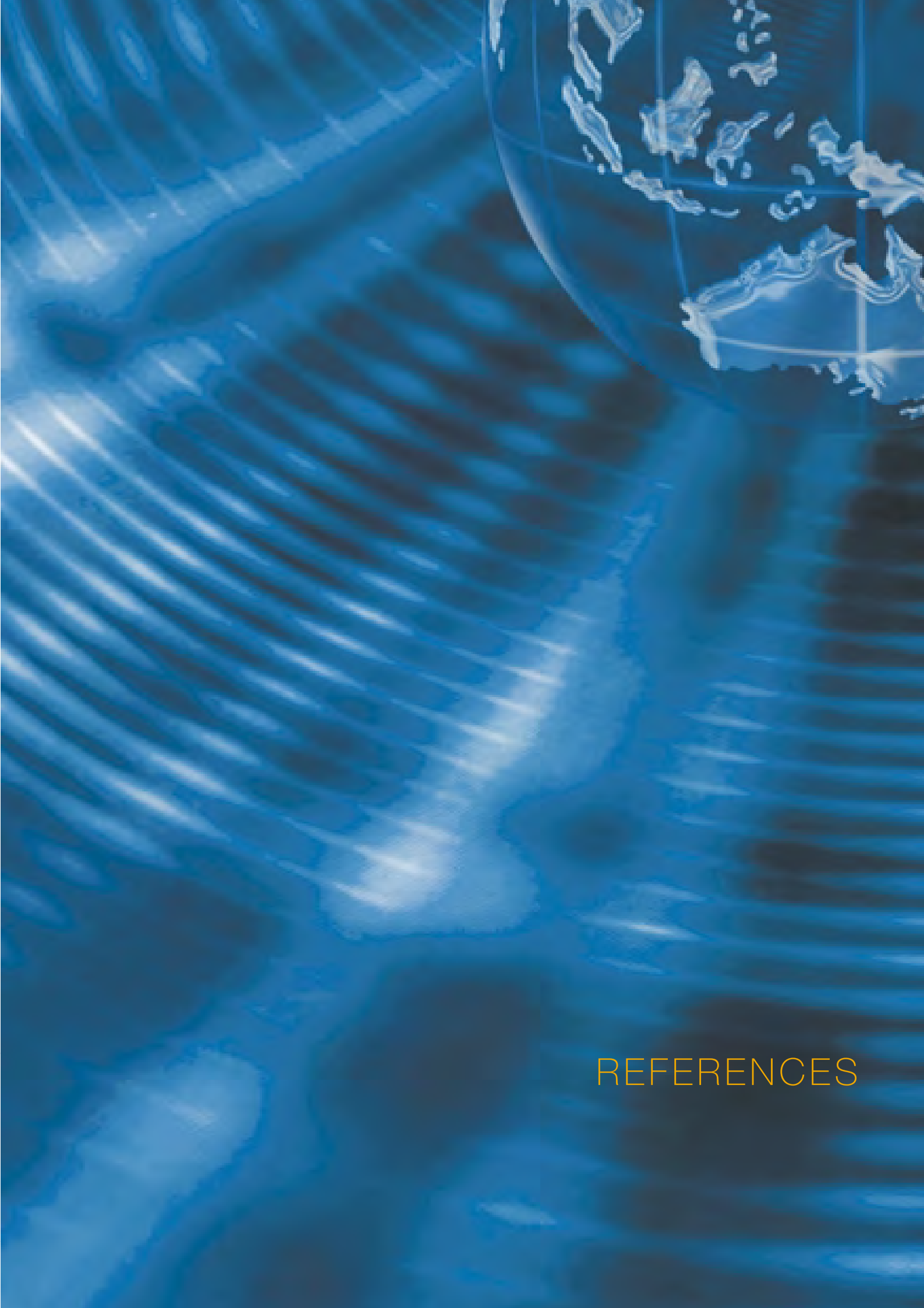
ABBREVIATIONS

Abbreviations

Abbreviation	Description
ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACF	Australian Conservation Foundation
AGO	Australian Greenhouse Office
AHC	Australian Heritage Commission
AMSA	Australian Maritime Safety Authority
APPEA	Australian Petroleum Production Exploration Association Limited
AQIS	Australian Quarantine and Inspection Service
AS	Australian Standard
ATSIC	Aboriginal and Torres Strait Islander Commission
BTEX	benzene, toluene, ethylbenzene and xylene
CALM	Conservation and Land Management (WA)
CES	Chevron Energy Solutions
CO ₂	carbon dioxide
CO ₂ CRC	CO2 Cooperative Research Centre
CO ₂ e	carbon dioxide equivalents
CPDEP	ChevronTexaco Project Development and Execution Process
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DBNGP	Dampier to Bunbury Natural Gas Pipeline
DEP	Department of Environmental Protection (WA)
DIA	Department of Indigenous Affairs
DME	dimethyl ether
DOLA	Department of Land Administration (WA)
DPI	Department of Planning and Infrastructure (WA)
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EP Act	<i>Environmental Protection Act 1986 (WA)</i>
EPA	Environmental Protection Authority (WA)
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
ESE Review	Environmental, Social and Economic Review of the Gorgon Gas Development on Barrow Island
FIFO	Fly-in fly-out
FLNG	Floating Liquefied Natural Gas
GDP	Gross Domestic Product
GEODISC	GEODISC Research Program
GIS	Geographic Information System
GJ	gigajoule
GSP	Gross State Product
GTL	gas-to-liquids
GWP	Global Warming Potential
H ₂ S	hydrogen sulfide
ha	hectare

Abbreviations (Cont.)

