Gorgon Gas Development and Jansz Feed Gas Pipeline

Environmental Performance Report 2021

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1 Introduction

1.1 Proponent

Chevron Australia Pty Ltd (CAPL) is the Proponent and the person taking the action for the Gorgon Gas Development and Jansz Feed Gas Pipeline (collectively referred to hereafter as the Gorgon Gas Development [the 'Project']) on behalf of these companies (collectively known as the Gorgon Joint Venture Participants):

- Chevron Australia Pty Ltd
- Chevron (TAPL) Pty Ltd
- Shell Australia Pty Ltd
- Mobil Australia Resources Company Pty Ltd
- Osaka Gas Gorgon Pty Ltd
- Tokyo Gas Gorgon Pty Ltd
- JERA Gorgon Pty Ltd.

1.2 Purpose of this Environmental Performance Report

CAPL, as the Proponent, is required to prepare an Environmental Performance Report (EPR) in accordance with:

- Condition 5 and Schedule 3 of Ministerial Statement (MS) 800 (and Condition 2 of MS 965)
- Condition 5 and Schedule 3 of MS 769
- Condition 4 and Schedule 3 of EPBC 2003/1294
- Condition 4 and Schedule 3 of EPBC 2008/4178
- relevant systems, programs, and plans as amended or replaced from time to time approved under MS 800, MS 769, MS 965, and EPBC 2003/1294 and 2008/4178.

1.3 Contents of this EPR

This EPR covers the period from 10 August 2020 to 9 August 2021 (the 'Reporting Period') unless otherwise stated. Table 1-1 lists the State and Commonwealth Condition requirements of this EPR and the sections in this EPR that fulfil them. This includes the EPR requirements under Schedule 3 of MS 800, MS 769, EPBC 2003/1294, and EPBC 2008/4178 and any additional EPR commitments contained in relevant systems, programs, and plans.

Table 1-1: Environmental Performance Reporting Requirements Addressed in this EPR

Environmental Aspect	MS 800	MS 769	EPBC 2003/1294	EPBC 2008/4178	EMP Commitment	Section in this EPR
Terrestrial and Subterranean Environment State	✓	✓	✓	✓	✓	2
Terrestrial and Marine Quarantine (including weed management)	✓		✓	✓		3
Marine Turtles (including light and noise management)	✓		✓	✓		4
Short-range Endemics and Subterranean Fauna	✓		✓	✓		5
Fire Management	✓	✓	✓	✓		6
Carbon Dioxide Injection Project	✓		✓	✓		7
Air Quality	✓					0
Coastal Stability	✓		✓	✓		9
Terrestrial Rehabilitation	✓				✓	10
Greenhouse Gas Abatement	✓					11
Spill Management		✓				12

1.4 Project

CAPL is developing the gas reserves of the Greater Gorgon Area. The gas is processed in a Gas Treatment Plant (GTP) on Barrow Island, which is located off the Pilbara coast 85 km north-north-east (NNE) of Onslow in Western Australia (WA) (Figure 1-1).

Subsea gathering systems and pipelines deliver feed gas from the Gorgon and Jansz–Io gas fields to the west coast of Barrow Island. The underground feed gas pipeline system then traverses Barrow Island to the east coast where the GTP is located. The GTP includes natural gas trains that produce liquefied natural gas (LNG) as well as condensate and domestic gas (DomGas). Carbon dioxide (CO_2), which occurs naturally in the feed gas, is separated during the production process, and injected into deep rock formations below Barrow Island. The LNG and condensate are loaded onto tankers from a jetty, and then transported to international markets. Gas for domestic use is exported by pipeline from Barrow Island to the DomGas collection and distribution network on the WA mainland.

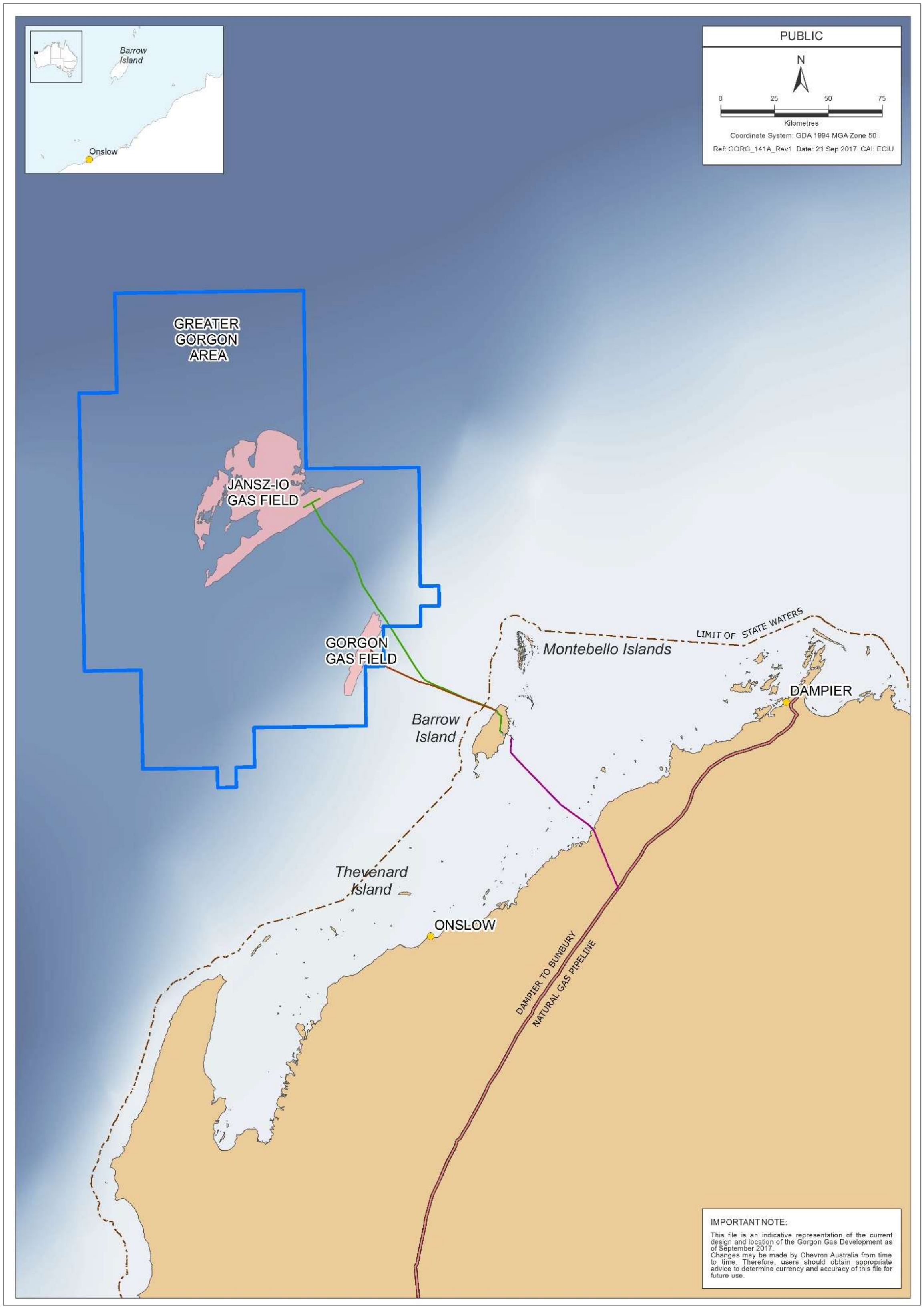

Figure 1-1: Location of Gorgon Gas Development and Greater Gorgon Area

1.4.1 Status of Implementation

Significant progress has been made on the Gorgon Gas Development since construction began in December 2009. The Project has been operational, exporting LNG and supplying domestic gas to WA since 2016.

During the Reporting Period, CAPL:

- completed 2 scheduled major maintenance ‘turnarounds’ on Gorgon’s LNG Train 2 and Train 3 (turnarounds are routine major maintenance shutdowns, which involve numerous inspections, repairs, and equipment changeouts)
- finished drilling and completing 11 additional wells associated with the Gorgon Stage 2 development, which is part of the approved field development plan for Gorgon
- the Gorgon Joint Venture announced it will proceed with the Jansz–Io Compression Project
- reached a significant milestone with the injection of 5 million tonnes of greenhouse gas (carbon dioxide equivalent, CO_2e) since safely starting the carbon dioxide injection system in 2019.

2 Terrestrial and Subterranean Environment State

Table 2-1: EPR Reporting Requirements for Terrestrial and Subterranean Environment

Item	Source	Section in this EPR
Results of monitoring and any measurable impacts from the Project, including any changes from the baseline	MS 800, Schedule 3(1i) MS 769, Schedule 3(1i) EPBC 2003/1294 and 2008/4178, Schedule 3(1i)	2.1
Conclusions as to the Project stressors (if any) causing the impacts identified	MS 800, Schedule 3(1ii) MS 769, Schedule 3(1ii) EPBC 2003/1294 and 2008/4178, Schedule 3(1ii)	Not applicable (N/A)[1]
Any mitigation measures applied during the Reporting Period, and results of that mitigation	MS 800, Schedule 3(1iii) MS 769, Schedule 3(1iii) EPBC 2003/1294 and 2008/4178, Schedule 3(1iii)	N/A[2]
Any changes to monitoring sites	MS 800, Schedule 3(1iv) MS 769, Schedule 3(1iv) EPBC 2003/1294 and 2008/4178, Schedule 3(1iv)	2.1
Any changes to monitoring sites below the minimum number required	Terrestrial and Subterranean Environment Monitoring Program (TSEMP) (Ref. 1), Section 3.4	N/A[3]
Any changes to ecological elements	TSEMP (Ref. 1), Section 5	2.1
Threatened or listed fauna cared for, injured, or killed within the Terrestrial Disturbance Footprint (TDF)	Terrestrial and Subterranean Environment Protection Plan (Ref. 2), Section 7.2	2.2

1 *No Project-related adverse impacts to ecological elements (as listed in Condition 6.1 of MS 800 and MS 769, and Condition 5.1 EPBC 2003/1294 and 2008/4178) were identified outside the TDF during the Reporting Period; therefore, reporting is not applicable at this time.*

2 *No mitigation measures were implemented in response to Project-related adverse impacts outside the TDF during the Reporting Period; therefore, reporting is not applicable at this time.*

3 *No changes were made to the TSEMP monitoring sites during the Reporting Period.*

2.1 Monitoring Results

The objective of the Terrestrial and Subterranean Environment Management Plan (TSEMP; Ref. 1), as defined by Ministerial Conditions, is to establish a statistically valid ecological monitoring program to detect any Material or Serious Environmental Harm to the ecological elements outside the TDF.

The ecological elements considered at risk from the Gorgon Gas Development that require monitoring on Barrow Island are listed in the TSEMP (Ref. 1).

At Risk zones (located within the relevant TDF—a zone where potential impacts are predicted to occur) and Reference zones (located in comparable areas beyond the TDF) were established for each monitoring program to detect changes attributable to Gorgon Gas Development activities.

Where applicable, monitoring data are presented in time-series control charts, which are used to diagnose trends in population abundance. Trends identified in control charts act as early-warning signals to guide a tiered management approach. A management response is triggered if a parameter demonstrates a trend towards or changes beyond statistical deviations (± 1, ± 2, or ± 3 statistical deviations [e.g. standard deviation (SD)]) from baseline conditions or other reference point (e.g. the zero centre-line of a ratio).

This is the sixth Reporting Period in which an annual difference between the standardised At Risk and Reference zone population density metric (standardised density difference ratio) was applied to control charts for mammals and birds, to improve diagnosis of trends. Alternative analyses are applied to groundwater and surface water landform monitoring data, where control charting was inappropriate for comparing trends over time.

Golden Bandicoot monitoring is undertaken at least every 5 years, or in response to 3 consecutive years of above- or below-average annual rainfall at Barrow Island. Monitoring was last completed in 2018, hence there was no requirement to conduct Golden Bandicoot monitoring during this reporting period.

The 2020–2021 monitoring results for the ecological elements listed in the TSEMP (Ref. 1) are summarised in the following tables.

Ecological Element: Vegetation
Objective
To detect loss of diversity—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.
Changes to Monitoring Sites
No changes were made to vegetation monitoring sites since the previous monitoring survey in 2019.
Methodology
• Survey Method: Biennial survey of 124 vegetation monitoring transects across 15 vegetation associations encompassing both At Risk (59 transects) and Reference (65 transects) zones. Parameters comprised: percentage foliage cover (PFC); total species richness; known, suspected, or potential non-indigenous species (NIS); and plant health. The survey was undertaken in June 2021, ~7 weeks after a significant rainfall event of 103 mm on Barrow Island. • Analysis Method: An exponentially weighted moving average (EWMA) control chart approach was applied to total species richness, PFC, and plant health. A permutation-based multivariate analysis of variance was used to examine if there were differences in floristic composition and health of plants between the At Risk and Reference sites, or between years. The site type by year interaction was also tested for significance, and where a significant interaction was detected, 2-dimensional ordination plots were developed to investigate changes.
Results
• No significant decline was detected in species richness, PFC, or plant health in 2021 when compared to the previous monitoring period. The EWMA total species richness metric has continued an upward trend and now exceeds the 2 SD control limit as a result of an increase within the At Risk zone relative to the Reference zone (Figure 2-1). • All monitored variables (total species richness, perennial species richness, PFC of all species, PFC of perennial species, plant health of all species, and perennial species plant health), when considered individually by vegetation association, remained within the 3 SD control limit. • Five vegetation associations (L8a4, C1c1, C4a1, L7d2, and C3b1) had variables exceeding the 2 SD or 3 SD control limits due to a favourable trend at the At Risk sites, relative to Reference sites. • One vegetation association (D5a1) exceeded the 2 SD control limit for total species richness and perennial species richness as a result of the relative increase of these metrics within the Reference zone compared to the At Risk zone. • No known, suspected, or potential NIS were identified in the transects.
Conclusions
• Monitoring has not detected an adverse impact (attributable to the Gorgon Gas Development) on total species richness or PFC within the At Risk zone since vegetation monitoring began in 2009. • No significant and detrimental change in vegetation cover and plant health has been detected either spatially or temporally within or outside the At Risk zone since the commencement of the Gorgon Gas Development.

Ecological Element: Vegetation
• Above-average rainfall in the 12 months before the survey resulted in most plants being in 'fair' (33%) to 'good'(41%) health during the 2021 survey. This trend has been observed for previous survey years, with higher rainfall linked to better plant health, for both the At Risk and Reference transects. • Vegetation affected by the bushfire (caused by lightning) in October 2013 continues to progress towards a similar structure to that surveyed before being burnt.

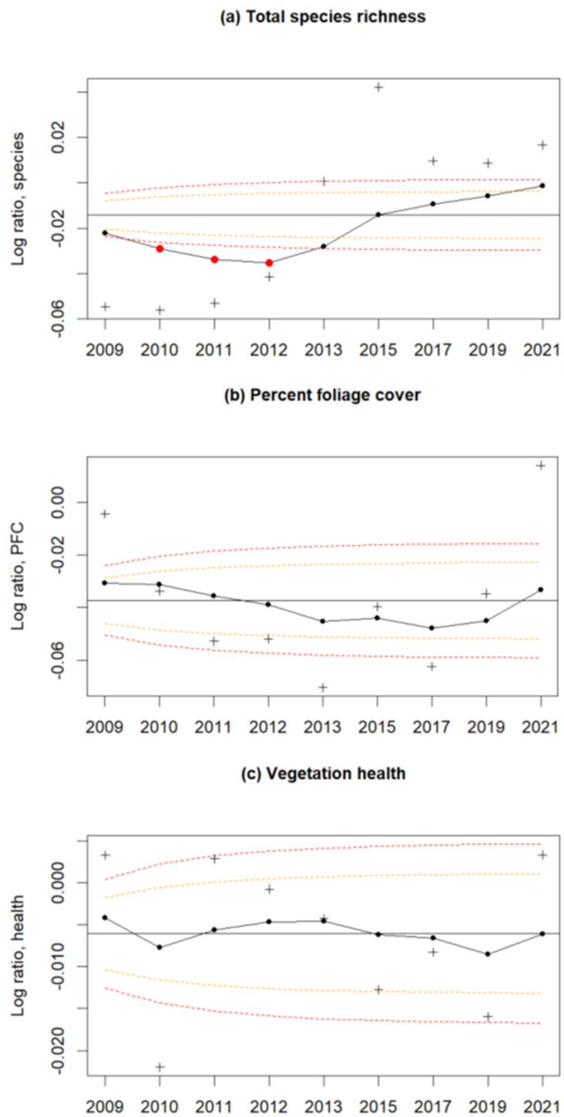

Figure 2-1: Exponentially Weighted Moving Average (EWMA) Control Charts for (a) Total Species Richness, (b) Percent Foliage Cover, and (c) Vegetation Health

Solid horizontal line = random effects estimate of all sampled seasons. Solid dots = smoothed log response ratio (LRR) metric based on an EWMA. Crosses = the calculated LRR metric for the At Risk population compared with the Reference population. Orange dotted line = 2 SD control limit. Red dotted line = 3 SD control limit.

Ecological Element: White-winged Fairy-wren (Barrow Island)
Objective
Detect variation in abundance—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time

Ecological Element: White-winged Fairy-wren (Barrow Island)
Changes to Monitoring Sites
Following a review of the long-term dataset to determine optimal sampling efficacy, a subset of the 2019 transects were sampled, yielding 213 km of transect coverage in 2020 (down from 270 km in 2019). This reduction in sampling was found to maintain reliable density estimates with an acceptable level of precision.
Methodology
• Survey method: Diurnal distance sampling across 26 transects (each up to 12.6 km long and orientated east–west at 500 m spacing across Barrow Island) to compare the densities of White-winged Fairy-wrens (WWFW) within the At Risk and Reference zones during October 2020. The combined total length of the transects was 213 km, with 124 km of transects in the Reference zone and 89 km in the At Risk zone. The locations of observed White-winged Fairy-wrens along the transects were recorded by taking a GPS fix at the location of the animal. • Analysis method: White-winged Fairy-wren observations were converted to density estimates using distance sampling software, with a truncation distance of 55 m applied. Changes in relative density were determined by the degree of variation observed between At Risk and Reference zones, and were plotted using time-series control charts to understand trends in abundance between zones over time.
Results
• The estimated density of White-winged Fairy-wrens within the Reference zone decreased from 0.14 (± 0.02) individuals per hectare (ind/ha) in 2019 to 0.12 (± 0.04) ind/ha in 2020. In contrast, estimated density within the At Risk zone increased from 0.24 (± 0.03) ind/ha in 2019 to 0.31 (± 0.07) ind/ha in the 2020 monitoring period. • The Barrow Island-wide density estimate slightly increased from 0.18 (± 0.02) ind/ha in 2019 to 0.20 (± 0.04) in 2020, with an overall population estimate of 4,973 (± 925) wrens being the highest abundance since 2017. • The ratio between the estimated At Risk and Reference zone densities increased from 1.72 in 2019 to 2.68 in 2020, the second highest At Risk to Reference ratio since the inception of annual monitoring in 2009. As a result, the EWMA metric has returned to a controlled state after exceeding the −1 SD alert trigger in the previous monitoring period (Figure 2-2).
Conclusions
• The density of White-winged Fairy-wrens within the At Risk zone has always been greater than that within the Reference zone (Figure 2-3) due to a highly correlated association with their preferred habitat, *Melaleuca cardiophylla*, being more prominent within the At Risk zone. • The EWMA control chart metric is within control limits, and monitoring has not detected an adverse variation in abundance, attributable to the Gorgon Gas Development, to the Barrow Island White-winged Fairy-wren population.

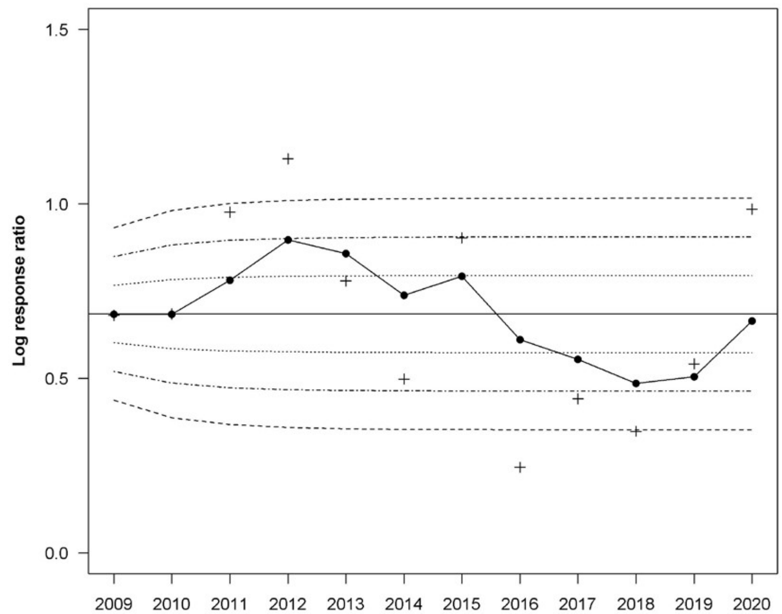

Figure 2-2: EWMA Control Chart for White-winged Fairy-wren Density at Barrow Island

The response variable is the log of the At Risk:Reference zone density estimate ratio.

EWMA Chart: + = log ratio of observed data; • = smoothed standardised difference metric based on exponentially weighted 3-year moving average; dotted curves represent ±1 SD, ±2 SD, and ±3 SD

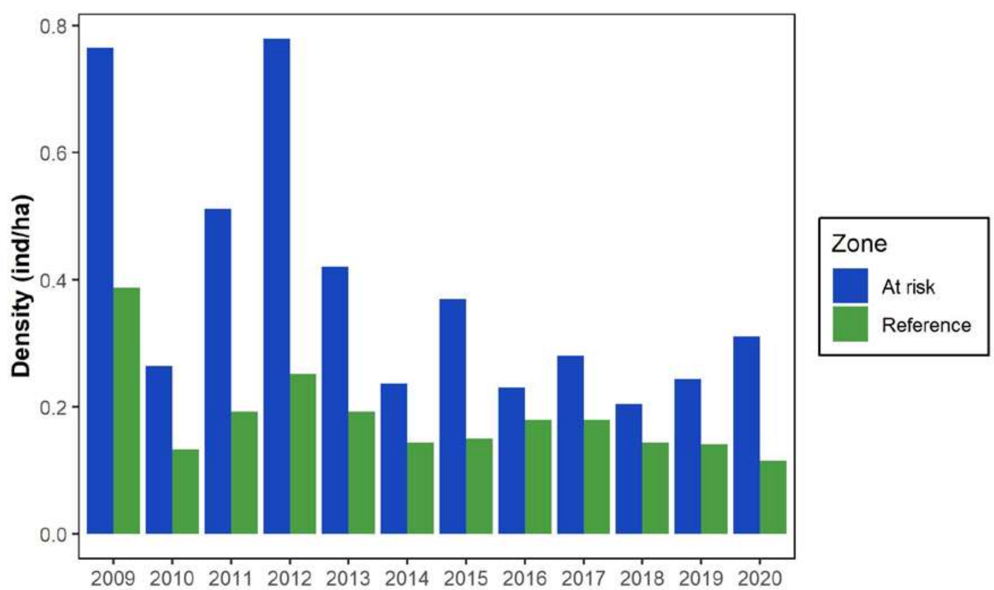

Figure 2-3: Annual Estimates of White-winged Fairy-wren Densities within the At Risk and Reference Zones

Monitoring Program: Euro (Barrow Island)
Objective
Detect variation in abundance—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.
Changes to Monitoring Sites
• Following a review of the long-term dataset to determine optimal sampling efficacy, a subset of the 2019 transects were sampled, yielding 177 km of transects coverage in 2020 (down from 270 km in 2019). This reduction in sampling was found to maintain reliable density estimates with an acceptable level of precision. • Transects were surveyed during the night using a spotlight, which was a departure from the 2019 survey approach which was diurnal surveys with a focus on survey effort during the early morning and late afternoon. Although diurnal surveys for the Barrow Island Euro were still undertaken in 2020 during the White-winged Fairy-wren survey for comparative purposes, this data proved to be unreliable for population estimates due to a large margin of error and a dip in observations at the transect line. Therefore, diurnal data has not been included in any subsequent analyses.
Methodology
• Survey method: Nocturnal distance sampling across 29 transects (each up to 12.8 km long and orientated east–west at 500 m spacing across Barrow Island) to compare the densities of Barrow Island Euro within the At Risk and Reference zones during September 2020. The combined total length of the transects was 177 km (107 km in the Reference zone; 70 km in the At Risk zone). The location of observed Barrow Island Euros along the transects were recorded by taking a distance and bearing from the observer to the animal to minimise any disturbance to the animal. • Analysis method: Barrow Island Euro observations were converted to density estimates using distance sampling software, with a truncation distance of 32 m applied. Changes in relative density were determined by the degree of variation observed between At Risk and Reference zones, and were plotted using time-series control charts to understand trends in abundance between zones over time.
Results
• The estimated density of Barrow Island Euro within the Reference zone increased substantially from 0.059 (± 0.014) ind./ha-1 in 2019 to 0.174 (± 0.055) ind./ha-1 in 2020. Similarly, estimated density within the At Risk zone more than doubled from 0.043 (± 0.012) ind./ha-1 in 2019 to 0.090 (± 0.033) ind./ha-1 in the 2020 monitoring period. • The Barrow Island-wide density estimate increased from 0.05 (± 0.01) ind./ha-1 in 2019 to 0.14 (± 0.03) in 2020, with an overall population estimate of 3,486 (± 869) Barrow Island Euros being the highest abundance since annual population monitoring began in 2010. • Against a backdrop of an increase in abundance within both zones, the ratio between the estimated At Risk and Reference zone densities has declined for the third consecutive year to a value of 0.52 as result of the larger proportional increase in density occurring within the Reference zone relative to the At Risk zone. As a result, the EWMA metric now exceeds the −1 SD alert trigger (Figure 2-4).
Conclusions
• In the initial monitoring years (2010–2012), the At Risk zone supported a greater density of Barrow Island Euros. Since 2013 this relationship has reversed and stabilised, representing a potential shift in relative distribution of Barrow Island Euro from the At Risk zone to Reference zone where they are found in higher abundance (Figure 2-5). • The EWMA control chart metric has exceeded the −1 SD alert trigger as a result of the proportionally larger Barrow Island Euro abundance increase within the Reference zone relative to the At Risk zone causing a decline in ratio. • Monitoring has not detected an adverse variation in abundance (attributable to the Gorgon Gas Development) to the Barrow Island Euro population.

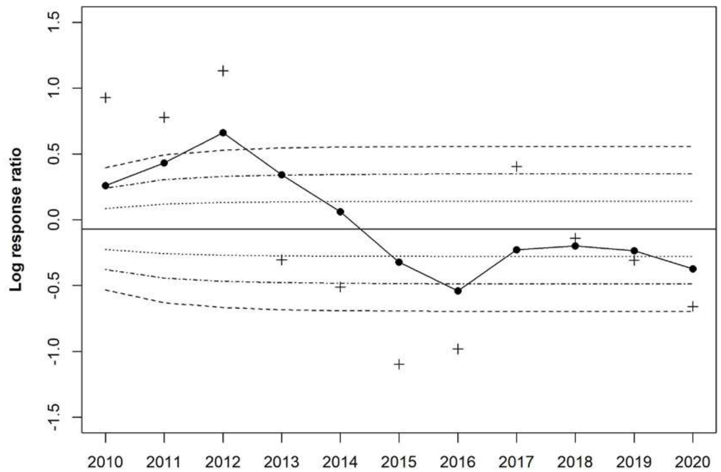

Figure 2-4: EWMA Control Chart for Barrow Island Euro Density at Barrow Island

The response variable is the log of the At Risk:Reference zone density estimate ratio.

EWMA Chart: + = log ratio of observed data; • = smoothed standardised difference metric based on exponentially weighted 3-year moving average; dotted curves represent ±1 SD, ±2 SD, and ±3 SD.

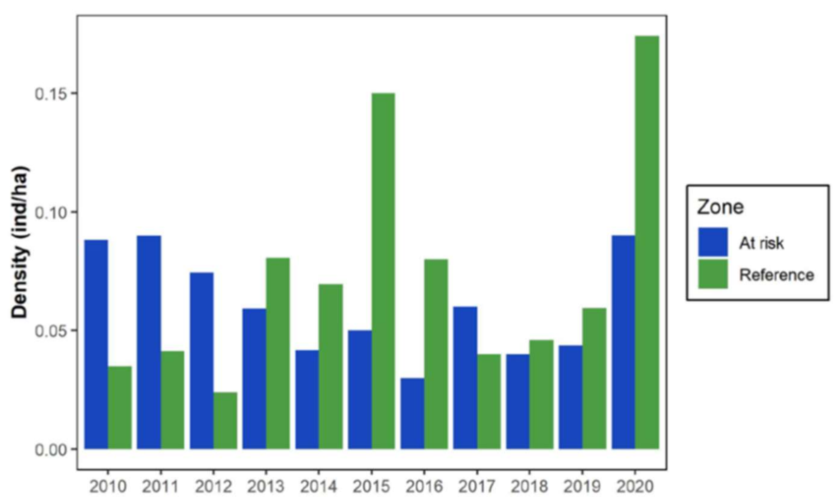

Figure 2-5: Annual Estimates of Barrow Island Euro Densities within the At Risk and Reference Zones

Monitoring Program: Spectacled Hare-wallaby (Barrow Island)
Objective
Detect variation in abundance—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.
Changes to Monitoring Sites
Following a review of the long-term dataset to determine optimal sampling efficacy, a subset of the 2019 transects were sampled, yielding 177 km of transect coverage in 2020 (down from 204 km in 2019). This reduction in sampling was found to maintain reliable density estimates with an acceptable level of precision.

