Gorgon Gas Development and Jansz Feed Gas Pipeline

Environmental Performance Report 2024

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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 as the Gorgon Gas Development [the 'Project']) on behalf of these companies (collectively known as the Gorgon Joint Venture Participants):

- Chevron Australia Pty Ltd
- Shell Australia Pty Ltd
- Mobil Australia Resources Company Pty Ltd
- Osaka Gas Gorgon Pty Ltd
- Midocean 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), as amended by MS 1198
- 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 2023 to 9 August 2024 (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 System			✓	✓		7
Air Quality	✓					8
Coastal Stability	✓		✓	✓		9
Terrestrial Rehabilitation	✓				✓	10
Spill Management		✓				11

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 GTP on the east coast. The GTP includes natural gas trains that produce liquefied natural gas (LNG), 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.

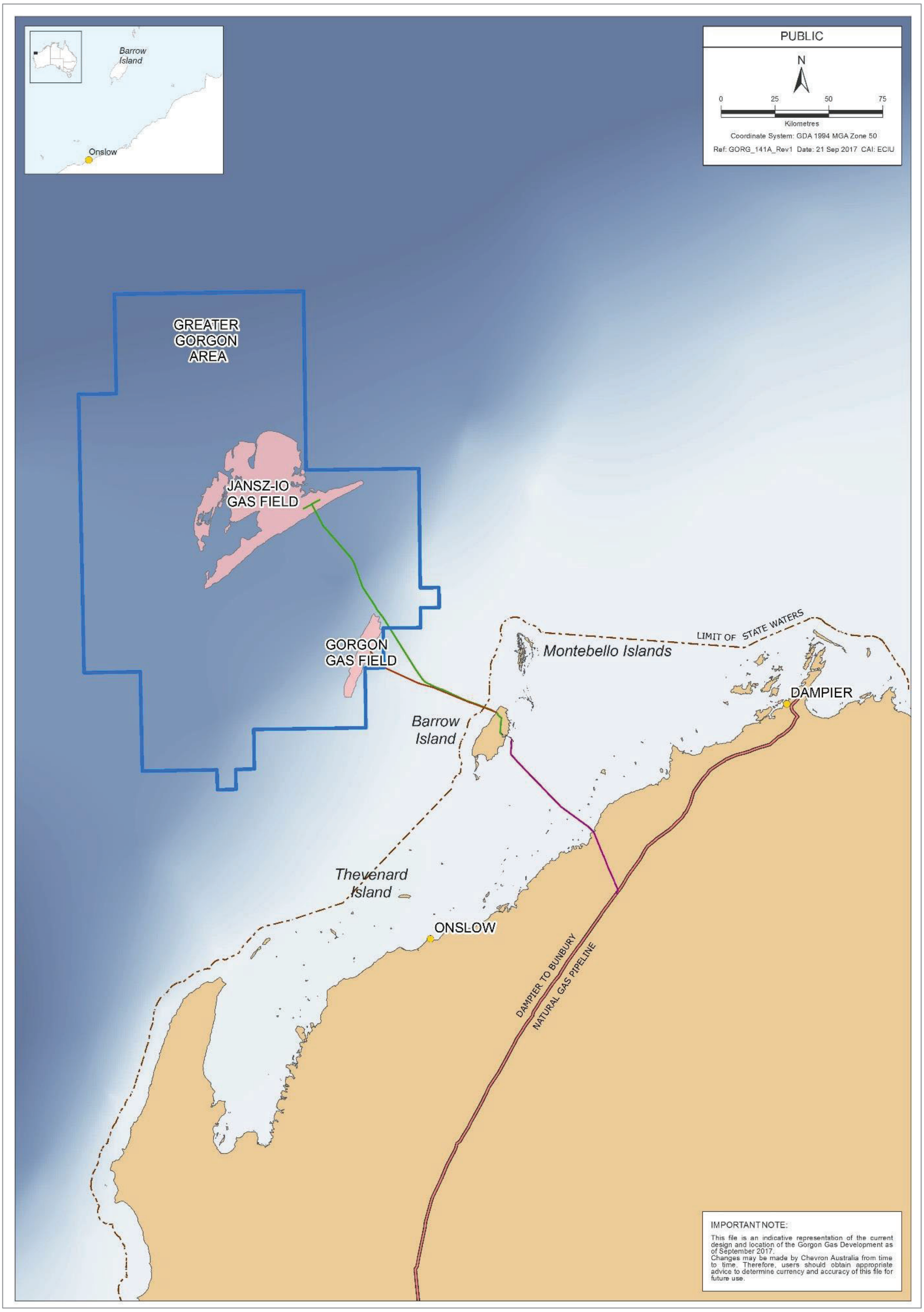

Figure 1-1: Location of Gorgon Gas Development and Greater Gorgon Area

1.4.1 Status of implementation

Construction of the Gorgon Gas Development started in December 2009 and 3-train LNG operations began in July 2018.

During the Reporting Period:

- The Gorgon Gas Development delivered more than 25 per cent of Western Australia's domestic gas supply.
- Achieved the significant milestone of more than 10 million tonnes of greenhouse gas (GHG) (carbon dioxide equivalent [CO_2e]) injected since safely starting the CO_2 injection system in 2019.
- Commenced implementation of measures to address constraints with the CO2 injection system's pressure management capacity that will enable increased carbon dioxide injection rates over the life of Gorgon.
- The Western Australian (WA) Government launched the Lower Carbon Grants Program – Gorgon Fund and GreenTech Hub with the Gorgon Joint Venture a founding contributor, committing A$40 million to the Program.
- A scheduled major maintenance turnaround occurred for Train 2 (July 2024). Turnarounds are routine major maintenance shutdowns, which involve numerous inspections, repairs, and equipment changeouts.
- Progressed projects to maintain gas supply to Gorgon that will ensure continued reliable energy supply to Western Australia and the Asia Pacific region.

2 Terrestrial and subterranean environment state

Table 2-1: EPR 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 6.3	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 Monitoring Program (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), as defined in the TSEMP (Ref. 1).

Since 2016, annual differences between the standardised At Risk and Reference zone population density metric (standardised density difference ratio) have been applied to control charts for mammals and birds to improve the diagnosis of trends. Alternative analyses are applied to groundwater and surface water landform monitoring data, where control charting is inappropriate for comparing trends over time.

The 2023–2024 monitoring results for the ecological elements listed in the TSEMP (Ref. 1) are summarised in the following tables and all monitoring programs met the requirements of the TSEMP (Ref. 1). Note: Surveys for terrestrial fauna were undertaken between June and September 2023, before the Reporting Period (Ref. 3, Ref. 4, Ref. 5 and Ref. 6). Surveys for seabirds were undertaken between November 2023 and March 2024 (Ref. 7); and biennial vegetation surveys were not required in 2024.

Ecological element: Fauna / habitat

Taxon, feature or species

White-winged Fairy-wren (Barrow Island) (*Malurus leucopterus edouardi*) (WWFW)

Objective

To detect variation in abundance—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time

Changes to monitoring sites

There were no substantial changes to monitoring sites during the Reporting Period.

Methodology

Survey method

- Diurnal distance sampling across 25 transects (each up to 13.1 km long and orientated east–west at 500 m spacing across Barrow Island) to compare the densities of WWFWs within the At Risk and Reference zones during September 2023 (Figure 2-1). The combined total length of the transects was 194 km (107 km in the Reference zone; 87 km in the At Risk zone). The locations of observed WWFWs along the transects were recorded by taking a GPS fix at each animal's approximate location.

Analysis method

- WWFW observations were converted to density estimates using distance sampling software, with a truncation distance of 70 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 WWFWs within the Reference zone was 0.25 (± 0.07) individuals per hectare (ind/ha) and the estimated density within the At Risk zone was 0.38 (± 0.07) ind/ha.
- The population estimate of WWFWs within the Reference zone was 3,704 (± 1,065) individuals and the population estimate within the At Risk zone was 4,016 (± 786) individuals.
- The Barrow Island-wide density estimate was 0.31 (± 0.06) ind/ha, with an overall population estimate of 7,720 (± 1,448) WWFWs.
- The ratio between the estimated At Risk and Reference zone densities decreased from 2.69 in 2022 to 1.49 in 2023, owing to a larger increase in density within the Reference zone relative to the At Risk zone (Figure 2-2).
- A linear model indicated that WWFW density differed significantly between zones ($F_{1,26}$ = 19.43, P <0.001) and that density (and resulted estimates of abundance) declined over time, but not significantly ($F_{1,26}$ = 7.40, P = 0.10). The slope of the declines also did not differ significantly between the two zones ($F_{1,26}$ = 1.52, P = 0.22).

Ecological element: Fauna / habitat
Discussion and conclusions
• The 2023 monitoring indicated that the measured density ratio parameter for WWFWs returned to within control limits, having exceeded the +1 Standard Deviation (SD) control limit for the previous two consecutive years due to a higher population density within the At Risk zone relative to the Reference zone. • The density of WWFWs 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*, which is more prominent within the At Risk zone. • Linear modelling indicates that WWFW density has declined, generally, over time within both zones but that the declines do not differ significantly between zones, although density and abundance estimates have increased in more recent years. This suggests that the declines are more likely due to broad environmental conditions across Barrow Island rather than any Project-related effects in the At Risk zone. • A key stressor for WWFW is habitat loss, particularly of their preferred habitat, *Melaleuca cardiophylla*. There was no clearing of this habitat within the reporting period. • Noise within the At Risk zone associated with construction and general operational activities of the Gorgon Gas Development was initially identified as a possible environmental stressor for WWFWs. Noise could potentially interfere with the communications and resulting social structure of WWFWs, which rely on calling to establish and maintain territories and to attract mates. Although noise generated from ongoing general operational activities may result in some disturbance, this continues to be localised in area and does not appear to have impacted the population adversely. • The key driver for variation in abundance estimates is presumed to be rainfall. WWFWs can also breed outside regular breeding months if there is good rainfall, which would be expected to result in increased recruitment into the adult population. Significant correlations were found between the population of WWFWs and two rainfall indices, indicating that WWFW numbers increase following significant rainfall, with a 6-month lag time. It is unclear why the disproportionate increase occurred in the Reference zone in 2023—it could be due to variation in resource availability that is related to local rainfall variability, with greater rainfall recorded in the north and west of the island compared to the east of the island. • Overall, results indicate current WWFW population estimates are within the range of historical values, and the variation in WWFW abundance is likely driven by variability in rainfall and other environmental conditions, with no evidence of impacts attributable to the Gorgon Gas Development.

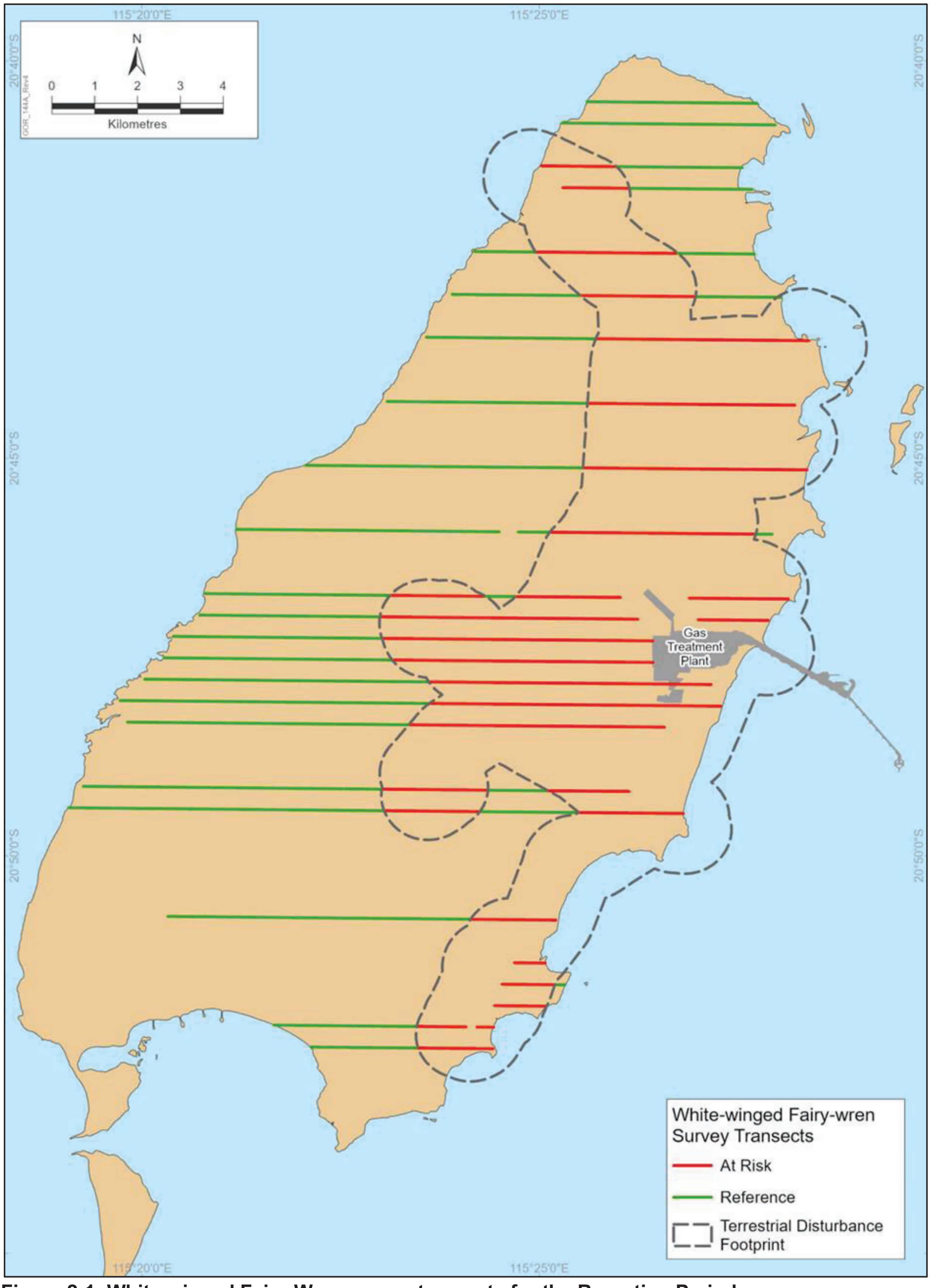

Figure 2-1: White-winged Fairy-Wren survey transects for the Reporting Period

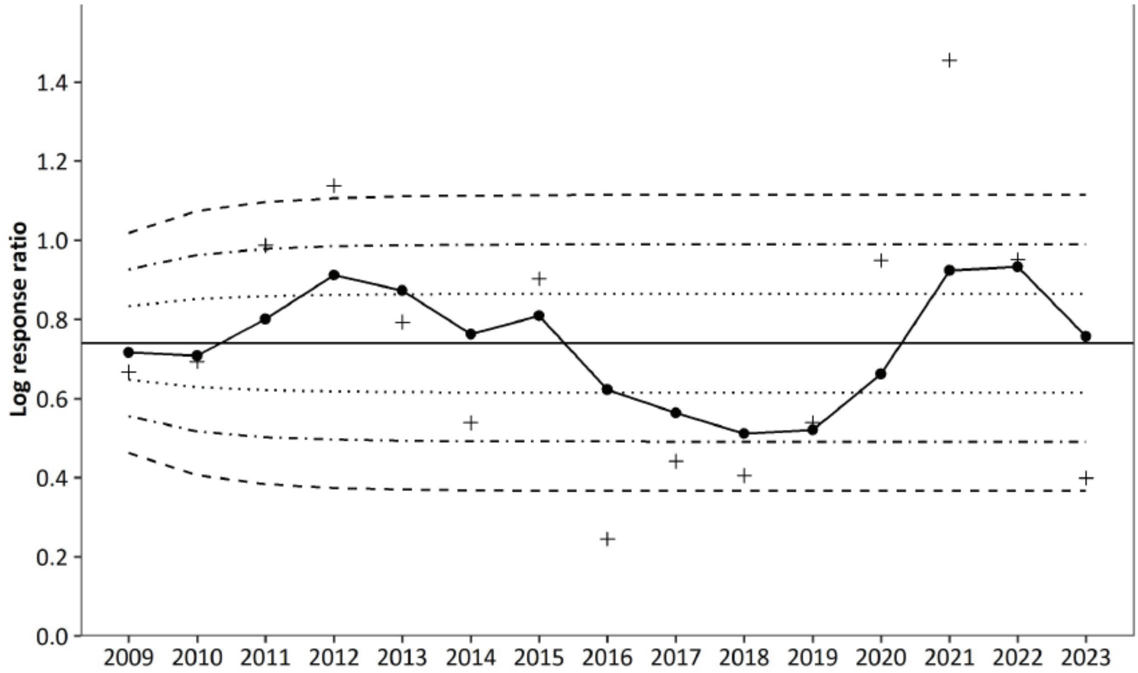

Figure 2-2: Exponentially weighted moving average (EWMA) control chart for White-winged Fairy-wren density at Barrow Island

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

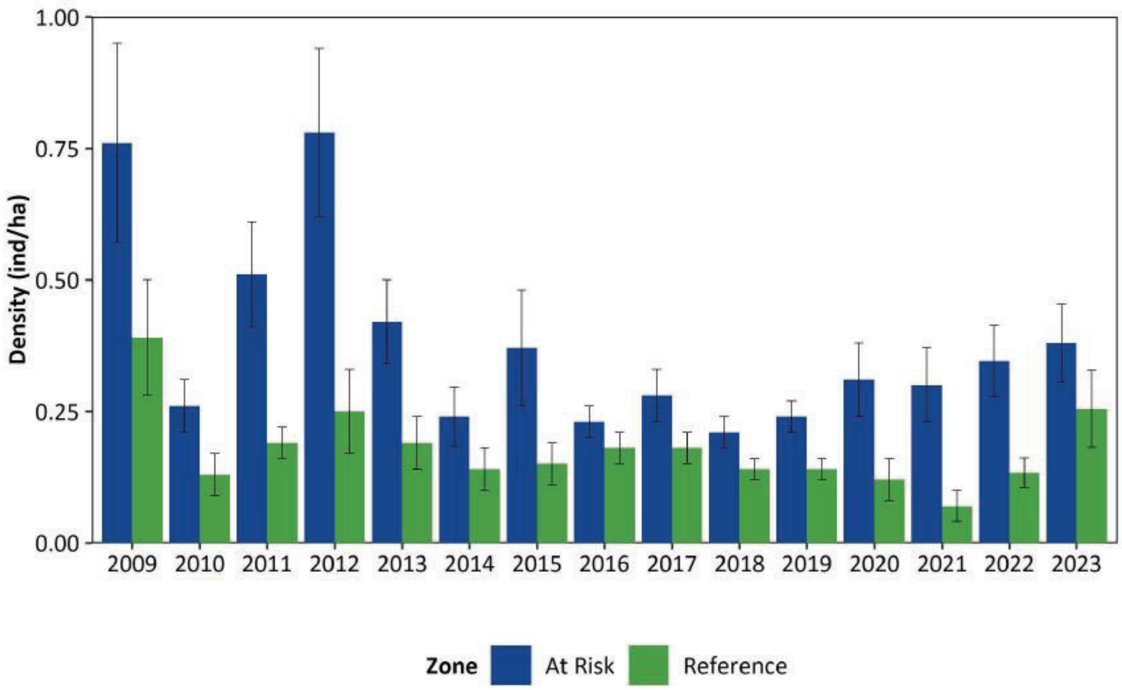

Figure 2-3: Annual estimates and trend over time of White-winged Fairy-wren densities within the At Risk and Reference Zones

Ecological element: Fauna / habitat

Taxon, feature, or species

Barrow Island Euro (*Osphranter robustus isabellinus*)

Objective

To detect variation in abundance—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.

Source: J. Kalau

Changes to monitoring sites

There were no substantial changes to monitoring sites during the Reporting Period.

Methodology

Survey method

- Remotely piloted aircraft (RPA) thermal detection aerial surveys; this was the sole method used for the Barrow Island Euro in 2023.
- During June 2023, 44 transects (ranging from 2–5.2 km long and orientated east–west across Barrow Island) were flown to compare the densities of Barrow Island Euros within the At Risk and Reference zones (Figure 2-4). The combined total length of the transects was 195.1 km (112 km in the Reference zone; 83.1 km in the At Risk zone).
- Transects were flown at 30 m above ground level (AGL), with a forward speed of 5 m/s and a camera pitch of 20° below horizon. The ‘white hot’ thermal palette was selected as the most appropriate for animal detection.
- An in-field zoologist reviewed the video footage in real time to identify different species. If the animal could not be immediately identified with confidence, the camera zoom and height AGL was adjusted - until all animals were reliably identified.

Analysis method

- Barrow Island Euro observations were converted to density estimates using distance sampling software, with a truncation distance of 100 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 Euros within the Reference zone was 0.20 (± 0.09) ind/ha and the estimated density within the At Risk zone was 0.08 (± 0.03) ind/ha.
- The estimated abundance of Barrow Island Euros within the Reference zone was 2,968 (± 1,282) individuals and the estimated abundance within the At Risk zone was 856 (± 366) individuals.
- The Barrow Island-wide density estimate was 0.15 (± 0.06) ind/ha, with an overall population estimate of 3,824 (± 1,497) Barrow Island Euros.
- The ratio between the At Risk and Reference zone densities decreased from 0.55 in 2022 to 0.40 in 2023, owing to a proportionally greater increase in density within the Reference zone.
- The EWMA metric exceeded the −2 SD control limit for the first time since 2016, following three consecutive years below the −1 SD control limit, resulting in a management review, discussed below (Figure 2-5, Figure 2-6).

Discussion and conclusions

- The whole island population estimate for Barrow Island Euros has been relatively stable over time, with the highest population estimates recorded over the last four years. The models for recent years are considered reliable based on available metrics and there is growing evidence that the traditional on-ground spotlighting methods and models used before 2020 may have underestimated the Barrow Island Euro population.
- Analysis found no significant correlations between the Barrow Island Euro population and the time since significant rainfall, or the amount of rainfall received preceding monitoring. However, the non-significant but positive correlation between rainfall and abundance does suggest that population estimates were generally higher

Ecological element: Fauna / habitat
during wetter periods. Barrow Island Euros are understood to be more physiologically sensitive to water stress (Ref. 8); therefore, rainfall would be expected to be an important population driver. • Despite relatively stable Barrow Island-wide population estimates, the ratio of the density estimates indicates that there has been a shift in estimated density and abundance from the At Risk zone to the Reference zone from the commencement of monitoring in 2009, through to 2023. Trend analysis indicates that Barrow Island Euro density has not changed significantly over time within the Reference zone but has shown a U-shaped response over time within the At Risk zone. Therefore, changes within the At Risk zone are more likely to be Project-related or natural factors acting at a local scale, rather than broad environmental conditions. The decline in the At Risk to Reference density ratio from 2012–2016 was suggested to be possibly due to noise effects and/or Project-related mortality. However, the number of industry-related mortalities was positively correlated with the change in abundance estimates within the Reference zone and whole of island population estimate. It is likely that as abundance increased, so has the incidence of mortality. • Despite the significant increase in density estimates within the At Risk zone since 2020, that increase has been proportionally less compared with that in the Reference zone, thus triggering a management review in 2023. • The management review resulted in a Barrow Island Euro diagnostic report (Ref. 9). The current exceedance trigger is largely a result of increased density and abundance estimates in recent years, particularly in the Reference zone. This suggests that the population is likely to have been previously underestimated using the traditional on-ground survey techniques before 2021 when thermal camera survey methods were introduced. It is possible that the refined and improved survey methods and analyses adopted in more recent years (2021–2023) have highlighted a naturally higher density in the Reference zone. The recommended outcome is to continue the current monitoring program including the same transects and methodology each year for consistency to build confidence in density and abundance estimates. • Despite variability evident in the At Risk and Reference zones, abundance estimates indicate a stable, whole of island population of Euros, with no evidence of impacts attributable to the Gorgon Gas Development.

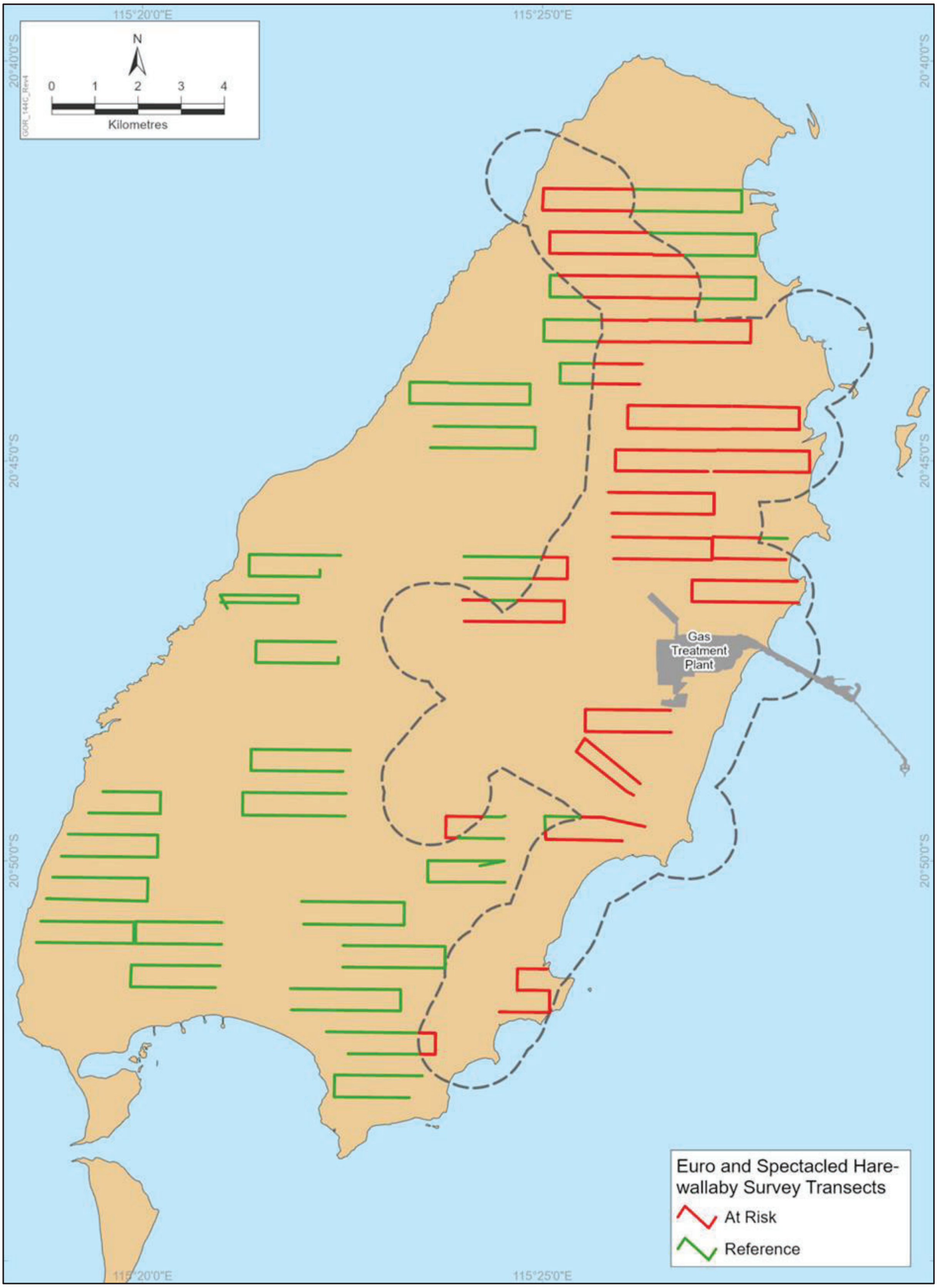

Figure 2-4: Euro and Spectacle Hare-wallaby (Barrow Island) survey transects for the Reporting Period

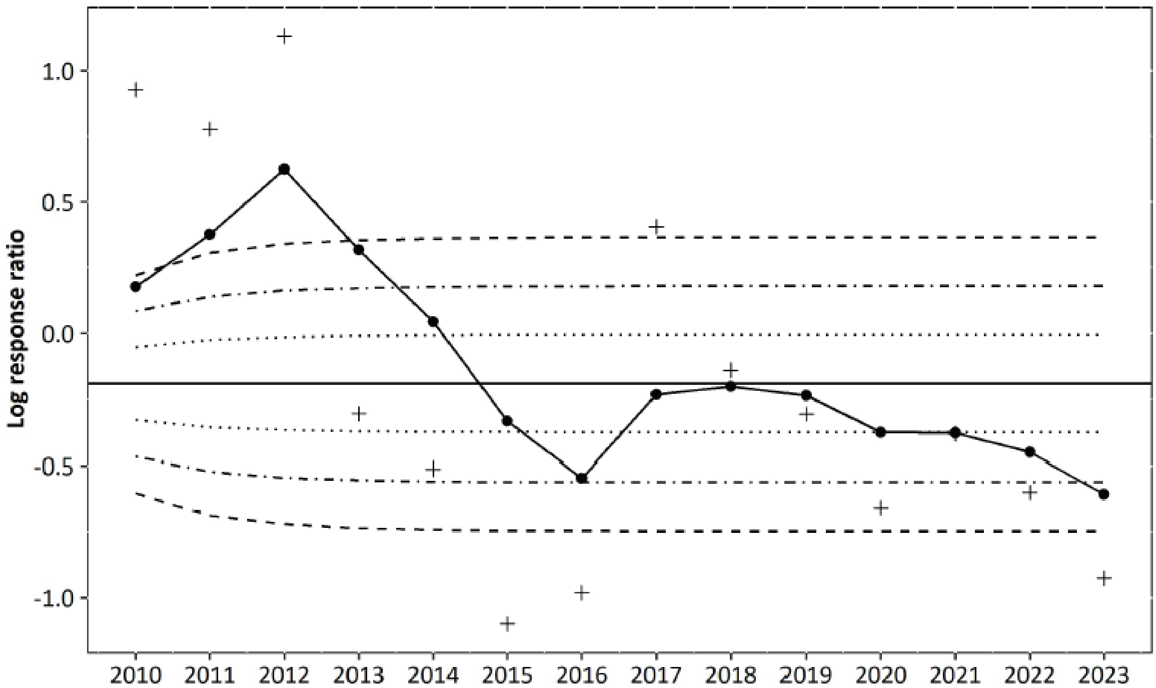

Figure 2-5: EWMA control chart for Barrow Island Euro density at Barrow Island

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.