Hg	mercury
IISD	International Institute for Sustainable Development
IMO	International Maritime Organisation
IPCC	Intergovernmental Panel on Climate Change
kL	kilolitre
LNG	Liquefied Natural Gas
MCHE	Main Cryogenic Heat Exchanger
MMscfd	million standard cubic feet per day
MOF	Materials Offloading Facility
mol%	percentage composition based on the number of molecules
MPa	megapascal
MPR	Department of Mineral and Petroleum Resources (WA)
MTPA	million tonnes per annum
MW	megawatts
NATPLAN	National Plan to Combat Pollution of the Sea by Oil and Other Noxious and Hazardous Substances
NGO	Non-government organisation
NSESD	National Strategy for Ecologically Sustainable Development
NWS	North West Shelf
OECD	Organisation for Economic Cooperation and Development
PJ	petajoule
PJ/a	petajoules per annum
PLEM	Pipeline End Manifold
PNG	Papua New Guinea
PRRT	Petroleum Resource Rent Tax
psi	pounds per square inch
ROV	Remote Operated Vehicle
SACS	Saline Aquifer CO ₂ Storage
SANGAE [™]	ChevronTexaco's System Analysis for Greenhouse Gas Emissions and Energy Assessment
SES Guidelines	Guidelines for the Social, Economic and Strategic Evaluation of the Gorgon Gas Development Proposal
SIAC	Standing Inter-Agency Committee of Chief Executive Officers
SPU	Sustainability Policy Unit
TAFE	Technical and Further Education
TBT	tributyltin
Tcf	trillion cubic feet
TJ	terajoule
TJ/d	terajoules per day
VIP	Value Improvement Practice
WACOSS	Western Australian Council of Social Services
WAPET	West Australian Petroleum Pty Ltd
WWF	World Wide Fund for Nature



REFERENCES

REFERENCES

Access Economics 2002, 'National and Western Australian economic impacts of the Gorgon gas supply and LNG projects', report prepared for the Gorgon Venture, Perth.

Astron Environmental 2002, 'Methanol plant Withnell East Industrial Estate fauna report' June 2002.

Australian Bureau of Statistics 2001, *2001 Census of population and housing*, Commonwealth of Australia, Canberra.

Australian Greenhouse Office 1998, *The national greenhouse strategy: strategic framework for advancing Australia's greenhouse response*, Commonwealth of Australia, Canberra.

Australian Greenhouse Office 2002a, *National greenhouse inventory 2000*, Commonwealth of Australia, Canberra.

Australian Greenhouse Office 2002b, *Australia's third national communication on climate change*, Commonwealth of Australia, Canberra.

Australian Petroleum Production and Exploration Association (APPEA) 2001, *Report to the greenhouse challenge program*, APPEA Limited, Canberra.

Beard, JS 1980, 'A new phytogeographic map of Western Australia', *Research Notes Western Australian Herbarium*, vol. 3, pp. 37-58.

Bradbury, JH 2002, 'Melitid amphipods of Barrow Island, Western Australia, Part II – recent discoveries', *Records of the Western Australian Museum*, vol. 21, pp. 83-103.

Bradshaw, J 2002, 'The potential for geological sequestration of CO₂ in Australia: preliminary findings and implications for new gas field development', *APPEA Journal*, vol. 42.

Buckley, RC 1983, 'The flora and vegetation of Barrow Island, Western Australia', *Journal of the Royal Society of Western Australia*, vol.66, no. 3.

ChevronTexaco Corporation 2002, ChevronTexaco Corporation San Ramon, CA, viewed December 2002, <<http://www.chevrontexaco.com/about/careers/>>.

Clements, KW & Greig RA 1994, *Modelling large resource development projects in an open economy: the case of Australia's North West Shelf Project*, The Blackstone Company, Mount Pleasant, MI.

Commonwealth Scientific and Industrial Research Organisation (CSIRO) 1996, 'Gorgon greenhouse gas studies', report prepared for West Australian Petroleum Pty Ltd, Perth.

Council of Australian Governments 1992, *National strategy for ecologically sustainable development*, Commonwealth of Australia, Canberra.

Department of Conservation and Land Management (CALM) 1999, 'Barrow Island group: interim management guidelines for necessary operations', Internal CALM report.

Department for Environment, Food and Rural Affairs (DEFRA) 2001, *The UK's third national communication under the United Nations Framework Convention on Climate Change*, DEFRA Publications, UK.

Department of Fisheries 2002, *State of the fisheries report 2001/2002*, Fisheries Research Division, Department of Fisheries, Perth.

Department of Industry Science and Resources 1998, *Minerals and petroleum resources policy statement*, Commonwealth of Australia, Canberra.

Department of Industry Science and Resources 2000, *Liquefied natural gas action agenda*, Commonwealth of Australia, Canberra.

Department of Local Government and Regional Development 2001, *Regional trends and indicators: Pilbara Region*, Government of Western Australia, Perth.

Department of Mineral and Petroleum Resources 2003, Department of Mineral and Petroleum Resources, Perth, Western Australia, viewed January 2003, <<http://www.dme.wa.gov.au/statistics/FactSheetOct02.htm>>.

Department of Mineral and Petroleum Resources 2002, *Western Australian oil and gas industry – July 2002*, Government of Western Australia, Perth.

Department of Mineral and Petroleum Resources Western Australia 2002, Office of Major Projects, Perth, Western Australia, viewed December 2002, <<http://www.mpr.wa.gov.au/majproj/html/index.htm>> .

Department of the Premier and Cabinet 2002a, *Focus on the future: the Western Australian state sustainability strategy (consultation draft)*, Government of Western Australia, Perth.

Department of the Premier and Cabinet 2002b, *Focus on the future: opportunities for sustainability in Western Australia*, Government of Western Australia, Perth.

Department of Resource Development 2000, *Central Pilbara infrastructure planning study*, Government of Western Australia, Perth.