Monitoring Program: Spectacled Hare-wallaby (Barrow Island)
Methodology
• Survey method: Nocturnal distance sampling across 29 transects (each up to 12.8 km long and orientated east–west at 500 m spacing across the island) to compare the densities of Spectacled Hare-wallaby (SHW) within the At Risk and Reference zones during September 2020. The combined total length of the transects was 177 km (107 km in the Reference zone; 70 km in the At Risk zone). The locations of observed SHW along the transects were recorded by taking a distance and bearing from the observer to the animal to minimise any disturbance to the animal. • Analysis method: Spectacled Hare-wallaby observations were converted to density estimates using distance sampling software, with a truncation distance of 25 m applied. Changes in relative density were determined by the degree of variation observed between At Risk and Reference zones, and were plotted using time-series control charts to understand trends in abundance between zones over time.
Results
• The estimated density of SHW was greater within the Reference zone at 0.67 (± 0.13) ind./ha-1 compared to 0.49 (± 0.13) ind./ha-1 within the At Risk zone. • The Barrow Island-wide density estimate increased from 0.52 (± 0.03) ind./ha-1 in 2019 to 0.60 (± 0.09) in 2020, with an overall population estimate of 15,012 (± 2,280) SHW, which is similar to the highest abundance estimates since annual population monitoring began in 2010. • The ratio between the estimated At Risk and Reference zone densities has increased for the third consecutive year to a value of 0.73 as result of the larger proportional increase in density occurring within the At Risk zone relative to the Reference zone. As a result, the EWMA metric is now back within control limits after exceeding the −1 SD alert trigger in the 2019 monitoring period (Figure 2-6).
Conclusions
• Although SHW density increased in both zones during the 2020 monitoring period, the increase was relatively greater within the At Risk zone, resulting in an increase in the ratio and EWMA control chart metric. As a result, the EWMA metric is now within control limits after 4 consecutive seasons in exceedance of the −1 SD alert trigger (Figure 2-6). • SHW density has continued to be greater within the Reference zone (Figure 2-7), partly due to high association within the two burnt areas in the north and south of the island, which are within the Reference zone. • Monitoring has not detected an adverse variation in abundance (attributable to the Gorgon Gas Development) to the Barrow Island SHW population.

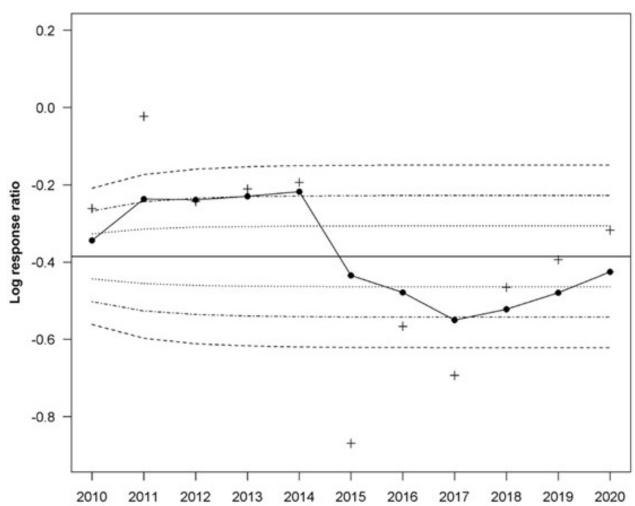

Figure 2-6: EWMA Control Chart for Spectacled Hare-wallaby Density at Barrow Island

The response variable is the log of the At Risk:Reference zone density estimate ratio.

EWMA Chart: + = log ratio of observed data; • = smoothed standardised difference metric based on exponentially weighted 3-year moving average; dotted curves represent ±1 SD, ±2 SD, and ±3 SD.

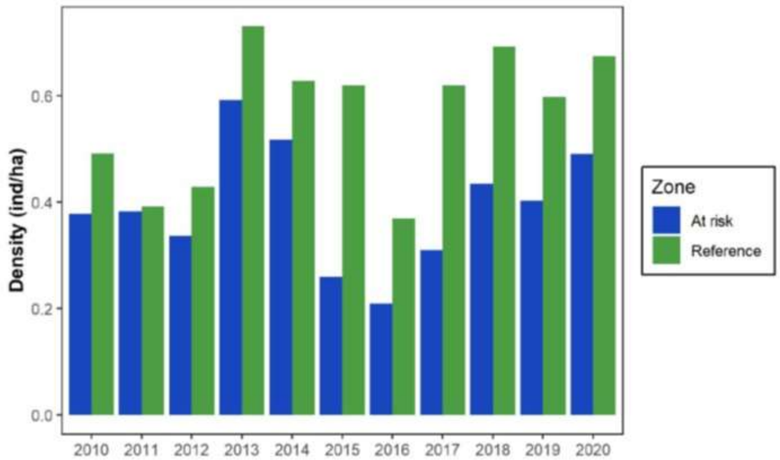

Figure 2-7: Annual Estimates of Spectacled Hare-wallaby Densities within the At Risk and Reference Zones

Monitoring Program: Burrowing Bettong (Boodie) (Barrow Island)
Objective
Detect variation in abundance—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.
Changes to Monitoring Sites
• Following a review of the long-term dataset to determine optimal sampling efficacy, a subset of the long-term Burrowing Bettong (Boodie) warrens were sampled, along with a reduction in trapping nights from 4 in 2019, to 3 consecutive nights in 2020. This reduction in sampling was found to maintain reliable abundance estimates with an acceptable level of precision. • The number of warrens sampled was reduced. At Risk warrens sampled went from 29 in 2019 to 12 in 2020, while Reference warrens sampled went from 11 in 2019 to 10 in 2020. All warrens sampled in 2020 have long-term sampling history, with the subset selected based on level of activity (occupancy) and where known, social connectivity.
Methodology
• Survey method: Annual capture-mark-recapture sampling using baited cage traps at 22 active Burrowing Bettong warrens (10 in the Reference zone, 12 in the At Risk zone) for 3 consecutive nights in September 2020. • Analysis method: The capture-mark-recapture analyses included all capture histories from available data for the 22 sampled warrens using a robust design Huggins model, which included a closed component (across nights) and open component (across years) to derive 'at warren' abundance estimates. Changes in relative abundance were determined by the degree of variation observed between At Risk and Reference zones, and were plotted using time-series control charts to understand trends in abundance between zones over time
Results
• The EWMA control chart for Burrowing Bettong abundance at monitored warrens remained in control for the 2020 monitoring period (Figure 2-8). • Following the trend recorded since starting 'at warren' monitoring, there was a further decline in the abundance estimates at monitored mounds during the 2020 monitoring period in both the At Risk and Reference zones (Figure 2-9). The potential decline identified may be attributable to the sampling in 2020 which involved fewer locations than previous sampling events (i.e. 18 fewer warrens were sampled in 2020, and therefore resident individuals within these warrens are not included in the modelled zone-level abundance estimate). • When considering raw capture data alone between years and at consistently monitored warrens, the number of individual Burrowing Bettongs reduced slightly from 86 to 69, and 104 to 101 between 2019

Monitoring Program: Burrowing Bettong (Boodie) (Barrow Island)
and 2020 for the Reference and At Risk zones, respectively. This reduction may, in part, be attributed to a reduction of sampling from 4 nights in 2019 to 3 nights in 2020.
Conclusions
• Changes in Burrowing Bettong abundance between the At Risk zone relative to the Reference zone trended downwards and remained within control limits during the 2020 reporting period (Figure 2-8). This shift in ratio is likely a consequence of the larger reduction in abundance estimate within the At Risk zone (from 160 in 2019 to 117 in 2020, a 27% decline) relative to the Reference zone (from 95 in 2019 to 86 in 2020, a 9.5% decline). • The apparent decline in Burrowing Bettong abundance within both zones during the 2020 monitoring period should be interpreted in the context of the reduced number of warrens monitored. Pre-2020 data will be remodelled and corrected for this change in program design going forward and presented in the subsequent 2022 EPR. • Monitoring has not detected an adverse variation in abundance (attributable to the Gorgon Gas Development) to the Barrow Island Burrowing Bettong population.

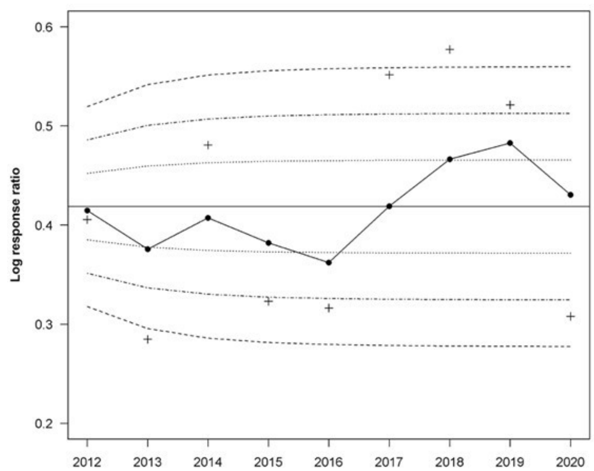

Figure 2-8: EWMA Control Chart for Burrowing Bettong (Boodie) Abundance at Monitored Warrens, Barrow Island

The response variable is the log of the At Risk: Reference zone abundance estimate ratio.

EWMA Chart: + = log ratio of observed data; • = smoothed standardised difference metric based on exponentially weighted 3-year moving average; dotted curves represent ±1 SD, ±2 SD, and ±3 SD.

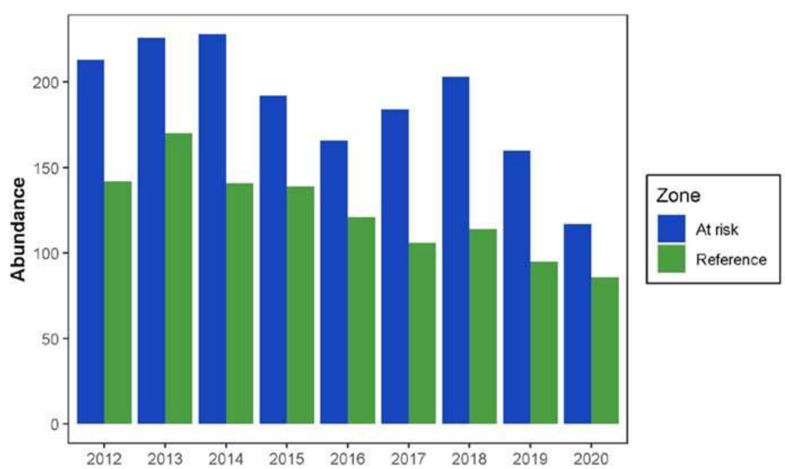

Figure 2-9: Annual Estimates of Burrowing Bettong Abundance at Monitored Mounds within the At Risk and Reference Zones

Monitoring Program: Wedge-tailed Shearwater
Objective
Detect variation in abundance and demographics—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.
Changes to Monitoring Sites
Changes in categorisation of a burrow's contents has occurred over the course of the monitoring program. To allow for consistency over the monitoring program, the long-term dataset was reviewed in 2020 and raw data was recategorised to be consistent over the monitoring program. The presence of an adult alone is now considered a breeding attempt across all seasons.
Methodology
• Survey method: Three fixed long-term transects (100 m × 10 m) on each of Double Island North (DIN), Double Island South (DIS) (At Risk islands), and Ah Chong Island (AHC) (Reference island) were surveyed twice during the summer breeding season. For each survey, all burrows within transects were counted and contents identified using a purpose-built burrowscope to determine breeding status. The first survey was undertaken during the early egg incubation period (November 2020) to derive breeding participation estimates. The second survey was undertaken during late chick provision and just before fledging (March 2021) to determine fledging success estimates (burrows containing live, well-developed fledglings at this time were considered to be fledged). • Analysis method: The breeding performance metrics used for control charting were: – Burrow Density (per 100 m^2) = total number of burrows (active and inactive) within the transects – Breeding Participation (%) = number of breeding attempts / total number of burrows (active and inactive) – Fledging Success (%) = number of developed chicks / number of breeding attempts derived from the first field visit. • Changes were determined by the degree of variation observed between At Risk and Reference islands, and were plotted using time-series control charts to understand trends over time.
Results
• Wedge-tailed Shearwater (WTS) burrow density was similar between the Reference island AHC (9.5 ± 4.2) and At Risk island DIS (9.5 ± 2.9), both of which were double that reported from DIN (4.7 ± 1.7) where the nesting habitat and substrate differs. Burrow density at all 3 monitoring locations increased slightly from 2019, and this metric remains within control limits for both At Risk locations (DIS and DIN) (Figure 2-10). • WTS breeding participation was highest at DIN (62.2 ± 5.1%) in 2020-21, which was similar to that reported during the 2019-20 monitoring period (63.1 ± 8.4%). Breeding participation was lower at AHC (51.2 ± 4.0%) and DIS (45.4 ± 11.8%), which both exhibited a slight decrease from 2019-20 levels (58.4 ± 3.3% and 55.6 ± 8.3%, respectively). This metric remains within control limits for both At Risk locations DIS and DIN despite an upward trend at DIN relative to AHC due to the static breeding participation at this location between years (Figure 2-10). • WTS fledging success was highest at DIS (62.0 ± 5.4%) and represented an increase from levels reported in 2019-20 (55.4 ± 5.8%). In contrast, fledging success has decreased at DIN (from 49.9 ± 13.3% in 2019-20 to 39.6 ± 13.7% in 2020-21) and AHC (from 76.0 ± 5.2% in 2019-20 to 53.9 ± 1.7% in 2020-21). This metric remains within control limits for both At Risk locations DIS and DIN, with DIS trending upwards as result of an increase at this location in parallel to a decline at the Reference location AHC (Figure 2-10).
Conclusions
• Of the 3 metrics, burrow density and breeding participation at At Risk DIN saw the greatest change relative to Reference island AHC. Similar results were not observed at At Risk DIS where the smoothed LRR sits on or very close to, the estimated average true LRR effect. • Burrow density was lower at DIN than at either DIS and AHC; however, this likely reflects habitat and nesting substrate type. • Variation in breeding performance metrics has been observed between seasons for all locations. This variation may be due to, in part, variability in oceanographic conditions and prey availability which influences the reproductive performance in seabirds and their subsequent breeding participation.

Monitoring Program: Wedge-tailed Shearwater
• Monitoring has not detected an adverse variation (attributable to the Gorgon Gas Development) to the abundance and demographics of WTSs.

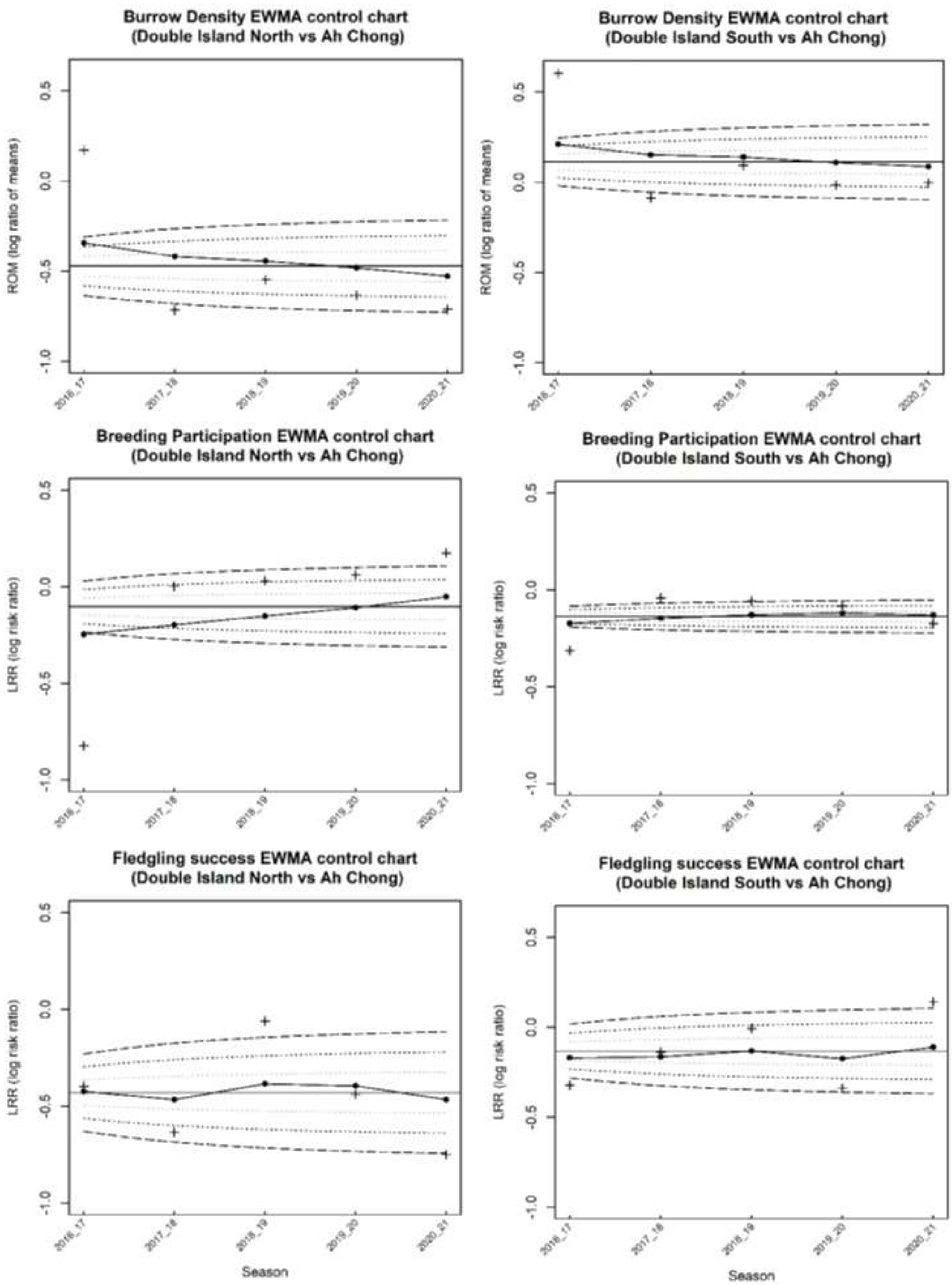

Figure 2-10: Wedge-tailed Shearwater EWMA Control Charts for Nest Density (top), Breeding Participation (middle), and Fledging Success (bottom) between At Risk Islands (Double Island North and South) and Reference Island (Ah Chong)

+ = standardised difference metric; • = smoothed standardised difference metric based on exponentially weighted three-year moving average; dotted curves represent ±1 SD, ±2 SD, and ±3 SD.

Monitoring Program: Bridled Tern
Objective
Detect variation in abundance and demographics—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.
Changes to Monitoring Sites
Changes in categorisation of a burrow's contents has occurred over the course of the monitoring program. To allow for consistency over the monitoring program, the long-term dataset was reviewed in 2020 and raw data was recategorised to be consistent over the monitoring program. The presence of an adult alone is now considered a breeding attempt across all seasons.
Methodology
• Survey method: Three fixed long-term transects (100 m × 10 m) on each of Double Island North (DIN), Double Island South (DIS) (At Risk islands), and Parakeelya Island (PAR) (Reference island) were surveyed twice during the summer breeding season. For each survey, all nest sites within transects were counted and contents identified to determine breeding status. The first survey was undertaken during the early egg incubation period (January 2021) to derive breeding participation and nest density estimates. The second survey was undertaken during late chick provision and just before fledging (March 2021) to determine fledging success estimates (either through direct sighting of a chick, or other indicators such as the presence of guano in the nest scrape). • Analysis method: The breeding performance metrics used for control charting were: – Nest Density (per 100 m^2) = total number of nests (active and inactive) within the transects – Breeding Participation (%) = number of breeding attempts / total number of nests (active and inactive) – Fledging Success (%) = number of fledglings evident / number of breeding attempts derived from the first field visit. • Changes were determined by the degree of variation observed between At Risk and Reference islands, and were plotted using time-series control charts to understand trends over time.
Results
• The highest nest densities were observed on the At Risk islands DIS (9.9 ± 2.5) and DIN (9.7 ± 1.2) compared to a lower density on the Reference island PAR (8.2 ± 0.8). Nest density remained similar for all locations in 2020-21 compared to the previous monitoring period, causing this metric to remain within control limits for both DIS and DIN (Figure 2-11) • Breeding participation was higher at At Risk DIN (39.8 ± 14.2%) and DIS (40.9 ± 7.5%) than the Reference island PAR, which declined from a similar level of 43.7 ± 2.2% in 2019-20, to 27.8 ± 5.4% in 2020-21. This metric remains within control limits for both DIS and DIN; however, is trending upwards towards the +1 SD alert trigger due to the relative decline in nest density at PAR in parallel to a slight increase at the At Risk locations DIS and DIN (Figure 2-11). • Fledging success was highest at PAR, where a there was a marked increase from 56.8 ± 9.9% in 2019-20 to 88.9 ± 9.6% in the 2020-21 monitoring period. In contrast, fledging success remained relatively static between years at DIS (81.0 ± 3.0% in 2019-20 compared to 79.6 ± 1.6% in 2020-21), whereas DIN declined from 97.4 ± 10.3% in 2019-20 to 70.0 ± 8.4% in the 2020-21. Despite these relative changes, the EWMA metric remains within control limits for the At Risk locations DIS and DIN (Figure 2-11).
Conclusions
• Breeding participation on PAR was notably lower this season compared to 2019-20 and was likely due to interspecies competition for space below *Rhagodia* sp. shrubs for nest sites with Silver Gulls, which were observed in increased abundance. Silver Gulls can predate Bridled Tern eggs and chicks and may also reduce parental attendance and chick provisioning, via disturbance and kleptoparasitism. Despite the large number of Silver Gull nest sites on PAR this season, Bridled Tern fledging success remained high. • Historically, fledging success has been highly variable at all islands since the inception of monitoring, lacking any discernible trends. • All Bridled Tern breeding performance metrics remained within control limits for both At Risk islands during the 2020-21 reporting period.

Monitoring Program: Bridled Tern
• Monitoring has not detected an adverse variation (attributable to the Gorgon Gas Development) to the abundance and demographics of Bridled Terns.

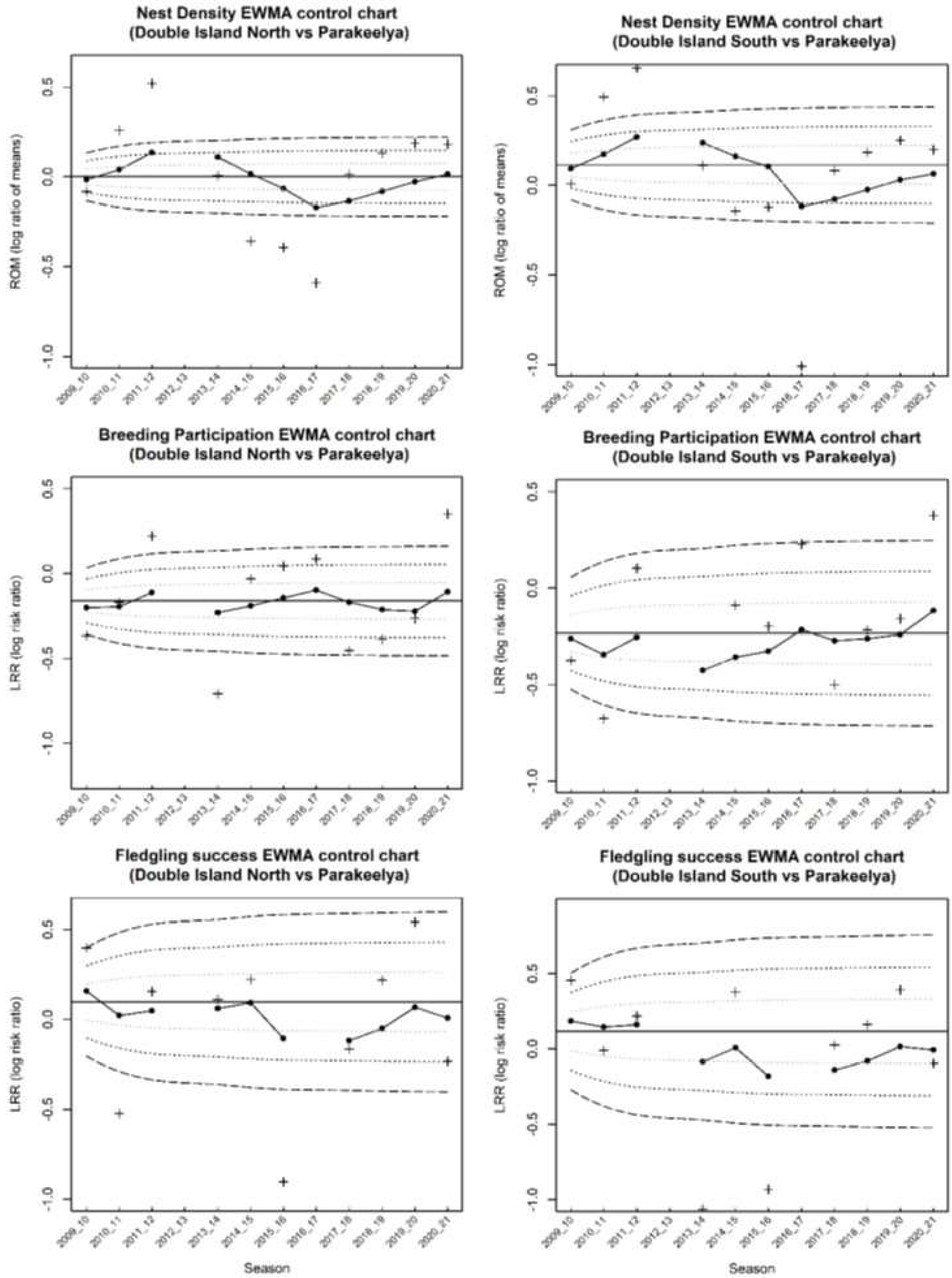

Figure 2-11: Bridled Tern Control Charts for Nest Density (top), Breeding Participation (middle), and Fledging Success (bottom), between the At Risk Islands (Double Island South and North) and Reference Island (Parakeelya)

+ = standardised difference metric; • = smoothed standardised difference metric based on exponentially weighted three-year moving average; dotted curves represent ±1 SD, ±2 SD, and ±3 SD. No Bridled Tern monitoring occurred in 2012–2013 and fledging success could not be estimated in 2016.