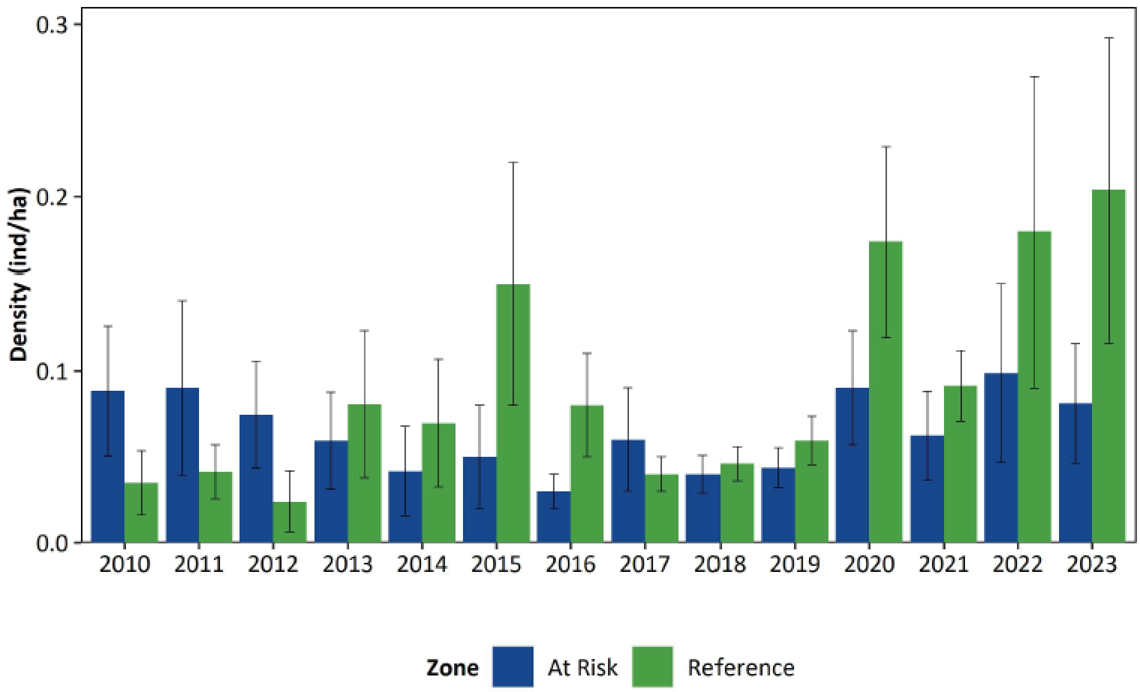

Figure 2-6: Annual estimates of Barrow Island Euro densities within the At Risk and Reference Zones

Ecological element: Fauna / habitat	
Taxon, feature, or species	
Spectacled Hare-wallaby (Barrow Island) (*Lagorchestes conspicillatus conspicillatus*)	
Objective	
To detect variation in abundance—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.	

Changes to monitoring sites

There were no substantial changes to monitoring sites during the Reporting Period.

Methodology

The survey method and data analysis used for the Spectacled Hare-wallaby were the same as those used for the Barrow Island Euro.

Results

- The estimated density of Spectacled Hare-wallabies within the Reference zone was 0.20 (± 0.05) ind/ha and the estimated density within the At Risk zone was 0.12 (± 0.13) ind/ha.
- The estimated abundance of Spectacled Hare-wallabies within the Reference zone was 2,951 (± 793) individuals and the estimated abundance within the At Risk zone was 1,300 (± 344) individuals.
- The Barrow Island-wide density estimate was 0.17 (± 0.04) ind/ha, with an overall population estimate of 4,251 (± 908) Spectacled Hare-wallabies.
- The ratio between the At Risk and Reference zone densities increased from 0.53 in 2022 to 0.61 in 2023, due to a greater density within the Reference zone compared to the At Risk zone. There has been an increase in the measured parameter (density ratio) since 2017, with a decrease in 2022, before increasing again in 2023. The EWMA metric remained within control limits for the fourth consecutive year (Figure 2-7, Figure 2-8).

Discussion and conclusions

- The results from the 2023 monitoring indicate the ratio of population densities in the At Risk to Reference zone for Spectacled Hare-wallabies is within control limits. After deviating outside the EWMA −1 SD control limit in 2019, the ratio between the At Risk and Reference zones returned to within control limits. The ratio has remained in control for the fourth consecutive year, with a slight increase from 2022 due to a greater decrease in the Reference zone density relative to the At Risk zone.
- There was a decrease in density and abundance estimates of Spectacled Hare-wallabies in 2023 across the whole of island and within each zone—these estimates were the lowest recorded since monitoring began. The whole of island population estimate for Spectacled Hare-wallabies has varied considerably over the years, as has the density and abundance estimates within each zone. However, no significant trends over time can be found.
- Although the densities have not changed significantly, the current decrease might be due to below average rainfall, particularly in the three months preceding the survey (53% below average); however, no significant correlations between the amount of rainfall or time since rainfall preceding the surveys and the population estimate of Spectacled Hare-wallabies were found. The lower densities recorded in 2023 may also be due to the more clustered and patchy distribution of Spectacled Hare-wallabies, and that transects in 2023 did not capture as many of these ‘clusters’ as previous years.
- No impacts on the abundance of Spectacled Hare-wallabies appear to be attributable to the Gorgon Gas Development in 2023—the At Risk to Reference density ratio remained within control limits, and there were no significant trends in density estimates over time within each zone.

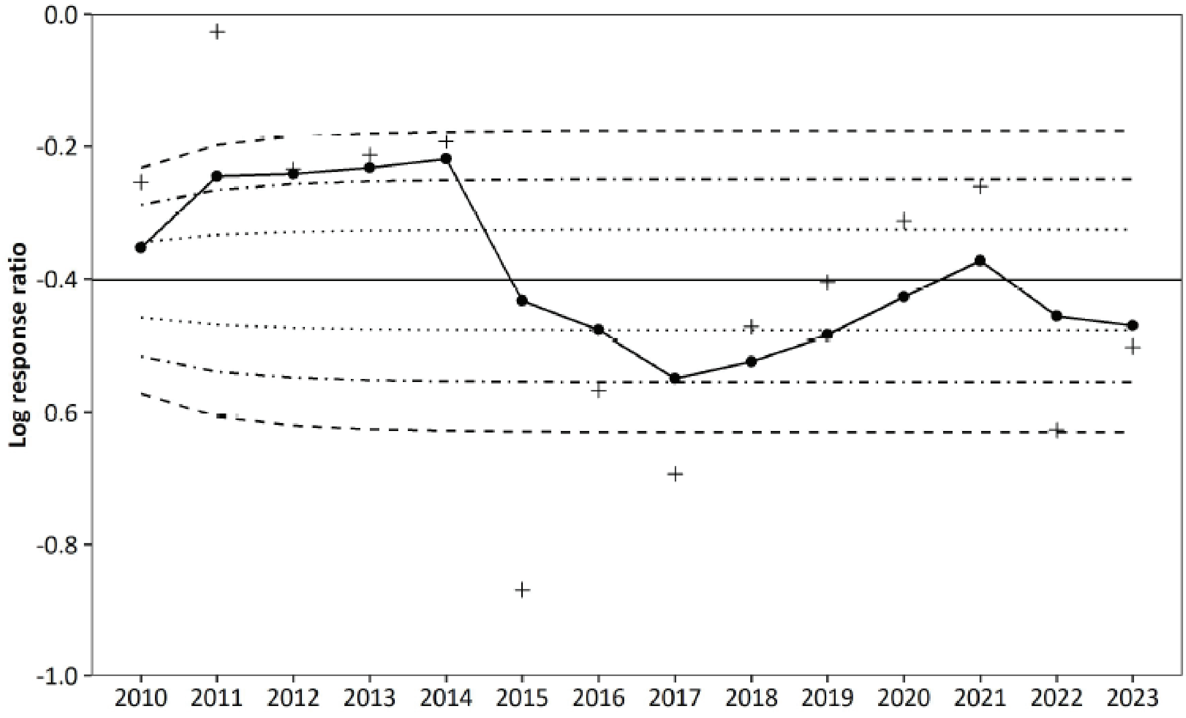

Figure 2-7: EWMA control chart for Spectacled Hare-wallaby density at Barrow Island

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.

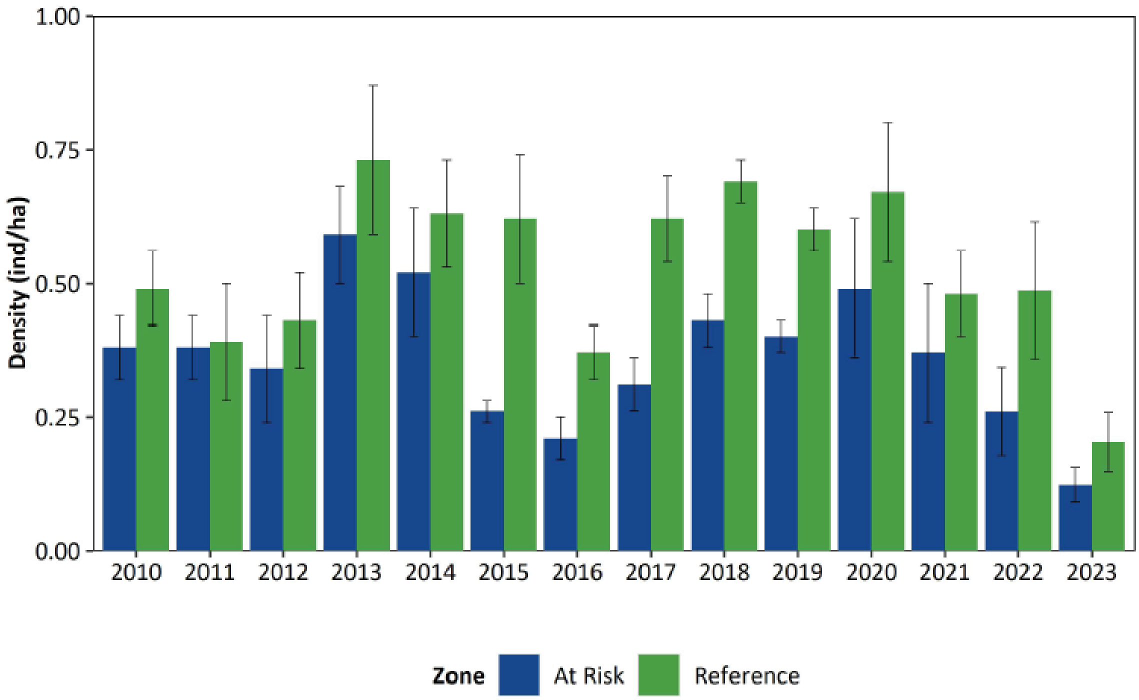

Figure 2-8: Annual estimates of Spectacled Hare-wallaby densities within the At Risk and Reference Zones

Ecological element: Fauna / habitat

Taxon, feature, or species

Burrowing Bettong, Boodie (Barrow and Boodie Islands) (*Bettongia lesueur Barrow* and Boodie Islands subspecies)

Objective

To detect variation in abundance—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.

Changes to monitoring sites

There were no substantial changes to monitoring sites during the Reporting Period.

Methodology

Survey method

- Annual capture-mark-recapture (CMR) sampling using baited cage traps at 25 active Burrowing Bettong warrens (10 in the Reference zone, 15 in the At Risk zone) for three consecutive nights in August 2023.

Analysis method

- The CMR analyses included all capture histories from available data for the 25 sampled warrens using a robust Huggins model design, which included a closed population component (across nights) and open population 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. The 2023 CMR analyses included capture histories from 2012 to 2023.

Notes

- Previous missing data from 2013 and 2014 were made available for this year's report and have been included in the analyses for 2023.
- Data collected between 2009 and 2011 were not used in the analyses as abundance estimates were not accurate due to the trapping grids being confounded by their distance to the nearest Burrowing Bettong warren/s.
- To account for differences in number of traps and number of trapping nights across years, all historical data from warrens that were not monitored in 2023 were excluded from the analysis, and only data from the first three nights of trapping for each warren were retained to align with the most recent sampling design.

Results

- The EWMA control chart for Burrowing Bettong abundance at monitored warrens deviated outside the +2 SD control limit for the first time since monitoring began, with an increasing trend in the abundance At Risk: Reference ratio observed since 2017 (Figure 2-10). This increasing trend is due primarily to a relative decrease in estimated abundance within the Reference zone over time. This deviation triggered an independent review (Ref. 10) of the Burrowing Bettong monitoring database, analysis and results to determine whether any apparent island-wide and/or zone-specific trends might be attributable to anthropogenic hazards or sampling method.
- Although the At Risk to Reference abundance ratio has increased over time, the actual abundance estimates have demonstrated a general decline in both zones since 2014.
- Of the 25 Burrowing Bettong warrens, 14 (56%) have recorded a decline in abundance over the 12 years of monitoring, within both At Risk and Reference warrens experiencing declines to below average abundance estimates in 2023. No Burrowing Bettongs were recorded at three of the warrens within the At Risk zone in 2023.
- In 2023, 14 (56%) warrens recorded an increase in the estimated number of individuals from 2022: Five Reference warrens and nine At Risk warrens. Conversely, six warrens recorded a decrease in the number of individuals from 2022: Three Reference warrens and three At Risk warrens. Five warrens did not change between 2022 and 2023: One warren within the At Risk zone has not recorded any Burrowing Bettongs since 2021.
- In terms of demographics, 164 individual Burrowing Bettongs were recorded in 2023. Monitoring results showed a similar proportion of males (82) and females (81). One additional Burrowing Bettong escaped before it was sexed.

Ecological element: Fauna / habitat
Discussion and conclusions
• The results from the 2023 monitoring indicate that the EWMA metric for Burrowing Bettong abundance has increased due to higher estimated abundance in the At Risk zone when compared to a decrease in estimated abundance within the Reference zone. Actual abundance estimates for Burrowing Bettongs have exhibited a significant declining trend over time in both zones. The change over time within the two zones were significantly positively correlated, suggesting that the declines are, in part, likely due to similar factors acting across all warrens. • The independent review found that the Burrowing Bettong monitoring program on Barrow Island is well-established and provides a robust framework for assessing the risk of exposure of the Burrowing Bettong population to the Gorgon Gas Development (Ref. 10). Based on various forms of datasets derived from the long-term monitoring program, it was concluded (using multiple lines of evidence) that there was no apparent long-term impact to date on Burrowing Bettong population dynamics attributable to exposure to the Gorgon Gas Development. Any apparent decline in Burrowing Bettong population abundance seems most likely due to a combination of two coincidental factors: – a prolonged drought that had an abrupt but temporary impact on Burrowing Bettong annual recruitment rates leading to a decline in the population, and; – to a lesser extent, the change in sampling team and sampling effort per warren from four to three nights, and removal of rotational sampling, from 2020 onwards.

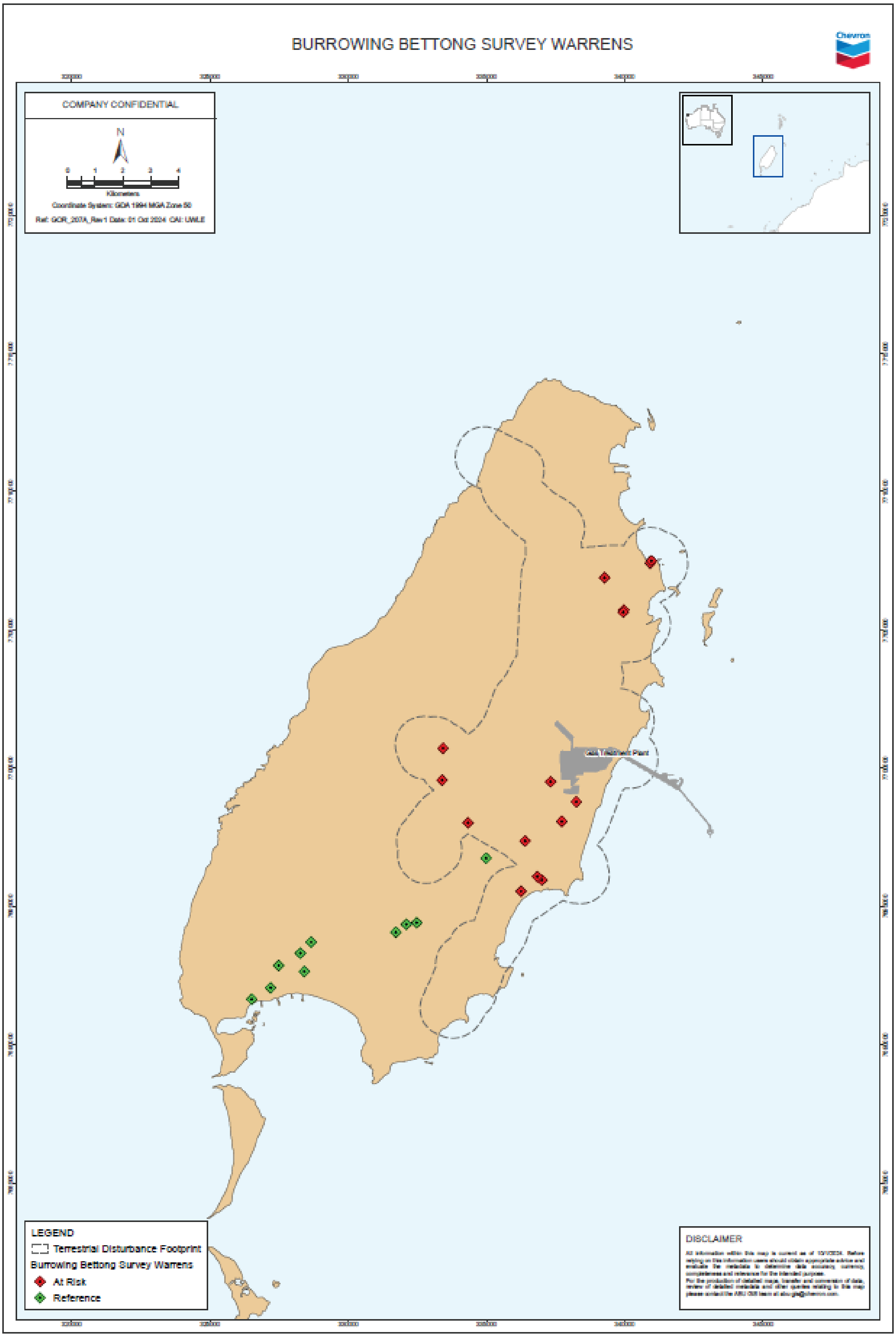

Figure 2-9: Burrowing Bettong warrens surveyed for the Reporting Period

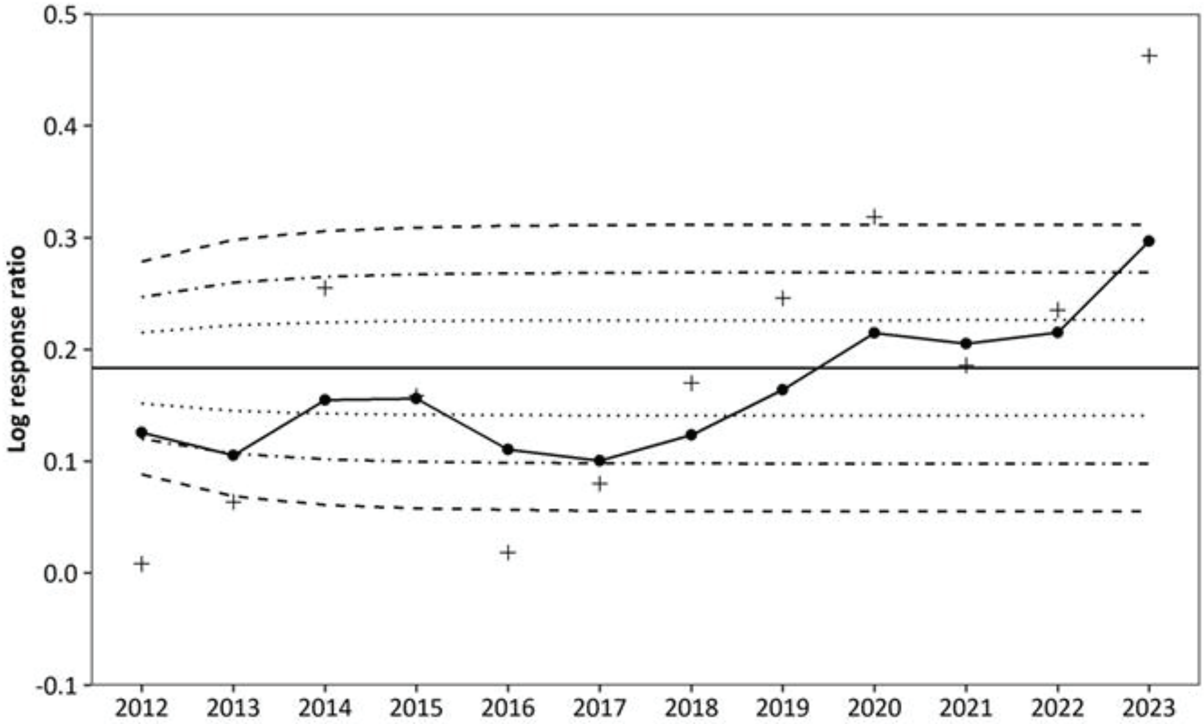

Figure 2-10: EWMA control chart for Burrowing Bettong (Boodie) abundance at monitored warrens.

The response variable is the log of the At Risk/Reference abundance ratio. + = 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. Note: As described in Methodology section above, addition of 2013/14 data has resulted in a variation from figures presented in previous EPRs.

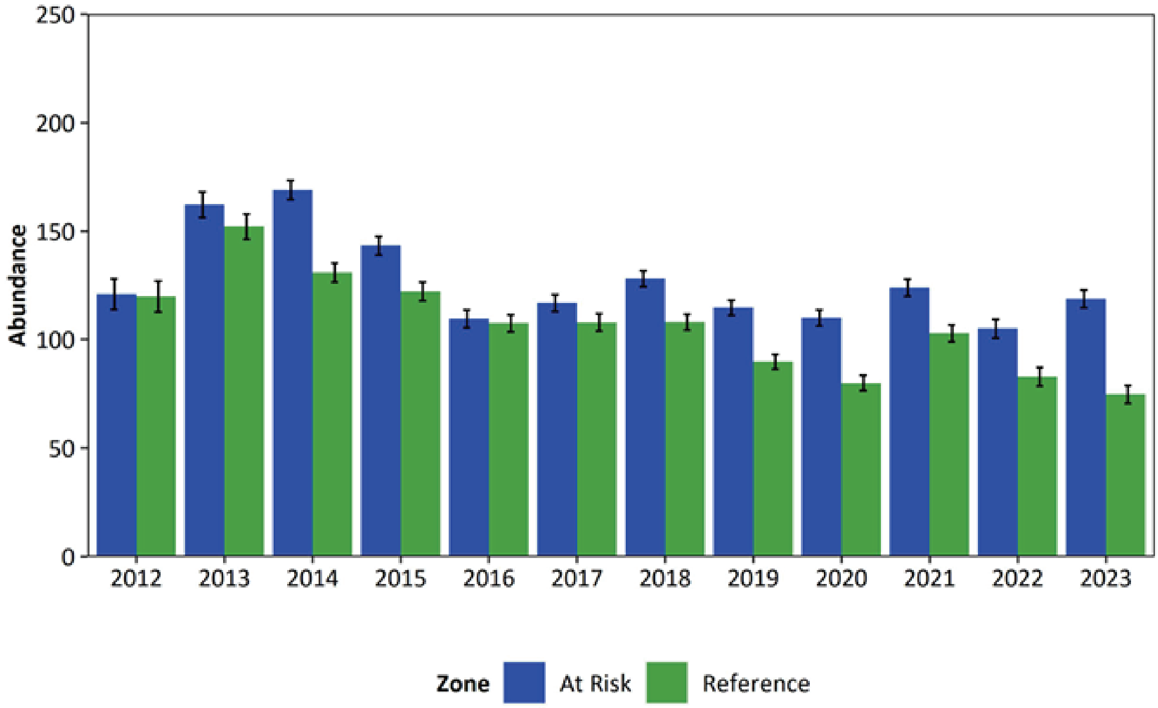

Figure 2-11: Annual estimates of Burrowing Bettong abundance at monitored warrens within the At Risk and Reference Zones

Ecological element: Fauna / habitat	
Taxon, feature, or species	 Source: C. Surman
Wedge-tailed Shearwater (*Ardenna pacifica*)	
Objective	
To detect variation in abundance and demographics—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.	

Changes to monitoring sites

There were no changes to monitoring sites during the Reporting Period.

Methodology

Survey method

- Three fixed long-term transects (100 m × 10 m) on each of Double Island North and Double Island South (At Risk island), and Ah Chong Island (Reference island) were surveyed twice during the summer breeding season (Figure 2-12).
- For each survey, all burrows within transects were counted and their contents identified using a purpose-built burrow scope to determine breeding status. The first survey was undertaken during the early egg incubation period (November 2023) to derive breeding participation estimates. The second survey was undertaken during late chick provision and just before fledging (March 2024) to determine fledging success estimates (burrows that contained live, well-developed fledglings were considered 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 plotted using time-series control charts to understand trends over time.
- Wedge-tailed Shearwater data from the previous season (2022–2023) were revised to exclude old collapsed burrow counts from breeding density and breeding participation calculations. Removing old collapsed burrow counts enabled equivalent comparisons with the current season (2023–2024). Old collapsed burrows represent historical information from previous seasons and are no longer a viable burrow structure that can be used by breeding birds, so should be excluded from current density and participation metrics.

Results

- Wedge-tailed Shearwater burrow density was similar between the Ah Chong Island (9.7 ± 2.4 nests per 100 m^2) and Double Island South (9.4 ± 2.1 nests per 100 m^2), both of which were double that reported from Double Island North (4.8 ± 1.5 nests per 100 m^2) where the nesting habitat and substrate differs. Burrow density at all three monitoring locations were similar to the previous season. For the 2023/24 season the burrow density metric at Double Island South remained within the control limit, and the metric for Double Island North remained outside −1 SD (Figure 2-13).
- Wedge-tailed Shearwater breeding participation was again highest at Double Island North (58.7 ± 2.7%) in 2023–2024, though slightly lower than that reported during the 2022–2023 monitoring period. Breeding participation was also higher at Ah Chong Island (54.7 ± 5.6%) and Double Island South (54.4 ± 16.0%), again increasing from 2022–2023 levels. Wedge-tailed Shearwater breeding participation was slightly lower for the Double Island North population than in the 2022–2023 season, and remained outside the 1 SD control limit (Figure 2-13).
- Wedge-tailed Shearwater fledgling success increased notably across the islands for the season. Double Island South increased to 69.1 ± 3.5%, Double Island North increased to 69.8 ± 19.2% (a similar value to 2021–2022) and Ah Chong Island increased to 74.8 ± 4.0%. Overall, the fledgling success for 2023–2024 remained within control limits for both At Risk islands.

Ecological element: Fauna / habitat
Discussion and conclusions
• The current 2023–2024 season experienced an El Niño event following three previous consecutive years of La Niña oceanographic conditions. Variability in oceanographic conditions such as sea surface temperature are known to affect foraging ability through changes in prey distribution, which influences the reproductive performance in seabirds and their subsequent breeding participation (Ref. 11; Ref. 12; Ref. 13; Ref. 14). However, this season's El Niño conditions were considered relatively weak compared to the last two main events (Ref. 15) and therefore did not appear to create unfavourable conditions for breeding this season. • Wedge-tailed Shearwater burrow density at Double Island North and Ah Chong Island remained similar to 2022–2023, with a minor decrease occurring at Double Island South. Similar to last season, Wedge-tailed Shearwater burrow density at Double Island North exceeded the −1 SD control limit, while Double Island South remained within the control limits. The −1 SD control limit exceedance and associated management alert trigger at Double Island North was again determined to be attributable to the differences in habitat type between the islands. • Wedge-tailed Shearwater breeding participation was slightly lower for the Double Island North population than in the 2022–2023 season, exceeding the +1 SD control limit. The +1 SD control limit exceedance and associated management alert trigger was a result of the relative decrease in breeding participation at Double Island North being less than the relative increase in breeding participation at Ah Chong Island. • Wedge-tailed Shearwater fledgling success has fluctuated over time at both At Risk islands, with less apparent fluctuations recorded at Ah Chong Island. The fledgling success of Wedge-tailed Shearwaters in 2023–2024 showed a significant increase on all islands compared to the previous season (Double Island South 67%; Double Island North 70%; and Ah Chong Island 75%). The cause for the higher fledgling success in 2023–2024 may be related to the provision of sufficient food during the late fledgling development stage, where adults were able to supply enough food for their nestlings. • The Gorgon Seabird Monitoring Program has now obtained 15 years of data (breeding metrics) for the population at Double Island, in comparison with Reference sites. In the absence of baseline monitoring prior to the Gorgon Gas Development, control chart breeding performance metrics obtained from comparing At Risk with Reference sites each season have provided the most appropriate measure to detect potential impacts. There was no indication of Project-attributable impacts to Wedge-tailed Shearwater breeding participation or success in the 2023–2024 breeding season.