REFERENCES

- Devuyst, D 1999, 'Sustainability assessment: the application of a methodological framework', *Journal of Environmental Assessment Policy and Management*, vol. 4, pp. 459 – 487.
- Ecologically Sustainable Development Steering Committee 1992, *National strategy for ecologically sustainable development*, Council of Australian Governments, Canberra.
- Environmental Protection Authority 2002, *Guidance statement for minimising greenhouse gas emissions*, Government of Western Australia, Perth.
- Fremantle Port Authority 2000, *Fremantle Port: its economic impact*, Department for Planning and Infrastructure, Government of Western Australia, Perth.
- Hardi, P & Zdan, T 1997, *Assessing sustainable development: principles in practice*, International Institute for Sustainable Development, Manitoba.
- Humphreys, WF 2001, 'The subterranean fauna of Barrow Island (north-western Australia)', *Memoires de Biospeologie (International Journal of Subterranean Biology)*, vol. 2001.
- Independent Review Committee 2002, *Review of the project development approvals system – final report*, Government of Western Australia, Perth.
- Intergovernmental Panel on Climate Change (IPCC) 2001, *Climate change 2001: synthesis report, summary for policymakers*, Cambridge University Press, UK.
- IUCN 2000, *IUCN Guidelines for the prevention of biodiversity loss caused by alien invasive species*, The World Conservation Union (IUCN), Gland, Switzerland.
- Jenner, KCS, Jenner, MNM & McCabe, KA 2001, 'Geographical and temporal movements of humpback whales in Western Australian waters', *APPEA Journal*, vol. 41.
- Kemp, D (Minister for the Environment and Heritage) 2002, *Global greenhouse challenge: the way ahead for Australia*, media release, Parliament House, Canberra, 15 August.
- Lonsdale, WM 1999, 'Global patterns of plant invasions and the concept of invisibility', *Ecology*, vol. 80, no. 5, pp. 1522–1536.
- Mattiske & Associates 1993, 'State of knowledge on vegetation, Barrow Island', report prepared for West Australian Petroleum Pty Ltd, Perth.
- Mattiske Consulting Pty Ltd 1997, '1996 assessment of revegetation on seismic lines, Barrow Island', report prepared for West Australian Petroleum Pty Ltd, Perth.

Mining Minerals and Sustainable Development 2002, *Seven questions to sustainability: how to assess the contribution of mining and minerals activities*, International Institute for Sustainable Development, Manitoba.

Morris, K, Burbidge, A, Drew, M & Gregor, K 2001, 'Mammal monitoring, Barrow Island Nature Reserve', Department of Conservation and Land Management, Western Australia.

Murray, R 1991, *From the edge of a timeless land: a history of the North West Shelf Gas Project*, Allen and Unwin, North Sydney.

Naralup Associates 1998, 'Nickol Bay population study', Department of Resources Development, Perth.

Ninox Wildlife Consulting 1997, 'Gorgon project area: vertebrate fauna report and summary of management issues', report prepared for Gorgon Australia LNG.

Office of Territory Development 2002, Department of the Chief Minister, Darwin, viewed 23 January 2003, <<http://www.otd.nt.gov.au/>>.

Origin Energy 2002, *Environment effects statement/environment impact statement - BassGas Project*, Origin Energy, Sydney.

Organisation for Economic Cooperation and Development (OECD) 2001, *OECD environmental strategy for the first decade of the 21st Century*, OECD, Paris.

Osborne, S, Bancroft, K, D'Adamo, N & Monks, L 2000, 'Montebello-Barrow Islands – regional perspective 2000', Marine Conservation Branch, Department of Conservation and Land Management, Western Australia.

Pendoley, K 1997, 'Sea turtles and management of marine seismic programs Western Australia', *PESA Journal*, no. 25, pp. 8-15.

Pilbara Development Commission 2002, *Pilbara in focus*, Government of Western Australia, Perth.

Prince, RIT 1986, 'Dugong in Northern Waters of Western Australia – 1984', *Technical Report No.7*, Department of Conservation and Land Management, Western Australia.

Prince, RIT 1990, 'Status of the Western Australian marine turtle populations: the Western Australian marine turtle project 1986-1990', *Proceedings of the Australian marine turtle conservation workshop*, ANCA, Canberra.

REFERENCES

- Prince, RIT, Lawler, IR & Marsh RG 2001, 'The distribution and abundance of dugong and other mega vertebrates in Western Australian coastal waters extending seaward of the 20m isobath between NW Cape and the De Grey River mouth, April 2000', CALM completion report to Environment Australia, Canberra.
- Pruett-Jones, SG & O'Donnell E 2002, 'Land birds on Barrow Island: population estimates and responses to an oil-field development', in possession of the author, Chicago.
- Pruett-Jones, SG & Tarvin, KA 2001, 'Aspects of the ecology and behaviour of White-winged Fairy-wrens on Barrow Island', *Emu*, Vol. 101, no. 1, pp. 73-78.
- Saline Aquifer CO₂ Storage (SACS) Project in prep., 'Best practice manual', SACS Project, U.K.
- Sedgwick, EH 1978, 'A population study of the Barrow Island avifauna', *W.A. Naturalist*, vol. 14, no. 4, pp. 85-108.
- Short, J, Turner, B & Majors, C 1989, 'The distribution, relative abundance, and habitat preferences of rare macropods and bandicoots on Barrow, Boodie, Bernier and Dorre Islands', report to the National Kangaroo Monitoring Unit, Australian National Parks and Wildlife Service.
- Sibbel, A 2002, 'The psychosocial wellbeing of children from fly-in fly-out mining families', Honours thesis, Edith Cowan University, Western Australia.
- Solem, A 1997, 'Camaenid land snails from western and central Australia (Mollusca: Pulmonata: Camaenidae) VII taxa from Dampierland through the Nullabor', *Records of the Western Australian Museum*, Supplement no. 50, pp. 1461-1906.
- State of the Environment Reference Group 1998, *Environment of Western Australia: state of the environment report*, Government of Western Australia, Perth.
- Strahan, R (ed.) 1995, *The Australian Museum complete book of Australian mammals*, Angus and Robertson, Sydney.
- Swan, JM, Neff, JM & Young, PC (eds.) 1994, *Environmental implications of offshore oil and gas development in Australia- the findings of an independent scientific review*, APPEA, Canberra.
- Trudgen, M 1989, 'A report on the progress of the regeneration of vegetation on areas disturbed during oil production on Barrow Island', report prepared for West Australian Petroleum Pty Ltd.
- URS Australia 2002, *Darwin 10 MTPA LNG facility public environmental report*, Phillips Petroleum, Australia.