Monitoring Program: Groundwater
Objective
Collect information on groundwater levels and the physicochemical parameters of the groundwater to diagnose observed changes—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.
Changes to Monitoring Sites
No deviation from the Operational Sampling and Analysis Plan (SAQP) (Ref. 3) except adopting individual well pre-operations baseline values for the assessment.
Methodology
Monitoring frequency • Since November 2016 biannual sampling has been undertaken at the site in accordance with the Operational SAQP (Ref. 3). During the Reporting Period, two biannual groundwater monitoring events (GMEs) were undertaken (September 2020 and March 2021). **Sampling method** • Groundwater samples were collected from 13 wells within the GTP, 2 wells near the permanent water disposal location on Road 5, and 2 wells near the temporary water disposal location at the central processing facility. Samples were collected using low-flow and passive sampling techniques. • Physical parameters (including water level, pH, electrical conductivity, redox potential [ORP], dissolved oxygen [DO], and temperature) were recorded in the field. • Samples were also sent to a National Association of Testing Authorities (NATA) accredited laboratory for further analysis. **Sample Analysis** *GTP Wells – Shallow* • Laboratory analysis was conducted for physical parameters, major cations, major anions, mercury, monoethylene glycol (MEG), activated methyldiethanolamine (aMDEA), benzene, toluene, ethylbenzene and xylenes (BTEX), total recoverable hydrocarbons (TRH), and dissolved organic carbon (DOC). *GTP Wells – Deep* • Laboratory analysis was conducted for physical parameters, major cations, major anions, mercury, MEG, aMDEA, and DOC. *Permanent Disposal Wells* • Laboratory analysis was conducted for physical parameters, major cations, major anions, mercury, MEG, aMDEA, BTEX, TRH, DOC, and nutrients. • Based on the primary analytical results, some wells were analysed for additional analytes such as an additional dissolved metals suite. *Temporary Disposal Wells* • Laboratory analysis was conducted for physical parameters, major cations, major anions, mercury, BTEX, TRH, DOC, and nutrients. • Based on the primary analytical results, some wells were analysed for additional analytes such as TRH silica gel clean-up (SGC), polycyclic aromatic hydrocarbons (PAH), monocyclic aromatic hydrocarbons (MAH), or an additional dissolved metals suite. • Field and laboratory results were compared to baseline values. and compared against published water quality criteria guidelines or Limits of Reporting (LORs) where applicable. Changes in selected groundwater parameters are used as an indirect habitat indicator for stygofauna.
Results
GTP Wells

Monitoring Program: Groundwater

Analysis of results for the GTP wells indicated that parameters were generally within the range of baseline results, were not detected above the LOR, or were below assessment criteria (as outlined in the Operational SAQP [Ref. 3]), except for:

- Physical parameters: Some pH, DO, salinity, and ORP values were recorded outside the baseline values at GTP wells during the September 2020 and March 2021 GMEs.
- The groundwater at GW-GTP-01A and GW-GTP-03A has increased in DO content from ‘low’ levels during pre-operations, to ‘high’ levels during the September and March GMEs. Conversely, the ‘high’ DO level reported at GW-GTP-04A in September 2020 decreased to ‘low’ DO levels during the March 2021 GME.
- During the March GME, the salinity at the shallow wells was reported slightly lower than the baseline, whereas the salinity in the deeper wells was reported slightly higher than the baseline values. This change in water quality during the March GME might be attributable to a rain event that occurred on 3 March 2021 (68.6 mm).
- A change in water classification only occurred at GW-GTP-02A, which reported brackish groundwater conditions during the baseline and was reported as fresh in the March 2021 GME.
- The pH of the groundwater at all monitoring wells has been classified as ‘neutral’. During the March 2021 GME, the pH exceeded the baseline pH ranges set for each well at all locations except for monitoring wells GW05-B and GW-GTP-03A, which were within baseline ranges.
- Generally, a trend towards an oxidising redox state can be observed at most well locations during the March 2021 GME with results at most wells exceeding baseline values. The groundwater at GW-GTP-02A and GW-05B was reported as mildly reducing to mildly oxidising during the baseline; however, the redox state of the March 2021 GME was reported as oxidising. GW-GTP-03A and GW-GTP-14A reported an oxidising redox state in March 2021, compared to a mildly oxidising redox state recorded during the baseline. A similar trend was observed for GW-GTP-03B, which reported a mildly oxidising redox state in March 2021 but a mildly reducing redox state during the baseline. This trend has also been observed during the September GME, particularly for GW-GTP-02B where groundwater conditions changed from reducing to mildly oxidising during the baseline, to mildly oxidising since March 2018.
- Mercury, TRH, BTEX, naphthalene, aMDEA, and MEG were not detected above the LOR in the GTP Wells in September 2020 and March 2021.

Temporary Disposal Wells

Analysis of results for the temporary disposal wells indicated that parameters were generally within the range of baseline results, were not detected above the LOR, or were below assessment criteria (as outlined in the Operational SAQP [Ref. 3]), except for:

- The groundwater at DWDB1-MW2 recorded a ‘low’ DO concentration during the September 2020 GME, while the DO was recorded as ‘high’ during pre-operation conditions and again during the March 2021 GME.
- The pH value of 6.45 recorded at DWDB2-MW3 was outside the baseline value and assessment criteria pH range of 6.5–8.5.
- In the September 2020 and March 2021 GMEs, the concentration of nitrate (as N) at DWDB2-MW3 (8.08–10.6 mg/L) was reported below the baseline values. The concentration of nitrate (as N) at DWDB1-MW2 (9.1–9.50 mg/L) was above the baseline range but within the same order of magnitude as previous monitoring events.
- The TRH > C_{16}–C_{34} F3 fraction (0.18 mg/L) at DWDB1-MW2 exceeded the assessment criterion of 0.1 mg/L in September 2020. TRH was detected above the LOR in previous monitoring rounds. Additional analysis of PAH, MAH, and TRH SGC were conducted for the DWDB1-MW2 sample as a result of the TRH detection. No MAH, PAH, or SGC results were recorded above the laboratory LOR. BTEX and naphthalene were not detected above the LOR.
- Additional metal analysis was undertaken for monitoring well DWDB2-MW3, and metal concentrations did not exceed the relevant assessment criteria.

Permanent Disposal Wells

Analysis of results for the GTP wells indicated that parameters were generally within the range of baseline results, were not detected above the LOR, or were below assessment criteria (as outlined in the Operational SAQP [Ref. 3]), except for:

- Physical parameters: Groundwater conditions at the permanent disposal wells GW-RD5-02 and GW-RD5-03 have reported trends of reduced salinity. During the baseline, groundwater conditions were

Monitoring Program: Groundwater
reported as saline, but have been reported as fresh to brackish since August 2017 including the September 2020 and March 2021 GMEs. • The pH of the groundwater at GW-RD5-02 (pH 7.60–7.70) was outside the baseline pH range of 7.04–7.24 in September 2020 and March 2021.Groundwater conditions at GW-RD5-02 were reported as reducing to mildly reducing in the baseline but have been reported as mildly oxidising since March 2018. The concentration of nitrate (as N) at GW-RD5-02 (1.75–1.86 mg/L) exceeded the baseline value and assessment criterion of 1.70 mg/L in September 2020 and March 2021, but is within the order of magnitude of previous nitrate (as N) concentrations. Additional metal analysis was undertaken for monitoring well GW-RD5-02. Concentrations of chromium (hexavalent), copper, and zinc were reported above the respective maximum baseline value, with copper exceeding the relevant assessment criterion. All other metal concentrations were not detected or were within or below baseline concentrations. These changes may indicate changes to aquifer conditions. • Mercury, TRH, BTEX, naphthalene, aMDEA, and MEG were not detected above the LOR in the permanent disposal wells in the September 2020 and March 2021 GMEs, consistent with previous monitoring results.
Conclusions
• Groundwater monitoring during the Reporting Period is considered to have been completed in accordance with the TSEMP. Monitoring was undertaken in accordance with the Operational SAQP (Ref. 3).” • Monitoring near the GTP and permanent and temporary disposal wells has generally indicated that no significant observable changes to groundwater were attributable to the Project during the Reporting Period.

Monitoring Program: Surface Water Landform
Objective
To detect impacts to surface water landforms—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.
Changes to Monitoring Sites
No changes to monitoring sites.
Methodology
Remote sensing or direct field inspection following heavy or cyclonic rainfall.
Results
No significant erosion or sedimentation was observed at any of the 14 monitoring sites.
Conclusions
Monitoring to date has not detected an adverse impact (attributable to the Gorgon Gas Development) to surface water landforms.

2.2 Event Data

The Threatened or Listed fauna reporting undertaken during the Reporting Period is summarised in the following table.

Event Data: Threatened or Listed Fauna Reporting
Reporting Requirement
Threatened or Listed fauna cared for, injured, or killed within the TDF.
Results
• Table 2-2 lists the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Threatened or Listed fauna injured or killed within the TDF during the Reporting Period. • The Barrow Island Golden Bandicoot represents 56% of the deceased records, followed by the Barrow Island Spectacled Hare-wallaby (22%), Barrow Island Boodie (12%), and Barrow Island Euro (1%) (Table 2-2). The predominant cause of death for these species was vehicle strike (96%). The mortality counts for these species represent only a small proportion (~≤1%) of estimated Barrow Island abundance for these species. • Two threatened or listed fauna were cared for[3] during the Reporting Period. Both species (Bridled Tern and Wedge-tailed Shearwater) were released on Barrow Island.

Table 2-2: EPBC Act Threatened or Listed Fauna Recorded as Injured or Deceased within the TDF

Common Name	Species Name	No. Injured[1]	No. Deceased[2]
Bridled Tern	*Onychoprion anaethetus*	1	0
Barrow Island Burrowing Bettong (Boodie)	*Bettongia lesueur*	0	12
Barrow Island Euro	*Macropus robustus isabellinus*	0	1
Barrow Island Golden Bandicoot	*Isoodon auratus barrowensis*	0	55
Barrow Island Spectacled Hare-wallaby	*Lagorchestes conspicillatus*	0	22
Barrow Island White-winged Fairy-wren	*Malurus leucopterus edouardi*	0	1
Silver Gull	*Chroicocephalus novaehollandiae*	0	3
Wedge-tailed Shearwater	*Ardenna pacifica*	1	3
Welcome Swallow	*Hirundo neoxena*	0	1

1 Includes injured fauna where the cause of injury is attributed to the Gorgon Gas Development or where the cause of injury is unknown; does not include fauna where the cause of injury was natural.

2 Includes fauna deaths where the cause of death is attributed to the Gorgon Gas Development, and sick or injured fauna that were cared for and subsequently euthanised; does not include fauna where the cause of death was natural.

3 Cared for fauna does not include fauna that is held temporarily which is not believed to be sick, diseased, injured or abandoned.

3 Terrestrial and Marine Quarantine

Table 3-1: EPR Reporting Requirements for Terrestrial and Marine Quarantine

Item	Source	Section in this EPR
Results of the audit and monitoring programs	MS 800, Schedule 3(2i) EPBC 2003/1294 and 2008/4178, Schedule 3(2i)	3.1, 3.2
Detected introduction(s) of non-indigenous terrestrial flora or fauna (NIS) and marine pest species, including procedure breaches and 'near misses' including special reference to weeds	MS 800, Schedule 3(2ii) EPBC 2003/1294 and 2008/4178, Schedule 3(2ii)	3.2, 3.3
Consequences of the introduction	MS 800, Schedule 3(2iii) EPBC 2003/1294 and 2008/4178, Schedule 3(2iii)	N/A[1]
Modification, if any, to the Quarantine Management System (QMS) because of: • audits and monitoring • detected introductions • 'best practice' improvements.	MS 800, Schedule 3(2iv) EPBC 2003/1294 and 2008/4178, Schedule 3(2iv)	3.4
Eradication actions if any taken; reasons for any action or non-action; changes to improve procedures and outcomes and progress	MS 800, Schedule 3(2v) EPBC 2003/1294 and 2008/4178, Schedule 3(2v)	N/A[2]
Mitigation actions	MS 800, Schedule 3(2vi) EPBC 2003/1294 and 2008/4178, Schedule 3(2vi)	N/A[2]
Results of any QMS-related studies, where conducted, to improve performance	MS 800, Schedule 3(2vii) EPBC 2003/1294 and 2008/4178, Schedule 3(2vii)	N/A[3]
Weed management incidents: • new infestations • proliferations	MS 800, Schedule 3(2viii) EPBC 2003/1294 and 2008/4178, Schedule 3(2viii)	N/A[1]
Weed eradication performance; and • areas treated • results against measurable indicators and limits	MS 800, Schedule 3(2xi) EPBC 2003/1294 and 2008/4178, Schedule 3(2ix)	N/A[1]
Targets proposed for the next year	MS 800, Schedule 3(2x) EPBC 2003/1294 and 2008/4178, Schedule 3(2x)	N/A[4]

1. *No introductions of NIS or marine pests, or proliferations of existing weeds or new weed establishments, were recorded during the Reporting Period; therefore, reporting is not applicable at this time.*
2. *No eradication or mitigation actions in response to an introduction of a NIS or Marine Pest occurred during the Reporting Period; therefore, reporting is not applicable at this time.*
3. *No QMS-related studies were implemented during the Reporting Period; therefore, reporting is not applicable at this time.*
4. *Targets are developed in response to introductions of NIS or Marine Pests, or in response to proliferations of existing weeds or new weed establishment. During the Reporting Period, no introductions of NIS or Marine Pests, or proliferation of existing weeds or establishment of new weeds were recorded; therefore, reporting is not applicable at this time.*

3.1 Audits

CAPL audits of the quarantine management measures described in the QMS (Ref. 6) are conducted at least every 2 years during operations. CAPL conducted a QMS audit in 2020, therefore no further CAPL audits were undertaken on the

QMS during the Reporting Period. Similarly, no Regulator audits were carried out on the QMS during the Reporting Period.

CAPL received a warning letter from the WA Department of Water and Environmental Regulation (DWER) regarding a finding of non-compliance in relation to the late reporting of 5 historical quarantine incidents involving detection of bulrush on Barrow Island between 2015 and 2019. These incidents were originally classified as 'non-events' because there was no evidence they were project-attributable. During a meeting of the Quarantine Expert Panel (QEP), the WA Department of Biodiversity, Conservation and Attractions took the view that these incidents were attributable to the Project. CAPL did not report these incidents until the QEP minutes were confirmed and finalised, which was outside the 48-hour Reporting Period. Bulrush has not established on Barrow Island and any detected bulrush has been managed; there has been no environmental impact associated with bulrush detections.

3.2 Monitoring Results

A quarantine surveillance program determines the presence or absence of NIS (plants, invertebrates, and vertebrates) on Barrow Island and Marine Pests in the waters surrounding Barrow Island.

The results of surveillance programs implemented during the Reporting Period are summarised in the following tables.

Surveillance Program: Plant NIS
Objective
Detect the presence and/or proliferation of plant NIS (weeds) on Barrow Island attributable to Gorgon Gas Development activities.
Methodology
• Repeated weed surveillance at identified risk localities within the Gorgon Gas Development tenure and surrounding areas. • Repeated weed inspections of areas where weeds were previously recorded as a follow-up measure to ensure any further weed detections are controlled immediately.
Results
• Weed species detected and controlled within the Gorgon Gas Development tenure or surrounding areas under weed surveillance during the Reporting Period: – Buffel Grass (*Cenchrus ciliaris*) – Blackberry Nightshade (*Solanum nigrum*) – Common Sowthistle (*Sonchus oleraceus*) – Cape Weed (*Arctotheca calendula*) – one unidentified plant (could not be identified due to its juvenile life stage) detected at the waste transfer station – *Typha* sp. plants were detected in drains in the GTP area. • Surveillance associated with Kapok (*Aerva javanica*) detected in the 2016–2017 Reporting Period continued. There were 26 unseeded kapok bush seedlings detected during the Reporting Period (detected around the same location as those noted in the 2016–2017 Reporting Period). • There was no requirement to establish any new Weed Hygiene Zones during the Reporting Period.
Conclusions
No introduction or proliferation of weed species (attributable to the Gorgon Gas Development) was recorded during the Reporting Period.

Surveillance Program: Invertebrate NIS
Objective
Detect the presence and/or proliferation of invertebrate NIS on Barrow Island attributable to Gorgon Gas Development activities.
Methodology
• Surveillance effort focused on identified risk localities, and used multiple surveillance system components (SSCs). • The SSCs used for the Reporting Period included: light traps, baited traps (including sticky traps), biologist structured and unstructured surveys, vacuuming shrubs, vehicle vibration surveillance, and workforce observations/reporting.
Results
• The following NIS invertebrates were recorded during the reporting period: – one Ring-legged Earwig (*Euborellia annulipes*) was detected in a sticky trap at Butler Park – 10 Maritime Earwigs (*Anisolabis maritima*) were detected in sticky traps at the Material Offloading Facility (MOF) – one Longicorn Beetle (*Coleocoptus senio*) was detected in a light trap at Oliver Laydown, followed by another 3 during further light trap surveillance (one at WA Oil base and 2 at Oliver Laydown) – one *Calomyrmex purpureus smaragdinus* ant was detected in a light trap in vegetation near Oliver Laydown – one *Podomyrma adelaidae* ant was detected from a biologist structured survey in vegetation near the Old Airport – Lesser Auger Beetles (*Heterobostrychus aequalis*) were recorded by workforce observation/reporting; these were in a container at Oliver Laydown. • All the invertebrates mentioned above were contained and captured following detection. Targeted surveillance for the Longicorn Beetle, Lesser Auger Beetle, and Maritime Earwig remains in place as a safeguard. • Identification of some specimens from the 2020–2021 surveillance program is still pending, and any NIS detections will be included in the 2022 EPR.
Conclusions
All NIS detected during the Reporting Period were controlled immediately. No introduction of invertebrate NIS can be attributed to Gorgon Gas Development activities during the Reporting Period.

Surveillance Program: Vertebrate NIS
Objective
Detect the presence and/or proliferation of vertebrate NIS on Barrow Island attributable to Gorgon Gas Development activities.
Methodology
• Surveillance effort focused on identified risk localities, and used several SSCs. • The SSCs used for the Reporting Period included: biologist unstructured surveys, biologist structured surveys (night and day), scat searches, Elliot traps, environmental acoustic recognition sensors, print acquisition for wildlife sensors, and workforce observations/reporting.
Results
One Desert Tree Frog (*Litoria rubella*) was detected by passive workforce observation/reporting. A first response was initiated, and no further frogs were detected.
Conclusions
No introductions of vertebrate NIS that can be attributed to Gorgon Gas Development activities were recorded during the Reporting Period.

Surveillance Program: Marine Pests
Objective
Detect the presence of Marine Pests that might be the result of Gorgon Gas Development activities.
Methodology
• The Marine Pest Surveillance Program conducted at Barrow Island during the Reporting Period included these components: – intertidal surveillance, using visual surveillance transects – visual examination of settlement arrays – analysis of environmental deoxyribonucleic acid (eDNA) from additional settlement arrays and water samples. DNA present on settlement arrays and in water samples is analysed using next-generation sequencing methodology, or real-time polymerase chain reaction testing, and the results are compared against a reference database of targeted Marine Pests. • Surveillance and sampling locations focused on high-risk localities around operational areas.
Results
• Two intertidal surveys and visual examination of 2 settlement arrays, which had been immersed for 6 months, were completed (January and July 2021). No Marine Pests were detected from visual examinations. • Six sampling events from 12 settlement arrays were completed for eDNA analysis (in October, November 2020, and January, March, May, and July 2021). No Marine Pests were detected[1].
Conclusions
No introduction of Marine Pests that can be attributed to Gorgon Gas Development activities was recorded during the Reporting Period.

1 *Note: eDNA analysis of settlement plate arrays and water samples from the Reporting Period is still pending. Any NIS detections will be included in the 2022 EPR.*

3.3 Event Data

The quarantine detections recorded during the Reporting Period are summarised in the following table.

Event Data: Quarantine Detections
Reporting Requirement
Detected introduction(s) of NIS and Marine Pest species, procedure breaches, and ‘near misses’, with special reference to weeds. *Note: During this Reporting Period, the term ‘near miss’ was retired to better align with event classifications defined in the QMS (see Section 13 for quarantine event terminology)*
Results
• During the Reporting Period, no Quarantine Introductions (including for Marine Pest species and weeds), 10 Quarantine Incidents, 194 Quarantine Intercepts, and 43 Quarantine Procedural Breaches were recorded (see Section 13 for quarantine event terminology). • Six Level 1 incidents were associated with NIS invertebrates: – Lesser Auger Beetle (*Heterobostrychus aequalis*) – Longicorn Beetle (*Coleocoptus senio*) – Ring-legged Earwig (*Euborellia annulipes*) – Maritime Earwig (*Anisolabis maritima*) – *Calomyrmex purpureus smaragdinus* ant – Desert Muscleman Ant (*Podomyrma adelaidae*) • One Level 1 incident was associated with a NIS vertebrate—one Desert Tree Frog (*Litoria rubella*) was detected by the workforce during general work activity.

Event Data: Quarantine Detections
• Three Level 1 incidents were associated with weeds: – one Cape Weed (*Arctotheca calendula*) detected at Butler Park – one unidentified plant detected at the waste transfer station – *Typha* sp. plants detected in drains in the GTP area • Most Quarantine Intercepts were associated with seed material (40%) and NIS invertebrates (34%). • During this Reporting Period, 5 historical quarantine records were reclassified from non-events (not Project-attributable) to Level 1 incidents, following a review by the QEP. These events were associated with *Typha* sp. (recorded between 2015 and 2019).
Conclusions
• All NIS detected during the Reporting Period were successfully controlled immediately following detection. Targeted surveillance remains in place for detecting the Lesser Auger Beetle, Longicorn Beetle, and Maritime Earwig. • Quarantine first-response and eradication activities for the Indian House Cricket (*Gryllodes sigillatus*)[1] continued during the Reporting Period. Activities included monitoring and treatments. Numbers of this species continue to decrease across all life stages. More than 3,000 monitoring stations are deployed around the GTP, MOF, the surrounding native vegetation, and targeted satellite sites. • Quarantine first-response activities for the jumping spider (*Menemerus nigli*)[1] continued during the Reporting Period. • Surveillance will continue for Buffel Grass (*Cenchrus ciliaris*) and Kapok Bush (*Aerva javanica*) until CAPL is confident no residual seed banks remain. • Following the Quarantine Incidents, Intercepts, and Procedural Breaches recorded, actions were taken to reinforce quarantine training, procedures, and Gorgon Gas Development requirements.

1 *Note: Indian House Cricket (*Gryllodes sigillatus*) and jumping spider (*Menemerus nigli*) were detected in a previous Reporting Period.*

3.4 Review of the Quarantine Management System

A review of the QMS commenced during the Reporting Period. The objective of the review is to ensure the QMS is fit for purpose in Operations. It is anticipated that a revised version of the QMS will be published in 2022.

4 Marine Turtles

Table 4-1: EPR Reporting Requirements for Marine Turtles

Item	Source	Section in this EPR
Results of all marine turtle monitoring carried out by the Proponent, including any detected changes to the Flatback Turtle population	MS 800, Schedule 3(3i) EPBC 2003/1294 and 2008/4178, Schedule 3(3i)	4.1, 4.4
Reportable incidents involving harm to marine turtles	MS 800, Schedule 3(3ii) EPBC 2003/1294 and 2008/4178, Schedule 3(3ii)	4.2
Changes to the marine turtle monitoring program	MS 800, Schedule 3(3iii) EPBC 2003/1294 and 2008/4178, Schedule 3(3iii)	4.1
Conclusions about the status of Flatback and other marine turtle populations on Barrow Island	MS 800, Schedule 3(3iv) EPBC 2003/1294 and 2008/4178, Schedule 3(3iv)	4.1, 4.4
Changes (if any) to the Long-term Marine Turtle Management Plan	MS 800, Schedule 3(3v) EPBC 2003/1294 and 2008/4178, Schedule 3(3v)	4.4
Findings of the annual audit and review on the effectiveness of lighting design features, management measures, and operating controls including details of light management initiatives and activities undertaken during the year	MS 800, Schedule 3(3vi) EPBC 2003/1294 and 2008/4178, Schedule 3(3vi)	4.3
Results of studies undertaken	MS 800, Schedule 3(3vii) EPBC 2003/1294 and 2008/4178, Schedule 3(3vii)	4.1
Noise monitoring results and a discussion on the success (or otherwise) in meeting noise emission targets	MS 800, Schedule 3(3viii) EPBC 2003/1294 and 2008/4178, Schedule 3(3viii)	N/A[1]

1 *No specific noise emission targets for the Gorgon Gas Development apply to environmental receptors; noise monitoring is considered in relation to monitoring results for the Flatback Turtle population. As reported in the 2010 – 2015 Five-year EPR): 'Given the results to date, the difficulty in detecting any onshore noise or vibration effects from Project activities on the beaches, and endorsement from the Marine Turtle Expert Panel (and subsequent regulatory approval), the noise and vibration monitoring program was suspended after the 2011–2012 season.' Therefore, reporting for this item is not applicable.*

4.1 Monitoring Results

An objective of the Long-term Marine Turtle Management Plan (LTMTMP) (Ref. 4), as defined by Ministerial Conditions, is to establish a statistically valid monitoring program to measure and detect changes to the Flatback Turtle population on Barrow Island.

Key demographic parameters were identified as necessary for understanding the population dynamics and population viability of the Flatback Turtle rookery on Barrow Island. A mainland Reference site (Mundabullangana [MDA]) was also established. Where relevant, data related to these key parameters are also captured at MDA for comparison with the Barrow Island Flatback Turtle data (Ref. 4).

Changes in key demographic parameters are measured using time-series control charts. Trends identified in control charts act as early-warning signals to guide a tiered management approach. A management response is triggered if a demographic parameter demonstrates a trend towards, or changes beyond statistical deviations (± 1, ± 2, or ±3 SD, standard error [SE], mean or median absolute deviation [MAD]) from baseline conditions (Ref. 4).

The 2020–2021 results (Ref. 5) for the monitoring programs listed in the LTMTMP, including any changes detected to the Barrow Island Flatback Turtle population, are summarised in the following tables.

Monitoring Program: Flatback Turtle Abundance and Distribution
Objective
To measure and detect changes to the abundance, distribution, and nesting behaviour of adult Flatback Turtles.
Changes to Program
• No changes were made to the Flatback Turtle Abundance and Distribution Program during the Reporting Period. • The Adult Survival Probability Control Chart is no longer presented. This parameter has been modelled and plotted as a constant mean value over all seasons and does not have the potential to exceed the control limits. • The abundance and distribution program at MDA was ended on 7 December 2020 due to rainfall associated with a tropical low that restricted access to the beach. This resulted in the loss of 31 monitoring nights. No monitoring nights were lost at Barrow Island.
Methodology
• Capture-recapture sampling of nesting adult female Flatback Turtles to estimate these demographic parameters: – annual nester abundance – adult female survival probability – adult female breeding omission probability – nesting activity – clutch frequency – internesting interval. • Only key demographic parameters are control-charted; these include annual nester abundance, adult female breeding omission probability and clutch frequency. • Variation in modelled estimates can occur when models are re-run each year with additional data. Therefore, minor variations from year to year might occur in historical control-charted parameter estimates presented in this EPR.
Results
Annual Nester Abundance • The EWMA control chart between the Barrow Island (At Risk) and MDA (Reference) sites shows that the annual nester abundance of adult female Flatback Turtles on Barrow Island has remained in control since 2009–2010 (Figure 4-1). • The abundance estimates at both Barrow Island and MDA followed a similar trend in 2020–2021, with both sites decreasing in abundance since the previous season. Population size modelling using a capture-mark-recapture multi-state open robust design (MSORD) estimated an annual nester abundance of 1,693 female turtles at Barrow Island and 1,195 female turtles at MDA. This was the lowest annual nester abundance estimate for Barrow Island since 2011–2012 and for MDA since 2009–2010 (Figure 4-2). *Adult Female Survival Probability* • The estimated annual survival probability for nesting Flatback Turtles on Barrow Island was 0.94 (95% CI: 0.937–0.943). There were no control limit exceedances for the current nesting season. *Adult Female Breeding Omission Probability* • Adult female breeding omission probability at Barrow Island was 0.85 (95% CI: 0.83–0.87), exceeding the +3 SD management trigger limit for this parameter (Figure 4-2).

Monitoring Program: Flatback Turtle Abundance and Distribution

Clutch Frequency

- The estimated clutch frequency at Barrow Island was 3.4 clutches per female per season (95% CI: 3.2–3.5). Due to limited sampling, clutch frequency could not be estimated for MDA this season (Figure 4-2).

Internesting Interval

- The mean internesting interval for Flatback Turtles at Barrow Island and MDA was 12.9 ± 2.2 and 12.6 ± 2.9 days, respectively.

Nesting Activity (spatial and temporal distribution)

- When compared to baseline, the nesting population has demonstrated temporal and spatial variation in how they use certain beaches at Barrow Island. For example, the percentage use of Inga, Bivalve, and Terminal beaches has decreased since baseline, with the most notable decrease at Bivalve Beach. In contrast, the percentage use of Yacht Club South (YCS), Yacht Club North (YCN), and Mushroom beaches has increased since baseline, with the most notable increase at Mushroom Beach. Consistent with previous seasons since construction of the causeway/MOF, Flatback Turtles that used Inga, Bivalve, and Terminal beaches have also shown a change in their distribution and pattern of nesting activity across the beach in the direction of causeway/MOF.
- Nesting Flatback Turtles continued to demonstrate a strong fidelity to the beach where they had been sighted at least once previously. The beaches with the strongest fidelity—Terminal (76.1%) and Mushroom (82.0%)—are north of the MOF/causeway. Both beaches also recorded the largest fidelity value out of all previous seasons, with the fidelity at Mushroom Beach the largest ever percentage out of all beaches in all previous seasons. Inga Beach had the lowest fidelity out of any routine monitored beach (54.0%), which was closely followed by YCS (55.6%) and Bivalve beaches (56.6%). At Terminal Beach, the overall percentage of turtles sighted south of the MOF/causeway has decreased annually since 2014–2015 to its lowest value (8.3%) since monitoring commenced.
- When turtles did move away from a beach, they were most frequently sighted on adjacent beaches. For example, for turtles sighted at least once on YCS Beach, 31.2% of their sightings were also on YCN beach; and for Bivalve Beach turtles, 16.5% of their sightings were on Inga Beach to the south.
- Identifying the cause for the temporal and spatial variation is challenging and likely influenced by a combination of factors. This is also confounded by the multi-beach use of individual turtles within, and across, seasons. A shift of remigrant Flatback Turtles away from one beach to other beaches over time is particularly noticeable for remigrant turtles sighted at beaches north of the causeway/MOF. Remigrant turtles sighted at Terminal Beach this season were previously also sighted at Bivalve Beach (29% of their sightings in 2009–2010 were at Bivalve). Yet since construction of the causeway/MOF, their sightings at Bivalve Beach has consistently decreased each season to the point that in 2019–2020, there were no sightings of them using Bivalve Beach at all. On that basis, the causeway/MOF appears to be a physical impediment that deters turtles from moving from the northern beaches (Mushroom and Terminal) to Bivalve Beach and vice versa.
- Although there has been a significant reduction in the use of Bivalve Beach for nesting, the Flatback Turtles that did select this beach for nesting during this season did not appear to be deterred from using the beach again following their initial nesting experience. Furthermore, the historic use of Bivalve by the 88 remigrant turtles sighted at the beach this season is consistent, indicating that Bivalve is still being repeatedly used by those remigrant turtles despite the changes to the beach.