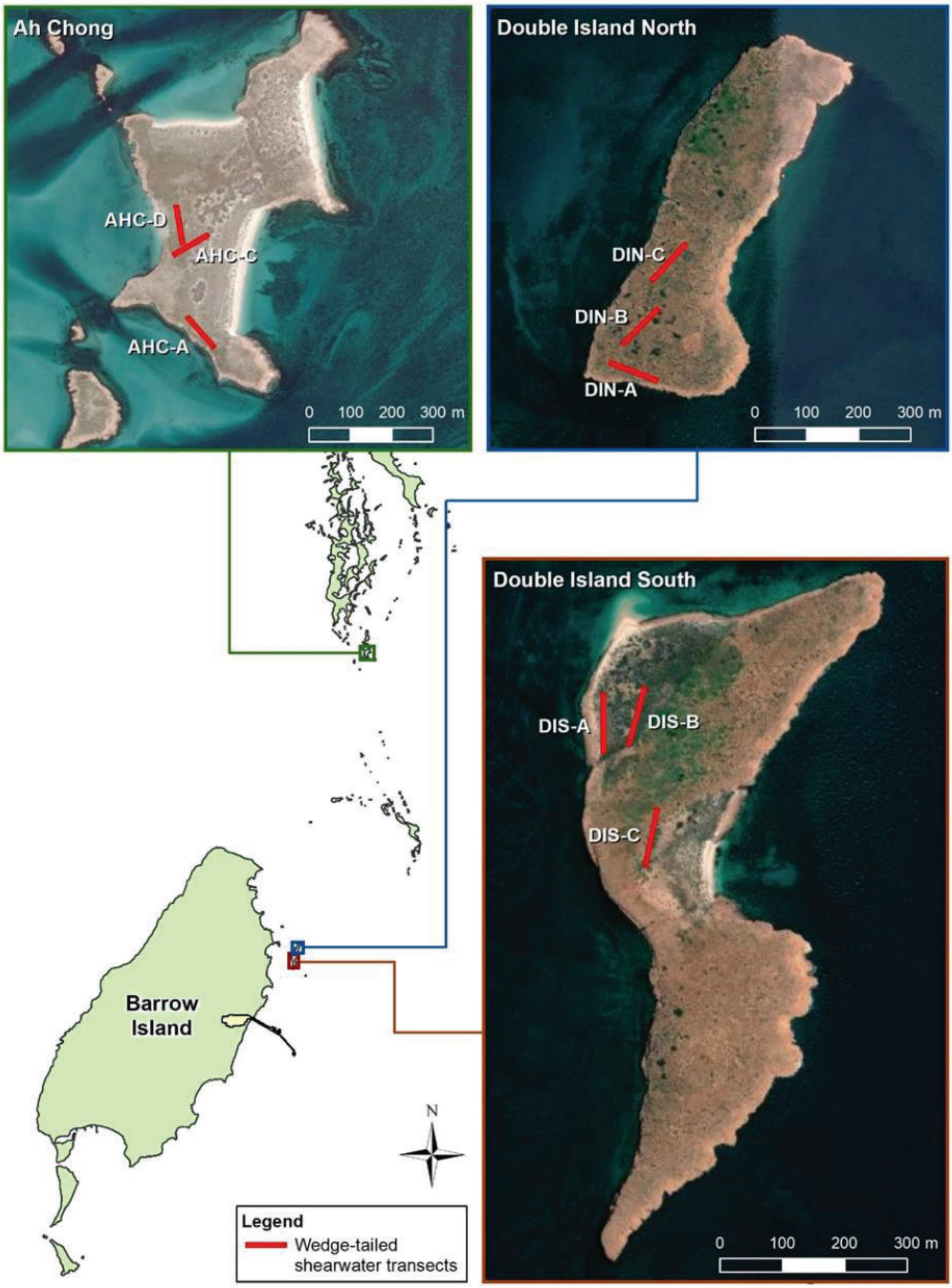

Figure 2-12: Wedge-tailed Shearwater survey transects for the Reporting Period

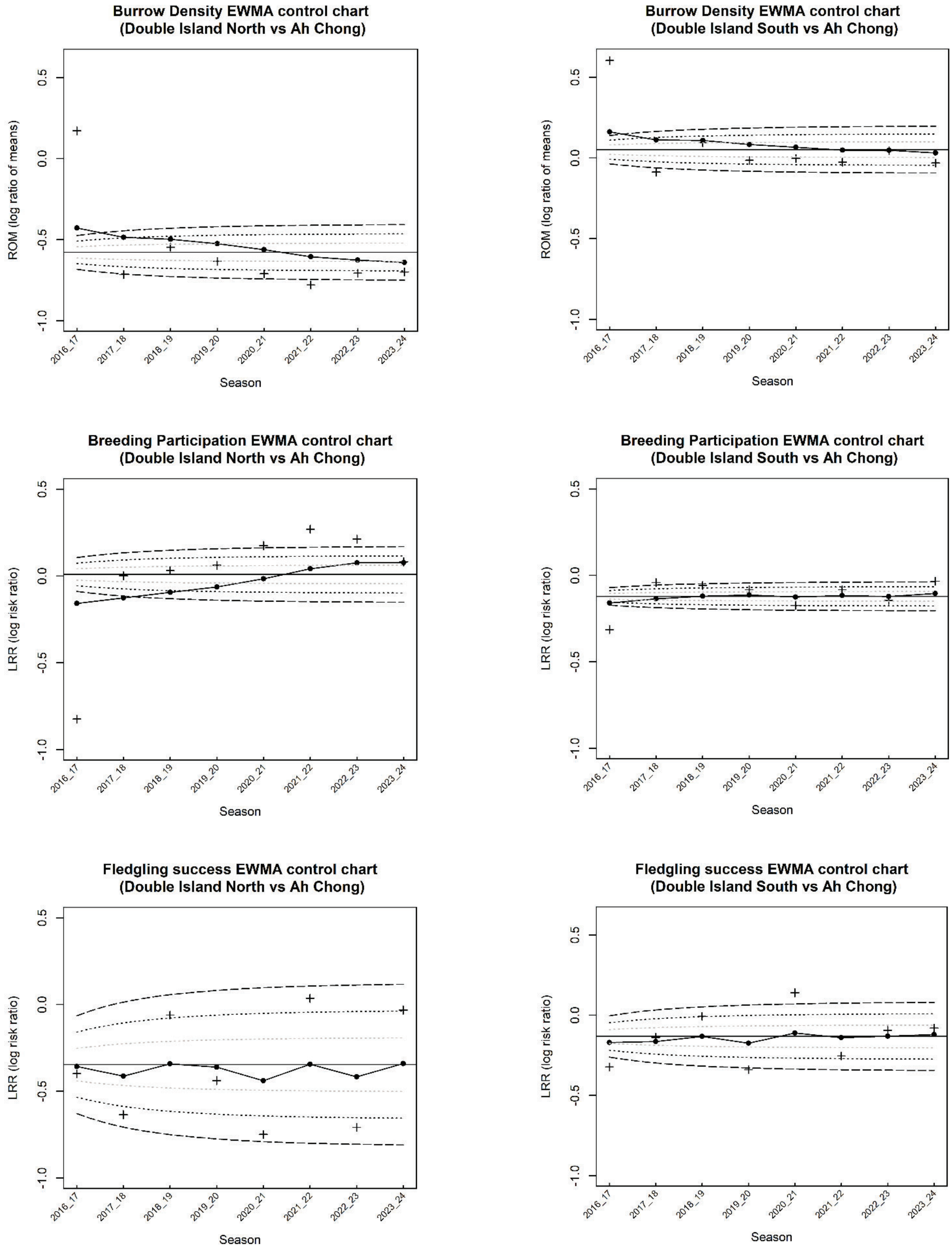

Figure 2-13: Wedge-tailed Shearwater EWMA control charts for nest density (top), breeding participation (middle), and fledgling success (bottom) between At Risk islands (Double Island North and South) and Reference island (Ah Chong)

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

Ecological element: Fauna / habitat

Taxon, species, or feature

Bridled Tern (*Onychoprion anaethetus*)

Objective

To detect variation in abundance and demographics—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.

Changes to monitoring sites

There were no changes to monitoring sites during the Reporting Period.

Methodology

Survey method

- Three fixed long-term transects (100 m × 10 m) on each of Double Island North, Double Island South (At Risk islands), and Parakeelya Island (Reference island) were surveyed twice during the summer breeding season (Figure 2-14).
- For each survey, all nest sites within transects were counted and their contents identified to determine breeding status. The first survey was undertaken during the early egg incubation period (January 2024) to derive breeding participation and nest density estimates. The second survey was undertaken during late chick provision and just before fledging (March 2023) to determine fledgling success estimates (either through direct sighting of a chick, or other indicators such as guano [sign of chick presence but no actual chick observed] 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)
  - Fledgling 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 plotted using time-series control charts to understand trends over time.

Results

- Bridled Tern nest density was similar between Parakeelya Island (8.2 ± 0.7 nests per 100 m^2), Double Island South (9.9 ± 2.6 nests per 100 m^2) and Double Island North (9.0 ± 3.2 nests per 100 m^2). Burrow density at all monitoring locations was similar to 2022–2023 and remained within the control limit for the season (Figure 2-15).
- Breeding participation was marginally lower at all locations in 2023–2024 when compared to the previous season—Parakeelya Island (39.9 ± 5.1%), Double Island South (48.8 ± 5.7%) and Double Island North (41.2 ± 13.0%). Control charts for breeding participation recorded an increasing trend at Double Island South and Double Island North, relative to Parakeelya Island, indicating the relative increases observed at At Risk islands have been greater than that observed at Parakeelya Island (Figure 2-15). At both Double Island South and Double Island North, the metric exceeded the +1 SD control limit and triggered a management alert.
- Fledgling success increased at Double Island North and Double Island South and decreased at Parakeelya Island when compared to the previous season, remaining within the control limits for the 2023–2024 season (Figure 2-15).

Discussion and conclusions

- The current 2023–2024 season experienced an El Niño event following three previous consecutive years of La Niña oceanographic conditions. Variability in oceanographic conditions such as sea surface temperature are known to affect foraging ability through changes in prey distribution, which influences the reproductive performance in seabirds and their subsequent breeding participation (Ref. 11; Ref. 12; Ref. 13; Ref. 14). However, this season's El Niño conditions were considered relatively weak compared to the last two main events (Ref. 15) and therefore did not appear to create unfavourable conditions for breeding this season.

Ecological element: Fauna / habitat
• Nest density for Bridled Terns remained stable in 2023–2024, similar to the previous season, and stayed within the range recorded since 2018–2019. • Bridled Tern breeding participation for both the Double Island North and Double Island South populations was slightly lower than in the 2022–2023 season and exceeded the ±1 SD control limit. Investigation of the +1 SD control limit exceedance and associated management alert trigger indicates these parameters still fell within expected ranges given the level of environmental variability for these breeding populations from one year to the next. Furthermore, as Bridled Tern participation was higher on Double Island South and Double Island North than Parakeelya Island, the lower participation rates at Parakeelya Island may be due to interspecies competition with Silver Gulls for space below *Rhagodia* sp. shrubs for nest sites. • Fledgling success for Bridled Terns was lower on Parakeelya Island and higher at At Risk islands, compared to that observed in 2022–2023, but both remained within control limits for the season. • The Gorgon Seabird Monitoring Program has now obtained 15 years of data (breeding metrics) for the population at Double Island, in comparison with Reference sites. In the absence of baseline monitoring prior to the Gorgon Gas Development, control chart breeding performance metrics obtained from comparing At Risk with Reference sites each season have provided the most appropriate measure to detect potential impacts There is no evidence to suggest observed variations in abundance and demographics parameters are attributable to Gorgon Gas Development.

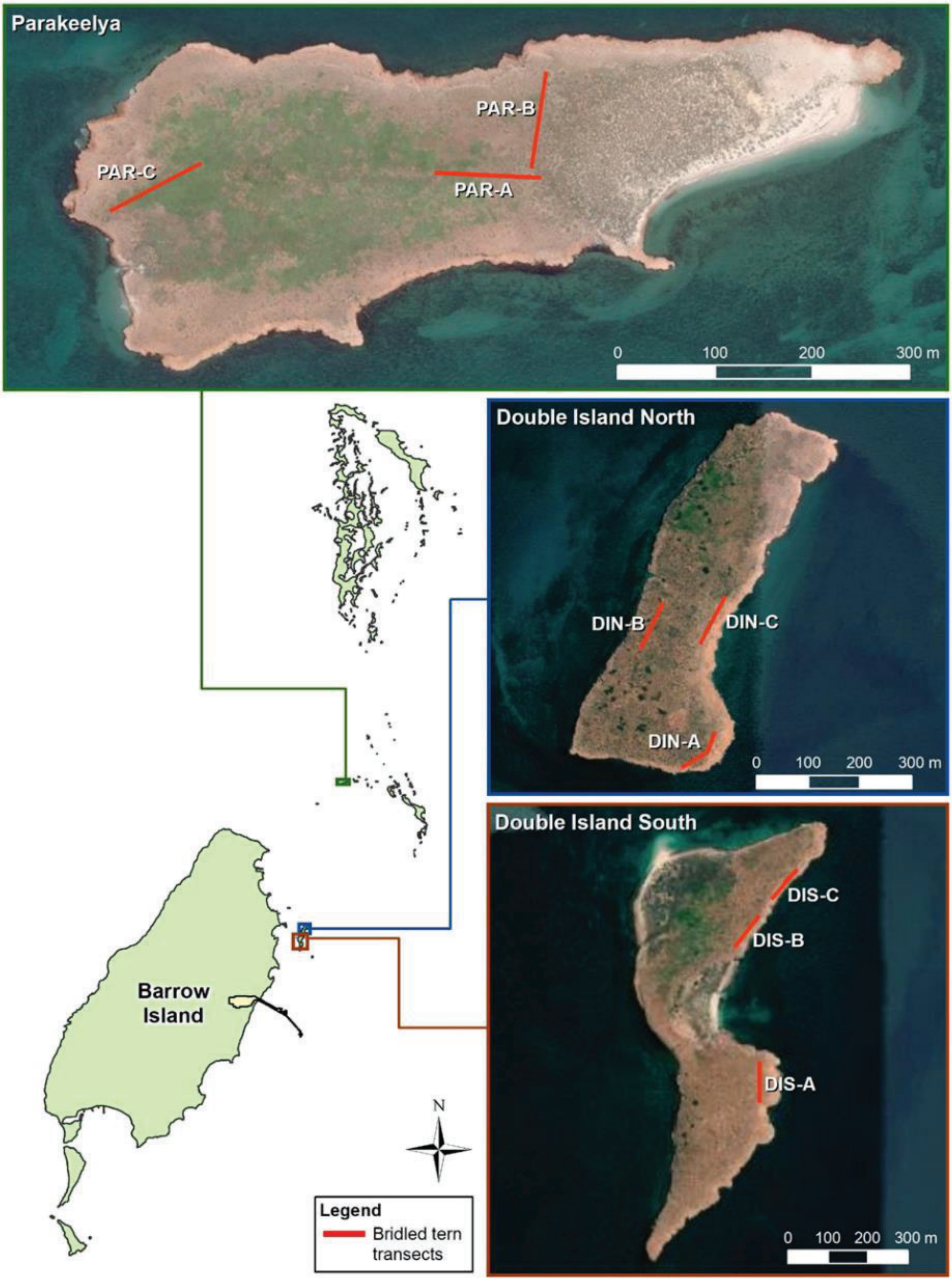

Figure 2-14: Bridled Tern survey transects for the Reporting Period

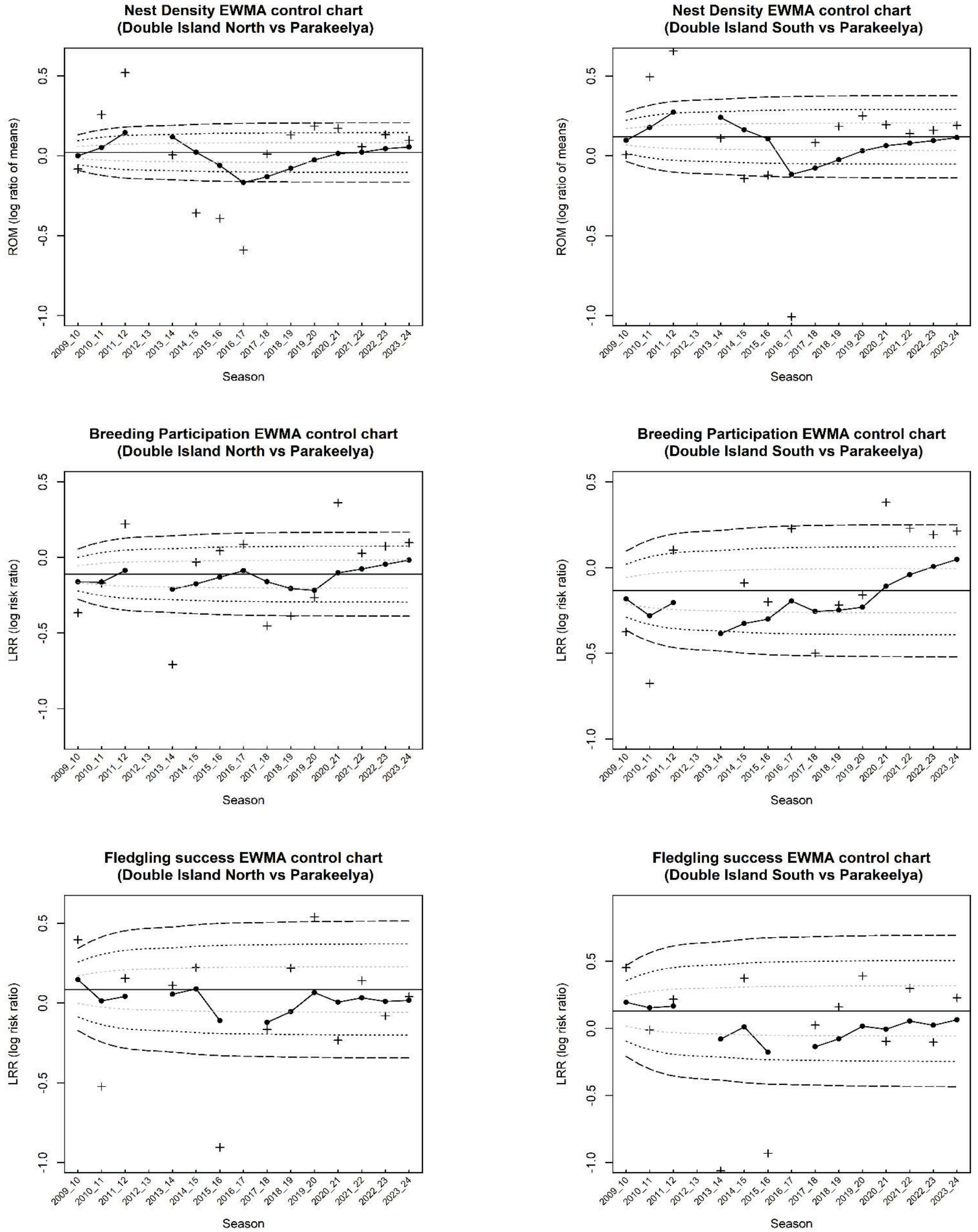

Figure 2-15: Bridled Tern control charts for nest density (top), breeding participation (middle), and fledgling success (bottom), between the At Risk islands (Double Island South and North) and Reference island (Parakeelya)

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

No Bridled Tern monitoring occurred in 2012–2013 and fledgling success could not be estimated in 2016.

Ecological element: Groundwater / ecological communities
Taxon, feature, or species
Superficial aquifer
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
There were no changes to monitoring sites during the Reporting Period.
Methodology

Monitoring frequency
• Since November 2016 biannual sampling has been undertaken in accordance with the Operational SAQP (Ref. 16).
• During the Reporting Period, two biannual groundwater monitoring events (GMEs) were undertaken (August 2023 and March/April 2024).
Sampling method
• Groundwater samples were collected from 14 monitoring wells within the GTP, two monitoring wells near the Permanent Wastewater Disposal (PWD) wells on Road 5, and two monitoring wells near the Temporary Wastewater Injection Plant (TWIP) wells. 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 monitoring wells - shallow
  – Laboratory analysis was conducted for physical parameters, major cations, major anions, mercury, monoethylene glycol (MEG), methyldiethanolamine (MDEA), benzene, toluene, ethylbenzene, and xylenes (BTEX), total recoverable hydrocarbons (TRH), and dissolved organic carbon (DOC).
• GTP monitoring wells - deep
  – Laboratory analysis was conducted for physical parameters, major cations, major anions, mercury, MEG, MDEA, and DOC.
• Monitoring wells near PWD wells
  – Laboratory analysis was conducted for physical parameters, major cations, major anions, mercury, MEG, MDEA, BTEX, TRH, DOC, and nutrients.
• Monitoring wells near TWIP wells
  – Laboratory analysis was conducted for physical parameters, major cations, major anions, BTEX, TRH, DOC, and nutrients.
Based on the primary analytical results, some wells were analysed for additional analyses 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 against baseline values for each well and 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 monitoring wells Analysis of results for the GTP monitoring 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. 16]), except for the following: • Physical parameters: – All monitoring wells recorded one or more quality parameters (EC, TDS, sodium, potassium, calcium, magnesium, chloride and sulfate) outside the baseline minimum maximum range but within the same order of magnitude during the August 2023 and March/April 2024 GMEs.

Ecological element: Groundwater / ecological communities
– Monitoring wells GW05-B, GW05-E, GW-GTP-01A, GW-GTP-01B, GW-GTP-04A and GW-GTP-14A reported a slight increase in pH during both sampling periods, but the recorded values were within the adopted assessment criteria. – Generally, a trend towards an oxidising redox state was observed at most well locations during the August 2023 GME, with results at most wells exceeding baseline values. In the March/April 2024 GME, two monitoring wells reported a change of redox state from their baseline states of mildly reducing to mildly oxidising (GW-GTP-02B) and mildly reducing to oxidising (GW-GTP-03B). • Mercury, MDEA, TRH, BTEX, naphthalene, and MEG were not detected above the LOR in the GTP wells that are part of the routine monitoring plan (as outlined in the Operational SAQP [Ref. 16]) in August 2023 and March/April 2024. • In August 2023, some metal concentrations were recorded below the pre-operation minimum baseline value or within baseline values for most monitoring wells, except for GW-GTP-15A, GW-GTP-24B and GW05-B. Monitoring well GW-GTP-15A reported barium, strontium, and zinc slightly above the maximum baseline concentrations but below the assessment criteria. Strontium in monitoring well GW-GTP-24B and barium in monitoring well GW05-B were reported slightly above the maximum baseline concentrations but below the assessment criteria. Cadmium was not detected above the LOR at GW-GTP-01B and GW-GTP-02B in August 2023, however, the LOR for cadmium (<0.0002 mg/L) was greater than the maximum baseline (<0.0001 mg/L). Zinc was not detected above the LOR at GW-GTP-01B and GW-GTP-04B in August 2023, however, the LOR for zinc (<0.005 mg/L) was greater than the maximum baseline for zinc at each well (0.004 mg/L and 0.003 mg/L, respectively). • In March/April 2024, some metal concentrations were recorded below the pre-operation minimum baseline value or within baseline values for most monitoring wells, except for GW-GTP-15A, GW-GTP-01A, GW-GTP-03A, GW-GTP-04A and GW05-B. Monitoring well GW-GTP-15A reported barium, cadmium, cobalt, strontium and zinc above the maximum baseline, though within ranges reported in previous monitoring rounds. Barium exceeded the maximum baseline concentration in monitoring well GW05-B, and vanadium exceeded the maximum baseline concentration in GW-GTP-01A and GW-GTP-03A, however, all these results were below the respective assessment criteria. Hexavalent chromium exceeded the assessment criteria (0.001 mg/L) in GW-GTP-04A (0.002 mg/L). These results were all within the same order of magnitude when compared to baseline concentrations, therefore, no further management action was taken. • During the April 2023 monitoring event in the previous reporting period, MDEA was detected above the LOR and assessment criteria of 0.001 mg/L in five monitoring wells (GW-GTP-03A, GW-GTP-03B, GW-GTP-04A, GW-GTP-04B and GW-GTP-014A) located in the south portion of the GTP. Re-sampling of these wells was undertaken during a separate event in October 2023, in which MDEA was not detected above the LOR in any of the wells. These results were confirmed during both the August 2023 and March/April 2024 monitoring events. Further investigation with the field team and laboratory personnel supported the conclusion that the MDEA detections in April 2023 were anomalous, likely due to cross-contamination during sampling and/or transport of the samples to the laboratory, and that the results are not representative of the groundwater quality at the GTP. *Monitoring wells near TWIP wells* Analysis of results for the monitoring wells in proximity to the TWIP 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. 16]), except for the following: The concentration of nitrate (as N) reported at DWDB1-MW2 slightly exceeded the pre-operations maximum baseline value (8.3 mg/L) in August 2023 (9.72 mg/L) and was subsequently below the maximum pre-operations baseline value in March/April 2024 (8.24 mg/L). Concentrations of nitrate (as N) in both wells (DWDB1-MW2 and DWDB2-MW3) during both monitoring events exceeded the assessment criterion of 1.70 mg/L; however, given that the minimum baseline values for both DWDB1-MW2 (2.4 mg/L) and DWDB2-MW3 (4.7 mg/L) exceed the criterion for this analyte, no further management action was taken. • At DWDB1-MW2, barium levels exceeded the assessment criteria (0.61 mg/L) in August 2023 (0.904 mg/L) and in March/April 2024 (0.928 mg/L). In August 2023 and March/April 2024, strontium levels at DWDB1-MW2 (3.93 mg/L and 4.22 mg/L) exceeded the assessment criteria (3.3 mg/L). An exceedance of the assessment criteria for consecutive GMEs triggered further investigation of existing data and relevant information. These results for barium and strontium were all within the same order of magnitude when compared to baseline concentrations, therefore, no further management action was taken. • Hexavalent chromium levels at DWDB2-MW3 in August 2023 (0.006 mg/L) and March/April 2024 (0.005 mg/L) were below the pre-operation baseline maximum (0.03 mg/L) but exceeded the assessment criteria (0.001 mg/L) during both events. Given that the pre-operation baseline minimum concentration (0.002 mg/L) also exceeds the assessment criteria, no further management action was taken. • Naphthalene and BTEX were below the LOR in both wells during the August 2023 and March/April 2024 GMEs. At location DWDB1-MW2, TRH >C_{16}-C_{34} Fraction F3 was detected during both the August 2023 (0.11 mg/L) and March/April 2024 (0.15 mg/L) events which is above the assessment criteria (0.10 mg/L) but below the pre-

Ecological element: Groundwater / ecological communities
operation baseline maximum (0.20 mg/L). Additional analysis of TRH with silica gel clean-up (SGC) was conducted on each sample from DWDB1-MW2 with results reporting TRH below the LOR. *Monitoring wells near the PWD wells* Analysis of results for the monitoring wells in proximity to the PWD 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. 16]), except for the following: • Physical parameters: – Groundwater conditions at GW-RD5-02 and GW-RD5-03 have shown a trend of decreasing salinity since operations commenced. In the August 2023 and in the March/April 2024 GME, the groundwater salinity at both wells has been reported as 'fresh' since August 2017. Lower salinity was reported in GW-RD5-02 and GW-RD5-03 during the August 2023 and March/April 2024 events. – The redox state of GW-RD5-02 was reported as reducing to mildly reducing during the baseline; however, in the March/April 2024 GME was reported as mildly oxidising. A change in overall oxidation-reduction state from baseline results was observed at GW-RD5-02 and GW-RD5-03 during the August 2023 GME. – The DO in both PWD monitoring wells (GW-RD5-02 and GW-RD5-03) remains high, ranging between three and ten times higher when compared to the maximum baseline values. – Observed variability in physiochemistry from baseline ranges was generally only marginal and potentially attributed to seasonality. • Elevated levels of nitrate (as N) were reported at GW-RD5-02 in the August 2023 GME (2.12 mg/L) and March/April 2024 GME (1.87 mg/L), with the concentration exceeding the pre-operation baseline maximum values (0.3 mg/L) and the assessment criterion (1.70 mg/L). An exceedance of the assessment criteria for consecutive GMEs triggered further investigation of existing data and relevant information, and levels were found to be consistent with previous levels at this location. Further routine monitoring is planned to continue to examine this trend. • Total phosphorus exceeded the adopted assessment criteria (0.015 mg/L) at GW-RD5-02 (0.02 mg/L) and GW-RD5-03 (0.04 mg/L) during the August 2023 event and at GW-RD5-02 (0.02 mg/L) during the March/April 2024 event, however, these were only slightly above the respective baseline maximum values (0.01 mg/L and 0.014 mg/L), therefore no further management action was required. • Mercury, TRH, BTEX, naphthalene, MDEA, and MEG were not detected above the LOR in the monitoring wells in the August 2023 and March/April 2024 GMEs, consistent with previous monitoring results. The LOR for naphthalene (<0.005 mg/L) exceeded the adopted assessment criteria (0.001 mg/L). • Metals concentrations were generally recorded below the baseline minimum value or within baseline values for both permanent disposal monitoring locations, except for vanadium at GW-RD5-02, which marginally exceeded the baseline maximum value during the March/April 2024 event but was below the assessment criteria.
Discussion and conclusions
• Groundwater monitoring during the reporting period is considered to have been completed in accordance with the TSEMP (Ref. 1). Monitoring was undertaken in accordance with the Operational SAQP (Ref. 16). • The results from the groundwater monitoring program, as per the Operational SAQP, have generally indicated that no significant observable changes to relevant groundwater parameters were attributable to the Gorgon Gas Development during the Reporting Period. • As such, no unacceptable risk to local stygofauna is present at the site as groundwater is representative of natural background chemistry in the karstic aquifer and it is likely that stygofauna communities are adapted to these environmental conditions.

Ecological element: Surface water landforms
Taxon, feature, or species
Geomorphological profile of drainage lines and claypans
Objective
To detect impacts to surface water landforms—attributable to the Gorgon Gas Development and Jansz Feed Gas Pipeline—over time.

Ecological element: Surface water landforms
Changes to monitoring sites
There were no changes to monitoring sites during the Reporting Period. All 14 sites were transitioned to direct field inspection in 2020 after two or more years had elapsed since clearing or earthworks, and remote sensing had not identified any Project-related impacts (Figure 2-16).
Methodology
• Detecting changes to surface water landforms at risk of erosion or sedimentation is undertaken annually using remote sensing and/or direct field inspection of Reference sites (upstream of the disturbance, e.g. road, pipeline right-of-way) and At Risk sites (downstream of the disturbance) or by direct field inspection after heavy or cyclonic rainfall. • A review of aerial imagery was undertaken, comparing imagery captured in October 2022 and October 2023 (Ref. 17).
Results
Below average rainfall occurred on Barrow Island in 2023 with no rainfall recorded in June, July, September and December. A single above average rainfall event occurred during August (18.0 mm). With this level of rainfall, no significant erosion or sedimentation was observed at any of the 14 monitoring sites via aerial imagery. As there were no areas of significant impact to surface water landforms identified through desktop analysis, follow up field inspections were not required.
Discussion and conclusions
Monitoring to date has not detected impacts (attributable to the Gorgon Gas Development) to surface water landforms.

