Gorgon Project:

Coastal Stability Management and Monitoring Plan

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Table of Contents

List of Tables

List of Figures

Terminology, Definitions, and Abbreviations

Terms, definitions, and abbreviations used in this document are listed below. These align with the terms, definitions and abbreviations defined in Schedule 2 of the Western Australian Gorgon Gas Development Ministerial Implementation Statement No. 800 (Statement No. 800) and the Commonwealth Gorgon Gas Development Ministerial Approvals (EPBC Reference: 2003/1294, 2008/4178).

ABU	Australasia Business Unit
ARI	Assessment on Referral Information (for the proposed Jansz Feed Gas Pipeline dated September 2007) as amended or supplemented from time to time.
AS/NZS	Australian Standard/New Zealand Standard
ASBU	Australasia Strategic Business Unit
Bathymetry	Measurements of the depths of water bodies.
BD	Base of Primary Dune; sampling site located at the base of the primary dune
Beach Face	Sloping section of beach between the foredune area and the nearshore rock platform
Berm	A nearly horizontal portion of a beach formed by the deposition of sediment from wave action
Best Practice / Best Practicable Measures	Best Practice, as described in Guidance Document No. 55 (Environmental Protection Authority [EPA] 2003), involves the prevention of environmental impact, or if this is not practicable, minimising the environmental impact and also minimising the risk of environmental impact, through the incorporation of Best Practicable Measures. Best Practicable Measures therefore incorporate the technology and environmental management procedures which are practicable, having regard to, among other things, local conditions and circumstances, including costs, and to the current state of technical knowledge, including the availability of reliable, proven technology.
Bund	An area of containment, such as a dam, wall, or other artificial embankment
Carbon Dioxide (CO_2) Injection System	The mechanical components required to be constructed to enable the injection of reservoir carbon dioxide, including but not limited to compressors, pipelines and wells.
CBF	Crest of Beach Face; sampling site located at the change in slope at the transition between the beach face and foredune area

CD	Chart Datum; the level of water that charted depths displayed on nautical charts are measured from. The chart datum is generally a tidal datum; i.e. a datum derived from some phase of the tide. Common CDs are lowest astronomical tide and mean lower low water.
CO_2	Carbon dioxide
Coast	The land adjacent to the sea upon which waves have an effect, extending from Mean Low Water to beyond the permanent dune vegetation line
Construction	Construction includes any Proposal-related (or action-related) construction and commissioning activities within the Terrestrial and Marine Disturbance Footprints, excluding investigatory works such as, but not limited to, geotechnical, geophysical, biological and cultural heritage surveys, baseline monitoring surveys and technology trials.
DEC	Former Western Australian Department of Environment and Conservation (now Parks and Wildlife)
DEWHA	Former Commonwealth Department of Environment, Water, Heritage and the Arts (then became SEWPaC and now DotE)
DoT	Western Australian Department of Transport
DotE	Commonwealth Department of the Environment (formerly SEWPaC)
DSDG	Dredge Spoil Disposal Ground
EIS/ERMP	Environmental Impact Statement/Environmental Review and Management Programme (for the Proposed Gorgon Gas Development dated September 2005 as amended or supplemented from time to time) as amended or supplemented from time to time.
EMP	Environmental Management Plan
EP Act	Western Australian *Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPBC Reference: 2003/1294	Commonwealth Ministerial Approval for the Gorgon Gas Development as amended or replaced from time to time.
EPBC Reference: 2005/2184	Commonwealth Ministerial Approval (for the Jansz Feed Gas Pipeline) as amended or replaced from time to time.
EPBC Reference: 2008/4178	Commonwealth Ministerial Approval (for the Revised Gorgon Gas Development) as amended or replaced from time to time.

FA	Foredune Area; sampling site located between the beach face and the primary dune, which is populated by scattered vegetative hummocks and marine turtle body holes
Gorgon Gas Development	The Gorgon Gas Development as approved under Statement No. 800 and EPBC Reference: 2003/1294 and 2008/4178 as amended or replaced from time to time.
ha	Hectare
HES	Health, Environment, and Safety
IMS	Impact Mitigation Strategy
ISO	International Organization for Standardization
Jansz Feed Gas Pipeline	The Jansz Feed Gas Pipeline as approved in Statement No. 769 and EPBC Reference: 2005/2184 as amended or replaced from time to time.
KJVG	Kellogg Joint Venture Gorgon
km	Kilometre
LAT	Lowest Astronomical Tide
Littoral	A shore; the zone between high tide and low tide; of, or related to the shore, especially the seashore
LNG	Liquefied Natural Gas
m	Metre
m/s	Metres per second
m^3	Cubic metre
M2	Main lunar tidal constituent
Management Triggers	Are quantitative, or where this is demonstrated to be not practicable, qualitative matters above or below whichever relevant additional management measures may be considered. Management Triggers for the Coastal Stability Management and Monitoring Plan are defined in the Coastal Stability Management and Monitoring Plan Supplement: Management Triggers (Chevron Australia, 2015)
Marine Disturbance Footprint	The area of the seabed to be disturbed by construction or operations activities associated with the Marine Facilities listed in Condition 17.2 of Statement No. 800 and Condition 13.2 in EPBC Reference: 2003/1294 and 2008/4178 (excepting that area of the seabed to be disturbed by the generation of turbidity and sedimentation from dredging and dredge spoil disposal)

Marine Facilities	In relation to Condition 17.2 of Statement No. 800 and Condition 13.2 of EPBC Reference: 2003/1294 and 2008/4178, the Marine Facilities are the: • Materials Offloading Facility (MOF) • LNG Jetty.
Marine Turtles	Flatback, Green, and Hawksbill Turtles nesting on Barrow Island
MGA 50 Zone, GDA94	Map Grid of Australia Zone 50 (WA); projection based on the Geocentric Datum of Australia 1994
MOF	Materials Offloading Facility
MTEP	Marine Turtle Expert Panel
MTPA	Million Tonnes Per Annum
NATA	National Association of Testing Authorities
nm	Nautical Miles
NNE	North-north-east
OE	Operational Excellence
OEMS	Operational Excellence Management System
OEPA	Office of the Environmental Protection Authority (Western Australia)
Operations (Gorgon Gas Development)	In relation to Statement No. 800 and EPBC Reference: 2003/1294 and 2008/4178, for the respective LNG trains, this is the period from the date on which the Gorgon Joint Venturers issue a notice of acceptance of work under the Engineering, Procurement and Construction Management (EPCM) contract, or equivalent contract entered into in respect of that LNG train of the Gas Treatment Plant; until the date on which the Gorgon Joint Venturers commence decommissioning of that LNG train.
Parks and Wildlife	Western Australian Department of Parks and Wildlife (formerly DEC)
PD	Primary Dune; sampling site located on the primary dune beyond the permanent vegetation line
PER	Public Environmental Review for the Gorgon Gas Development Revised and Expanded Proposal, as amended or supplemented from time to time.
Performance Standards	Are matters which are developed for assessing performance, not compliance, and are quantitative targets or where that is demonstrated to be not practicable, qualitative targets, against which progress towards achievement of the objectives of conditions can be measured.

Practicable	Practicable means reasonably practicable having regard to, among other things, local conditions and circumstances (including costs) and to the current state of technical knowledge. For the purposes of the conditions of EPBC Reference 2003/1294 and 2008/4178, which include the term 'practicable', when considering whether the draft plan meets the requirements of these conditions, the Commonwealth Minister will determine what is 'practicable' having regard to local conditions and circumstances including but not limited to personnel safety, weather or geographical conditions, costs, environmental benefit, and the current state of scientific and technical knowledge
Primary Dune	The largest and most mature seaward dune
RTK GPS	Real-time Kinetic Global Positioning System
SEWPaC	Former Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now DotE; formerly also DEWHA)
SSE	South-south-east
Statement No. 748	Western Australian Ministerial Implementation Statement No. 748 (for the Gorgon Gas Development) as amended from time to time [superseded by Statement No. 800].
Statement No. 769	Western Australian Ministerial Implementation Statement No. 769 (for the Jansz Feed Gas Pipeline) as amended or replaced from time to time.
Statement No. 800	Western Australian Ministerial Implementation Statement No. 800 (for the Gorgon Gas Development) as amended or replaced from time to time.
Statement No. 865	Western Australian Ministerial Implementation Statement No. 865 (for the Gorgon Gas Development) as amended from time to time.
TAPL	Texaco Australia Pty Ltd
Transect	The path along which a researcher moves, counts and records observations
WAPET	West Australian Petroleum Pty Ltd
WAPET Landing	Proper name referring to the site of the barge landing existing on the east coast of Barrow Island prior to the date of Statement No. 800.

1.0 Introduction

1.1 Proponent

Chevron Australia Pty Ltd (Chevron Australia) is the proponent and the person taking the action for the Gorgon Gas Development on behalf of the following companies (collectively known as the Gorgon Joint Venturers):

- Chevron Australia Pty Ltd
- Chevron (TAPL) Pty Ltd
- Shell Development (Australia) Pty Ltd
- Mobil Australia Resources Company Pty Limited
- Osaka Gas Gorgon Pty Ltd
- Tokyo Gas Gorgon Pty Ltd
- Chubu Electric Power Gorgon Pty Ltd

pursuant to Statement No. 800 and EPBC Reference: 2003/1294 and 2008/4178.

Chevron Australia is also the proponent and the person taking the action for the Jansz Feed Gas Pipeline on behalf of the Gorgon Joint Venturers, pursuant to Statement No. 769 and EPBC Reference: 2005/2184.

1.2 Project

Chevron Australia proposes to develop the gas reserves of the Greater Gorgon Area (Figure 1-1).

Subsea gathering systems and subsea pipelines will be installed to deliver feed gas from the Gorgon and Jansz–Io gas fields to the west coast of Barrow Island. The feed gas pipeline system will be buried as it traverses from the west coast to the east coast of the Island where the system will tie in to the Gas Treatment Plant located at Town Point. The Gas Treatment Plant will comprise three Liquefied Natural Gas (LNG) trains capable of producing a nominal capacity of five Million Tonnes Per Annum (MTPA) per train. The Gas Treatment Plant will also produce condensate and domestic gas. Carbon dioxide (CO_2), which occurs naturally in the feed gas, will be separated during the production process. As part of the Gorgon Gas Development, Chevron Australia will inject the separated CO_2 into deep formations below Barrow Island. The LNG and condensate will be loaded from a dedicated jetty offshore from Town Point and then transported by dedicated carriers to international markets. Gas for domestic use will be exported by a pipeline from Town Point to the domestic gas collection and distribution network on the mainland (Figure 1-2).

1.3 Location

The Gorgon gas field is located approximately 130 km and the Jansz–Io field approximately 200 km off the north-west coast of Western Australia. Barrow Island is located off the Pilbara coast 85 km north-north-east of Onslow and 140 km west of Karratha. Barrow Island is approximately 25 km long and 10 km wide and covers 23 567 ha. It is the largest of a group of islands, including the Montebello and Lowendal Islands.

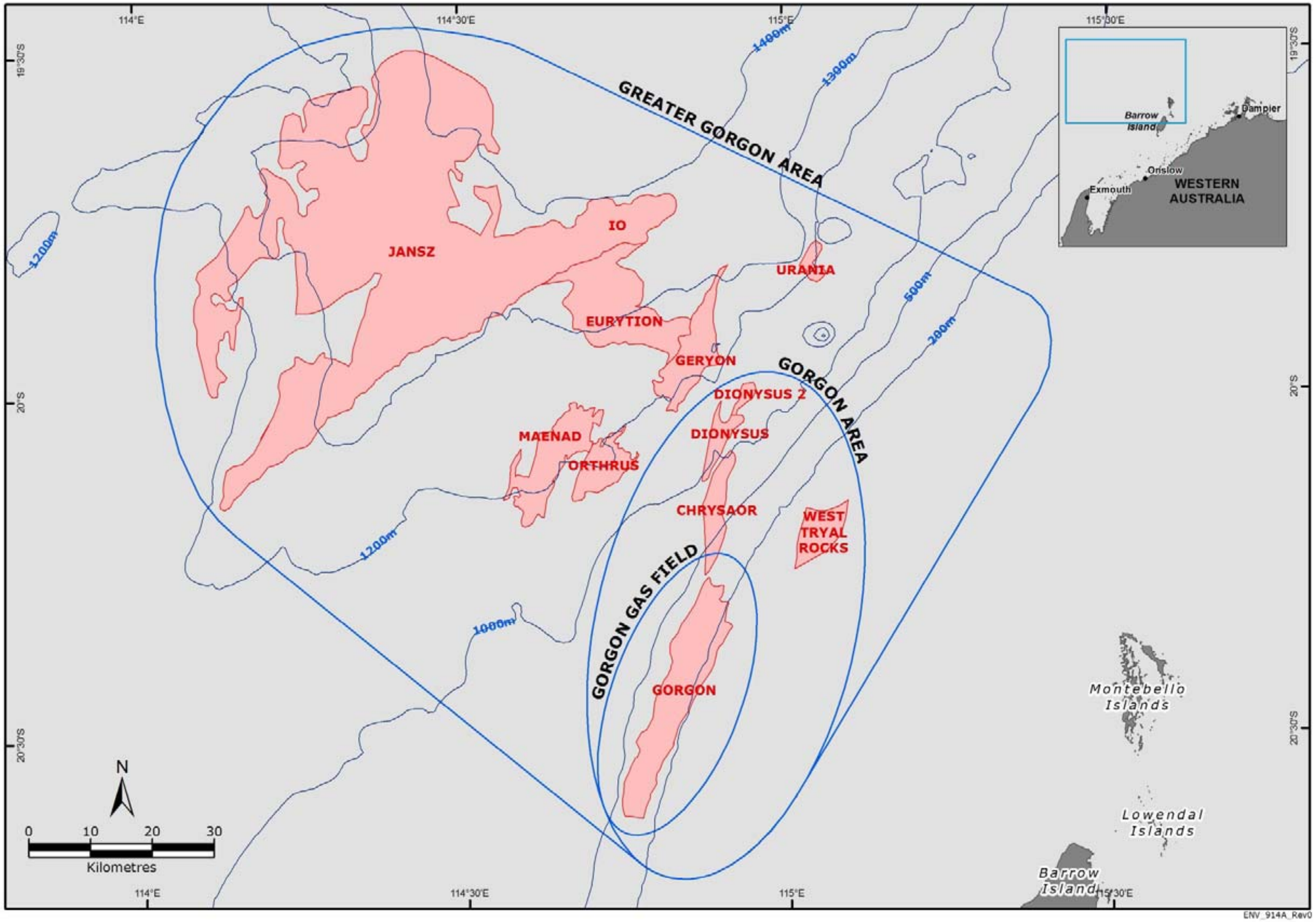
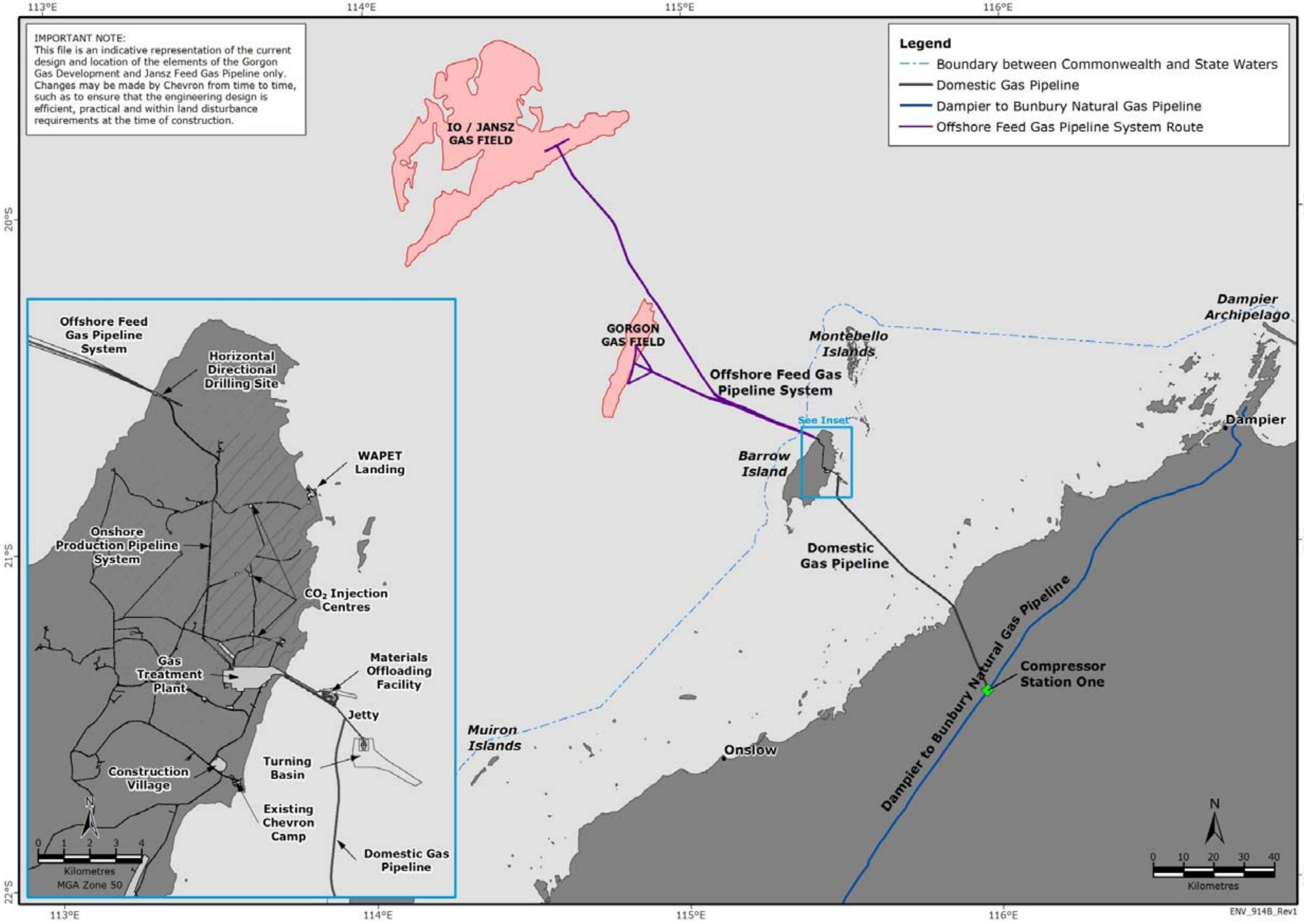


Figure 1-1 Location of the Greater Gorgon Area



IMPORTANT NOTE:
This file is an indicative representation of the current design and location of the elements of the Gorgon Gas Development and Jansz Feed Gas Pipeline only. Changes may be made by Chevron from time to time, such as to ensure that the engineering design is efficient, practical and within land disturbance requirements at the time of construction.

Figure 1-2 Location of the Gorgon Gas Development and Jansz Feed Gas Pipeline

1.4 Approvals

The initial Gorgon Gas Development was assessed through an Environmental Impact Statement/Environmental Review and Management Programme (EIS/ERMP) assessment process (Chevron Australia 2005, 2006).

The initial Gorgon Gas Development was approved by the Western Australian State Minister for the Environment on 6 September 2007 by way of Ministerial Implementation Statement No. 748 (Statement No. 748) and the Commonwealth Minister for the Environment and Water Resources on 3 October 2007 (EPBC Reference: 2003/1294).

In May 2008, under section 45C of the Western Australian *Environmental Protection Act 1986* (EP Act), the Environmental Protection Authority (EPA) approved some minor changes to the Gorgon Gas Development that it considered 'not to result in a significant, detrimental, environmental effect in addition to, or different from, the effect of the original proposal' (EPA 2008). The approved changes are:

- excavation of a berthing pocket at the Barge (WAPET) Landing facility
- installation of additional communications facilities (microwave communications towers)
- relocation of the seawater intake
- modification to the seismic monitoring program.

In September 2008, Chevron Australia sought both State and Commonwealth approval through a Public Environment Review (PER) assessment process (Chevron Australia 2008) for the Revised and Expanded Gorgon Gas Development to make some changes to 'Key Proposal Characteristics' of the initial Gorgon Gas Development (outlined in Schedule 1 of Statement No. 748), as outlined below:

- addition of a five MTPA LNG train, increasing the number of LNG trains from two to three
- expansion of the CO_2 Injection System, increasing the number of injection wells and surface drill locations
- extension of the causeway and the Materials Offloading Facility (MOF) into deeper water.

The Revised and Expanded Gorgon Gas Development was approved by the Western Australian State Minister for the Environment on 10 August 2009 by way of Ministerial Implementation Statement No. 800 (Statement No. 800). Statement No. 800 also superseded Statement No. 748 as the approval for the initial Gorgon Gas Development. Statement No. 800 therefore provides approval for both the initial Gorgon Gas Development and the Revised and Expanded Gorgon Gas Development, which together are known as the Gorgon Gas Development. Amendments to Statement No. 800 Conditions 18, 20, and 21 under section 46 of the EP Act were approved by the Western Australian State Minister for the Environment on 7 June 2011 by way of Ministerial Implementation Statement No. 865 (Statement No. 865). However, implementation of the Gorgon Gas Development will continue to be in accordance with Statement No. 800, as amended by Statement No. 865.

On 26 August 2009, the then Commonwealth Minister for the Environment, Heritage and the Arts issued approval for the Revised and Expanded Gorgon Gas Development (EPBC Reference: 2008/4178), and varied the conditions for the initial Gorgon Gas Development (EPBC Reference: 2003/1294).

Since the Revised and Expanded Gorgon Gas Development was approved, further minor changes have also been made and/or approved to the Gorgon Gas Development and are now also part of the Development. Further changes may also be made/approved in the future. This Plan relates to any such changes, and where necessary this document will be specifically revised to address the impacts of those changes.

Use of an additional 32 ha of uncleared land for the Gorgon Gas Development Additional Construction, Laydown, and Operations Support Area (Additional Support Area) was approved by the Western Australian State Minister for Environment on 2 April 2014 by way of Ministerial Implementation Statement No. 965 and by Variation issued by the Commonwealth Minister for the Environment. Statement No. 965 applies the conditions of Statement No.800 to the Additional Support Area and requires all implementation, management, monitoring, compliance assessment and reporting, environmental performance reporting, protocol setting and record keeping requirements applicable to the Additional Support Area under Statement No. 800 to be carried out on a joint basis with the Gorgon Gas Development.

The Jansz Feed Gas Pipeline was assessed via Environmental Impact Statement/Assessment on Referral Information (ARI) and EPBC Referral assessment processes (Mobil Australia 2005, 2006).

The Jansz Feed Gas Pipeline was approved by the Western Australian State Minister for the Environment on 28 May 2008 by way of Ministerial Implementation Statement No. 769 (Statement No. 769) and the Commonwealth Minister for the Environment and Water Resources on 22 March 2006 (EPBC Reference: 2005/2184).

This Coastal Stability Management and Monitoring Plan (this Plan) covers the Gorgon Gas Development as approved under Statement No. 800 and as approved by EPBC Reference: 2003/1294 and EPBC Reference: 2008/4178.

In respect of the Carbon Dioxide Seismic Baseline Survey Works Program, which comprises the only works approved under Statement No. 748 before it was superseded, and under EPBC Reference: 2003/1294 before the Minister approved a variation to it on 26 August 2009, note that under Condition 1A.1 of Ministerial Statement No. 800 and Condition 1.4 of EPBC Reference: 2003/1294 and 2008/4178 this Plan is authorised to continue for six months subject to the existing approved plans, reports, programs and systems for the Program, and the works under the Program are not the subject of this Plan.

1.5 Purpose of this Plan

1.5.1 Legislative Requirements

1.5.1.1 State Ministerial Conditions

This Plan is required under Condition 25 of Statement No. 800, which is quoted below:

> *Prior to the commencement of construction of the marine facilities listed in Condition 17.2, the Proponent shall submit a Coastal Stability Management and Monitoring Plan (the Plan) to the Minister that meets the objectives set in Condition 25.3 and the requirements of Condition 25.4 as determined by the Minister, unless otherwise allowed in Condition 25.1A.*

Condition 25.5 requires the Proponent to implement the Plan.

1.5.1.2 Commonwealth Ministerial Conditions

This Plan also satisfies the requirements of Condition 18 of EPBC Reference: 2003/1294 and 2008/4178, which are quoted below:

> *Prior to the commencement of construction of the marine facilities listed in Condition 13.2, the person taking the action must submit a Coastal Stability Management and Monitoring Plan (the Plan) to the Minister, for approval, that meets the objectives and requirements set out in this Condition, unless otherwise allowed in Condition 18.1A*

1.5.2 Objectives

The objectives of this Plan, as stated in Condition 25.3 of Statement No. 800, are to:

- ensure that the Marine Facilities listed in Condition 17.2 (excluding WAPET Landing) do not cause significant adverse impacts to the beaches adjacent to those facilities
- establish a monitoring program to detect adverse changes to the beach structure and beach sediments that could have implications for marine turtles nesting on the beaches adjacent to the Marine Facilities listed in Condition 17.2 (excluding WAPET Landing) on Barrow Island.

The objectives of this Plan, as stated in Condition 18 of EPBC Reference: 2003/1294 and 2008/4178, are to:

- ensure that the marine facilities listed in Condition 13.2 do not cause significant adverse impacts to the beaches adjacent to those facilities
- establish a monitoring program to detect adverse changes to the beach structure and beach sediments that could have implications for marine turtles nesting on the beaches adjacent to the marine facilities listed in Condition 13.2 on Barrow Island.

1.5.3 Requirements

The requirements of this Plan, as stated in Condition 25.4 of Statement No. 800 and Conditions 3 and 18 of EPBC Reference: 2003/1294 and 2008/4178, are listed in Table 1-1.

Table 1-1 Requirements of this Plan

Ministerial Document	Condition No.	Requirement	Section Reference in this Plan
Statement No. 800	25.4.i	The Plan shall include the baseline state of the beaches adjacent to Town Point from Mean Low Water to beyond the permanent dune vegetation line.	Section 3.5
Statement No. 800	25.4.ii	The Plan shall include a monitoring program to detect changes to profiles of beaches and grain size adjacent to Town Point from Mean Low Water to beyond the permanent dune vegetation line and the extent of any erosion or accretion of sand.	Section 5.2
Statement No. 800	25.4.iii	The Plan shall include performance standards against which achievement of the objectives of this condition can be determined.	Section 6.3
Statement No. 800	25.4.iv	The Plan shall include management triggers.	Section 5.3
Statement No. 800	25.5	The Proponent shall implement the Plan.	Section 7.0
EPBC Refs: 2003/1294 and 2008/4178	3.2.1	A description of the EPBC Act listed species and their habitat likely to be impacted by the components of the action which are the subject of that plan.	Appendix 5
EPBC Refs: 2003/1294 and 2008/4178	3.2.2	An assessment of the risk to these species from the components of the action which are the subject of that plan, relevant to that plan.	Appendix 5
EPBC Refs: 2003/1294 and 2008/4178	3.2.3	Details of the management measures proposed in relation to these species if it is a requirement of the condition requiring that plan.	Section 5.4

Ministerial Document	Condition No.	Requirement	Section Reference in this Plan
EPBC Refs: 2003/1294 and 2008/4178	3.2.4	Details of monitoring proposed for that species if it is a requirement of the condition requiring that plan.	Section 5.2
EPBC Refs: 2003/1294 and 2008/4178	3.2.5	Performance standards in relation to that species if it is a requirement of the condition requiring that plan	Section 6.3
EPBC Refs: 2003/1294 and 2008/4178	3.2.6	Management triggers in relation to that species if it is a requirement of the condition requiring that plan.	Section 5.3
EPBC Refs: 2003/1294 and 2008/4178	3.2.7	Protocols for reporting impacts on the species to the Department.	Section 8.2
EPBC Refs: 2003/1294 and 2008/4178	18.4.i	Baseline state of the beaches adjacent to Town Point from Mean Low Water to the permanent dune vegetation line.	Section 3.5
EPBC Refs: 2003/1294 and 2008/4178	18.4.ii	A monitoring program to detect changes to profiles of beaches and sand grain size adjacent to Town Point from Mean Low Water to the permanent dune vegetation line and the extent of any erosion or accretion of sand.	Section 5.2
EPBC Refs: 2003/1294 and 2008/4178	18.4.iii	Performance Standards against which achievement of the objectives of this condition can be determined.	Section 6.3
EPBC Refs: 2003/1294 and 2008/4178	18.4.iv	Management Triggers.	Section 5.3
EPBC Refs: 2003/1294 and 2008/4178	18.5	The person taking the action must implement the Plan.	Section 7.0

Any matter specified in this Plan is relevant to the Gorgon Gas Development only if that matter relates to the specific activities or facilities associated with that particular development.

The sections in this Plan, which are noted in Table 1-1 to meet the conditions of EPBC Reference: 2003/1294 and 2008/4178, shall be read and interpreted as only requiring implementation under EPBC Reference: 2003/1294 and 2008/4178 for managing the impacts of the Gorgon Gas Development on, or protecting the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) matters listed in Appendix 5. The implementation of matters required only to meet the requirements of Statement No. 800 (and Statement No. 769) are not the subject of the EPBC Reference: 2003/1294 and 2008/4178.

1.5.4 Scope and Application

This Plan only applies to the Marine Facilities listed in Condition 17.2 (excluding WAPET Landing) as approved under Statement No. 800 and Condition 13.2 of EPBC Reference: 2003/1294 and 2008/4178 (see Section 2.0). Consequently, monitoring the coastal stability of west coast beaches of Barrow Island is outside the scope of this Plan.

The two key purposes of the monitoring program are to monitor and detect any significant adverse changes to the stability of the beaches occurring as a result of the presence of the MOF and LNG Jetty; and to be able to detect changes in beach structure and/or beach sediments that could have implications for marine turtle nesting.

This Plan contains information on the baseline beach structure and beach sediments of the east coast beaches of Barrow Island in the vicinity of the MOF and the LNG Jetty. This Plan also contains details of the monitoring program for these beaches. More detailed information on the baseline state of Barrow Island's coastal and marine environment, specifically in relation to hard and soft corals, non-coral benthic macroinvertebrates, macroalgae, seagrass, mangroves, demersal fish, surficial sediment characteristics, and water quality (turbidity and light) can be found in the Coastal and Marine Baseline State and Environmental Impact Report (Chevron Australia 2013), which is a requirement under Condition 14.2 of Statement No. 800, Condition 12.2 of Statement No. 769, and Condition 11.2 of EPBC Reference: 2003/1294 and 2008/4178.

Revision 2 of this Plan (this version) incorporates changes relating to implementation of new, but interim, Management Triggers related to detecting adverse changes to the beach structure and beach sediments that could have implications for marine turtles nesting on the beaches adjacent to the MOF. These new interim Management Triggers are detailed in the Coastal Stability Management and Monitoring Plan Supplement: Management Triggers (Chevron Australia 2015). It is Chevron Australia's intention to revise this Plan in 2016 upon completion of sediment transport modelling studies; at this time the interim Management Triggers will be reviewed and amended as necessary.

1.5.5 Hierarchy of Documentation

This Plan will be implemented for the Gorgon Gas Development via the Chevron Australasia Business Unit (ABU) Operational Excellence Management System (OEMS). The OEMS is the standardised approach that applies across the ABU to continuously improve the management of safety, health, environment, reliability, and efficiency to achieve world-class performance. Implementation of the OEMS enables the Chevron ABU to integrate its Operational Excellence (OE) objectives, processes, procedures, values and behaviours into the daily operations of Chevron Australia personnel and any contractors working under Chevron Australia's supervision. The OEMS is designed to be consistent with and, in some respects, go beyond ISO 14001-2004 (Environmental Management Systems – Requirements with Guidance for Use) (Standards Australia/Standards New Zealand 2004).

Figure 1-3 provides an overview of the overall hierarchy of environmental management documentation within which this Plan exists. Further details on environmental documentation for the Gorgon Gas Development are provided in Section 7.1 of this Plan.

This Plan is to be implemented in conjunction with the Long-term Marine Turtle Management Plan (Chevron Australia 2014a) and the Marine Facilities Construction Environmental Management Plan (Chevron Australia 2009a) as changes to the beaches adjacent the MOF and the LNG Jetty may have the potential to affect the marine turtles that nest on these beaches.