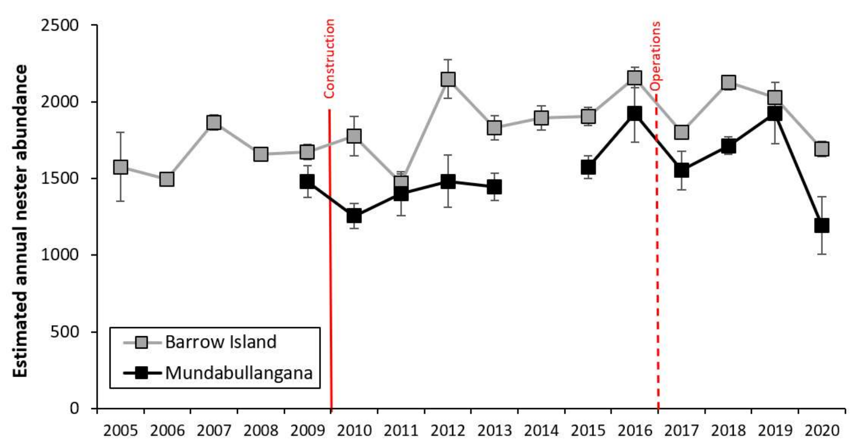

Figure 4-1: Annual Abundance Estimates at Barrow Island and Mundabullangana between 2005–2006 and 2020–2021[1]

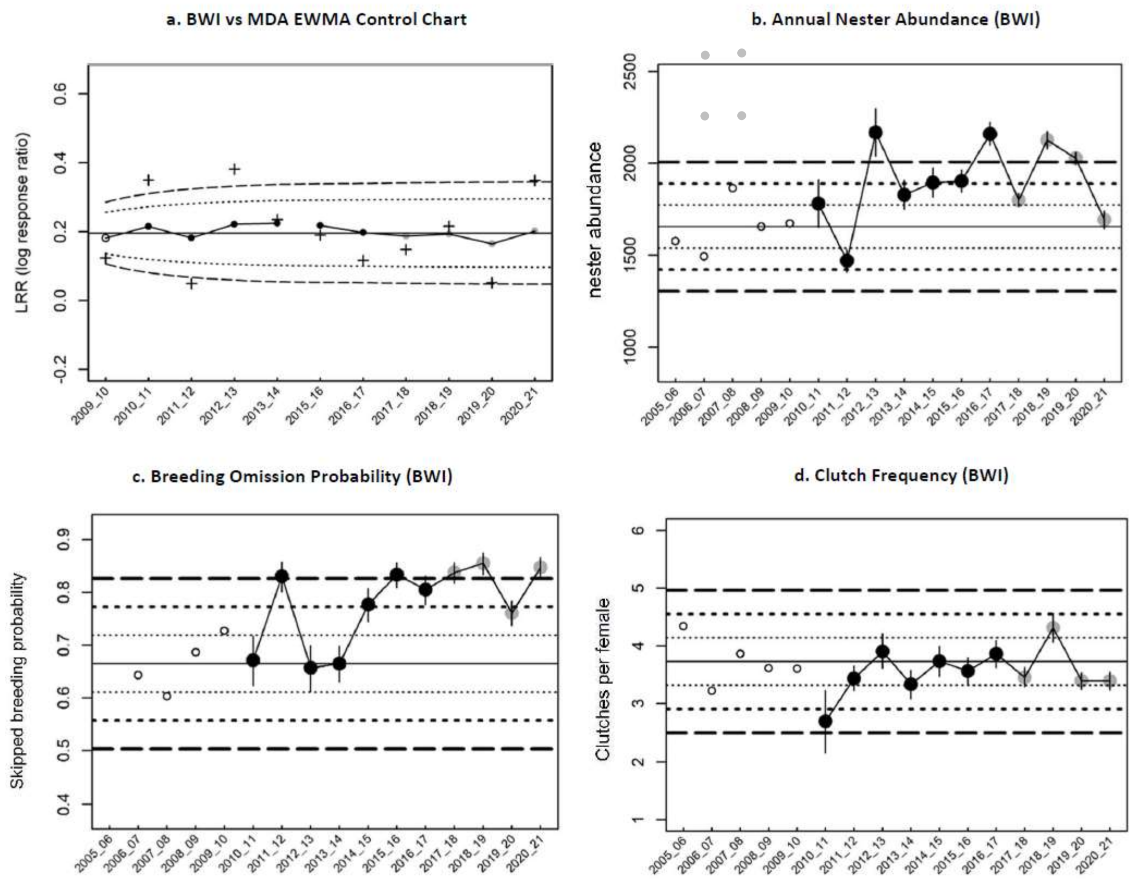

Figure 4-2: Control Charts for Flatback Turtle Population Demographic Metrics at Barrow Island (BWI) including (a) Annual Nester Abundance for BWI vs MDA, (b) Annual Nester Abundance at BWI, (c) Breeding Omission Probability at BWI, and (d) Clutch Frequency at BWI[1,2]

1 *EWMA chart based on an exponentially weighted 3-year moving average. Open dot = smoothed LRR in baseline; black dots = smoothed LRR in construction; grey dots = smoothed LRR in operations; crosses = unsmoothed LRR. Positive values show an effect that is higher at the At Risk site compared to the Reference site, and vice versa. The solid horizontal centre-line is the estimated average true LRR effect. Dotted curves = ±1 SD at each year for the smoothed metric, and dot-dashed curves = ±2 SD.* ***Note****: There was no annual abundance estimate for MDA in 2014–2015 due to the limited sampling in that season.*

2 *Open dots = baseline estimate derived from empirical data, black dots = construction parameter estimate, grey dots = operations parameter estimate, solid horizontal line = long-term expected estimate derived from baseline estimates (mean or median), dotted lines = ±1 SE (or 1 MAD for annual nester abundance), small dashed lines = ±2 SE (or 2 MAD), long dashed lines = ±3 SE (or 3 MAD). Error bars indicate 95% CI.*

Monitoring Program: Flatback Turtle Incubation Success
Objective
To measure and detect changes to Flatback Turtle incubation success.
Changes to Program
• No changes were made to the Flatback Turtle incubation success monitoring program during the Reporting Period.

Monitoring Program: Flatback Turtle Incubation Success
• Marked clutches were unable to be excavated at MDA in January or February 2021 due to restricted access caused by high rainfall. Excavations took place in May 2021, which prevented analysis of the hatchling emergence probability for each marked clutch.
Methodology
• Routine monitoring at Inga, Bivalve, Terminal, and Mushroom beaches. • Monitoring marked nests to estimate these parameters: – egg hatching probability – hatchling emergence probability – incubation duration – incubation temperature – clutch fate – clutch size. • Only key demographic parameters for Barrow Island are control-charted; these include median egg hatching probability and median hatchling emergence probability for complete clutches. Mean values for both complete and incomplete clutches are presented for comparison. Incomplete clutches are those disturbed by other turtles or predators, lost during incubation, mixed with another clutch, or inundated.
Incubation Success Results
Egg Hatching Probability • There were no control limit exceedances for median egg hatching probability at Barrow Island (84.6%; 95% CI: 80.8–87.3,Figure 4-3). • For all clutches (complete and incomplete), the mean overall egg hatching probability at Barrow Island was 71.0 ± 30.9%. Results for individual beaches are shown in Table 4-2. The mean overall egg hatching probability for only complete clutches was 77.5 ± 24.0%. Results for individual beaches and MDA are shown in • Table 4-3. *Hatchling Emergence Probability* • There were no control limit exceedances for median hatchling emergence probability at Barrow Island (84.1%; 95% CI: 80.5–87.4, Figure 4-3). • Mean hatchling emergence probability for complete clutches at Barrow Island was 76.9 ± 24.3%. Results for individual beaches and MDA are shown in • Table 4-3. *Incubation Duration* • The mean incubation duration at Barrow Island was 47.0 ± 1.7 days. Results for individual beaches and MDA are shown in Table 4-2. *Incubation Temperature* • The mean daily clutch temperatures for individual beaches and MDA are shown in Table 4-2. • Mean daily clutch temperatures at Terminal Beach were not significantly different to baseline. Bivalve Beach was significantly cooler when compared to baseline. There is no baseline data for Inga and Mushroom beaches. *Clutch Fate* • Of the 100 marked clutches, 83 were considered complete and 14 were incomplete (Table 4-2). *Clutch Size* • The mean clutch size at excavation was 49.1 ± 8.7 eggs at Barrow Island and 49.0 ± 5.6 eggs at MDA (recorded at laying). Results for individual beaches and MDA are shown in • Table 4-3.

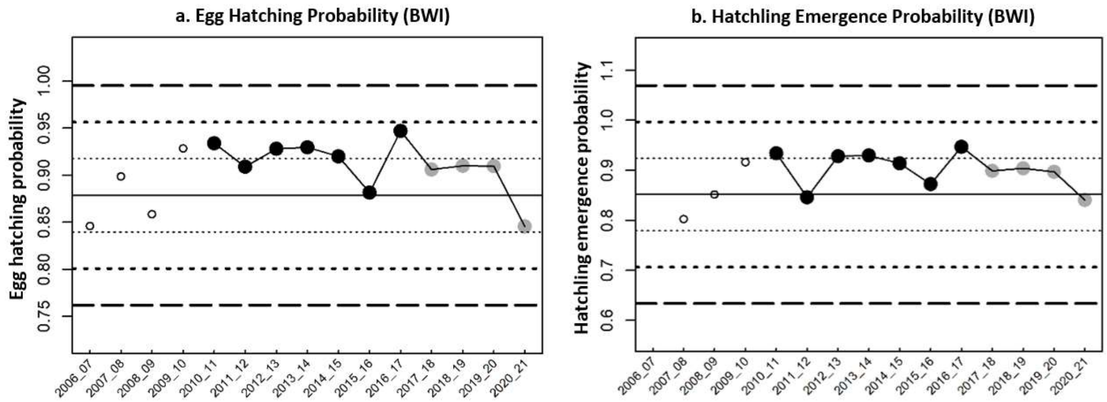

Figure 4-3: Control Chart for (a) Egg Hatching Probability and (b) Hatchling Emergence Probability for Complete Clutches at Routine Barrow Island Beaches[1]

1 *Open dots = baseline estimate derived from empirical data, black dots = construction parameter estimate, grey dots = operations parameter estimate, solid horizontal line = long-term expected estimate derived from baseline estimates (mean or median), dotted lines = ±1 SE (or 1 MAD), small dashed lines = ±2 SE (or 2 MAD), long dashed lines = ±3 SE (or 3 MAD).*

Table 4-2: Summary of Clutch Fate and Mean Egg Hatching Probability for All Clutches (Complete and Incomplete) at Routine Beaches

Beach	Mean Egg Hatching Probability ± SD (%)	Clutch Fate				
		Mixed Clutch	Inundation	Disturbed (by Turtle / Predator)	Lost (during Incubation)	Total Marked Clutches
Inga	73.7 ± 26.8	1	0	3	1	25
Bivalve	67.7 ± 34.7	1	0	1	2	25
Terminal	74.4 ± 28.3	1	0	1	1	25
Mushroom	67.6 ± 34.6	0	0	0	2	25
BWI (Routine)	71.0 ± 30.9	3	0	5	6	100
MDA	76.2 ± 27.5	0	0	2	0	31

Table 4-3: Summary of Incubation Success Parameters (Complete Clutches Only)

Beach	Monitoring Season (Mean ± SD)	
	2020–2021	Baseline
Egg Hatching Probability (%)		
Inga	82.3 ± 15.7 (n = 20)	Not available
Bivalve	76.6 ± 25.3 (n = 20)	85.0 ± 16.6 (n = 35)
Terminal	77.2 ± 25.3 (n = 22)	72.9 ± 27.4 (n = 35)
Mushroom	74.1 ± 28.6 (n = 21)	Not available
BWI (Routine)	77.5 ± 24.0 (n = 83)	79.4 ± 23.2 (n = 72)
MDA	79.8 ± 23.7 (n = 29)	56.4 ± 23.0 (n = 24)
Hatchling Emergence Probability (%)		
Inga	81.3 ± 16.6 (n = 20)	Not available
Bivalve	76.4 ± 25.5 (n = 20)	83.5 ± 18.1 (n = 35)
Terminal	76.7 ± 25.6 (n = 22)	70.5 ± 27.3 (n = 35)
Mushroom	73.5 ± 28.7 (n = 21)	Not available
BWI (Routine)	76.9 ± 24.3 (n = 83)	76.7 ± 24.0 (n = 70)
MDA	Not available	52.1 ± 23.6 (n = 24)
Incubation Duration (days)		
Inga	46.1 ± 1.8 (n = 16)	Not available
Bivalve	46.8 ± 1.4 (n = 12)	47.8 ± 2.4 (n = 12)
Terminal	47.1 ± 1.8 (n = 16)	47.9 ± 1.2 (n = 13)
Mushroom	48.3 ± 1.2 (n = 12)	Not available
BWI (Routine)	47.0 ± 1.7 (n = 56)	47.9 ± 1.9 (n = 25)
MDA	48.2 ± 1.1 (n = 14)	46.5 ± 4.4 (n = 23)
Clutch Temperature (°C)		
Inga	31.9 ± 1.8 (n = 16)	Not available
Bivalve	31.4 ± 1.8 (n = 12)	32.4 ± 2.0 (n = 10)
Terminal	31.6 ± 2.0 (n = 16)	32.1 ± 2.0 (n = 10)
Mushroom	31.7 ± 2.0 (n = 12)	Not available
BWI (Routine)	32.1 ± 2.2 (n = 14)	34.1 ± 1.3 (n = 12)
MDA	31.9 ± 1.8 (n = 16)	Not available
Clutch Size (number of eggs)		
Inga	48.3 ± 10.0 (n = 20)	Not available
Bivalve	49.7 ± 6.4 (n = 20)	47.1 ± 9.9 (n = 36)
Terminal	49.1 ± 9.5 (n = 22)	44.7 ± 16.3 (n = 34)
Mushroom	49.3 ± 9.0 (n = 21)	Not available
BWI (Routine)	49.1 ± 8.7 (n = 83)	45.7 ± 13.2 (n = 71)
MDA	49.0 ± 5.6 (n = 29)	46.5 ± 11.6 (n = 46)

Monitoring Program: Hatchling Orientation
Objective
To measure and detect variation in dispersal patterns of Flatback Turtle hatchlings following emergence from the nest.
Changes to Program
No changes were made to the hatchling orientation monitoring program during the Reporting Period.
Methodology
• Measures of artificial light (magnitude and bearing) on marine turtle nesting beaches using specialised light-measurement cameras. • Measures of the orientation (fan spread angle [disorientation] and fan offset angle [from most direct line to the ocean—misorientation]) of marine turtle hatchling tracks on beaches. These parameters are control-charted for Bivalve and Terminal beaches.
Light Results
• Sources of night-time light emissions included the GTP, ground flare, offshore infrastructure including the MOF, LNG Jetty head, and LNG tanker (when present), Main Camp, and Butler Park. • The level of brightness at each monitoring site demonstrated a spatial relationship with the distance from the GTP; i.e. brighter values were recorded at closer sites and darker values at more distant sites. • Night-time light emissions (whole-of-sky) were brightest at Bivalve Beach followed by (in order of descending magnitude) Inga, Terminal, YCN, YCS, and Mushroom beaches. • Increased flaring activity was detected on 2 survey nights (12 and 13 February) and increased the visibility of light emissions from the LNG site at all monitoring locations. Whole-of-sky brightness values peaked on 13 February when this flaring activity coincided with moderate cloud cover.
Hatchling Orientation Results
• Modelled hatchling post-emergence dispersion spread (disorientation) at Bivalve Beach exceeded the +1 SD control limit (management alert trigger). There were no exceedances in the control limits for modelled hatchling post-emergence offset (misorientation) at Bivalve Beach (Figure 4-4). • Modelled hatchling post-emergence dispersion spread (disorientation) at Terminal Beach remained within control limits, while the modelled hatchling post-emergence dispersion offset (misorientation) exceeded the +1 SD control limit (management alert trigger). • In addition to the modelled control chart estimates for Bivalve and Terminal beaches, measures of orientation on these and other Barrow Island beaches (i.e. YCS, YCN, Inga, and Mushroom) indicated: – The smallest mean fan spread angle for Flatback Turtles was at Terminal Beach, the largest mean fan spread was at YCS Beach and was significantly different between beaches. Conversely, YCS had the smallest mean fan offset angle. The largest fan offset angle this season was at Mushroom Beach; however, fan offset angle was not significantly different among any of the monitored beaches. – Fan spread angle at all monitored beaches on nights with increased flaring activity (12 and 13 Feb 2021) was similar when compared to the fan spread angle at all monitored beaches on non-flaring nights. • Similar to previous years, there was a larger proportion of hatchling fan spread and offset angles in a southerly direction compared to baseline across all beaches. Lighting from Main Camp was substantially less visible this season, and no new light sources were detected that may explain the southerly shift in hatchling spread and offset angles. • No observations were made of hatchlings orienting directly inland towards the LNG site and hatchlings generally oriented in a seaward direction.

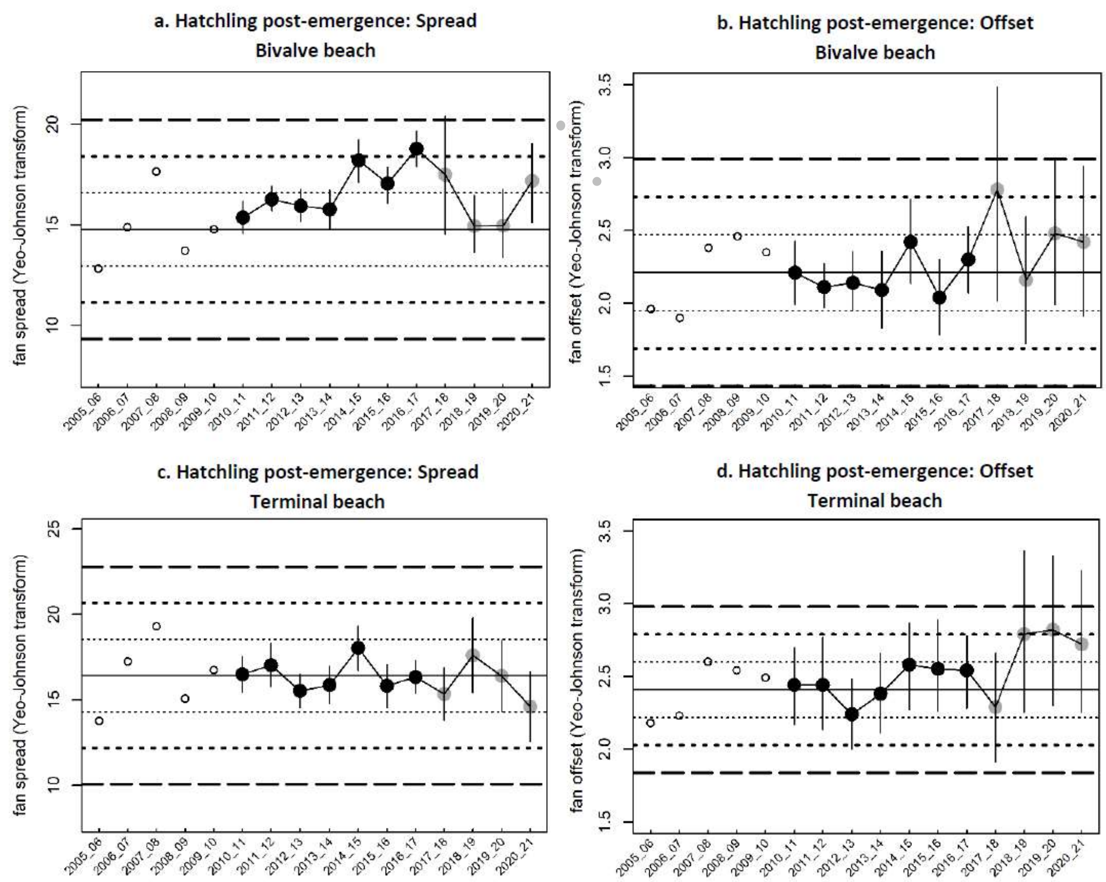

Figure 4-4: Control Charts for Hatchling Post-emergence Dispersion: Fan Spread and Offset Estimates at Terminal and Bivalve Beaches[1]

1 *Open dots = baseline estimate derived from empirical data, black dots = construction parameter estimate, grey dots = operations parameter estimate, solid horizontal line = long-term expected estimate derived from baseline estimates (mean or median), dotted lines = ±1 SE (or 1 MAD), small dashed lines = ±2 SE (or 2 MAD), long dashed lines = ±3 SE (or 3 MAD). Error bars indicate 95% CI.*

4.1.1 Flatback Turtle Tagging – A07 and Junction Beaches

A study was initiated during 2017–2018 to better understand the spatial and temporal variation in nesting beach usage and beach fidelity for those turtles encountered at A07, Junction, and Camp beaches, which are not monitored during the routine Flatback Turtle Abundance and Distribution Monitoring Program. This study was continued during the Reporting Period, with additional tagging effort at 2 of the study beaches—A07 and Junction.

The additional monitoring at A07 and Junction beaches identified 471 Flatback Turtles (90% remigrant and 10% new turtles) that were not encountered on the routine long-term monitored beaches during the season. These turtles continued to show a strong fidelity to the 2 beaches. For turtles sighted at least once at A07 Beach, 56.2% of their sightings during the entire season were recorded at that beach. The highest percentage of sightings at beaches other than A07 were at the adjacent Junction Beach (34.1%). For turtles sighted at least once on Junction Beach, 71.1% of their sightings during the entire season were recorded at that beach. The highest percentage of sightings at beaches other than Junction were at the adjacent A07 Beach (18.4%).

These findings have potential implications on the demographic data for the population, as turtles using both beaches do not regularly use the long-term monitored beaches. Some 350 remigrant turtles and 38 new turtles were only encountered at these 2 beaches and were only sighted in small numbers on beaches situated further north.

4.1.2 Incubation Success – A07, Junction, YCS, and YCN Beaches

To better understand the hatch/emergence success and incubation environment of Flatback Turtles clutches on A07, Junction, YCS, and YCN beaches, CAPL continued a study during the Reporting Period that had been initiated at Inga Beach in 2016–2017. The study used the same methodology as the routine Incubation Success Program.

Of the 45 marked clutches, most (91%) were found to be undisturbed. Of the 4 incomplete clutches, 2 were disturbed by other nesters or natural predators, and 2 could not be found. For all clutches, mean overall egg hatching probability ranged from 59.8 ± 32.4% at A07 Beach to 66.6 ± 30.8% at YCN Beach.

This season, the incubation environment at the additional beaches remained suitable, with no significant difference between the egg hatching probability or hatchling emergence probability for complete clutches and all clutches at the additional beaches when compared to the routine beaches. One main difference between the incubation environment at the additional beaches compared to the routine beaches is their warmer natural environment for incubating clutches. This warmer environment resulted in a shorter incubation duration and a warmer thermosensitive period compared to the routine beaches. However, based on the egg hatching and hatchling emergence probability comparison described above, there is no evidence that the warmer temperatures at the additional beaches provided unfavourable conditions for successful incubation.

4.2 Event Data

Incidents involving harm to marine turtles reported during the Reporting Period are summarised in the following table.

Event Data: Harm to Marine Turtles
Reporting Requirement
Reportable incidents involving harm to marine turtles.
Results
Three reportable incidents occurred during the Reporting Period, none of which were considered Project-attributable. • Two were for deceased Green Turtles found on two Barrow Island beaches. The cause of the observed injuries from these 2 incidents was determined as natural causes, or was not able to be conclusively determined as anthropogenic. • One was for a deceased Flatback Turtle found on a Barrow Island beach. The cause of the incident was determined to be natural causes.

4.3 Audit and Review

Findings of the annual audit and review of lighting design features, management measures, and operating controls, including details of light management initiatives and activities undertaken during the Reporting Period, are summarised in the following table.

Stressor: Light
Audit Results
• An external audit of the LTMTMP by DWER commenced on 3 June 2021 (desktop audit) and included a site audit between 10 and 11 August 2021. The audit was not completed during the Reporting Period.
Light Management Initiatives, Activities, and Reasonably Practicable Lighting Improvements
• A digital Lighting Inspection Checklist mobile application was implemented on site and resulted in 57 individual lighting inspections being undertaken at onshore facilities, including the GTP, MOF, Tug Pen, Toll Abutment, and Temporary Lighting Towers. • Site planning sessions continued for activities with the potential to affect marine turtle behaviour before and during the marine turtle nesting season. • Marine turtle awareness communications were sent to all staff and contractors at the start of, and throughout the turtle season, highlighting the relationships between lighting management and impacts to marine turtles. These were incorporated into routine prestart and contractor meetings, and site notices. • Personnel engagement continued via the marine turtle nesting and turtle hatchling tours to raise awareness of the environmental commitments associated with marine turtles. Additional information was also disseminated through the accommodation TVs on the marine turtle nesting season, monitoring programs, and lighting management. • Lighting along the LNG Jetty and MOF was switched off, except where required for work and safety reasons. • Mobile solar-powered lighting towers are gradually replacing traditional diesel-powered lighting towers. These towers have been programmed to meet optimal turtle lighting requirements for wavelength and light intensity. • WA Oil Production Camp was closed in July 2020 with all personnel now accommodated at Butler Park. This action has reduced the light spill near east coast beaches, as only minimal safety and security lights are left in place.
Conclusions on the Effectiveness of Lighting Design Features, Management Measures, and Operating Controls

• CAPL considers lighting design features, management measures, and operating controls are 'effective' if the environmental objectives of the LTMTMP are met, and if they reduce potential adverse impacts to Barrow Island marine turtle populations. Lighting management for the Gorgon Gas Development was considered effective during the Reporting Period, for these reasons:
  – Artificial light levels varied across monitored marine turtle nesting beaches, and there was evidence of localised misorientation (+1 SD management trigger exceedance) of hatchlings at Terminal Beach, and localised disorientation (+1 SD management trigger exceedance) at Bivalve Beach. Both exceedances were likely due to a combination of low sample size and narrower distribution of fans across the beach compared to baseline. Visible artificial light may have been a contributing factor at Bivalve Beach.
  – Overall, analysis of hatchling sea-finding parameters on monitored beaches demonstrated that Gorgon Gas Development lighting did not adversely affect the sea-finding ability of hatchlings during the Reporting Period, and emergent Flatback Turtle hatchlings continued to orientate successfully towards the ocean.
• Given the above, no changes were required during the Reporting Period to lighting design features, management measures, and operating controls, beyond the improvements and initiatives undertaken to reduce artificial lighting.

4.4 Changes to the Long-term Marine Turtle Management Plan

No amendments to the LTMTMP were proposed and/or approved during the Reporting Period.

4.5 Conclusion

Despite a lower annual nester abundance estimate for both Barrow Island and MDA this season, annual monitoring did not detect any significant change in the population demographic parameters for annual Flatback Turtle nester abundance and clutch frequency at Barrow Island. For the seventh consecutive season, an exceedance in the breeding omission probability was detected for the Barrow Island population and warrants further investigation. The nesting population's use of certain beaches has also varied due to changes in coastal processes likely caused by a combination of Project-related activities and environmental conditions, notably at Inga, Bivalve, and Terminal beaches, which have recorded reductions in percentage beach use and between 61% (Bivalve) and 74% (Inga) reduction in the size of their optimal nesting habitat area since baseline. The distribution of nesting activity across these same beaches has also changed since baseline, with the pattern of activity changing and shifting towards the causeway/MOF in response to the physical changes at the beach.

The parameters for incubation success (egg hatching and hatchling emergence probability) were within control limits. Additional investigation into the fate of marked clutches and density-dependent effects attributed to temporal and spatial variation in the nesting population's use of beaches at Barrow Island, found no localised impact on the egg hatching probability this season, and was likely due to lower beach usage due to low annual nester abundance this season.

Overall, analysis of hatchling sea-finding parameters on monitored beaches demonstrated that Gorgon Gas Development lighting did not adversely affect the sea-finding ability of hatchlings during the Reporting Period, and emergent Flatback Turtle hatchlings continued to orientate successfully towards the ocean.

Outcomes of the monitoring programs, investigations into observed deviations in demographic parameters, and nesting behaviour, indicate that the Flatback Turtle population nesting on Barrow Island remains stable and demographically healthy, with consistently high survival rates observed for nesting females.

5 Short-range Endemics and Subterranean Fauna

Table 5-1: EPR Reporting Requirements for Short-range Endemics and Subterranean Fauna

Item	Source	Section in this EPR
Results of survey and studies to locate outside the GTP footprint and Additional Support Area (ASA) those remaining short-range endemics (SRE) and subterranean fauna species previously found only within the GTP footprint and ASA	MS 800, Schedule 3(4i)	5.1

5.1 Monitoring Results

The Short-Range Endemics and Subterranean Fauna Monitoring Plan (SRESFMP) (Ref. 8) focuses on surveys to locate and identify those SRE and subterranean fauna species that had only previously been located within the GTP footprint and the ASA. Several of these species were confirmed outside the GTP footprint and ASA before construction commenced, and a further 2 subterranean fauna species were identified during construction (Ref. 8). Therefore, the ongoing focus of the SRESFMP is to locate these 4 taxa:

- terrestrial SRE fauna: *Idiommata* sp.
- subterranean stygofauna SRE fauna: *Oniscidea* sp. nov. 1. and *Pilbaracandona* sp. nov. 1.
- subterranean troglofauna SRE fauna: *Symphyla* sp.