Western Australian Chamber of Commerce and Industry (CCI) 2002, *Western Australian Economic Review*, CCI, Perth.

West Australian Petroleum Pty Ltd (WAPET) 1989, 'Barrow Island oilfield environmental review 1963-1988', WAPET, Perth.

West Australian Petroleum Pty Ltd (WAPET) 1992, 'Saladin oilfield triennial environmental management report', WAPET, Perth.

Western Mining Corporation (WMC) 1995, *East spar offshore gas/condensate proposal, consultative environmental review*, WMC.

Wilson BR, Berry PF, Carman-Brown A, Crossland CJ, Eliot I, Hatcher B, Jones HE, Kirkman H, Lenanton RC, Marsh LM, Ottaway JR, Poole M, Semeniuk V, Simpson CJ, Slack-Smith S.M, Walker DI, Wilson BR, Chevis H, May RF & King S 1994, 'A representative marine reserve system for Western Australia', report of the Marine Parks and Reserves Selection Working Group, Department of Conservation and Land Management.

Witherington BE & Martin RE 1996, 'Understanding, assessing, and resolving light-pollution problems on sea turtle nesting beaches', *Florida Marine Research Institute Technical Report*, no. 2, p. 73.

Woodside 1997, *North West Shelf Gas Project domgas debottle-necking and 2nd trunkline installation project: public environmental review and public environment report*, Woodside Offshore Petroleum Pty Ltd, Perth.

Woodside 1998, *Public environmental review/public environmental report – additional NWS LNG facilities project*, Woodside Offshore Petroleum Pty Ltd, Perth.

World Commission on Environment and Development 1987, *Our common future (the Brundtland report)*, Oxford University Press, Oxford.



APPENDIX 1

LETTER FROM WA MINISTER FOR STATE
DEVELOPMENT, 20/11/01



GOVERNMENT OF WESTERN AUSTRALIA

**MINISTER FOR STATE DEVELOPMENT;
TOURISM; SMALL BUSINESS**

Our ref: 00759

Ms Rhonda Zygocki
Chief Executive Officer
Chevron Australia Pty Ltd
250 St George's Terrace
PERTH 6000

Dear Ms Zygocki

INITIAL DEVELOPMENT OF GORGON PROJECT – USE OF BARROW ISLAND

I write in response to your request, on behalf of the Gorgon Venture Participants, that the Government consider the possible restricted use of Barrow Island ("Barrow"), in relation to the initial development of the Gorgon project.

As you appreciate, Barrow is recognised locally, nationally and internationally as an extremely important part of our conservation estate. It is a great credit to all involved that for nearly 40 years Barrow has set a benchmark for the operation of petroleum production facilities in an environmentally responsible manner that has ensured, and in no small way enhanced, the enduring conservation value of the island.

Against this background and without any guarantee of outcome, the Government is prepared to give consideration, after the relevant environmental, social, economic and strategic ramifications have been examined and the results made available, to the restricted use of Barrow in relation to the initial development of the Gorgon project, provided that there are net conservation benefits associated with the proposed development.

I would anticipate that the reports relating to environmental, social, economic and strategic ramifications would include comparisons with outcomes that would occur if alternative locations were used for the project.

I would also expect that the important and sensitive issues of Native Title and land tenure will need to be addressed before the Government gives its final consideration to the matter.

In summary, if the Gorgon Venture wishes to pursue development on Barrow it would do so at its own risk but in the knowledge that the Government will keep an open mind on the matter and would give any proposal its balanced consideration once all relevant information was made available to it.

Level 19, 197 St George's Terrace, Perth, Western Australia 6000
Telephone: +618 9222 9699 Facsimile: +618 9481 0223
E-mail: clive.brown@dpc.wa.gov.au
Website: www.ministers.wa.gov.au/brown

If you wish to proceed on this basis, the Department of Mineral and Petroleum Resources would undertake examination and reporting of the social, economic and strategic aspects, while the Environmental Protection Authority would attend to the environmental examination and reporting. The Government would also obtain advice from the Conservation Commission as the vesting authority for the Barrow Island "A" class Nature Reserve.

The Department of Mineral and Petroleum Resources would assist you to co-ordinate your usual project development needs within Government, as the Gorgon Project has been a high priority for the State for some years.