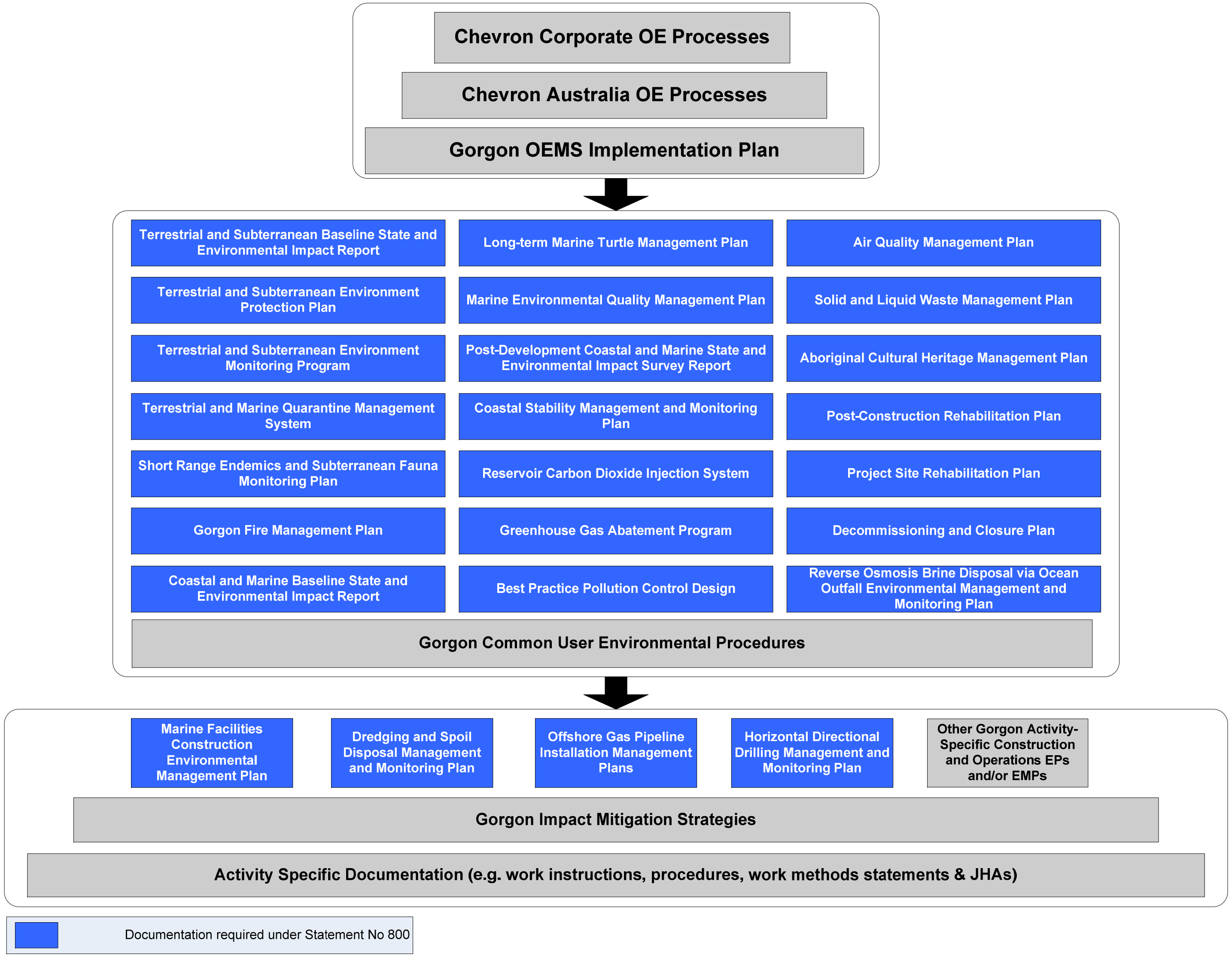


Figure 1-3 Hierarchy of Gorgon Gas Development Environmental Documentation

Note: Figure 1-3 refers to all Plans required for Statement No. 800. These Plans are only relevant to EPBC Reference: 2003/1294 and 2008/4178, if required for the conditions of those approvals.

1.5.6 Scientific Expertise

BMT Oceanica provided technical support for the revision of this Plan, particularly the development of methods to map and quantify marine turtle Nesting Habitat Zones, as detailed in the Coastal Stability Management and Monitoring Plan Supplement: Management Triggers (Chevron Australia 2015).

1.5.7 Stakeholder Consultation

Regular consultation with stakeholders has been undertaken by Chevron Australia throughout the development of the environmental impact assessment management documentation for the Gorgon Gas Development. This stakeholder consultation has included engagement with the community, government departments, industry operators, and contractors to Chevron Australia via planning workshops, risk assessments, meetings, teleconferences, and the PER and EIS/ERMP formal approval processes.

In accordance with Condition 25.2 of Statement No. 800 and Condition 18.2 of EPBC Reference: 2003/1294 and 2008/4178, the Western Australian Department for Transport (DoT), the Marine Turtle Expert Panel (MTEP), the Commonwealth Department of the Environment (DotE; previously the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC), and prior to that the Department of Environment, Water, Heritage and the Arts [DEWHA]), and the Western Australian Department of Parks and Wildlife (Parks and Wildlife; previously the Department of Environment and Conservation [DEC]) are to be consulted during the preparation of this Plan.

This document was prepared with ongoing consultation from the government agencies, expert panels, and specialists listed below and the outcomes of these consultations have been incorporated into this Plan where relevant.

Consultations for Revision 0 (2009):

- DEC (now Parks and Wildlife): Workshops and meetings were held involving both the DEC and Chevron Australia personnel to discuss the scope and content of this Plan. The DEC reviewed and provided comment on the Draft Plan.
- DoT: DoT and their independent expert (Mr Matt Eliot) reviewed the coastal process modelling undertaken to predict the impact of constructing the MOF at Town Point. DoT reviewed and provided comment on the Draft Plan.
- DEWHA (now DotE): DEWHA reviewed and provided comment on the Draft Plan.
- MTEP: The MTEP reviewed and provided comment on the Draft Plan.
- Mr Matt Eliot of Global Environmental Modelling Systems, Independent Expert Reviewer: Mr Eliot reviewed early drafts of this Plan and provided Chevron Australia with his comments and recommendations.

Consultations for Revision 1 and Revision 1 Amendment 1 (2014):

- Parks and Wildlife: The proposed revisions to the Plan were provided to Parks and Wildlife who reviewed the Plan and provided comments which were addressed; Parks and Wildlife subsequently endorsed the Plan.
- DoT: The proposed revisions to the monitoring program were provided to DoT. DoT endorsed the changes to the monitoring program.
- DotE: The proposed revisions to this Plan were presented at a meeting with DotE. DotE has reviewed and provided comment on this Plan. Approval was received on 16 December 2014.
- MTEP: The proposed revisions to the monitoring program were presented at MTEP meetings. MTEP endorsed the changes to the monitoring program.

- Dr Bruce Hegge of BMT Oceanica, Expert Reviewer: Dr Hegge reviewed drafts of the Plan and provided Chevron Australia with his comments and recommendations.

Consultations for Revision 2 (this Version):

- Parks and Wildlife: The proposed content, scope and structure of changes to the Plan were presented to Parks and Wildlife on 11 September 2015 and subsequently endorsed.
- DoT: The proposed content, scope and structure of changes to the Plan were communicated to DoT who advised that they did not need to review the detail of proposed changes based on the scope of the revision.
- DotE: The proposed content, scope and structure of changes to the Plan were communicated to DotE and the revised Plan will be submitted to DotE for approval.
- MTEP: The proposed content, scope and structure of changes to the Plan were presented at an MTEP meeting in August 2015. MTEP endorsed the proposed changes to the Plan via a letter to Chevron Australia and the State and Commonwealth Ministers for the Environment on 24 September 2015.

Figure 1-4 shows the development, review, and approval process for this Plan.

1.5.8 Public Availability

This Plan will be made public as and when determined by the Minister, under Condition 35 of Statement No. 800 and Condition 22 of EPBC Reference: 2003/1294 and 2008/4178.

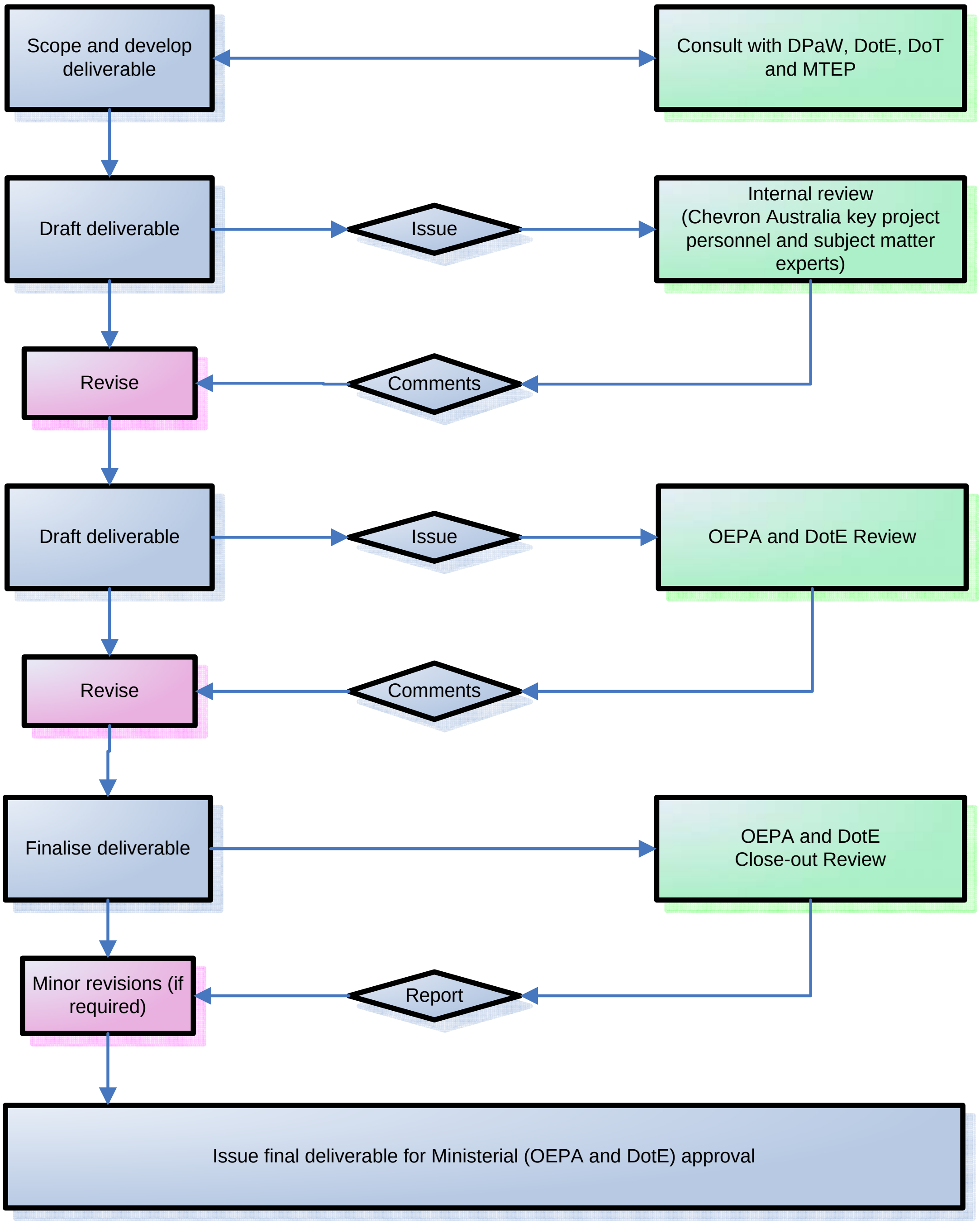


Figure 1-4 Deliverable Development, Review, and Approval Flow Chart

2.0 Relevant Facilities and Activities

2.1 Marine Facilities

This Plan addresses issues associated with the Marine Facilities of the Gorgon Gas Development, which are shown in Figure 1-2 and Figure 2-1 of this Plan. These Marine Facilities are defined in Condition 17.2 of Statement No. 800 and Condition 13.2 of EPBC Reference: 2003/1294 and 2008/4178 as the:

- Materials Offloading Facility (MOF)
- LNG Jetty.

Additional details on the Marine Facilities can be found in the Draft EIS/ERMP (Chevron Australia 2005), the section 45C approval (EPA 2008), and the PER (Chevron Australia 2008).

Note: The description of the Marine Facilities provided in subsequent sections was current when the current revision of this Plan was prepared. More specific details are contained in various Gorgon Gas Development approval and assessment documents, which are issued from time to time.

2.1.1 Materials Offloading Facility

The MOF was constructed in the following stages:

- Pioneer MOF Platform
- Pioneer MOF Causeway
- extension of the Pioneer MOF to complete the full MOF.

The full MOF (Causeway and Offloading Facilities) is approximately 2120 m long.

The Pioneer MOF was initially required for offloading equipment and materials (via large barges and roll-on/roll-off vessels) for the construction of the Gas Treatment Plant and associated terrestrial infrastructure on Barrow Island. Construction activities for the Pioneer MOF Platform included:

- dredging an access channel (-6.5 m Chart Datum [CD]) and berth pockets (-8 m CD)
- reclaiming suitable dredged material from the MOF access channel, turning basin, and LNG channel
- constructing a perimeter bund using a combination of suitably-sized dredged material and rock transported from the mainland
- placing dredged material within the perimeter bund to form the Pioneer MOF Platform. Primary and secondary armour rock sourced from the mainland was installed on the external face of the Pioneer MOF Platform
- constructing the berthing facilities for offloading vessels
- installing permanent and temporary navigation aids.

A Causeway to connect the Pioneer MOF Platform to Town Point was constructed using material excavated from the Gas Treatment Plant site.

Once the Pioneer MOF Platform was constructed, work commenced on extending it seaward and widening the Causeway; these construction activities included:

- extending the MOF Platform seaward, forming a breakwater to protect tug pen moorings, the heavy lift facility, and other berths. This work will be completed using material excavated from Barrow Island and suitable dredged material.
- constructing a heavy lift facility and tug pens

- raising the existing MOF Causeway by adding an upper causeway section (upper causeway height varies between +12 m to +16.5 m CD) to accommodate a pipe rack containing LNG, condensate, and other pipelines for export and operations of the LNG Jetty offloading facilities. This work will be completed using material excavated from Barrow Island.

2.1.2 LNG Jetty

A two-kilometre long LNG Jetty will extend from the MOF Platform head. The Jetty is required to support a series of LNG, condensate, vapour return, firewater, and other pipelines connecting the Gas Treatment Plant to the jetty head. The jetty head will be located in approximately -10 m Lowest Astronomical Tide (LAT) water depth and requires dredging to -13.5 m CD and -15 m at the berthing pockets.

Activities associated with the construction of the LNG Jetty include installing:

- piles for trestle structure
- jetty trestle structures containing roadway, pipeway, loops, firewater intake structure, and platforms
- jetty head structures comprising two LNG and condensate loading platforms, and four berthing and mooring dolphins at each platform
- navigation aids.

Two jetty loading platforms will be installed at the jetty head, each accommodating:

- jetty head control panel shelter and supports
- loading arms
- access platform
- fire monitor towers
- gangway tower
- foam skid.

The design of the LNG Jetty is based on an open structure with gravity base concrete caissons founded on the seabed. Typically, each caisson has four piles that are embedded in the caisson and that support the jetty superstructure.

A range of marine construction vessels will be required for marine construction activities. In addition, a number of ancillary vessels will be required, including supply vessels, refuelling vessels, crew change vessels, survey vessels, and marine construction support vessels.

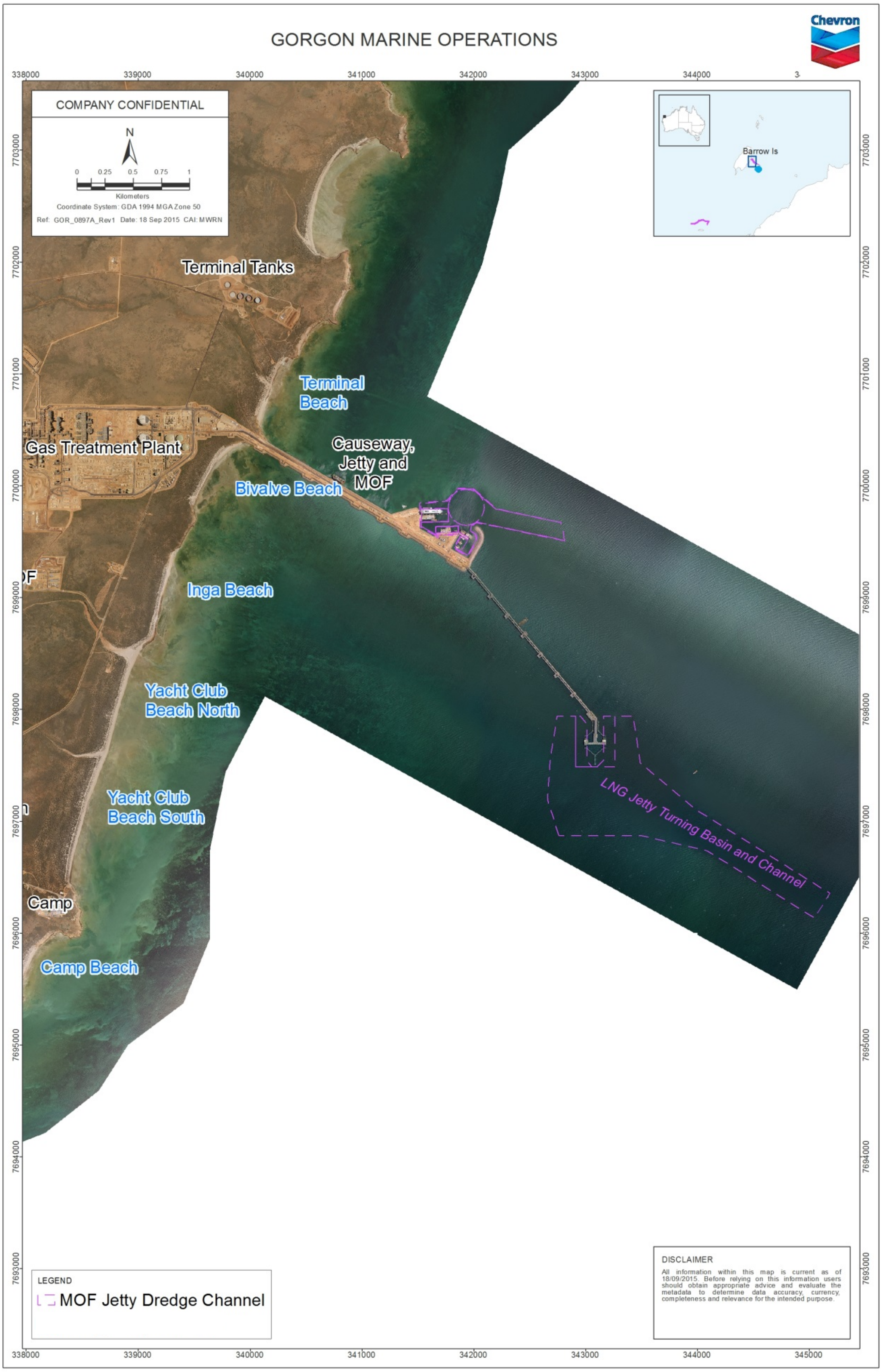


Figure 2-1 Location of the MOF (and Causeway) and the LNG Jetty Marine Facilities

2.1.3 Dredge Spoil Disposal Ground

Dredging was carried out between May 2010 and November 2011 to provide access channels, berths, and a turning basin associated with the MOF and LNG Jetty. Some of the dredge spoil generated during dredging activities was used for reclamation and development of the MOF; the remainder was disposed of at the designated Dredge Spoil Disposal Ground (DSDG).

The dredged volume for the MOF and the LNG Jetty was approximately 7.6 million m^3, comprising approximately 1.1 million m^3 of dredged material from the MOF berths and access channel areas and approximately 6.5 million m^3 of dredged material from the LNG berthing pockets, access channel, and turning basin.

A proportion of dredged material was used in the construction of the MOF and the remaining dredged material was deposited at the DSDG approximately 6 km south-east of the LNG dredged area. The Commonwealth Sea Dumping Permit (SD2004/0030) provided approval to dispose of up to 8.5 million m^3 of dredged material. The dredged material was transported by hopper barge or Trailer Suction Hopper Dredge from the dredge location to the DSDG.

The dredging program was undertaken in two stages. The first stage included:

- dredging the MOF area
- constructing the MOF using a combination of reclaimed material and material from the site excavation
- dredging berth pockets in the LNG turning basin to allow construction of the LNG berths.

The second stage of construction involved completing the remainder of dredging associated with the LNG access channel and turning basin.

2.2 Activity Overview

The planned activities and schedule associated with the construction of the Marine Facilities on the east coast of Barrow Island are provided in the 'Description of Works' section of the Marine Facilities Construction Environmental Management Plan (Chevron Australia 2009a). The planned activities and indicative schedule associated with the dredging program are provided in the Dredging and Spoil Disposal Management and Monitoring Plan (Chevron Australia 2009b).

Table 2-1 summarises the marine construction activities completed to date.

Table 2-1 Gorgon Project Marine Construction Activities

Activity	Description of Scope of Activities	Start Date	Status
Mooring installation	Installing operational vessel moorings in approved locations within the Barrow Island Port.	January 2010	Ongoing (as required)
MOF	Constructing the Pioneer MOF Platform, MOF Causeway, and extension to the Full MOF (includes creating bunds, laying geotextile lining, placing core material, installing rock and concrete armour, berthing and heavy lift facilities).	July 2010	Ongoing
Dredging and Spoil Disposal Activities	Dredging the MOF and LNG Jetty area. Dredged material was used in construction of the MOF or deposited at the DSDG.	May 2010	Complete (November 2011)
LNG Jetty	Preparing the seabed; placing foundation gravel layer; installing caissons, trestle structure, and loading platforms.	February 2012	Complete (August 2015)

3.0 Existing Environment

3.1 Site Description

The central east coast of Barrow Island is a sheltered, low-energy environment consisting of sandy beaches, small rocky headlands, and a wide intertidal rock platform. The MOF Causeway connects to Barrow Island at Town Point, which is a rocky headland situated between Terminal Beach to the north and Bivalve Beach to the south. The geology of Town Point consists of low, subvertical limestone cliffs (up to 5 m high), with rock fall debris and coastal sea-cut caves. Terminal and Bivalve beaches are both bay beaches, approximately 600 m long, situated between rocky headlands and upon a broad, gently graded rock platform, which extends approximately two to four km seaward (Kellogg Joint Venture Gorgon [KJVG] 2008).

Inga, Yacht Club North, and Yacht Club South beaches are all located south of Bivalve Beach. Inga Beach is separated from Bivalve Beach by a wide rocky headland; Yacht Club North is separated from Inga Beach by an exposed rock platform and intermittently flowing creek; and Yacht Club South is separated from Yacht Club North by a rarely flowing creek. Yacht Club South is bounded to the south by Camp Point, a large rocky headland. Inga Beach is short and linear (approximately 600 m long), while the Yacht Club beaches are long and linear (approximately 2000 m long in total). All beaches are underpinned by the same broad, gently graded rock platform that characterise Terminal and Bivalve beaches.

The typical (simplified) cross-shore profile (Figure 3-1) of the east coast beaches consists of an active beach face, crested by a berm (crest of beach face). A narrow foredune area lies above the crest of beach face, consisting of a series of low-level, sparsely vegetated hummocks. Landward of the foredune area is a steep primary dune, typically between 5 m and 8 m high. Historic aerial photography indicates a relatively stable sparse vegetation line present on the foredune area, and a dense vegetation line located on the primary dune (Worley 2004; KJVG 2008; Appendix 1).

The coastal dune system is an 'Ecological Element' of the Barrow Island environment, identified as a 'physical landform' under Condition 6.1.viii of Statement No. 800 and Condition 5.1 viii of EPBC Reference: 2003/1294 and 2008/4178. The ecological importance of sandy beaches in the region is primarily related to their significance for marine turtle nesting, seabird nesting, roosting, and foraging, and as foraging areas for terrestrial species, such as the Perentie (*Varanus giganteus*), Brushtail Possum (*Trichosurus vulpecula*), Golden Bandicoot (*Isoodon auratus*), and Water-rat (*Hydromys chrysogaster*).

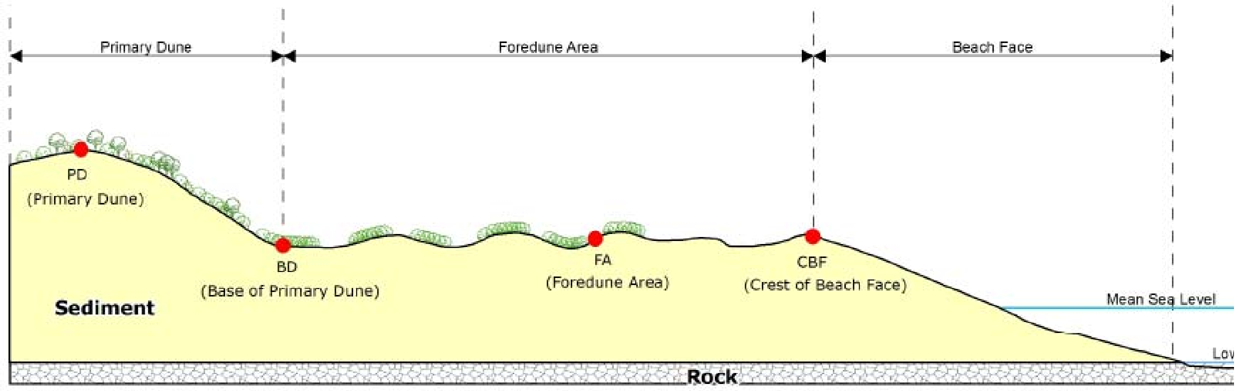


Figure 3-1 Typical Cross-shore Beach Profile on the East Coast of Barrow Island

3.2 Meteorological and Oceanographic Conditions

3.2.1 Winds

Barrow Island has two dominant seasons—wet and dry—separated by transitional periods of up to approximately one month. These seasons are characterised by distinct wind regimes, with the shorter dry season wind pattern punctuating the otherwise dominant wet season pattern of westerly and south-westerly winds persistent from September through to the end of March. The dry season, generally between April and August, can be more variable with significant periods of strong easterly and southerly winds. Quarterly wind roses for the period of coastal stability monitoring at Barrow Island are shown in Figure 3-2 to Figure 3-5.

3.2.2 Storms and Tropical Cyclones

Barrow Island is in a region of high tropical cyclone frequency, with approximately four cyclones per year (on average) passing within 400 nm of Barrow Island between November and April (MetOcean Engineers 2006). Between April and August, easterly storms are generated, resulting in prolonged periods of easterly gales (12.5 to 20 m/s) (KJVG 2008).

Waves and elevated water levels generated by storms and tropical cyclones are the most likely conditions under which significant changes to the shoreline and beach profile can occur. Storm surges elevate water levels, exposing higher sections of the beach not normally vulnerable to wave influence (KJVG 2008). The beaches around Town Point are sheltered by the land mass of Barrow Island from storm and cyclone waves from the north-west to north-east. The waves must diffract around Barrow Island, resulting in smaller incident waves (and therefore reduced wave energy). The waves are further limited as there is reduced set-up in the water levels, resulting in greater depth limitation of waves across the rock platform. The restricted wave climate reduces the potential for sediment transport. The Lowendal Shelf to the north-east and the more northerly Montebello Islands provide sheltering through depth limitation of waves from the north.

Storms and cyclones that generate winds from an easterly direction have the most potential for generating storm waves at the east coast beaches of Barrow Island; the aspect of these beaches provides shelter from storm surges generated from the west (KJVG 2008; RPS Metocean 2008).