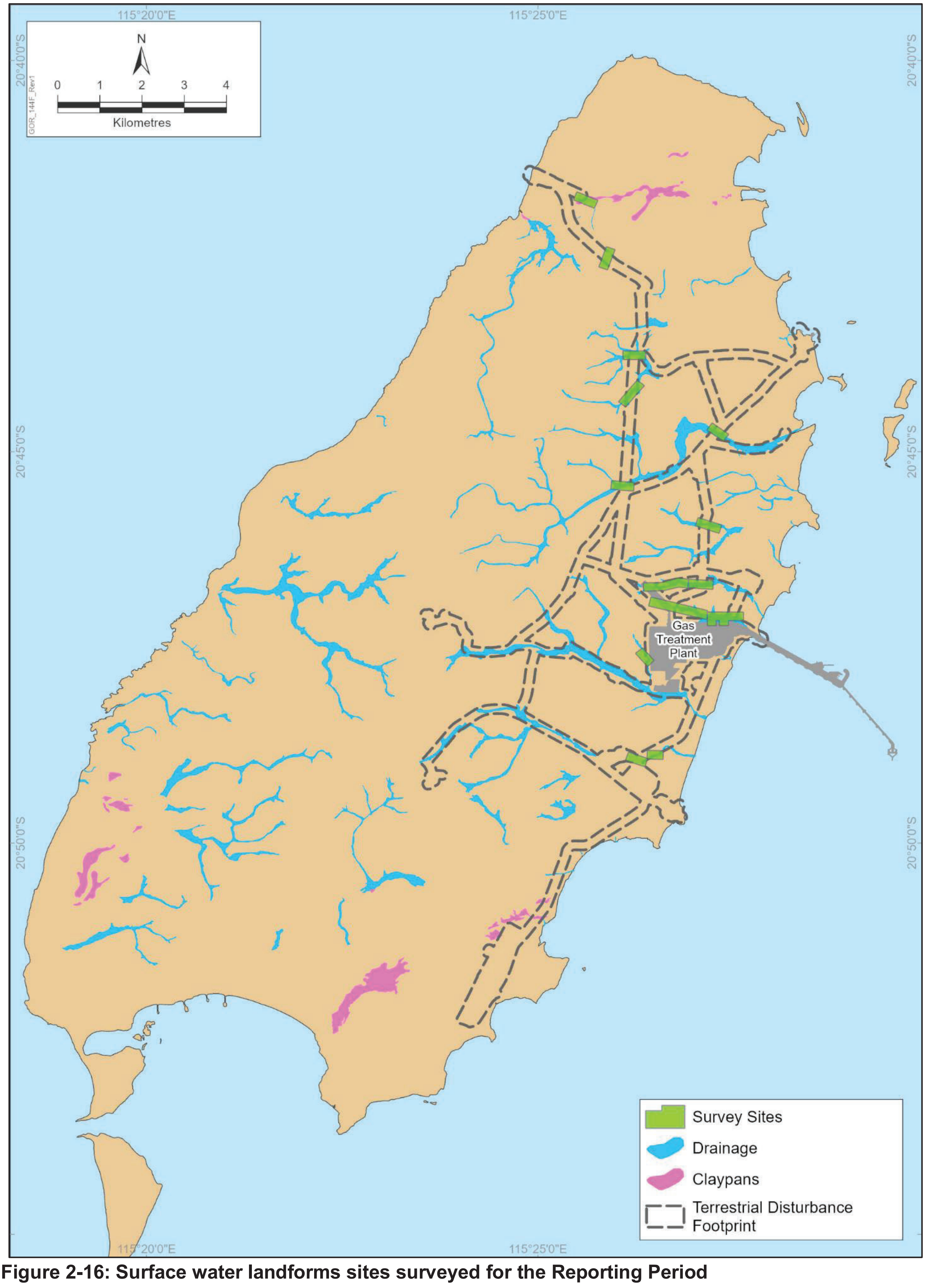

Figure 2-16: Surface water landforms sites surveyed for the Reporting Period

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) and WA *Biodiversity Conservation Act 2016* (BC Act) Threatened or Listed fauna injured or killed during the Reporting Period both within and outside the TDF. This includes where the cause was either attributed to the Gorgon Gas Development or listed as unknown.
Fauna interaction: Management initiatives, activities, and improvements
• A comprehensive awareness campaign was undertaken during the Reporting Period to highlight operational risks to fauna and reinforce reporting commitments, in the form of site notices, toolbox talks, and attendance of ecologists and environmental specialists at prestart meetings. • A roadside vegetation clearing trial was undertaken to increase visibility of fauna along roads. • Maximum vehicle speed limitations changed during the last reporting period from 40 km/h during civil twilight hours to 40 km/h between sunrise/sunset. This resulted in a greater time period each day where the maximum speed was 40 km/h, a reduction from the previous maximum speed (60 km/h) during the period of higher risk of fauna / vehicle interactions. • Vehicle speed limit reductions (to 40km/hr) were introduced during and following rainfall events, to reduce risk of impacts to fauna when they are more prevalent/active along roads. • Fauna road signs continued to be installed in areas considered at higher risk of fauna / vehicle interactions. • The development of an online Fauna Event tool continued to progress during the reporting period; this will support direct upload of fauna event information into the reporting database • Ongoing investigation of additional safeguards to further reduce the incidence of vehicle strikes. • No threatened or listed fauna were cared for[2] during the Reporting Period

Table 2-2: EPBC Act and BC Act Threatened or Listed fauna recorded as injured or deceased during the Reporting Period within and outside the TDF

Common name	Species name	No. deceased[1]
Barrow Island Euro	*Osphranter robustus isabellinus*	28
Burrowing Bettong, Boodie (Barrow and Boodie Islands)	*Bettongia lesueur Barrow and Boodie Islands subspecies*	7
Spectacled Hare-wallaby (Barrow Island)	*Lagorchestes conspicillatus conspicillatus*	51
Golden Bandicoot (Barrow Island)	*Isoodon auratus barrowensis*	161
Water Rat, Rakali	*Hydromys chrysogaster*	1
Nankeen Kestrel	*Falco cenchroides*	3
Silver Gull	*Chroicocephalus novaehollandiae*	3
Wedge-tailed Shearwater	*Ardenna pacifica*	2
Welcome Swallow	*Hirundo neoxena*	1

1 *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 death was from natural causes.*

2 *Does not include cared-for fauna that is held temporarily, and that is not believed to be sick, diseased or abandoned (i.e. captured and temporarily held for relocation). The following are not included as cared for fauna:*

   a. *Fatigued fauna, such as storm-blown seabirds.*

b. *Fauna captured for relocation and held temporarily until dusk or dawn for release.*

c. *Injured fauna which is immediately euthanised.*

d. *Fledgling birds (uninjured and not sick) that are subsequently released on island.*

2.3 Changes to the Terrestrial and Subterranean Environment Monitoring Program

The TSEMP (Ref. 1) was revised and submitted for approval during the Reporting Period. In accordance with the variation to EPBC 2003/1294 and 2008/4178 conditions issued 7 August 2023, Revision 2.2 of the TSEMP was submitted to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 28 June 2024. Subsequently it was also submitted to the WA Department of Water and Environmental Regulation (DWER) on 5 August 2024. Included in Revision 2.2 were updates to background information and consultation process, review of current monitoring programs and management triggers and inclusion of new monitoring programs and research opportunities. Revision 2.2 of the TSEMP was under review with both DCCEEW and DWER during the Reporting Period, and CAPL continues to engage with the regulators on this matter.

3 Terrestrial and marine quarantine

Table 3-1: EPR 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'[1] 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)	3.2
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)	3.2
Mitigation actions	MS 800, Schedule 3(2vi) EPBC 2003/1294 and 2008/4178, Schedule 3(2vi)	3.2
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[2]
Weed management incidents: • new infestations • proliferations	MS 800, Schedule 3(2viii) EPBC 2003/1294 and 2008/4178, Schedule 3(2viii)	N/A[3]
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[3]
Targets proposed for the next year	MS 800, Schedule 3(2x) EPBC 2003/1294 and 2008/4178, Schedule 3(2x)	3.2

1. *Although MS 800 refers to 'near misses', 'intercept' is the appropriate term, and therefore is used below. The term 'intercept' is used throughout the QMS (Ref. 18).*
2. *No QMS-related studies were implemented during the Reporting Period; therefore, reporting is not applicable at this time.*
3. *No proliferations of existing weeds or new weed establishments were recorded during the Reporting Period; therefore, reporting is not applicable at this time.*

3.1 Audits

CAPL audits of the quarantine management measures described in the QMS (Ref. 18) are conducted at least every two years during operations. There was one internal audit undertaken during the Reporting Period. This audit was completed by a third-party scientific consultant and focused on 21 selected commitments from the QMS and six conditions relating to the QMS in MS 800. The audit methodology followed the ABU OE Assurance Audit Procedure (OE-12.01.1018) and included interviews, desktop document reviews and data collection and visual observations of activities (including site and contractor facility inspections). The audit identified two findings, five recommendations, three observations, 14 satisfactory outcomes and four examples of good practice.

- The first finding related to the Quarantine response activities associated with the detection of NIS on Barrow Island and highlighted inconsistent commitments between the QMS and the Quarantine Response Guideline. The corrective action involves reviewing the QMS or supporting documentation to align transition criteria between the different response phases.
- The second finding related to Quarantine Advice Reports. The QMS requires the contractor to complete actions outlined in Advice Reports within a specified timeframe and to the satisfaction of the Chevron Australia Quarantine Manager. There was limited evidence observed during the audit to demonstrate how contractors were completing actions in Advice Reports per the requirements of the QMS (including within specified timeframes and to the satisfaction of the Chevron Australia Quarantine Manager). The corrective action involves reviewing the Advice Report template to improve the recording of completed actions and to demonstrate approval by Chevron Australia.

No regulator audits were carried out on the QMS during the Reporting Period.

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
To 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. • Validation of the weed surveillance program was completed by undertaking a Botanist Assurance field visit (weed inspection, surveillance and control within designated areas on Barrow Island).
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*), all vegetative – Blackberry Nightshade (*Solanum nigrum*), including fruiting and flowering individuals – Common Sowthistle (*Sonchus oleraceus*), all vegetative – Bulrush (*Typha sp.*) plants were detected in drains within the GTP. • Surveillance associated with Kapok (*Aerva javanica*) detected in the 2016–2017 Reporting Period continued. There were no detections of kapok bush during the Reporting Period. • No new Weed Hygiene Zones were required to be established during the Reporting Period.

Surveillance program: Plant NIS

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

To 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: baited traps (including sticky traps), cardboard traps, biologist structured surveys (day and night), pitfall traps, leaf litter sieving, and workforce observations/reporting.

Results

NIS invertebrates recorded during the Reporting Period were:

- Jumping Spider (*Menemerus nigli*)
- Maritime Earwigs (*Anisolabis maritima*)

Jumping Spider (Menemerus nigli)

- During the Reporting Period, 393 M. nigli were detected associated with infrastructure at the Materials Offloading Facility (MOF), Butler Park, the Barrow Island airport, the Old Airport, Terminal Tanks, POF and the GTP (Figure 3-1). Surveillance included 206 hours across 22 locations, including 10 which were away from infrastructure. The species was not recorded in new areas during the Reporting Period, and it was not detected in the natural environment on Barrow Island.
- During the previous Reporting Period, CAPL reported on *M. nigli* which is a NIS that was introduced to Barrow Island because of, and after, the Gorgon Gas Development commenced.
  - In accordance with MS 800 Conditions 9.2 and 10.3, the QEP wrote to the Minister for Environment on 16 September 2021 to notify them of this establishment. CAPL will continue to engage with the Minister, the QEP and other SMEs on this matter.
  - The consequences of introduction are yet to be determined; however, initial advice from SMEs anticipates that M. nigli will have a low to negligible impact on Barrow Island's biodiversity. Eradication or mitigation measures are yet to be determined following further advice from the Minister.
  - CAPL has implemented control measures, including insecticide treatment of selected infrastructure, to minimise the potential for proliferation.
  - Targets are developed in response to introductions of NIS. Delineation surveillance continues to be undertaken and, following further advice from the Minister, this will determine the response or management program and targets.

Maritime Earwig (Anisolabis maritima)

- 160 Maritime Earwigs were detected in sticky traps at the MOF, within the Reporting Period, as part of an ongoing Quarantine Response (NIS detected in the previous Reporting Periods). Although numbers have reduced compared to the previous reporting period, there has been an increase in the response area and response activities remain in place.

Ring legged Earwig (Euborellia annulipes)

- During the reporting period first response activities continued within Butler Park and the GTP in search for the ring legged earwig (*E. annulipes*). There were no detections recorded.

Identification of some specimens from the 2023–2024 surveillance program is still pending, and any NIS detections will be included in the 2025 EPR.
Conclusions
Menemerus nigli is an NIS, which was introduced to Barrow Island because of, and after, the commencement of the Gorgon Gas Development. This declaration was made during the 2021–2022 Reporting Period. During this Reporting Period, delineation is continuing, to establish the extent of this species on Barrow Island. All other NIS detected during the Reporting Period were controlled immediately or are under an ongoing Quarantine Response.

Figure 3-1 Known detections of Jumping Spider (*Menemerus nigli*) during the Reporting Period

Surveillance program: Vertebrate NIS
Objective
To 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), cage traps, Elliot traps, pitfall traps, hair cards, environmental acoustic recognition sensors, print acquisition for wildlife sensors, and workforce observations/reporting.
Results
The following NIS vertebrates were recorded during the reporting period: • One Asian House Gecko (AHG) (*Hemidactylus frenatus*) was detected in a maintenance workshop within the GTP via a remote surveillance device customised to detect AHG vocalisation. A Quarantine Response was initiated and an adult male AHG was captured four days later. The Quarantine response remained in place for 11 weeks and included 418 hours of targeted surveillance and inspection of materials and personnel working in the area. The site was released back to normal operations following the treatment of equipment and infrastructure with methyl bromide.
Conclusions
No introductions of vertebrate NIS, attributable to Gorgon Gas Development activities, were recorded during the Reporting Period.

Surveillance program: Marine pests
Objective
Detect the presence of Marine Pests in the waters around Barrow Island, attributable to Gorgon Gas Development activities.
Methodology
• The Marine Pest Surveillance Program conducted at Barrow Island during the Reporting Period included analysis of environmental deoxyribonucleic acid (eDNA) from settlement arrays (including 16 plates each) and water samples. DNA present on settlement arrays and in water samples was analysed using next-generation sequencing methodology, or real-time polymerase chain reaction testing, and the results compared against a reference database of targeted Marine Pests. • Surveillance and sampling locations focused on high-risk localities around operational areas. • Thirty-three settlement plates (soaked for either approximately two or seven months) were collected. Three replicates were taken from each array and analysed. .
Results
Five sampling events from six settlement arrays were completed for eDNA analysis during the Reporting Period (in October and November 2023, and February, May, and July 2024). Cyclone response activities impacted the settlement plate sampling schedule, with some sampling delayed, or brought forward as needed. The White ascidian (*Didenmum perlucidum*) was detected in settlement plates sampled from the tug pen in May 2024. This species is widespread in Western Australian waters. *Didemnum perlucidum* has been recorded in Barrow Island waters periodically since 2012 and it is considered likely that this species was present before the Gorgon Gas Development commenced. The detection of *D. perlucidum* during the 2023–2024 Reporting Period is not considered attributable to Gorgon Gas Development activities. No other Marine Pests were detected during this Reporting Period or the 2022-2023 Reporting Period.[1]
Conclusions
No introduction of Marine Pests, attributable to Gorgon Gas Development activities, was recorded during the Reporting Period.

1 *The outcome of some of the eDNA analysis of settlement plate arrays and water samples from 2022-2023 Reporting Period are also presented in this Report, as results were not available during the previous Reporting Period.*

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 intercepts, with special reference to weeds.

Figure 3-2 Asian house gecko at GTP

Figure 3-3 Bulrush within drain at GTP

Results

During the 2021-2022 Reporting Period a quarantine introduction was declared (Jumping Spider, *Menemerus nigli*; refer to invertebrate NIS surveillance section above for further detail). This species is still present and under a delineation and surveillance response.

During the Reporting Period, three Quarantine Incidents, 32 Quarantine Intercepts, and 12 Quarantine Procedural Deviations were recorded (see Section 12 for quarantine event terminology). Details are provided below.

Quarantine Incidents

- Two Level 1 incidents involving the detection of Bulrush (*Typha sp.*) in the drains within the GTP. All non-indigenous species associated with these incidents were collected, contained and removed. Surveillance was implemented and, in each case, no additional specimens were detected.
- One Level 3 incident involving the detection of AHG (*Hemidactylus frenatus*) in a maintenance workshop within the GTP (Refer to NIS vertebrate surveillance section above for further detail).

Quarantine Intercepts

- Most Quarantine Intercepts were associated with NIS invertebrates (41%) and seed material (38%).
- One Gisborne Cockroach (*Drymaplaneta semivitta*) was detected and contained within a consignment of fresh food opened within Butler Park camp facilities. As a precaution, surveillance was implemented, and no additional specimens were detected.
- One AHG scat was detected during final quarantine clearance of a half-height container from the marine vessel at the MOF (during discharge). A quarantine response was implemented, with the container and vessel ultimately rejected from Barrow Island.

Procedural Deviations

- The detection and remediation/rejection of containers with holes or onion (peeling) rust and the detection and removal of non-compliant commodities from site (eg. unapproved natural materials).

Conclusions

- Delineation and surveillance activities for *M. nigli* continues, which was declared during the 2021-2022 Reporting Period as introduced to Barrow Island, as a result of and after the Gorgon Gas Development commenced.
- All other NIS detected during the Reporting Period were responded to and controlled immediately following detection or remain under a quarantine response as indicated above.
- Surveillance will continue for Buffel Grass (*Cenchrus ciliaris*) and Kapok Bush (*Aerva javanica*) until CAPL is confident no residual seed banks remain within the Weed Hygiene Zones.
- Following the Quarantine Incidents, Intercepts, and Procedural Breaches recorded, actions were taken to reinforce quarantine training, procedures, and Gorgon Gas Development quarantine requirements.

3.4 Changes to the Quarantine Management System

Following the review of the QMS (Ref. 5) during the 2021-2022 Reporting Period, the updated QMS was submitted to the DWER in February 2022 and DCCEEW in October 2022. CAPL are yet to receive approval for the updated QMS and continue to engage with DWER and DCCEEW on this matter.

4 Marine turtles

Table 4-1: EPR 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, 4.6
Reportable incidents involving harm to marine turtles	MS 800, Schedule 3(3ii) EPBC 2003/1294 and 2008/4178, Schedule 3(3ii)	4.3
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, 4.5
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)	4.5
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)	4.2
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 (Ref. 19): '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. 20), 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) was also established. Where relevant, data related to these key parameters are also captured at Mundabullangana for comparison with the Barrow Island Flatback Turtle data (Ref. 20).

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. 20).

The 2023–2024 results (Ref. 21) 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.

Source: J. Kalau

Changes to program

Six out of a planned 60 monitoring nights at Mundabullangana were not completed due to the presence of lightning, rainfall and strong winds.

Methodology

Survey method

- Flatback Turtle abundance and distribution monitoring via capture-mark-recapture (CMR) was undertaken between 24 November 2023 and 28 January 2024 on six beaches north and south of the GTP on Barrow Island, as shown in Figure 4 1. Routinely monitored beaches are Mushroom, Terminal, Bivalve, Inga, Yacht Club North and Yacht Club South.
- Monitoring at Mundabullangana was undertaken between 6 November 2023 and 13 January 2024 on the beaches shown in Figure 4 2.

Analysis method

- CMR sampling of nesting adult female Flatback Turtles was used to estimate these demographic parameters:
  - annual nester abundance
  - adult female survival probability
  - adult female breeding omission probability
  - nesting activity
  - clutch frequency
  - internesting interval.
- A multi-state open robust design (MSORD) model uses the CMR dataset to derive the population demographic estimates. To facilitate comparison, the same parameters are estimated for Mundabullangana using the same approach as Barrow Island.
- Exponentially weighted moving average (EWMA) control charts have been used to compare nester abundance between the At Risk site Barrow Island and the Reference site Mundabullangana since 2009/10. Only key demographic parameters are control-charted—including annual nester abundance, adult female breeding omission probability and clutch frequency. The adult survival probability control chart is no longer presented as 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.
- 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 the historical control-charted parameter estimates presented in this EPR.

Error in previous monitoring results

- In 2024, an error was discovered in the MSORD model code responsible for filtering the CMR dataset. The error related to data collected on Junction, A07 and Camp beaches, which are non-routine monitoring beaches on Barrow Island, and part of a study to investigate turtle movements outside the six routine beaches (see Section 4.2.1). This error led to an overestimation of the annual abundance of adult flatback turtle nesters in each season since 2016/17. DWER and DCCEEW were informed of this error in July 2024.

Monitoring program: Flatback Turtle abundance and distribution
• This filtering error has been corrected, so the MSORD results presented in this EPR use the updated CMR dataset to derive the population demographic estimates. Consequently, the estimates in the control charts for annual nester abundance, breeding omission probability, and clutch frequency will differ from those presented in previous EPRs since 2016/17, as will the EWMA control chart that compares Barrow Island and Mundabullangana annual nester abundance.
Results
Annual nester abundance (-2 MAD control limit exceedance) • Population size modelling using a capture-mark-recapture MSORD model estimated an annual nester abundance of 1,237 ± 22 female turtles on the six monitored beaches at Barrow Island and 1,259 ± 39 female turtles on the two monitored beaches at Mundabullangana (Figure 4-3). • The abundance estimates for Barrow Island and Mundabullangana remained within the EWMA control limits, and decreased at both locations when compared to the 2022/23 season (Figure 4-3). • The annual nester abundance, at Barrow Island exceeded the -2 MAD control limit which was the lowest annual estimate since monitoring commenced (Figure 4-4 a.i). As the previous two seasons at both Barrow Island and Mundabullangana experienced higher-than-usual nester abundance, therefore it was concluded that more turtles would have had a higher probability of skipping breeding this season to replenish reserves etc. leading to a lower abundance. *Adult female survival probability* • The estimated annual survival probability for nesting Flatback Turtles on Barrow Island was 0.922 (95% CI (confidence interval): 0.919–0.925) and at Mundabullangana was 0.942 (95% CI: 0.937–0.945). *Adult female breeding omission probability (+3 SD control limit exceedance)* • The breeding omission probability of a Flatback Turtle nesting at Barrow Island in a season (if the turtle nested the previous season) was estimated as 0.83 ± 0.01. This parameter exceeded the +3 SD control limit, returning from -2 SD exceedance in 2022–2023 (Figure 4-4b). The breeding omission probability at Mundabullangana was 0.54 ± 0.02, higher than the 2022-2023 season (0.28) but lower than the probability estimated for Barrow Island this season. Indicating that there was a lower probability of a turtle that nested in the previous season, skipped the next nesting season at Mundabullangana compared to Barrow Island. *Clutch frequency (-1 SD control limit exceedance)* • The estimated clutch frequency at Barrow Island was 3.3 ± 0.1 SE per female per season, exceeding the -1 SD control limit (Figure 4-4c). *Internesting interval* • The mean internesting interval for Flatback Turtles at Barrow Island was 14.3 ± 1.8 days and showed no significant trend. At Mundabullangana, the mean internesting interval for Flatback Turtles was 12.5 ± 1.8 days and showed no significant trend. *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. Consistent with recent seasons, the nesting population's use of certain beaches has likely varied due to changes in coastal processes, notably at Inga, Bivalve, and Terminal beaches, which have recorded a reduction and redistribution of nesting habitat (see Section 9 on Coastal Stability). Concurrently, the same beaches have recorded a shift in the location and change in the pattern of their nesting activities and, in the case of Bivalve beach, a significant decreasing trend in use of the beach.

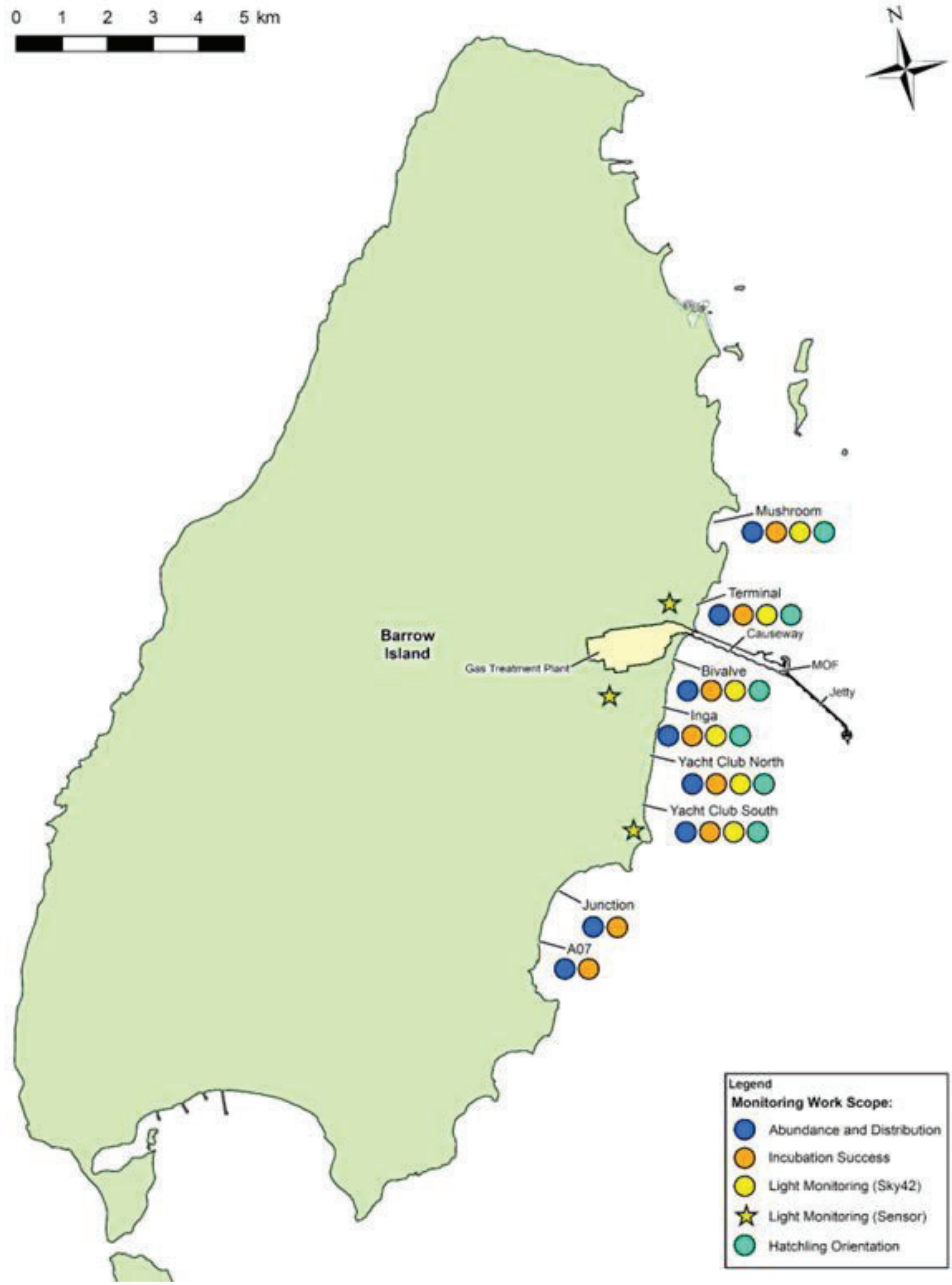

Figure 4-1: Flatback Turtle beaches on Barrow Island surveyed during the Reporting Period

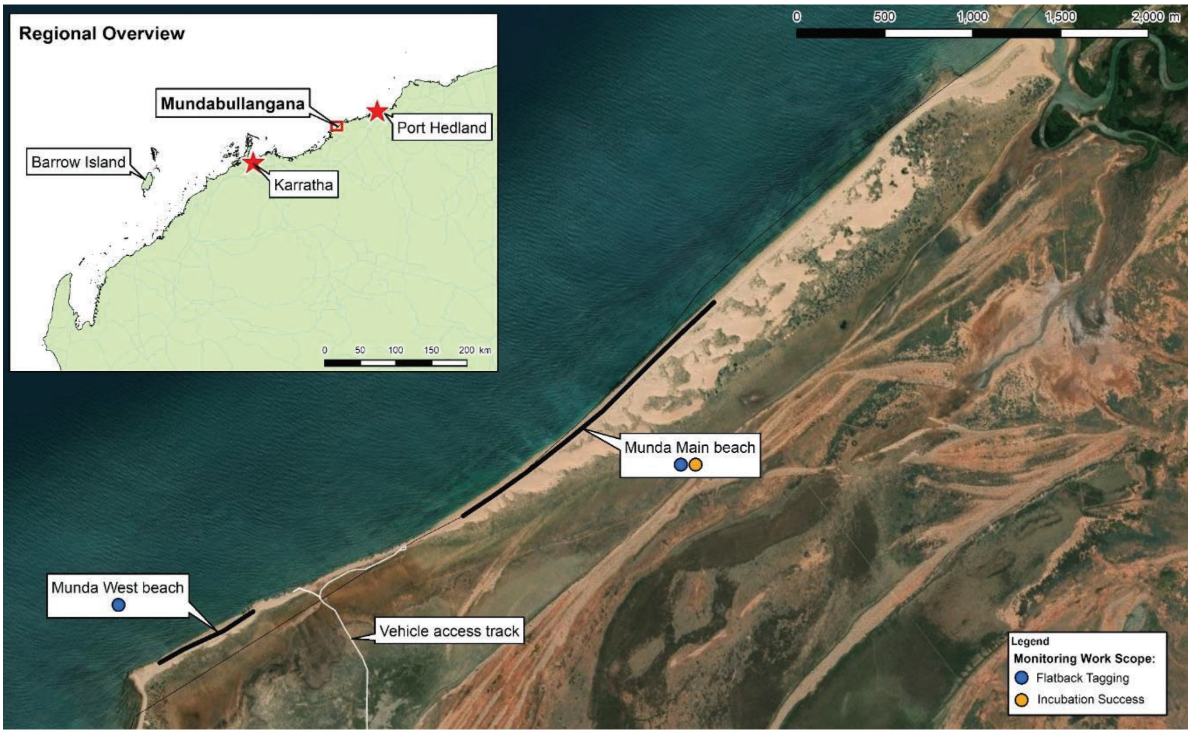

Figure 4-2: Flatback Turtle beaches at Mundabullangana surveyed during the Reporting Period