Yours sincerely



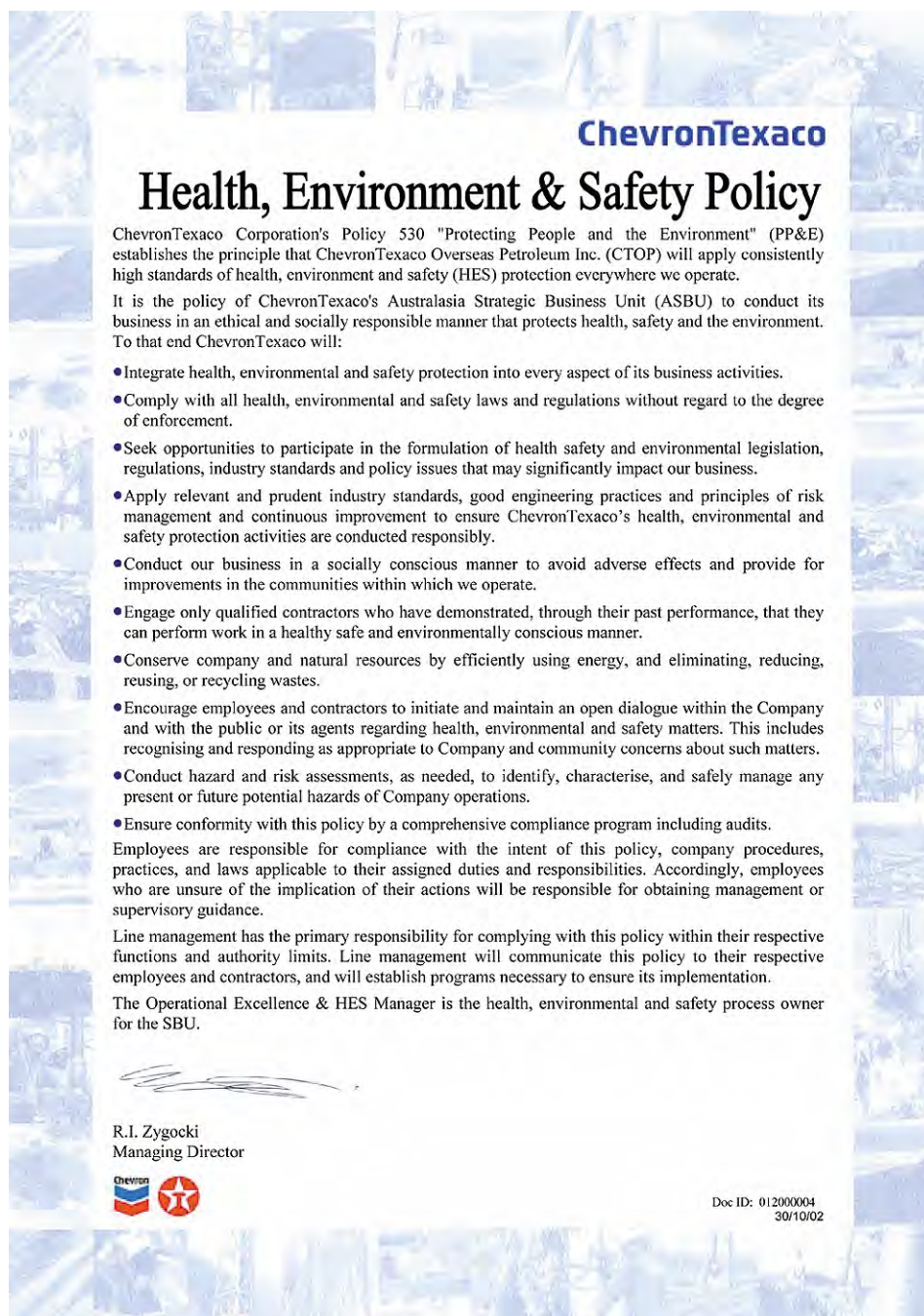
CLIVE BROWN MLA
MINISTER FOR STATE DEVELOPMENT

20 NOV 2001





APPENDIX 2
CHEVRONTEXACO HEALTH, ENVIRONMENT
AND SAFETY POLICY



APPENDIX 3
CHEVRONTEXACO WORLDWIDE
OPERATIONS IN SENSITIVE ENVIRONMENTS

ChevronTexaco

ChevronTexaco is committed to protecting people and the environment. Operations in sensitive environments employ a variety of best practices to meet this commitment. Generally they fall into several general categories of activity that are briefly described below along with illustrative examples:

- **Planning and organisational capacity** – At the Corporate level, all operations are expected to develop and improve their Health, Environment and Safety management systems that establish objectives for environmental performance. Environmental Impact Assessment practices are under review to ensure effective alignment with operations and project planning, including integration of biodiversity values. Integrated waste management, stressing minimisation and re-use, is strongly encouraged.
- **Baseline assessments** – Many operations around the world, such as Nigeria, Kazakhstan and Venezuela, incorporate sophisticated remote sensing technology in their efforts to document baseline environmental conditions and to understand changes that may result from natural variability or human activity.
- **Conservation agreements** – A legal framework for protecting biodiversity values is secured by cooperative agreements with government agencies to establish conservation management areas in places such as the San Joaquin Valley in California and the Zamrud field in Indonesia.



ChevronTexaco

- **Partnerships** – To ensure stakeholder concerns are effectively taken into account during development and conservation planning in areas potentially affected by ChevronTexaco operations, partnerships with non-government organisations, local communities and academia have been successful for the ChevronTexaco refinery in Panama and the Kutubu production operation in Papua New Guinea.
- **Operating with care** – Minimising operating footprints and avoiding essential habitat are the focus of special efforts in the San Joaquin Valley where production activities co-occur with a diverse assemblage of unique and protected plant and animal species. Protective buffers surround operations at the Pembroke Refinery in Wales and Malongo in Angola. The export pipeline from the Kutubu field is carefully routed to avoid harm to sensitive rainforest and watershed vegetation. Measures tailored to the operational circumstances are used to protect specific resources like sea turtles in Angola, offshore marine mammals in the Gulf of Mexico, mangrove communities in Nigeria and Panama, and raptors in the Rocky Mountains. Extensive culvert and siphon systems are used in Rangely, Colorado, to prevent potential spills from reaching the White River that flows through the field and is critical habitat for several endangered fish species.
- **Monitoring** – Long-term studies are underway to understand the effects of offshore production discharges in the Gulf of Mexico, Angola and Nigeria. ChevronTexaco supported a 15-year program to evaluate the effects on the unique communities surrounding production operations at the Elk Hills Naval Petroleum Reserve.



ChevronTexaco

- **Habitat restoration and creation** – Abandoned production and pipeline sites are routinely rehabilitated. Degraded wetlands have been improved in Nigeria, in connection with operations at the Port Arthur, Texas, refinery and remediation site, and at the Pascagoula, Mississippi, refinery. New wetland habitat is available as a result of wastewater management practices at the Richmond, California, refinery. Projects are being developed to restore natural areas near production operations in Nigeria and Indonesia.
- **Support for conservation efforts** – A primary focus of ChevronTexaco's environmental contributions program for many years is to support conservation efforts for sensitive species, communities and ecosystems around the world.