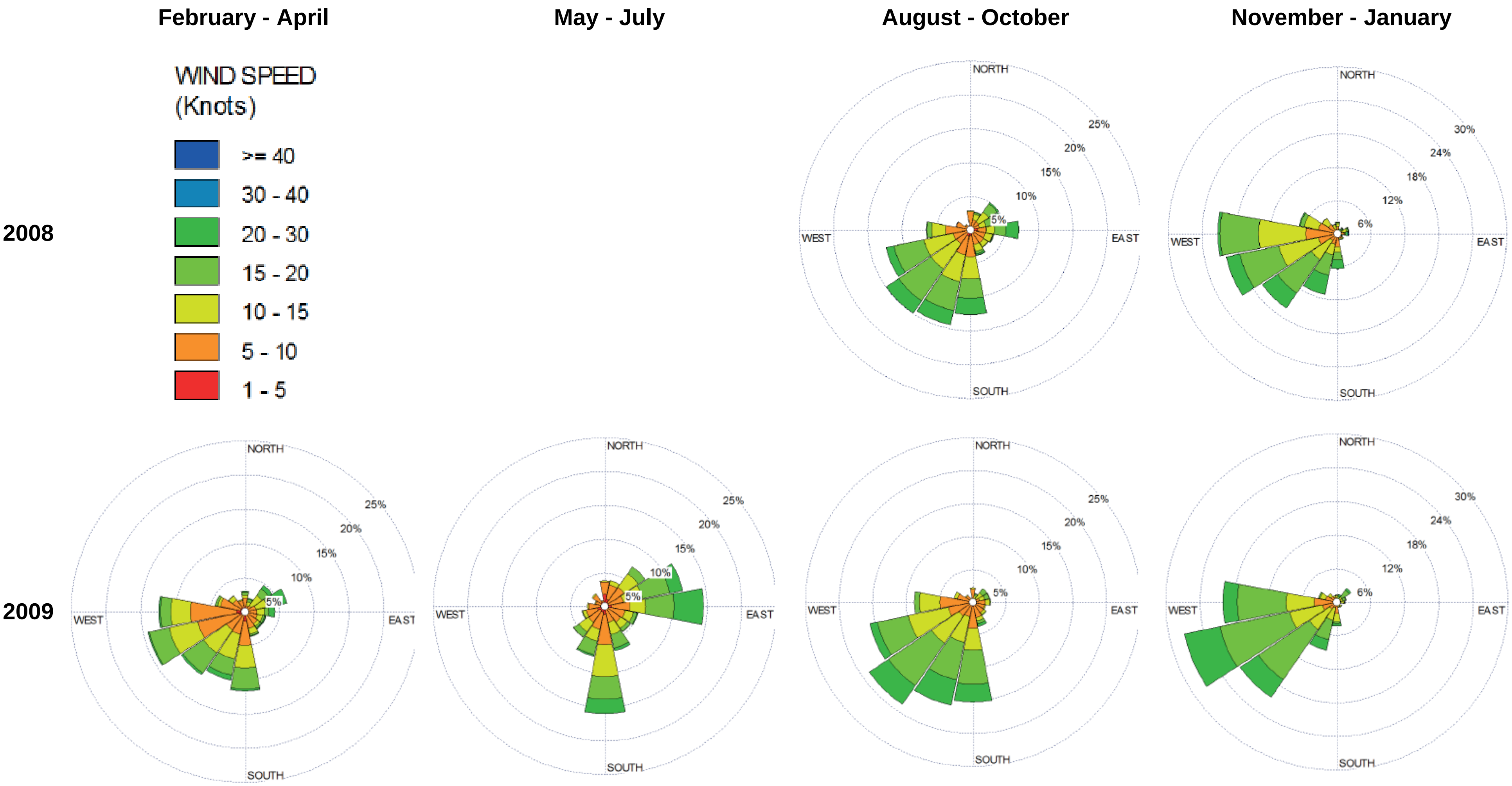


Figure 3-2 Quarterly Wind Roses for Barrow Island from 2008 to 2009

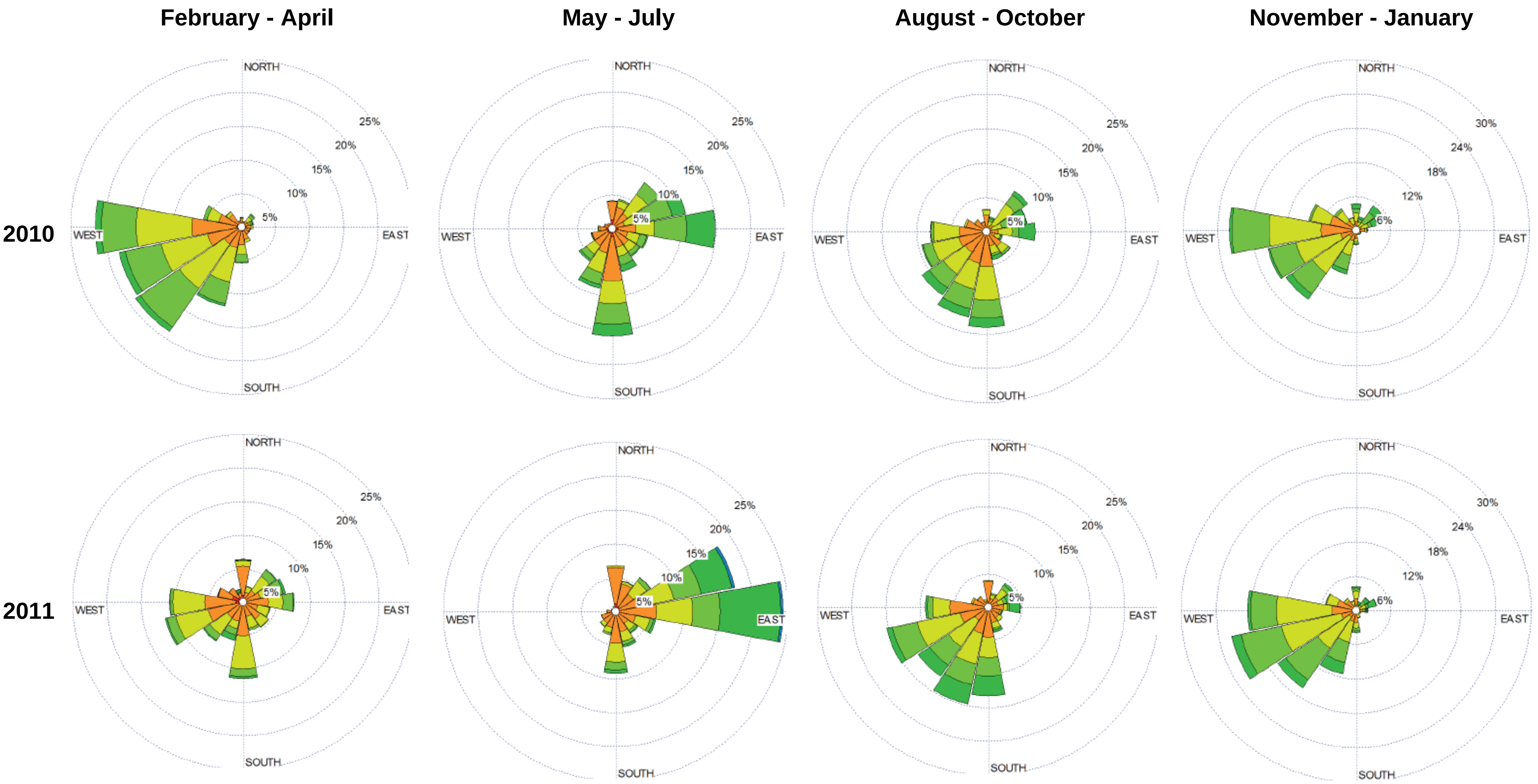


Figure 3-3 Quarterly Wind Roses for Barrow Island from 2010 to 2011

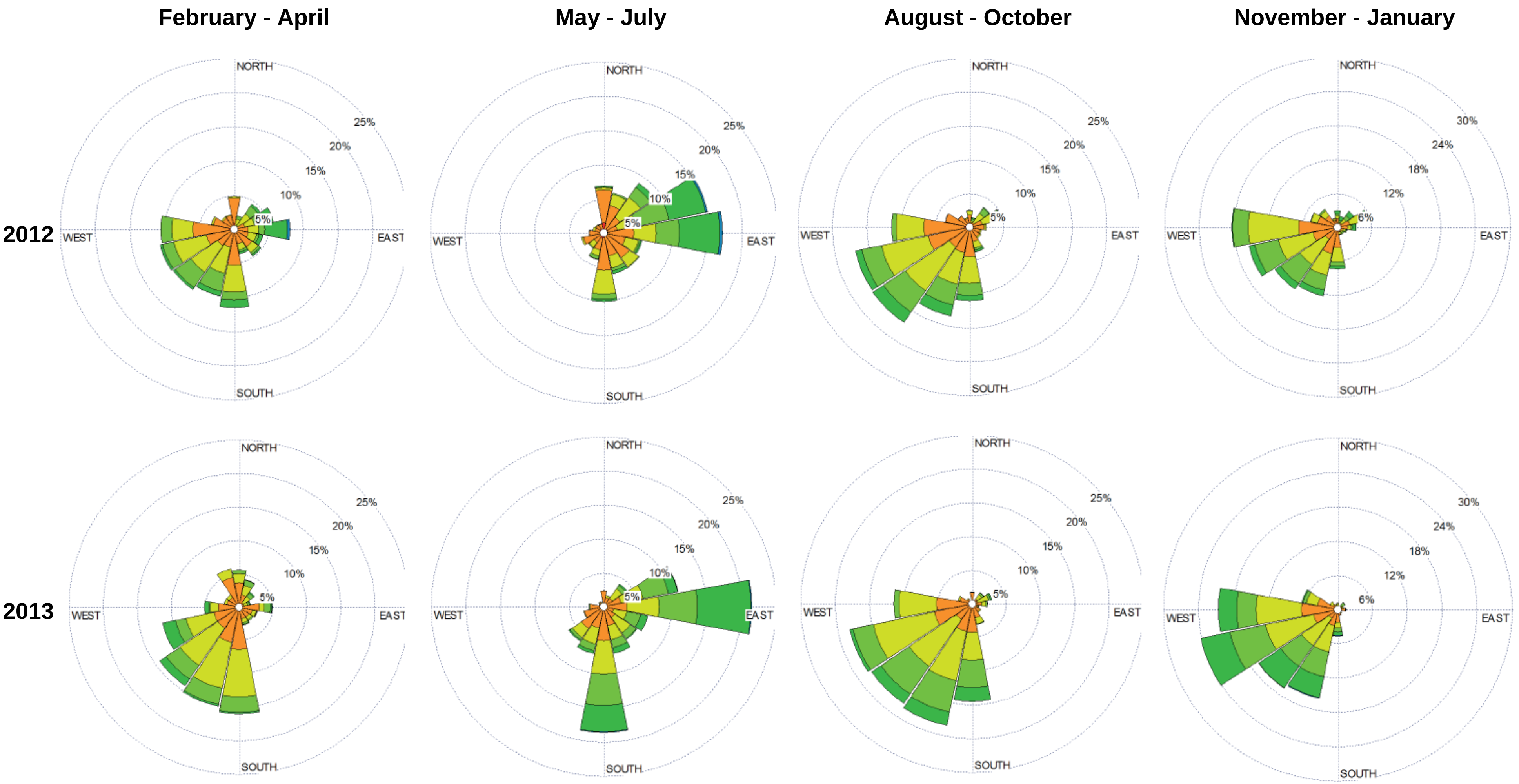


Figure 3-4 Quarterly Wind Roses for Barrow Island from 2012 to 2013

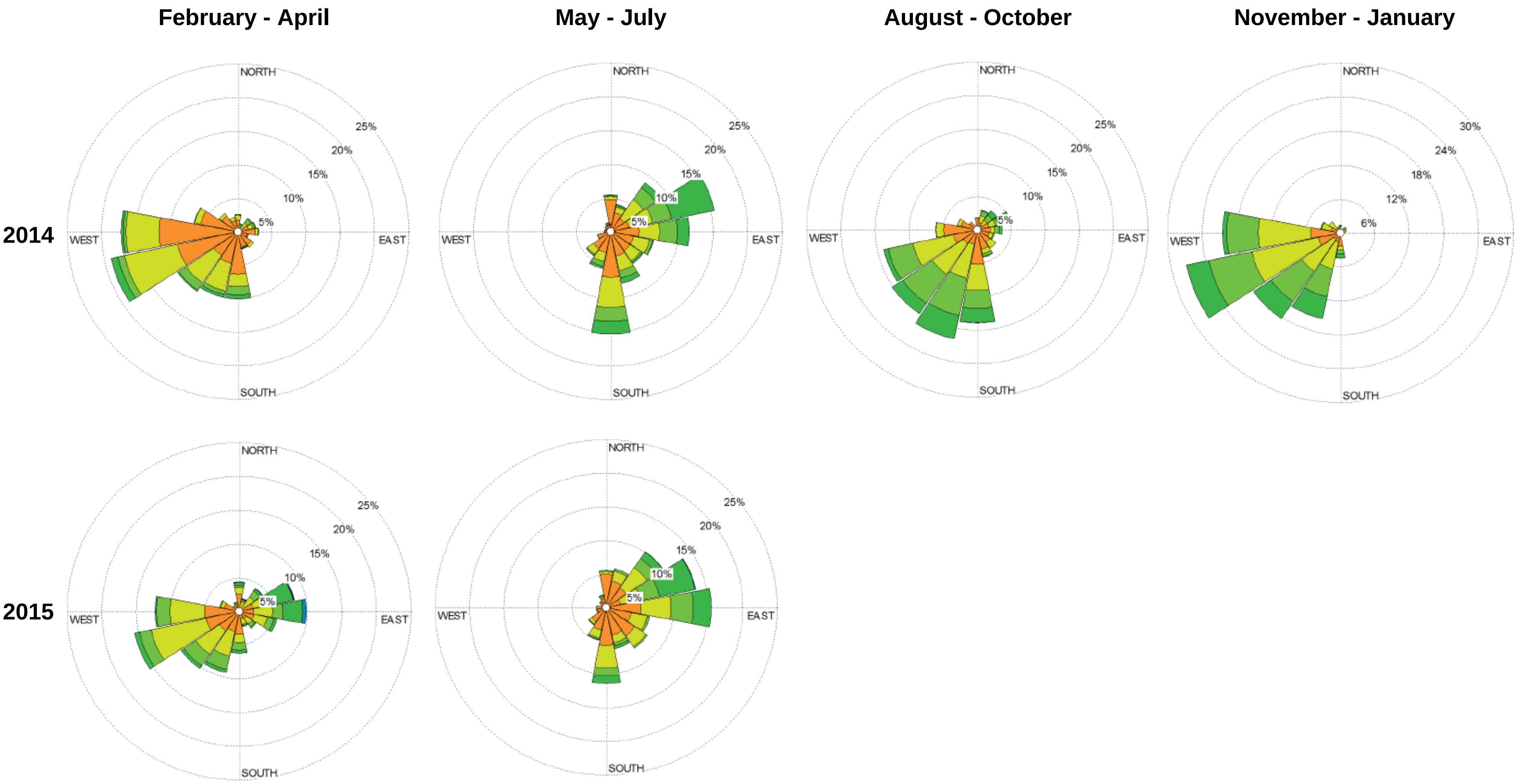


Figure 3-5 Quarterly Wind Roses for Barrow Island from 2014 to 2015

3.2.3 Tides

The tides at Barrow Island are semidiurnal. The tidal range varies significantly around Barrow Island with a maximum spring tide range on the east coast of 4.75 m, while on the west coast the tidal range is less than 2.5 m (Australian Geological Survey Organisation 1998; Australian Hydrographic Service 2008; KJVG 2008). The difference in tidal amplitude is caused by the difference in bathymetry. On the east coast, the sea floor is shallow and gently sloping, while on the west coast, the sea floor drops steeply to the edge of the continental shelf. This causes a variation in the propagation of the tidal waves around Barrow Island. The significant tidal ranges and shallow bathymetry result in large areas of exposed seabed on the east coast of Barrow Island at low tide (West Australian Petroleum 1989).

There is a significant change in tidal amplitudes around Barrow Island where, for example, the main lunar tidal constituent, M2, undergoes a 100% change in amplitude from one side of the island to the other. This variation is due to the varied propagation of the tidal wave around Barrow Island where the eastern side bathymetry is very shallow and the western side bathymetry slopes away to the shelf edge.

As a result of the shallow bathymetry, the flood tide cannot fully propagate to the coast across the Barrow Shoals or through the channel(s) between Barrow Island and the Montebello Islands, and a large water flux is forced northward along the western side of Barrow Island and then flows to the coast around the northern end of the Montebello Islands. This produces a southward-flowing flood tide on the east coast of the Montebello and Barrow Islands. There is a region near the south-eastern end of Barrow Island where this flow meets the flow coming across the Barrow Shoals and they join up to flow towards the coast.

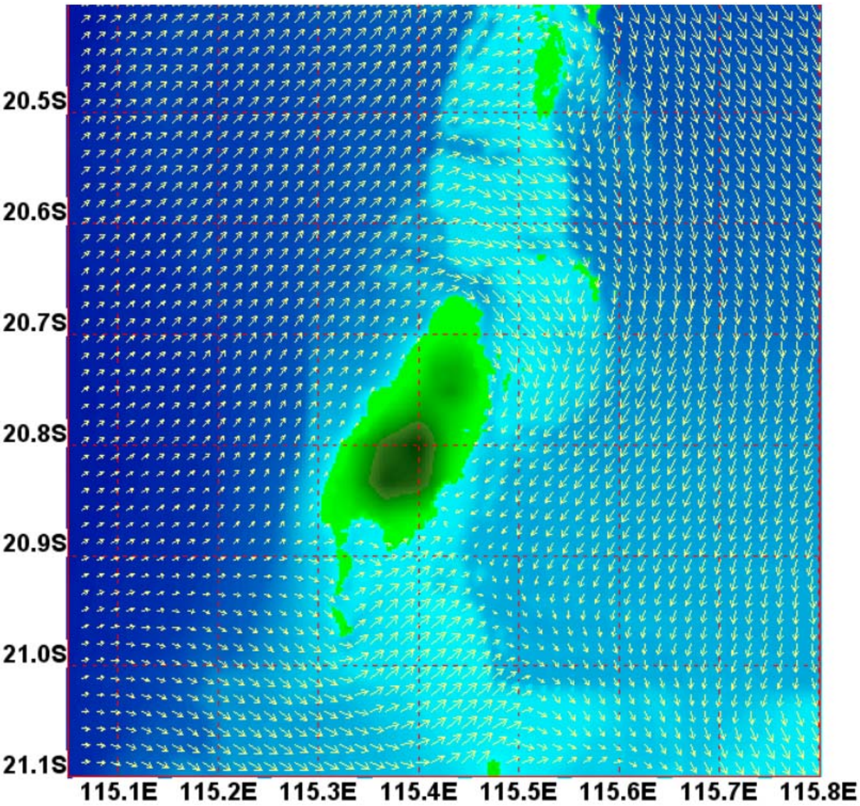
The ebb tide behaves approximately in reverse and most of the water flux flows up the eastern side of the Lowendal Shelf and around the northern end of the Montebello Islands. This is the major flushing mechanism from the eastern side of Barrow Island to the open sea.

3.2.4 Currents

The instantaneous current patterns on the eastern side of Barrow Island are strongly dominated by the barotropic tide and its spring–neap cycle. However, longer-term transport over the inner- and mid-shelf are mainly controlled by wind-driven currents, which follow the seasonal switch from summer monsoon winds to south-easterly trade winds in winter. The currents on the eastern side of Barrow Island can be quite strong due to the tidal mechanisms. However, on the western side of Barrow Island the balance of the driving forces for ocean currents can be more complex. The tidal currents are weaker, particularly in the deeper waters, but satellite imagery indicates that phenomena associated with large-scale ocean circulations in the Indian Ocean, such as eddies and other geostrophic flows, can impinge on the region.

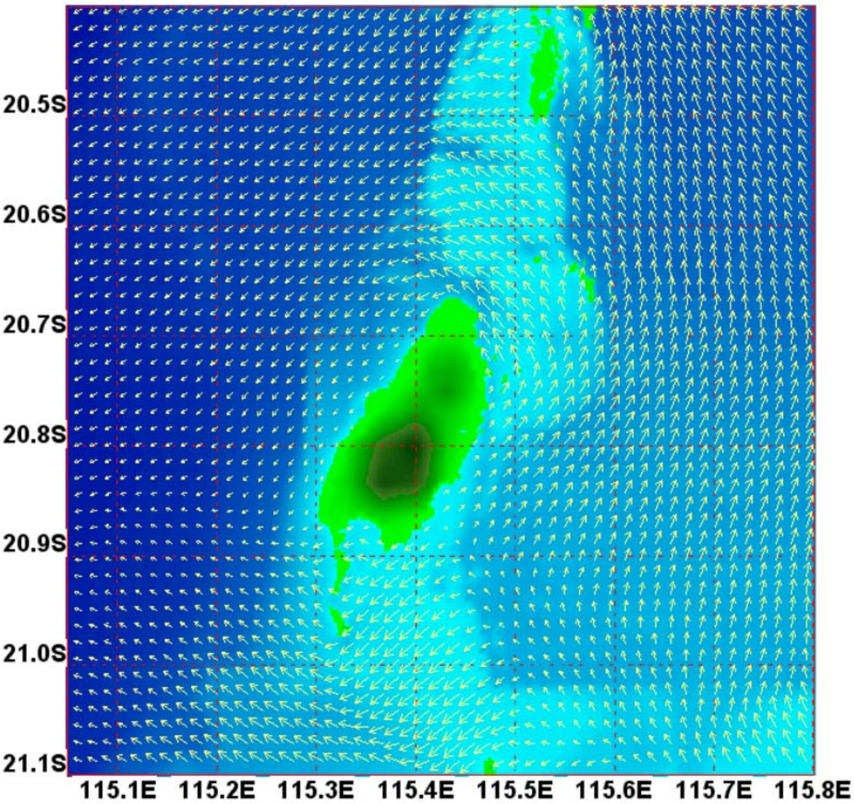
Sample flood and ebb currents around Barrow Island from the verified modelling undertaken by Global Environmental Modelling Systems (2007) are shown in Figure 3-6 and Figure 3-7.

Current measurements at the tanker mooring (situated 9 km off the east coast of Barrow Island) confirm the tidal nature of these currents, reflecting a distinct flood flow towards the south-west and an ebb flow towards the north-east (Figure 3-8) (Chevron Texaco Australia 2003). The maximum current speed measured at the tanker mooring is 0.62 m/s.



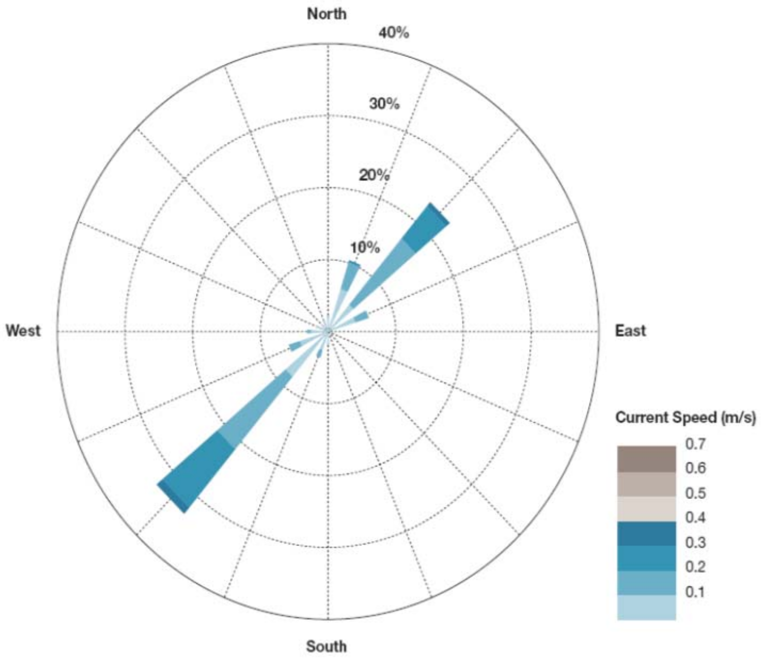
Source: Global Environmental Modelling Systems 2007

Figure 3-6 Example of the Flood Tide near Barrow Island



Source: Global Environmental Modelling Systems 2007

Figure 3-7 Example of the Ebb Tide near Barrow Island



Source: Chevron Texaco Australia 2003

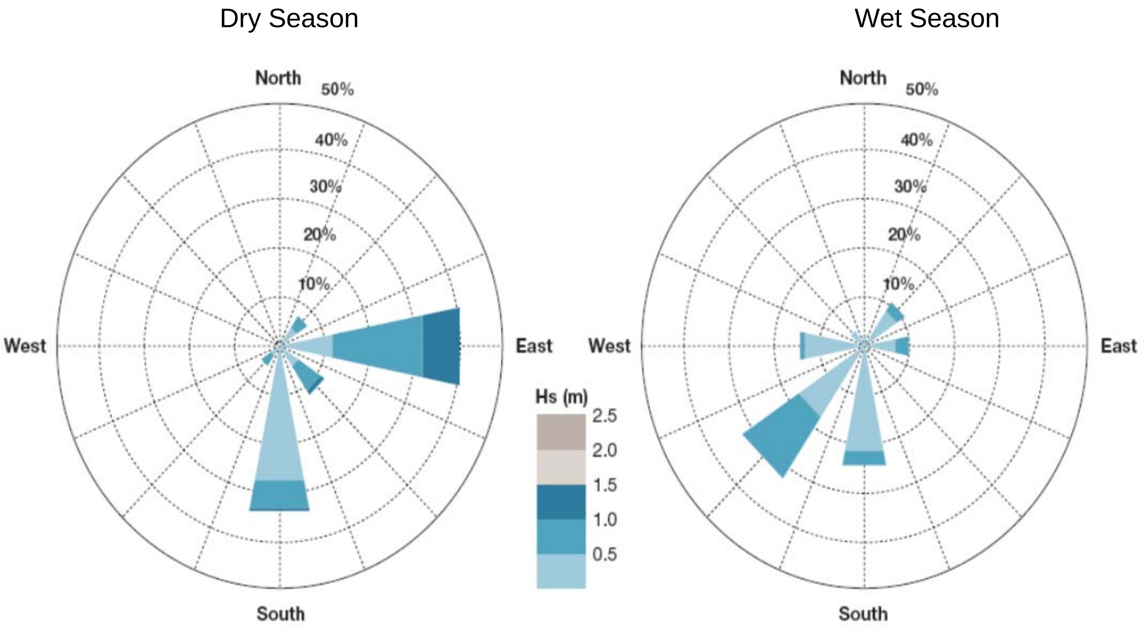
Figure 3-8 Example Surface Currents (wet season) Measured at the Tanker Mooring, 9 km East of Barrow Island

3.2.5 Waves

The western side of Barrow Island is exposed to the open ocean and a relatively vigorous wave climate bringing long-period southern ocean swells and shorter period local wind waves, particularly during times of sustained southerly winds. At times, the southern ocean swell can refract around the northern and southern ends of Barrow Island but the shallow bathymetry prevents significant propagation (Chevron Texaco Australia 2003).

The east coast beaches of Barrow Island are largely sheltered from most ocean swells as a result of their aspect, the Lowendal Shelf, and the shallow bathymetry between Barrow Island and the mainland (Chevron Texaco Australia 2003; KJVG 2008). During the wet season, the nearshore wave climate is dominated by south-westerly and southerly waves, while in the dry season the wave climate is southerly and easterly (Figure 3-9). At Town Point, wave heights typically range between 0.2 and 0.5 m (RPS Metocean 2008). The mean significant wave height at the MOF is 0.47 m, with a maximum wave height of 2.11 m.

Given the available fetch off Town Point, only easterly winds, in combination with high tides, are capable of producing moderate waves on the east coast (Damara 2006). Wave energy approaching the east coast of Barrow Island is attenuated by the nearshore rock platform (KJVG 2008; RPS Metocean 2008), and therefore wave energy reaching the beaches is generally low. The nearshore rock platform also refracts the waves so that they arrive perpendicular to the shoreline, limiting the potential for longshore sediment transport (KJVG 2008; RPS Metocean 2008).



Source: ChevronTexaco Australia 2003

Figure 3-9 Combined Wave Field Data from the Tanker Loading Facility, 9 km east of Barrow Island

3.3 Coastal Processes

Beaches are dynamic environments and beach morphology can change over a range of spatial (both between beaches and within beaches) and temporal (seasonal, interannual, sub-decadal, decadal, to multi-decadal) scales in response to a number of coastal processes (e.g. daily or weekly variations in tidal level or wave climate; seasonal and storm-induced variations in wave climate). No long-term data (ten to 30 years) on beach morphology are available for the Barrow Island east coast beaches.

3.3.1 Background

The beaches on the east coast of Barrow Island are sheltered, low-energy, perched (underpinned by rock), and separated by small rocky headlands. Perched beaches tend to be generally stable under ambient conditions, but can be highly dynamic under elevated water levels (Damara 2006; Trenhaile 2004). Each of the rocky headlands bounding the east coast beaches represents a sediment cell[1] boundary, which constrains sediment movement in or out of the cell under ambient conditions. The relatively linear nature of the beaches, and their gradient, suggests that they are wave dominated (Damara 2006). Wave-dominated beaches tend to be quick to respond to storm-induced changes, provided that net sediment loss has not occurred (Damara 2006).

Sediment supply to the beaches is generally limited (Fugro 2003, 2006), with either a very thin (5 to 30 cm) or absent sediment layer over the nearshore rock platform. Offshore sediments consist of carbonate sand with shells and shell fragments, and a minor proportion of silts and clays. Sources of beach sediments are likely to be:

- abrasion of corals, shells, the rock platform, and headlands (marine sources)

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[1] A sediment cell is delineated by a source, sink, and transport path operating between fixed (e.g. headlands, structures) or fluctuating boundaries (e.g. variations in wave forcing or shoreline response) (Carter 1988).

- alluvium washed down Barrow Island creeks to the shoreline following rainfall events (terrestrial sources).

The primary source of sediments to the dune system is believed to be from ephemeral creek discharges to the ocean after extreme rainfall events (KJVG 2008; RPS MetOcean 2008). Aerial photographs of the beaches clearly indicate sand deltas at creek mouths. Once the sand discharged from the creeks is washed onto the beach face, the consistent sea breeze will push the sand back onto the dune systems over time. The dune vegetation captures the sand and prevents wind erosion. The lack of clear offshore sedimentary features and accretion further indicates that there is no major offshore sediment source (KJVG 2008). Furthermore, the magnitude of littoral transport along the east coast of Barrow Island is restricted by the effect of headland control on bay planform, the limited sediment supply, the limited range of wave approaches across the rock platform, and the low ambient currents in the tidal convergence zone that occurs on the east side of Barrow Island (KJVG 2008).

No long-term (ten to 30 years) directly measured data on beach morphology are available for the Barrow Island east coast beaches. A series of historic aerial photographs of the shoreline near Town Point were examined (1991, 1994, 1997, 1999, 2001, 2005, 2008; Appendix 1). Visual analysis demonstrated that there was likely no net erosion or accretion of Terminal or Bivalve beaches, or around the headland features, indicating that the shoreline had been relatively stable over this time frame (Worley 2004; KJVG 2008). Vegetation lines visible on the aerial photographs (Appendix 1) can also be used to assess to assess historic shoreline change where surveys are unavailable (Camfield and Morang 1996). Small-scale changes related to interannual cyclone frequency were observed in the vegetation lines. However, these may have been the result of both sediment volume changes and physical removal during extreme events, and/or also attributable to unrelated factors such as seasonal changes or drought.

3.3.2 Predicted Impacts

Desktop studies predicted that construction of the MOF would create a sheltered zone on either side of the MOF, where there is limited capacity for sediment transport (Worley 2004; Damara 2006). It was predicted that sediment captured in the shelter zone would represent material lost from the beaches, and consequently there would be a realignment of the beaches, with sediment gain closest to the MOF and sediment loss furthest from the MOF (Worley 2004; Damara 2006). The extent of erosion at the furthest ends of the beaches was not expected to move beyond the dense vegetation line, and net loss of vegetation was unlikely (Worley 2004). Based on the prevailing wave climate, Terminal Beach was expected to have the greatest adjustment, whereas the adjustment at Bivalve Beach would be smaller. Larger adjustments were predicted to take place over the dry season (Worley 2004).

Sediment transport and circulation modelling prior to construction assessed the potential impact of the MOF on ambient circulation and wave patterns, ambient sediment transport characteristics offshore from the surf zone, stability of the shoreline during ambient conditions, and stability of the shoreline during cyclonic conditions (MetOcean Engineers 2006; KJVG 2008; RPS MetOcean 2008). This modelling also predicted a shadowing effect caused by the presence of the MOF, but predicted that construction of the MOF was unlikely to have a significant effect on coastal processes and was not expected to cause significant accretion or erosion of the shoreline.

Monitoring since construction of the MOF has broadly confirmed the predictions of Worley (2004) and Damara (2006), with longshore redistribution of sand towards the MOF occurring at both Terminal and Bivalve Beaches as a result of the presence of the MOF. The greatest changes have occurred across the beach face, in the active wave zone, with minimal evidence of change in the back shore and foredune area. Overall, the greatest changes occurred in 2011 and 2012, particularly during periods of strong easterly winds, as the beaches adjusted to the new headland control location created by the MOF. The rate of sand redistribution appears to have decreased since 2012, indicating that further changes may be incremental and more aligned with regional variation in metocean conditions.

Despite these changes, at no stage has there ever been significant adverse impacts to the stability of the beaches as the foredune and vegetation lines have remained unaffected. Changes to the beaches have not resulted in detectable impacts to marine turtles nesting on the beaches (3.4.3).

3.4 Marine Turtles

3.4.1 Background

Six species of marine turtle are known to be present in the Montebello/Barrow Island region, all of which are protected under the International Bonn Convention, the Commonwealth EPBC Act, and the Western Australian *Wildlife Conservation Act 1950*:

- Green Turtle (*Chelonia mydas*)
- Flatback Turtle (*Natator depressus*)
- Olive Ridley Turtle (*Lepidochelys olivacea*)
- Loggerhead Turtle (*Caretta caretta*)
- Hawksbill Turtle (*Eretmochelys imbricata*)
- Leatherback Turtle (*Dermochelys coriacea*).

Barrow Island is a regionally important nesting area for Flatback Turtles (east coast beaches) and Green Turtles (west coast beaches). Hawksbill Turtles nest at low densities around Barrow Island and Loggerhead Turtles have only been recorded occasionally (Chevron Australia 2014a). Further information on the ecology and biology of Barrow Island turtles can be found in the Long-term Marine Turtle Management Plan (Chevron Australia 2014a).

The estimated size of the total Green Turtle reproductive population at Barrow Island is approximately 20 000 females, with a similar level of nesting in the Montebello Group (Pendoley 2005) and as such is of regional significance (Prince 1994) and potentially of significance to the Western Australian stock. Green Turtles favour the west and north-east coasts of Barrow Island where beaches are characterised by high energy, deep, steeply sloped, sandy beaches with an unobstructed foreshore approach (Pendoley 2005). Most Green Turtles nest on Barrow Island between December and February, with hatchling emergence occurring from February to March (Chevron Australia 2014a).

The east coast beaches support an estimated annual population of 1400 nesting female Flatback Turtles. These beaches are preferred by Flatback Turtles due to their sandy, gently sloping gradient, low energy, and wide, shallow intertidal zones (Pendoley Environmental 2008). Terminal, Bivalve, Mushroom, and the Yacht Club beaches support the highest nesting densities (Chevron Australia 2005), with lower nesting density on Inga Beach and other south-western, northern, and north-eastern beaches (Pendoley Environmental 2009). The nesting season for Flatback Turtles occurs mainly during December and January, with peak hatchling emergence occurring during February and March (Chevron Australia 2014a).

3.4.2 Nesting Characteristics

The general requirements of a marine turtle nesting beach are that:

- the beach is accessible from the ocean and is elevated enough to prevent inundation of the eggs by tides or the water table
- the sand composition allows the nest to be constructed without collapse, and allows gas diffusion (Mortimer 1982; Pendoley Environmental 2008).

Beach slope, aspect, and sand particle size can also influence nesting behaviour. Green and Loggerhead Turtle nesting is highest in uniformly sorted, medium-sized sands, and nests are more likely to collapse if the sand is coarse or dry (Mortimer 1990). There is very limited information on the influence of sand particle size on Flatback Turtle nesting.

The nest of a marine turtle is defined as the area below the surface of the sand comprising the egg chamber and the neck of the chamber. Surveys of nests on Barrow Island east coast beaches (1616 records) indicate that 39% of nests are situated above the high tide level between the crest of the beach face and the start of the vegetated foredune, 30% along the front edge of the vegetated foredune, and 23% scattered through the vegetated foredune (Pendoley Environmental 2006). The average depth of a Flatback Turtle nest is approximately 64 cm (Pendoley Environmental 2007). There is considerable sand disturbance during the turtle nesting season, with the turtles excavating large body pits to lay their eggs (KJVG 2009). This sand movement is dynamic and localised, with no net shoreline change.

The sediment characteristics of the east coast beaches make them ideal nesting beaches, given the availability of deep, loose sand above the high tide mark and favourable physicochemical (i.e. moisture content, pH, organic matter content) and physical (i.e. particle size, density) conditions (Pendoley Environmental 2008).

3.4.3 Potential Effects of Beach Structure and Beach Sediment on Turtle Nesting and Nest Success

Changes in beach structure and beach sediment characteristics can potentially have significant effects on turtle nesting and nest success. Characteristics, such as beach slope, sediment particle size, substratum compactness, vegetation coverage, air temperature, and precipitation are all factors known to influence nesting site selection by female turtles (Mortimer 1982, 1990; Johannes and Rimmer 1984; Miller 1996; Karavas *et al*. 2005; Wood and Bjorndal 2000; Kikukawa *et al*. 1999; Chen *et al.* 2007). While there has been some research undertaken to identify the characteristics of beaches that make them suitable for turtle nesting (Johannes and Rimmer 1984; Wood and Bjorndal 2000; Kikukawa *et al*. 1999; Chen *et al.* 2007), as yet there is no clear published method based on coastal morphology for identifying those beach characteristics that provide suitable nesting habitat (Global Environmental Modelling Systems 2008).

Beach selection and emergence are thought to largely depend on offshore cues and beach characteristics such as slope (Provancha and Ehrhart 1987; Horrocks and Scott 1991), while nest placement is thought to be driven by visual cues such as the berm scarp and vegetation line (Blamires *et al.* 2003; Bustard 1972). Beach erosion can adversely impact turtle nesting activities by physically removing the nesting beach sand or by forming sand scarps that restrict access to the supratidal sand (Nelson and Blihovde 1998; Pendoley Environmental 2008a). Similarly, exposure of underlying rock through erosion may also limit access to the foredune area. Such a reduction in preferred nesting area, or access to it, may cause female turtles to return to the ocean without nesting or force nesting females to lay eggs below the high tide water level, where they are more susceptible to frequent and prolonged tidal inundation. Studies undertaken at Cape Dommett in northern Western Australia found that change in nest depth by as much as 30 cm as a result of sand loss had no significant effect on Flatback Turtle hatchling success, emergence success, or escape success (Koch *et al.* 2007).

Beach sediment characteristics are known to influence nesting site selection by female turtles as well as nest success. The nesting activity of Loggerhead (*Caretta caretta*) and Green (*Chelonia mydas*) Turtles has been reported to be highest in medium-sized and uniformly sorted sand (Mortimer 1990; Karavas *et al*. 2005) and nests were more likely to collapse if the sand was poorly sorted, coarse, or dry resulting in lower nesting success (Mortimer 1990; Ackerman 1996). Changes in ambient sand characteristics, such as average particle size, sediment density, moisture content, gas exchange, temperature, salinity and pH, and sediment permeability may also have significant effects on turtle nesting and nest success. For example, changes to particle size distribution may have negative impacts on nest structure as a result of beach hardening and the microclimate of the nest, which in turn influences the embryonic development of the eggs and hatchling emergence from the nest (Ackermann 1996).