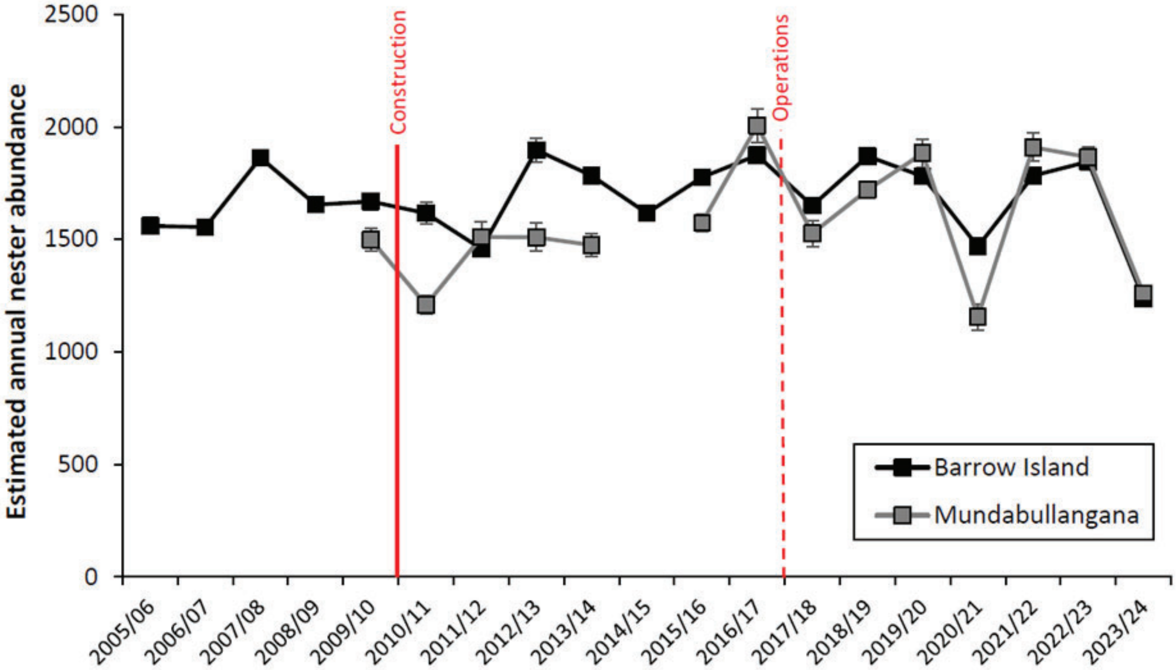

Figure 4-3: Annual abundance estimates at Barrow Island and Mundabullangana between 2005–2006 and 2023–2024[1]

1. *Error bars indicate 95% confidence intervals (CI). Red line indicates commencement of construction. Red dashed line indicates commencement of operations. No estimate is available for 2014–2015 at Mundabullangana due to limited sampling in that season.*

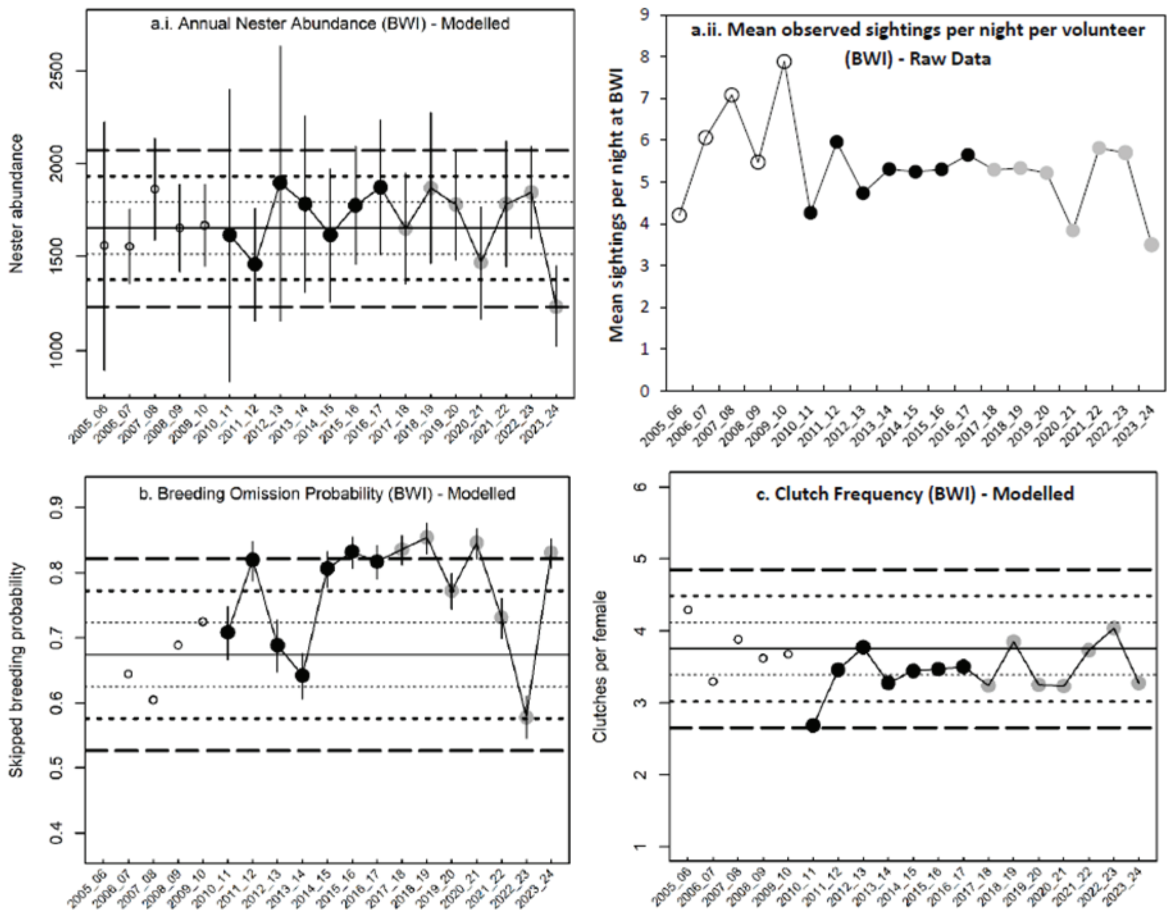

Figure 4-4: Control charts for Flatback Turtle population demographic metrics at Barrow Island including (a.i) annual nester abundance for Barrow Island vs Mundabullangana, (a.ii) mean observed sightings per night per volunteer (included as a comparison to modelled annual nester abundance), (b) adult female breeding omission probability at Barrow Island, and (c) clutch frequency at Barrow Island[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 for annual nester abundance), small dashed lines = ±2 SE (or 2 MAD), long dashed lines = ±3 SE (or 3 MAD). Error bars: a.i the lower error bar represents the minimum number of turtles based on raw counts, while the upper bar represents the difference between the raw turtle count and the estimated value but in an upwards direction; and b. the error bars indicate standard error.*

Monitoring program: Flatback Turtle incubation success

Objective

To measure and detect changes to Flatback Turtle incubation success.

Source: J. Kalau

Changes to program

No changes were made to the Flatback Turtle Incubation success monitoring program during the Reporting Period.

Methodology

- Flatback turtle incubation monitoring was undertaken on Routine Beaches: Inga, Bivalve, Terminal and Mushroom beaches between 4 December 2023 and 18 March 2024 (Figure 4-1). This was later than original scheduled dates due to delays from a potential cyclonic weather system. Monitoring at Mundabullangana was undertaken between 7 November 2023 and 13 January 2024 (Figure 4-2).
- 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. 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

- The median egg hatching probability at Barrow Island (complete clutches) was 94.1%, which was significantly higher compared to all clutches at Mundabullangana (91.2%). The parameter remained within management control limits (Figure 4-5a).

Hatchling emergence probability

- The median hatchling emergence probability at Barrow Island (complete clutches) was 93.9%, which was significantly higher compared to Mundabullangana (87.7%). The parameter remained within management control limits (Figure 4-5b).

Incubation duration

- The mean incubation duration at Barrow Island and Mundabullangana was 46.3 ± 2.6 and 46.3 ± 1.2 days, respectively.

Incubation temperature

- The mean daily clutch temperature during incubation at Barrow Island and Mundabullangana was 31.1 ± 1.3 °C and 32.1 ± 1.2 °C, respectively.

Clutch fate

- Of the 152 marked clutches at Barrow Island, 128 (84%) were considered complete. The remaining 24 incomplete clutches were either disturbed by another turtle or predator (n=18) or lost during incubation (n=6). These disturbance events occurred during incubation (as indicated by the temperature logger data). The percentage of marked clutches that were categorised as incomplete at Barrow Island (all beaches combined) in each season since 2010–2011 does not show a significant trend.

Clutch size

Monitoring program: Flatback Turtle incubation success

- The mean clutch size at excavation was 44.3 ± 8.9 eggs at Barrow Island and 48.1 ± 6.1 eggs at Mundabullangana.

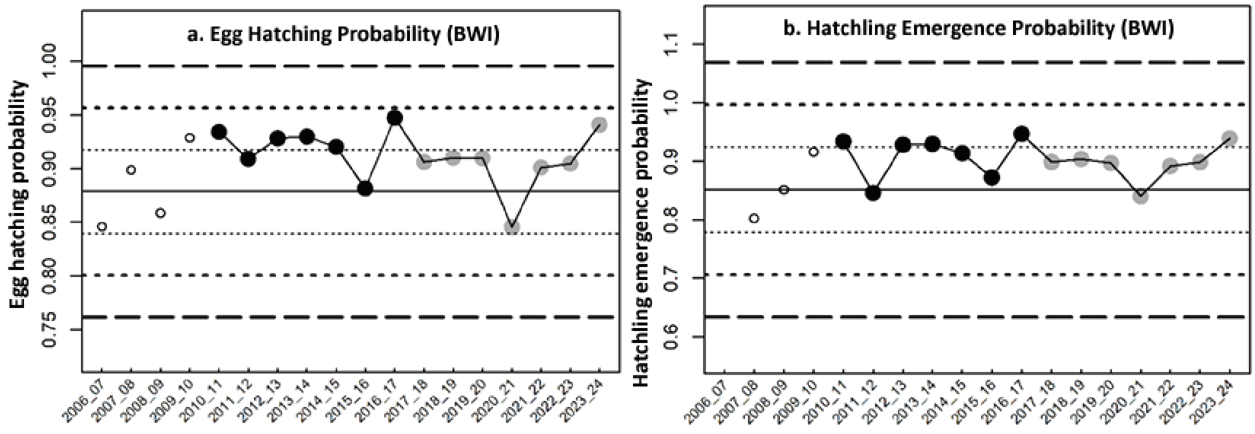

Figure 4-5 Control chart for (a) egg hatchling probability and (b) hatchling emergence probability for complete clutches[1]

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).*

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

- Measure artificial light (magnitude and bearing) on marine turtle nesting beaches using specialised light-measurement cameras.
- Measure 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, Butler Park, and offshore infrastructure including the MOF, LNG Jetty head, LNG tanker (when present).

Monitoring program: Hatchling orientation
• The level of brightness at each monitoring site demonstrated a spatial relationship with the distance from the GTP and associated infrastructure (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, Yacht Club North (YCN), Yacht Club South (YCS), and Mushroom beaches.
Hatchling orientation results
• No exceedances in the modelled hatchling post-emergence spread (disorientation) or offset (misorientation) occurred at Bivalve Beach during the reporting period (Figure 4-6[a-b]). • At Terminal Beach the offset (misorientation) exceeded the -1 SD control limit (management alert, Figure 4-6 [c-d]). There was no exceedance in the modelled hatchling post-emergence spread (disorientation) at Terminal Beach during the Reporting Period. • 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 was at Terminal and largest at Mushroom. – Fan spread angle was significantly smaller on Terminal Beach compared to baseline. There was no significant difference in the fan spread angle at YCS, YCN, Bivalve, or Mushroom beaches when compared to baseline. Comparison of the fan spread angle at Inga was not possible due to the limited number of samples recorded at baseline. – The smallest mean fan offset angle was at Mushroom beach and the largest was at YCS beach. – There was no significant difference in the fan offset angle at YCS, YCN, Bivalve, Terminal or Mushroom beaches when compared to the baseline. Comparison of the fan offset angle at Inga Beach was not possible due to the limited number of samples recorded at baseline. – Hatchlings generally orientated in a seaward direction and, similar to 2022–2023, a larger proportion of hatchling fan spread and offset angles were in a southerly direction compared to the baseline, across all beaches. There were no new light sources detected that may explain the southerly shift in hatchling spread and offset angles. – There were no hatchling disorientation events and no observations were made of hatchlings orienting directly inland towards light sources associated with the Gorgon Gas Development.

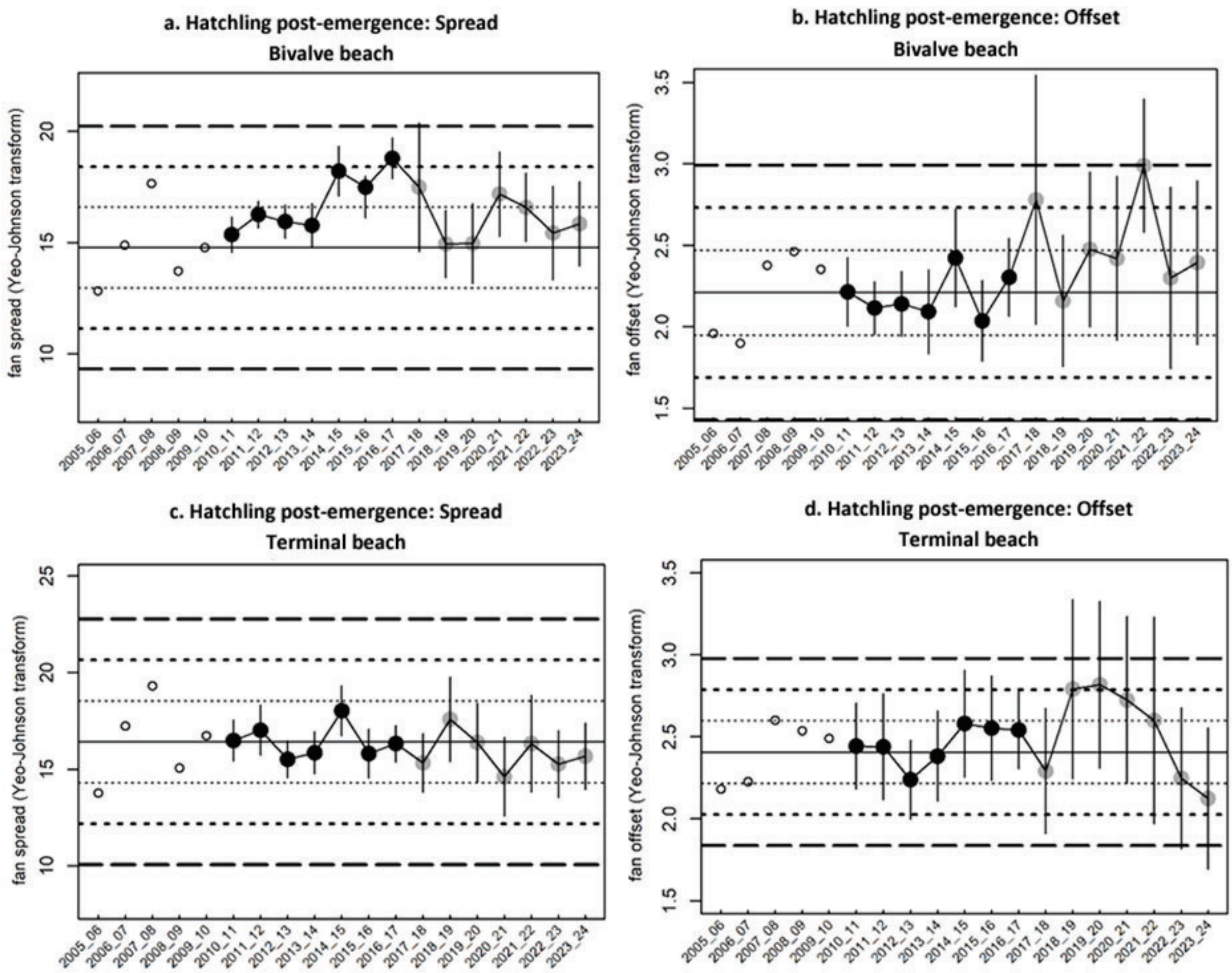

Figure 4-6 Control charts for hatchling post-emergence dispersion; Fan spread and offset estimates at Terminal and Bivalve Beaches[1]

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.*

4.2 Study results

4.2.1 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 two of the study beaches—A07 and Junction.

The additional monitoring effort at A07 and Junction beaches identified 250 turtles that were not encountered on the routine beaches (Mushroom, Terminal, Bivalve, Inga, YCN, and YCS) during the season, and hence excluded from the population size MSORD modelling. This was 20% of all individual turtles encountered at all Barrow Island beaches this season, which was consistent with previous seasons (seasonal monitoring commenced at these beaches in 2017–2018). The 250 turtles at A07 and Junction beaches included 239 remigrant turtles (96%) and 11 new turtles (4%).

4.2.2 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 was started at Inga Beach in 2016–2017. The study used the same methodology as the routine Incubation Success Program.

For the 2023–2024 season, egg hatching probability (complete clutches) for A07, Junction, YCS and YCN beaches was 88.6 ± 26.9%, 80.3 ± 29.6%, 92.7 ± 8.4% and 92.8 ± 5.7%, respectively. The egg hatching probability at those beaches where Flatback Turtles have demonstrated a change in the spatial distribution of their nesting activity (i.e. Inga, Bivalve, and Terminal) was similar to the other monitored beaches this season (i.e. A07, Junction, YCS, YCN, and Mushroom) combined.

For the 2023–2024 season, hatchling emergence probability (complete clutches) for A07, Junction, YCS and YCN beaches was 88.6 ± 26.9%, 80.3 ± 29.6%, 92.7 ± 9.4% and 92.8 ± 5.7%, respectively.

4.2.3 Hatchling dispersal and survivorship

In February 2024, a pilot study was undertaken into using alternative methods for studying the dispersal and survivorship of Flatback Turtle hatchlings as they leave the beach and swim through the nearshore marine environment at Barrow Island. Acoustic telemetry was trialled using 69 kHz receivers and nano transmitters, revealing improved range detection from previous applications of the technology. In parallel, investigations into marine predator species that may prey on Flatback Turtle hatchlings in the nearshore environment continued with further field studies involving gut content analysis and a trial of cloacal swabs for subsequent DNA analysis.

4.2.4 Onshore predation and nesting success

During the Reporting Period, a student Masters degree project commenced to investigate the onshore predation rate on Flatback Turtle hatchlings and the nesting success of adult female Flatback Turtles. The study used continuous recording from 16 UV video cameras on four solar powered stations on Terminal and YCS beaches. Results of this study will be reported in the 2025 EPR. .

4.3 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[1] involving harm to marine turtles.
Results
There were no reportable incidents during the Reporting Period involving harm to marine turtles as a result of the Gorgon Gas Development.

1 *Reportable incidents are defined in the LTMTMP (Ref. 20) as: 'Harm or mortality to listed marine turtles attributable to the Gorgon Gas Development, and significant impacts detected by the monitoring program on matters of national environmental significance relevant to this Plan'*

4.4 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
• A Lighting Effectiveness Review and Annual Audit was undertaken during the Reporting Period (Ref. 22). Between 10 August 2023 and 9 August 2024, 78 site lighting inspections were undertaken, from which 47 actions were identified, all of which were closed out within a satisfactory timeframe. • The 2023–2024 Lighting Effectiveness Review and Annual Audit identified three Recommendations (Ref. 22) which were in the process of being action at the time of this report. • Six Recommendations made in the 2022–2023 Annual Lighting Effectiveness Review were actioned and closed out within the allocated timeframe. • Two Recommendations and one Finding identified in the 2022–2023 LTMTMP Audit (related to lighting) were actioned and closed out within the allocated timeframe.
Light management initiatives, activities, and reasonably practicable lighting improvements
• Site planning sessions continued for operational activities occurring before and during the marine turtle nesting season with the potential to affect marine turtle behaviour. • Marine turtle awareness communications were sent to staff and contractors at the start of and throughout the turtle season, highlighting the relationships between lighting management and impacts on marine turtles. These were incorporated into routine prestart and contractor meetings and site notices. • Marine turtle awareness information was made available to ships entering the Port of Barrow Island via a Turtle Season Marine Notice accessible via the CAPL website, in addition to routine information contained within the Port of Barrow Island Information Manual (all available from https://australia.chevron.com/our-businesses/barrow-island/barrow-island-port). • Personnel engagement continued via marine turtle nesting and turtle hatchling tours to raise awareness of the environmental commitments associated with marine turtles. Additional information on the marine turtle nesting season, monitoring programs, and lighting management was also disseminated through the accommodation televisions. • Lighting along the LNG Jetty and MOF was switched off, except where required for work and safety reasons. • Direct engagement with cargo vessels visiting the Port of Barrow Island providing recognition of effective lighting minimisation practices and improvement actions undertaken.
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. • The level of brightness at each monitoring site consistently demonstrated a spatial relationship with the distance from the LNG site; brighter values were recorded at sites closest to the LNG site and darker values at sites furthest away. Sources were similar when compared with 2022–2023, with the main sources of light being the LNG site, ground flare, MOF, the Jetty Head, and Butler Park. An LNG/condensate tanker was present on five of the seven monitoring nights at the Jetty Head as an additional source of light. • Night-time light emissions were highest at Bivalve Beach followed by (in order of descending magnitude) Terminal, Inga, YCN, YCS, and Mushroom beaches. In general, greater variation in sky brightness was reported on nights with cloud cover and/or with increased flaring events. • 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 to lighting design features, management measures, and operating controls were required during the Reporting Period, beyond the improvements and initiatives undertaken to reduce artificial lighting.

4.5 Changes to the Long-term Marine Turtle Management Plan

The LTMTMP (Ref. 20) was revised and submitted for approval during the Reporting Period. In accordance with the variation to EPBC 2003/1294 and 2008/4178 conditions issued 7 August 2023, Revision 1.1 of the LTMTMP was submitted to DCCEEW on 28 June 2024. This revision was also provided to DWER for information on 1 August 2024, with the intention of formally submitting once any comments from DCCEEW have been received and addressed.

Included in Revision 1.1 were updates to background information, consultation process, summary of current and future activities in alignment with operational focus, risk assessments and associated management measures.

4.6 Discussion and conclusion

The estimated number of nesting flatback turtles at Barrow Island during the 2023-2024 nesting season was significantly lower than baseline; however, this was consistent with the findings at the Mundabullangana reference site. This decrease was likely due to the natural inter-annual variation in nester abundance that is known to occur for populations of flatback turtles.

The nesting population has shown varying patterns of beach utilisation across the east coast of Barrow Island, primarily influenced by changes in coastal processes and the presence of marine infrastructure associated with the Gorgon Gas Development. This is particularly noticeable at Inga, Bivalve, and Terminal beaches, where the availability and distribution of optimal nesting habitat has been affected, resulting in a notable reduction in its size. Consequently, all impacted beaches have experienced changes in the distribution and pattern of nesting activities. Bivalve Beach has recorded a significant decrease in its usage over time and Mushroom Beach has recorded a significant increase in usage over time.

Despite the reduction in the optimal nesting habitat size, the overall low abundance of adult nesters likely mitigated any potential density-related impacts this season. This is evidenced by a relatively low clutch disturbance rate that was comparable to the reference site at Mundabullangana, and no observed relationship between the density value for marked clutches and their resulting egg hatching probability.

The brightness of artificial light at Barrow Island varied across survey nights due to the occurrence of flaring, the presence of cloud and/or an LNG/condensate tanker. Despite this varying brightness, the influence on hatchling sea-finding ability appeared minimal, with generally similar spread and offset values recorded at beaches in comparison to baseline.

CAPL continues to engage with the Marine Turtle Expert Panel and other SMEs on outcomes of the LTMTMP monitoring program and relevant results from the coastal stability monitoring program (See Section 9). This includes evaluation of additional risk-based studies to better understand the risks to Flatback Turtles at Barrow Island from the Gorgon Gas Development marine facilities and those that aim to improve the understanding of the Flatback Turtle population.

5 Short-range endemics and subterranean fauna

Table 5-1: EPR 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. 23) focuses on surveys to locate and identify SRE and subterranean fauna species that had only previously been located within the GTP footprint and/or the ASA. Several of these species were confirmed outside the GTP footprint and ASA before construction commenced, and a further two subterranean fauna species were identified during construction (Ref. 23). Therefore, the ongoing focus of the SRESFMP is to locate the following 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 five-yearly.

Prior to the commencement of the five-yearly survey, the *Idiommata* sp. (Brush-footed Trapdoor Spider) was reclassified as *Aurecocrypta* ep. MYG319. The specimen found on Barrow Island matched with genetic sequences from other individuals recorded widely throughout the Western Pilbara. Based on previous reports and the confirmation of wider distribution, SRE monitoring was not included in the 2023 survey and is not planned for future surveys (Ref. 34)

The five-yearly, Subterranean Fauna Monitoring Program was undertaken in between June and September 2023. The scope of the program included:

- sampling 12 sites for stygofauna and troglofauna using haul net, scrape, and litter trap collection methods (Figure 5-1 and Figure 5-2)
- eDNA investigative methods at five northern sites
- comprehensive desktop assessment of all previous subterranean fauna survey results.

Results suggest the three targeted subterranean fauna species are unlikely to be confined to the GTP and/or ASA footprint. The target '*Oniscidae* sp. nov. 1' specimen is likely to be a *Nedsia* species; possibly *N. hurlberti*. *Nedsia* species have been shown to have relatively broad distributions on Barrow Island and in the Robe Valley region of the Pilbara. The updated identification of *Pilbaracandona* sp. nov. as *P. rosa* confirms the distribution of this target species is not confined to the very southern boundary of the ASA as previously identified but extends outside the GTP/ASA footprint to Reference areas north of the GTP.

Despite extensive searching, only two symphylans have been collected (12 km apart) on Barrow Island since monitoring began. Morphological identification was limited due to the poor condition of each specimen; however, DNA analysis confirmed the original specimen located in the GTP buffer zone could be genetically identified to belong to the *Scutigerellidae* family, prompting a name change to *Scutigerellidae* sp. 1. Although relatedness between specimens could not be established, the distribution of *Scutigerellidae* sp. 1 is considered likely to extend well beyond the GTP buffer for several kilometres, based on the demonstrated distribution of Pilbara *Symphylan* species. This is evidenced by the only other troglofauna species collected from the same well, *Draculoides bramstokeri*, which has been recorded across most of Barrow Island. Although the broader distribution extent of *Scutigerellidae* sp. 1 has not been demonstrated, the extent of the distribution range is considered to be wider within the broader expanse of karstic subterranean habitat present across much of Barrow Island, and not confined to the immediate vicinity of the GTP buffer.

Since 1991, more than 11,132 stygofauna specimens representing at least 61 taxa, and, more than 643 troglofauna specimens, representing >25 taxa have been collected at Barrow Island. The documented distributions of species of the subterranean fauna assemblages that range across much of Barrow Island are consistent with the geological and hydrogeological assessments that the subterranean fauna habitats present within the karstic and fractured geology are relatively well interconnected, and broadly contiguous across most of the island.