The background is a deep blue with a complex, abstract pattern. In the upper right corner, a portion of a globe is visible, showing landmasses in a lighter blue. From the bottom left, a series of bright, white, diagonal light rays or energy beams extend towards the center of the image. The overall effect is one of dynamic energy and global connectivity.

APPENDIX 4

EXPERT PANEL REPORT

ENVIRONMENTAL, SOCIAL & ECONOMIC REVIEW EXPERT PANEL

24 January 2003

Mr Paul Oen
General Manager, Gorgon Development
ChevronTexaco Australia Pty Ltd
17th Floor, QV1 Building
250 St George's Terrace
Perth WA 6000

Dear Mr Oen

Expert Panel Report

Attached is the report of the Expert Panel appointed to review the Environmental, Social & Economic Review Document.

On behalf of the panel members, I commend the process engaged by the company in the conduct of the review. The panel members would like to thank you for the opportunity to be involved in the first such process to address sustainability of a major project in Western Australia.

The panel members appreciated the enthusiasm and commitment of Gorgon staff in undertaking the review and would like to express their thanks for their openness and preparedness to provide all relevant information upon request.

The panel was impressed by the magnitude of the project and mindful of the potential environmental, social and economic benefits and the innovative approach to addressing key issues such as greenhouse gas management and sustainability.

Yours sincerely



Hendy Cowan
Chairman, Expert Panel

1.1 INTRODUCTION

The Gorgon Participants are seeking in principle approval for the restricted use of Barrow Island for an initial gas development. In 2001, the Minister for State Development wrote to ChevronTexaco, the operators of Gorgon, indicating “that the Government is prepared to give consideration, after the relevant environmental, social, economic and strategic ramifications have been examined and the results made available, to the restricted use of Barrow in relation to the initial development of the Gorgon project, provided that there are net conservation benefits associated with the proposed development.”

The Gorgon Participants have conducted the Environmental, Social and Economic (ESE) Review of the Gorgon development. The ESE Review has addressed the ability of the development to achieve a range of environmental, social, economic and strategic objectives.

The environmental aspects of the ESE Review are being coordinated through the Environmental Protection Authority (EPA) and the social, economic and strategic aspects of the Review are being coordinated through the Department of Mineral and Petroleum Resources (MPR).

The Gorgon Participants have conducted the ESE Review in a manner consistent with the Administrative Procedures for environmental impact assessment. Section 6.2 of the Administrative Procedures allows a proponent to engage a person (or persons) to undertake a peer review of the findings and conclusions of the assessment, prior to the assessment being released for public comment.

Accordingly, in consultation with EPA and MPR, an Expert Panel consisting of:

- The Hon Hendy Cowan Chair
- Dr Des Kelly Member
- Dr Brian Robinson Member
- Dr Denis Saunders Member

was appointed with the following terms of reference.

1.2 TERMS OF REFERENCE

The Expert Panel will principally review and comment on the draft ESE Review document. Input and comment may also be sought on the specialist studies and any other material considered relevant by ChevronTexaco.

Members of the Expert Panel will undertake the following tasks:

- review material provided by ChevronTexaco;
 - attend Expert Panel meetings (ideally in person, but via tele-conference may be acceptable); and
 - provide constructive comment and feedback on material provided by ChevronTexaco. (Comment is expected to be related to, but not limited to, the particular expertise of the member.)
-

1.3 METHOD OF OPERATION

In conducting its review, the Expert Panel was issued with the Gorgon Gas Development Environmental, Social & Economic Review Scoping Document dated 5 July 2002, a draft of the Environmental, Social & Economic Review of the Gorgon Gas Development dated 18 December 2002 (Rev B1) prepared as a result of the Scoping Document, and technical appendices relating to the environment (Terrestrial Fauna, Terrestrial Flora, Marine and Intertidal, Migratory Birds, Subterranean Fauna and Terrestrial Molluscs), economics (national and Western Australian economic impacts), site selection (identification of suitable locations for a land based processing facility), social impacts (social impact of the proposed development), and guidelines for the social, economic and strategic evaluation of the Gorgon gas development proposal (MPR).

On 8 January 2003 the Expert Panel visited Barrow Island and inspected the sites potentially impacted by the proposed development and inspected facilities on the Island.

On 9 January 2003 the Expert Panel examined the ESE draft review in the light of the technical appendices and their expertise, and provided detailed comments to ChevronTexaco, who then revised the ESE review and issued revision number C dated 18 January 2003. The Expert Panel made further comment on this draft at a meeting on 23 January 2003.

On the basis of this document and the outcomes of that meeting, the Expert Panel makes the following statements.

1.4 RESPONSE TO TERMS OF REFERENCE

Overview Comment

Since the discovery of the Gorgon gas reserves, the Gorgon participants have conducted extensive examinations of options for its commercial development and concluded that the viability of the venture depends on the restricted use of Barrow Island. Barrow Island is an A Class Nature Reserve. There has been a producing oil field on the Island since the mid 1960s managed by ChevronTexaco or its predecessors with no apparent loss of nature conservation values.

In this context, the Expert Panel notes that the document contains commitments to:

- **Incorporation of sustainability principles** and criteria into all aspects of the project.
- **Protection of Environmental and Conservation Values** by development of a conservation agreement with CALM for the management of the Island, development of a single management system for the Island, limiting clearing to a maximum of 300 hectares, an enhanced rehabilitation program, establishing a foundation to provide net conservation benefits, enhancing the effective terrestrial quarantine system, developing a best practice marine quarantine system, and an improved waste management system; and minimising greenhouse emissions by energy efficiency, CO₂ reinjection, and minimisation of plant emissions.
- **Providing social benefits** by a best practice occupational health and safety system, a commitment to addressing fly in fly out social issues, a positive

contribution to the West Australian community welfare and providing a catalytic role in community capacity building in the Pilbara.