Many biological, environmental, and anthropogenic factors can influence both hatching and emergence success. The successful deposition and incubation of eggs is also a function of beach structure and beach sediment characteristics, such as moisture content, gas concentrations, temperature, and beach slope, which in turn are influenced by the prevailing weather conditions, nest depth, sediment characteristics, and the aspect and exposure of the nesting site (Ackerman 1980; Packard and Packard 1988; Miller 1996; Wood and Bjorndal 2000). Embryonic growth, development, and survival (Horrocks and Scott 1991; Ackerman 1997; Mota and Peterson 2003; Trullas and Paladino 2007) and the rate of hatchling development, hatchling sex, hatchling size, mass, and energy reserves are all influenced by the physical and chemical characteristics of the nesting environment (Hendrickson 1958; Bustard and Greenham 1968; Ackerman 1980; Hendrickson 1980; Yntema and Mrosovsky 1982; Standora and Spotila 1985; Mortimer 1990; Peters *et al*. 1994; Packard and Packard 1988; Hewavisenthi and Parmenter 2001; Booth and Astill 2001; Matsuzawa *et al*. 2002). Clutch survival of Green Turtles has been reported to be lower on beaches with dryer, more poorly sorted sand, while lower hatching success was found with large sand particle size, high salinity, proximity to the surface, and proximity to the spring high tide level (Mortimer 1990).

The effects of cyclones and storm surges on beaches may also have a significant effect on turtles (Pendoley Environmental 2008a). The cyclone season at Barrow Island (November to April), overlaps the turtle breeding season (Pendoley Environmental 2008a). Nesting turtles and hatchlings may be disorientated by abnormal beach profiles, which can form as a result of storm surges (Koch *et al*. 2007). Eggs/embryos and hatchlings can be killed in the nest by inundation with sea water or altered sand depth over the nest (Agardy 1990; Minerals Management Service 2003), or saturated sand following cyclone or storm activity and heavy rainfall may prevent hatchlings escaping from the egg chamber (Pendoley Environmental 2008a). Accumulated beach debris may prevent access to nesting habitat (Hills 1992) and prevent hatchlings from escaping the nest (Agardy 1990). However, turtles have evolved a strategy to offset natural events such as tropical cyclones by laying large numbers of eggs and by distributing their nests both spatially and temporally (National Marine Fisheries Service and US Fish and Wildlife Service 2008).

Despite the observed changes to beach structure to October 2014 resulting in a reduced area of available nesting habitat, the changes have, to date, not resulted in a detectable impact to marine turtle biological indicators as:

- nesting success measures at Terminal and Bivalve Beaches are not significantly different between October 2014 and baseline (Pendoley Environmental, 2015a)
- hatchling and emergence success rates remain high across Terminal and Bivalve Beaches and statistically similar, or higher, during the construction period compared to baseline (Pendoley Environmental, 2015b)
- population parameters show a continued high nester abundance and survival probability for the Barrow Island rookery (Chaloupka, 2015)

3.5 Baseline State Information on Characteristics of Beaches Adjacent to Town Point

3.5.1 Overview

Baseline shoreline data were collected on five east coast marine turtle nesting beaches (Terminal Beach and Bivalve Beach adjacent to Town Point, and Inga Beach, Yacht Club Beach North, and Yacht Club Beach South) to establish the beach structure and beach sediment characteristics prior to the installation of the MOF and LNG Jetty. The baseline data from beaches were collected between Mean Low Water and the permanent vegetation line; and were collected at quarterly intervals between July 2008 and April 2010.

The following information was collected as part of the baseline program:

- beach profiles from the furthest possible seaward extent on the day of surveying (dependent on tides) to beyond the primary dune
- beach sediment particle size distribution (i.e. sand grain-size)
- beach sediment density (compaction)
- beach sediment moisture content.

The results from the baseline surveys are summarised below.

Note: The results from the baseline monitoring program have generated information on short-term and seasonal variability in beach structure and beach sediments; however, the datasets are insufficient to determine net medium- or long-term trends in shape, erosion, or accretion patterns.

3.5.2 Beach Structure

A selection of beach profiles are provided for Terminal Beach (T4, T11, T13, T19, T22, and T23; Figure 3-10), Bivalve Beach (B5, B11, B16, B21, B22, and B23; Figure 3-11) and the three reference beaches: Inga Beach (I1 and I2; Figure 3-12), Yacht Club North Beach (YCN1 and YCN2; Figure 3-13), and Yacht Club South Beach (YCS1 and YCS2; Figure 3-14). The figures represent an overlay of the recorded profiles for each survey. Surface elevation between measured points is inferred.

For all beaches, there was little change in the profile shapes of the transects surveyed (Figure 3-10 to Figure 3-14). The zone of greatest change on all transects was the active beach face, seaward of the crest of beach face and landward of the rock platform, where most wave action occurs. Localised changes occurred over the foredune area; these were most likely attributable to turtle nests and body pits. There were no clear seasonal patterns in the beach level; however, all beaches showed a slight trend of erosion at the southern end and accretion at the northern end over the baseline time period. For each beach, the greatest changes in beach level for the subset of transects shown were T23 (1.1 m), B5 (0.65 m), I2 (0.81 m), YCN2 (0.55 m), and YCS1 (0.39 m). All maximum changes were located over the beach face, except for YCN2, which was located over the foredune area.

Photographs of the beaches show a gently sloping beach face, and sparse vegetation cover over the low foredunes before higher primary dunes with denser vegetation (e.g. see Figure 3-15 and Figure 3-16 for Terminal and Bivalve beaches respectively). Some variation in sediment profile over the active beach face can be observed.

The full set of beach profiles and photographs taken during the baseline monitoring period (July 2008 to April 2010) are available within KJVG 2009 and KJVG 2010.

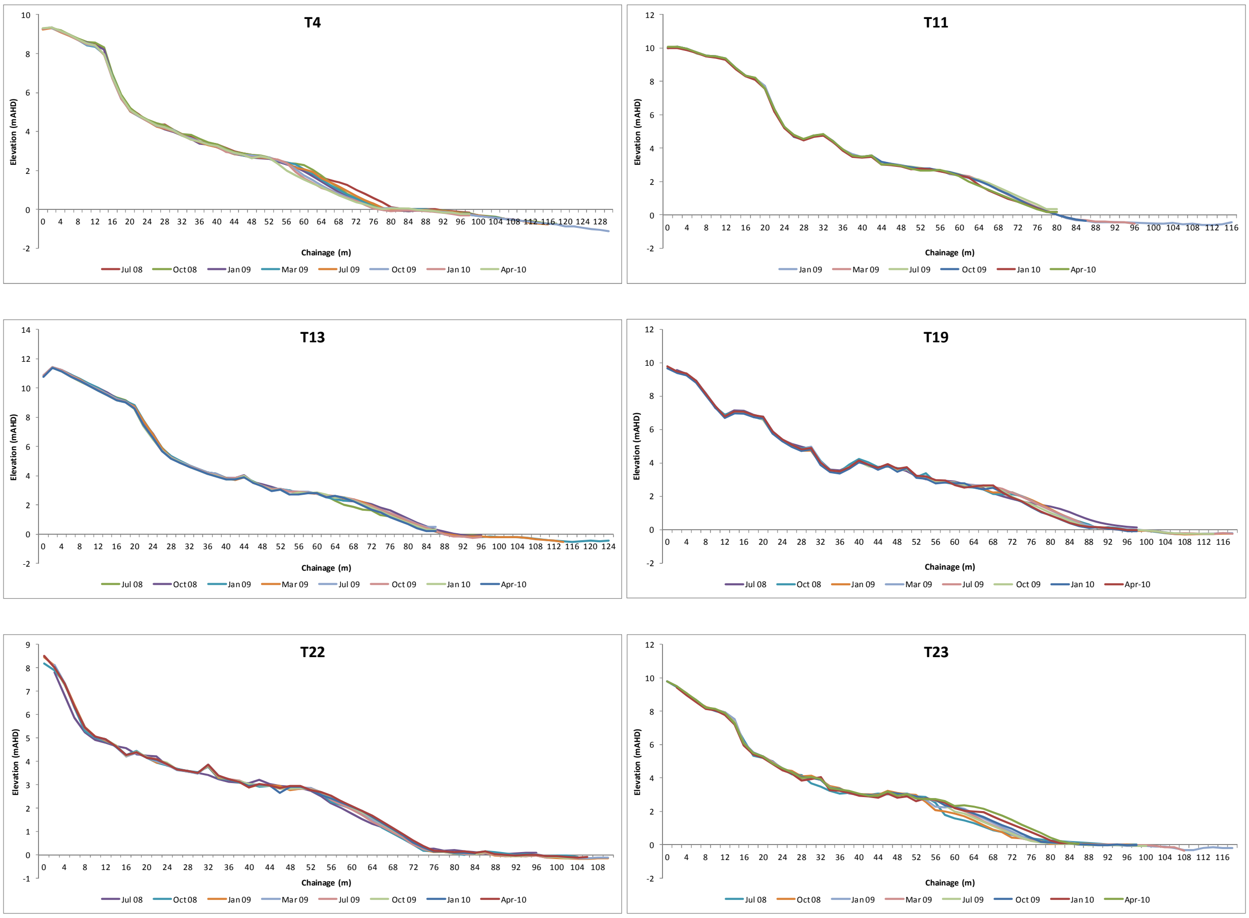

Figure 3-10 Baseline Beach Profiles for Terminal Beach, July 2008 to April 2010

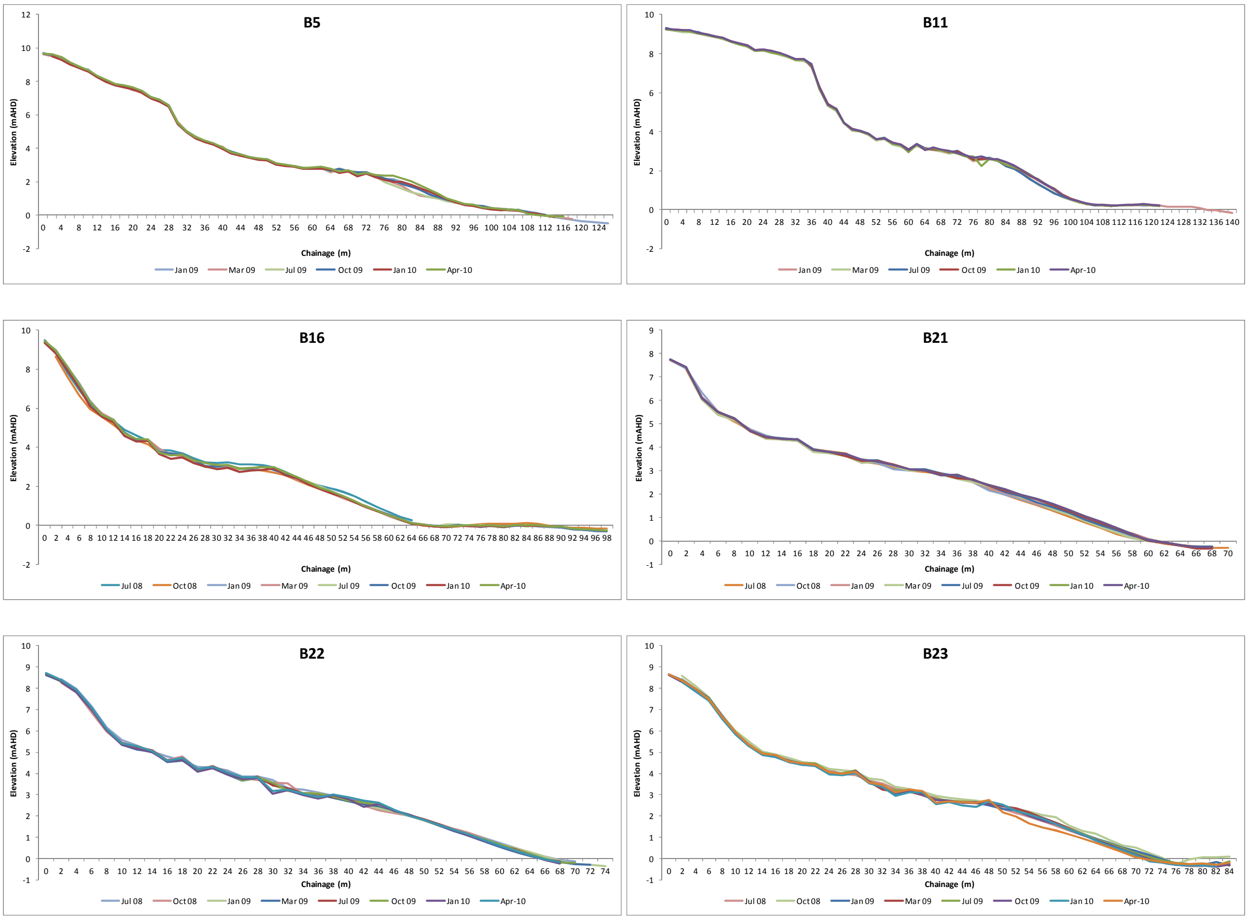

Figure 3-11 Baseline Beach Profiles for Bivalve Beach, July 2008 to April 2010

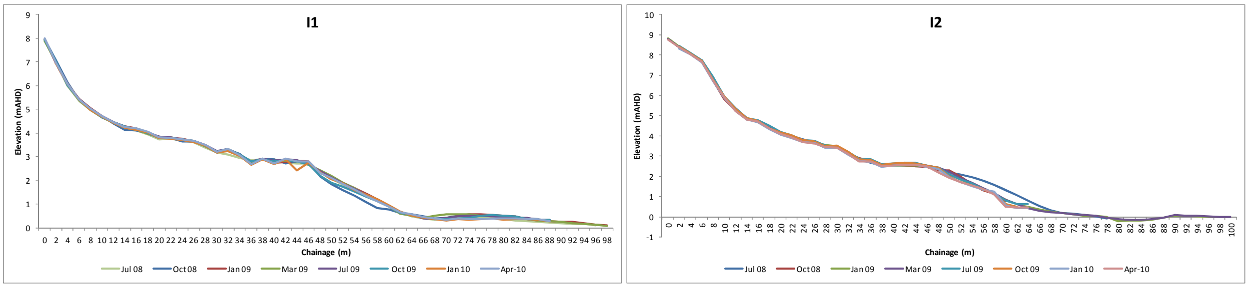

Figure 3-12 Baseline Beach Profiles for Inga Beach, July 2008 to April 2010

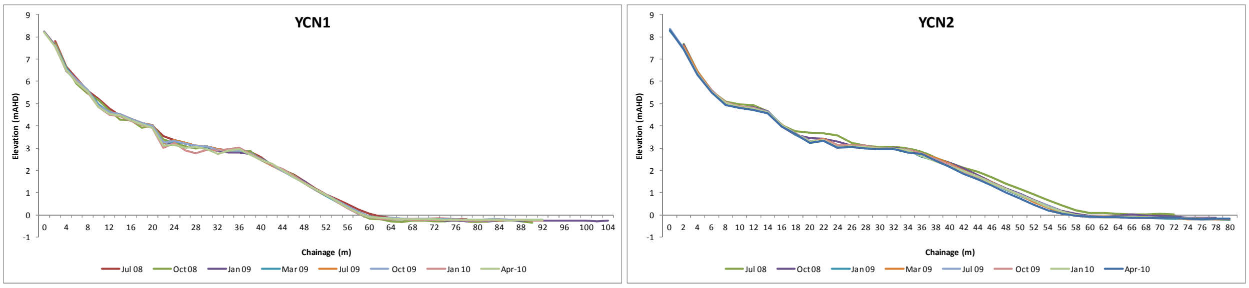

Figure 3-13 Baseline Beach Profiles for Yacht Club North Beach, July 2008 to April 2010

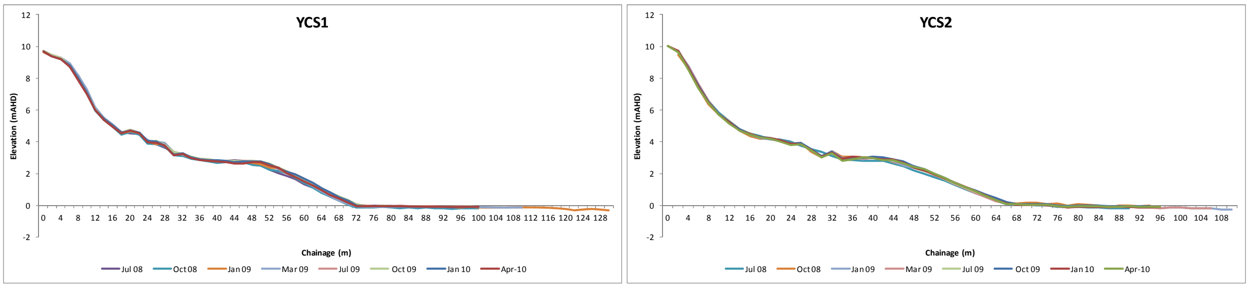

Figure 3-14 Baseline Beach Profiles for Yacht Club South Beach, July 2008 to April 2010

Terminal Beach – View North	
October 2009 Low Tide 0.73 m 04:27 Photo Taken: 07:19 High Tide 2.68 m 10:31 03/10/2009	April 2010 High Tide 3.26m 11:19 Photo Taken: 14:32 Low Tide 0.57m 17:44 15/04/2010
	
Terminal Beach – View South	
October 2009 High Tide 2.89 m 11:30 Photo Taken: 16:35 Low Tide 0.61 m 17:21 05/10/2009	April 2010 High Tide 3.26m 11:19 Photo Taken: 15:07 Low Tide 0.57m 17:44 15/04/2010
	

Figure 3-15 Elevated alongshore views of Terminal Beach in October 2009 and April 2010

Bivalve Beach – View North

October 2009	April 2010
High Tide 2.81 m 11:01 Photo Taken: 15:35 Low Tide 0.64 m 16:57 04/10/2009	Low Tide 0.89 m 05:33 Photo Taken: 08:14 High Tide 3.34 m 11:46 16/04/2009
	

Bivalve Beach – View South

October 2009	April 2010
Low Tide 0.23 m 06:54 Photo Taken: 08:01 High Tide 2.76 m 12:59 08/10/2009	Low Tide 0.90 m 05:59 Photo Taken: 07:32 High Tide 3.38 m 12:14 17/04/2010
	

Figure 3-16 Elevated alongshore views of Bivalve Beach in October 2009 and April 2010

3.5.3 Beach Sediments

The east coast beaches generally comprise poorly graded, medium to coarse grained sand, with low variability across all beaches and sample depths (KJVG 2009). Small amounts (7% to 32%) of fine material (clay/silt) were present, particularly in deeper samples collected at the crest of beach face and foredune area. Fine to medium grained gravels were also encountered, typically overlaying rock at the crest of beach face (KJVG 2009).

Perth Sand Penetrometer (PSP) testing indicated that the density of the beach sediments typically varied from loose to medium dense (KJVG 2009). Although silty/clayey sediments were encountered underlying the sand at some locations, any increase in PSP blow counts/150 mm recorded in this material was minor. This is likely to be due to the in situ moisture content of these sediments. Sediment density was generally consistent across all seasons sampled, with no marked changes in beach sediment density recorded at any of the sampling locations over the baseline monitoring period.

Moisture content of the sediments varied among beaches, position on the beach, depth, and season (KJVG 2009). The lowest moisture contents were generally recorded at sites further up the beach, and generally increased with depth. Moisture content is also a reflection of the tidal regime prior to the samples being collected, particularly at the crest of beach face; i.e. a recent high tide results in higher moisture content.

Sediment samples collected during the 2007–2008 turtle nesting season found that the sediments of the east coast beaches were alkaline (pH 9.1 to 9.3), with low total organic carbon content (Pendoley Environmental 2008).

The full set of beach sediment sample results collected during the baseline monitoring period (July 2008 to April 2010) are available within KJVG 2009 and KJVG 2010.

4.0 Risk Assessment

4.1 Overview

Chevron Australia has prepared the HES Risk Management: ASBU – Standardized OE Process (Chevron Australia 2012a) to assess and manage health, environment, and safety (HES) risks, which it internally requires its employees, contractors, etc. to comply with.

A number of environmental risk assessments have been completed for the Gorgon Gas Development. A strategic risk assessment was undertaken during the preparation of the Draft EIS/ERMP to determine the environmental acceptability of the Development, and to identify key areas of risk requiring mitigation (Chevron Australia 2005).

This original assessment was reviewed as part of the development of the Gorgon Gas Development Revised and Expanded Proposal PER (Chevron Australia 2008), in light of the changes to the Gorgon Gas Development (described in Section 1.4). The outcomes of these assessments have been reviewed and considered during the preparation of this Plan.

Additional detailed risk assessments have been undertaken for specific scopes of work, using Chevron's RiskMan2 Procedure (Chevron Corporation 2008).

Table 4-1 summarises the risk assessments that have been undertaken to date, and that have provided input into this Plan.

Table 4-1 Risk Assessments Relevant to this Plan

Scope of Risk Assessment	Method(s)	Documentation	Year
Entire Scope of the Approved Gorgon Gas Development	AS/NZS 4360:2004	Draft EIS/ERMP (Chevron Australia 2005)	2005
Entire Scope of the Revised and Expanded Proposal	AS/NZS 4360:2004	Gorgon Gas Development PER (Chevron Australia 2008)	2008
Long-term Marine Turtle Management Plan Risk Assessment	RiskMan2	Long-term Marine Turtle Management Plan (Chevron Australia 2014)	2009
Long-term Marine Turtle Risk Assessment	RiskMan2	Long-term Marine Turtle Management Plan (Chevron Australia in prep)	2015

4.2 Methodology

The methodology for the environmental risk assessments undertaken during the EIS/ERMP assessment process is documented in Chapter 9 of the Draft EIS/ERMP (Chevron Australia 2005).

The risk assessments were undertaken in accordance with the following standards:

- Australian Standard/New Zealand Standard (AS/NZS) 4360:2004 Risk Management (Standards Australia/Standards New Zealand 2004a)
- AS/NZS Handbook 203:2006 Environmental Risk Management – Principles and Process (Standards Australia/Standards New Zealand 2006)
- AS/NZS 3931:1998 Risk Analysis of Technological Systems – Application Guide (Standards Australia/Standards New Zealand 1998).

The main components of the RiskMan2 risk assessment methodology include:

- **Hazard Identification:** Identifying potential hazards that are applicable to Gorgon Gas Development activities and determining the hazardous events to be evaluated.
- **Hazard Analysis:** Determining the possible causes that could lead to the hazardous events identified; the consequences of the hazardous events; and the safeguards and controls currently in place to mitigate the events and/or the consequences.
- **Risk Evaluation:** Evaluating the risks using the Chevron Integrated Risk Prioritization Matrix (Appendix 1). The risk ranking is determined by a combination of the expected frequency of the hazard occurring (likelihood) and the consequence of its occurrence. Note that when assessing the consequence no credit is given to the hazard controls; hazard controls are taken into account in determining the likelihood of the event.
- **Residual Risk Treatment:** Reviewing the proposed management controls for each of the risks identified and proposing additional controls or making recommendations, if required.

Using the Chevron Integrated Risk Prioritization Matrix (Appendix 1), identified risks are categorised into four groups, which determine the level of response and effort in managing the risks. The risk-ranking categories have been used in the development of this Plan to determine whether the residual risks were acceptable or whether further mitigation was required.

4.3 Outcomes

4.3.1 Risk Assessment Outcomes

Condition 3.2.1 of EPBC Reference: 2003/1294 and 2008/4178 requires a description of the EPBC Act listed species likely to be impacted by the components of the action that is the subject of this Plan. Condition 3.2.1 of EPBC Reference: 2003/1294 and 2008/4178 also requires descriptions of the habitat of those listed species. The EPBC Act listed species and habitat descriptions are detailed in Appendix 5.

Condition 3.2.2 of EPBC Reference: 2003/1294 and 2008/4178 requires an assessment of the risk to EPBC Act listed species from the components of the action. The risks identified during the assessments listed in Table 4-1 include the risks to the listed species in Appendix 5.

The potential for the MOF and the LNG Jetty to impact on the dynamics of the existing foreshore environment at beaches adjacent to Town Point was assessed in the Draft EIS/ERMP (Chevron Australia 2005).

The most important impacts identified were:

- soil compaction associated with earthworks
- changes in the foreshore profile
- accretion and/or erosion of the shoreline adjacent to Town Point
- potential for the Causeway to locally enhance storm surge adjacent to Town Point
- potential for disruption of tidal flows by the Causeway, resulting in reduced water exchange and a decrease of water quality
- change of wave climate due to diffraction/reflection from the MOF/Causeway facility.

These risks were assessed in the Draft EIS/ERMP (Chevron Australia 2005) as ‘Medium’ during construction and ‘Low’ during operations. The risks were reviewed and reassessed as part of the approval process for the Revised Proposal; the results indicated that potential for the MOF and LNG Jetty to cause impact to the dynamics of the existing foreshore environment on beaches adjacent to Town Point remained as ‘Medium’ and ’Low’ for construction and operations respectively (Chevron Australia 2008).

The potential for the physical presence of the MOF and the LNG Jetty to impact on the population viability of marine turtles was assessed as part of the Risk Assessment within the Long-term Marine Turtle Management Plan (see Section 4.0; Chevron Australia 2014a).

The predicted marine turtle stressors identified were:

- potential influence to turtle nesting patterns and marine movements along Barrow Island east coast beaches
- potential changes to beach erosion/accretion
- creation of a predator ‘feeding station’ at the end of the MOF
- potential influence on hatchlings (need to expend additional energy to reach the open ocean)
- destruction of internesting and feeding habitat; however, the creation of an artificial reef system as a result of the MOF and LNG Jetty will increase feeding opportunities for turtles foraging in the area and increase the risk of vessel strike.

These risks to hatchlings, foraging juveniles and adults, and nesting and mating adults were assessed in the Long-term Marine Turtle Management Plan (Chevron Australia 2014a) as ‘Medium’ during operations.

A revision to the Risk Assessment for the Long-term Marine Turtle Management Plan was undertaken in 2015 (Chevron Australia, in prep), informed by five years’ of environmental monitoring results since commencement of construction activities. The following risks to marine turtles from potential changes to coastal processes were assessed as ‘Tolerable if ALARP’ (equivalent to ‘Medium’ in prior Risk Assessments):

- Potential changes to availability of turtle nesting habitat due to sediment movement along beaches.
- Potential influence on turtle nesting patterns and nesting success (energy expended on nesting affects the success of nesting event) and internesting movements along Barrow Island east coast beaches.
- Potential changes to incubation environment (eggs).

These risk assessments were used to guide the design of the monitoring program and the nature of the Management Triggers.

5.0 Monitoring and Management Program

5.1 Background

The monitoring program has been designed to detect changes to the beach structure and beach sediments—occurring as a result of the marine facilities (MOF and LNG Jetty)—that could have potential implications for coastal stability and/or turtle nesting.

Monitoring of selected east coast beaches on Barrow Island commenced in July 2008. Between July 2008 and April 2014[2], monitoring included beach profiles, sediment compaction, and sediment samples collected for particle size analysis and moisture content. Monitoring from October 2014 onwards includes surface elevation measurements over the entire beach area and sediment samples collected for particle size analysis[3]. Table 5-1 summarises the monitoring programs.

Table 5-1 Summary of Coastal Stability Monitoring Programs

	Monitoring Program: July 2008 to April 2014	Monitoring Program: October 2014 onward
Location	*Potential Impact Beaches*: Terminal and Bivalve *Reference Beaches*: Inga, Yacht Club North, Yacht Club South	*Potential Impact Beaches*: Terminal and Bivalve *Reference Beaches*: Inga, Yacht Club North, Yacht Club South
Frequency	Four times per year Post Major Event	Twice per year Post Major Event
Beach Structure	*Beach Morphology* Real-time Kinetic Global Positioning System (RTK-GPS) beach profiles measured along 25 transects on Terminal, 24 transects on Bivalve, and two transects each on Inga, Yacht Club North, and Yacht Club South beaches	*Beach Morphology* Remote sensing surveys to generate digital surface elevation models over entire beach
Beach Sediments	*Sediment Sampling* Four locations (CBF, FA, BD, PD[1]) and at four depths (0.0 m, 0.3 m, 0.6 m, 1.0 m) along selected transects (seven on Terminal, six on Bivalve, two each on Inga, Yacht Club North, and Yacht Club South beaches) analysed for: • particle size distribution • moisture content	*Sediment Sampling* Two locations (CBF, FA) and up to two depths[2] (0.0 m, 0.6 m) along selected transects (seven on Terminal, six on Bivalve, two each on Inga, Yacht Club North, and Yacht Club South beaches) analysed for: • particle size distribution
	In Situ Sediment Characteristics Profile of vertical compaction collected at four locations (CBF, FA, BD, PD[1]) along selected transects (seven on Terminal, six on Bivalve, two each on Inga, Yacht Club North, and Yacht Club South beaches)	

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[2] This monitoring program collected baseline information between July 2008 and April 2010. Construction of Marine Facilities commenced in May 2010; and therefore the first construction survey was undertaken in July 2010.

[3] The justification for the change in survey technique and monitored parameters was provided in a memorandum to the regulators (Chevron Austalia 2014a, 2014b).

	Monitoring Program: July 2008 to April 2014	Monitoring Program: October 2014 onward
Visual Record	*In situ Photography* Photographs taken looking north, south, east, and west from each CBF sediment sampling site on all five beaches. Alongshore photographs taken from elevated views along Terminal and Bivalve beaches.	*In Situ Photography* Photographs taken looking north and south from each CBF sediment sampling site on Inga, Yacht Club North, and Yacht Club South beaches. Alongshore photographs taken from elevated views along Terminal and Bivalve beaches.
		Aerial Photography[3] Aerial imagery collected annually extending over full length of coastline from north of Terminal Beach to south of Yacht Club South Beach.

Notes:

1. *PD location only sampled annually.*
2. *0.6 m depth sampled at FA location only.*
3. *Aerial photography only captured annually.*

5.2 Monitoring Program

The monitoring program described in this section is relevant for surveys undertaken from April 2014. The previous monitoring program, which was undertaken between July 2008 and January 2014, is described in Appendix 3.

5.2.1 Site Locations

Monitoring will be undertaken at these east coast beaches (Figure 5-1):

- Potential impact beaches: Terminal Beach and Bivalve Beach (i.e. beaches immediately adjacent to the MOF and LNG Jetty)
- Reference beaches: Inga Beach, Yacht Club North Beach, and Yacht Club South Beach.

Figure 5-1 Site Locations for the Coastal Stability Monitoring Program

5.2.2 Frequency

5.2.2.1 Routine Monitoring

Routine monitoring will be undertaken twice a year, at the end of the dry and wet seasons where practicable.

The timing of these surveys allows for an assessment of net change over the preceding season to be completed. The timing of the surveys also approximately aligns with the beginning (i.e. post-dry season survey) and end (i.e. post-wet season survey) of the turtle nesting season on the east coast beaches of Barrow Island.

5.2.2.1.1 Aerial Photography

Aerial photography (part of the routine monitoring program) will be undertaken annually, at the end of the dry season where practicable.

5.2.2.2 Major Event Monitoring

Major event monitoring will be undertaken as soon as reasonably practicable after a major event; a major event is defined as:

> *A sustained period (four days or longer) of winds with an easterly component (NNE to SSE), during which the total duration of winds greater than 18 knots is greater than or equal to 96 hours is recorded at Barrow Island.*

The definition of a major event is based on an analysis of wind data and shoreline change observed to date (BMT Oceanica 2014). This analysis showed that extended periods of moderate to strong easterly wind conditions were linked to the greatest shoreline changes recorded, which is likely due to greater energy reaching the sheltered east coast beaches under easterly wind conditions.

Note: If monitoring for a major event is mobilised within two weeks before a scheduled routine monitoring event, the two surveys can be combined provided that the monitoring methods are the same as those described for a routine monitoring survey.

5.2.3 Methods

5.2.3.1 Beach Structure

The purpose of beach structure (also known as beach morphology) monitoring is to measure changes to the beach profile shape over time and to quantify the extent of any erosion or accretion of sediment. Beach morphology changes in response to different forcing conditions (e.g. waves, tides, wind, and currents).

A remote sensing survey capturing horizontal (x,y-plane) and vertical (z-plane) data, and capable of generating a digital surface elevation model, is to be undertaken over each of the beaches covering the area from landward of the primary dune to the waterline. Where practicable, surveys should be carried out on low spring tides to capture as much of the intertidal rock platform as possible.

5.2.3.2 Beach Sediments

The purpose of beach sediment monitoring is to measure changes in sediment characteristics, in particular particle size distribution, over time. Beach sediments provide an integrated measure of the prevailing processes acting on the beaches. From the base of the beach face and across the foredune (to the primary dune), the predominant driving processes are waves and currents, with an increasing influence from wind with distance from the waterline. Surface sediments from the approximate crest of beach face assist in understanding the prevailing wave processes over timescales of days to weeks. Conversely, surface sediments from the foredune area provide a longer-term capture of beach conditions, reflecting impacts from monthly tidal cycles and storms over timescales of up to several months (Dr Bruce Hegge, pers. comm. May 2013). The foredune area is also the primary area where marine turtle nesting occurs.

Sediment samples are to be collected, where practicable, from the sites shown in Figure 5-1. Sampling locations are located within the Foredune Area (FA) and approximately at the Crest of Beach Face (CBF) (Figure 3-1). Two depths are sampled: surface (CBF and FA sites) and approximately 0.6 m below the surface (FA sites only). The collected samples are to be transported to a National Association of Testing Authorities (NATA) accredited laboratory for particle size analysis.