The SRESFMP was amended in 2019, in consultation with relevant regulatory agencies, to reduce the monitoring frequency for subterranean fauna and terrestrial SRE fauna from yearly to 5-yearly. Targeted subterranean fauna sampling was last undertaken on Barrow Island in February, April, and June 2018. Therefore, no subterranean fauna monitoring results are presented in this EPR. Similarly, targeted monitoring of terrestrial SRE fauna was last undertaken in May 2016 and was not completed in subsequent years due to low rainfall.

The 2020–2021 results for monitoring of the terrestrial SRE fauna species are summarised in the following table.

Monitoring Program: Terrestrial Short-range Endemics
Objective
Locate *Idiommata* sp. outside GTP site and Additional Support Area
Methodology
• Targeted monitoring every 5 years using burrow searches and excavation; and night searches using torches to scan the bare ground and vegetation for wandering individuals. No burrow searches or excavations were undertaken during the Reporting Period. • A total of 57 hours of night visual surveillance searches were carried out during the Reporting Period. • Pitfall trapping, considered opportunistic monitoring for *Idiommata* sp. as part of the vertebrate NIS surveillance program. Note: Pitfall trapping was not undertaken during the Reporting Period due to COVID-19 delays and restrictions and a change to pitfall trapping frequency in the NIS surveillance program.
Results
Idiommata sp. was not detected outside the GTP footprint or ASA during the NIS surveillance program.
Conclusions
Idiommata sp. was not detected outside the GTP footprint or ASA during the Reporting Period.

6 Fire Management

Table 6-1: EPR Reporting Requirements for Fire Management

Item	Source	Section in this EPR
Incidence of fires caused by the Proposal, and fires that impact on the Proponent's facilities, including details of cause, lessons learnt, and recommended actions	MS 800, Schedule 3(5i) MS 769, Schedule 3(2i) EPBC 2003/1294 and 2008/4178, Schedule 3(4i)	6.1
Material or Serious Environmental Harm caused by fire directly attributable to the Proposal	MS 800, Schedule 3(5ii) MS 769, Schedule 3(2ii) EPBC 2003/1294 and 2008/4178, Schedule 3(4ii)	N/A[1]
Any changes to the Gorgon Gas Development Fire Management Plan (Ref. 9) including: • management responses to address Material or Serious Environmental Harm caused by fire directly attributable to the Proposal improvement to fire management practices.	MS 800, Schedule 3(5iii) MS 769, Schedule 3(2iii) EPBC 2003/1294 and 2008/4178, Schedule 3(4iii)	6.2

1 *No Material or Serious Environmental Harm caused by fire was recorded during the Reporting Period.*

6.1 Event Data

Incidences of fire caused by the Gorgon Gas Development, or fires that impacted on Project facilities during the Reporting Period, including details of cause, lessons learnt, and recommended actions, are provided in the following table.

Event Data: Fires
Results
• No fire events occurred during the Reporting Period that caused Material or Serious Environmental Harm outside the TDF. • One fire impacted the Gorgon Gas Development facilities. • Table 6-2 summarises the event cause, completed actions, and lessons learnt for fire events attributable to Gorgon Gas Development activities during the Reporting Period.

Table 6-2: Causes, Completed Actions, and Lessons Learnt for Fire Events Attributable to Gorgon Gas Development Activities during the Reporting Period

Date	Event Cause	Completed Actions[1]	Lessons Learnt
11/04/21	Lightning strike on AGRU (Acid Gas removal unit) 3 resulting in minor stack fire.	• Lightning strike was observed by outside operator (and later on CCTV) and reported to the CCR via radio. • Subsequently flames were visible from AGRU 3 CO2 Vent stack. • The AGRU was shut down for turnaround at the time of the lighting strike. • Flames were extinguished by closure of vent stack valves by the CCR and the scene was attended by the ERT. • A Structural and earthing survey was completed	• Gorgon LNG Plant has moved to a fully automated lightning notification system and updated the Barrow Island Adverse Weather Procedure to specify activities that pause during each lightning phase (60km, 30km, 15km etc.)

Date	Event Cause	Completed Actions[1]	Lessons Learnt
		• An inspection of the stack was conducted after the event to ensure the area was safe for work and operations to continue.	

1 Schedule 3(5i) of MS 800, Schedule 3(2i) of MS 769, and Schedule 3(4i) of EPBC 2003/1294 and 2008/4178, requires 'Recommended Actions' to be reported; this was changed to 'Completed Actions' because the actions from the fire event have now been completed.

6.2 Changes to the Fire Management Plan

No changes or revisions were made to the Gorgon Gas Development Fire Management Plan (Ref. 9) during the Reporting Period.

7 Carbon Dioxide Injection Project

The Gorgon Carbon Dioxide Injection Project is the largest of its kind in the world and represents the largest greenhouse gas (GHG) abatement project undertaken by industry to date.

To date, the Gorgon Joint Venture Participants have invested more than AU$3 billion in the Carbon Dioxide Injection Project and remain committed to safely reducing the Gorgon Gas Development's GHG emissions.

Since CO_2 injection started in August 2019, approximately 5.5 million tonnes of GHG have been injected.

Table 7-1 lists the matters related to the Carbon Dioxide Injection Project to be reported on in this EPR.

Table 7-1: EPR Reporting Requirements for Carbon Dioxide Injection Project

Item	Source	Section in this EPR
Volume of reservoir carbon dioxide and other acid gases removed from the incoming natural gas stream and available for injection	MS 800, Schedule 3(6i) EPBC 2003/1294 and 2008/4178, Schedule 3(5i)	7.1
Volume of reservoir carbon dioxide and other acid gases injected	MS 800, Schedule 3(6ii) EPBC 2003/1294 and 2008/4178, Schedule 3(5ii)	7.2
Results of environmental monitoring and identified Material or Serious Environmental Harm, if any, resulting from the seepage of injected carbon dioxide to the surface or near-surface environments including those which may support subterranean fauna (including the Blind Gudgeon [*Milyeringa veritas*])	MS 800, Schedule 3(6iii) EPBC 2003/1294 and 2008/4178, Schedule 3(5iii)	N/A
Reasons for shortfall between the volume of reservoir carbon dioxide extracted and injected	MS 800, Schedule 3(6iv) EPBC 2003/1294 and 2008/4178, Schedule 3(5iv)	7.3
In the event the amount of carbon dioxide injected falls significantly below the target levels CAPL shall report on: • measures that could be implemented that would ensure the target level is met or, if injection is not considered feasible for all or some of the gas, measures to otherwise offset • which if any of these measures the Proponent intents to implement	MS 800, Schedule 3(6v) EPBC 2003/1294 and 2008/4178, Schedule 3(5v)	7.4
In the event that monitoring shows there is an elevated risk of Material or Serious Environmental Harm and/or risk to human health associated with the injection of reservoir carbon dioxide, the Proponent shall report to the Minister on the efficacy of continuing to geosequester and alternative offsets considered instead of continuing injection of reservoir carbon dioxide	MS 800, Schedule 3(6vi) EPBC 2003/1294 and 2008/4178, Schedule 3(5vi)	N/A

7.1 Volume of Reservoir Carbon Dioxide Removed

The Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER Act) contains provisions on the reporting of emissions from the transport, injection, and underground storage of GHGs. To comply with NGER Act reporting requirements, CAPL is required to determine the volume of reservoir CO_2 removed from the incoming natural gas stream that is available for injection. This EPR includes data on the volumes of reservoir CO_2 extracted for the most recent financial year; these data align with CAPL's NGER Act reporting obligations. This enables the processes and procedures (including quality assurance, audit, and sign off checks) developed for NGER Act compliance to be applied to these data.

Volume of Reservoir Carbon Dioxide Removed
1,620,124x10^3 standard cubic metres of reservoir CO2 was removed from the incoming natural gas stream during the 2020–2021 financial year. This equates to 3,169,705 tonnes carbon dioxide equivalent (CO_2e).

7.2 Volume of Reservoir Carbon Dioxide Injected

This EPR includes data on the volumes of reservoir CO_2 injected for the most recent financial year; these data align with CAPL's NGER Act reporting obligations.

Volume of Reservoir Carbon Dioxide Injected
1,098,651x10^3 standard cubic metres of reservoir CO_2 was injected during the 2020–2021 financial year. This equates to 2,170,594 tonnes carbon dioxide equivalent (CO_2e).

7.3 Reasons for Shortfall Between Volume Extracted and Injected

The key reasons for the shortfall between the volume of reservoir CO_2 extracted and injected for the 2020-2021 financial year are:

- in December 2020, the WA Department of Mines Industry Regulation and Safety required that daily injection rates be limited to a daily maximum of 70 MMscf/d (as a condition of the Pipeline Licence 93 Consent to Operate) until such time as the pressure management system was fully operational. The pressure management system had encountered unanticipated material technical issues with water injectivity into the Barrow Group as part of the pressure management system. In November 2020 the presence of solids in produced formation water was identified as the key issue that needed to be resolved to restore injectivity into the Barrow Group. Significant remedial work has been undertaken to address this including the delivery of customised solids removal equipment which was sourced internationally. The solids removal equipment (hydrocyclone and filtration units) has been installed and commissioned at pressure management drill centres DC-D and DC-E, and all of the wells at these drill centres have been operated simultaneously. The pressure management system is now operational.
- planned and unplanned maintenance events.

7.4 Measures Being Implemented

Determination of commencement date of Condition 26.2

On 18 June 2018, the Chair of the WA Environmental Protection Authority (EPA) wrote to CAPL advising that the Minister for the Environment (the Minister) had requested '*an inquiry into the reservoir carbon dioxide injection system conditions for the Gorgon Gas Development under section 46 of the Environmental Protection Act 1986 (WA)*'. The Chair of the EPA stated that '*the inquiry was initiated in view of the release of the annual EPR for the Gorgon Gas Development and the need to have a clearly defined starting point for the commencement of the carbon dioxide injection system*'.

On 25 September 2019 the EPA published its report (Report 1649) and on 29 May 2020, in Ministerial Statement 1136, the Minister determined the commencement date of Condition 26.2 as follows:

Condition 26.2 of Ministerial Statement 800 is deleted and replaced with:

26.2 The Proponent must:
(1) implement all practicable means to inject underground all reservoir carbon dioxide removed during Gas Processing Operations of the Gas Treatment Plant; and
(2) ensure that, calculated on a 5 year rolling average commencing on 18 July 2016, at least 80 per cent of reservoir carbon dioxide removed during Gas Processing Operations of the Gas Treatment Plant that would otherwise be vented to the atmosphere is injected underground.

<u>Gas Processing Operations of the Gas Treatment Plant:</u> For the purposes of condition 26.2, Gas Processing Operations of the Gas Treatment Plant comprise:
(a) the gas processing operations that are carried out at LNG Train 1 on and after the commencement date of the first grant of the licence to operate that Train under Part V, Division 3 of the EP Act, being 18 July 2016; and
(b) the gas processing operations that are carried out at LNG Trains 2 and 3 on and after the date of the first grant of the licence to operate those Trains under Part V, Division 3 of the EP Act, being 30 July 2018.

Following the Minister's determination of the commencement date for Condition 26.2, the first five year rolling average period is from 18 July 2016 to 17 July 2021.

In accordance with Condition 26.2 reservoir carbon dioxide removed during gas processing operations is calculated as follows for the purposes of the condition:

- Gas processing operations carried out at Train 1 between 18 July 2016 and 29 July 2018.
- Gas processing operations carried out at Trains 1, 2 and 3 from 30 July 2018.

Measures to otherwise offset shortfall from target level set in Condition 26.2

As reported in the 2017 and 2018 Environmental Performance Reports (EPR), during the pre-commissioning and start-up checks technical issues associated with the Carbon Dioxide Injection Project were identified. These technical issues were addressed successfully, and the safe start-up and operation of the carbon dioxide injection system commenced on 6 August 2019. Since the commencement of injection approximately 5.5 million tonnes of GHG have been injected.

As a result of the time needed to address the technical issues to ensure the safe operation of the Carbon Dioxide Injection Project over the life of the Gorgon Project it was not possible to meet the target level set in Condition 26.2 in the period from 18 July 2016 to 17 July 2021.

In accordance with Schedule 3, 6v of Ministerial Statement 800, CAPL is therefore reporting on:

a) measures that could be implemented that would ensure that target level set in Condition 26.2 is met or, if injection is not considered feasible for all or some of the gas, measures to otherwise offset
b) which if any of these measures the Proponent intends to implement

The shortfall from the target level set in Condition 26.2 for the period 18 July 2016 and 17 July 2021 is 5.23 million tonnes CO_2e. CAPL will acquire and surrender credible GHG offsets recognised by the Western Australian government to otherwise offset this shortfall. The offsets to be acquired and surrendered are as follows:

- Australian Carbon Credit Units issued under the *Carbon Credits (Carbon Farming Initiative) Act 2011* (Cth);
- Verified Emission Reductions issued under the Gold Standard program;
- Verified Carbon Units issued under the Verified Carbon Standard program; or
- other offset units that the Minister has notified in writing meet integrity principles and are based on clear, enforceable and accountable methods.

The proportion of Australian Carbon Credit Units (including those generated in Western Australia) to be acquired and surrendered will depend on availability and impact on the Australian Carbon Credit Unit market. CAPL will use reasonable endeavours to complete the acquisition and surrender of the offsets by 17 July 2022 (end of the next five-year rolling average period under Condition 26.2). Once the GHG offsets have been surrendered, CAPL will have fully offset the shortfall for the period 18 July 2016 to 17 July 2021.

CAPL will report on the status of the acquisition and surrender of the offsets in the 2021/2022 Environmental Performance Report.

In addition to fully offsetting the shortfall through the acquisition and surrender of 5.23 million GHG offsets, CAPL will also invest AU$40 million in Western Australian lower carbon projects. CAPL is committed to working with the Western Australian government on the arrangements relating to the lower carbon investment and will report on the status in the 2021/2022 Environmental Performance Report.

8 Air Quality

Table 8-1: EPR Reporting Requirements for Air Quality

Item	Source	Section in this EPR
Air quality monitoring results, with a discussion on the success (or otherwise) in meeting emissions targets	MS 800, Schedule 3(7i)	8.1

8.1 Monitoring Results

The objectives of the Gorgon Gas Development Air Quality Management Plan (AQMP) (Ref. 10), as defined by Ministerial Conditions, are to:

- ensure air quality meets the appropriate standards for human health in the workplace
- ensure air emissions from GTP operations do not pose a risk of Material or Serious Environmental Harm to the flora, vegetation communities, terrestrial fauna, and subterranean fauna of Barrow Island.

The Ambient Air Quality Monitoring Program measures air quality for selected atmospheric pollutants and air toxics emissions associated with the operation of the GTP, and then compares these data against the applicable assessment criteria defined in the AQMP (Ref. 10).

The AQMP also specifies emission targets for selected atmospheric pollutants and air toxics emitted from major GTP emission sources (Frame 9 Gas Turbine Generators [GTGs] and Frame 7 Liquefaction Compressor Gas Turbines [LCGTs]) (Ref. 10). Emissions from these major sources are monitored via sampling at the point of discharge (the stacks) to the environment.

Due to logistical and resource constraints during COVID-19, the relocatable monitoring stations and passive diffuse samplers [barge (WAPET) landing and P36 well site] were removed in March–April 2020. All monitoring equipment was reinstated in July 2021.

The 2020–2021 air quality monitoring results, including assessment of exceedances, are summarised in the tables below.

Monitoring Program: Ambient Air Quality
Results
There were no recorded exceedances for nitrogen dioxide (NO2), ozone (O3), sulfur dioxide (SO2), carbon monoxide (CO), or aromatic hydrocarbons (benzene, toluene, and xylene) against the relevant National Environmental Protection Measure (NEPM) and National Occupational Health Exposure Standards (NOHES) guidelines (Table 8-2). • The PM_{10} exceedances against the NEPM guideline at the Communications Tower (CT) location are likely due to the proximity of the CT air quality monitoring station (AQMS) to an unsealed road, with the potential for dust lift-off caused by vehicle movements to directly impact the AQMS. An evaluation of $PM_{2.5/10}$ ratio data indicates likely crustal origin, which was not correlated with broader regional effects because Butler Park (BP) and CT observations were not concurrent. Given typically low PM contribution from point source emissions (e.g. clean-burning turbines) within the GTP site, the most likely cause for the observed exceedances is local, transport-related dust from vehicle movements. • The PM_{10} exceedances against the 1-day NEPM guideline at the BP AQMS are likely due to localised particulate sources, including resuspended road dust and vehicular emissions due to transport of personnel to and from BP. • Hydrogen sulfide (H_2S) exceedances at CT occurred during the Reporting Period, but mainly between December 2020 and March 2021, with most exceedances occurring in January 2021. At the time of the

Monitoring Program: Ambient Air Quality
exceedances, winds were typically light (<5 m/s) and south-westerly. Under light winds, sources are most likely localised. The Acid Gas Removal Units' vents continue to be the most likely source of the H_2S, given the prevailing wind direction at the time of the exceedances and that H_2S is known to be present in the acid gas being vented (Ref. 11). The number of H_2S exceedances has fallen for a second consecutive year. This further reduction is likely due to major maintenance activities that involved shutdown.
Conclusions
• Exceedances for PM_{10} and H_2S were inferred to be derived from localised sources. The exceedances of PM_{10} are not considered attributable to GTP emission sources, and the Acid Gas Removal Units' vents were the most likely source of the H_2S. • Although exceedances against the World Health Organization guideline for H_2S occurred, this guideline is for nuisance affects only for H_2S, and is 3 orders of magnitude below the NOHES guidelines. • Overall, results of the ambient air quality monitoring demonstrated that air quality was below the relevant NEPM and NOHES guidelines during the Reporting Period. This indicates that air emissions were within appropriate standards for human health in the workplace, and GTP operations did not pose a risk of Material or Serious Environmental Harm to the flora, vegetation communities, terrestrial fauna, and subterranean fauna of Barrow Island.

Table 8-2: Summary of Exceedances against Guideline Values during the Reporting Period

Guideline Value			No. of Exceedances	
Parameter	**Concentration**	**Averaging Period**	**CT**	**Butler Park**
PM_{10}	50 µg/m^3	1 day	27	23
	25 µg/m^3	1 year[1]	1	0
NO_2	0.12 ppm	1 hour	0	0
	0.03 ppm	1 year[1]	0	0
O_3	0.10 ppm	1 hour	0	0
	0.08 ppm	4 hours	0	0
SO_2	0.20 ppm	1 hour	0	0
	0.08 ppm	1 day	0	0
	0.02 ppm	1 year[1]	0	0
H_2S	7 µg/m^3	30 minutes	65	0
CO	9.0 ppm	8 hours	0	0
Benzene	0.003 ppm	1 year[1]	0	0
Toluene	1 ppm	1 day[2]	0	0
	0.1 ppm	1 year[1]	0	0
Xylene	0.25 ppm	1 day[2]	0	0
	0.2 ppm	1 year[1]	0	0

1 *In NEPM, the annual averaging period is based on a calendar year. For the purposes of this report, the period 10 August 2020 to 9 August 2021 is used as the yearly averaging period.*

2 *This is based on a conservative estimate where it is assumed that the pollutant concentration measured over the sampling period (nominally 14 days) was due to a single event lasting one day.*

Monitoring Program: Stack Air Quality (Major Emission Sources)
Results
All air quality parameters, except nitrogen oxides (NO_X), were below the relevant emission targets in the Reporting Period for the emission sources considered (Table 8-3) (Ref. 11).
Conclusions
• Overall, results of the stack air quality monitoring demonstrated that all measured parameters remained within emission targets during the Reporting Period, except for some exceedances for NO_X. • The NO_X exceedances on the GTGs occurred during periods when GTGs were operating under low loads (typically <30% capacity). The NO_X target only applies when the GTGs are running at >55% load (Ref. 20). Optimisation of GTGs is ongoing to improve performance.

Table 8-3: Summary of Exceedances against Stationary Source Emissions Targets during the Reporting Period

Emission Source	Emission Targets[1]		No. of Exceedances[2]
	Parameter	Concentration (mg/m^3)	
GTG 1	NO_x	70	2
	CO	125	0
GTG 2	NO_x	70	0
	CO	125	0
GTG 3	NO_x	70	1
	CO	125	0
GTG 4	NO_x	70	3
	CO	125	0
GTG 5	NO_x	70	1
	CO	125	0
LCGTs	NO_x	70	0
	CO	125	0

1 *Emission targets apply at the point of discharge to the environment.*

2 *Target does not apply when GTGs are operating under low loads (<30% capacity).*

9 Coastal Stability

Table 9-1: EPR Reporting Requirements for Coastal Stability

Item	Source	Section in this EPR
Results of beach and sediment monitoring	MS 800, Schedule 3(8i) EPBC 2003/1294 and 2008/4178, Schedule 3(6i)	9.1, 9.2
Any mitigation measures applied in response to action-related impacts of beach profile	MS 800, Schedule 3(8ii) EPBC 2003/1294 and 2008/4178, Schedule 3(6ii)	N/A[1]
All exceedances of management triggers	Approval letter from the former WA Department of Environment and Conservation to CAPL (Ref. 16)	9.1, 9.2

1 No mitigation measures as required under Condition 25.6(iii) of MS 800 and Condition 18.6(iii) of EPBC 2003/1294 and 2008/4178 were implemented during the Reporting Period; therefore, reporting is not applicable at this time.

9.1 Monitoring Results

The objectives of the Gorgon Gas Development Coastal Stability Management and Monitoring Plan (CSMMP) (Ref. 12), as defined by Ministerial Conditions, are to:

- ensure that the MOF and LNG Jetty 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 MOF and LNG Jetty.

The monitoring program detects changes to the beach morphology (beach structure and beach sediments) that could have potential implications for coastal stability and/or marine turtle nesting (Ref. 12).

Coastal stability management triggers have been established for beach volume, beach slope, and sediment particle size, and data from each monitoring event are compared against these management triggers. The actions required if a management trigger exceedance occurs are set out in the CSMMP Supplement: Management Triggers (Ref. 13). Management triggers specific to changes in turtle nesting habitat, based on the quantification of marine turtle nesting areas through habitat mapping, have been defined. These marine turtle nesting habitat management triggers only apply to the beaches adjacent to the MOF and LNG Jetty (i.e. Terminal and Bivalve beaches), and only to data collected at the end of dry season monitoring event (Ref. 12; Ref. 13).

The 2020–2021 monitoring results, including any detected exceedances and major event monitoring[1], are summarised in the following tables.

[1] Major event: a sustained period (4 days or more) of winds with an easterly component (NNE to SSE), during which the total duration of winds >18 knots is ≥96 hours recorded at Barrow Island. (Ref. 12)

Monitoring Program: Beach Structure
Objective
Detect changes to the beaches adjacent to the MOF and LNG Jetty that may affect the stability of those beaches by measuring beach profile, beach volume, and quantifying the extent of any erosion or accretion of sediment over time.
Methodology
• Remote sensing surveys are completed twice each year (at the end of the dry and wet seasons where practicable, typically October and April) or after a major weather event. These surveys capture horizontal (x,y-plane) and vertical (z-plane) data to generate digital surface elevation models over the entire beach (landward of the primary dune to the waterline) at Terminal, Bivalve, Inga, YCN, and YCS beaches. • Topographic surveys (using remote sensing or Real-time Kinematic GPS methods) to record beach morphology are also undertaken, where practicable, after a major weather event.
Survey Timing
• End of dry season routine monitoring event: – on-ground survey 2–6 October 2020 – topographic survey 29 October 2020 • End of wet season routine monitoring event: – on-ground survey 14–16 April 2021 – topographic survey 13 May 2021
Results
Surface Elevation – Patterns of Erosion and Accretion • Measurements of surface elevation are presented in the context of change since baseline condition (October 2009 to May 2021), and most recent annual (May 2020 to May 2021) and seasonal change (October 2020 to May 2021). Changes to each beach are described with reference to the 2009 sparse vegetation line (SVL), which separated the foredune area (FA) (landward of the SVL) from the active zone of the beach (seaward of the SVL) in October 2009. *Terminal Beach* • Between October 2009 and May 2021, Terminal Beach (immediately north of the MOF) eroded at the northern end of the beach and accreted at the southern end of the beach, with some accretion also evident in the creek bed at the centre of the beach (Figure 9-1). Changes were greatest in the active zone of the beach; however, changes have also occurred at the FA, which includes building out the foredune at the southern end of the beach and eroding the edge of the FA at northern end of the beach, leading to some minor loss of sparse foredune vegetation (Ref. 14). • Between May 2020 and May 2021, changes to surface elevation occurred at the southern end of Terminal Beach, with localised erosion increasing the southern extent of exposed bedrock, and localised accretion occurring in the lee of the rock headland (Figure 9-1). *Bivalve Beach* • Between October 2009 and May 2021, Bivalve Beach (immediately south of the MOF) exhibited the opposite trend to Terminal Beach, eroding at the southern end of the beach and accreting at the northern end (Figure 9-2). Erosion is also evident in the creek bed at the southern end of the beach. Erosion has encroached on the seaward edge of the FA, along approximately two-thirds of the beach, which has resulted in some minor loss of sparse foredune vegetation (Ref. 14). • Changes occurring between May 2020 and May 2021 were minor, with a small localised area of accretion recorded in the lee of the rock headland at the northern end of the beach, and erosion recorded at the toe of the headland at the southern end (Figure 9-2). *Inga Beach* • Between October 2009 and May 2021, Inga Beach exhibited a similar trend to Bivalve Beach, accreting at the northern end and eroding along southern sections (Figure 9-3). Changes occurred predominantly at the beach face, with some erosion encroaching on the seaward edge of the FA along the central third of the beach. Erosion at Inga Beach has resulted in the progressive exposure of bedrock, as well as a veneer of loose rock rubble at the northern extent of bedrock exposure (Ref. 14). Accretion at the northern end of the beach has resulted in sparse coastal vegetation establishing in areas that were previously bare (i.e. before construction of the MOF) (Ref. 14). There is evidence of sediments in the area of accretion being transported around the rock headland at the northern end of the beach (Ref. 15).

Monitoring Program: Beach Structure
• Very little change occurred from May 2020 to May 2021 at Inga Beach, as indicated by the surface elevation map. Some very small pockets of erosion were detected at the toe of the rock headland at the northern end of the beach (Figure 9-3). *YCN Beach* • Between October 2009 and May 2021, YCN Beach accreted at the beach face over the northern third of the beach, and at the base on the FA along the length of the beach (Figure 9-4). Beach face erosion has occurred over the southern half of the beach, and in a localised area on the lower beach face at the very northern extent. Changes at YCN Beach are strongly linked to changes occurring at YCS Beach to the south and to the Terminal Creek mouth area to the north, which periodically changes due to creek flow events. • Between May 2020 and May 2021, YCN Beach remained relatively stable (Figure 9-4). *YCS Beach* • Between October 2009 and May 2021, erosion occurred at the beach face along the length of YCS Beach, which is an extension of the erosion over the southern half of YCN Beach (Figure 9-5). Similar to YCN Beach, accretion was detected at the base of the FA along the length of the beach. Despite foredune accretion, there has been no gross trend of vegetation establishing seaward of the 2009 SVL (Ref. 14). • Between May 2020 and May 2021, erosion was recorded at the beach face, to the north and south of the persistent rock outcrop in the central third of the beach (Figure 9-5). Accretion was localised to a thin strip at the base of the foredune area, immediately north of the same rock outcrop.