- **Providing positive economic benefits** to Australia, Western Australia and the Pilbara.
- **Open and transparent processes** through annual reporting on all aspects of the project.

Noting these commitments by the Proponents, the Expert Panel is of the opinion that:

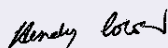
- the project is worthy of consideration by government; and
- the ESE Review addresses all issues critical to the Western Australian Government making an informed decision on whether to grant in-principle approval for the restricted use of Barrow Island.

Response to the Individual Terms of Reference:

In respect to the Terms of Reference for the Expert Panel, the Panel is of the opinion that:

- the ESE Review has been prepared in accordance with the ESE Review Scoping Document;
- all relevant issues have been addressed in an appropriate manner and to an adequate level of detail. Should the Government grant in principle restricted use of Barrow Island, the Panel notes that a detailed Environment Impact Assessment and other approvals processes must be carried out to provide additional levels of detailed information before the project could proceed; and
- the findings and conclusions of the Review are valid and justified and adequately describe the nature and impact of the proposal;

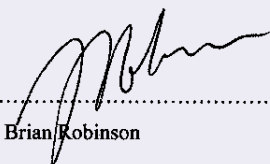
thus providing the information upon which the Government may make an in principle decision for the restricted use of Barrow Island.



.....
The Hon Hendy Cowan



.....
Dr Des Kelly



.....
Dr Brian Robinson



.....
Dr Denis Saunders





APPENDIX 5
BARROW ISLAND ENVIRONMENTAL
RESEARCH PROJECTS

APPENDICES

Year	Recipients	Details
1973	Mr LA Smith	Study of the terrestrial species of reptiles, their distribution, breeding condition, diet, body size and time of activity. Discuss relationship between Barrow Island and mainland fauna.
1974	Mr LS Hammond	Fauna of littoral environment, including soft mud, rocky shores on western and eastern sides, mangrove areas and sandy beaches.
1975	Dr HR Bakker	Adaptation of Spectacled Hare-wallaby to arid conditions. Studied water and electrolyte metabolism.
1976	Mr EH Sedgewick	Adaptation summary of birds so far recorded, indication of breeding status, localities sighted and population strength. Population survey of resident land birds.
1977	Prof. H Heatwole	The structure of an assemblage of 12 species of lizard from a typical <i>Triodia</i> habitat.
1978	Mr BJ Stephens	The role of metabolically active metals (eg. Cu, Zn) in Barrow Island mammals and establishment of baseline levels of toxic heavy metals in the area.
1979	Dr RD Wooler & DR SJ Bradley	Examination of the insect diet of some main bird species, calls and behavioural responses of <i>Spinifex</i> Birds and genetic differences with mainland species.
1980	Dr RC Buckley	Botanical survey and flora checklist, resulting in the identification of 29 vegetation units. Detailed descriptions and mapping of main units. Assessment of factors responsible for distribution of species.
1981	Dr KJ McNamara & GW Kendrick	Study of Miocene fossils in the Trealla Limestone. New species of fossils discovered.
1982	Dr CN Smithers	Production of an insect inventory on Barrow Island and nearby islands.
1983 to 1984	Dr DR King & Dr B Green	Thermoregulation, turnover rates and diet of the Perentie, <i>Varanus giganteus</i> .
1986 -	Dr RIT Prince	Tagging and monitoring of nesting turtle populations.

1987 to 89	Dr JC Short	Distribution, abundance and habitat preference of the Burrowing Bettong, <i>Bettongia lesueur</i> . Also includes work on Bandicoots, <i>Isodon auratus</i> , and other rare macropods on Barrow Island, and studies on Bernier and Dorre Islands, Shark Bay.
1988	Dr IT Grierson & Dr MM Lewis	Development of a soils and vegetation Geographic Database for Barrow Island with the aid of remote sensing and oxygen.
1988 to 94	Prof. D Bradshaw	Resource utilisation by mammals. Use of radioisotopes to trace wildlife requirements such as water, sodium and oxygen.
1991 & 1998 to 2002	Dr W Humphreys	Survey of caves on Barrow Island for invertebrate species. Discovered one new genus and 9 new species.
1993	Dr K Aplin	Vertebrate palaeontology. Found fossils 5000 to 7 million years old. Indications of environmental change they reflect.
1993	Perth Zoo & CALM	Survey of Barrow Island for Black-footed Rock Wallabies. Population stable at around 150 animals.
1994 to 1996	Ms J King, University of Western Australia	Use of physiological parameters to monitor stress levels in rare mammal populations and adaptation to the arid environment. Genetic variation in wallabies and euros very low; euros anaemic; hormone levels measured in relation to water stress.
1995 to 1997	Mr D Moro, University of Western Australia	Selective control of the house mouse (<i>Mus domesticus</i>) on Thevenard Island. House mouse needed 1.5 times more water than the native mouse (<i>Leggadina lakedownensis</i>).
1998 & 2001	University of Chicago	Study of black and white wren.
2002	Edith Cowan University	Study of Humpback Whale WA sub-populations.





APPENDIX 6
GORGON AUSTRALIAN INDUSTRY
PARTICIPATION POLICY



AUSTRALIAN INDUSTRY PARTICIPATION POLICY

“As a major Australian gas project, the Gorgon Development will actively support Australian industry participation as a core business policy, in line with the Australian Industry Participation National Framework and APPEA/ACE policy.”