Note: If sediment is not available to be sampled, the site is to be moved landward to a point where sediment is available to be collected, and the new site coordinates recorded.

5.2.3.3 In Situ Photography and Observations

In situ photographs should be taken from fixed, elevated (where practicable) locations, looking alongshore each beach (Table 5-2). The photograph should be taken at a consistent height above ground (approximately 1.5 m) to ensure the same field of view is captured each time.

Table 5-2 In Situ Photograph Locations for Terminal, Bivalve, and Reference Beaches

Beach	Site Description	Easting[1]	Northing[1]
Terminal Beach	Elevated view north from Town Point	340110	7700433
	Elevated view north from rock headland	340067	7700567
	View south from beach	340336	7701151
	Elevated view south from rock headland	340341	7701156
Bivalve Beach	View south from Town Point	339975	7700395
	Elevated view south from rock headland	339842	7700359
	Elevated view north from rock headland	339482	7699799
Reference beaches[2]	View north and south from site I1 CBF	339254	7699193
	View north and south from site I2 CBF	339182	7698910
	View north and south from site YCN1 CBF	338872	7698220
	View north and south from site YCN2 CBF	338775	7697847
	View north and south from site YCS1 CBF	338583	7697296
	View north and south from site YCS2 CBF	338441	7696838

Notes:

1. *Coordinates given relative to MGA Zone 50, GDA 94.*
2. *Alongshore photographs for the Reference beaches are to be taken at each of the Crest of Beach Face sampling locations.*

5.2.3.4 Aerial Photography

Aerial photographs enable mapping to be undertaken and assist in the interpretation of any detected shoreline changes.

Photography capable of generating an orthomosiac image is to be undertaken over each of the beaches, covering the area from landward of the primary dune to the waterline. Where practicable, photographs should be taken at low tide to capture as much of the intertidal rock platform as possible; and be timed to minimise sun glint from the water surface.

5.2.3.5 Major Event Monitoring

As a minimum, beach structure monitoring is to be carried out to determine any impact from a storm. Where practicable, monitoring consistent with the methods described in Section 5.2.3.1 are to be used; alternatively, RTK-GPS transects consistent with previous methods (see

Appendix 3) can be used. Sediment sampling and in situ photography (consistent with Sections 5.2.3.2 and 5.2.3.3 respectively) may also be carried out, where practicable.

5.3 Management Triggers

The Management Triggers as required under Condition 25.4.iv of Statement No. 800 and Condition 18.4.iv of EPBC Reference: 2003/1294 and 2008/4178 are detailed in the Coastal Stability Management and Monitoring Plan Supplement: Management Triggers (Chevron Australia 2015), as amended from time to time.

5.4 Potential Management Actions

If the review of monitoring data, either through the annual reporting process or via exceedance of a Beach Structure or Beach Sediments Management Trigger, shows that there is a change in beach structure or beach sediments on Terminal or Bivalve Beach beyond the Performance Standards (see Section 6.3), which is attributable to the presence of the MOF and LNG Jetty, Chevron Australia may consider a range of potential actions, including:

- stabilising, enhancing, and protecting the natural dune system by planting and managing native vegetation
- profile contouring, levelling, or equilibrating, which is the process of adjusting a beach profile from one shape to another that is more in an equilibrium condition with the waves and tides
- beach scraping, which is the transfer of sand (usually by mechanical equipment) from the lower beach to the upper beach, to redistribute the sand to parts of the beach above tide level
- beach draining (beach-face dewatering), which is the process of lowering the water table locally beneath the beach face, causing accretion of sand above the drainage system
- beach sand placement (beach nourishment, replenishment, recharge, or restoration), which involves placing imported sand on the beach face or near to the shore to increase material in the littoral zone. Beach sand placement projects:
    - depend on the placed sediment being highly compatible (i.e. grain size, grain shape, sand colour, mineral content, etc.) with naturally occurring beach sediments in the area
    - must ensure that imported sands do not contain contaminants
    - incorporate compaction and profile remediation measures
- nest management activities, e.g. the relocation of nests that are predicted to be at risk of loss by environmental factors such as erosion or repeated tidal inundation
- additional studies and continued monitoring of coastal processes
- construction of hard structures
- no mitigation action.

Note: Any potential mitigation or management action is to undergo a robust evaluation of the environmental benefits and environment cost, and take into consideration the timing of implementation in regards to the turtle nesting and hatchling seasons.

5.5 Summary

The monitoring, data analysis, and annual reporting activities associated with the monitoring program are shown in Figure 5-2. The data for each routine twice-yearly monitoring survey are to be assessed against the Beach Structure and Beach Sediments Management Triggers; only data from the post-dry season routine monitoring survey are to be assessed against the interim Marine Turtle Nesting Habitat Management Triggers. Data from major event monitoring are not assessed against any Management Triggers.

At the end of a monitoring season (Note: ‘monitoring season’ is based around the turtle nesting season and so includes the post-dry and subsequent post-wet season survey [i.e. not a calendar year]) an annual report is prepared compiling all data and trend analysis.

If the assessments within the annual report show a change beyond a Performance Standard (see definitions in Table 6-1), a report shall be submitted to the State and Commonwealth Ministers for the Environment (or their delegates) within three months of the detection of the change as per Condition 25.6 of Statement No. 800 and Condition 18.6 of EPBC Reference: 2003/1294 and 2008/4178.

Note that reporting and notification associated with exceeding a Management Trigger is separate to the process shown in Figure 5-2 and is defined in Section 8.2 and the Coastal Stability Management and Monitoring Plan Supplement: Management Triggers.

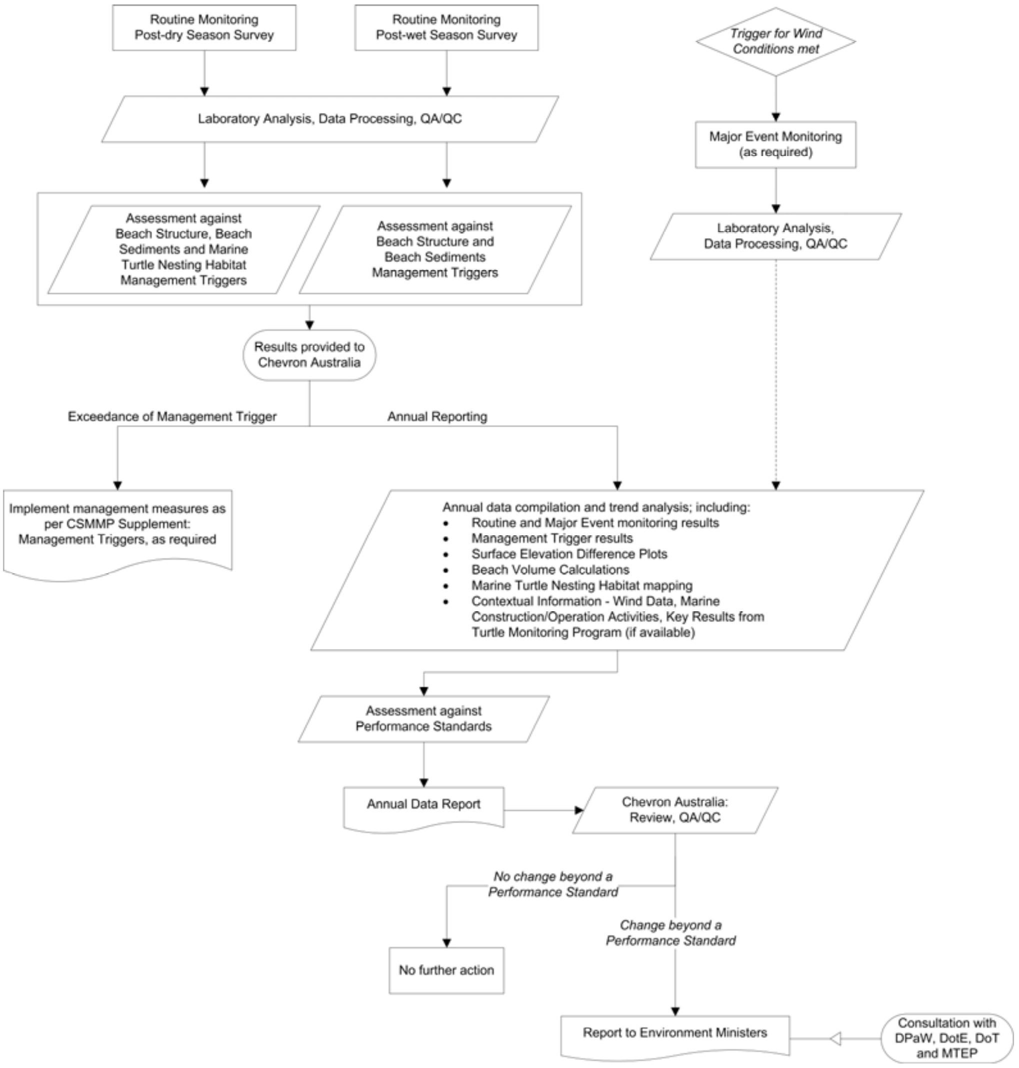

Figure 5-2 Monitoring, Data Analysis, and Annual Reporting Activities associated with the Coastal Stability Monitoring and Management Plan

6.0 Objectives, Performance Standards, and Relevant Documentation

6.1 Overview

This section summarises the environmental objectives, performance standards, and relevant documentation that have been developed as part of a systematic approach to the management of environmental risks. Specific objectives, performance standards, and documentation will be used to assess the overall environmental performance for the Gorgon Gas Development against the stated environmental objectives.

Table 6-1 details the objectives, performance standards, and documentation that relate to this Plan.

6.2 Objectives

Chevron Australia is committed to conducting activities associated with the Gorgon Gas Development and Jansz Feed Gas Pipeline in an environmentally responsible manner, and aims to implement best practice environmental management as part of a program of continual improvement. To meet this commitment, objectives have been defined that relate to the management of the identified environmental risks for the Gorgon Gas Development. These objectives are those in Condition 25.3 of Statement No. 800 and Condition 18.3 of EPBC Reference: 2003/1294 and 2008/4178, and where necessary, additional, more specific objectives have been developed.

Table 6-1 details the objectives specific to this Plan.

6.3 Performance Standards

Performance standards are the measures Chevron Australia will use to assess whether or not it is meeting its objectives. For each objective and element of each objective, Chevron Australia has described a matter (‘description’) that will be measured, and a quantitative target or, where there is no practicable quantitative target, a qualitative target, which is to be measured against when assessing whether the objective has been met. These targets have been developed specifically for assessing performance, not compliance, and so failure to meet the target does not represent a breach of this Plan. Rather, it indicates that an objective may not have been met and there may be a need for management action or review of this Plan.

Table 6-1 details the performance standards specific to this Plan.

6.4 Relevant Documentation

Chevron Australia has defined the relevant documentation that contains information about whether the performance standards have been met.

Table 6-1 details the relevant documentation specific to this Plan.

Additionally, Condition 25.6 of Statement No. 800 and Condition 18.6 of EPBC Reference: 2003/1294 and 2008/4178 require the proponent (the person taking the action) to submit a report to the State and Commonwealth Ministers for the Environment within three months of detecting a change beyond a Performance Standard describing:

- the nature and extent of any change and implications for marine turtle nesting
- the likely causes of that change

- proposed mitigation measures to reduce or offset the impacts, including identifying appropriate sand sources and vegetation stock for any rehabilitation works required.

Table 6-1 Environmental Objectives, Performance Standards, and Relevant Documentation

Objectives	Performance Standards		Evidence/Relevant Documentation
	Descriptor	Target	
Ensure that the MOF and the LNG Jetty do not cause significant adverse impacts to the beaches adjacent to these facilities.	Significant adverse impacts to the beaches adjacent to the MOF and LNG Jetty.	No significant adverse impacts to the stability of Terminal or Bivalve beaches resulting from the presence of the MOF and LNG Jetty.	Results from the Monitoring Program and associated analysis and mapping.
Establish a monitoring program to detect adverse changes to the beach structure and beach sediments that could have implications for marine turtles nesting on those beaches adjacent to the MOF and the LNG Jetty on Barrow Island.	Monitoring Program to detect adverse changes to the beach structure and beach sediments that could have implications for marine turtles nesting on beaches adjacent to the MOF and the LNG Jetty.	Monitoring Program is able to detect: • an adverse change to beach structure • an adverse change to beach sediments • beach erosion or accretion which results in the exceedance of an (interim) Marine Turtle Nesting Habitat Management Trigger.	• This Plan. • Results from the Annual Report and associated analysis and mapping (Figure 5-2) • Long-term Marine Turtle Management Plan monitoring reports

7.0 Implementation

7.1 Environmental Management Documentation

7.1.1 Overview

Figure 1-3 in Section 1.5.4 of this Plan shows the hierarchy of environmental management documentation within which this Plan exists. The following sections describe each level of documentation in greater detail.

7.1.2 Chevron ABU OE Documentation

As part of the Chevron ABU, the Gorgon Gas Development is governed by the requirements of the ABU OEMS, within which a number of OE Processes exist. The Gorgon Gas Development will implement internally those OE Processes (and supporting OE Procedures) that apply to the Gorgon Gas Development's activities, where those Processes are appropriate and reasonably practicable.

The key ABU OE Processes taken into account during the development of this Plan, with a description of the intent of each Process, are:

- **HES Risk Management Process** (Chevron Australia 2012a): Process for identifying, assessing and managing HES, operability, efficiency, and reliability risks related to the Gorgon Gas Development.
- **Environmental Stewardship Process** (Chevron Corporation 2007): Applies during the Operations Phase of the Gorgon Gas Development. Process for ensuring all environmental aspects are identified, regulatory compliance is achieved, environmental management programs are maintained, continuous improvement in performance is achieved, and alignment with ISO 14001-2004 (Standards Australia/Standards New Zealand 2004) is achieved.
- **Hazardous Communication Process** (Chevron Australia 2006a): Process for managing and communicating chemical and physical hazards to the workforce.
- **Management of Change Process** (Chevron Australia 2008a): Process for assessing and managing risks stemming from permanent or temporary changes to prevent incidents.
- **Contractor Health, Environment and Safety Management Process** (Chevron Australia 2010a): Process for defining the critical roles, responsibilities and requirements to effectively manage contractors involved with the Gorgon Gas Development.
- **Competency Development Process** (Chevron Australia 2010b): Process for ensuring that the workforce has the skills and knowledge to perform their jobs in an incident-free manner, and in compliance with applicable laws and regulations.
- **Incident Investigation and Reporting Process** (Chevron Australia 2010c): Process for reporting and investigating incidents (including near misses) to reduce or eliminate root causes and prevent future incidents.
- **Emergency Management Process** (Chevron Australia 2010d): Process for providing organisational structures, management processes and tools necessary to respond to emergencies and to prevent or mitigate emergency and/or crisis situations.
- **Compliance Assurance Process** (Chevron Australia 2009b): Process for ensuring that all HES and OE-related legal and policy requirements are recognised, implemented and periodically audited for compliance.

7.1.3 Gorgon Gas Development Documentation

7.1.3.1 Ministerial Plans and Reports

In addition to this Plan, a number of other plans and reports have been (or will be) developed for the Gorgon Gas Development that are required under State and/or Commonwealth Ministerial Conditions (refer to Figure 1-3). These documents address the requirements of specific conditions and provide standards for environmental performance for the Gorgon Gas Development.

7.1.3.2 Environmental Management Plans

A number of activity-specific Environmental Management Plans (EMPs) are required under Ministerial Conditions (refer to Figure 1-3); however, other internal work scope EMPs (work scope EMPs) are also being developed to effectively manage specific work scopes for the Gorgon Gas Development. These work scope EMPs will be developed and implemented such that any requirements specified in higher level documents (such as this Plan) are met.

Gorgon personnel, including contractors and subcontractors, involved in a particular scope of work for the Gorgon Gas Development are internally required to comply with the work scope EMP associated with that work scope where reasonably practicable.

7.1.3.3 Impact Mitigation Strategies

Impact Mitigation Strategies (IMSs) are aspect-based management standards that accompany the activity-specific EMPs (refer to Figure 1-3). The IMSs document the detailed management requirements associated with potential impacts for the Gorgon Gas Development. Each IMS covers a particular environmental aspect that requires management (e.g. light, noise and vibration, atmospheric emissions, etc.).

Personnel (including contractors and subcontractors) involved in that particular scope of work are internally required to comply with the IMSs where reasonably practicable. The IMSs also document requirements for contractors to develop internal work scope EMPs for the Gorgon Gas Development, which include work procedures (such as step-by-step procedures and work method statements) to mitigate their impacts.

7.1.3.4 Contractor and Subcontractor Documentation

A variety of internal Chevron Australia contractor and subcontractor documentation will be developed, including documents such as task-specific work instructions, procedures, work method statements, and Job Hazard Analyses. These detailed documents will specify the way activities shall be performed in a step-by-step manner.

These procedural documents are specific to the Gorgon Gas Development (where required) and include any environmental requirements that are detailed in higher level documentation relevant to a specific scope of work (i.e. the IMSs and EMPs described in the previous sections).

7.2 Training and Inductions

All personnel (including contractors and subcontractors) are required to attend environmental inductions and training relevant to their role on the Gorgon Gas Development. Training and induction programs facilitate the understanding personnel have of their environmental responsibilities, and increase their awareness of the management and protection measures required to reduce potential impacts on the environment.

Chevron Australia has prepared the ABU Competency Development Process (Chevron Australia 2010b) to deal with the identification and assessment of required competencies for environmental roles and which it internally requires its employees, contractors, etc. to comply with.

Environmental training and competency requirements for personnel, including contractors and subcontractors, are maintained in a Gorgon Gas Development HES training matrix or the Competence Management System for operations personnel.

8.0 Auditing, Reporting, and Review

8.1 Auditing

8.1.1 Internal Auditing

Chevron Australia has prepared the internal ABU Compliance Assurance Process (Chevron Australia 2009b) to manage compliance, and which it internally requires its employees, contractors, etc. to comply with. This Process will also be applied to assess compliance of the Gorgon Gas Development against the requirements of Statement No. 800, and EPBC Reference: 2003/1294 and 2008/4178 where this is appropriate and reasonably practicable.

An internal Audit Schedule has been developed and will be maintained for the Gorgon Gas Development that includes audits of the Development’s environmental performance and compliance with the Ministerial Conditions. A record of all internal audits and the audit outcomes is maintained. Actions arising from internal audits are tracked until their close-out.

Under EPBC Reference: 2003/1294 and 2008/4178, Condition 24 also requires that the person taking the action must maintain accurate records of activities associated with or relevant to the conditions of approval and make them available on request by DotE. Such documents may be subject to audit by DotE and used to verify compliance with the conditions of approval.

Any document that is required to be implemented under this Plan will be made available to the relevant OEPA and DotE auditor.

8.1.2 External Auditing

Audits and/or inspections undertaken by external regulators will be facilitated via the Gorgon Gas Development’s Regulatory Approvals and Compliance Team. The findings of external regulatory audits will be recorded and actions and/or recommendations will be addressed and tracked. Chevron Australia may also undertake independent external auditing during the Gorgon Gas Development Project.

Under EPBC Reference: 2003/1294 and 2008/4178, Condition 23 also requires that upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction of the Minister.

8.2 Reporting

8.2.1 Compliance Reporting

Condition 4 of Statement No. 800 and Condition 2 of EPBC Reference: 2003/1294 and 2008/4178 requires Chevron Australia to submit a Compliance Assessment Report annually to address the previous 12-month period. A compliance reporting table is provided in Appendix 4 to assist with auditing for compliance with this Plan for Statement No. 800 and EPBC Reference: 2003/1294 and 2008/4178.

8.2.2 Environmental Performance Reporting

Condition 5.1 of Statement No. 800 and Condition 4.2 of EPBC Reference: 2003/1294 and 2008/4178 require that Chevron Australia submits an annual Environmental Performance Report to the Western Australian Minister for the Environment and to the Commonwealth DotE respectively for the previous 12-month period.

In addition, under Condition 5.3 of Statement No. 800 and Condition 4.2 for EPBC Reference: 2003/1294 and 2008/4178, every five years from the date of the first annual Report, Chevron

Australia shall submit to the Western Australian Minister for the Environment an Environmental Performance Report covering the previous five year period.

Specific details on the content of the Environmental Performance Report are defined in Condition 5.2 and Schedule 3 of Statement No. 800, and Schedule 3 of EPBC Reference: 2003/1294 and 2008/4178.

The details that are specific to this Plan include:

- results of beach and sediment monitoring
- any mitigation measures applied in response to project-related impacts on beach profiles.

The information in the Environmental Performance Report will also partly meet the requirements of Condition 3.2.7 of EPBC Reference: 2003/1294 and 2008/4178.

8.2.3 Routine Internal Reporting

The Gorgon Gas Development will use a number of routine internal reporting formats to effectively implement the requirements of this Plan. Routine reporting is likely to include daily, weekly, and/or monthly HES reports for specific scopes of work on the Development. These reports include information on a number of relevant environmental aspects, such as details of environmental incidents (if any), environmental statistics and records, records of environmental audits and inspections undertaken, status of environmental monitoring programs, tracking of environmental performance against performance indicators, targets and criteria, etc.

8.2.4 External Reporting

Chevron Australia has prepared the ABU Emergency Management Process (Chevron Australia 2010d) and Incident Investigation and Reporting Process (Chevron Australia 2010c), which it internally requires its employees, contractors, etc. to follow in the event of environmental incidents. These processes will also be applied internally to environmental incidents identified in this Plan, where this is appropriate and reasonably practicable.

In accordance with Condition 3.2.7 of EPBC Reference: 2003/1294 and 2008/4178, impacts on EPBC Act listed species relevant to this Plan (see Appendix 5) detected by the monitoring programs under this Plan will follow the protocols for reporting to DotE, whether or not the impact is caused by the Gorgon Gas Development. Table 8-1 lists the external reporting requirements for environmental incidents and changes beyond Performance Standards; reporting commitments for exceeding Management Triggers are also specified in Table 8-1 .

Table 8-1 External Reporting Requirements

Event	Reporting to	Timing and Nature of Report
Impact to EPBC Act listed species covered within the scope of the monitoring program (marine turtles, specifically Flatback Turtles) included in this Plan	DotE	Notification within 48 hours of detection
Project attributable exceedance of a Beach Structure or Beach Sediments Management Trigger	OEPA and DotE	Notification within 10 business days of verified detection
Change in beach profiles and sediment grain size beyond the Performance Standards listed in Table 6-1	OEPA and DotE	Notification within 20 business days of verified detection from a Beach Structure or Beach Sediments Management Trigger exceedance
	Commonwealth and State Ministers for the Environment	Within three months of verified detection from a Management Trigger exceedance, or from completion of the annual data report, a report describing (with the advice of MTEP): • the nature and extent of any change and implications for marine turtle nesting • the likely causes of that change • proposed mitigation measures to reduce or offset the impacts, including identifying appropriate sand sources and vegetation stock for any rehabilitation works required. The report will be prepared in consultation with DoT, MTEP, DotE and OEPA
Project attributable exceedance of an interim Marine Turtle Nesting Habitat Management Trigger – Level 1	OEPA and DotE	Notification within 10 business days of verified detection
	OEPA and DotE	Within three months of detection, a report to the OEPA and DotE describing the cause of the change
Project attributable exceedance of interim Marine Turtle Nesting Habitat Management Trigger – Level 2	OEPA and DotE	Within one month of the upcoming turtle monitoring season final data reports under the Long-Term Marine Turtle Management Plan becoming available to Chevron Australia, a report describing: • the nature and extent of any change and implications for marine turtle nesting • the likely causes of that change • requirements (if any) and recommendations for mitigation measures to reduce or offset the impacts, and • further information required to support assessments on the implications to marine turtles nesting

8.3 Review of this Plan

Chevron Australia is committed to conducting activities in an environmentally responsible manner and aims to implement best practice environmental management as part of a program of continuous improvement. This commitment to continuous improvement means that Chevron Australia will review this Plan every five years or more often as required (e.g. in response to new information).

Reviews will address matters such as the overall design and effectiveness of the Plan, progress in environmental performance, changes in environmental risks, changes in business conditions, and any relevant emerging environmental issues.

If the Plan no longer meets the aims, objectives or requirements of the Plan, if works are not appropriately covered by the Plan, or measures are identified to improve the Plan, Chevron Australia may submit an amendment or addendum to the Plan to the State Minister for the Environment for approval under Condition 36 of Statement No. 800 and Condition 25 of EPBC Reference: 2003/1294 and 2008/4178. The State Minister for the Environment may also direct Chevron Australia to revise the Plan under Condition 36.2 of Statement No. 800.

Revision 2 of this Plan (this version) incorporates changes relating to implementation of new, but interim, Management Triggers related to detecting adverse changes to the beach structure and beach sediments that could have implications for marine turtles nesting on the beaches adjacent to the MOF. These new interim Management Triggers are detailed in the Coastal Stability Management and Monitoring Plan Supplement: Management Triggers (Chevron Australia 2015). It is Chevron Australia’s intention to revise this Plan in 2016 upon completion of sediment transport modelling studies; at this time the interim Management Triggers may be reviewed and amended as necessary.

If Chevron Australia wishes to carry out an activity other than in accordance with the Plan, Chevron Australia will update the Plan and submit it to the Commonwealth Minister for the Environment for approval in accordance with Condition 25 of EPBC Reference: 2003/1294 and 2008/4178. The Commonwealth Minister for the Environment may request Chevron Australia to revise the Plan under Condition 26 of EPBC Reference: 2003/1294 and 2008/4178.

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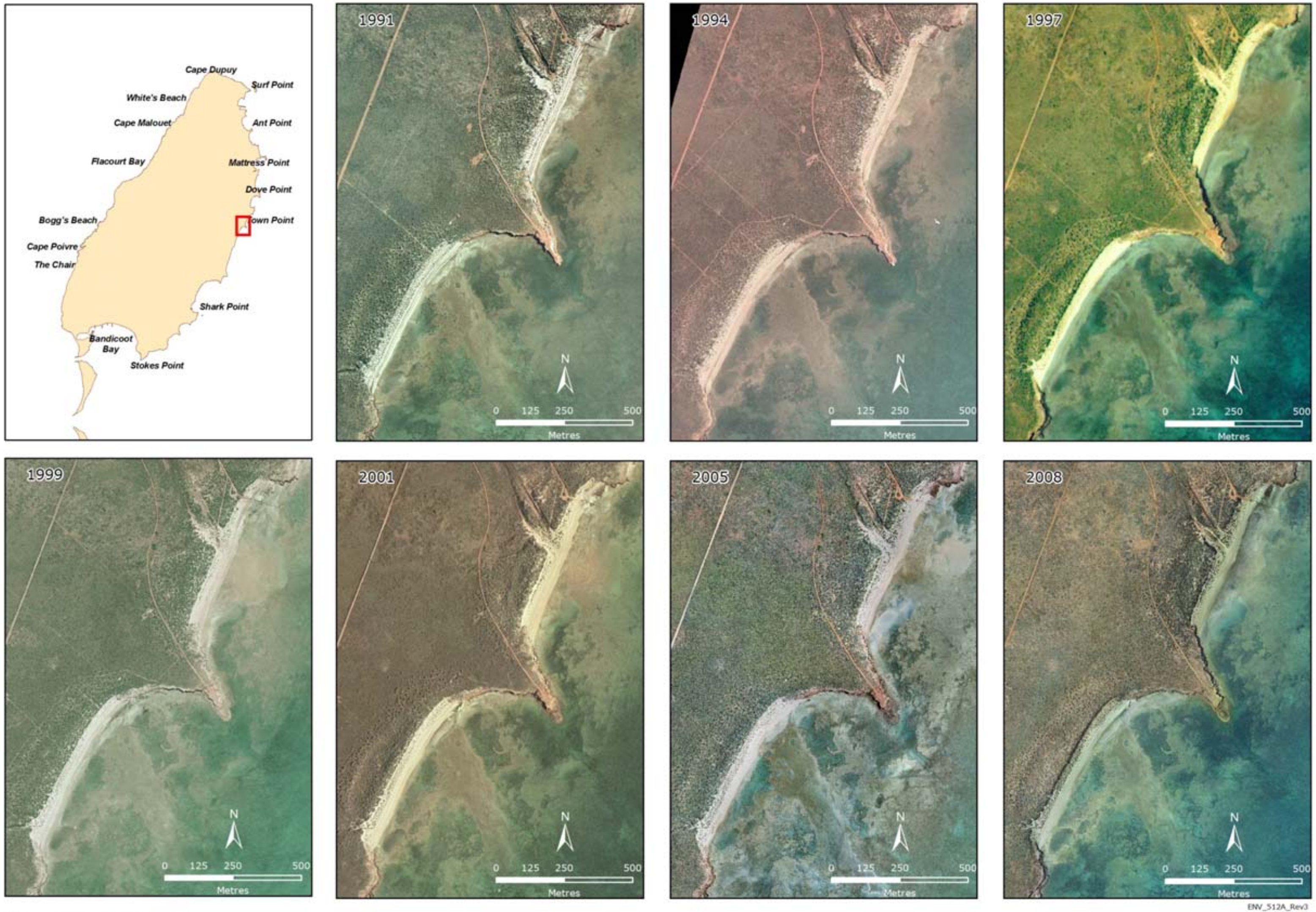
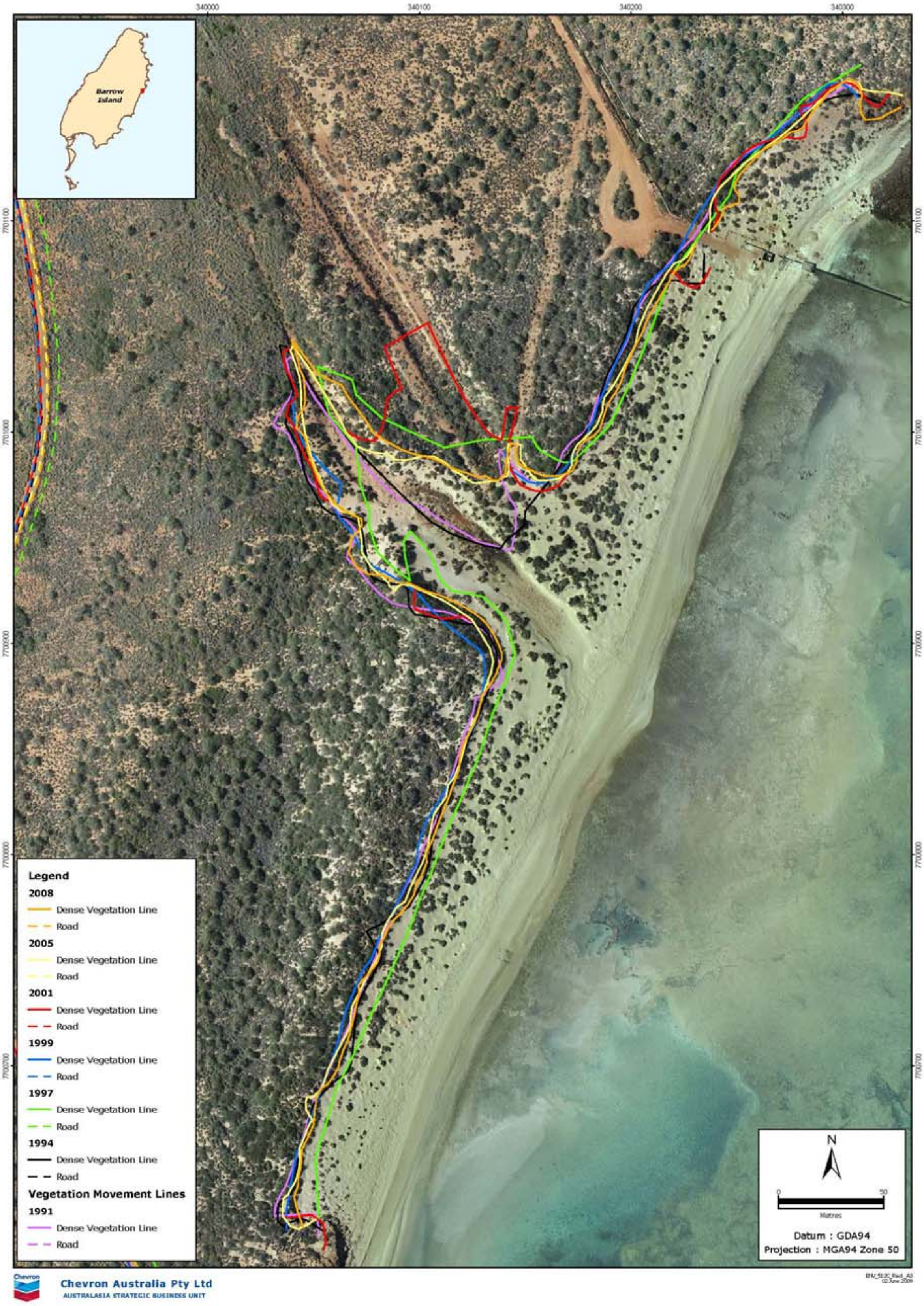
Appendix 1 Historical Aerial Imagery and Vegetation Line Mapping