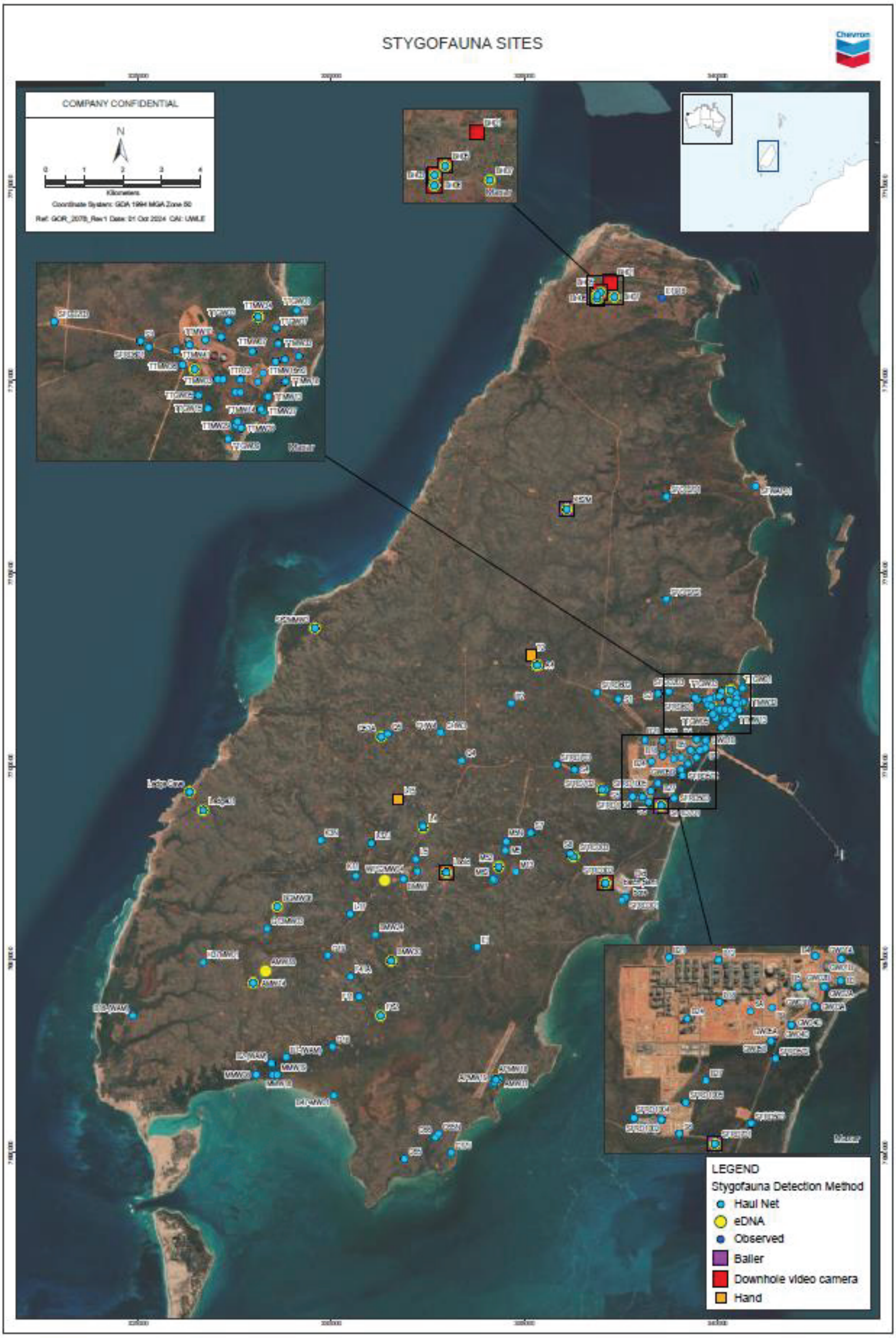

Figure 5-1: Locations of stygofauna haul net and eDNA sample sites on Barrow Island in 2023

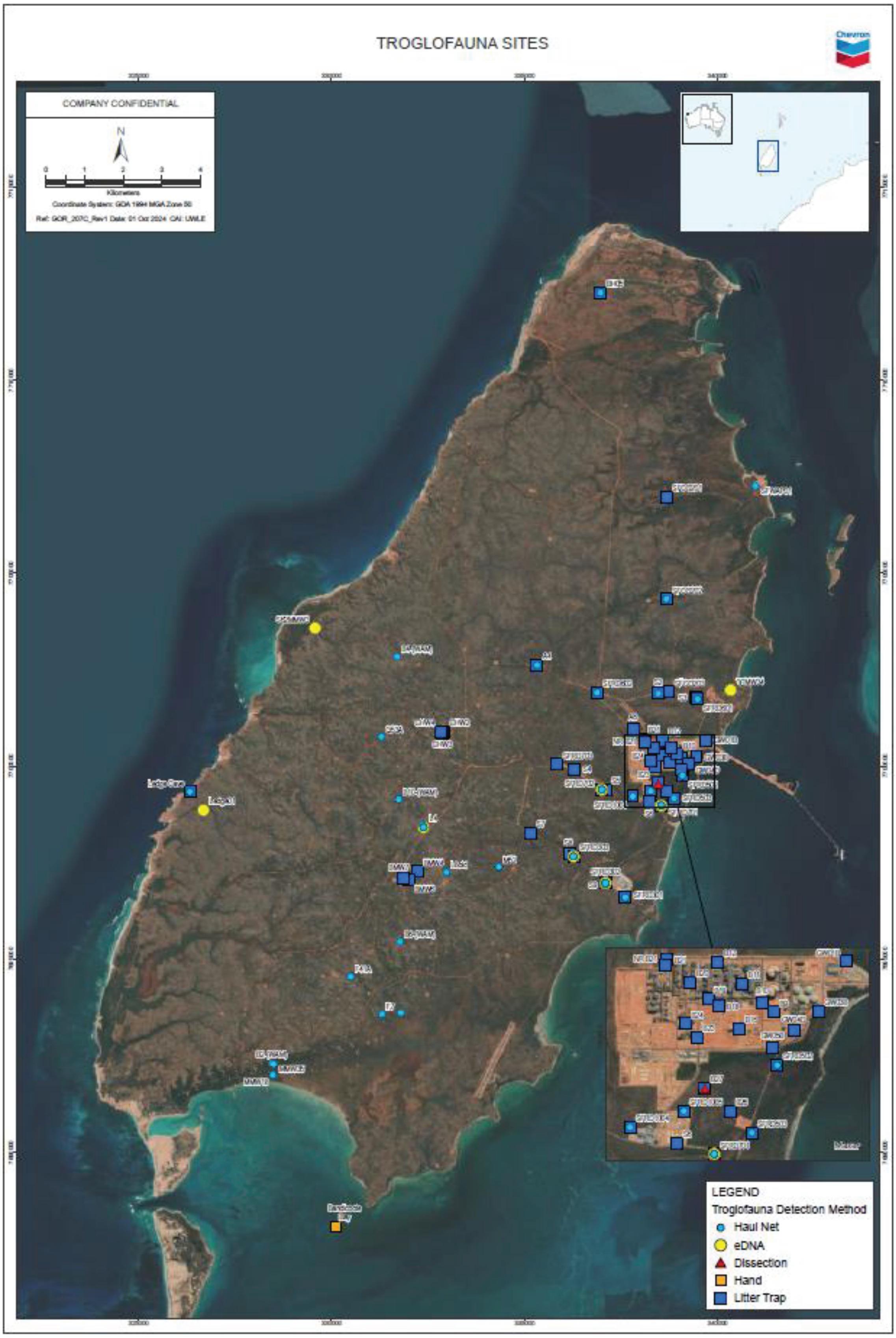

Figure 5-2: Locations of troglofauna litter trap sample sites on Barrow Island in 2023

6 Fire management

Table 6-1: EPR 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. 24) including: • management responses to address Material or Serious Environmental Harm caused by fire directly attributable to the Proposal; and • improvement to fire management practices.	MS 800, Schedule 3(5iii) MS 769, Schedule 3(2iii) EPBC 2003/1294 and 2008/4178, Schedule 3(4iii)	0

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 • No fire events impacted the Gorgon Gas Development facilities. • There were three minor events attributable to Gorgon Gas Development activities during the Reporting Period. The event cause, completed actions and lessons learnt are summarised.			
Date	**Event Cause**	**Recommended Actions**	**Lessons Learnt**
28 August 2023	Water trailer engine ignited due to a malfunction whilst in use at a maintenance workshop. The small flame was immediately extinguished by the operator. There was no impact to vegetation.	• Condition of remaining small diesel-powered water trailers were assessed. • Review completed on inspection and maintenance schedule for water trailer assets.	Small diesel-powered water trailers should be adequately maintained to reduce the risk of introducing hazards, such as fire.
11 May 2024	A small fire occurred on a telehandler due to an electrical malfunction on the starter motor while parked at an equipment storage yard. The bonnet on the telehandler had been damaged previously and was impacting on the wiring.	• Telehandler was removed from service and repaired.	External damage to assets should be repaired promptly. The damage may impact on the internal electrical components of the asset which has the potential to introduce hazards, such as fire.

Event data: Fires			
	The small flame was immediately extinguished by the operator. There was no impact to vegetation.		
30 July 2024	A small amount of residual paint on pipework ignited and immediately self-extinguished during a post-weld heat treatment (PWHT) as part of the shutdown of LNG Train 2 for turnaround activities. The activity was being completed under an open flame hot work permit with fire watch and fire extinguisher in place. There was no impact to vegetation.	• Review underway of relevant work packs to increase area of paint removal in proximity to PWHT. • Review underway of schedule for future PWHT activities to include a verification step for confirming a suitable amount of paint has been removed in proximity to PWHT.	Removal of sufficient paint in proximity to PWHT is important to reduce the risk of introducing hazards, such as fire.

6.2 Changes to the Fire Management Plan

The Gorgon Gas Development Fire Management Plan (FMP) (Ref. 24) was revised and submitted for approval during the Reporting Period. In accordance with the variation to EPBC 2003/1294 and 2008/4178 conditions issued 7 August 2023, Revision 1.2 of the FMP was submitted to DCCEEW on 28 June 2024. Subsequently it was also submitted to DWER on 5 August 2024.

Included in Revision 1.2 were updates to background information, descriptions of relevant facilities and activities, summary of FMP interface with the Major Hazard Facility Report and Safety Case regime, risk assessments and associated management measures.

Revision 1.2 of the FMP was under review by both DCCEEW and DWER during the Reporting Period and CAPL continues to engage with the regulators on this matter.

7 Carbon Dioxide Injection Project

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

As at the date of this EPR, the Gorgon Joint Venture Participants remain committed to safely reducing the Gorgon Gas Development's GHG emissions and have:

- injected or offset more than 20 million tonnes of GHG (including more than 10 million tonnes of actual abatement and more than 10 million credible offsets acquired and surrendered)
- invested more than AU$3.2 billion in the Carbon Dioxide Injection System with further investment planned to improve system performance and increase injection rates
- commenced a project that aims to expand the Carbon Dioxide Injection System's capacity to manage water found within the reservoir where carbon dioxide is stored, thereby reducing reservoir pressure and enabling increased carbon dioxide injection rates over the life of the Gorgon Gas Development
- committed A$40 million to the Western Australian Government's Lower Carbon Grants Program – Gorgon Fund and GreenTech Hub.

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

Table 7-1: EPR requirements for the 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	EPBC 2003/1294 and 2008/4178, Schedule 3(5i)	7.1
Volume of reservoir carbon dioxide and other acid gases injected	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*])	EPBC 2003/1294 and 2008/4178, Schedule 3(5iii)	N/A[1]
Reasons for shortfall between the volume of reservoir carbon dioxide extracted and injected	EPBC 2003/1294 and 2008/4178, Schedule 3(5iv)	7.3
If the amount of carbon dioxide injected falls significantly below the target levels, CAPL must 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	EPBC 2003/1294 and 2008/4178, Schedule 3(5v)	7.4
If 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 must report to the Minister on the efficacy of continuing to geosequester and alternative offsets considered instead of continuing injection of reservoir carbon dioxide	EPBC 2003/1294 and 2008/4178, Schedule 3(5vi)	N/A[1]

1 *Environmental monitoring was not required during the Reporting Period as seepage of injected CO_2 to the surface or near-surface environments was not detected. Therefore, no elevated risk of Material or Serious Environmental Harm and/or risk to human health was identified.*

7.1 Volume of reservoir carbon dioxide removed

The Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER Act) contains provisions for reporting emissions from transporting and injecting GHGs, and storing them underground. 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 (1 July to 30 June), which aligns 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
2,705,250 × 10^3 standard cubic metres of reservoir CO_2 was removed from the incoming natural gas stream during the 2023–2024 financial year. This equates to 5,317,668 tonnes of carbon dioxide equivalent (tCO_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, which aligns with CAPL's NGER Act reporting obligations.

Volume of reservoir carbon dioxide injected
802,951 × 10^3 standard cubic metres of reservoir CO_2 was injected during the 2023–2024 financial year. This equates to 1,594,340 tCO_2e.

7.3 Reasons for shortfall between volume extracted and injected

The key reason for the shortfall between the volume of reservoir CO_2 extracted and injected for the 2023–2024 financial year is the careful management of reservoir CO_2 injection rates. This ensures reservoir pressure in the Dupuy Formation remains within an acceptable range while the pressure management capacity of the CO_2 injection system is constrained.

7.4 Measures being implemented

Early reservoir performance and modelling indicates that additional pressure management capacity is needed to manage reservoir pressures in the Dupuy Formation.

A project has commenced that aims to expand the system's capacity to manage water found within the reservoir where carbon dioxide is stored, thereby reducing reservoir pressure and enabling increased carbon dioxide injection rates.

The project consists of optimising existing infrastructure through the:

- modification of four existing water producing wells to expand reservoir water extraction capability
- installation of new surface infrastructure to enhance water processing
- modification of two existing water injection wells to increase the volume and flow rate of water that can be processed, and
- drilling of two new water injection wells to increase the total volume of water that can be processed.

In addition to this project, CAPL continues to explore options to further increase carbon dioxide injection rates within the system.

While these measures are being implemented, CAPL will continue to inject as much reservoir CO_2 as practicable.

In accordance with Condition 26.4 of MS1198, CAPL will offset the quantity of reservoir CO_2 that was not injected underground.

8 Air quality

Table 8-1: EPR 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. 25), as defined by Ministerial Conditions, are to ensure:

- air quality meets the appropriate standards for human health in the workplace
- 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 operating the GTP, and then compares these data against the applicable assessment criteria defined in the AQMP (Ref. 25). The occupational hygiene monitoring plan is implemented within the GTP to evaluate workplace exposure standards for airborne contaminants (Ref. 26)

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. 25). Emissions from these major sources are monitored via sampling at the point of discharge (the stacks) to the environment.

The tables below summarise the 2023–2024 air quality monitoring results, including exceedance assessments.

Monitoring program: Ambient air quality
Results
The ambient air quality monitoring program recorded no exceedances of the relevant National Environmental Protection Measures (NEPM) (Table 8-2) and National Occupational Health Exposure Standards (NOHES) guidelines for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), or aromatic hydrocarbons (BTEX). The occupational hygiene monitoring plan was implemented within the GTP including evaluating mercury (Hg), H_2S, and aromatic hydrocarbons (BTEX) against relevant workplace exposure standards for airborne contaminants. During the reporting period the following exceedances occurred (Table 8-2): • 61 exceedances of the NEPM daily guideline for particulate matter (PM_{10}) occurred at the Communications Tower (CT) location and 29 exceedances at Butler Park (BP). • PM_{10} daily exceedances increased relative to previous reporting periods. At the CT this was caused by earthworks on the unsealed road that runs adjacent to the air quality monitoring station (AQMS). At BP increased exceedances were caused by additional vehicular movements and the area adjacent to the AQMS being temporarily used for equipment laydown. • The increased frequency of daily PM_{10} exceedances contributed to exceedances of the annual guideline (25 µg/m^3) for both locations with CT and BP recording annual average PM_{10} measurements of 39 and 29 µg/m^3 respectively. – 23 of the 29 exceedances measured at BP also had corresponding exceedances at CT indicating that 80% of the BP exceedances were not likely a result of localised activity and instead reflect generalised elevated dust levels on BWI. – The operation of the GTP is unlikely to be a source of elevated particulates as no exceedance events to date have been directly attributable to GTP operating conditions. • 14 exceedances of the NEPM guideline for ozone (O_3) occurred at the CT location and 11 exceedances at BP.

Monitoring program: Ambient air quality
– O_3 exceedances occurred between 5 and 7 November 2023. This coincided with an extreme weather event across the northwest of Australia and was not attributable to GTP operation. Detections of H_2S above 'nuisance' World Health Organization guideline levels occurred at the CT, but these were three orders of magnitude below NOHES guidelines. During periods of elevated H_2S, winds were typically light (<5 m/s) and a south-westerly to westerly direction. Under light winds, sources are most likely localised. The acid gas removal vents continue to be the most likely source of H_2S, based on the prevailing wind direction and that H_2S is known to be present in the acid gas being vented. Measured ambient air quality results were evaluated against modelling predictions relevant for current operating conditions involving higher venting rates and generally were found to be within modelled predictions for atmospheric pollutants and air toxics.
Conclusions
• Except for PM_{10} and O_3, no other exceedances were recorded for parameters against NEPM and NOHES guidelines associated with the ambient air quality monitoring program. Results from the occupational hygiene monitoring plan met relevant workplace exposure standards for human health in the workplace. These findings are consistent with those from previous years. – Exceedances for PM_{10} were inferred to have originated from localised unsealed road and laydown dust lift-off and increased project activity. These exceedances are not considered attributable to GTP emission sources. – Exceedances for O_3 were a result of an extreme weather event across the northwest of Australia and are not considered attributable to GTP emission sources. • Measured ambient air quality results were within model predictions—neither the modelled nor the measured results exceed applicable assessment criteria outlined in the AQMP. • Overall, results of the ambient air quality monitoring program demonstrated that air quality was below the relevant NEPM and NOHES guidelines during the Reporting Period. Consequently, during the Reporting Period the ambient air quality was assessed to have met 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[1]	**Concentration**	**Averaging period**	**Communications Tower**	**Butler Park**
PM_{10}	50 µg/m^3	1 day	61	29
	25 µg/m^3	1 year[1]	1	1
NO_2	0.08 ppm	1 hour	0	0
	0.015 ppm	1 year[1]	0	0
O_3	0.065 ppm	8 hours	14	11
SO_2	0.10 ppm	1 hour	0	0
	0.02 ppm	1 day	0	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 the NEPM, the annual averaging period is based on a calendar year. For this EPR, the period 10 August 2023 to 9 August 2024 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
During the reporting period there were two NO_x and one CO exceedances of emissions targets from the Gas Turbine Generators (GTGs). All other monitoring results were below the relevant emission targets for the emission sources considered (Table 8-3).
Conclusions
• Overall, results of the stack air quality monitoring demonstrated that all measured parameters remained within emission targets for the GTGs and LCGTs during the Reporting Period, except for two exceedances for NO_X and one exceedance for CO. • The two NO_x and one CO exceedances of emission targets occurred at GTG 2 and GTG 4 during periods when the GTGs were operating under low loads. The NO_X target (of 70 mg/m^3) only applies when the GTGs are running at >55% load. 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	0
	CO	125	0
GTG 2	NO_x	70	1
	CO	125	1
GTG 3	NO_x	70	0
	CO	125	0
GTG 4	NO_x	70	1
	CO	125	0
GTG 5	NO_x	70	0
	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 (<55% capacity).*

9 Coastal stability

Table 9-1: EPR 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. 27)	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. 28), 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. 28). Monitoring is carried out on two potential impact beaches (Terminal and Bivalve) and three reference beaches (Inga, YCN, and YCS).

Coastal stability management triggers have been established for beach volume, beach slope, and sediment particle size at potential impact beaches, 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. 29) and include assessing defined Performance Standards. Interim management triggers specific to changes in turtle nesting habitat, based on the quantifying marine turtle nesting areas through habitat mapping, have also been defined in the approved CSMMP Supplement: Management Triggers (Ref. 29). These marine turtle nesting habitat interim management triggers apply to the Potential Impact beaches (i.e. Terminal and Bivalve, immediately adjacent to the MOF), and to data collected at the end of dry season monitoring event (Ref. 28; Ref. 29).

The 2023–2024 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. 28)

Monitoring program: Beach structure
Objective
Detect changes to the beaches adjacent to the Causeway, MOF and LNG Jetty (Marine Infrastructure) 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). 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 Potential Impact beaches (Terminal and Bivalve) and Reference beaches (Inga, YCN, and YCS). • 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 30 October–2 November 2023 – topographic survey 30 November 2023 – aerial image capture 2–4 December 2023 • End of wet season routine monitoring event: – on-ground survey 12–15 April 2024 – topographic survey 11 April 2024.
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 April 2024), and most recent annual (May 2023 to April 2024) and seasonal change (November 2023 to April 2024). 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 April 2024, Terminal Beach (immediately north of the Marine Infrastructure) has 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, minor 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 the northern end of the beach, leading to some changes in sparse foredune vegetation (Ref. 31). • Between May 2023 and April 2024, there was minor erosion along the length of the SVL, and patchy erosion over the beach face and at the toe of the beach face at the southern end of the beach (Figure 9-1). • Between November 2023 and April 2024, erosion and accretion occurred at the southern end of the beach. Minor erosion was evident along the length of the SVL with changes typically within the limit of detection (±0.25 m) elsewhere (Figure 9-1). *Bivalve Beach* • Between October 2009 and April 2024, Bivalve Beach (immediately south of the Marine Infrastructure) 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. 31). • Between May 2023 and April 2024, there was minor erosion along the length of the SVL, and patchy erosion over the beach face (Figure 9-2). • Between November 2023 and April 2024, there was minor erosion along the length of the SVL, and patches of erosion and accretion over the active zone of the northern third of the beach (Figure 9-2).

Monitoring program: Beach structure
Inga Beach • Between October 2009 and April 2024, 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 over the active zone of the beach, with some erosion encroaching onto 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 and a veneer of loose pebbles and cobbles at the northern extent of bedrock exposure. Accretion at the northern end of the beach has resulted in sparse coastal vegetation establishing in areas that were previously bare (i.e. before marine infrastructure was constructed). There is evidence of sediments in the area of accretion being transported around the rock headland at the northern end of the beach (Ref. 31). • Between May 2023 to April 2024 there was minor erosion along the length of the SVL, and patchy erosion over the beach face (Figure 9-3). • Between November 2023 and April 2024, there was minor erosion along the length of the SVL, and patches of erosion and accretion over the active zone of the northern third of the beach (Figure 9-3). *YCN Beach* • Between October 2009 and April 2024, 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 mouth area of Terminal Creek to the north, which periodically changes due to creek flow events. • Between May 2023 and April 2024, there was minor erosion along the length of the SVL, and patchy erosion over the beach face (Figure 9-4). • Between November 2023 to April 2024, changes to surface elevation were minimal, with changes typically occurring within the limit of detection (±0.25 m; Figure 9-4). *YCS Beach* • Between October 2009 and May 2023, 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. • Between May 2023 and April 2024, there was minor erosion along the length of the SVL, and patchy erosion over the beach face (Figure 9-5). • Between November 2023 and April 2024, patches of both erosion and accretion were detected near the persistent rock outcrop in the centre of the beach (Figure 9-5).