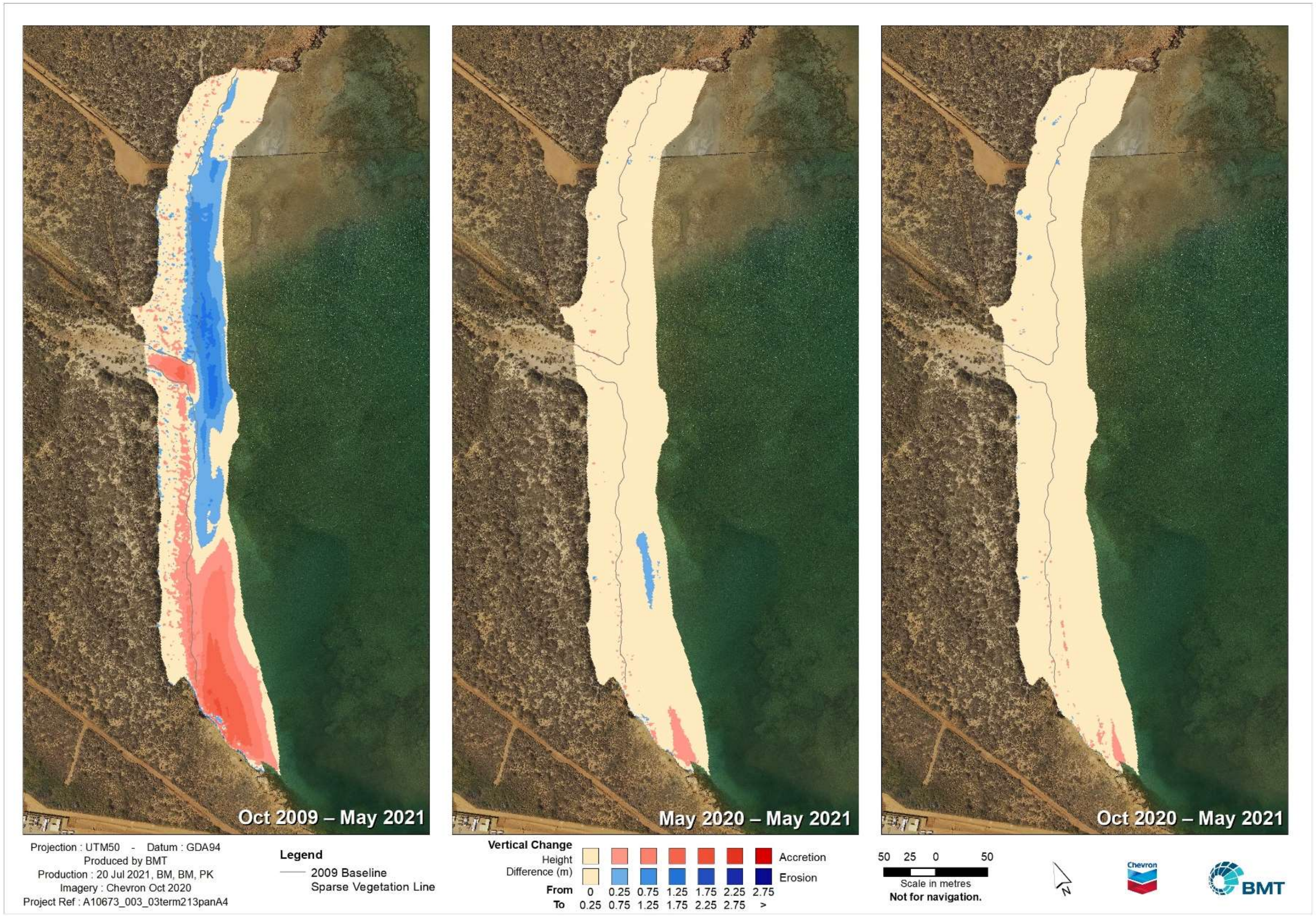

Figure 9-1: Surface Elevation Changes at Terminal Beach

Figure 9-2: Surface Elevation Changes at Bivalve Beach

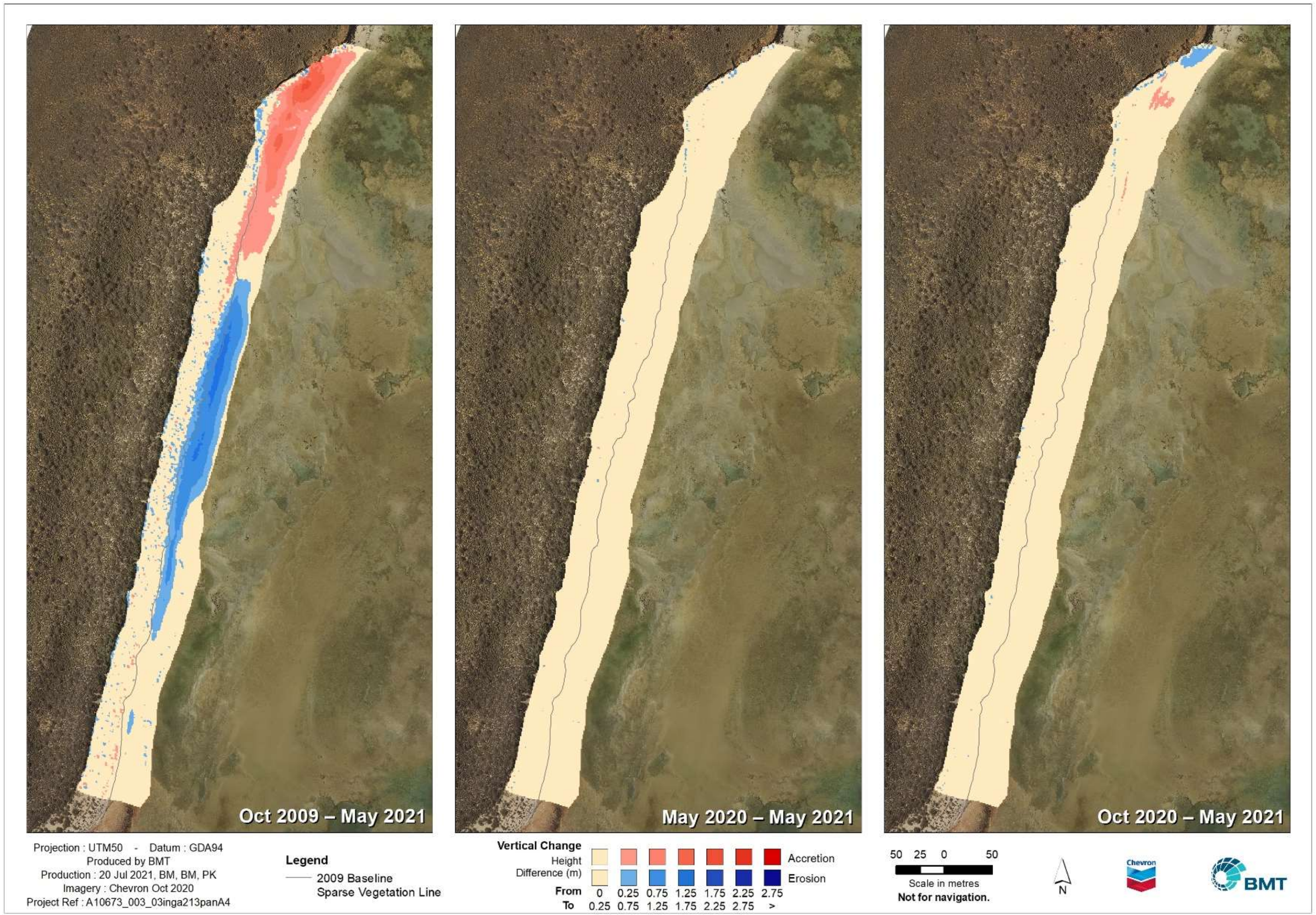

Figure 9-3: Surface Elevation Changes at Inga Beach

Figure 9-4: Surface Elevation Changes at Yacht Club North Beach

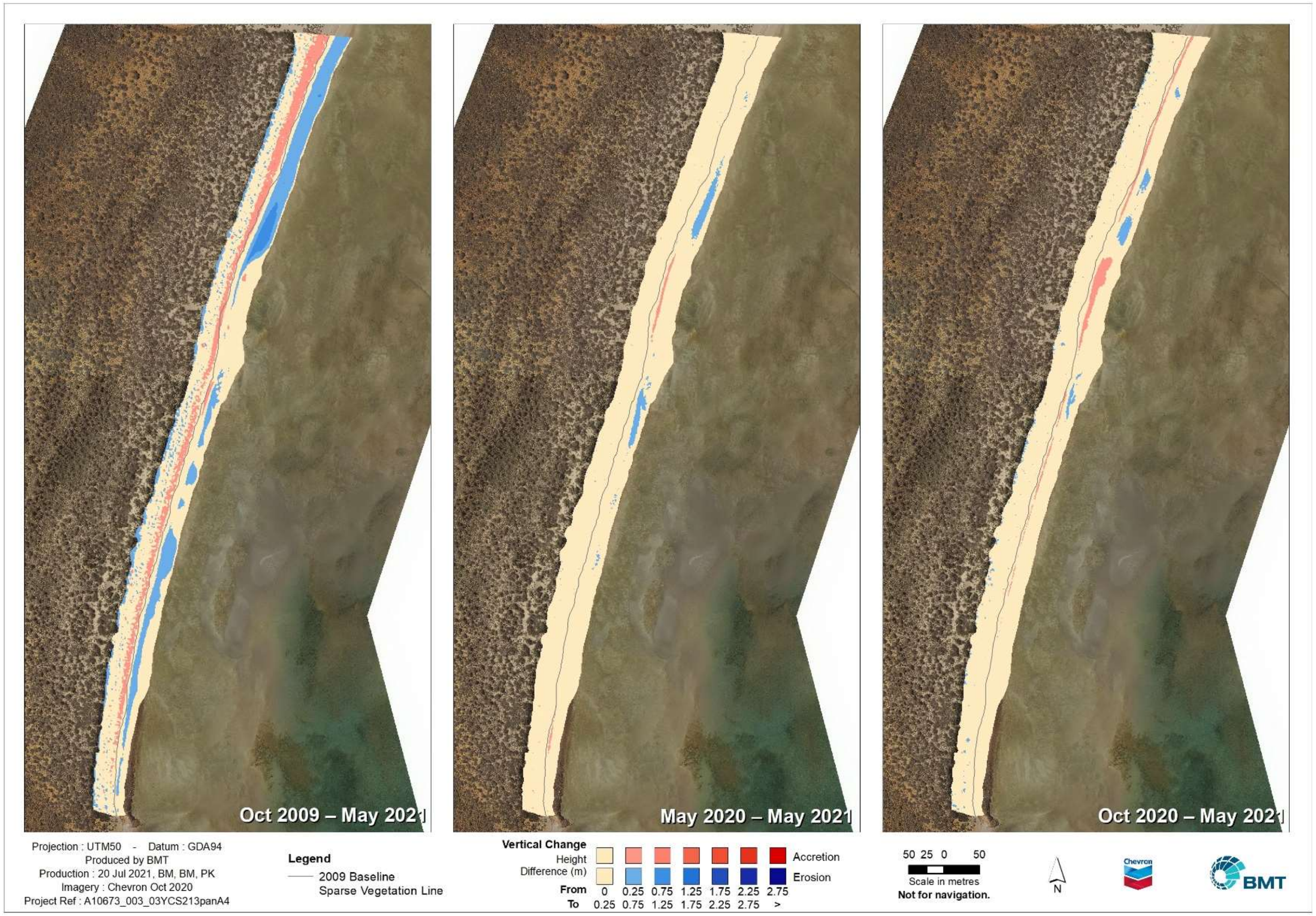

Figure 9-5: Surface Elevation Changes at Yacht Club South Beach

Monitoring Program: Beach Structure
Results
Net Volume Change • Net sand volume on the beaches fluctuates as a result of seasonal and regional interannual cycles, or specific events such as tropical cyclones (Figure 9-6) (Ref. 15). Seasonal changes are linked to wind patterns and the resulting incident wave climate. Interannual changes can be linked to regional influences, such as water-level fluctuations (e.g. caused by the El Niño Southern Oscillation) and other metocean variability or anomalies. • Since baseline (October 2009) to May 2021, a net reduction of sediment from the beach face has occurred on all reference beaches (Inga, YCS, and YCN), and a net gain has occurred on Terminal Beach (net gain 2,515 m^3) and Bivalve Beach (net gain 762 m^3) (Figure 9-2**).** • Over the dry season (May 2020 to October 2020), a net reduction of sediment occurred on all monitored beaches. In contrast, a net gain occurred on all beaches over the wet season (October 2020 to May 2021); however, the magnitude of sediment loss from the active zone was greater than the magnitude of sediment gain (Table 9-2, Figure 9-7). Therefore, a net sediment reduction for the annual period May 2020–May 2021 was recorded for all beaches, with the greatest reductions occurring on the Reference beaches (Table 9-2). **Major Event Monitoring** • During the Reporting Period no weather events exceeded the CSMMP post-major event monitoring trigger at Barrow Island. Similarly, no storms or tropical cyclones generated conditions warranting further investigation. Therefore, no major event monitoring was undertaken during the Reporting Period.
Management Trigger Exceedances
• Management trigger exceedances were recorded for these sites and parameters during the Reporting Period: – Terminal Beach: beach volume at the crest of beach face (CBF) at Transects 11 and 22, beach volume and slope at the FA at Transects 11 and 22. – Bivalve Beach: beach volume at the CBF at Transect 11 and beach volume and slope at Transect 22; beach slope at the FA at Transect 22 (Table 9-3). • Exceedances of management triggers at Terminal and Bivalve beaches have been detected since post-construction monitoring began in July 2010. The cause of these exceedances has been attributed both to natural variability and to the presence of the MOF, which has caused the realignment of Terminal Beach and Bivalve Beach. Because most FAs on Terminal and Bivalve beaches have accreted or remained the same, with the changes typically restricted to the area seaward of the CBF, investigations conclude that that the shoreline changes occurring on Terminal and Bivalve beaches are not having significant adverse impacts on the stability of these beaches.

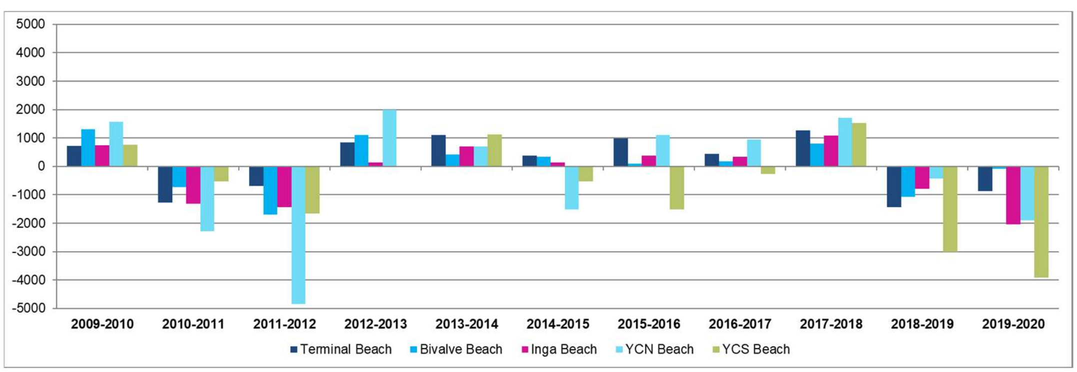

Figure 9-6: Annual Net Volume Change of the Active Zone of the Beach (below the SVL) at Monitored Beaches, October to October, 2009–2020

Table 9-2: Net Volume Changes (m^3) across the Active Zone[1] of the Beach at Monitored Beaches

Beach	Length (m)	Change since Baseline		Annual change		Seasonal change	
		Oct 09–Oct 20	Oct 09–May 21	Nov 19–Oct 20	May 20–May 21	May 20–Oct 20	Oct 20–May 21
Terminal	700	1,434	2,515	−873	−130	−1,211	1,081
Bivalve	785	693	762	−86	−556	−625	69
Inga	818	−2,050	−1,277	−2,047	−990	−1,763	773
YCN	832	−2,937	−2,383	−1,901	−1,396	−1,951	554
YCS	1,175	−7,953	−7,223	−3,912	−2,310	−3,040	730

1 *Active Zone = the beach face, defined as the area below the 2009 SVL.*

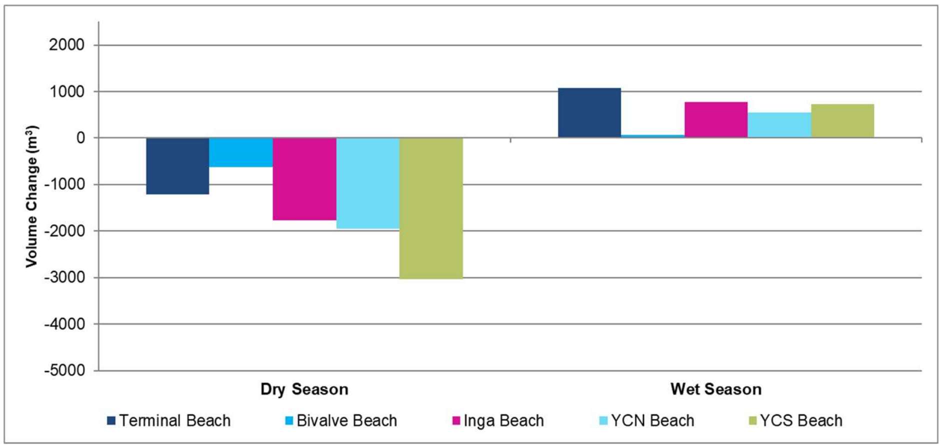

Figure 9-7: Seasonal Net Volume Change of the Active Zone of the Beach (below the SVL) at Monitored Beaches

Note: Dry season: May–October 2020; Wet season: October 2020–May 2021

Table 9-3: Management Trigger Exceedances at Terminal and Bivalve Beaches During the Reporting Period

Location	Transect	Survey Date	Volume Trigger[1,2]				Slope Trigger[1,2]				Change from Baseline Mean
			1	2	3	4	1	2	3	4	
Terminal (CBF)	11	Oct 2020	x	x	x	x	-	-	-	-	Increase volume, no change slope
		May 2021	x	x	x	x	-	-	-	-	Increase volume, no change slope
	22	Oct 2020	x	x	x	x	-	-	-	-	Decrease volume no change slope
		May 2021	x	x	x	x	-	-	-	-	Decrease volume, no change slope
Bivalve (CBF)	11	Oct 2020	x	x	x	x	-	-	-	-	Increase volume, no change slope
		May 2021	x	x	x	x	-	-	-	-	Increase volume, no change slope
	22	Oct 2020	x	x	x	x	-	-	-	x	Decrease volume, increase slope
		May 2021	x	x	x	x	-	-	-	x	Decrease volume, increase slope
Terminal (FA)	11	Oct 2020	x	x	x	x	x	x	x	x	Increase volume, decrease slope
		May 2021	x	x	x	x	x	x	x	x	Increase volume, decrease slope
	22	Oct 2020	-	-	-	x	x	x	x	-	Increase volume, increase slope
		May 2021	-	-	-	x	x	x	x	-	Increase volume, increase slope

Location	Transect	Survey Date	Volume Trigger[1,2]				Slope Trigger[1,2]				Change from Baseline Mean
			1	2	3	4	1	2	3	4	
Bivalve (FA)	11	Oct 2020	-	-	-	-	-	-	-	-	No change volume, no change slope
		May 2021	-	-	-	-	-	-	-	-	No change volume, no change slope
	22	Oct 2020	-	-	-	-	x	x	x	-	No change volume, increase slope
		May 2021	-	-	-	-	x	x	x	-	No change volume, increase slope

1 *Trigger 1 = single point ±3 SD from the baseline mean; Trigger 2 = 2 out of 3 consecutive points ±2 SD from the baseline mean; Trigger 3 = 4 out of 5 consecutive points ±1 SD from the baseline mean; Trigger 4 = 8 consecutive points on the same side of the baseline mean.*

2 *'x' = exceedance; '-' = no exceedance.*

3 *Measurements at B11 for foredune volume in October 2020 and May 2021 were reported as Trigger 3 exceedances to DWER and Commonwealth Department of Agriculture, Water and the Environment (DAWE) following the respective coastal surveys; however, they have since been reclassified as non-exceedances because they equalled but did not exceed control chart limits.*

Monitoring Program: Beach Sediments

Objective

Detect changes to beach sediments as a result of the presence of the MOF and LNG Jetty.

Methodology

- Sediment sampling is completed once each year, at the end of the dry season (typically October) where practicable. Sediments are sampled at 2 locations (CBF and FA), and up to 3 depths (0.0 m, 0.3 m, 0.6 m) along selected transects (7 on Terminal; 6 on Bivalve; and 2 each on Inga, YCN, and YCS beaches), then analysed to measure changes in particle size distribution (PSD) over time.
- Beach sediment sampling is also undertaken after a major (weather) event, where practicable.

Results

Annual Monitoring

Terminal and Bivalve beaches

- At Terminal Beach, sediment coverage has decreased and sediment size has coarsened within CBF sediments at the northern end of the beach since the baseline survey. In October 2020, CBF sediment samples were not collected from transects T19, T21, or T22 due to insufficient sediment at these sites. Changes in sediments at the FA have been less pronounced; however, a reduction in the gravel component in FA sediments at the northern end of the beach has been observed (Ref. 14).
- At Bivalve Beach, sediment coverage has decreased since the baseline survey at the southern end of the beach at both CBF and FA sites, noting some interannual variation. In October 2020, CBF samples were not collected from transect B24 due to insufficient sediment coverage. In the previous year (November 2019), sediments were not able to be collected from transect B22 CBF or from B24 (CBF and FA sites). At the northern end of the beach, there has been a decrease in the gravel fraction in CBF sediments since baseline (Ref. 14).

Inga, YCN, and YCS beaches

- Sediments sampled at Inga, YCN, and YCS beaches in 2020 generally comprised similar PSDs to samples from the previous sampling event (November 2019) and from baseline (Ref. 14).

Management Trigger Exceedances

- The beach sediment management trigger is qualitative and based on a change from baseline sediment characteristics. At some sites, the management trigger can no longer be assessed due to erosion. Due to this, and the qualitative nature of the management trigger, no exceedances of management triggers for sediment PSD were identified during the Reporting Period.

Monitoring Program: Marine Turtle Nesting Habitat
Objective
Detect adverse changes to the beach structure and beach sediments (as a result of the presence of the MOF and LNG Jetty) that could have implications for marine turtle nesting on the beaches adjacent to these marine facilities.
Methodology
• Multiple physical characteristics of the beaches are used to categorise and map the suitability of areas on each beach for marine turtle nesting. Areas were categorised as one of 3 zones: – Optimal Nesting Zone: characteristics of the measured physical parameters within the study area are considered ideal for marine turtle nesting – Suboptimal Nesting Zone: characteristics of the measured physical parameters within the study area are considered less than ideal but may still allow successful marine turtle nesting – Unsuitable Nesting Zone: characteristics of the measured physical parameters within the study area are unlikely to allow successful marine turtle nesting. • Physical characteristics used to classify the nesting habitat zones include: landward and seaward boundaries, presence of rock (e.g. intertidal rock, subaerial rock), sediment composition, sand depth, and other (e.g. presence of infrastructure, discontinuous nesting areas within otherwise unsuitable area).
Results
• The total available (defined as optimal + suboptimal) Flatback Turtle nesting area for the mapped Barrow Island beaches in October 2009 was 14.7 ha, with 89% of this area defined as optimal nesting habitat. In October 2020, the total available nesting area was 12.7 ha, with 71% of this defined as optimal nesting habitat (Figure 9-10). • Changes in the size of nesting areas since baseline (October 2009) have varied between individual beaches, with the greatest changes observed on beaches closest to the MOF (Terminal, Bivalve, and Inga beaches). Changes are primarily attributable to increases in the amount of intertidal rock exposed on the beach face over time, resulting in optimal nesting habitat being reclassified as either suboptimal or unsuitable as sandy access pathways to the FA area are eroded. • Progressive exposure of intertidal rock since baseline is due to the ongoing realignment of Terminal, Bivalve, and Inga beaches towards the MOF via longshore sediment redistribution. Realignment has resulted in a gain in optimal nesting area on each beach at the end closest to the MOF (northern end for Bivalve and Inga beaches, southern end for Terminal Beach), and a reduction in optimal nesting area at the end furthest from the MOF. *Terminal Beach* • The area of mapped optimal nesting habitat at Terminal Beach has progressively reduced since baseline, from 2.25 ha in October 2009 to 0.83 ha in October 2020. The greatest change has occurred in the northern two-thirds of the beach, where intertidal rock has been gradually exposed. In the southern third of the beach, optimal habitat has been created further south of the baseline nesting area on the accreted sections of beach (Figure 9-8, Figure 9-9). • In October 2020, the northern third of Terminal Beach was classified as unsuitable nesting habitat, and the central third was largely classified as suboptimal, with a smaller area also deemed unsuitable. The southern third of Terminal Beach was classified predominantly as optimal habitat, with some unsuitable areas of shallow sand depth adjacent to the rock headland (Figure 9-9). • Between November 2019 and October 2020, the area of optimal nesting habitat increased from 12.6% of the study area in 2019 (0.77 ha) to 13.6% in 2020 (0.83 ha). Similarly, the area of suboptimal nesting habitat increased from 7% in 2019 (0.43 ha) to 11% in 2020 (0.67 ha) (Figure 9-8). The optimal area increased as a result of continued accretion in the lee of the southern rock headland, which increased the sand depth in this area. Small changes in the sediment distributed over bedrock in the central third of the beach led to an increase in suboptimal nesting area (Figure 9-9). *Bivalve Beach* • At Bivalve Beach, the area of optimal nesting habitat has progressively reduced since baseline, from 2.10 ha in October 2009 to 0.82 ha in October 2020. Optimal nesting habitat has been reclassified to suboptimal or unsuitable along the southern two-thirds of the beach where intertidal rock has been exposed. In the northern third of the beach, optimal habitat has been created further north of the baseline nesting area on the accreted section of beach (Figure 9-8, Figure 9-10).

Monitoring Program: Marine Turtle Nesting Habitat

- In October 2020, the southern two-thirds of Bivalve Beach were predominantly classified as suboptimal habitat, with small areas of unsuitable habitat. The northern third was largely classified as optimal habitat, with some unsuitable areas of shallow sand depth adjacent to the rock headland (Figure 9-10).
- Between November 2019 and October 2020, optimal nesting area increased from 12.5% of the study area in 2019 (0.68 ha) to 14.8% in 2020 (0.82 ha). The area of suboptimal nesting habitat also increased, from 13.9% in 2019 (0.76 ha) to 17.6% in 2020 (0.97 ha). Changes in optimal and suboptimal nesting zones were predominantly associated with changes in sediment distribution, which reduced exposure of intertidal rock in some areas (Figure 9-10).

Inga Beach

- Optimal nesting area at Inga Beach has decreased over time from 1.86 ha in October 2009 to 0.49 ha in October 2020. Optimal nesting habitat has been replaced with either suboptimal or unsuitable habitat along the southern two-thirds of the beach, due to exposure of intertidal rock or loose rock rubble. At the northern end of the beach, optimal habitat has been created further north of the baseline nesting area on the accreted section of beach (Figure 9-11).
- In October 2020, the southern third of Inga Beach was classified as unsuitable nesting area, the central third predominantly suboptimal nesting area, and the northern third predominantly optimal nesting area.
- Between November 2019 and October 2020, optimal nesting area on Inga Beach decreased from 11.3% of the study area in 2019 (0.72 ha) to 7.6% in 2020 (0.49 ha). This was accompanied by an increase in suboptimal nesting area, from 10.6% in 2019 (0.68 ha) to 13.0% in 2020 (0.83 ha). These changes correspond to an increase in rock exposure, including an area of loose rock rubble, encroaching north over the lower beach face.

YCN Beach

- YCN Beach has undergone very minor changes in turtle nesting habitat since baseline, with changes relating to the annual position of the mean high water springs line, which is influenced by patterns of erosion and accretion. No intertidal rock has been exposed at YCN Beach since baseline (Figure 9-12). In October 2009 3.49 ha of optimal nesting area was recorded—this has increased to 3.67 ha in October 2020.
- Between November 2019 and October 2020, optimal nesting area on YCN Beach increased from 53.1% of the study area in 2019 (3.43 ha) to 56.8% in 2020 (3.67 ha) (Figure 9-8).

YCS Beach

- YCS Beach has seen a minor decrease in optimal nesting area and a minor increase in suboptimal nesting area since baseline. In October 2009, 3.44 ha of optimal nesting area was recorded, and in October 2020 this had reduced to 3.20 ha. Changes in the size of nesting areas relate to exposure of intertidal rock, particularly in the central section of beach (Figure 9-13).
- Between November 2019 and October 2020, optimal nesting area on YCS Beach increased from 30.8% of the study area in 2019 (2.90 ha) to 33.9% in 2020 (3.20 ha) (Figure 9-8).

Management Trigger Exceedances

No exceedances of the interim marine turtle nesting habitat management triggers occurred during the Reporting Period at Terminal or Bivalve beaches.