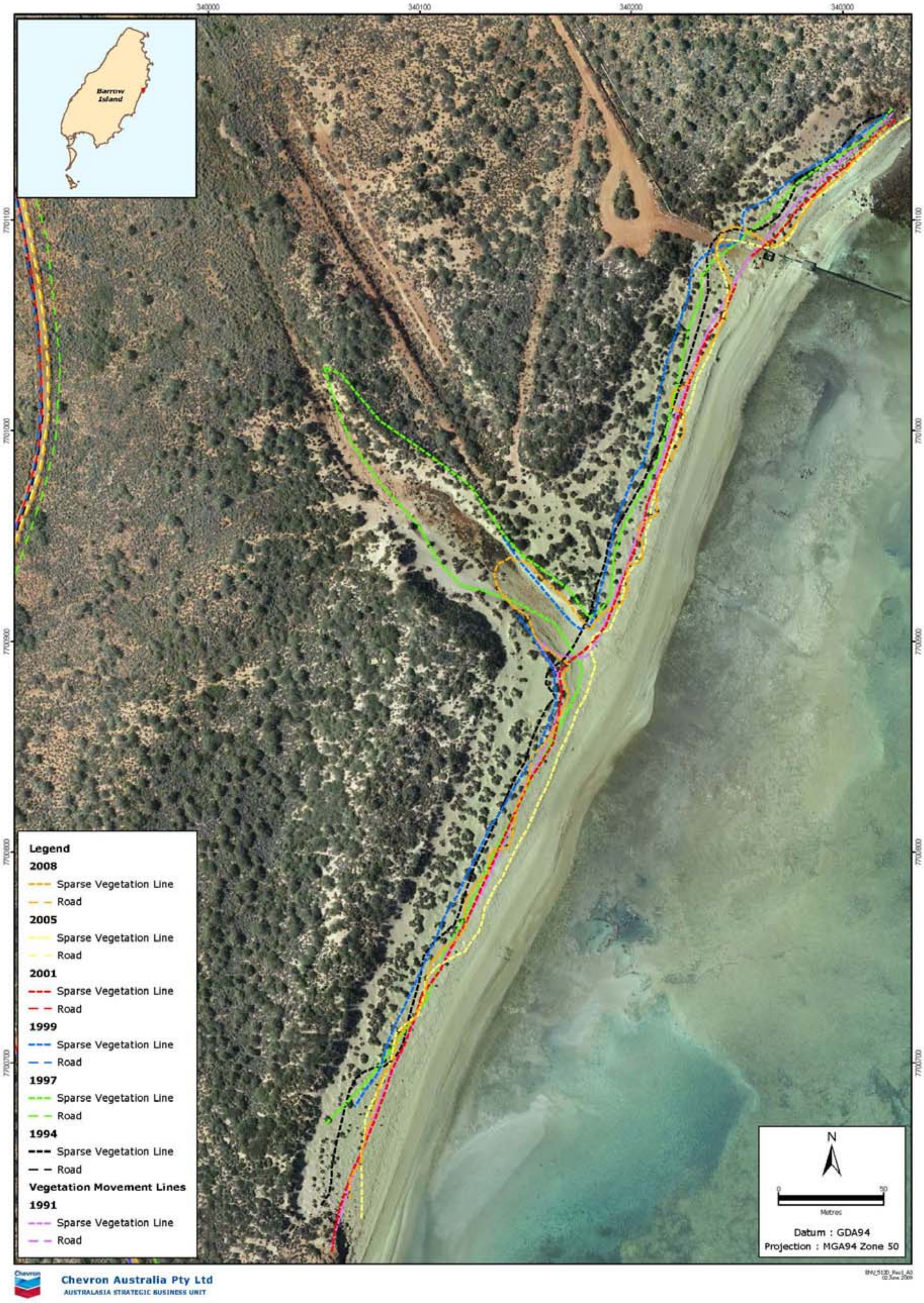
Chevron Australia Pty Ltd
AUSTRALASIA STRATEGIC BUSINESS UNIT

BARROW ISLAND - TOWN POINT TEMPORAL COMPARISON
NEAR SHORE MARINE COASTAL PROCESSES

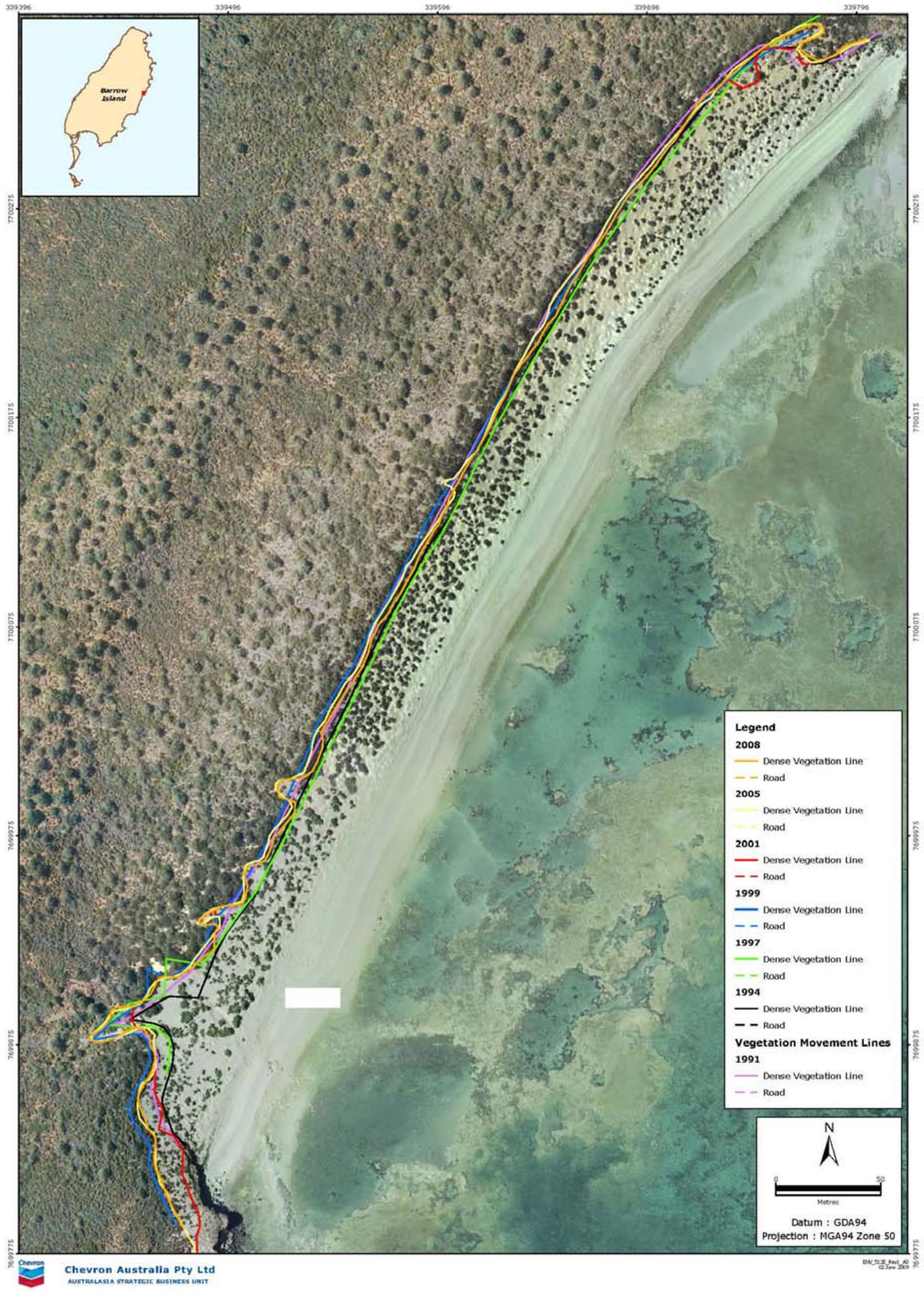
Historical Photographs used in Shoreline Movement Analysis



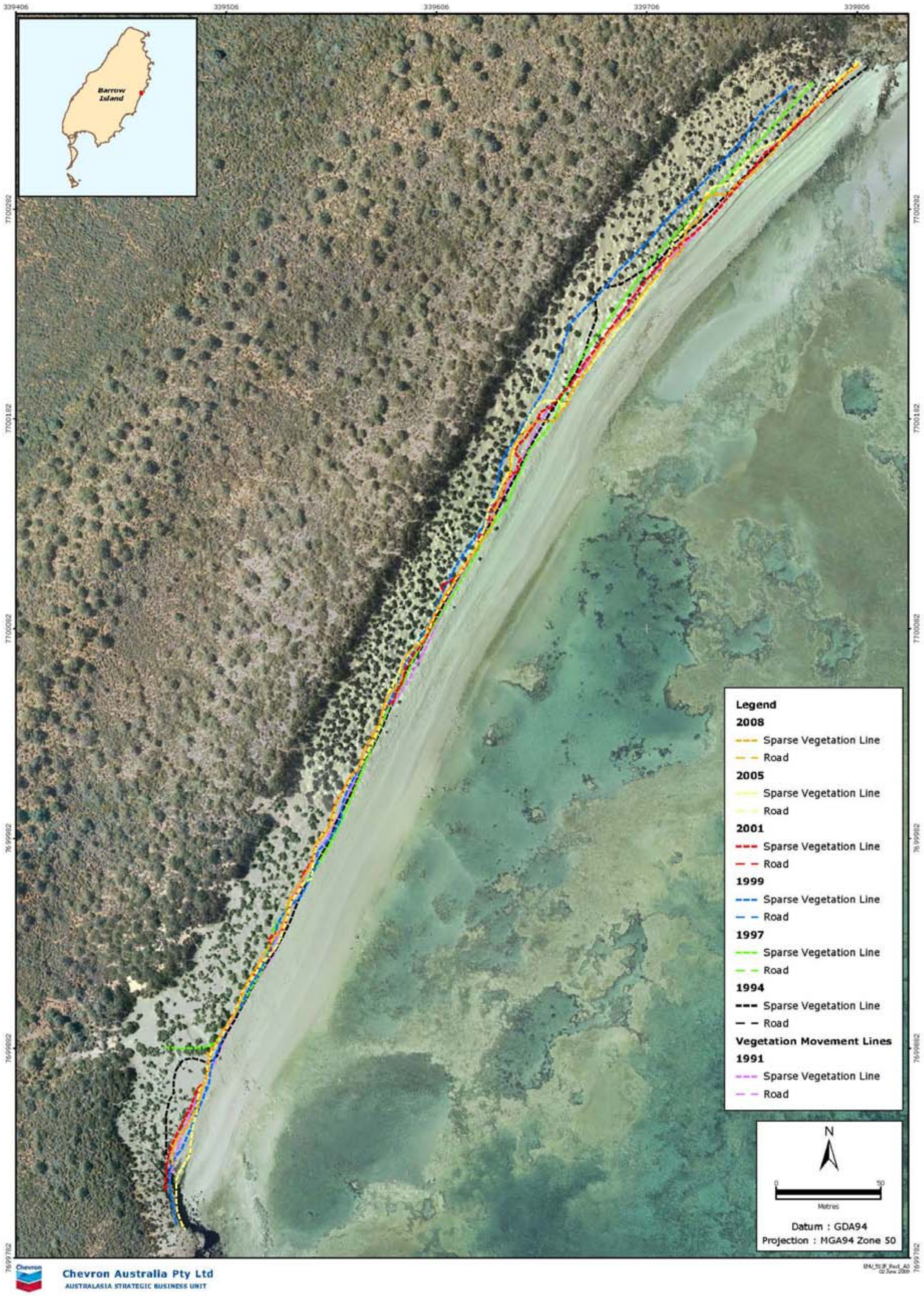
Dense Vegetation Line Movement Analysis Terminal Beach



Sparse Vegetation Line Movement Analysis Terminal Beach

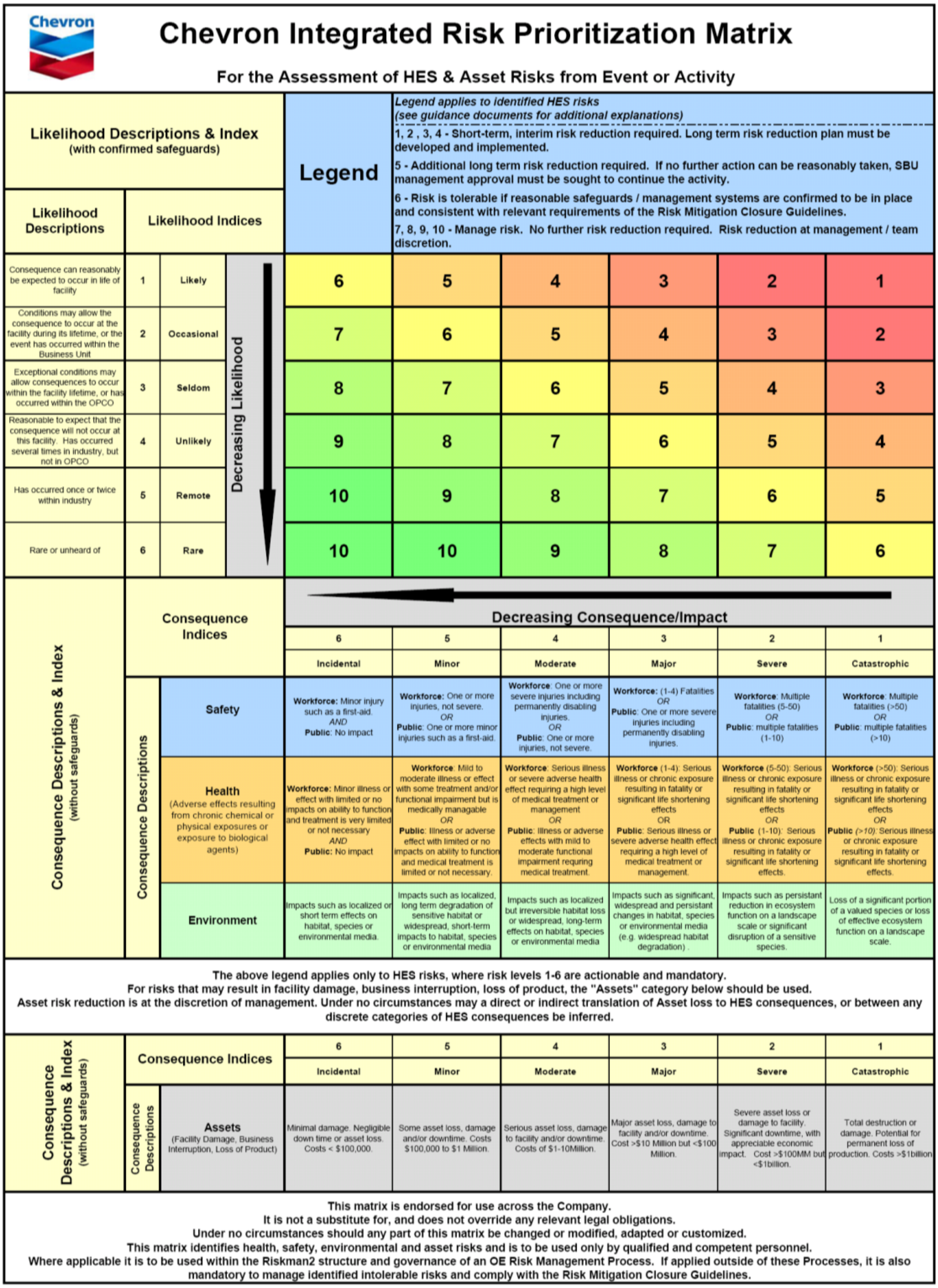


Dense Vegetation Line Movement Analysis Bivalve Beach



Sparse Vegetation Line Movement Analysis Bivalve Beach

Appendix 2 Chevron Integrated Risk Prioritization Matrix



Chevron

Chevron Integrated Risk Prioritization Matrix

For the Assessment of HES & Asset Risks from Event or Activity

Likelihood Descriptions & Index
(with confirmed safeguards)

Legend

Legend applies to identified HES risks
(see guidance documents for additional explanations)

1, 2 , 3, 4 - Short-term, interim risk reduction required. Long term risk reduction plan must be developed and implemented.

5 - Additional long term risk reduction required. If no further action can be reasonably taken, SBU management approval must be sought to continue the activity.

6 - Risk is tolerable if reasonable safeguards / management systems are confirmed to be in place and consistent with relevant requirements of the Risk Mitigation Closure Guidelines.

7, 8, 9, 10 - Manage risk. No further risk reduction required. Risk reduction at management / team discretion.

Likelihood Descriptions	Likelihood Indices		Decreasing Likelihood						
Consequence can reasonably be expected to occur in life of facility	1	Likely		6	5	4	3	2	1
Conditions may allow the consequence to occur at the facility during its lifetime, or the event has occurred within the Business Unit	2	Occasional		7	6	5	4	3	2
Exceptional conditions may allow consequences to occur within the facility lifetime, or has occurred within the OPCO	3	Seldom		8	7	6	5	4	3
Reasonable to expect that the consequence will not occur at this facility. Has occurred several times in industry, but not in OPCO	4	Unlikely		9	8	7	6	5	4
Has occurred once or twice within industry	5	Remote		10	9	8	7	6	5
Rare or unheard of	6	Rare		10	10	9	8	7	6

Decreasing Consequence/Impact

Consequence Descriptions & Index (without safeguards)	Consequence Indices	6	5	4	3	2	1
		Incidental	**Minor**	**Moderate**	**Major**	**Severe**	**Catastrophic**
Consequence Descriptions	**Safety**	**Workforce:** Minor injury such as a first-aid. *AND* **Public**: No impact	**Workforce:** One or more injuries, not severe. *OR* **Public**: One or more minor injuries such as a first-aid.	**Workforce**: One or more severe injuries including permanently disabling injuries. *OR* **Public**: One or more injuries, not severe.	**Workforce:** (1-4) Fatalities *OR* **Public**: One or more severe injuries including permanently disabling injuries.	**Workforce**: Multiple fatalities (5-50) *OR* **Public**: multiple fatalities (1-10)	**Workforce**: Multiple fatalities (>50) *OR* **Public**: multiple fatalities (>10)
	Health (Adverse effects resulting from chronic chemical or physical exposures or exposure to biological agents)	**Workforce:** Minor illness or effect with limited or no impacts on ability to function and treatment is very limited or not necessary *AND* **Public:** No impact	**Workforce**: Mild to moderate illness or effect with some treatment and/or functional impairment but is medically managable *OR* **Public**: Illness or adverse effect with limited or no impacts on ability to function and medical treatment is limited or not necessary.	**Workforce**: Serious illness or severe adverse health effect requiring a high level of medical treatment or management *OR* **Public**: Illness or adverse effects with mild to moderate functional impairment requring medical treatment.	**Workforce** (1-4): Serious illness or chronic exposure resulting in fatality or significant life shortening effects OR **Public**: Serious illness or severe adverse health effect requiring a high level of medical treatment or management.	**Workforce** (5-50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** (1-10): Serious illness or chronic exposure resulting in fatality or significant life shortening effects.	**Workforce** (>50): Serious illness or chronic exposure resulting in fatality or significant life shortening effects *OR* **Public** *(>10):* Serious illness or chronic exposure resulting in fatality or significant life shortening effects.
	Environment	Impacts such as localized or short term effects on habitat, species or environmental media.	Impacts such as localized, long term degradation of sensitive habitat or widespread, short-term impacts to habitat, species or environmental media	Impacts such as localized but irreversible habitat loss or widespread, long-term effects on habitat, species or environmental media	Impacts such as significant, widespread and persistant changes in habitat, species or environmental media (e.g. widespread habitat degradation) .	Impacts such as persistant reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.	Loss of a significant portion of a valued species or loss of effective ecosystem function on a landscape scale.

The above legend applies only to HES risks, where risk levels 1-6 are actionable and mandatory.
For risks that may result in facility damage, business interruption, loss of product, the "Assets" category below should be used.
Asset risk reduction is at the discretion of management. Under no circumstances may a direct or indirect translation of Asset loss to HES consequences, or between any discrete categories of HES consequences be inferred.

Consequence Descriptions & Index (without safeguards)	Consequence Indices	6	5	4	3	2	1
		Incidental	**Minor**	**Moderate**	**Major**	**Severe**	**Catastrophic**
Consequence Descriptions	**Assets** (Facility Damage, Business Interruption, Loss of Product)	Minimal damage. Negligible down time or asset loss. Costs < $100,000.	Some asset loss, damage and/or downtime. Costs $100,000 to $1 Million.	Serious asset loss, damage to facility and/or downtime. Costs of $1-10Million.	Major asset loss, damage to facility and/or downtime. Cost >$10 Million but <$100 Million.	Severe asset loss or damage to facility. Significant downtime, with appreciable economic impact. Cost >$100MM but <$1billion.	Total destruction or damage. Potential for permanent loss of production. Costs >$1billion

This matrix is endorsed for use across the Company.
It is not a substitute for, and does not override any relevant legal obligations.
Under no circumstances should any part of this matrix be changed or modified, adapted or customized.
This matrix identifies health, safety, environmental and asset risks and is to be used only by qualified and competent personnel.
Where applicable it is to be used within the Riskman2 structure and governance of an OE Risk Management Process. If applied outside of these Processes, it is also mandatory to manage identified intolerable risks and comply with the Risk Mitigation Closure Guidelines.

Appendix 3 Monitoring Program (July 2008 – January 2014)

The text and figures below are an extract from Revision 0 of the CSSMP, describing the monitoring program undertaken between July 2008 and January 2014.

Scope

A monitoring program will be implemented during the construction and operation of the MOF and the LNG Jetty at Town Point, to detect adverse changes to the beach structure (beach envelope, beach volume and beach slope—specifically the extent of any erosion or accretion of sand) and beach sediments (sediment characteristics—Particle Size Distribution, sediment density and moisture content) of the adjacent beaches which may result from the presence of the MOF and the LNG Jetty. The data on beach structure and beach sediments will be used with the information gathered from the marine turtle monitoring program (number of tracks left by turtles traversing the beach for nesting, nesting success, hatching success and emergence success; Chevron Australia 2009a) to determine if the presence of the MOF and the LNG Jetty is impacting on marine turtles nesting on these beaches.

Sampling effort will be concentrated on those beaches (or parts thereof) that the modelling predicts will be most likely to be impacted as a consequence of the presence of the MOF and the LNG Jetty at Town Point). Sampling will also be undertaken at beaches that have been identified as the independent monitoring reference sites. The reference beaches (Inga Beach, Yacht Club Beach North and Yacht Club Beach South) were selected because the geomorphology of these beaches is similar to that at the potential impact beaches (Terminal Beach and Bivalve Beach).

Beach Profile Transect Sites

Twenty-five beach profile Transects are surveyed along Terminal Beach (Figure A), 24 along Bivalve Beach (Figure B) and two Transects are surveyed along each of Inga Beach (Figure C), Yacht Club Beach North (Figure D) and Yacht Club Beach South (Figure E).

In July and October 2008, five Transects were surveyed along Terminal Beach and Bivalve Beach located adjacent to Town Point. Two Transects were surveyed at each of Inga Beach, Yacht Club Beach North and Yacht Club Beach South. From January 2009 onwards, additional Transects were surveyed at Terminal Beach and Bivalve Beach. Transects have been established every 10 m for the first 100 m from the Town Point end of the beaches, every 20 m for the next 200 m, and every 100 m for the remainder of the length of the beaches, where practicable. This spacing is considered to be of a sufficient spatial resolution to enable the detection of any small-scale changes. The highest intensity of beach profiles is at the end of Terminal Beach and Bivalve Beach closest to the MOF and the LNG Jetty, as it is expected that if any changes in beach structure or sediment characteristics were to occur, impacts would first be detected at these locations. In addition, from July 2009, two Transects located 10 m either side of the pipeline which crosses the northern end of Terminal Beach, have been established. The Transects established in July and October 2008 have continued to be surveyed. While adverse changes to the beaches adjacent Town Point are unlikely as a result of the MOF and the LNG Jetty, this precautionary approach will ensure that any changes are detected through ongoing monitoring.

Beach sediment Particle Size Distribution, sediment density and moisture content are sampled at four locations along the beach profiles: the Crest of Beach Face (CBF), within the Foredune Area (FA), the Base of Primary Dune (BD) and the Primary Dune (PD) (Figure F). Beach sediment characteristics are sampled along seven Transects at Terminal Beach (T1, T11, T13, T16, T19, T21 and T22; see Figure A), six Transects at Bivalve Beach (B1, B11, B16, B21, B22 and B24; see Figure B) and along both Transects at Inga Beach, Yacht Club Beach North and Yacht Club Beach South.

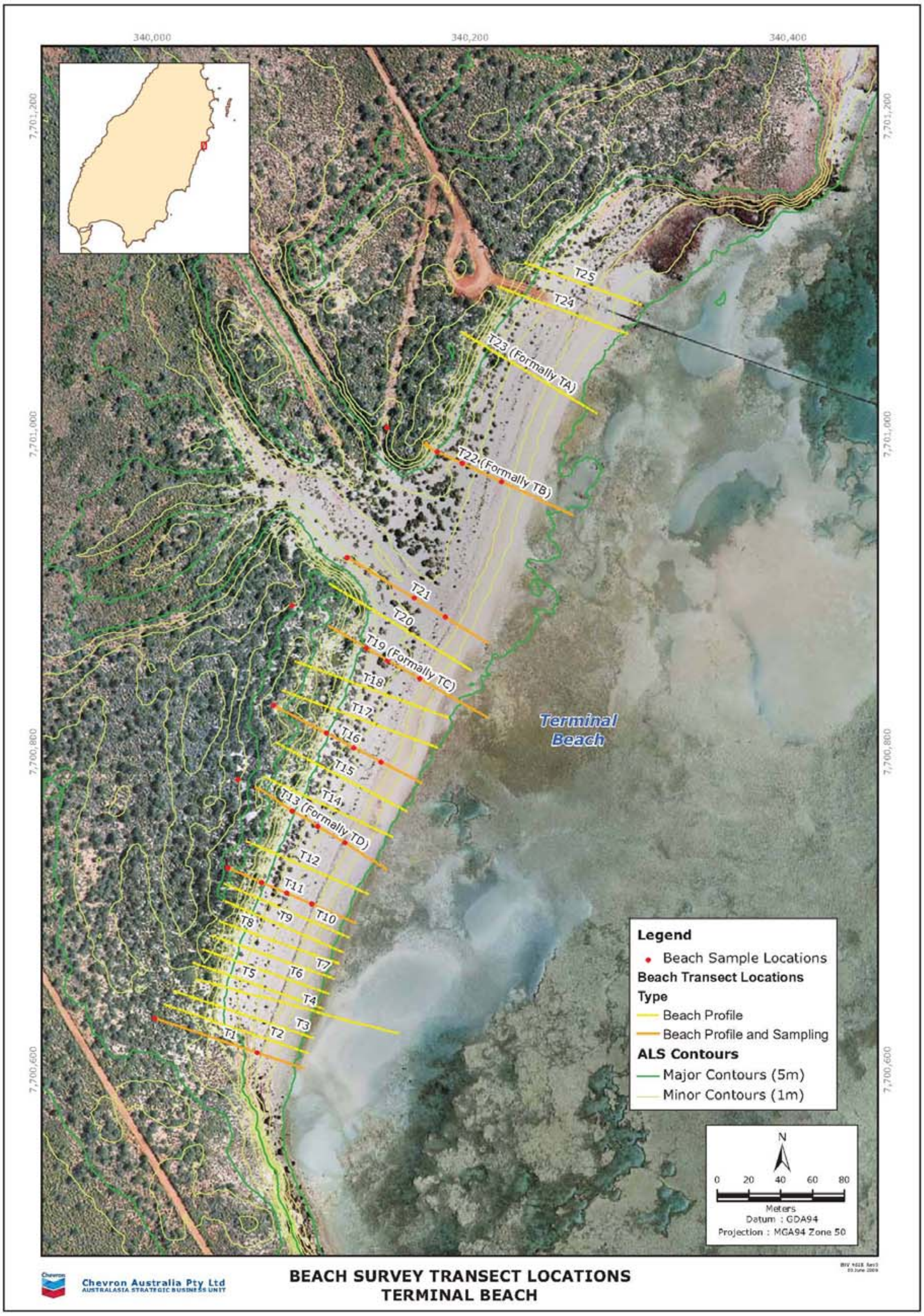


Figure A: Beach Survey Transect Locations Terminal Beach

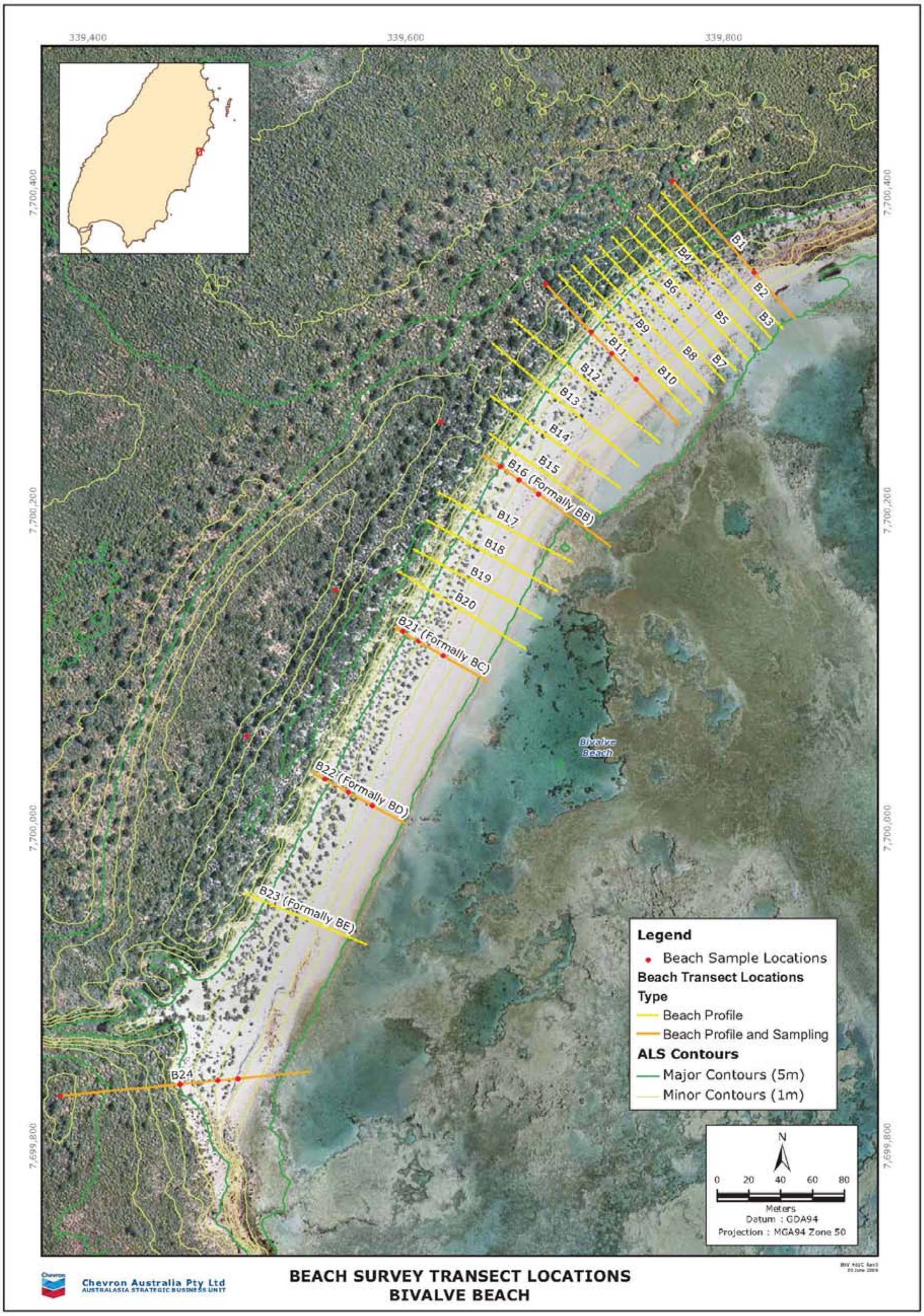


Figure B: Beach Survey Transect Locations Bivalve Beach

Figure C: Beach Survey Transect Locations Inga Beach

Figure D: Beach Survey Transect Locations Yacht Club Beach North

Figure E: Beach Survey Transect Locations Yacht Club Beach South

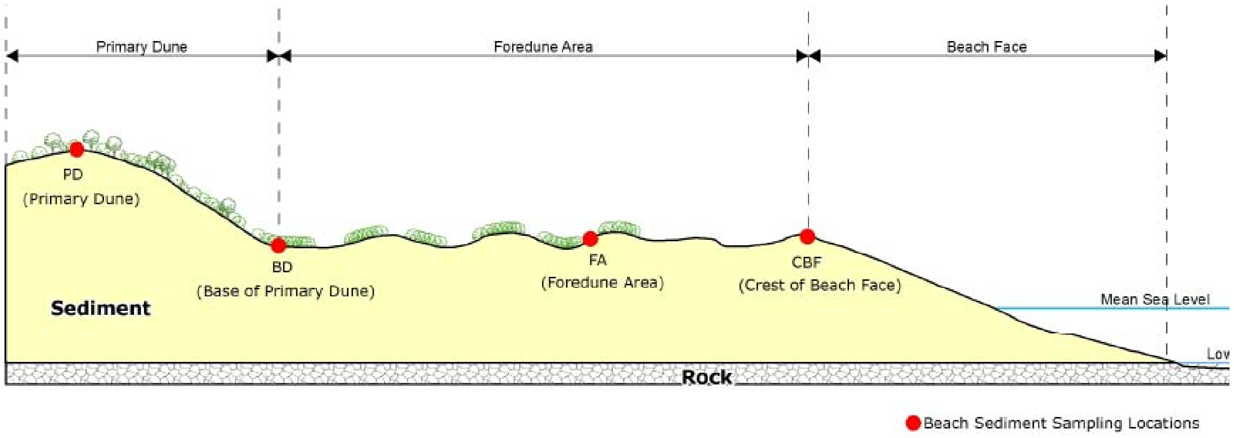


Figure F: Coastal Dune System Beach Transect and Beach Sediment Sampling Locations

Methodology

Beach Profiles

Where reasonably practicable, beach profiles are taken from the crest of the primary dune to Mean Low Water. The start point of each profile is as far back on the dune crest as practicably possible, while also satisfying the survey objectives; and coincides with the commencement of the dense vegetation where reasonably practicable. Where reasonably practicable, the timing of survey work is scheduled to coincide with low tides at Barrow Island. For health and safety considerations, profiles are generally terminated approximately 30 m past the ‘shoreline’ or at a location where the depth of water precludes the further advancement of field personnel across the rock platform. The point at which the dense vegetation line begins is recorded and the point at which the sand ends and the intertidal rock platform continues is recorded for each profile. In addition, where a survey point is in an area of beach directly affected by turtle nesting (e.g. evidence of turtles excavating large body pits to lay their eggs), this is recorded.