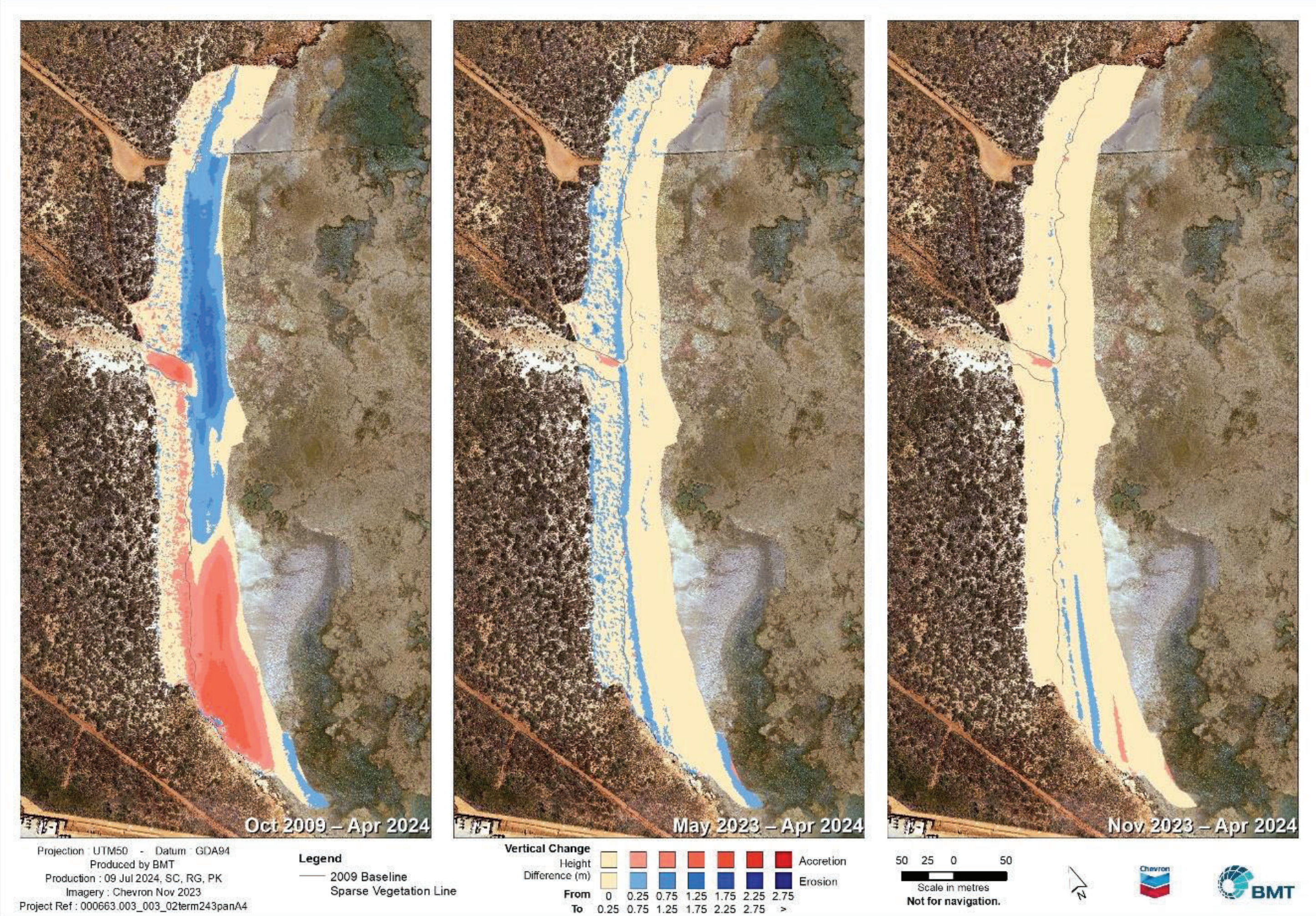

Figure 9-1: Surface elevation changes at Terminal Beach

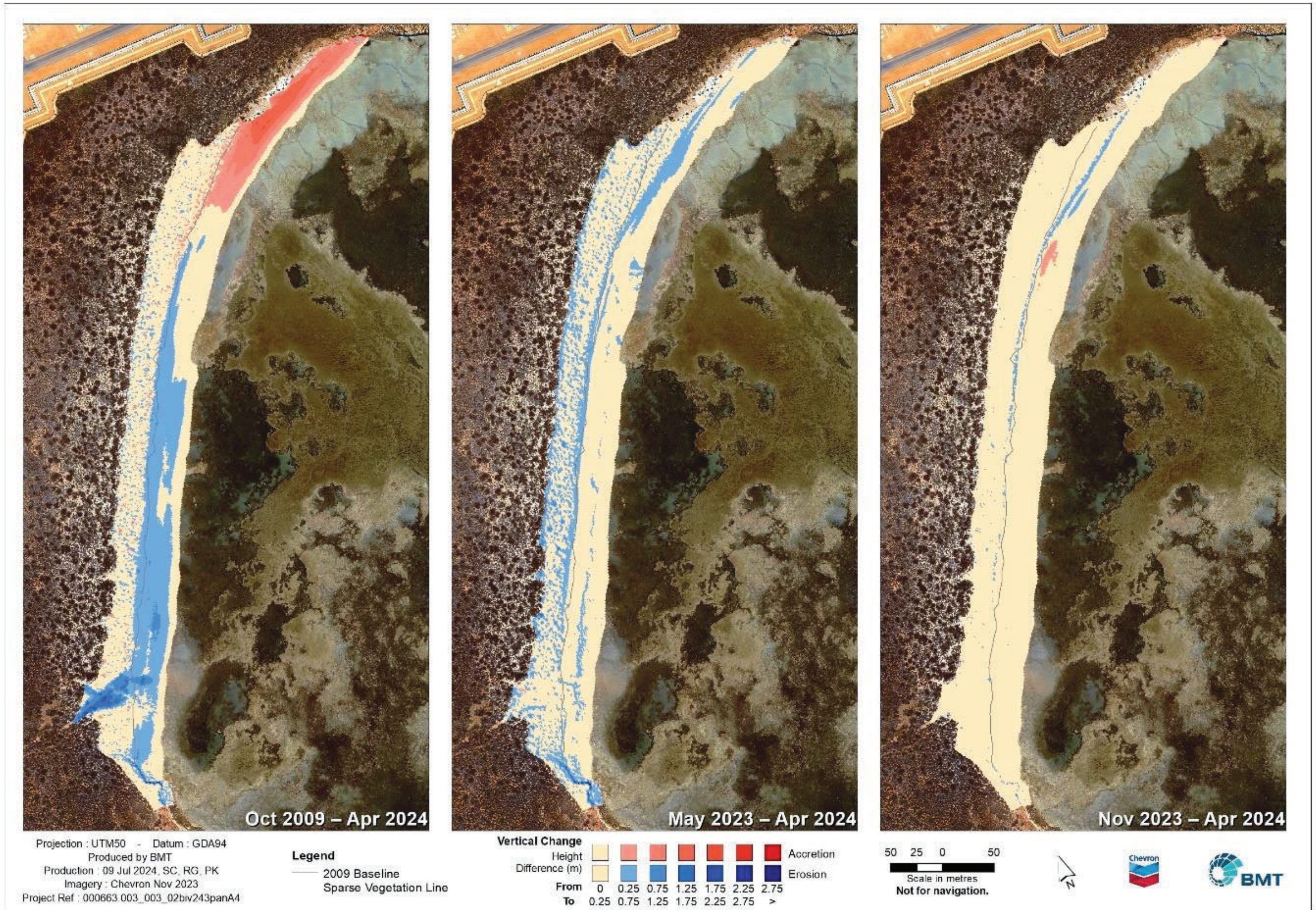

Figure 9-2: Surface elevation changes at Bivalve Beach

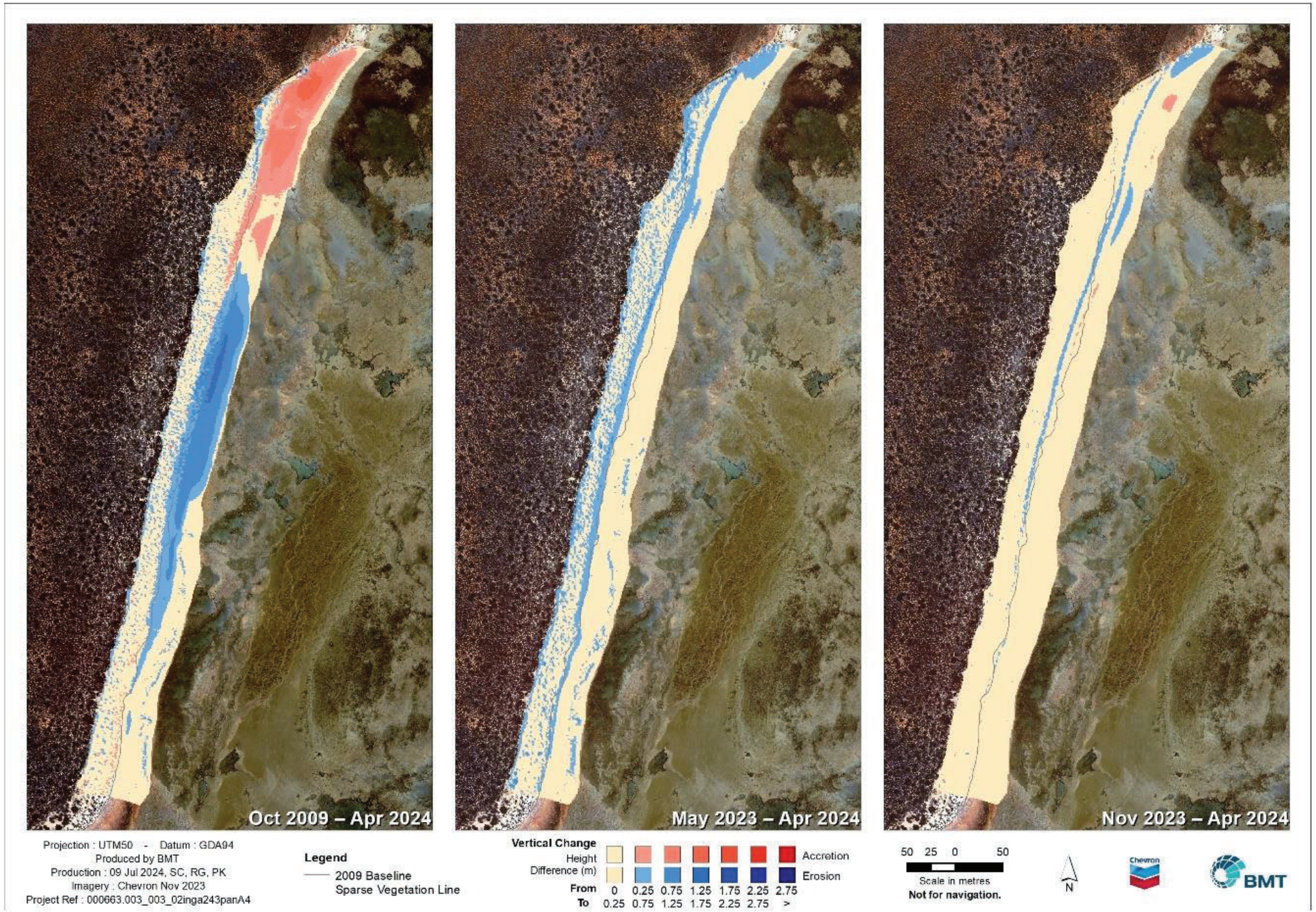

Figure 9-3: Surface elevation changes at Inga Beach

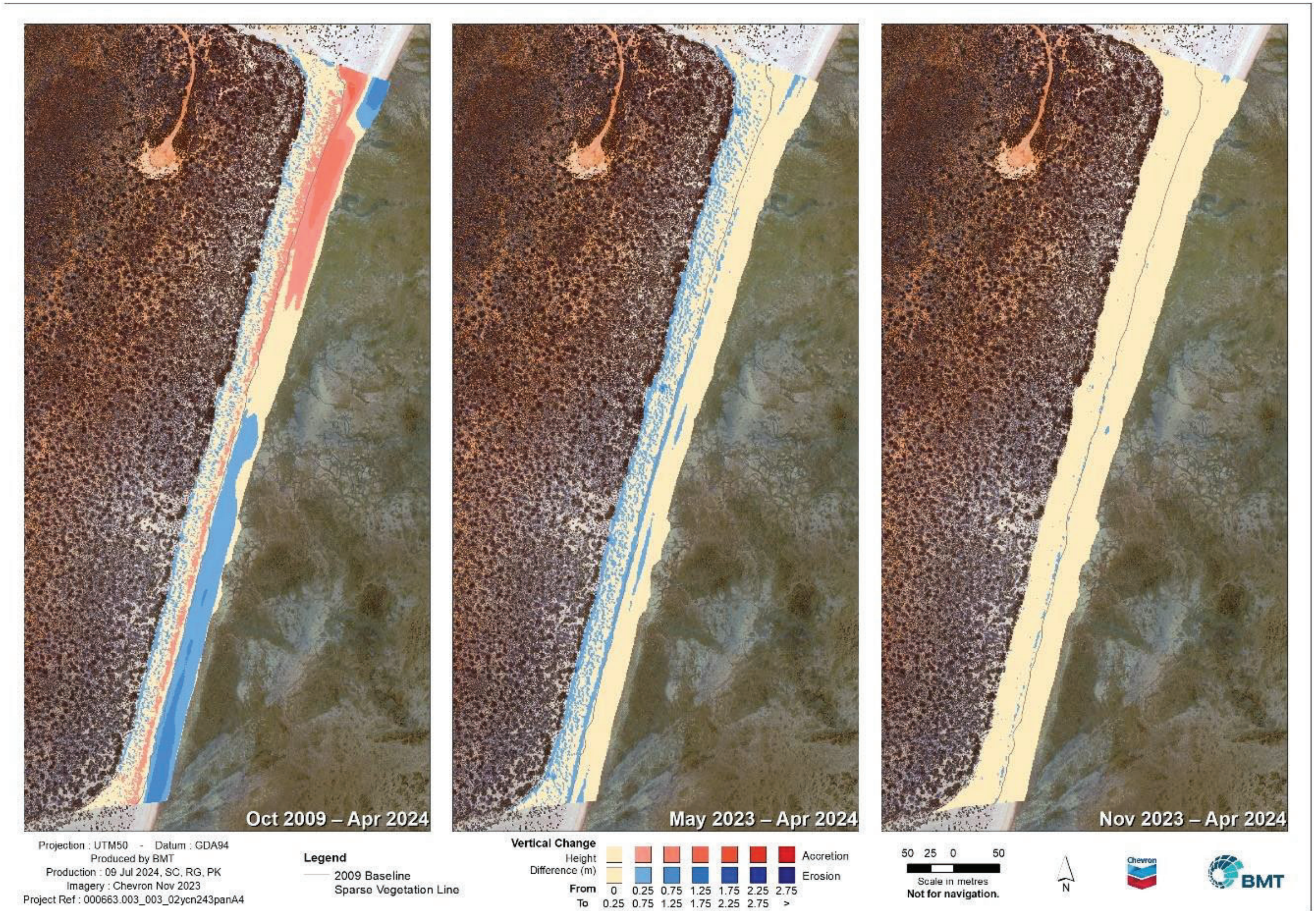

Figure 9-4: Surface elevation changes at Yacht Club North Beach

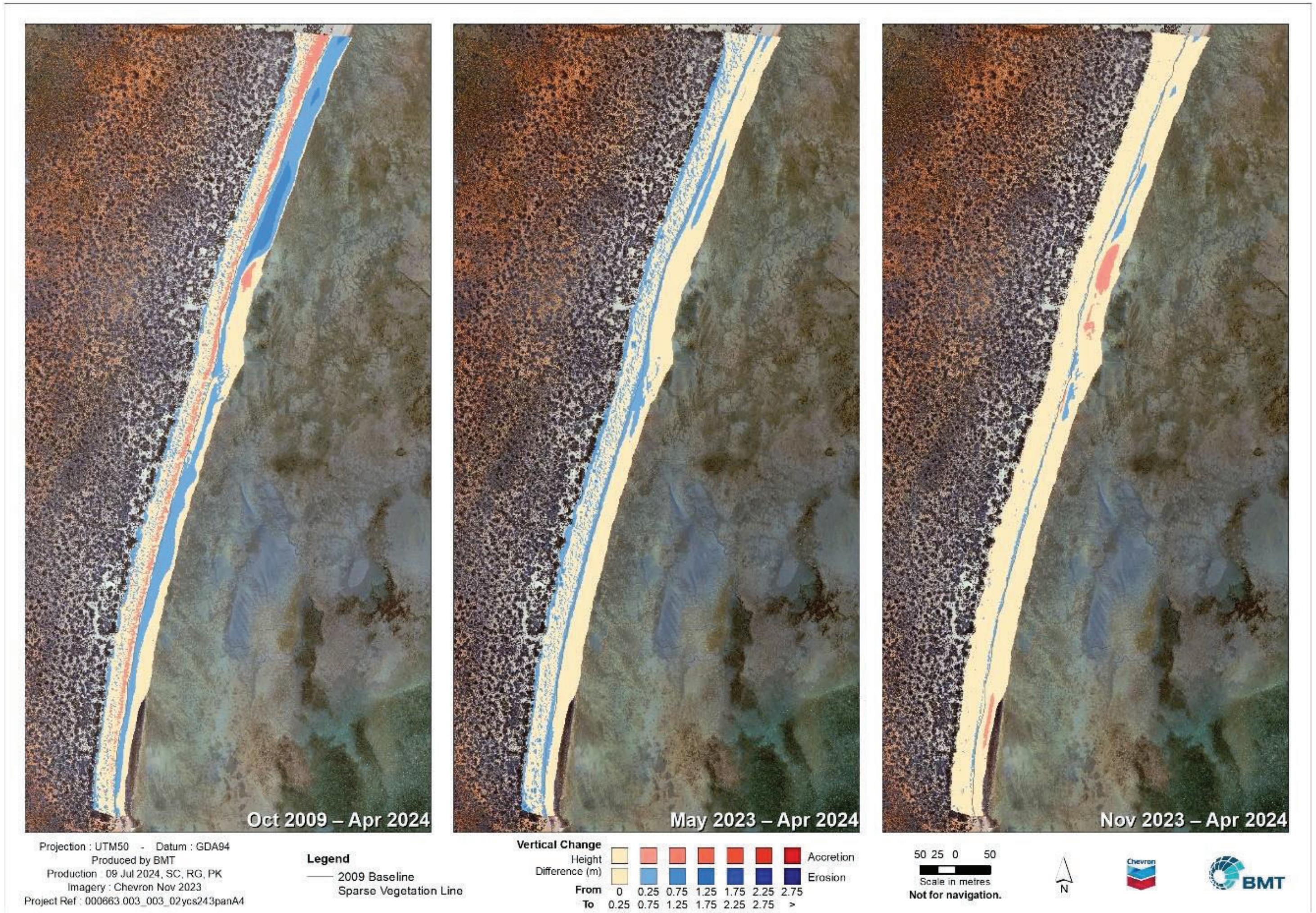

Figure 9-5: Surface elevation changes at Yacht Club South Beach

Monitoring program: Beach structure
Results (continued)
Net volume change • Net sand volume on the beaches fluctuates because of seasonal and regional interannual cycles, or specific events such as tropical cyclones (Figure 9-6). 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 (i.e. October 2009 to April 2024), a net reduction of sediment from the beach face has occurred on Bivalve (−753 m^3), Inga (−2,858 m^3), YCN (−2,495 m^3) and YCS (−9,529 m^3) beaches, and a net gain has occurred on Terminal Beach (+1,196 m^3) (Figure 9-2). • Over the dry season (May to November 2023) and the wet season (November 2023 to April 2024) a net reduction of sediment occurred on all monitored beaches (Table 9-2, Figure 9-7). Therefore, a net sediment reduction for the annual period May 2023 to April 2024 was recorded for all beaches, with the greatest losses occurring on Terminal, Bivalve and Inga 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 and slope at the crest of beach face (CBF) and FA at Transects 11 and 22 – Bivalve Beach: beach volume and slope at the CBF and FA at Transects 11 and 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 Marine Infrastructure, which has caused the realignment of Terminal and Bivalve beaches. Because most FA sites 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 the shoreline changes occurring on Terminal and Bivalve beaches are not having significant adverse impacts on the stability of these beaches.

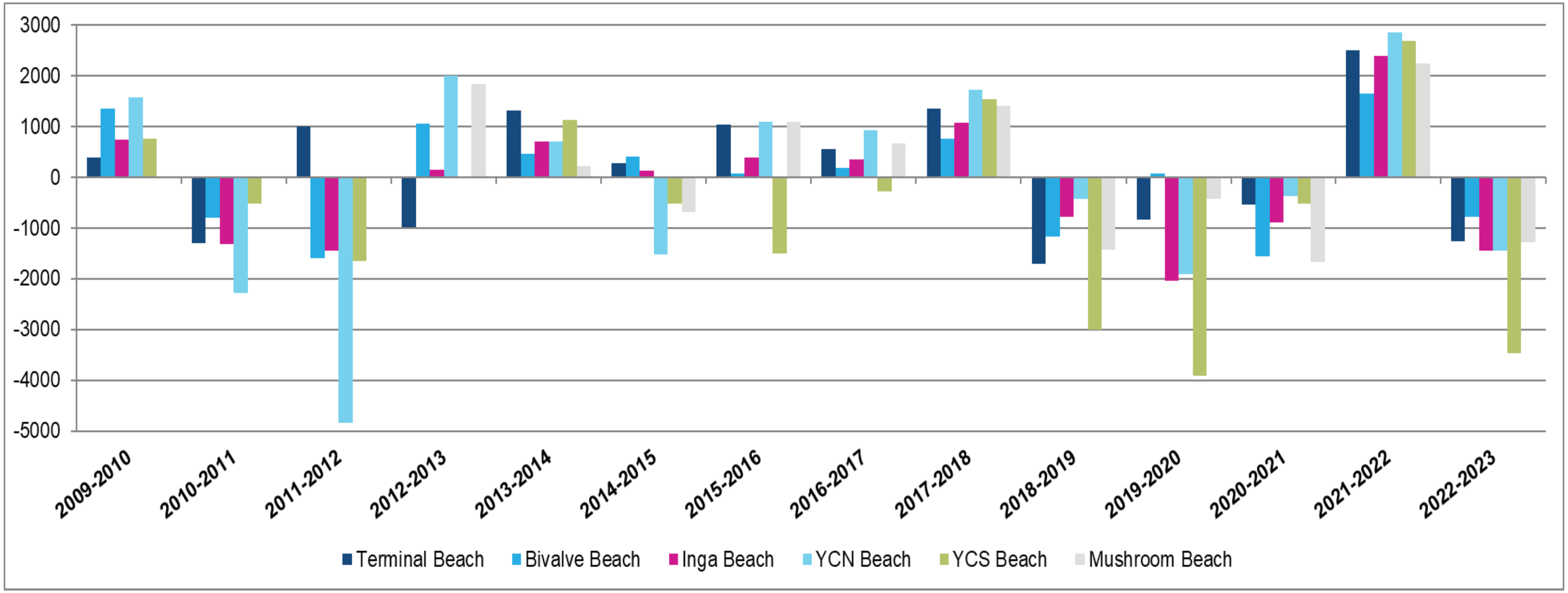

Figure 9-6: Annual net volume change of the active zone of the beach (below the SVL) at monitored beaches, October to November, 2009–2023

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–Nov 23	Oct 09–Apr 24	Oct 22–Nov 23	May 23–Apr 24	May 23–Nov 23	Nov 23–Apr 24
Terminal	700	1,644	1,196	−1,253	−3,620	−3,173	−448
Bivalve	785	83	−753	−776	−4,233	−3,397	−836
Inga	818	−1,973	−2,858	−1,441	−4,034	−3,149	−885
YCN	832	−1,888	−2,495	−1,441	−3,126	−2,519	−608
YCS	1,175	−9,252	−9,529	−3,469	−3,974	−3,696	−277

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

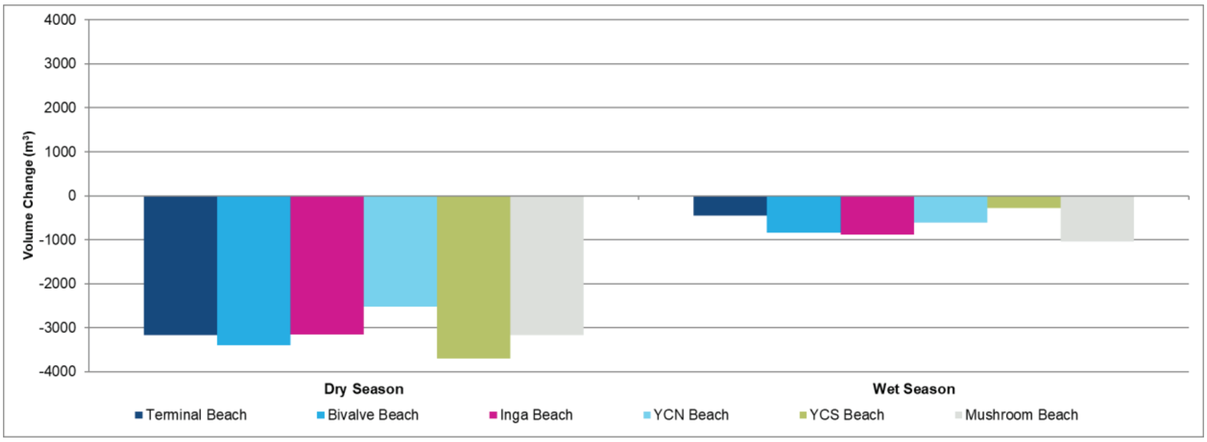

Figure 9-7: Seasonal net volume change of the active zone of the beach (below the SVL) at monitored beaches

Note: Dry season: May–November 2023; Wet season: November 2023–April 2024

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	Nov 2023	x	x	x	x	-	x	x	-	Increase volume, increase slope
		Apr 2024	x	x	x	x	x	x	x	-	Increase volume, increase slope
	22	Nov 2023	x	x	x	x	-	-	-	-	Decrease volume no change slope
		Apr 2024	x	x	x	x	-	-	-	-	Decrease volume, no change slope
Bivalve (CBF)	11	Nov 2023	x	x	x	x	-	x	-	-	Increase volume, increase slope
		Apr 2024	-	x	x	x	-	x	-	-	Increase volume, increase slope
	22	Nov 2023	x	x	x	x	-	-	-	-	Decrease volume, no change slope
		Apr 2024	x	x	x	x	-	-	-	-	Decrease volume, no change slope
Terminal (FA)	11	Nov 2023	x	x	x	x	x	x	x	x	Increase volume, decrease slope
		Apr 2024	x	x	x	x	x	x	x	x	Increase volume, decrease slope
	22	Nov 2023	-	-	-	x	x	x	x	-	Increase volume, increase slope
		Apr 2024	-	-	-	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	Nov 2023	-	-	-	-	x	x	x	-	No change volume, decrease slope
		Apr 2024	-	-	-	-	x	x	x	-	No change volume, decrease slope
	22	Nov 2023	-	-	-	-	x	x	x	x	No change volume, increase slope
		Apr 2024	-	-	-	-	x	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.*

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 per year, at the end of the dry season (typically October), where practicable. Sediments are sampled at two locations (CBF and FA), and up to three depths (0.0 m, 0.3 m, 0.6 m) along selected transects (seven on Terminal; six on Bivalve; and two each on Inga, YCN, and YCS beaches) and 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
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 2023, CBF sediment samples were not collected from transects T19 or T21 due to insufficient sediment at these sites. At the southern end of the beach, a greater proportion of fine sediments has been observed at the CBF compared with baseline, while the northern end of the beach has a greater proportion of gravel. Changes in sediments at the FA have been less pronounced; however, there is an increased component of fine sediments across most sites (Ref. 31). • 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 (Ref. 30). At the northern end of the beach, there has been a decrease in the gravel fraction in CBF sediments since baseline and at the most southern end of the beach, there has been an increase in the gravel fraction in CBF sediments (Ref. 31). *Inga, YCN, and YCS beaches* • Sediments sampled at YCN, and YCS beaches in 2023 generally comprised similar PSDs to samples from the previous sampling event (October 2022) and from baseline (Ref. 31). At Inga Beach, there was a slight increase in fines and decrease in gravel at CBF sites, and a slight increase in gravel at FA sites.
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 three zones, based on the characteristics of the measured physical parameters within the study area: – Optimal Nesting Zone: considered ideal for marine turtle nesting – Suboptimal Nesting Zone: considered less than ideal but may still allow successful marine turtle nesting – Unsuitable Nesting Zone: 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 (i.e. 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 late 2023, the total available nesting area was 11.6 ha, with 74% defined as optimal nesting habitat (Figure 9-8). • 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 Marine Infrastructure (Terminal, Bivalve, and Inga). 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 are eroded. • Progressive exposure of intertidal rock since baseline is due to the ongoing realignment of Terminal, Bivalve, and Inga beaches towards the Marine Infrastructure via longshore sediment redistribution. Realignment has resulted in a gain in optimal nesting area on each beach at the end closest to the Marine Infrastructure (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 Marine Infrastructure. *Terminal Beach* • The area of mapped optimal nesting habitat at Terminal Beach progressively reduced between 2009 and 2012, from 2.25 ha in October 2009 to 0.81 ha in October 2012. Since 2012, optimal nesting habitat has stabilised and averaged 0.85 ha (0.92 ha in late 2023). The greatest change has occurred in the northern two-thirds of the beach, where intertidal rock has been 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 late 2023, the southern third of Terminal Beach was classified as optimal nesting habitat (with some small areas classified as unsuitable and suboptimal due to shallow sand), the middle third was classified as suboptimal, and the northern third was classified as unsuitable (Figure 9-9). • Between late 2022 and late 2023, the area of optimal nesting habitat increased from 14.9% (0.91 ha) to 15.1% (0.92 ha) of the study area, which was the fifth subsequent year of optimal nesting habitat increase. The area of suboptimal nesting habitat increased from 12.0% (0.73 ha) to 12.5% (0.77 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 seaward extent of nesting habitat, and a change in sediment particle size. Changes in the exposure of bedrock in the central third of the beach led to the increase in suboptimal nesting area, with rock that was exposed marginally above the mean high water springs (MHWS) tide mark in 2022, now re-covered due to natural sand redistribution (Figure 9-9). *Bivalve Beach* • At Bivalve Beach, the area of optimal nesting habitat progressively reduced between 2009 and 2015, from 2.10 ha in October 2009 to 0.78 ha in October 2015. Since 2015, optimal nesting habitat has stabilised and averaged 0.79 ha (0.79 ha in late 2023). 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). • In late 2023, the southern two-thirds of Bivalve Beach were predominantly classified as unsuitable habitat, with small areas of suboptimal habitat. The northern third was largely classified as optimal habitat, with some unsuitable areas of shallow sand adjacent to the rock headland (Figure 9-10).

Monitoring program: Marine turtle nesting habitat
• Between late 2022 and late 2023, the optimal nesting area decreased, from 16.3% (0.90 ha) to 14.3% (0.79 ha) of the study area. The area of suboptimal nesting habitat increased slightly, from 3.10% (0.17 ha) to 3.31% (0.18 ha). Changes in the optimal nesting zone were predominantly associated with removal of discontinuous nesting habitat included as optimal in 2022. Optimal and suboptimal nesting habitat were otherwise stable in 2023 (Figure 9-10). *Inga Beach* • Optimal nesting area at Inga Beach has decreased over time from 1.86 ha in October 2009 to 0.21 ha in late 2023. Optimal nesting habitat has been replaced with either suboptimal or unsuitable habitat along the southern two-thirds of the beach, due to the exposure of intertidal rock (consolidated and unconsolidated, i.e. loose pebbles and cobbles). 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 late 2023, a small section at the northern end of Inga Beach was classified as optimal nesting habitat, with the remainder being suboptimal in the middle section and unsuitable in the southern half. • Between late 2022 and late 2023, optimal nesting area on Inga Beach decreased from 3.8% (0.24 ha) to 3.3% (0.21 ha) of the study area. This was accompanied by an increase in suboptimal nesting area, from 14.3% (0.92 ha) to 14.9% (0.96 ha). These changes correspond to an increase in exposure of rock, cobbles, and pebbles, encroaching north over the lower beach face. *YCN Beach* • YCN Beach has undergone minor changes in turtle nesting habitat since baseline, with changes relating to the annual position of the MHWS line, which is influenced by patterns of erosion and accretion. No intertidal rock has been exposed at YCN Beach since baseline, and no areas of suboptimal or unsuitable nesting habitat have occurred since baseline (Figure 9-12). In October 2009, 3.49 ha of optimal nesting area was recorded; this had increased to 3.72 ha in late-2023. • Between late 2022 and late 2023, optimal nesting area on YCN Beach increased slightly, from 55.7% (3.60 ha) to 57.6% (3.72 ha) of the study area (Figure 9-8). *YCS Beach* • YCS Beach has seen a small decrease in optimal nesting area and a small increase in suboptimal nesting area since baseline. In October 2009, 3.44 ha of optimal nesting area was recorded, which had reduced to 2.91 ha by late 2023. Changes in the size of nesting areas relate to exposure of intertidal rock, particularly in the central section of beach (Figure 9-13). • Between late 2022 and late 2023, optimal nesting area on YCS Beach increased slightly, from 32.2% (3.04 ha) to 32.7% (3.08 ha) of the study area (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.

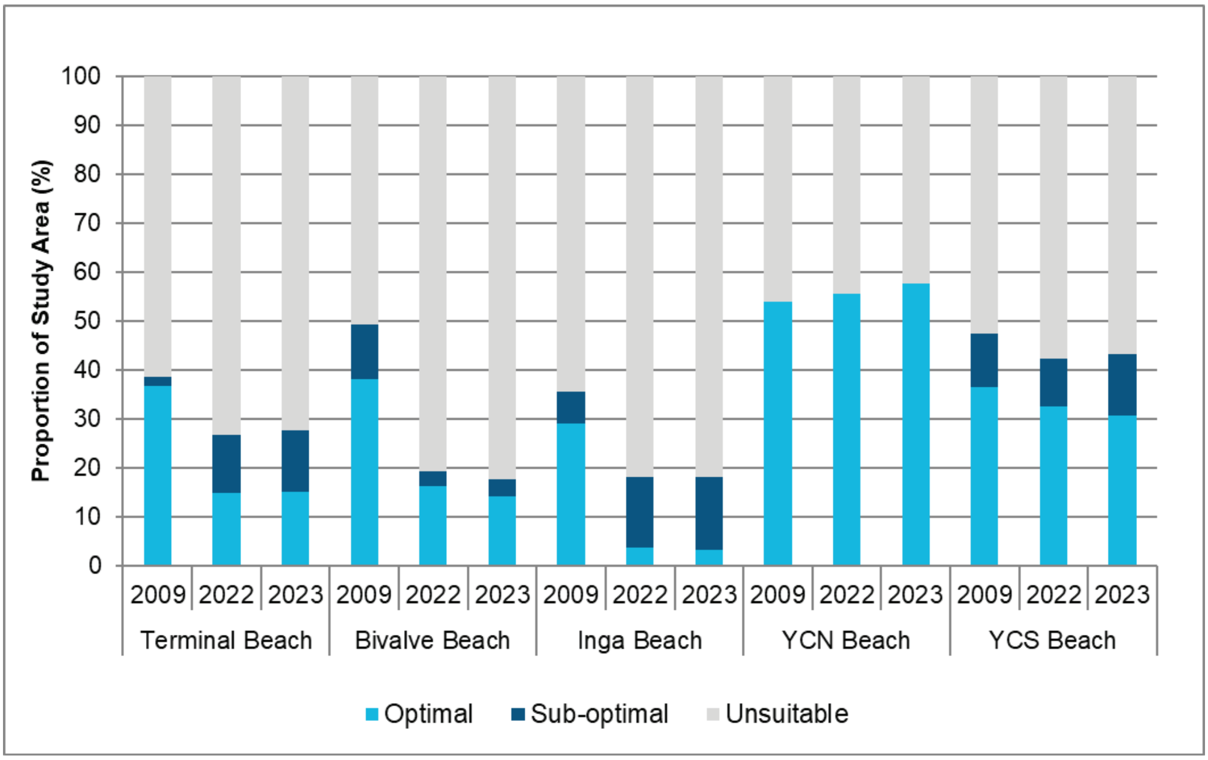

Figure 9-8: Proportions (%) of marine turtle nesting habitat zones for monitored beaches in 2009 (baseline), 2022, and 2023