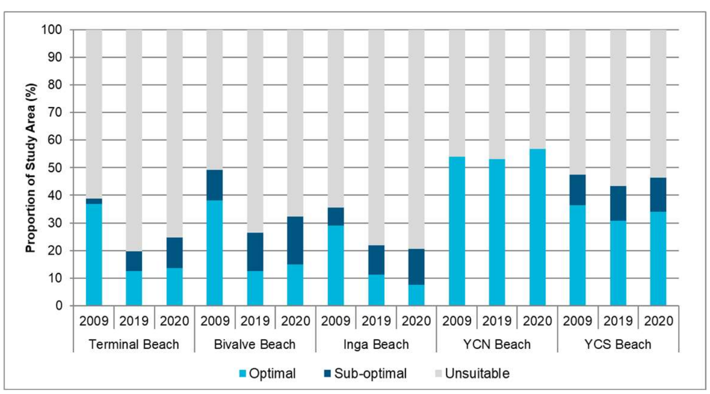

Figure 9-8: Proportions (%) of Marine Turtle Nesting Habitat Zones for Monitored Beaches in October 2009 (Baseline), November 2019, and October 2020

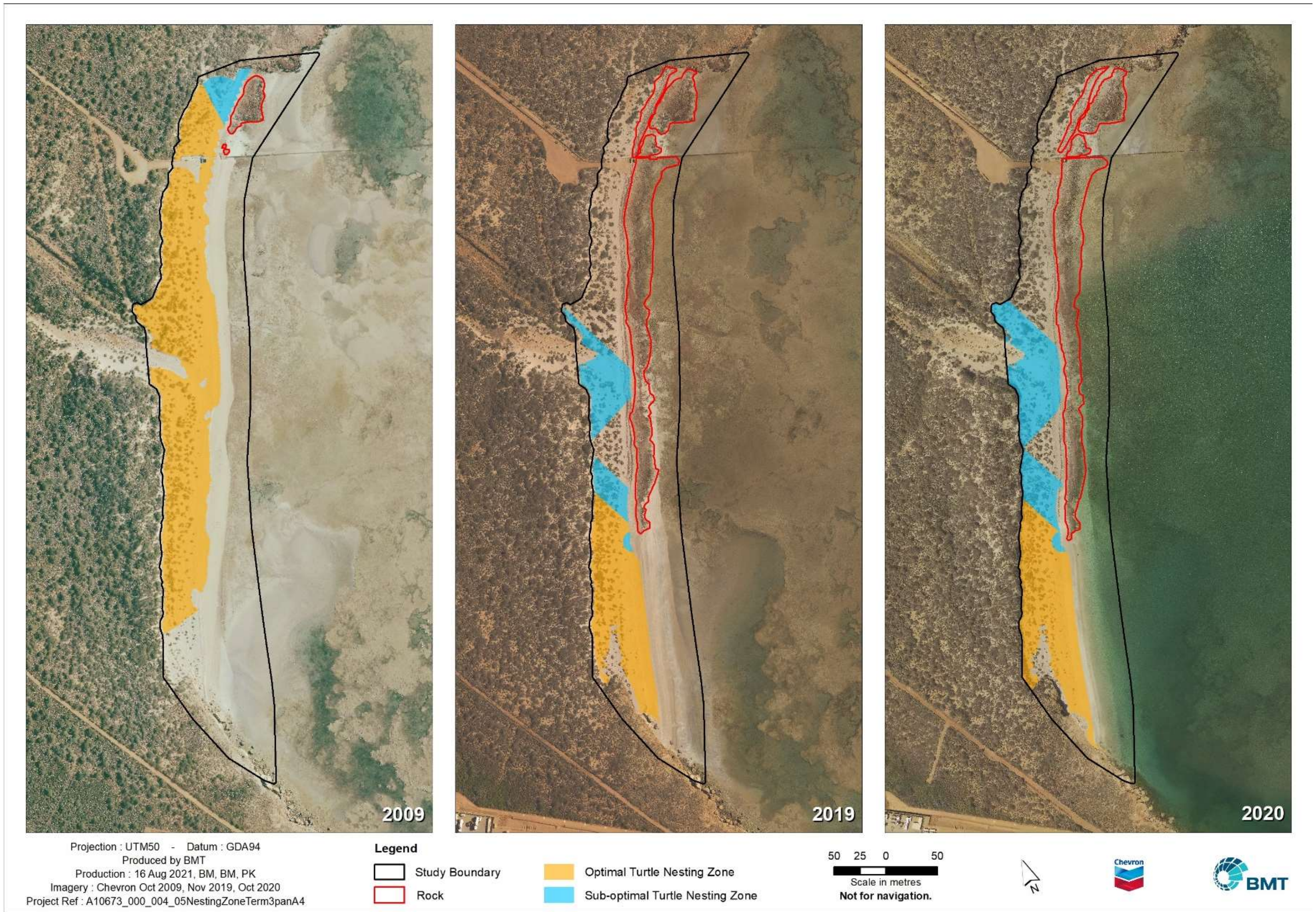

Figure 9-9: Marine Turtle Nesting Habitat Zones for Terminal Beach

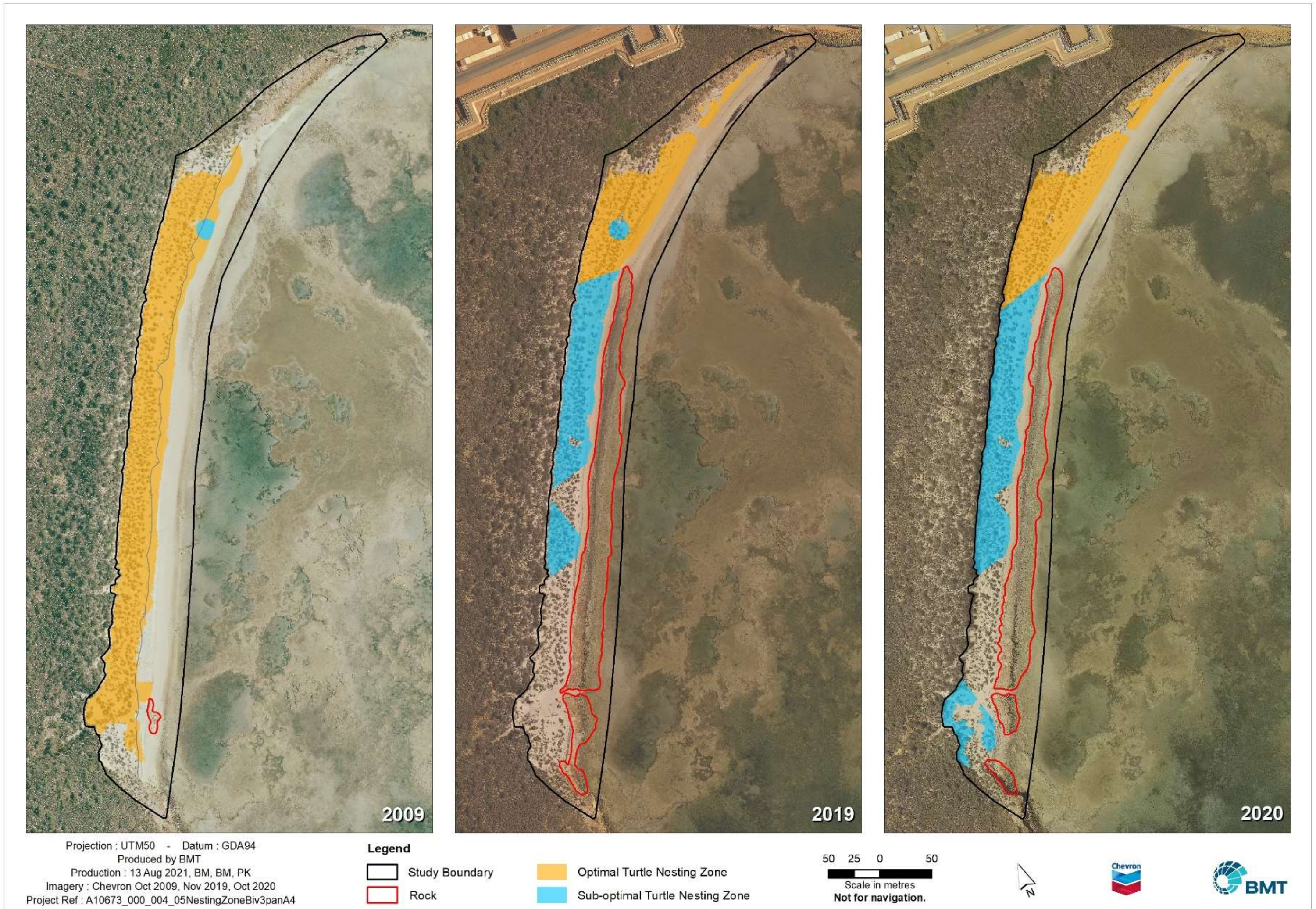

Figure 9-10: Marine Turtle Nesting Habitat Zones for Bivalve Beach

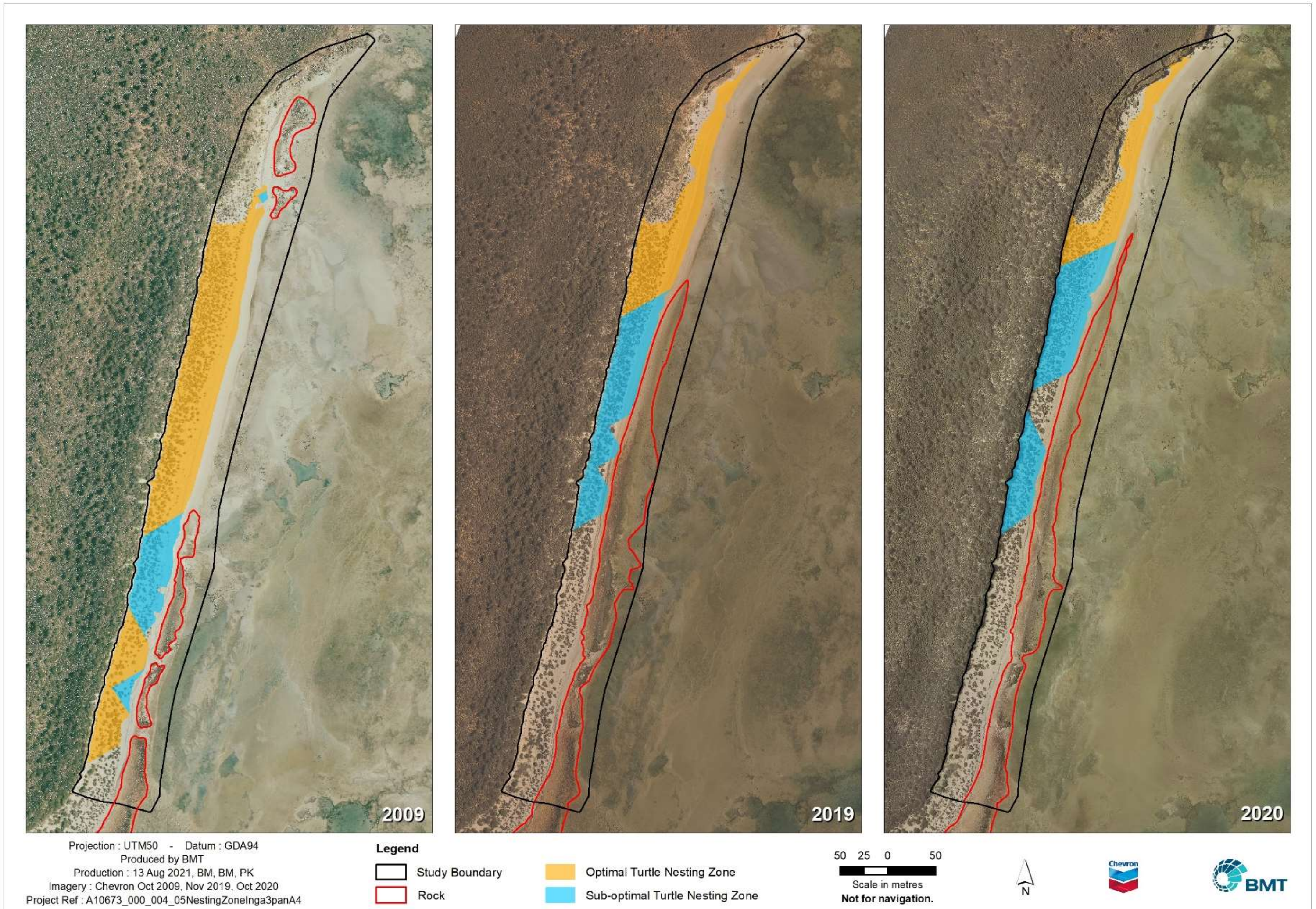

Figure 9-11: Marine Turtle Nesting Habitat Zones for Inga Beach

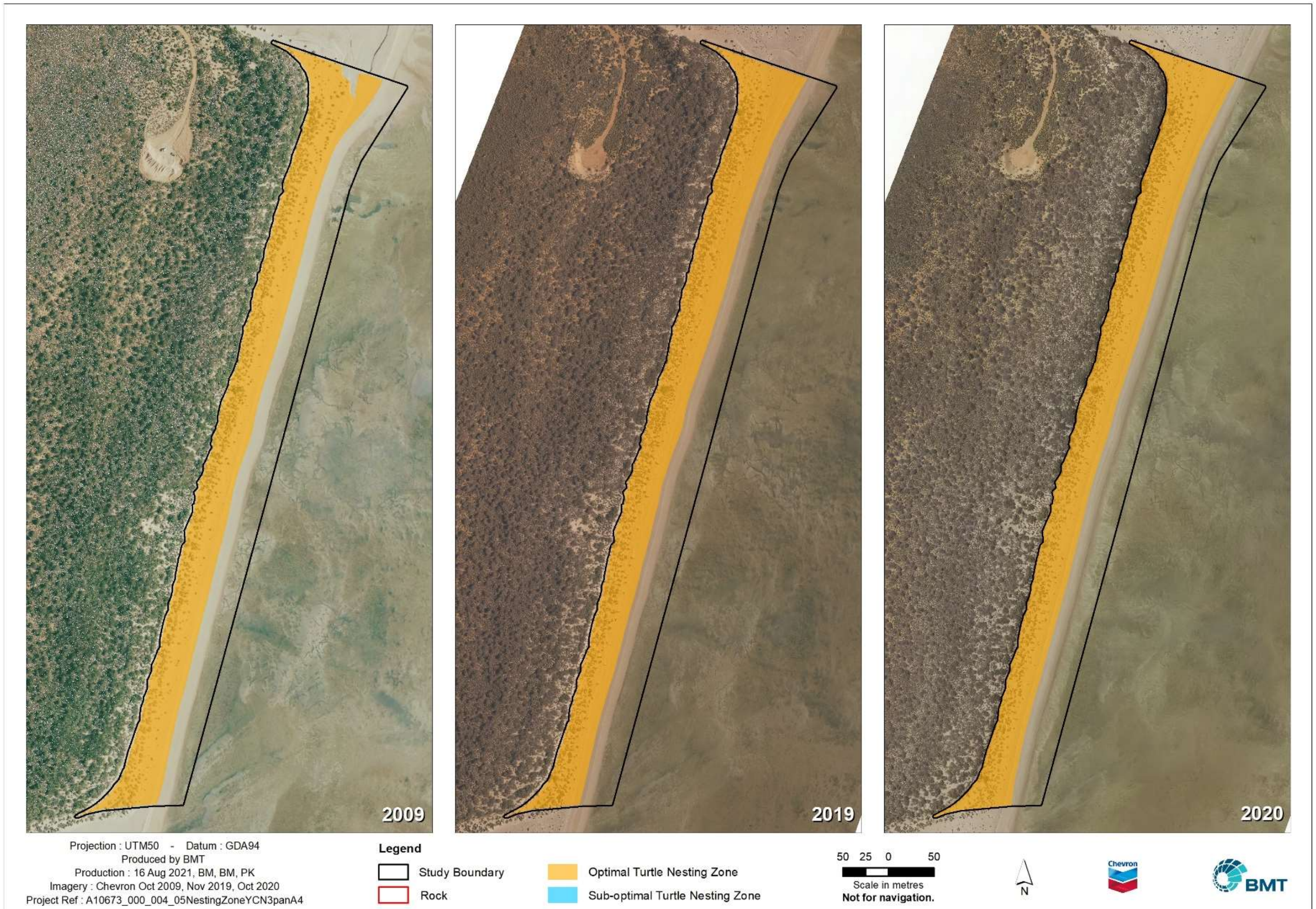

Figure 9-12: Marine Turtle Nesting Habitat Zones for YCN Beach

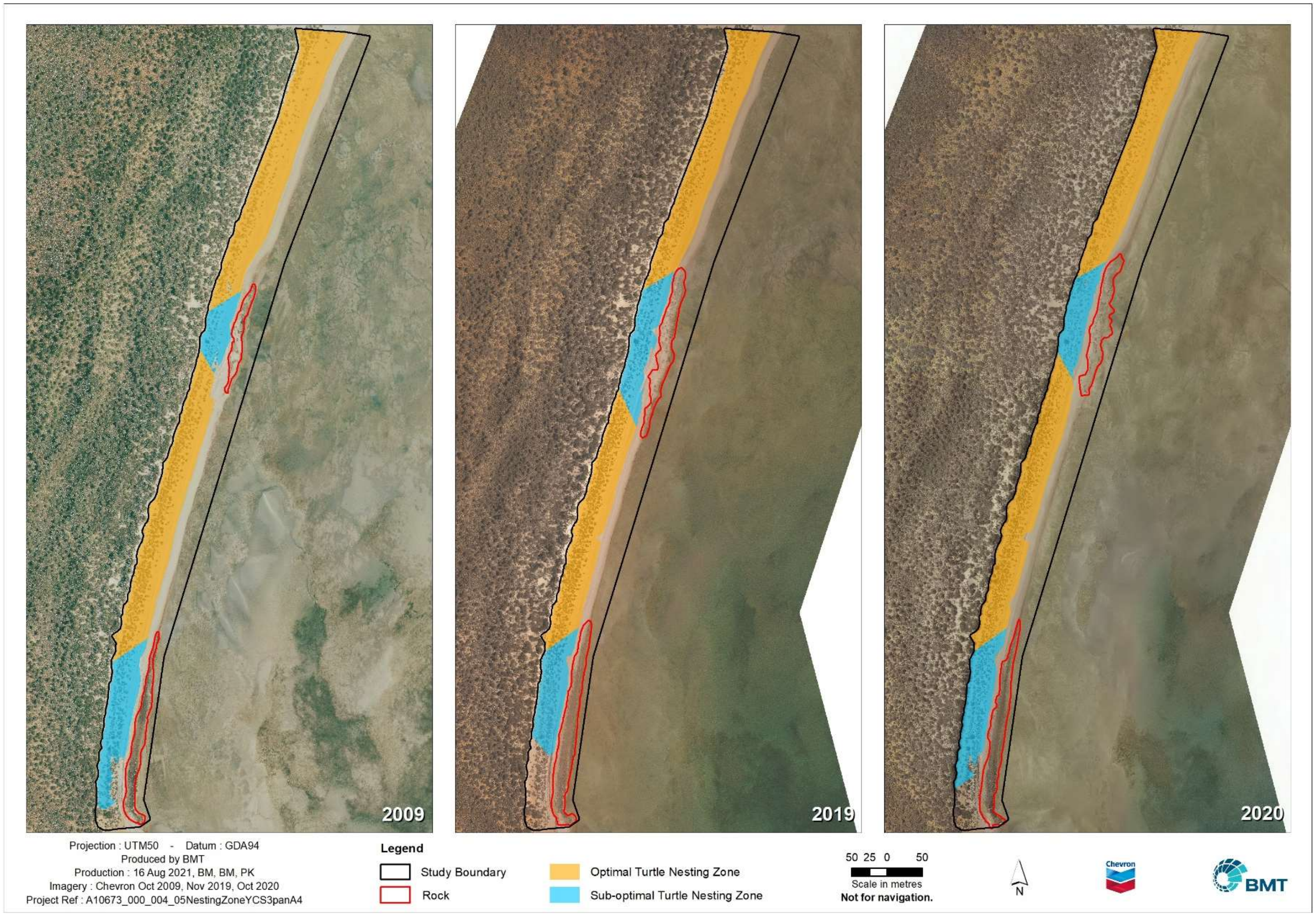

Figure 9-13: Marine Turtle Nesting Habitat Zones for YCS Beach

9.2 Conclusion

During the Reporting Period, exceedances of volume management triggers were detected for all CBF sites at monitoring transects on Terminal and Bivalve beaches, and for the FA sites on Terminal Beach. Slope exceedances were detected at B22 CBF, and at all FA sites except B11. These exceedances correspond to a trend of sand redistribution towards the MOF on Terminal and Bivalve beaches since baseline (October 2009). Terminal Beach has eroded in the north and accreted in the south, while Bivalve Beach has eroded in the south and accreted in the north. Changes on these beaches have predominantly occurred over the active beach face; however, erosion has encroached onto the seaward edge of the FA at some locations on Impact beaches, and has resulted in some vegetation loss.

Coastal instability is caused by erosion of the beach face and berm, allowing wave action to influence the backshore and sand dunes. Typically, a stable beach changes in the active zone (i.e. the beach face) but should remain relatively static in the backshore and sand dunes.

Terminal and Bivalve beaches are inherently stable through geological control; i.e. they are underpinned by rock and bounded at each end by rock headlands. Although erosion has generally occurred over the beach face since baseline, the presence of rock in the active zone may help prevent further encroachment of waves into the foredune and primary dune areas. Therefore, Terminal and Bivalve beaches are currently considered relatively stable, and it is unlikely the MOF has had a significant adverse impact on coastal stability—as a result, performance standards have not been exceeded. However, changes occurring on these beaches may increase the vulnerability of the FA and primary dunes to extreme metocean conditions, and the presence of the MOF will likely restrict the capacity for natural recovery after such events.

Inga, YCN, and YCS beaches are bounded by rock headlands (northern end of Inga Beach and southern end of YCS Beach), and are intersected by subaerial and intertidal rock outcrops and creeks. These features have a greater capacity for sediment exchange into and out of the study area boundaries, which results in lower capacity for trapping sediments than on Terminal and Bivalve beaches. Since baseline, Inga Beach has exhibited a similar trend to Bivalve Beach, eroding in the south and accreting in the north. YCN and YCS beaches, when examined as a single sediment transport cell, have also exhibited this trend.

Alongshore sand redistribution at the beach face since construction of the MOF has exposed large sections of the underlying rock platform on Terminal, Bivalve, and Inga beaches. Rock exposure has reduced the availability of sandy access pathways preferred by Flatback Turtles to access nesting habitat in the FA of each beach. Therefore, the largest reductions in optimal nesting habitat have occurred on Terminal, Bivalve, and Inga beaches, and this habitat has been replaced by suboptimal and unsuitable nesting habitat. In general, decreases in optimal nesting area have occurred on sections of beach furthest from the MOF (southern ends of Bivalve and Inga, northern end of Terminal) and increases have occurred closest to the MOF. No interim management triggers for marine turtle nesting habitat (which apply to Terminal and Bivalve beaches only) were exceeded during the Reporting Period. The reduction in optimal nesting habitat may represent an adverse change that could have implications for marine turtles.

Results of the CSMMP monitoring program since construction of the MOF have indicated that changes to Terminal, Bivalve, and Inga beaches have been greater than predicted. In response to these findings, a new revision (Revision 0.3) of the CSMMP was developed and submitted to DWER and DAWE in March 2019. The revision proposed new management triggers for coastal stability and marine turtle nesting habitat. Further improvements were proposed in Revision 0.4, submitted to DWER and DAWE in June 2020. At the time of this annual EPR, these CSMMP revisions were still awaiting approval.

As required by the CSMMP, CAPL will continue to monitor changes in beach morphology to detect and evaluate potential implications for marine turtle nesting and coastal stability. If exceedances of the CSMMP management triggers or performance standards are detected, they will be assessed in accordance with the requirements identified in the current approved CSMMP and relevant Ministerial Conditions.

10 Terrestrial Rehabilitation

Table 10-1: EPR Reporting Requirements for Terrestrial Rehabilitation

Item	Source	Section in this EPR
A description of any rehabilitation activities undertaken	MS 800, Schedule 3(9i)	10.2
Results of the rehabilitation monitoring program including performance against completion criteria targets	MS 800, Schedule 3(9ii)	10.3
Results of any studies to address knowledge gaps as referenced in Condition 32.5(x) and proposals for further studies (if any)	MS 800, Schedule 3(9iii)	N/A[1]
Recommended changes, if any, to the Gorgon Gas Development Post-Construction Rehabilitation Plan (PCRP) (Ref. 17)	MS 800, Schedule 3(9iv)	10.1
A figure identifying areas rehabilitated, areas planned to be rehabilitated, and disturbed areas to be retained for ongoing construction and operational needs	PCRP (Ref. 17), Section 7.2.2	10.2
Topsoil usage and topsoil balances	Gorgon Gas Development Topsoil Management Plan (TMP) (Ref. 18), Section 3.3	10.4
Changes to volume of soil stockpiled as a result of rehabilitation or clearing activities	TMP (Ref. 18), Section 3.3	10.4
Results of the topsoil monitoring program, topsoil performance reviews, and topsoil volume reconciliation	TMP (Ref. 18), Section 5.0	10.5
Progress against rehabilitation objectives in Table 5–2 of the PCRP (Ref. 17)	PCRP (Ref. 17), Table 5–2	10.2, 10.3, 10.4, 10.5

1 No ongoing studies to address knowledge gaps were undertaken during the Reporting Period; therefore, reporting is not applicable at this time.

10.1 Changes to the Post-Construction Rehabilitation Plan

No changes were made to the to the PCRP (Ref. 17) during the Reporting Period.

10.2 Rehabilitation Activities

Rehabilitation activities undertaken during the Reporting Period are summarised in the following table.

Rehabilitation Activities
• No new rehabilitation scopes were completed during the Reporting Period. • Areas rehabilitated for the Gorgon Gas Development are shown in Figure 10-1.

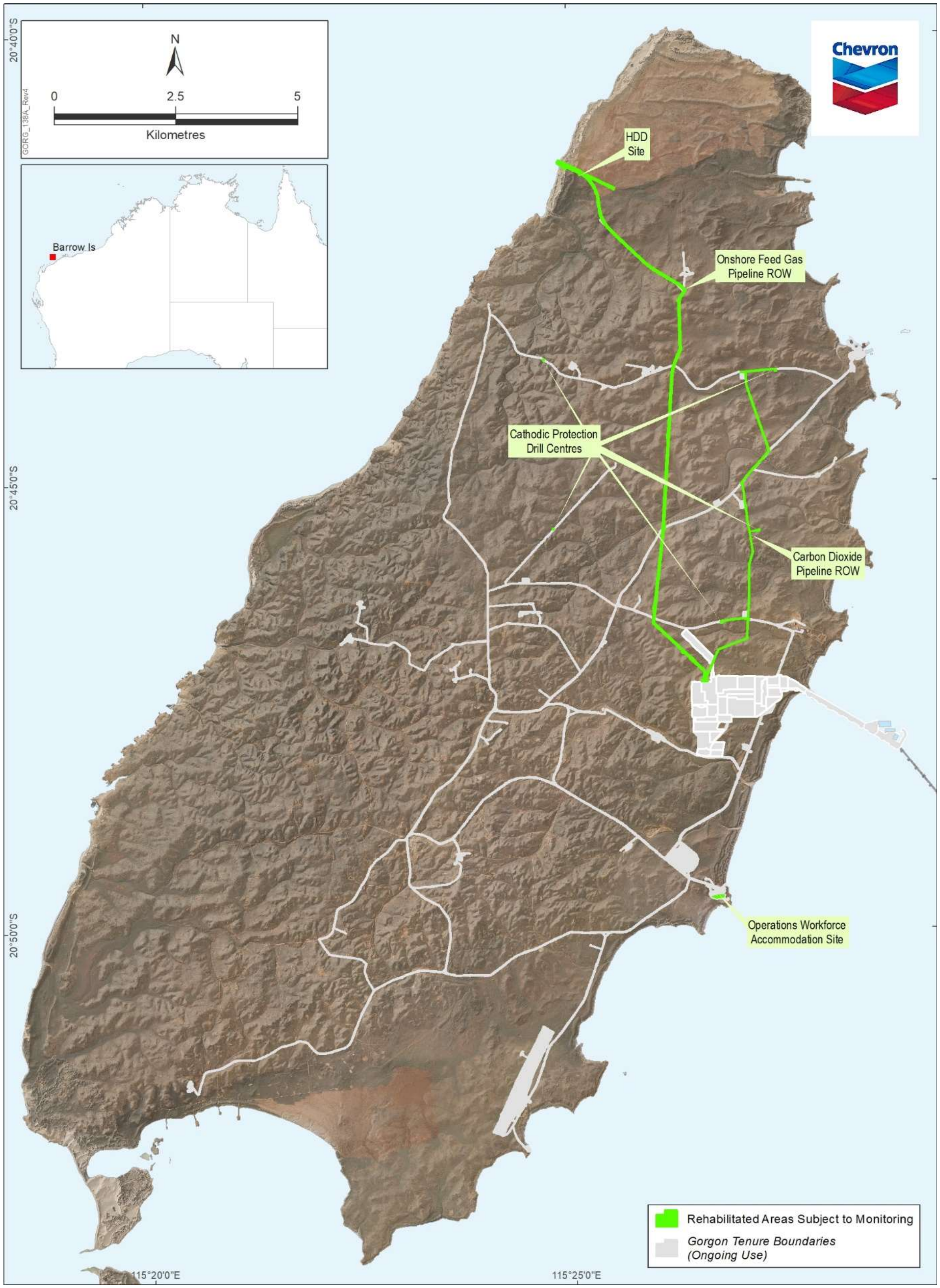

Figure 10-1: Areas Rehabilitated for the Gorgon Gas Development

10.3 Rehabilitation Monitoring

The PCRP (Ref. 17) details the rehabilitation methodology and completion criteria for rehabilitating lands temporarily disturbed by the Gorgon Gas Development. The rehabilitation monitoring methodology is Ecosystem Function Analysis (EFA), a method that has been used on Barrow Island since 2004.

The rehabilitation monitoring methodology and results are summarised in the following table.