Beach profiling is undertaken using a Real-time Kinematic Global Positioning System (RTK GPS) (or equivalent technology) relative to MGA Zone 50, GDA 94 datum. Eastings, northings and elevation (x, y, z coordinates) are recorded at the natural surface level of the beach, with a maximum spacing of 2 m intervals along each profile. Note that in July and October 2008, profiles were surveyed using a Differential Global Positioning System (DGPS) on the OmniSTAR-HP Service relative to MGA Zone 50, GDA 94 datum. The use of the RTK GPS provides an improved accuracy of ±0.020 m (compared to ±0.10 m 95% of the time provided by the OmniSTAR-HP DGPS).

Survey control is provided by both temporary benchmarks in the form of star-iron stakes established at the start of the survey Transects and the permanent benchmark at Town Point (Chevron Australia 2007a).

Beach Sediment Particle Size Distribution

Hand-augered boreholes are drilled at each of the four sampling locations along selected beach profiles to sample the beach sediments. The boreholes are drilled to a target depth of nominally 1 m below the existing beach surface, or refusal, whichever occurs first. The boreholes are cased to improve sample recovery in the dry sediment. Samples are taken from the surface and below the surface at 0.3 m, 0.6 m and 1.0 m depths. The 60 cm depth sample corresponds with the average depth of a Flatback Turtle nest, which is approximately 64 cm (Pendoley Environmental 2007). At each location, observations of beach surface characteristics (e.g. the presence of shell material) are also recorded.

Particle size analysis is undertaken on the samples using manual wet sieving techniques in accordance with AS 1289.3.6.1-1995. All sample analysis is undertaken by a laboratory with National Association of Testing Authorities (NATA) accredited methods.

Sediment Density

In situ testing of the resistance of the beach sediments to penetration is undertaken at each location along the beach profiles where samples are collected for beach sediment Particle Size Distribution analysis, using a Perth Sand Penetrometer in accordance with AS 1289.6.3.3-1997. The Perth Sand Penetrometer is a 16 mm (± 0.2 mm) diameter flat-tipped rod driven by a 9 kg mass dropping 600 mm, with blows recorded for each 150 mm of penetration to a depth of 1 m or as deep as physically allowable. The depth of refusal provides an indication of the depth of gravel and rock underlying the beach sediments.

Moisture Content

The moisture content (as a percentage of dry mass) of the samples collected for Particle Size Distribution analysis is determined in accordance with AS 1289.2.1.1-2005. All sample analysis is undertaken by a laboratory with NATA-accredited methods.

Land-based Photographs

On each survey occasion, photographs are taken from the Crest of Beach Face sampling location on Transects T1, T11 and T16 at Terminal Beach, B1, B11 and B16 at Bivalve Beach and on each Transect at Inga Beach, Yacht Club Beach North and Yacht Club Beach South. Photographs are taken at a fixed height of 1.5 m above surface level orientated to the north, south, east and west along the beach. Photographs are also taken of Terminal Beach and Bivalve Beach from fixed reference points located at Town Point; of the Town Point rock face from Terminal Beach and Bivalve Beach; and from the intertidal flat at Terminal Beach and Bivalve Beach. The photographs will provide a visual record of the structure of the beaches over time.

Frequency

Beach structure (beach profiles) and beach sediments will, where practicable, be routinely monitored quarterly. Beach sediments will be sampled annually at the Primary Dune sampling location. Baseline monitoring will continue at quarterly intervals until the construction of the MOF and the LNG Jetty at Town Point commences. This information will constitute additional baseline data. If the results from the monitoring program indicate there is no change after three years following the completion of construction of the MOF and the LNG Jetty, the sampling frequency may be reassessed by Chevron Australia.

In addition, monitoring will, where reasonably practicable, be undertaken after a major event such as a storm or tropical cyclone to assess change in beach structure. After a storm or tropical cyclone, monitoring will, where reasonably practicable, be undertaken at fortnightly intervals until the next scheduled routine quarterly monitoring. Beach sediments (Particle Size Distribution, sediment density and moisture content) may also be sampled.

Additional monitoring may also be undertaken in the event that a review of the results from the routine monitoring indicates that there is a significant change occurring as a result of Gorgon Gas Development related activities that requires further investigation.

Appendix 4 Compliance Reporting Table

Section No.	Actions	Timing
5.2.1	Monitoring will be undertaken at the following east coast beaches (Figure 5-1): • Potential impact beaches: Terminal Beach and Bivalve Beach (i.e. beaches immediately adjacent to the MOF and LNG Jetty) • Reference beaches: Inga Beach, Yacht Club North Beach, and Yacht Club South Beach.	Construction and Operation
5.2.2.1	Routine monitoring will be undertaken twice a year, at the end of the dry and wet seasons where practicable.	Construction and Operation
5.2.2.1.1	Aerial photography (part of the routine monitoring program) will be undertaken annually, at the end of the dry season where practicable.	Construction and Operation
5.2.2.2	Major event monitoring will be undertaken as soon as reasonably practicable after a major event; a major event is defined as: *A sustained period (four days or longer) of winds with an easterly component (NNE to SSE), during which the total duration of winds greater than 18 knots is greater than or equal to 96 hours is recorded at Barrow Island.*	Construction and Operation
8.1.1	Any document that is required to be implemented under this Plan will be made available to the relevant OEPA and DotE auditor.	Construction and Operation
8.1.2	The findings of external regulatory audits will be recorded and any actions and/or recommendations will be addressed and tracked.	Construction and Operation
Table 8-1	Impact to EPBC Act listed species covered within the scope of the monitoring program (marine turtles, specifically Flatback Turtles) included in this Plan is to be reported to DotE within 48 hours of detection.	Construction and Operation

Appendix 5 Identification and Risk Assessment of Marine Matters of National Environmental Significance (NES)

Gorgon Gas Development and Jansz Feed Gas Pipeline:

Appendix: Identification of Marine Matters of National Environmental Significance (NES) and their Habitat

Document No:	G1-NT-REPX0002887	Revision:	2
Revision Date:	12 August 2011	Copy No.:	
IP Security:	Public		

Table of Contents

List of Tables

1.0 Environment Protection and Biodiversity Conservation Act (Cth) Listed Species

A number of marine species that occur in Barrow Island waters in the vicinity of the Marine Facilities of the Gorgon Gas Development and Jansz Feed Gas Pipeline are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth). EPBC Act listed species were identified in the Draft Environmental Impact Statement/Environmental Review and Management Programme (EIS/ERMP) (Chevron Australia 2005) and were reviewed during the preparation of the Public Environmental Review (PER) (Chevron Australia 2008) for the Revised and Expanded Gorgon Gas Development. The marine species identified to date fall within a number of different protection categories under the EPBC Act; however, only those listed as threatened fauna species or listed as migratory species are identified in this Report, in accordance with Commonwealth Ministerial Approvals EPBC Reference 2003/1294 and EPBC Reference: 2008/4178. The threatened species categories, as stated in section 179 of the EPBC Act are:

- Extinct
- Extinct in the wild
- Critically endangered
- Endangered
- Vulnerable
- Conservation dependent.

There are 86 marine species that may occur in the waters surrounding the Gorgon Gas Development and Jansz Feed Gas Pipeline Marine Facilities and that are listed under the EPBC Act as either threatened and/or migratory species. The 86 protected species include 12 species of marine mammals, six species of marine reptiles, five species of fish, and 63 species of birds. These species have been identified via a review of journal articles, survey reports, the Draft EIS/ERMP (Chevron Australia 2005), the PER (Chevron Australia 2008) and searches of the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC; formerly the Department of Environment, Water, Heritage and the Arts [DEWHA]) current EPBC Act List of Threatened Fauna Species (SEWPaC 2009), List of Migratory Species (SEWPaC 2009a) and Species Profile and Threats (SPRAT) Database (SEWPaC 2011).

The EPBC Act listed threatened fauna species and listed migratory species that may occur within the vicinity of the Marine Facilities are listed in Table 1.1 and described in Section 1.1 (marine mammals), Section 1.2 (marine reptiles), Section 1.3 (fish) and Section 1.4 (avifauna). Section 2.0 describes the risk assessment process used to determine which listed threatened fauna species and listed migratory species and their habitat, are at risk of Material or Serious Environmental Harm from construction and operation of the Marine Facilities. For the purposes of this Report, Material or Serious Environmental Harm under the *Environmental Protection Act 1986* (EP Act) (WA) is considered the same as Significant Impact under the EPBC Act.

Table 1.1 EPBC Act Listed Threatened Fauna Species and Listed Migratory Species that may occur in the vicinity of the Marine Facilities

Species	Scientific Name	EPBC Act (Cth) Status
Marine Mammals		
Humpback Whale	*Megaptera novaeangliae*	Vulnerable, Migratory
Sei Whale	*Balaenoptera borealis*	Vulnerable, Migratory
Blue Whale	*Balaenoptera musculus*	Endangered, Migratory
Bryde’s Whale	*Balaenoptera edeni*	Migratory
Antarctic Minke Whale	*Balaenoptera bonaerensis*	Migratory

Species	Scientific Name	EPBC Act (Cth) Status
Sperm Whale	*Physeter macrocephalus*	Migratory
Killer Whale	*Orcinus orca*	Migratory
Dusky Dolphin	*Lagenorhynchus obscurus*	Migratory
Irrawaddy Dolphin	*Orcaella heinsohni*	Migratory
Indo-Pacific Humpback Dolphin	*Sousa chinensis*	Migratory
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	*Tursiops aduncus* (Arafura/Timor Sea populations)	Migratory
Dugong	*Dugong dugon*	Migratory
Marine Reptiles		
Olive Ridley Turtle	*Lepidochelys olivacea*	Endangered, Migratory
Loggerhead Turtle	*Caretta caretta*	Endangered, Migratory
Leatherback Turtle	*Dermochelys coriacea*	Vulnerable, Migratory
Hawksbill Turtle	*Eretmochelys imbricata*	Vulnerable, Migratory
Flatback Turtle	*Natator depressus*	Vulnerable, Migratory
Green Turtle	*Chelonia mydas*	Vulnerable, Migratory
Fish		
Whale Shark	*Rhincodon typus*	Vulnerable, Migratory
Great White Shark	*Carcharodon carcharias*	Vulnerable, Migratory
Grey Nurse Shark	*Carcharias taurus*	Vulnerable
Dwarf Sawfish	*Pristis clavata*	Vulnerable
Green Sawfish	*Pristis zijsron*	Vulnerable
Marine Avifauna		
Anatidae (ducks, geese and swans)		
Black Swan	*Cygnus atratus*	Migratory
Australian Wood Duck	*Chenonetta jubata*	Migratory
Grey Teal	*Anas gibberifrons*	Migratory
Procellariidae (shearwaters)		
Wedge-tailed Shearwater	*Puffinus pacificus*	Migratory
Diomedeidae (albatrosses)		
Yellow-nosed Albatross	*Diomedea chlororhynchos*	Migratory
Hydrobatidae (storm-petrels)		
Wilson’s Storm Petrel	*Oceanites oceanicus*	Migratory
Sulidae (gannets and boobies)		
Masked Booby	*Sula dactylatra*	Migratory
Brown Booby	*Sula leucogaster*	Migratory
Fregatidae		
Lesser Frigatebird	*Fregata ariel*	Migratory
Ardeidae (herons and egrets)		
Eastern Reef Egret	*Ardea (Egretta) sacra*	Migratory
Great Egret	*Ardea (Egretta) alba*	Migratory
Accipitridae (kites, hawks and eagles)		
Osprey	*Pandion haliaetus*	Migratory
Black-shouldered Kite	*Elanus notatus*	Migratory
Square-tailed Kite	*Lophoictinia isura*	Migratory
Black-breasted Buzzard	*Hamirostra melanosternon*	Migratory
Whistling Kite	*Haliastur sphenurus*	Migratory
Brahminy Kite	*Haliastur indus*	Migratory

Species	Scientific Name	EPBC Act (Cth) Status
White-bellied Sea-eagle	*Haliaeetus leucogaster*	Migratory
Spotted Harrier	*Circus assimilis*	Migratory
Wedge-tailed Eagle	*Aquila audax*	Migratory
Falconidae (falcons)		
Brown Falcon	*Falco berigora*	Migratory
Australian Hobby	*Falco longipennis*	Migratory
Nankeen Kestrel	*Falco cenchroides*	Migratory
Scolopacidae (sandpipers)		
Black-tailed Godwit	*Limosa limosa*	Migratory
Bar-tailed Godwit	*Limosa lapponica*	Migratory
Little Curlew	*Numenius minutus*	Migratory
Whimbrel	*Numenius phaeopus*	Migratory
Eastern Curlew	*Numenius madagascariensis*	Migratory
Marsh Sandpiper	*Tringa stagnatalis*	Migratory
Common Greenshank	*Tringa nebularia*	Migratory
Wood Sandpiper	*Tringa glareola*	Migratory
Terek Sandpiper	*Xenus cinerea (Tringa terek)*	Migratory
Common Sandpiper	*Tringa hypoleucos*	Migratory
Grey-tailed Tattler	*Tringa brevipes*	Migratory
Ruddy Turnstone	*Arenaria interpres*	Migratory
Great Knot	*Calidris tenuirostris*	Migratory
Red Knot	*Calidris canutus*	Migratory
Sanderling	*Calidris alba*	Migratory
Red-necked Stint	*Calidris ruficollis*	Migratory
Sharp-tailed Sandpiper	*Calidris acuminata*	Migratory
Curlew Sandpiper	*Calidris ferruginea*	Migratory
Recurvirostridae (stilts and avocets)		
Black-winged Stilt	*Himantopus himantopus*	Migratory
Banded Stilt	*Cladorhynchus leucocephalus*	Migratory
Charadriidae (lapwings and plovers)		
Pacific Golden Plover	*Pluvialis fulva*	Migratory
Grey Plover	*Pluvialis squatarola*	Migratory
Red-capped Plover	*Charadrius ruficapillus*	Migratory
Lesser Sand Plover	*Charadrius mongolus*	Migratory
Greater Sand Plover	*Charadrius leschenaultia*	Migratory
Oriental Plover	*Charadrius veredus*	Migratory
Glareolidae (waders)		
Oriental Pratincole	*Glareola maldivarum*	Migratory
Laridae (gulls and terns)		
Lesser Crested Tern	*Sterna bengalensis*	Migratory
Roseate Tern	*Sterna dougallii*	Migratory
Common Tern	*Sterna hirundo*	Migratory
Little Tern	*Sterna albifrons*	Migratory
Bridled Tern	*Sterna anaethetus*	Migratory
Caspian Tern	*Sterna caspia*	Migratory
White-winged Black Tern	*Chlidonias leucoptera*	Migratory
Sternidae (terns)		
Australian Lesser Noddy	*Anous tenuirostris melanops*	Vulnerable

Species	Scientific Name	EPBC Act (Cth) Status
Cuculidae (cuckoos)		
Oriental Cuckoo	*Cuculus saturatus*	Migratory
Strigidae (hawk-owls)		
Southern Boobook Owl	*Ninox novaeseelandiae*	Migratory
Apodidae (swifts)		
Fork-tailed Swift	*Apus pacificus*	Migratory
White-throated Needletail	*Hirundapus caudacutus*	Migratory
Motacillidae (pipits and true wagtails)		
Yellow Wagtail	*Motacilla flava*	Migratory

Sources: Chevron Australia (2005, 2008), SEWPaC (2009, 2009a, 2011).

1.1 Threatened and Migratory Marine Mammals and Habitat

The Pilbara region supports migratory, transient and resident marine mammals such as whales, dolphins and dugong (Chevron Australia 2005). There are 12 species of marine mammals that are listed as threatened fauna species and/or migratory species under the EPBC Act and under the Convention on Migratory Species (CMS) (Bonn Convention) that are likely to be found in the vicinity of the Marine Facilities (Table 1.1). These are the Humpback Whale (*Megaptera novaeangliae*), Sei Whale (*Balaenoptera borealis*), Blue Whale (*Balaenoptera musculus*), Bryde’s Whale (*Balaenoptera edeni*), Antarctic Minke Whale (*Balaenoptera bonaerensis*), Sperm Whale (*Physeter macrocephalus*), Killer Whale (*Orcinus orca*), Dusky Dolphin (*Lagenorhynchus obscures*), Irrawaddy Dolphin (*Orcaella heinsohni*), Indo-Pacific Humpback Dolphin (*Sousa chinensis*), Spotted Bottlenose Dolphin (*Tursiops aduncus*) (the Arafura/Timor Sea populations only), and Dugong (*Dugong dugon*). All of these species are listed as migratory species (Table 1.1), with the exception of the Blue Whale, which is also listed as Endangered, and the Humpback and Sei Whales, which are also listed as Vulnerable.

The regional distribution of many whale species is not well understood and while many species may occur in the Pilbara region, most are likely to be transient (Chevron Australia 2005). The Sei Whale, Blue Whale, Bryde’s Whale, Antarctic Minke Whale and Sperm Whale are generally more abundant in deeper waters (SEWPaC 2011) and are expected to be rare visitors to the shallow, inshore waters in the vicinity of the Marine Facilities on the east or west coasts of Barrow Island, and the waters between Barrow Island and the mainland (Chevron Australia 2005). Humpback Whales are regular visitors moving through Barrow Island waters between June and October on their annual migration between their feeding grounds in Antarctic waters and their calving grounds in Pilbara and Kimberley waters (Chevron Australia 2005). Humpback Whales are more common in waters on the west coast of Barrow Island but do visit the east coast of the Island (Chevron Australia 2005). The strong currents and extensive shoals are thought to deter the majority of Humpback Whales from the area between Barrow Island and the mainland (Jenner *et al.* 2001).

Dolphins may occasionally visit the subtidal marine areas associated with the Marine Facilities (Chevron Australia 2005). Similar to whales, the regional distribution of most dolphin species is poorly known and while many species may occur in the Pilbara region, most are likely to be transient (Chevron Australia 2005). In Australia, Killer Whales are generally most often seen in relatively deeper waters along the continental slope and on the continental shelf, particularly near seal colonies (SEWPaC 2011). Indo-Pacific Humpback Dolphins have resident populations within the shallow waters of the inner Rowley Shelf, including Barrow Island (Chevron Australia 2005). This species is known to inhabit coastal waters <20 m deep and estuarine environments (Bannister *et al.* 1996; Parra *et al.* 2006), and is therefore likely to occur between Barrow Island and the mainland. Irrawaddy Dolphins mainly occur in shallow coastal or estuarine waters (Beasley *et al.* 2002), which suggests they are more likely to occur in the waters between the east coast of Barrow Island and the mainland, rather than in the vicinity of the Marine Facilities on the west coast of Barrow Island. Dusky Dolphins are not well surveyed in Australian waters and are known from only 13 reports since 1828, with two sightings in the early 1980s (SEWPaC 2011a). The Dusky Dolphin occurs mostly in temperate and sub-Antarctic waters, primarily inhabiting inshore waters (Ross 2006). As their distribution in Australia is uncertain, they may occur in the vicinity of the Marine Facilities during construction and operation of the Gorgon Gas Development, although this is considered unlikely. The Spotted Bottlenose Dolphin inhabits warmer coastal areas, in waters less than 10 m (Bannister *et al.* 1996). The populations of Spotted Bottlenose Dolphins in the Arafura/Timor Sea are listed in Appendix II of the Bonn Convention. Since the Arafura/Timor Sea populations are listed as migratory and their distribution is thought to extend as far south as Exmouth, they may occur in the shallow waters surrounding Barrow Island, and also between Barrow Island and the mainland.

Dugongs occur throughout the shallow waters between the Pilbara offshore islands and the mainland (Chevron Australia 2005). Dugongs are generally associated with shallow seagrass meadows on which they feed and have been observed in the shallow waters over the Barrow Shoals, along the east coast of Barrow Island, and over the Lowendal Shelf (Chevron Australia 2005). They are likely to be occasional visitors to any area of subtidal seagrass in the vicinity of the Gorgon Gas Development Marine Facilities (Chevron Australia 2005).

1.2 Threatened and Migratory Marine Reptiles and Habitat

Six species of marine turtle occur in Western Australian waters, all of which are listed as threatened and migratory species under the EPBC Act (Table 1.1). These are the Green Turtle (*Chelonia mydas*), Flatback Turtle (*Natator depressus*), Olive Ridley Turtle (*Lepidochelys olivacea*), Loggerhead Turtle (*Caretta caretta*), Hawksbill Turtle (*Eretmochelys imbricata*) and Leatherback Turtle (*Dermochelys coriacea*). Of these species, Flatback Turtles, Green Turtles and Hawksbill Turtles have been recorded on the beaches and in the surrounding waters of Barrow Island, and the islands located between Barrow Island and the mainland (Pendoley *et al.* 2003; Pendoley 2005; Chevron Australia 2009). In general, the coastal islands within the Pilbara region have been recognised as important breeding sites for marine turtles (Department of Conservation and Land Management [CALM] 2002). Barrow Island is a regionally important nesting area for Green Turtles and Flatback Turtles, and Middle Passage Island and Sholl Island (in the vicinity of the Domestic Gas (DomGas) Pipeline) are considered regionally important Hawksbill Turtles rookeries (Pendoley *et al.* 2003; Chevron Australia 2005).

1.2.1 Flatback Turtles

Flatback Turtles nest only in northern Australia and the rookeries at Mundabullangana Station, Barrow Island, Lacepede Islands, Dampier Archipelago, Port Hedland, the Montebello Islands and the Lowendal Islands are considered regionally important (Chevron Australia 2005; Limpus 2007; Department for the Environment, Water, Heritage and the Arts [DEWHA] 2008). The peak nesting period for Flatback Turtles occurs during December and January (Chevron Australia 2009). The annual mean reproductive population of Flatback Turtles nesting at Barrow Island is currently estimated to be 1397 (Pendoley Environmental 2009), which is comparable to the rookery at Mundabullangana, near Port Hedland on the Western Australian mainland, which is estimated to be 1700 (Pendoley *et al.* 2011), and is smaller than the rookery at Cape Domett in far north-western Australia, which supports approximately 3250 nesting females per year (Whiting *et al.* 2008). Flatback Turtle nesting on Barrow Island is concentrated on the mid-east coast on deep sandy, low sloped beaches with wide shallow intertidal zones (Pendoley 2005). The highest average number of tracks per night occurs on Mushroom Beach, approximately 2 km north of Town Point (Chevron Australia 2009).

Flatback Turtles are also known to nest on the coastal islands located between Barrow Island and the mainland, with low to moderate levels of craters or tracks recorded on Great Sandy Island, North Sandy Island, Passage Island and Angle Island in 2002 (Pendoley *et al.* 2003). Internesting Flatback Turtles from Barrow Island are known to use the shallow waters between Barrow Island and the mainland (Pendoley Environmental 2010, 2010a). On the mainland, nesting by Flatback Turtles is considered widespread, occurring on beaches from Mundabullangana near Port Hedland, to Broome in the Kimberley region (Limpus 2007).

Flatback Turtle hatchlings emerge from their nests six to eight weeks after eggs are laid and are then present on beaches and in the waters around nesting beaches. The peak hatching period occurs in February and March (Chevron Australia 2009). Little is known about the behaviour of Flatback Turtle hatchlings after they leave their natal beaches (Chevron Australia 2009); however, it is known that they grow to maturity in shallow coastal waters close to their natal beaches, remaining within the continental shelf waters (Musick and Limpus 1996). Flatback Turtles are carnivorous and forage primarily on soft-bodied invertebrates such as soft corals, sea pens, and holothurians (Chevron Australia 2008). Post-hatchling Flatback Turtles may occur in mangrove habitats along the mainland coast (Chevron Australia 2009).

1.2.2 Green Turtles

The north-western Australian population of Green Turtles is considered regionally important due to high predation pressures on nesting and internesting turtles in other parts of the Indo-Pacific region (Chevron Australia 2005). The Green Turtle rookeries at North West Cape, Thevenard Island, Surrier Island, Barrow Island, the Montebello Islands, the Lacepede Islands, and Browse Island are considered regionally important (Chevron Australia 2005; DEWHA 2008; Limpus 2008). The estimated size of the Green Turtle reproductive population at Barrow Island is in the order of 20 000 females (Pendoley 2005), which may therefore represent a substantial component of the Pilbara region population (Prince 1994). However, this is considered less substantial than the Lacepede Island rookery (Chevron Australia 2009). Green Turtles tend to nest on the west and north-east coasts of Barrow Island where beaches are high energy, deep, steeply sloped, sandy, and have an unobstructed foreshore approach (Pendoley 2005). The nesting period for Green Turtles on the west coast of Barrow Island peaks between December and February (Pendoley 2005; Chevron Australia 2009). Green Turtle nesting has also been recorded on the islands located between Barrow Island and the mainland (Pendoley *et al.* 2003). In 2002, low densities of craters (1 per >10 m) were recorded on Passage Island and Middle Passage Island, whilst moderate (1 per 5-10 m) to high (1 per 1-5 m) densities of craters or tracks were recorded on Great Sandy Island, North Sandy Island, Angle Island and Long Island (Pendoley *et al.* 2003).

Green Turtle hatchlings emerge from their nests after eggs are laid and are then present on the beaches and in the waters around the nesting beaches (Chevron Australia 2009). The peak hatching period for Green Turtles is during February and March (Chevron Australia 2009). After the hatchling stage, juvenile Green Turtles typically use a number of nursery habitats located away from their natal beach (Musick and Limpus 1996). Green Turtles are herbivorous and graze on algae growing on intertidal rock platforms on the west coast of Barrow Island (Chevron Australia 2008, 2009). Internesting Green Turtles and foraging adult and juvenile Green Turtles are known to use the waters surrounding the Great Sandy and Passage Island groups, and may also occur in the shallow coastal waters and mangrove habitats along the mainland coast (Pendoley *et al.* 2003; Chevron Australia 2009). Juvenile Green Turtles in particular are thought to favour mangrove habitats (Chevron Australia 2009).

1.2.3 Hawksbill Turtles

In north-western Australia, the Hawksbill Turtle rookeries at Rosemary Island, the Montebello Islands, the Lowendal Islands, Sholl Island and Middle Passage Island are considered regionally important (Pendoley *et al.* 2003; Pendoley 2005; DEWHA 2008). The largest rookeries of Hawksbill Turtles are at Rosemary Island, the Lowendal Islands and the Montebello Islands, which have annual reproductive populations of ~1000, 1000 and 1300, respectively (Pendoley 2005; Limpus 2009). Similar levels of nesting occur at Sholl and Middle Passage Islands which are located between Barrow Island and the mainland (Pendoley *et al.* 2003). Barrow Island is not considered a regionally important nesting site for Hawksbill Turtles. The estimated size of the Hawksbill Turtle reproductive population at Barrow Island is 100 per year (Pendoley 2005; Limpus 2009).

Hawksbill Turtles nest in the Pilbara region all year round, and peak nesting occurs during October and November (Chevron Australia 2009). The highest densities of Hawksbill Turtle nesting on Barrow Island have been recorded on the north-east, mid-east and south-west beaches of Barrow Island (Pendoley Environmental 2008). Hawksbill Turtle nesting on Barrow Island typically occurs on beaches that are small, shallow, and characterised by coarse-grained sand or coral grit interspersed with rocks and beach wrack (Pendoley 2005). A survey conducted in 2002 recorded Hawksbill Turtle nesting on most of the islands within the Great Sandy and Passage Island groups (Pendoley *et al.* 2003). Hawksbill Turtle nesting activity was recorded on Middle Passage Island in high densities (1 track or crater every 1-5 m), on sandy beaches characterised by medium to coarse grain sizes (Pendoley *et al.* 2003). During the same survey, Hawksbill Turtle nesting activity was recorded at similar densities on all of the sandy beaches that surround Sholl Island (Pendoley *et al.* 2003). Lower densities of Hawksbill Turtle nesting activity have been recorded at Great Sandy Island, Pup Island, North Sandy Island, South Passage Island, Passage Island and Angle Island (Pendoley *et al.* 2003).

The peak hatching period for Hawksbill Turtles is during November and December (Chevron Australia 2009). Hawksbill Turtle hatchlings swim actively out to sea and are carried by currents during the pelagic phase of their life-cycle (Carr 1987). During this time they predominantly feed on plankton and macroalgae (Carr 1987). Juvenile and adult Hawksbill Turtles are generally associated with rocky and coral reef habitats, foraging on sponges and soft coral (Chevron Australia 2005). The waters surrounding the Mary Anne, Great Sandy and Passage Island groups are considered important feeding grounds for Hawksbill Turtles, and Hawksbill Turtles that nest at Varanus Island and Rosemary Island are known to forage in these waters (Pendoley *et al.* 2003; Pendoley 2005; Chevron Australia 2009).

1.3 Threatened and Migratory Fish and Habitat

Numerous species of fish are present in the offshore waters of the North West Shelf; however, only the Whale Shark (*Rhincodon typus*), the Grey Nurse Shark (*Carcharias taurus*), the Great White Shark (*Carcharodon carcharias*), the Dwarf Sawfish (*Pristis clavata*) and the Green Sawfish (*Pristis zijsron*) are listed as threatened and/or migratory species under the EPBC Act (Table 1.1). To date, none of these species has been recorded during baseline marine surveys conducted since 2007 in the vicinity of the Marine Facilities (Chevron Australia 2011).

Whale Sharks have a broad distribution in tropical and warm temperate seas (Chevron Australia 2005). They congregate annually off Ningaloo Reef, approximately 150 km south-west of Barrow Island between March and April (Chevron Australia 2005). Whale Sharks leave Ningaloo Reef between May and June, travelling north-east along the continental shelf (Wilson *et al.* 2006). Whale Sharks may pass through the deeper waters off Barrow Island occasionally; however, they do not aggregate there (Woodside Energy 2008).

Grey Nurse Sharks have a broad inshore distribution around Australia (Environment Australia 2002). The Grey Nurse Shark has been recorded as far north as the North West Shelf in Western Australia; however, distribution is generally confined to predominantly the coastal waters of the south-west (Environment Australia 2002).

Great White Sharks have a distribution from the southern coastline of Australia to the Northwest Cape and have been recorded just north of Exmouth (Commonwealth Scientific and Industrial Research Organisation [CSIRO] 2006). Barrow Island is the northern extreme of the documented distribution for Great White Sharks (Chevron Australia 2005). Great White Sharks are highly mobile, but generally more abundant in temperate waters and around seal and sea lion colonies of which there are none in the Barrow Island area (Chevron Australia 2005). Great White Sharks are unlikely to be encountered in the vicinity of the Marine Facilities, except on rare occasions (Chevron Australia 2005).

Dwarf Sawfish and Green Sawfish are listed as Vulnerable under the EPBC Act, and have been recorded in Australia from Cairns, around the Cape York Peninsula, across northern Australian waters to the Pilbara coast in Western Australia (Last and Stevens 1994; Department of Fisheries 2004; Stevens *et al.* 2005, 2008; Threatened Species Scientific Committee 2008, 2009). These species inhabit shallow coastal waters and estuarine habitats in the Pilbara region (SEWPaC 2011). Individuals tend to occupy a restricted range of only a few square kilometres in shallow waters along the coastline (Stevens *et al*. 2008). Studies indicate that the movements of Dwarf Sawfish and Green Sawfish are probably tidally influenced (Stevens *et al*. 2008). They appear to spend high tide resting within mangrove areas, and are more active on the moving tide when they tend to occupy mud and sand flats along the coastline (Stevens *et al*. 2008).

1.4 Threatened and Migratory Marine Avifauna and Habitat

Numerous species of littoral birds (or shorebirds), migratory seabirds, and raptors are found on Barrow Island (Chevron Australia 2005). There are 63 species of marine avifauna (Table 1.1) that may be present from time to time near the Marine Facilities, all of which are listed as migratory species under the EPBC Act.

Migratory shorebird abundances increase on Barrow Island between September and December as the birds migrate south from the northern hemisphere (Chevron Australia 2005). The abundances of some migratory shorebirds continue to increase during January and February, suggesting local movements of birds from the mainland to Barrow Island (Chevron Australia 2005). Abundances decrease as the migratory species leave the region to return north at the end of summer (Chevron Australia 2005).

Barrow Island is both a staging site and an important non-breeding site for migratory shorebirds (Chevron Australia 2005). The greatest abundances of shorebirds on Barrow Island (over two-thirds of records for most species) are associated with the south-eastern and southern coasts of the Island, from the existing Chevron camp to Bandicoot Bay (Chevron Australia 2005). These concentrations appear to be associated with the extensive tidal mudflats in these areas (Chevron Australia 2005). North Whites Beach on the west coast of Barrow Island (where the Feed Gas Pipeline Shore Crossing is located) does not provide significant shorebird habitat and abundances are generally low in these areas (Chevron Australia 2005).