IMPLEMENTATION

To fulfil the objectives of this policy, the Gorgon Development will:

- Provide full, fair and reasonable opportunity for Australian industry to supply goods and services to the project.
- Utilise the resources of the Industrial Supplies Office (ISO) network and other sources including SupplyBase Vendor Registration System as appropriate to identify those Australian companies able to supply goods or services commensurate with the quality, safety, environmental, reliability and delivery standards and objectives of the project.
- Provide information and facilitate project briefings to Australian industry so that local suppliers have adequate time to identify potential opportunities and establish their competitive position.
- Identify structural impediments to competitive Australian industry participation, such as lack of infrastructure and skills shortages and with ISO support, make industry and government aware of any such perceived limitations.
- Encourage offshore manufacturing and service companies who have leading edge technology applicable to the Gorgon development establish local facilities or manufacturing licences and aid in technology transfer.
- Assist Australian industry in forming strategic joint ventures or alliances with offshore companies.
- To facilitate Contractor and Sub-Contractor alignment with the policy, include the Core Policy statement in all contracts and purchase orders and make it a condition that is reflected in all sub-contracts and sub-orders.

- Ensure that Australian design, engineering, manufacturing, construction and project management capabilities are considered when preparing workscopes to enhance Australian industry opportunities, without impacting on the development's safety, environment, reliability, quality, cost or schedule objectives.
- Evaluate tenders on a "full life cycle cost basis" while taking into account all quality, safety, environment, reliability, delivery and on-going operational support considerations.
- Establish a supplier diversity program and work with regional organisations, indigenous organisations and ISO to establish links between the Gorgon development and local business, including a capability register and capacity building activities.
- Establish a measurement system to track and report the extent to which local content is utilised.

ACCOUNTABILITY

The General Manager – Gorgon Area will be accountable for developing and implementing this policy, whilst the responsibility for its application and measurement of performance lies with the Development Manager and the External Affairs Manager, together with the Contractors and Sub-Contractors engaged on the project.

Paul Oen

General Manager - Gorgon Area





APPENDIX 7

WA MINISTER FOR STATE DEVELOPMENT
MEDIA STATEMENT 28/06/02



MINISTER FOR STATE DEVELOPMENT **MEDIA STATEMENT**

28/06/02

Gorgon gas development possibility.

The Western Australian Government has agreed to examine proposals for development of the huge Gorgon gas reserves offshore from Dampier, including the possible use of a small area on Barrow Island.

State Development Minister Clive Brown said today the Government had been advised of efforts to harness the large Gorgon gas reserves, including a possible development scenario using a restricted area of the Barrow Island 'A' Class Nature Reserve.

The development proposal had come from ChevronTexaco.

"The Government would only consider this development after a rigorous, accountable and transparent examination of the environmental, social, and economic ramifications were undertaken," Mr Brown said.

"Recognising the important and complex issues such a proposal raises, we have not presumed or guaranteed any outcome at this time," he said.

The State Government has requested the Environmental Protection Authority conduct a strategic environmental evaluation of the proposal and report back.

As the vesting authority for the Barrow Island Nature Reserve, the Conservation Commission of WA will also be advising the Government on nature conservation matters relating to the nature reserve.

The Department of Mineral and Petroleum Resources would report to the Minister for State Development on the social and economic aspects.

The Government had therefore developed an integrated environmental, social and economic process to examine the proposal.

This evaluation was modelled on the usual environmental impact assessment processes of Part Four of the Environmental Protection Act and included a six-week public comment period.

Mr Brown said this did not mean that the Government would approve the use of Barrow Island for this purpose. However, it would keep an open mind.

The Government supported sustainable development of resources and believed the extensive reserves of natural gas off the WA coast could provide significant clean energy benefits to the wider community.

Mr Brown said that even with a 40-year history of industry and conservation coexisting on Barrow Island, the Government was especially aware that additional development on the island raised environmental concerns.

It therefore considered the best way to deal with these matters was through the rigorous and public processes it has developed for this proposal.

"We recognise and support the rigour of the State's environmental impact assessment process," Mr Brown said.

"The crucial role of CALM, the examination of alternative potential sites, and quarantine, are among the issues that will be addressed through this process, together with the economic and social benefits for the people of WA that would come from sensitive and responsible development of our natural resources."

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APPENDIX 8

GORGON MEDIA STATEMENT 28/06/02



MEDIA RELEASE

28 June 2002

GORGON TO UNDERTAKE STRATEGIC STUDY ON THE USE OF BARROW ISLAND

ChevronTexaco, operator of the Gorgon Joint Venture, today announced plans to undertake a strategic environmental, social and economic (ESE) study of the use of Barrow Island for the development of Gorgon gas.

ChevronTexaco is the operator of an oil production facility on Barrow Island, located off the Pilbara coast of Western Australia, and has had 40 years of successfully operating the oil field on the Island, which is a Class A nature reserve.

The Gorgon development has access to proved gas reserves of 13.8Tcf that can be supplied to a Barrow Island landfall at world competitive prices.

Rhonda Zygocki, Managing Director of ChevronTexaco in Australia said she was confident a strategic ESE study being undertaken by the Gorgon Joint Venture Partners would demonstrate that Barrow Island could be sustainably used for the Gorgon development.

Ms Zygocki was responding to a statement by the Minister for State Development, Clive Brown, that the WA Government would assess the use of Barrow Island for the development of Gorgon gas.

"The process established by the WA Government is transparent and provides opportunities for external stakeholders to provide input on the development proposal," Ms Zygocki said.

"We are very proud of our environmental management of Barrow Island and we are committed to maintaining our 40 year record of environmental excellence on the Island."

She said the Gorgon Joint Venture Partner's commitment to commercialise Gorgon gas was good news for Australia and Western Australia. The Gorgon development would provide considerable direct and indirect economic benefits.

"The Gorgon gas fields and neighbouring deep water discoveries in the greater Gorgon area make up one of the world's premier hydrocarbon resources, Ms Zygocki said."

Shell Australia Chairman, Dr Alan Parsley said: "The development of Gorgon is now a really attractive proposition. We see this development on Barrow Island as the key to commercialising the Gorgon gas reserves."

The Gorgon Joint Venture Partners are ChevronTexaco (47th interest), Shell (27th) and ExxonMobil (17th).

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ENVIRONMENTAL, SOCIAL AND ECONOMIC REVIEW of
THE GORGON GAS DEVELOPMENT on
BARROW ISLAND



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