Monitoring Program: Rehabilitation
Objectives
To meet the intent of the Ministerial objectives for rehabilitated areas, the PCRP (Table 5-2, in Ref. 17) further defines specific objectives for the rehabilitation of temporarily disturbed areas: • The rehabilitated land surface and soil properties are appropriate to support the target ecosystem • Vegetation in rehabilitated areas will have equivalent values as surrounding natural ecosystems • The rehabilitated ecosystem has equivalent functions and resilience as the target ecosystem • Rehabilitated sites provide appropriate habitat for fauna and fauna recruitment including EPBC Act (Commonwealth) listed species • The rehabilitated site should be able to be managed in the same way as surrounding land.
Methodology
• EFA is based on a methodology developed by the Commonwealth Scientific and Industrial Research Organisation, originally described as Landscape Function Analysis (LFA), which uses indicators that assess and determine functional status of the landscape. EFA differs from LFA in that ecosystem components such as vegetation composition, cover, and habitat complexity are also recorded and assessed to provide a quantitative measure of the ecological functionality of the site. LFA is a core component of EFA, and primarily focuses on stability, water infiltration, and nutrient indices. For arid environments, permanent EFA transects are set up to follow a line of resource flow, typically up to 50 m long. • In total, 23 rehabilitation sites were monitored—7 and 13 sites in the CO_2 and feed gas pipeline corridors, respectively, and 3 non-pipeline transects (previously monitored under WA Oil's rehabilitation monitoring scope, and included in the 2020 monitoring). • Two reference quadrats adjacent to the Horizontal Directional Drilling (HDD) site were also monitored. Eleven reference sites corresponding to limestone, drainage, or plain habitats were also monitored to allow assessment against the completion criteria in the PCRP. Broadly, the monitoring gathered data on: – landscape function (stability, infiltration, and nutrient cycling) – vegetation (*Triodia* cover, species diversity, density, cover and height, floristic composition, and functional structure) – erosion and visual amenity.
Results
• Although none of the rehabilitation sites monitored met all the completion criteria in the PCRP, none would be expected to at this relatively early stage of vegetation re-establishment. Criteria that were consistently not met for all sites were *Triodia* cover and total plant cover/height. This is not unexpected given that these criteria require time to reach completion. • Criteria that were frequently met were erosion, species provenance, weed presence, and landform consistency with surrounding areas (Ref. 19), indicating that the rehabilitation sites are fundamentally sound. Species diversity in rehabilitated sites was generally higher than in reference sites (where sufficient topsoil was added/exists), as is characteristic of disturbed landscapes transitioning from primary to late succession. It is expected that species diversity will continue to decline and become similar to reference sites as rehabilitation progresses. There was little change in LFA indices compared to the 2019 results. Several sites met infiltration and nutrient cycling completion criteria for LFA indices. • Total plant density declined at most sites, as is characteristic of arid zone rehabilitation where vegetation assemblage changes are dominated by long-lived perennial species. Vegetation cover continued to develop at some sites, although most recorded little change compared to 2019 results. Several sites increased their vegetation cover and LFA indices, despite the continuation of below-average rainfall during previous reporting periods, indicating continuing development of resilience.

Monitoring Program: Rehabilitation
• The first monitoring round of arthropod diversity (abundance and richness) from rehabilitated sites (Jansz Feed Gas Pipeline) and reference sites showed that the rehabilitated sites hosted comparable levels of diversity to reference sites. The rehabilitated sites yielded greater diversity values for parasitic *Hymenoptera* than reference sites, although not significantly. Compared with other 2020 study areas, there was overall lower diversity from Jansz Feed Gas Pipeline sites, and this may be influenced by the location of these sites in areas with shallower soil profiles over limestone. • Although the HDD area was stable with no wind or water erosion of concern, vegetation development remained slow.
Conclusions
• The rehabilitation monitoring program was completed in accordance with the requirements of the PCRP (Ref. 17) during the Reporting Period. • Completion criteria addressing key rehabilitation aspects such as erosion, weed presence, and landform consistency were met at all rehabilitation sites, indicating that the rehabilitation sites are fundamentally sound. • *Triodia* densities were generally below the levels considered likely to achieve adequate cover at maturity, however the species was detected on all but one transect. This is likely due to the continuation of below-average rainfall for the region. Overall, rehabilitation performance is indicative of rehabilitation sites becoming more resilient. • It is expected that other completion criteria will be met by an increasing number of sites as rehabilitation continues to progress.

10.4 Topsoil Activities

Topsoil activities undertaken during the Reporting Period and topsoil stockpile volumes are summarised in Table 10-2.

Table 10-2: Monitored Topsoil Stockpile Volume Summary (2020–2021)

Topsoil Stockpile	Original Topsoil Source Location	Changes to Volume Stockpiled During the Reporting Period (m^3)	Total Volume Stockpiled (m^3)
A28	GTP Site	None	7,483
Q31	GTP Site	None	7,984
X62J	GTP Site	None	17,655[1]
R Station	GTP Site	None	3,481
P13	CO_2 pipeline right-of-way	None	9,453[1]
ASA Stage 3	ASA Stages 3 and 4	None	2,272
ASA Stage 2	ASA Stages 1 and 2	None	3,550
Perentie II	GTP Site and ASA	None	8,884

1 The total volume stockpiled for X62J was updated following completion of the stockpile survey in November 2015. The total volume stockpiled for P13 was updated to include topsoil activities conducted after completion of the stockpile survey in October 2017

In 2020, Object-Based Image Analysis (OBIA) assessment of the Gorgon stockpiles was undertaken because COVID-19 restrictions prevented fieldwork from being completed. Not only did OBIA reduce the health and safety risks inherent in fieldwork, it also improved accuracy as it allowed coverage of the whole stockpile to be assessed. The results of this assessment are summarised in the sections below.

10.5 Monitoring Results

The TMP (Ref. 18) complements the PCRP (Ref. 17), and describes the stripping, transport, and re-use of recovered topsoil. The TMP also includes a monitoring program to measure topsoil viability. The monitoring program was amended in 2020 to accommodate the use of OBIA-based assessment with performance criteria developed that aligned with current criteria for Gorgon rehabilitation areas. The assessment used 2019 aerial imagery.

The topsoil monitoring results are summarised in the following table.

Monitoring Program: Topsoil
Objectives
• Measure and record the physical, chemical, and biological attributes, and the overall integrity, of the stored topsoil from the Gorgon Gas Development. • Provide assurance that the topsoil remains viable and stable.
Results
• OBIA of October 2019 aerial imagery was conducted for 8 stockpiles that had been monitored on-ground in June 2019. Comparison of the data suggests that estimates of total vegetation cover from the on-ground assessment averaged 46% (± 3% SE) compared with the average OBIA estimates of 53% (± 5%). Estimates of the *Triodia* component of vegetation cover were very similar, with 38% (± 5%) from on-ground assessment and 39% (± 5%) from OBIA. This indicates that the topsoil stockpiles are in a viable and stable condition. • Six stockpiles previously unmonitored for 2–4 years were monitored using OBIA. Results suggested an average of 54% (± 5% SE) total vegetation coverage compared to an average of 69% (± 9%) from on-ground estimates up to 4 years ago. This change is likely due to differing monitoring methodologies but may also reflect the results of below-average rainfall over this period. The Triodia cover component estimated by OBIA averaged 48% (± 6%). By comparison, the most recent on-ground estimates averaged 53% (± 13%), suggesting the stockpiles are mature or maturing. • No major wind or water erosion issues were observed in the monitoring. • The numbers of germinable seeds in topsoil stockpiles, as estimated through emergent seedlings, is now broadly similar to those in undisturbed soils from reference sites. For both stockpiles and reference sites, the overwhelming influence on the quantity of soil-stored seed in recent years is likely to have been insufficient rainfall to promote flowering. For *Triodia* species, the data supports the hypothesis that adequate rainfall in the previous winter, as well as in the summer/autumn flowering period, is critical.
Conclusion
The OBIA assessment data continues to support the trend from recent on-ground surveys that stockpiles are mature or maturing and developing into a stable resource that will be sufficient to sustain future topsoil harvesting.

11 Greenhouse Gas Abatement

Table 11-1: EPR Reporting Requirements for Greenhouse Gas Abatement

Item	Source	Section in this EPR
Data on greenhouse gas (GHG) emission intensity (defined as GHG emissions per tonne of LNG produced) averaged over one year, and describe the methodology used	MS 800, Schedule 3(10i)	11.1
Trend of annually averaged GHG emission intensity and explain the reasons for any change	MS 800, Schedule 3(10ii)	11.1
Recent advances in technology and/or operation processes for LNG processing facilities	MS 800, Schedule 3(10iii)	N/A[1]
Justification for the adoption or otherwise of the recent advances referred to in Schedule 3, Item 10iii	MS 800, Schedule 3(10iv)	N/A[1]
The actual energy efficiency[2] of gas turbines in the GTP	MS 800, Schedule 3(10v)	11.1

1 *As per MS 800 Condition 5.1 Schedule 3, items 10iii and 10iv are excluded from the EPR.*

2 *Although MS 800 refers to 'energy efficiency', 'thermal efficiency' is the appropriate term for calculating this metric, and therefore is used below.*

11.1 Monitoring Results

The 2020-–2021 results for GHG emission intensity and thermal efficiency are summarised in the following tables.

GHG Emission Intensity
Methodology
• GHG emissions are determined in accordance with the methods specified under the NGER Act. GHG emissions intensity and energy efficiency are prepared for the financial year (1 July 2020 to 30 June 2021) so as to align with the data prepared for compliance with the NGER Act[1]. • GHG emissions intensity is expressed as the total 'Scope 1' GHG emissions (expressed as tonnes of CO_2e) divided by the amount of saleable LNG[2] (expressed in tonnes of LNG). Emissions intensity value includes emissions associated with processing DomGas and condensate, and providing all Barrow Island utilities and support services. Care should be exercised when comparing this metric with similar metrics from other facilities to ensure a like-for-like comparison.
Results
• GHG emissions intensity trend for recent financial years: – 2015–2016: 19.6 tonnes CO_2e per tonne of saleable LNG – 2016–2017: 1.14 tonnes CO_2e per tonne of saleable LNG – 2017–2018: 0.63 tonnes CO_2e per tonne of saleable LNG – 2018–2019: 0.57 tonnes CO_2e per tonne of saleable LNG – 2019–2020: 0.43 tonnes CO_2e per tonne of saleable LNG – 2020–2021: 0.46 tonnes CO_2e per tonne of saleable LNG. • From 2017 to 2021 the average GHG emissions intensity decreased in line with the progression from commissioning into operations; however, the most recent Reporting Period was impacted by lower reservoir CO_2 injection than planned, and additional unplanned outages (turnarounds).

1 *Emissions/production during the Reporting Period that are in the 2021–2022 financial year will be reported in the 2022 EPR.*

2 *'Saleable LNG' is the LNG produced and loaded into the LNG storage tanks minus boil-off gas.*

Gas Turbine Generator Thermal Efficiency
Methodology
The thermal efficiency of the GTGs is determined by dividing the amount of electricity generated (expressed in Joules) by the energy content of the fuel used to power the turbines (also expressed in Joules). Thermal efficiency of the GTGs is calculated daily and averaged over the Reporting Period for the GTGs in operation.
Results
The thermal efficiency of the GTGs over the Reporting Period was 24.2% on a higher heating value basis.

12 Spill Management

Table 12-1: EPR Reporting Requirements for Spill Management

Item	Source	Section in this EPR
Incidence of spills caused by the Proposal, and spills that impact on the Proponent's facilities including details of cause and recommended actions	MS 769, Schedule 3(3i)	12.1

12.1 Event Data

No spills caused by the Jansz Feed Gas Pipeline, or spills that impacted on Jansz Feed Gas Pipeline facilities, occurred during the Reporting Period.

13 Terminology

Table 13-1 defines the acronyms, abbreviations, and terminology used in this document.

Table 13-1: Terminology

Term	Definition
~	Approximately
°C	Degrees Celsius
µg	Microgram
ABU	Australian Business Unit
Adult female breeding omission probability	Annual probability estimate of skipped breeding for adult female marine turtle nesters in a nesting population
Adult female survival probability	Annual estimated survival rate for adult female marine turtle nesters in a nesting population
AHC	Ah Chong Island
Alert trigger	Measured parameter deviates towards (but remains within) one SD for two consecutive years, or deviates outside a 1 SD limit
aMDEA	Activated methyldiethanolamine
Annual nester abundance	Estimate of total female marine turtle nesters per season at a rookery
AQMP	Air Quality Management Plan
AQMS	Air Quality Monitoring Station
ASA	Additional Support Area
At Risk	Being at risk of Material Environmental Harm or Serious Environmental Harm and/or, for the purposes of the EPBC Act relevant listed threatened species, threatened ecological communities, and listed migratory species, at risk of Material Environmental Harm or Serious Environmental Harm
At Risk zone/site/island	An area where potential impacts are predicted to occur
Backshore	An upper shore zone above high tide
Baseline	The study of the original status of the environment in the area before the development work of the project is started.
BTEX	Benzene, toluene, ethylbenzene, and xylene compounds
Butler Park	Barrow Island accommodation village (formerly known as the Construction Village)
CAPL	Chevron Australia Pty Ltd
CBF	Crest of Beach Face; sampling site located at the change in slope at the transition between the beach face and foredune area
CI	Confidence Interval; an interval that is likely to contain the true value of a population parameter, but reflects the inherent uncertainty in estimating this parameter from a sample. The level of confidence reflects the likelihood that the constructed interval contains the true parameter value, so a 95% Confidence Interval is an interval which 95% of the time will include the true parameter value. By convention, 95% Confidence Intervals are usually used to define reasonably upper and lower bounds for parameter estimates.
Clutch fate	The recorded fate of a Flatback turtle nest. Fate is determined based on set criteria including discrepancies between egg counts at laying vs. egg counts at excavation, and evidence of disturbance from other nesting turtles or predation.
Clutch frequency	The mean number of clutches laid per female marine turtle nester per season

Term	Definition
Clutch size	The mean number of eggs in a Flatback turtle nest.
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CSMMP	Coastal Stability Management and Monitoring Plan
CT	Communications Tower
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DIN	Double Island North
DIS	Double Island South
DNA	Deoxyribonucleic Acid
DO	Dissolved oxygen
DOC	Dissolved organic carbon
DomGas	Domestic Gas
DWER	Western Australian Department of Water and Environmental Regulation
e.g.	For example
eDNA	Environmental DNA; DNA that can be extracted from environmental samples
EFA	Ecosystem Function Analysis
Egg hatching probability	The median hatching success of eggs within complete clutches. Complete clutches refer to clutches not disturbed by other turtles, predated or lost.
EMP	Environmental Management Plan
Environmental Harm	Has the meaning given by Part 3A of the *Environmental Protection Act 1986* (WA)
EPBC 2003/1294	Commonwealth Ministerial Approval (for the Gorgon Gas Development) as amended or replaced from time to time.
EPBC 2008/4178	Commonwealth Ministerial Approval (for the Revised Gorgon Gas Development) as amended or replaced from time to time
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
EPR	Environmental Performance Report
EWMA	Exponentially Weighted Moving Average
F3	Total Recoverable Hydrocarbons Fraction 3, which corresponds the carbon number range C_{16}-C_{34} as specified in the National Environmental Protection Measure guidelines
FA	Foredune Area; area between the beach face and the primary dune, which is populated by scattered vegetative hummocks and marine turtle body holes
First Response	Quarantine activities that occur immediately after the detection of a suspect NIS or Marine Pest. The aim is to contain, control, and eliminate.
GHG	Greenhouse Gas
GME	Groundwater Monitoring Event
Gorgon Gas Development	Gorgon Gas Development and Jansz Feed Gas Pipeline
GPS	Global Positioning System
GTG	Gas Turbine Generator
GTP	Gas Treatment Plant

Term	Definition
H_2S	Hydrogen sulfide
ha	Hectare
Hatchling	Newly hatched marine turtle
Hacthling emergence probability	The median emergence success of hatchlings from clutches
Hatchling Disorientation	The range of dispersion (nest fan spread angle) of marine turtle hatchling tracks from the emergence point
Hatchling Misorientation	The degree of deflection (nest fan offset angle) of marine turtle hatchling tracks from the most direct line to the ocean
HDD	Horizontal Directional Drilling
HSE	Health, Safety, and Environment
i.e.	That is
Incubation duration	The mean incubation time period of a Flatback Turtle nest
Incubation temperature	The mean incubation temperature of a Flatback Turtle nest
Incursion Response	Coordinated quarantine activities that aim to delineate, delimit, and eliminate positively identified NIS and Marine Pests.
ind./ha-1	Individuals per hectare
Internesting interval	Period between a successful nest and subsequent nest or nesting attempt in a single breeding season. The females move to offshore internesting grounds while they form the next clutch of eggs. Internesting grounds may be close to or remote from the nesting beach.
km	Kilometre
L	Litre
LCGT	Liquefaction Compressor Gas Turbine
LFA	Landscape Function Analysis
LNG	Liquefied Natural Gas
LOR	Limit of Reporting (also known as the detection limit)
LRR	Log Response Ratio
LTMTMP	Long-term Marine Turtle Management Plan
m	Metre
m/s	Metres per second
m^2	Square metre
m^3	Cubic metre
MAD	Median Absolute Deviation
MAH	Monocyclic Aromatic Hydrocarbon
Management triggers	Quantitative, or where this is demonstrated to be not practicable, qualitative matters above or below which relevant additional management measures must be considered
Marine Pest	Species other than the native species known or those likely to occur in the waters of the Indo–West Pacific region and the Pilbara Offshore marine bioregion
Material Environmental Harm	Environmental Harm that is neither trivial nor negligible
MDA	Mundabullangana (Reference site on the WA mainland)

Term	Definition
MEG	Monoethylene glycol; used as a hydrate inhibitor
mg	Milligram
MMscfd	Million standard cubic feet per day
MOF	Materials Offloading Facility
MS	(Western Australian) Ministerial Statement
MS 769	Western Australian Ministerial Statement 769 (for the Jansz Feed Gas Pipeline) as amended from time to time
MS 800	Western Australian Ministerial Statement 800 (for the Gorgon Gas Development) as amended from time to time
MS 965	Western Australian Ministerial Statement 965, issued for the Additional Support Area, as amended from time to time
MSORD	Multi-state open robust design
N	Nitrogen
N/A	Not Applicable
NEPM	National Environmental Protection Measure
Nesting activity	The spatial and temporal nesting distribution of adult female Flatback Turtles
NGER Act	Commonwealth *National Greenhouse and Energy Reporting Act 2007*
NIS	Non-indigenous Terrestrial Species; any species of plant, animal, or microorganism not native to Barrow Island
NNE	North-north-east (compass direction)
NO_2	Nitrogen dioxide
NOHES	National Occupational Health Exposure Standards
NO_x	Nitrogen oxides (NO and NO_2)
O_3	Ozone
OBIA	Object-based Image Analysis
ORP	Oxidation-reduction Potential (also known as redox)
PAH	Polycyclic Aromatic Hydrocarbon
PAR	Parakeelya Island
PCRP	Post-Construction Rehabilitation Plan
PFC	Percentage foliage cover
pH	Measure of acidity or basicity of a solution
PM_{10}	Particulate matter less than 10 microns
ppm	Parts per million
Project	Gorgon Gas Development
Proliferation	Increase of a species, attributable to the Gorgon Gas Development, by frequent and repeated reproduction: • NIS plants (excluding those considered to be naturalised) proliferation: an increase in the distribution of NIS plants producing propagules outside existing Weed Hygiene Zones. • NIS animals' proliferation: an increase in reproductively capable offspring dispersing outside the known distribution.

Term	Definition
	• Marine Pest proliferation: an increase in reproductively capable offspring dispersing outside the known distribution in the waters surrounding Barrow Island.
PSD	Particle Size Distribution
QEP	Quarantine Expert Panel
QMS	Quarantine Management System
Quadrat	A rectangular or square measuring area used to sample living things in a given site; can vary in size
Quarantine Incident	A quarantine incident is declared (declaration is subject to positive identification*) by the CAPL Quarantine Manager following: • a detection of NIS or Marine Pest on Barrow Island after Final Quarantine Clearance, or • the proliferation of a NIS population on Barrow Island or Marine Pest in the waters surrounding Barrow Island. **Level 1 Quarantine Incident** • A confirmed detection of NIS on Barrow Island, after Final Quarantine Clearance, where the risk of the species to the biodiversity of Barrow Island is considered by CAPL, on advice of the Quarantine Expert Panel (QEP), to be low, or • A proliferation of existing NIS on Barrow Island as a consequence of Gorgon Gas Development activities. **Level 2 Quarantine Incident** A confirmed detection of NIS on Barrow Island, after Final Quarantine Clearance, where: • uncertainty exists (as determined by CAPL on advice of the QEP) as to the risk of the species to the biodiversity of Barrow Island due to a range of factors (e.g. the ability of the species to survive on Barrow Island, availability of suitable habitats), or • the risk to the biodiversity of Barrow Island is considered to be high (as determined by CAPL, on advice of the QEP), but the ability to detect and eradicate is considered readily achievable (due to factors such as visibility, fecundity, slow dispersal etc.). **Level 3 Quarantine Incident** **Terrestrial NIS**: A confirmed detection of NIS on Barrow Island, after Final Quarantine Clearance, where: • the risk to the biodiversity of Barrow Island is considered to be high and the ability to detect and eradicate is difficult (as determined by CAPL, on advice of the QEP), and/or • the consequence of eradication/control actions on the biodiversity of Barrow Island is considered to be high (as determined by CAPL, on advice of the QEP). **Marine Pests**: A confirmed detection of a Marine Pest on marine infrastructure or in the waters surrounding Barrow Island. Note: A Marine Pest that has only been detected on the wetsides of a vessel and not on marine infrastructure and/or in the waters surrounding Barrow Island is not considered an incident (see Quarantine Intercept). ** Positive identification is taxonomic (morphologic or molecular) confirmation in every instance except where there is high certainty of species identification in the expert judgement of the CAPL Quarantine Manager.* **Note**: An introduction of a Marine Pest is classified as a Level 3 Incident only.
Quarantine Intercept	**Terrestrial NIS**: The detection, containment, and removal of suspected NIS prior to Final Clearance.

Term	Definition
	Marine Pest: The detection, containment, and removal of a Marine Pest on a vessel (including barges etc.) wetsides after Final Quarantine Clearance is granted and when the vessel is within the limited access zone or controlled access zone.
Quarantine Introduction	The presence of viable NIS on Barrow Island, or of a Marine Pest in the waters surrounding Barrow Island (excluding on vessel wetsides—see Quarantine Intercept). In both instances, the species will be considered introduced if the species has survived First Response and Incursion Response.
Quarantine Procedural Breach	Any case where a quarantine observation, inspection, or audit detects a failure to comply with Barrow Island quarantine procedures, standards, or concessions. **Level 1 Quarantine Procedural Deviation** • Upon arrival of a vessel or material at Barrow Island, it is determined that a quarantine procedure, or part thereof, has not been followed and the potential impact of the deviation has low risk to the biodiversity of Barrow Island and surrounding waters. **Level 2 Quarantine Procedural Deviation** • Upon arrival of a vessel or material at Barrow Island, it is determined that a quarantine procedure, or part thereof, has not been followed and the potential impact of the deviation has high risk to the biodiversity of Barrow Island and surrounding waters.
Redox	*See* ORP
Reference zone/site/island	Specific areas of the environment that are not at risk of being affected by the Project or existing developments, that can be used to determine the natural state, including natural variability, of environmental attributes.
Rehabilitation Impact Site	A transect or other monitoring method located within an area that has been subject to anthropogenic disturbance and has since been rehabilitated according to the methodology in the PCRP (Ref. 17)
Rehabilitation Reference Site	A transect or other monitoring method located within an area that has not been subject to recent anthropogenic disturbance
Reporting Period	The period from 10 August 2020 to 9 August 2021 covered by this EPR
SAQP	Sampling and Analysis Quality Plan
Scope 1	Defined under the Greenhouse Gas Protocol (a Corporate Accounting and Reporting Standard) as 'all direct GHG emissions, where direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity'
SD	Standard deviation (statistical variation); a measure used to quantify the amount of variation or dispersion of a set of data values
SE	Standard error (statistical variation); a measure used to quantify the accuracy with which a sample mean represents a population mean
Serious Environmental Harm	Environmental harm that is: a) irreversible, of a high impact or on a wide scale; or b) significant or in an area of high conservation value or special significance and is neither trivial nor negligible.
SGC	Silica Gel Clean-up
SHW	Spectacled Hare-wallaby
SO_2	Sulfur dioxide
SRE	Short-range Endemics; taxonomic group of invertebrates that are unique to an area, found nowhere else, and have naturally small distributions (i.e. <10 000 km^2).
SRESFMP	Short-range Endemics and Subterranean Fauna Monitoring Plan
SSC	Surveillance System Components

Term	Definition
SSE	South-south-east (compass direction)
Stressor	An environmental condition or influence that stresses an organism
SVL	Sparse Vegetation Line
TAPL	Texaco Australia Pty Ltd
TDF	Terrestrial Disturbance Footprint The area to be disturbed by construction or operations activities associated with the Terrestrial Facilities listed in Condition 6.3 of MS 800, Condition 6.3 of MS 769, and Condition 5.2 of EPBC 2003/1294 and 2008/4178, and set out in the Terrestrial and Subterranean Baseline State and Environmental Impact Report required under Condition 6.1 of MS 800, Condition 6.1 of MS 769, and Condition 5.1 of EPBC 2003/1294 and 2008/4178.
Threatened Species	Species listed as extinct, extinct in the wild, critically endangered, endangered, vulnerable or conservation dependent under section 178 of the Commonwealth EPBC Act.
TMP	Topsoil Management Plan
Topsoil	The top layer of soil that stores seed and acts as the growth medium in which vegetation can establish itself
Transect	The path along which a researcher moves, counts, and records observations
TRH	Total Recoverable Hydrocarbons
TSEMP	Terrestrial and Subterranean Environment Monitoring Program
WA	Western Australia
Waters surrounding Barrow Island	Refers to the waters of the Barrow Island Marine Park and Barrow Island Marine Management Area (~4169 ha and 114 693 ha respectively), as well as the Port of Barrow Island representing the Pilbara Offshore Marine Bioregion.
Weed	Non-indigenous plant species; a plant that establishes in natural ecosystems, subsequently adversely affecting natural processes and ultimately resulting in the decline of the native vegetation community
Weed Hygiene Zone	An area within which non-indigenous plant species, assessed to be high-risk species, have established populations and/or where a seedbank of a high-risk species is present.
WTS	Wedge-tailed Shearwater
YCN	Yacht Club North (beach)
YCS	Yacht Club South (beach)

14 References

Table 14-1 lists the documentation referenced in this EPR.

Table 14-1: References

Ref. No.	Description	Document ID
1.	Chevron Australia. 2020. *Gorgon Gas Development and Jansz Feed Gas Pipeline: Terrestrial and Subterranean Environment Monitoring Program*. Rev. 2.0. Chevron Australia, Australia, Western Australia. Available from: https://Australia.chevron.com/-/media/Australia/our-businesses/documents/gorgon-terrestrial-and-subterranean-environment-monitoring-program.pdf [Accessed 4 Oct 2021]	GOR-COP-01696
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8.	Chevron Australia. 2019. *Gorgon Gas Development and Jansz Feed Gas Pipeline: Short-Range Endemics and Subterranean Fauna Monitoring Plan*. Rev. 4. Chevron Australia, Perth, Western Australia. Available from: https://australia.chevron.com/-/media/australia/our-businesses/documents/gorgon-emp-short-range-endemics-and-subterranean-fauna-monitoring-plan.pdf [Accessed 4 Oct 2021)]	G1-NT-PLNX0000295
9.	Chevron Australia. 2015. *Gorgon Gas Development and Jansz Feed Gas Pipeline: Fire Management Plan*. Rev. 1.0. Chevron Australia, Perth, Western Australia. Available from: https://australia.chevron.com/-/media/australia/our-businesses/documents/gorgon-emp-fire-management-plan.pdf [Accessed 4 Oct 2019]	GOR-COP-01238

Ref. No.	Description	Document ID
10.	Chevron Australia. 2020. *Gorgon Gas Development and Jansz Feed Gas Pipeline: Air Quality Management Plan*. Rev. 3. Chevron Australia, Perth, Western Australia. Available from: https://australia.chevron.com/-/media/australia/our-businesses/documents/gorgon_project_emp_air_quality_management_planrev2amendment1.pdf [Accessed 4 Oct 2021]	G1-NT-PLNX0000301
11.	Compliance Monitoring Pty Ltd. 2021. *Gorgon Air Quality Atmospheric Pollutants: Operations Phase Summary Report: August 2020 to August 2021: Annual Environmental Performance Report.* Rev. 0. Document Reference RPA088-643. Unpublished report for Chevron Australia, Perth, Western Australia.	ABU211000090
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17.	Chevron Australia. 2019. *Gorgon Gas Development and Jansz Feed Gas Pipeline: Post-Construction Rehabilitation Plan.* Rev. 3.0. Chevron Australia, Perth, Western Australia. Available from: https://australia.chevron.com/-/media/australia/our-businesses/documents/gorgon-emp-post-construction-rehabilitation-plan.pdf [Accessed 4 Oct 2021]	G1-NT-PLNX0000303
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20.	*Licence L9102/2017/1 Decision Report* (File No. DER2017/001839), 16 July 2018.	ABU190901271