The Montebello/Lowendal/Barrow Island region has significant rookeries of a number of migratory species, including the Wedge-tailed Shearwater (*Puffinus pacificus*), the Bridled Tern (*Sterna anaethetus*) and the Roseate Tern (*Sterna dougallii*) (Chevron Australia 2005). Double Island, approximately 5 km north of Town Point off the east coast of Barrow Island, is a regionally significant rookery for the Bridled Tern and a locally significant rookery for the Wedge-tailed Shearwater (Chevron Australia 2005). However, the Wedge-tailed Shearwater rookery is small compared to other rookeries in the immediate region (Chevron Australia 2005). Other species that may nest on Double Island from time to time include the Caspian Tern (*Sterna caspia*), Roseate Tern, and Lesser Crested Tern (*Sterna bengalensis*) (A. Burbidge pers. comm. 2008, cited in Chevron Australia 2009a).

The Red-necked Stint (*Calidris ruficollis*), Grey-tailed Tattler (*Tringa brevipes*), Ruddy Turnstone (*Arenaria interpres*), Bar-tailed Godwit (*Limosa lapponica*), Lesser Sand Plover (*Charadrius mongolus*), Greater Sand Plover (*Charadrius leschenaultia*), and the Common Tern (*Sterna hirundo*) are the most abundant migratory species of shorebirds that forage at Town Point on the east coast of Barrow Island (Chevron Australia 2005). Other migratory species, such as the Red-capped Plover (*Charadrius ruficapillus*), the Caspian Tern (*Sterna caspia*) and the Osprey (*Pandion haliaetus*), may nest in the area, but were not observed to nest there during surveys conducted in 2003/2004 for the Draft EIS/ERMP (Chevron Australia 2005). Town Point is not considered of local importance to any EPBC Act listed migratory species of shorebird (Chevron Australia 2005).

Ruddy Turnstones are seasonally abundant on Barrow Island and the Island is an internationally important site for this species (Chevron Australia 2005). While Ruddy Turnstones are one of the more abundant species at Town Point during spring and summer, their densities in the vicinity of the Marine Facilities are much lower than in the south and south-eastern areas of Barrow Island (Chevron Australia 2005). These are highly mobile birds that are not restricted to any of the habitats near Town Point on the east coast of Barrow Island (Chevron Australia 2005).

The offshore islands between Dampier and Onslow are considered important for nesting seabirds (Long and Long 1991; CALM 2002; DEWHA 2008). However information on seabird densities and nesting locations is sparse. The Wedge-tailed Shearwater, Caspian Tern, White-bellied Sea Eagle, Eastern Reef Egret and Osprey have been recorded nesting on offshore islands between Barrow Island and the mainland (Pendoley *et al.* 2003). Other migratory seabirds and shorebirds that have been recorded on the islands between Barrow Island and the mainland include the Ruddy Turnstone, Lesser Sand Plover, Grey-tailed Tattler, Nankeen Kestrel, Roseate Tern and the Whimbrel (Pendoley *et al.* 2003), but it is not known if these species use the islands for nesting.

Migratory shorebirds and terns are likely to occur on a seasonal basis on the intertidal flats, and within mangrove areas on the mainland (Bamford Consulting Ecologists and RPS Bowman Bishaw Gorham [BBG] 2006). Mangroves are considered important habitat for migratory bird species in the region, supporting a number of permanent and temporary resident species (Carr and Livesey 1996, cited in Astron Environmental Services 2009; Bamford Consulting Ecologists and RPS BBG 2006).

2.0 Threatened and Migratory Marine Species – Risk Assessment

2.1 Overview

A number of environmental risk assessments have been completed and are reported for the Gorgon Gas Development. A strategic risk assessment was undertaken during the preparation of the Draft EIS/ERMP to determine the environmental acceptability of the Gorgon Gas Development and identify the key areas of risk requiring mitigation (Chevron Australia 2005). This Draft EIS/ERMP assessment was reviewed as part of the development of the PER for the Revised and Expanded Proposal (Chevron Australia 2008), in light of the changes to the Gorgon Gas Development. The outcomes of these assessments have been reviewed and considered during the preparation of this Report.

A summary of the risk assessments that have been undertaken to date and that have provided input into this Report and the documents that support it, are provided in Table 2.1.

Table 2.1 Risk Assessments Relevant to this Report

Scope of Risk Assessment	Method(s)	Documentation	Year
Entire Scope of the Approved Development	AS/NZS 4360:2004	Draft EIS/ERMP (Chevron Australia 2005)	2005
Entire Scope of the Revised and Expanded Proposal	AS/NZS 4360:2004	Gorgon Gas Development PER (Chevron Australia 2008)	2008
Long-term Marine Turtle Management Plan Risk Assessment	RiskMan2	Long-term Marine Turtle Management Plan (Chevron Australia 2009)	2009
Marine Facilities Construction Environmental Management Plan (EMP) Risk Assessment	RiskMan2	Marine Facilities Construction Environmental Management Plan (Chevron Australia 2011)	2009
Dredge and Spoil Disposal Management and Monitoring Plan Risk Assessment	RiskMan2	Dredging and Spoil Disposal Management and Monitoring Plan (Chevron Australia 2011a)	2009
Horizontal Directional Drilling (HDD) Management and Monitoring Plan Risk Assessment	RiskMan2	HDD Management and Monitoring Plan (Chevron Australia 2011b)	2010
Offshore Feed Gas Pipeline System Risk Assessment	RiskMan2	Offshore Gas Pipeline Installation Management Plan (Chevron Australia 2011c)	2010
Offshore Domestic Gas Pipeline Risk Assessment	RiskMan2	Offshore Domestic Gas Pipeline Installation Management Plan (Chevron Australia 2011d)	2011

2.2 Methodology

The methodology for the environmental risk assessments undertaken during the EIS/ERMP and PER assessment processes is documented in Chapter 9 of the Draft EIS/ERMP and Chapter 5 of the PER, respectively (Chevron Australia 2005, 2008). The EIS/ERMP and PER risk assessments were undertaken in accordance with the following standards:

- Australian Standard/New Zealand Standard (AS/NZS) 4360:2004 Risk Management (Standards Australia/Standards New Zealand 2004)
- AS/NZS Handbook 203:2006 Environmental Risk Management – Principles and Process (Standards Australia/Standards New Zealand 2006)
- AS/NZS 3931:1998 Risk Analysis of Technological Systems – Application Guide (Standards Australia/Standards New Zealand 1998).

All other environmental risk assessments were undertaken in accordance with Chevron's RiskMan2 process. The main components of the RiskMan2 risk assessment methodology include:

- **Hazard Identification**: Identifying potential hazards that are applicable to Gorgon Gas Development activities and determining the hazardous events to be evaluated.
- **Hazard Analysis**: Determining the possible causes that could lead to the hazardous events identified; the consequences of the hazardous events; and the safeguards and controls currently in place to mitigate the events and/or the consequences.
- **Risk Evaluation**: Evaluating the risks using the Chevron Integrated Risk Prioritization Matrix. The risk ranking is determined by a combination of the expected frequency of the hazard occurring (likelihood) and the consequence of its occurrence. Note that when assessing the consequence no credit is given to the hazard controls. Hazard controls are taken into account in determining the likelihood of the event.
- **Residual Risk Treatment**: Reviewing the proposed management controls for each of the risks identified and proposing additional controls or making recommendations, if required.

Using the Chevron Integrated Risk Prioritization Matrix, identified risks are categorised into four groups, which determine the level of response and effort in managing the risks. The risk-ranking categories have been used in the development of this Report, to identify the risks that have the potential to result in Material or Serious Environmental Harm to threatened and/or migratory species.

2.3 Risk Assessment Outcomes

The marine fauna listed as threatened fauna species and/or migratory species under the EPBC Act that were considered at risk of some level of impact from the Gorgon Gas Development were identified in the Draft EIS/ERMP (Chevron Australia 2005). Subsequent risk assessments have since been conducted (as described in Section 2.1). The risk profile of these species and their habitat has been updated based on the outcomes of these more recent risk assessments.

Of the species identified in Table 1.1, those that are considered to be at risk of impacts that are categorised as ‘medium’ (RiskMan2 residual risk ratings of 5 or 6) or ‘high’ (RiskMan2 residual risk ratings of 1 to 4) are listed in Table 2.2. Also included in the table are the stressors and a brief summary of the scenarios associated with the risk ratings. For the purposes of this Report, ‘medium’ and ‘high’ risks are considered to be indicative of potential impacts that could result in Material or Serious Environmental Harm.

No ‘high’ risks were identified for EPBC Act listed threatened and/or migratory species. A total of 13 ‘medium’ risks are summarised in Table 2.2 comprising: five risks to whales, dolphins and dugong; six risks to Flatback Turtles, Green Turtles and Hawksbill Turtles; and two risks to migratory species of shorebirds, seabirds and raptors. Given that no ‘medium’ or ‘high’ risks were identified for marine fish, and that none of the five species listed in Table 1.1 have been recorded in the vicinity of the Marine Facilities, marine fish are not at risk of Material or Serious Environmental Harm and are therefore not discussed further.

These risks were all related to activities associated with the construction and operation of the Marine Facilities on the east coast of Barrow Island and the Offshore Feed Gas Pipeline System off the west coast.

All of the risks identified for EPBC Act listed threatened and migratory marine fauna species that were associated with HDD activities conducted on the west coast of Barrow Island were rated as ‘low’ (Chevron Australia 2011b). It is therefore unlikely that HDD activities will result in Material or Serious Environmental Harm, and they are not discussed further in this Report. Information on impacts associated with HDD activities is provided in the HDD Management and Monitoring Plan (Chevron Australia 2011b).

Similarly, all risks identified for EPBC Act listed threatened and migratory marine fauna species that were associated with the DomGas Pipeline were ranked as 'low' (Chevron Australia 2011d). Despite this, some risks ranked as 'low' do have the potential to result in Material or Serious Environmental Harm, and are therefore discussed further in Section 2.4. Additional information on impacts associated with DomGas Pipeline installation activities is also provided in the Offshore DomGas Pipeline Installation Management Plan (Chevron Australia 2011d).

The potential for the risks summarised in Table 2.2 to result in Material or Serious Environmental Harm to EPBC Act listed threatened and/or migratory marine fauna is discussed in Section 2.4.

Table 2.2 Medium and High Risks to Threatened and Migratory Species from the Construction and Operation of the Marine Facilities

Fauna	Stressor	Context	Risk Rating (Sources)
Whales, Dolphins and Dugongs	Physical Interaction	• Changes in localised distribution of marine fauna due to vessel collision/strike on the east coast of Barrow Island. • Change in local abundance/distribution of mobile fauna through construction of Marine Facilities on the east coast of Barrow Island, causing localised changes in fauna behaviour/movement, i.e. restricting preferential patterns of movement or access to certain waters. • Marine fauna injuries or fatalities from vessel movements or waste generation, storage and disposal associated with installation of the Offshore Feed Gas Pipeline System.	**Medium** Marine Facilities Construction Environmental Management Plan (Chevron Australia 2011) Offshore Gas Pipeline Installation Management Plan (Chevron Australia 2011c)
	Physical Presence	• Presence of the Materials Offloading Facility (MOF) and the Liquefied Natural Gas (LNG) Jetty on the east coast of Barrow Island causes localised changes in fauna behaviour/movements, i.e. restricting preferential patterns of movement or access to certain waters.	**Medium** Marine Facilities Construction Environmental Management Plan (Chevron Australia 20011)
	Light Spill	• Change in local abundance/distribution of mobile marine fauna through either attraction or avoidance of development areas on the east coast of Barrow Island. • Increased feeding opportunities for adaptable species leading to reduced numbers of prey species attracted to light. • Increased incidents of marine fauna collisions/interactions with vessels and equipment (e.g. bottlenose dolphins known to congregate in lit areas at night to assist in hunting).	**Medium** Dredging and Spoil Disposal Management and Monitoring Plan (Chevron Australia 2011a) Marine Facilities Construction Environmental Management Plan (Chevron Australia 2011) Offshore Gas Pipeline Installation Management Plan (Chevron Australia 2011c)
	Noise and Vibration	• Vibration and noise emissions generated by construction and dredge vessels, rock armouring activities and land-based excavator movements on the east coast of Barrow Island results in avoidance behaviour. • Shock waves, noise and vibration from underwater blasting and drilling on the east coast of Barrow Island results in mortality or injury (permanent and/or temporary hearing loss). • Disturbance to noise-sensitive marine fauna during helicopter movements, vessel movements and general operation of vessels and equipment, associated with installation of the Offshore Feed Gas Pipeline System.	**Medium** Dredging and Spoil Disposal Management and Monitoring Plan (Chevron Australia 2011a) Marine Facilities Construction Environmental Management Plan (Chevron Australia 2011) Offshore Gas Pipeline Installation Management Plan (Chevron Australia 2011c)
	Marine Water and Sediment Quality	• Turbid plume generated by the dredging and spoil disposal program on the east coast of Barrow Island results in a reduction in water quality causing avoidance of the area by fauna and/or reduced health or	**Medium** Dredging and Spoil Disposal Management and Monitoring Plan (Chevron Australia

Fauna	Stressor	Context	Risk Rating (Sources)
		mortality.	2011a)
Flatback Turtles, Green Turtles and Hawksbill Turtles	Physical Interaction	• Vessel strike during construction and operation of the Marine Facilities on the east coast of Barrow Island (Flatback Turtles and Green Turtles are considered at greater risk than Hawksbill Turtles). • Dredge-strike during construction and operation of the Marine Facilities on the east coast of Barrow Island (Flatback Turtles are considered at greater risk than Hawksbill Turtles and Green Turtles). • Marine fauna injuries or fatalities from vessel movements or waste generation, storage and disposal associated with installation of the Offshore Feed Gas Pipeline System.	**Medium** Long-term Marine Turtle Management Plan (Chevron Australia 2009) Offshore Gas Pipeline Installation Management Plan (Chevron Australia 2011c)
	Physical Presence	• Potential for the presence of the MOF and LNG Jetty on the east coast of Barrow Island for the duration of the Operations Phase to influence: o nesting and mating adults and hatchlings on the beaches adjacent to Town Point, e.g. due to beach erosion/accretion (Flatback Turtles are considered at greater risk than Hawksbill Turtles and Green Turtles) o foraging juveniles and adults of Flatback Turtles, Green Turtles and Hawksbill Turtles in the waters near Town Point.	**Medium** Long-term Marine Turtle Management Plan (Chevron Australia 2009)
	Light Spill	• Impacts to turtle nesting, breeding, mating and hatching from marine vessels and equipment, and Terrestrial Facilities during the marine construction period on the east coast of Barrow Island. • Impacts to mating adults and hatchlings from marine vessels and impacts to nesting adults and hatchlings from Terrestrial Facilities during the Operations Phase on the east coast of Barrow Island (Flatback Turtles are considered at greater risk than Hawksbill Turtles). • Impacts to hatchlings from marine construction light sources during the construction period on the west coast of Barrow Island (Green Turtles and Hawksbill Turtles are considered at greater risk than Flatback Turtles).	**Medium** Long-term Marine Turtle Management Plan (Chevron Australia 2009) Offshore Gas Pipeline Installation Management Plan (Chevron Australia 2011c)
	Noise and Vibration	• Impacts to mating and foraging adults and juveniles from marine vessels, helicopters and general operation of vessels during the marine construction period on the west coast of Barrow Island (Green and Hawksbill Turtles are considered at greater risk than Flatback Turtles).	**Medium** Long-term Marine Turtle Management Plan (Chevron Australia 2009) Offshore Gas Pipeline Installation Management Plan (Chevron Australia 2011c)
	Blasting	• Impacts during the marine construction period on the east coast of	**Medium**

Fauna	Stressor	Context	Risk Rating (Sources)
		Barrow Island.	Long-term Marine Turtle Management Plan (Chevron Australia 2009)
	Liquid Waste Discharges	• Turbidity during marine construction activities on the east coast of Barrow Island impacts foraging juveniles and adults and breeding adults of Flatback Turtles and Green Turtles. Impacts considered here include disorientation due to low visibility, covering of foraging grounds, etc.	**Medium** Long-term Marine Turtle Management Plan (Chevron Australia 2009)
Migratory species of shorebirds, seabirds and/or raptors	Light Spill	• Attraction of insects to artificial lighting on the east coast of Barrow Island may result in changes to community composition (e.g. an increase in Silver Gulls), and competition with threatened or migratory species. • Increased incidents of avifauna collisions/interaction with vessels and equipment on the east coast of Barrow Island due to light attraction (e.g. juvenile Wedge-tailed Shearwaters known to be attracted to light). • Temporary displacement/attraction of avifauna due to temporary land-based lighting attracting insects at night on MOF and LNG Jetty. • Attraction of marine fauna to artificial lighting on vessels and equipment at night during installation of the Offshore Feed Gas Pipeline System.	**Medium** Dredging and Spoil Disposal Management and Monitoring Plan (Chevron Australia 2011a) Marine Facilities Construction Environmental Management Plan (Chevron Australia 2011) Offshore Gas Pipeline Installation Management Plan (Chevron Australia 2011c)
	Noise and Vibration	• Vibration and noise emissions generated by construction and dredge vessels, rock armouring activities and land-based excavator movements on the east coast of Barrow Island results in avoidance behaviour. • Shock waves, noise and vibration from underwater blasting and drilling on the east coast of Barrow Island results in mortality or injury (permanent and/or temporary hearing loss).	**Medium** Dredging and Spoil Disposal Management and Monitoring Plan (Chevron Australia 2011a) Marine Facilities Construction Environmental Management Plan (Chevron Australia 2011)

2.4 Material or Serious Environmental Harm to Threatened and Migratory Marine Species

2.4.1 Overview

The SEWPaC (formerly DEWHA and Department of Environment and Heritage [DEH]) provides guidance on the criteria used in determining whether certain activities are likely to have a Significant Impact on EPBC Act listed species (DEWHA 2009). The Significant Impact criteria for the listed threatened fauna species and listed migratory species that are relevant to this Report are provided in Table 2.3. For the purposes of this Report, Material or Serious Environmental Harm under the EP Act is considered the same as Significant Impact under the EPBC Act. Therefore the Significant Impact criteria were considered in conjunction with the outcomes of the risk assessments conducted (and summarised in Table 2.2), in order to determine whether any listed threatened fauna species and listed migratory species are at risk of Material or Serious Environmental Harm due to construction and operation of the Marine Facilities.

It should be noted that in the guidance on Significant Impact criteria (DEWHA 2009), 'habitat' that is considered critical to the survival of a threatened fauna species refers to areas that are necessary for:

- activities such as foraging, breeding, roosting, or dispersal
- the long-term maintenance of the species (including the maintenance of species essential to the survival of the species, such as pollinators)
- maintaining genetic diversity and long-term evolutionary development
- the reintroduction of populations or recovery of the species.

Table 2.3 Significant Impact Criteria

EPBC Act (Cth) Category	Significant Impact Criteria
Threatened (Endangered) species	An action is likely to have a Significant Impact on a Critically Endangered or Endangered species if there is a real chance or possibility that it will: • lead to a long-term decrease in the size of a population • reduce the area of occupancy of the species • fragment an existing population into two or more populations • adversely affect habitat critical to the survival of a species • disrupt the breeding cycle of a population • modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline • result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat • introduce disease that may cause the species to decline • interfere with the recovery of the species.
Threatened (Vulnerable) species	An action is likely to have a significant impact on a Vulnerable species if there is a real chance or possibility that it will: • lead to a long-term decrease in the size of an important population of a species • reduce the area of occupancy of an important population • fragment an existing important population into two or more populations • adversely affect habitat critical to the survival of a species • disrupt the breeding cycle of an important population • modify, destroy, remove, isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline • result in invasive species that are harmful to a vulnerable species becoming

EPBC Act (Cth) Category	Significant Impact Criteria
	established in the vulnerable species' habitat • introduce disease that may cause the species to decline • interfere substantially with the recovery of the species.
Migratory species	An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will: • substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy, or isolate an area of important habitat for a migratory species • result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species • seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Source: DEWHA (2009).

2.4.2 Material or Serious Environmental Harm Impacts to Threatened and Migratory Marine Mammals

EPBC Act listed threatened fauna species and/or listed migratory species of whales, dolphins and dugongs are not at risk of Material or Serious Environmental Harm from the stressors and associated risks identified in Table 2.2. All these species are listed as migratory species (Table 1.1), with the exception of the Blue Whale, which is also listed as Endangered, and the Humpback and Sei Whales, which are also listed as Vulnerable.

When considering the Significant Impact criteria in Table 2.3 in conjunction with the risks in Table 2.2, the Blue Whale, Sei Whale and the Humpback Whale are not at risk of Material or Serious Environmental Harm from noise and vibration during construction activities such as drilling and blasting, vessel and helicopter movements, light spill to the marine environment, changes to marine water and sediment quality during dredging, or the physical presence of the MOF and LNG Jetty. These risks are associated with temporary construction activities, with the exception of the permanent presence of the MOF and LNG Jetty. However, Blue Whales, Sei Whales and Humpback Whales are unlikely to occur in significant numbers in the vicinity of the east coast Marine Facilities; therefore, the presence of the MOF and LNG Jetty are unlikely to obstruct their movements to such a degree that would result in Material or Serious Environmental Harm to those species.

The risks presented in Table 2.2 would not result in any long-term decreases in the size of the Blue Whale, Sei Whale or the Humpback Whale populations, would not fragment the existing populations, or reduce the area of occupancy of the species since they are mobile marine fauna. There is no habitat critical to the survival of the species that would be disturbed due to construction and operation of the Marine Facilities, and the potential impacts are not anticipated to disrupt the breeding cycle of their populations. Furthermore, these risks should not result in the introduction of invasive species or diseases that would result in adverse impacts to these species. The risks presented in Table 2.2 are unlikely to interfere with the recovery of the Blue Whale, Sei Whale and the Humpback Whale.

The remaining nine species of whales, dolphins and the Dugong are listed as migratory species. The risks identified in Table 2.2 should not result in Material or Serious Environmental Harm to these species. The marine habitats in the vicinity of the Marine Facilities are not known to represent important habitat for the Bryde's Whale, the Antarctic Minke Whale, the Sperm Whale, the Killer Whale, the Dusky Dolphin, the Irrawaddy Dolphin, the Indo-Pacific Humpback Dolphin, the Spotted Bottlenose Dolphin, or the Dugong. Furthermore, the risks identified in Table 2.2 should not result in the introduction of invasive species or diseases that would result in adverse impacts to these species. The populations of these species present in the vicinity of the Marine Facilities during construction and operation do not represent ecologically significant proportions, and therefore, impacts to breeding, feeding, migration, or resting behaviours would be limited to individuals of these species.

2.4.3 Material or Serious Environmental Harm to Threatened and Migratory Marine Turtles

All six species of marine turtles are listed as migratory, with Olive Ridley Turtles and Loggerhead Turtles also listed as Endangered, and Leatherback, Hawksbill, Flatback and Green Turtles also listed as Vulnerable under the EPBC Act. Of the six species, the Flatback Turtle is considered at risk of Material or Serious Environmental Harm from construction and operation of the Marine Facilities on the east coast of Barrow Island, and Green Turtles are considered to be at risk of Material or Serious Environmental Harm from construction of the Marine Facilities on the west coast of Barrow Island. Hawksbill Turtles are considered to be at risk of Material or Serious Environmental Harm, during construction of the DomGas Pipeline from the east coast of Barrow Island to the mainland. The Olive Ridley Turtle and Leatherback Turtle have not been recorded and the Loggerhead Turtle has rarely been seen in Barrow Island waters, on Barrow Island beaches, and in habitats between Barrow Island and the mainland, and are therefore not at risk of Material or Serious Environmental Harm from the construction and operation of the Marine Facilities.

As Barrow Island is considered a regionally important nesting site for Flatback Turtles, disruption to their breeding cycles has the potential to affect the Western Australian population of this species, thereby resulting in Material or Serious Environmental Harm. The beaches either side of Town Point where the MOF, LNG Jetty and the Barrow Island end of the DomGas Pipeline are located (Terminal Beach and Bivalve Beach), are important components of the Barrow Island rookery, with almost 30% of Flatback Turtle tracks occurring on these beaches (Chevron Australia 2005). The risks identified in Table 2.2 may disrupt the breeding cycle of Flatback Turtles and there is a chance that over time, the physical presence of the MOF, LNG Jetty and DomGas Pipeline could lead to a decrease in the size of the rookery over the longer term. It should be noted that whilst activities associated with the DomGas Pipeline installation are short-term, it is included here because it will become a permanent part of the MOF and LNG Jetty infrastructure. The risk also exists (and is identified in Table 2.2) that changes to the beach profile or sediment characteristics arising from the physical presence of the MOF, LNG Jetty and DomGas Pipeline could lead to a decrease in the availability or quality of nesting habitat for Flatback Turtles. It is for these reasons that Flatback Turtles and their habitat (the nesting beaches adjacent to Town Point at Terminal Beach and Bivalve Beach) are considered at risk of Material or Serious Environmental Harm during construction and operation of the Marine Facilities on the east coast of Barrow Island.

Similar to Flatback Turtles, the north-western Australian population of Green Turtles is considered regionally important. According to Prince (2004), the estimated size of the Green Turtle reproductive population at Barrow Island may represent a substantial component of the Pilbara region population, despite this rookery being smaller than the rookery at the Lacepede Islands. Therefore, disruption to their breeding cycle has the potential to affect the Pilbara regional population of this species, thereby resulting in Material or Serious Environmental Harm. Green Turtle nesting on Barrow Island is concentrated on the west and north-east coasts of Barrow Island (Pendoley 2005); therefore, although nesting activities are unlikely to be disrupted as a result of construction and operation of the Marine Facilities on the east coast of Barrow Island, construction on the west coast of Barrow Island does have the potential to cause Material or Serious Environmental Harm to the population. The shore crossing at North Whites Beach is not a locally important Green Turtle nesting site because the shallow sand and limestone reef, including a large limestone shelf along the waterline, make the beach unsuitable for nesting (Pendoley 2005; Pendoley Environmental 2008). However, injuries or fatalities to turtles from vessel movements or waste generation, storage and disposal; the potential impact of light spill on Green Turtle hatchlings and potential impacts on mating and foraging adults and juveniles from vessel and helicopter-related noise and vibration during construction (Table 2.2) were recognised as potential threats during the west coast construction period (Chevron Australia 2009, 2011c) that may cause Material or Serious Environmental Harm to the Green Turtle population.

In terms of habitat for Green Turtles, the national Recovery Report for Marine Turtles in Australia (Environment Australia 2003) identifies Barrow Island and waters within a 20 km radius of the Island as critical (Chevron Australia 2005). This is most likely due to their utilisation of this habitat for foraging and mating (Chevron Australia 2009). Whilst the physical presence of the MOF (Table 2.2) will result in the loss of an area of macroalgae-dominant limestone reef, this will not significantly reduce the feeding and pre-nesting areas for Green Turtles as data indicates that Green Turtles mate in greatest numbers in the shallow nearshore waters off the west coast of Barrow Island (Pendoley 2005). The waters off the west coast will be temporarily affected during construction of the Offshore Feed Gas Pipeline; however, baseline marine surveys show that macroalgae-dominant limestone reef habitat is extensive in the region (Chevron Australia 2008, 2011e). The benthic habitats used by Green Turtles are well represented around Barrow Island and in the broader region; therefore, the disturbance of the habitat associated with the Marine Facilities is unlikely to lead to a decline in the Green Turtle population at Barrow Island. The habitat of Green Turtles is therefore not considered at risk of Material or Serious Environmental from construction and operation of the Marine Facilities.

Hawksbill Turtles are considered at risk of Material or Serious Environmental Harm from construction and operations activities associated with the DomGas Pipeline. The Hawksbill Turtle rookeries at Middle Passage Island and Sholl Island (located approximately 12 km and 24 km, respectively, from the DomGas Pipeline) are considered regionally important. Other islands in the Great Sandy and Passage Island groups support lower levels of nesting, but are still of local importance to the Pilbara population of Hawksbill Turtles. The closest nesting beaches are located at South Passage Island, Passage Island and North Sandy Island, approximately 3 km, 3.5 km and 4.5 km, respectively, from the DomGas Pipeline. Therefore disruption to the breeding cycles of Hawksbill Turtles on these islands has the potential to affect the Pilbara population of this species, thereby resulting in Material or Serious Environmental Harm. Shallow water pipeline installation activities will occur in the vicinity of the Great Sandy and Passage Island groups for approximately two to three months. Whilst this construction period is short-term, depending on the actual timing of these activities, it is possible that pipeline installation activities could occur in the vicinity of nesting beaches for part of the peak nesting period for Hawksbill Turtles (October-November), which may affect the breeding population for that season. The potential impacts of light spill on nesting adults and hatchlings, when combined with the other risks identified (i.e. injuries or fatalities from vessel movements; noise and vibration impacts on foraging adults and juveniles), could have an overall adverse effect on Hawksbill Turtles that are present in the vicinity of the Great Sandy and Passage Island groups during DomGas Pipeline installation.

The coral, macroalgal and limestone reef assemblages in the waters surrounding the Mary Anne, Great Sandy and Passage Island groups (located either side of the DomGas Pipeline) are considered important foraging grounds for Hawksbill Turtles (Pendoley *et al.* 2003; Pendoley 2005; DEWHA 2008; Chevron Australia 2009). Installation of the DomGas Pipeline will therefore result in the direct and indirect disturbance of important habitat to Hawksbill Turtles. However, the majority of the DomGas Pipeline traverses a flat, subtidal sand plain, with only a few isolated areas that support low density macroalgae and coral growth (URS 2009). Indirect impacts on foraging habitat (e.g. sedimentation and turbidity) will occur during the construction phase only, and will therefore be temporary. Therefore whilst the potential for Material or Serious Environmental Harm to Hawksbill Turtle habitat exists, it is considered unlikely due to the low quality of foraging habitat affected and the temporary nature of DomGas Pipeline construction activities.

2.4.4 Material or Serious Environmental Harm to Threatened and Migratory Marine Avifauna

Of the marine avifauna listed as threatened fauna species and/or migratory species in Table 1.1, the Wedge-tailed Shearwater and the Bridled Tern are considered at risk of Material or Serious Environmental Harm from construction and operation of the Marine Facilities. This is because Double Island, off the east coast of Barrow Island, is a regionally significant rookery for Bridled Terns and a locally significant rookery for Wedge-tailed Shearwaters (Chevron Australia

2005). Whilst the Wedge-tailed Shearwater rookery is small compared to other rookeries in the region (Chevron Australia 2005), fledging Wedge-tailed Shearwaters have been documented as being attracted to the night lighting of the Gas Treatment Plant on nearby Varanus Island (Nicholson 2002). Therefore, this species has the potential to be impacted by lighting associated with construction and operation of the Marine Facilities on the east coast of Barrow Island.

Whilst Barrow Island is considered an important non-breeding site for many species of migratory shorebirds, the highest abundances (over two-thirds of records for most species) are associated with the south-eastern and southern coasts of the Island (Chevron Australia 2005). Therefore, whilst the risks presented in Table 2.2 may have some impact on migratory species of shorebirds, seabirds and raptors, the impacts are not anticipated to result in modification or disturbance of important habitat, nor are they expected to result in the introduction of harmful invasive species. The potential impacts are also not expected to impact the breeding, feeding, migration, and resting behaviours of an ecologically significant proportion of the populations of these migratory species of shorebirds, seabirds, and raptors.

Migratory species of shorebirds and terns on the mainland may be at risk of Material or Serious Environmental Harm from the removal of mangroves during construction of the DomGas Pipeline. This risk is described in the Offshore DomGas Pipeline Installation Management Plan (Chevron Australia 2011d) and is rated as ‘low’ (which is why it is not included in Table 2.2). Observations from surveys conducted in 2006 found that bird abundances along the DomGas Pipeline route were low to moderate, with the majority of shorebirds and terns recorded on tidal flats, mangroves and in oceanic areas (Bamford Consulting Ecologists and RPS BBG 2006). Despite the relatively low numbers observed, the mangroves along the mainland coast are considered important habitat for migratory birds (Bamford Consulting Ecologists and RPS BBG 2006). When compared with the Significant Impact criteria (DEWHA 2009), the temporary modification or fragmentation of an area of important habitat for a migratory species is considered a likely indication of Significant Impact (and therefore Material or Serious Environmental Harm).

Whilst the risk of Material or Serious Environmental Harm exists, disturbance to mangrove habitats will be temporary, as post-construction rehabilitation will commence soon after pipeline installation. Furthermore, mangrove habitats are extensive along the Pilbara coast and are not restricted to the DomGas Pipeline route. The area that will be cleared for pipeline installation represents <1% of the surrounding 5000 ha of mangroves in the region (Chevron Australia 2005), and is adjacent to an area of previously disturbed mangrove habitat (along the Apache pipeline easement), further reducing the effects associated with habitat fragmentation.

No major roosting sites have been identified along the DomGas Pipeline route (Bamford Consulting Ecologists and RPS BBG 2006). Therefore, potential impacts to migratory species of shorebirds, seabirds and raptors from the DomGas Pipeline route are not expected to result in the introduction of harmful invasive species. Given the relatively low numbers of migratory birds observed, and that mangrove habitats are extensive along the Pilbara coast, impacts to the breeding, feeding, migration and resting behaviours of an ecologically significant proportion of the populations of these migratory species is also unlikely.

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