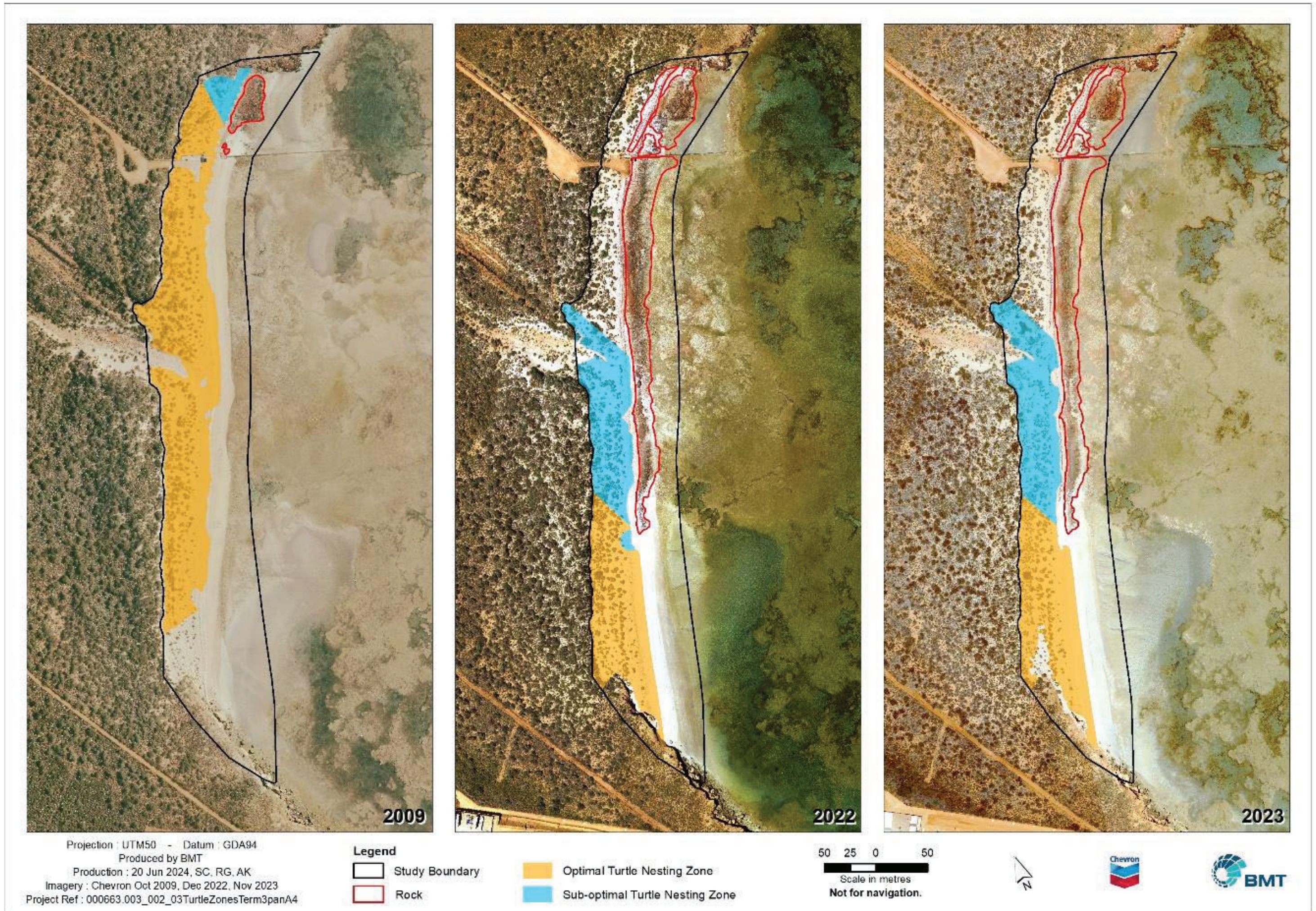

Figure 9-9: Marine turtle nesting habitat zones for Terminal Beach

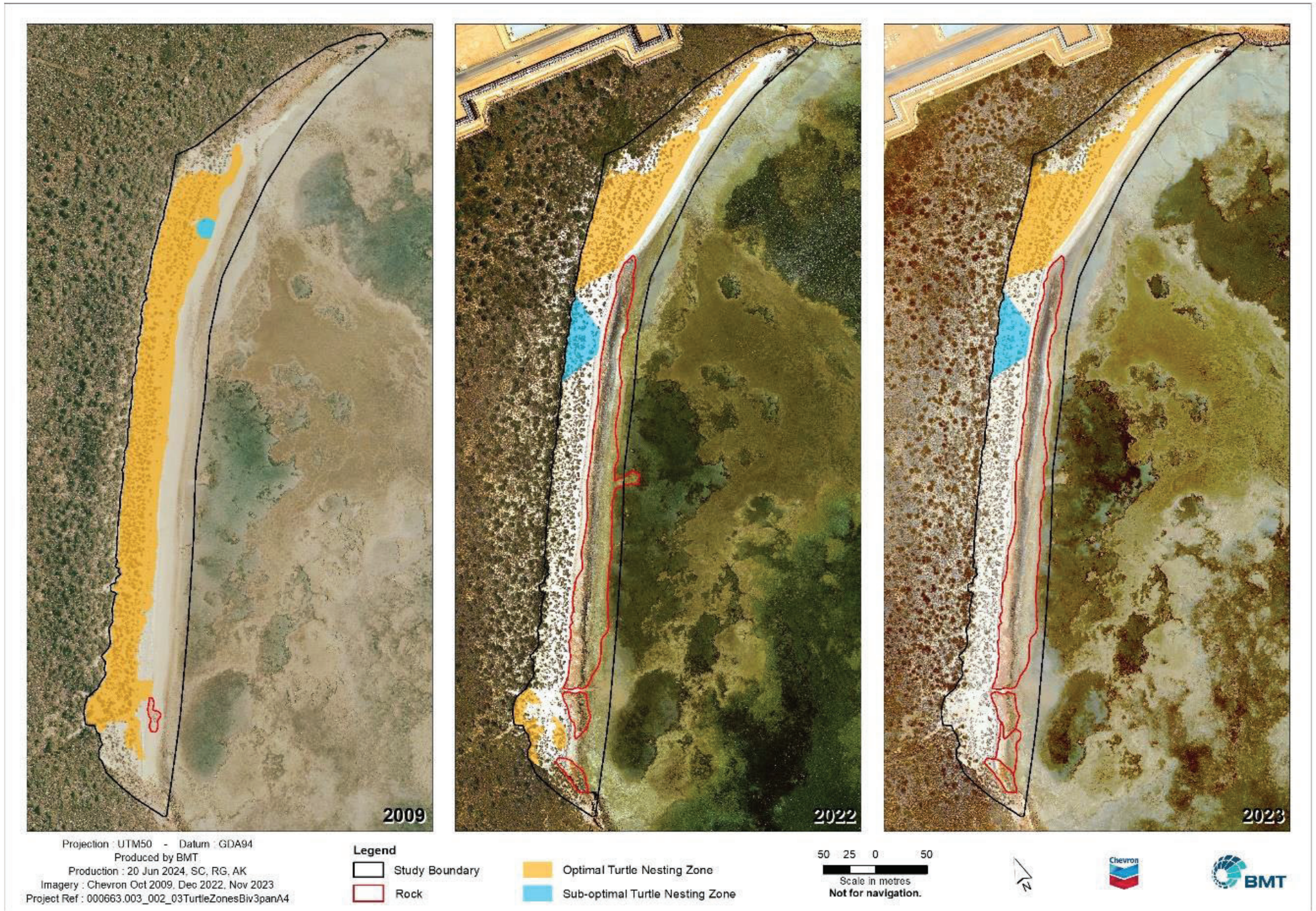

Figure 9-10: Marine turtle nesting habitat zones for Bivalve Beach

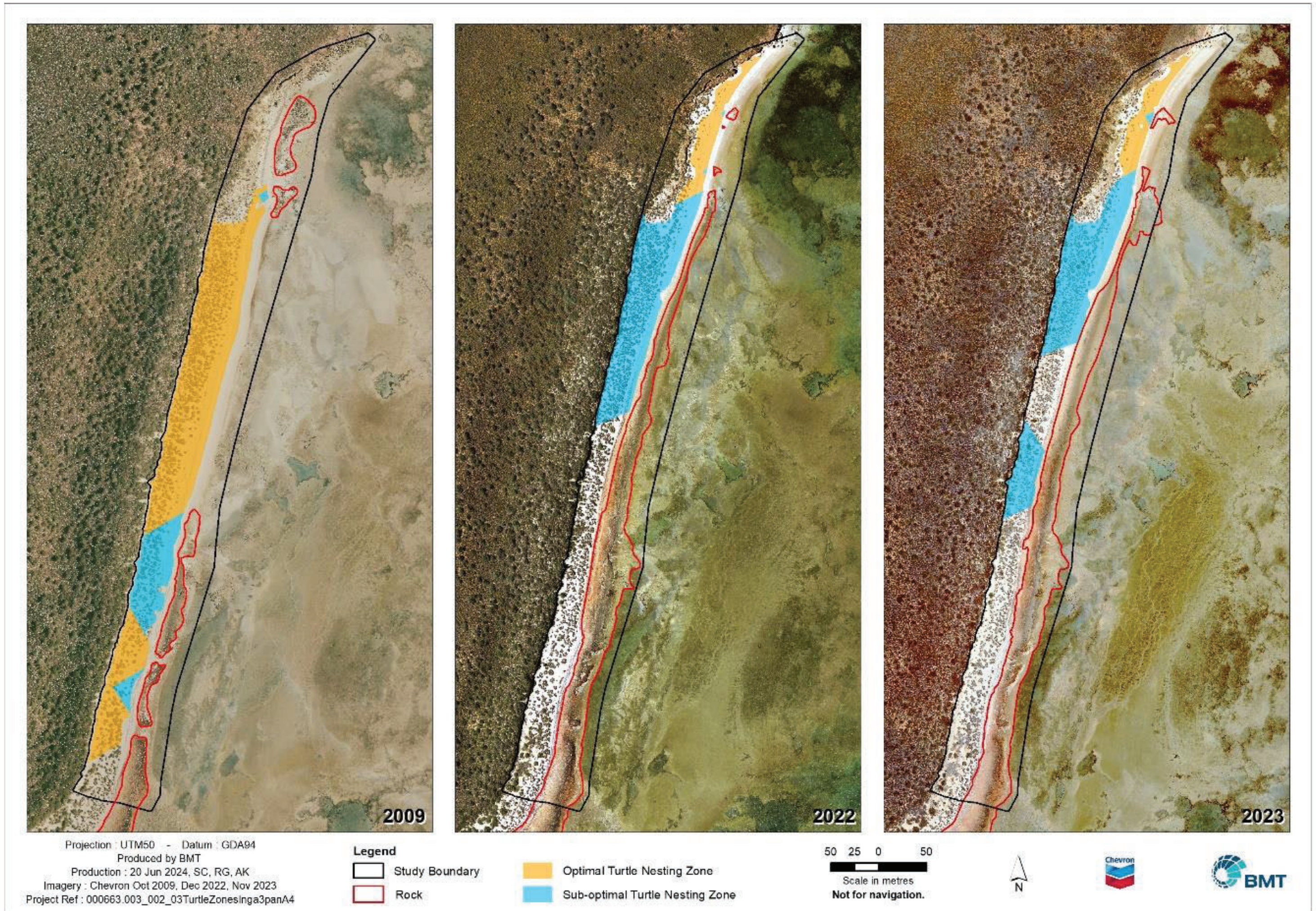

Figure 9-11: Marine turtle nesting habitat zones for Inga Beach

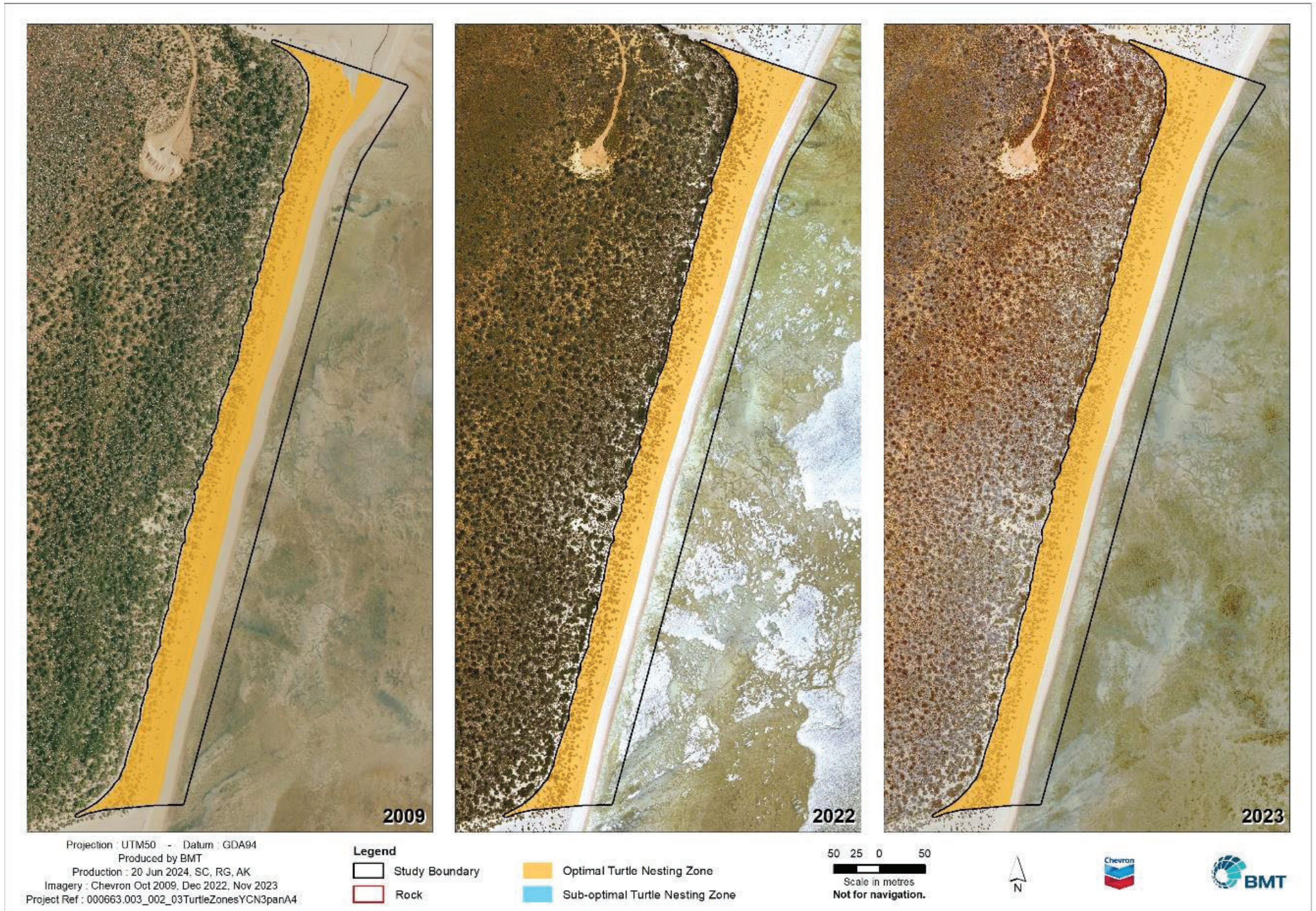

Figure 9-12: Marine turtle nesting habitat zones for YCN Beach

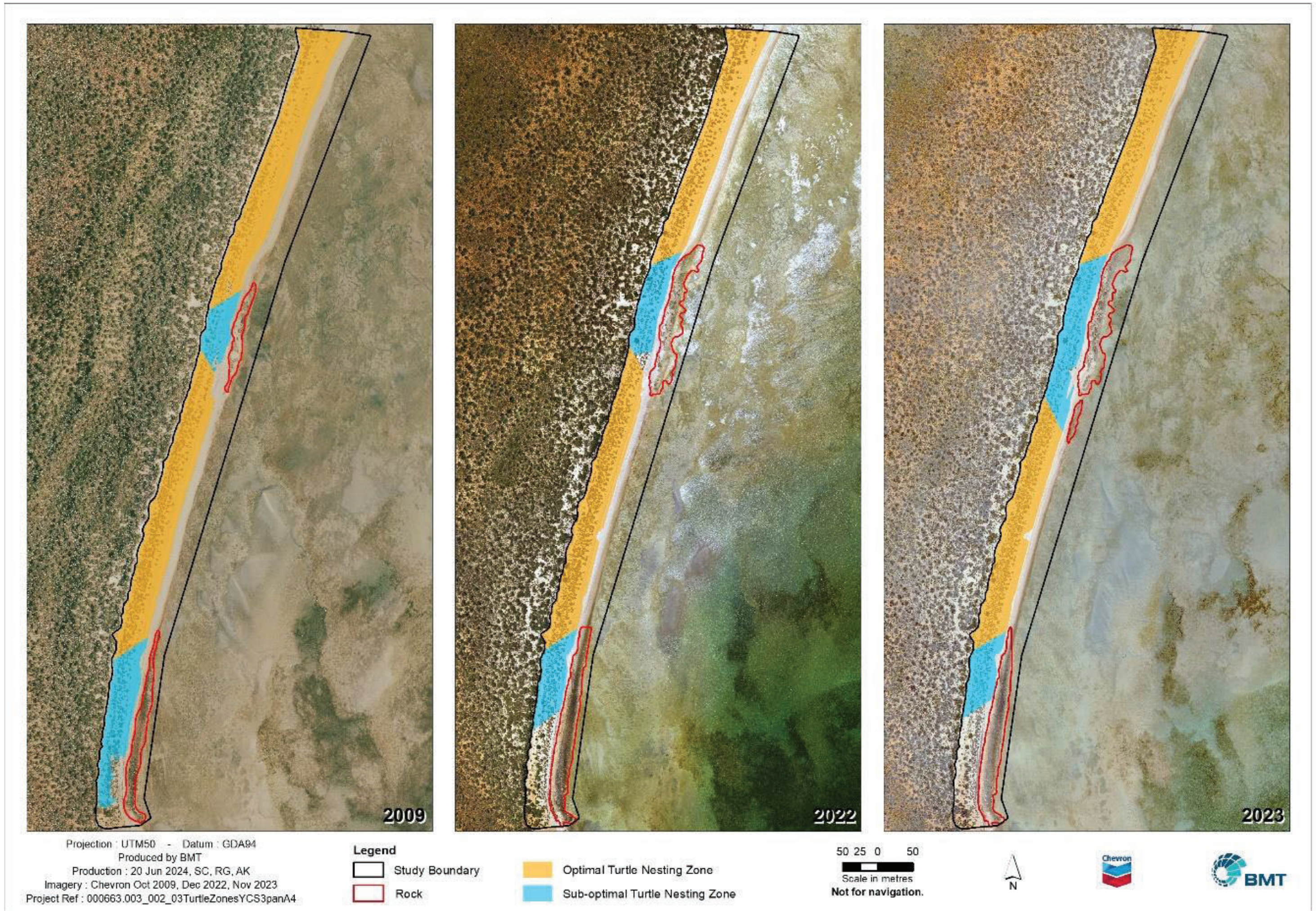

Figure 9-13: Marine turtle nesting habitat zones for YCS Beach

9.2 Changes to the Coastal Stability Management and Monitoring Plan

Results of the CSMMP monitoring program since installing the Marine Infrastructure have indicated that changes to Terminal, Bivalve, and Inga beaches have been greater than initially predicted. In response to these findings, a new revision (Revision 0.3) of the CSMMP was developed and submitted to DWER and DCCEEW in March 2019. The revision proposed new management triggers for coastal stability and marine turtle nesting habitat. Further improvements were proposed in Revisions 0.4, submitted to DWER and DCCEEW in June 2020.

The CSMMP (Ref. 28) was again revised and submitted for approval during the Reporting Period. In accordance with the variation to EPBC 2003/1294 and 2008/4178 conditions issued 7 August 2023, Revision 0.8 of the CSMMP was submitted to DCCEEW on 28 June 2024. This revision was also provided to DWER for information on 1 August 2024, with the intention of formally submitting once any comments from DCCEEW have been received and addressed.

9.3 Discussion and 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 FA sites on Terminal Beach. Slope exceedances were detected at one Terminal Beach and one Bivalve Beach CBF site, and at all FA sites. These exceedances correspond to a trend of sand redistribution towards the Marine Infrastructure 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 Potential Impact beaches, resulting 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 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—it is unlikely the Marine Infrastructure has had a significant adverse impact on coastal stability and 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 Marine Infrastructure may 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. The latter 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—i.e. 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.

Large sections of the underlying rock platform on Terminal, Bivalve, and Inga beaches have been gradually exposed as a result of sand redistribution at the beach face since construction, predominantly in the direction of Marine Infrastructure. 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 these beaches, and this habitat has been replaced by suboptimal and unsuitable nesting habitat. In general, decreases in optimal nesting habitat have occurred on sections of beach furthest from the Marine Infrastructure (southern ends of Bivalve and Inga beaches, northern end of Terminal Beach) and increases have occurred closest to the Marine Infrastructure. No interim management triggers for marine turtle nesting habitat (which apply to Terminal and Bivalve beaches only) were exceeded during the Reporting Period.

However, the reduction in optimal nesting habitat may represent an adverse change that could have implications for marine turtles. In response to monitored changes to beaches, CAPL is evaluating a range of mitigation options and continues to engage with DWER and DCCEEW on this matter.

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 requirements for terrestrial rehabilitation

Item	Source	Section in this EPR
A description of any rehabilitation activities undertaken	MS 800, Schedule 3(9i)	10.1
Results of the rehabilitation monitoring program including performance against completion criteria targets	MS 800, Schedule 3(9ii)	10.2
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. 32)	MS 800, Schedule 3(9iv)	10.5
A figure identifying areas rehabilitated, areas planned to be rehabilitated, and disturbed areas to be retained for ongoing construction and operational needs	PCRP (Ref. 32), Section 7.2.2	10.1
Topsoil usage and topsoil balances	Gorgon Gas Development Topsoil Management Plan (TMP) (Ref. 33), Section 3.3	10.3
Changes to volume of soil stockpiled as a result of rehabilitation or clearing activities	TMP (Ref. 33), Section 3.3	10.3
Results of the topsoil monitoring program, topsoil performance reviews, and topsoil volume reconciliation	TMP (Ref. 33), Section 5.0	10.4
Progress against rehabilitation objectives in Table 5-2 of the PCRP (Ref. 32)	PCRP (Ref. 32), Table 5-2	10.1, 10.2, 10.3, 10.4

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

10.1 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.

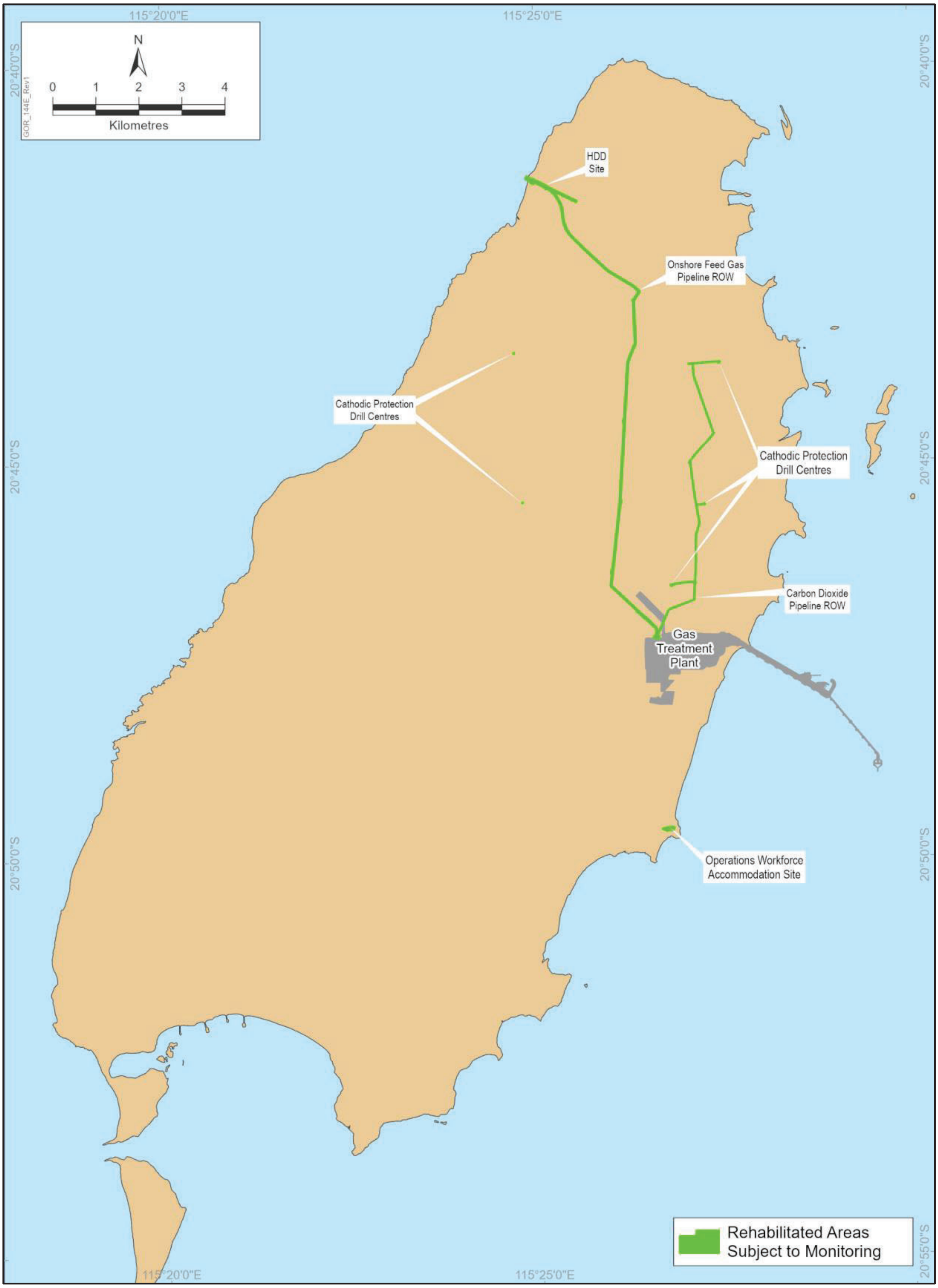

Figure 10-1: Areas rehabilitated for the Gorgon Gas Development

10.2 Rehabilitation monitoring results

The PCRP (Ref. 32) 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. 32) further defines specific objectives for rehabilitating 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 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 CSIRO, 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 function 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—20 sites in the CO_2 and feed gas pipeline corridors, and three non-pipeline transects. • Eight 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. • Monitoring was not completed at FGP_LT21 or the HDD quadrats as access was limited due to Jansz-Io Compression (JIC) project activities.
Results
• None of the monitored rehabilitation sites met all the completion criteria in the PCRP, although performance had improved between 2022 and 2023, particularly against criteria such as plant cover and *Triodia* cover. • Criteria that were frequently met were erosion and species diversity. • Overall in 2023, two limestone rehabilitation transects and two drainage/flats rehabilitation transects were within the analogue range for all landscape function indices. • Compared to 2022, landscape function was lower than recorded in 2023 in terms of instability (8 vs 14 transects), infiltration index (14 vs 17 transects) and nutrient cycling index (9 vs 11 transects). Total plant cover improved (11 vs 6 transects) as did *Triodia* cover (3 vs 2 transects). The other flora-based criteria values were lower in 2023. This was likely due to the extended dry period experienced before the 2023 survey. • Arthropod assessment was not possible in 2023 because of the JIC project and planned disturbance of monitoring sites during trap deployment.
Conclusions
• During the Reporting Period, the rehabilitation monitoring program was completed in accordance with the requirements of the PCRP (Ref. 32). • Completion criteria addressing key landscape function are trending positively since 2019 indicating that the rehabilitation sites are fundamentally sound.

Monitoring program: Rehabilitation
• Compared to 2022, the number of transects meeting vegetation criteria were slightly lower, although total plant cover and *Triodia* cover increased. An extended period of low rainfall before the survey may have contributed to the lower values recorded, indicating the rehabilitation sites are not as resilient as analogue sites as yet, which would be expected at this stage of site rehabilitation. • Overall, rehabilitation performance is progressing as expected at this stage of monitoring.

10.3 Topsoil activities

Topsoil stockpile volumes are summarised in Table 10-2. Topsoil stored at P13 and X62J increased by 440m^3 and 153m^3 respectively. Topsoil was recovered during clearing activities associated with earthworks along the CO_2 pipeline right-of-way.

Table 10-2: Monitored topsoil stockpile volume summary (2023–2024)

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 and CO_2 pipeline right-of-way	153	17,808
R Station	GTP Site	None	3,481
P13	CO_2 pipeline right-of-way	440	9,893
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

10.4 Topsoil monitoring results

The TMP (Ref. 33) complements the PCRP (Ref. 32), 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 assessment using object-based image analysis (OBIA), with performance criteria developed that aligned with current criteria for Gorgon rehabilitation areas. The assessment undertaken during this Reporting Period used 2022 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.
Methodology
Methodologies used to assess the stockpiles Included: • Germinable seed assessment • Object Based Image Analysis (OBIA) to assess vegetation • On-ground integrity assessment to assess stability, vegetation condition and presence of weeds
Results
• An on-ground integrity assessment found:

Monitoring program: Topsoil
– vegetation on the topsoil stockpiles were in excellent condition – no major erosion issues – no weed populations were observed. These findings were consistent with topsoil stockpile observations made in previous integrity assessments. • OBIA of October 2022 aerial imagery was conducted for 16 stockpiles. The assessment identified that total vegetative cover increased between 2021 and 2022 at 14 out of 16 topsoil stockpiles assessed. *Triodia* cover increased at 15 out of 16 stockpiles and contributed the majority (>50%) of overall cover at 11 out of 16 topsoil stockpiles. Above average rainfall in the 12 months prior to October 2022 likely contributed to favourable growing conditions, with a particularly high rainfall event noted in May 2022 (BOM 2023). • Patchy *Triodia* flowering on Barrow Island was observed during the reporting period. Although there was rainfall over this period, it may not have been sufficient to allow the seed set and as such, seed numbers in reference sites and stockpiles were relatively low. Soil-stored seed in stockpiles remained several times greater than in reference soils, for both monocots and dicots.
Conclusion
Topsoil stockpiles are stable. Numbers of soil-stored germinable seed in stockpiled soils has generally been similar to, or greater than, reference sites for several years. As long as the stockpiles remain undisturbed it is reasonable to expect that seed production from standing vegetation on the stockpiled soils will be maintained. No maintenance of the stockpiles is required based on the assessment results. Vegetation cover and stockpile integrity will become the primary focus of annual stockpile monitoring in future years.

10.5 Changes to the Post-Construction Rehabilitation Plan

No changes were made to the to the PCRP (Ref. 32) during the Reporting Period.

11 Spill management

Table 11-1: EPR 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)	11.1

11.1 Event data

No spills caused by the Jansz Feed Gas Pipeline, or spills that impacted on Jansz Feed Gas Pipeline facilities and met the threshold of a recordable or reportable incident (Ref. 35; Ref. 36), occurred during the Reporting Period.

12 Terminology

Table 12-1 defines the acronyms, abbreviations, and terminology used in this document.

Table 12-1: Terminology

Term	Definition
~	Approximately
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
AGL	Above ground level
Alert trigger	Measured parameter deviates towards (but remains within) 1 SD for 2 consecutive years, or deviates outside a 1 SD limit
Annual nester abundance	Estimate of total female marine turtle nesters per season at a rookery
AQMP	Air Quality Management Plan
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
AU$	Australian dollar
Backshore	An upper shore zone above high tide
Baseline	The original status of the environment in the area before the development work of the project is started
BC Act	Western Australian *Biodiversity Conservation Act 2016*
Butler Park	Barrow Island accommodation 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 that will include the true parameter value 95% of the time. By convention, 95% Confidence Intervals are usually used to define reasonably upper and lower bounds for parameter estimates.
Civil Twilight hours	The beginning of morning civil twilight is defined as the instant in the morning, when the centre of the Sun is at a depression angle of six degrees (6°) below an ideal horizon.
Clutch frequency	The mean number of clutches laid per female marine turtle nester per season
cm	Centimetre
CMR	Capture-mark-recapture
CO	Carbon monoxide
CO_2	Carbon dioxide

Term	Definition
CO_2e	Carbon dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSMMP	Coastal Stability Management and Monitoring Plan
DAWE	Former Commonwealth Department of Agriculture, Water and the Environment (dates: 1 Feb 2020 to 30 Jun 2022; split into Department of Climate Change, Energy, the Environment and Water and Department of Agriculture, Fisheries and Forestry on 1 Jul 2022)
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water (from 1 Jul 2022)
DNA	Deoxyribonucleic Acid
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
$F_{1,12}$	In linear regression, the F-statistic is the test statistic for the analysis of variance (ANOVA) approach to test the significance of the model or the components in the model.
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.
FMP	Fire Management Plan
GHG	Greenhouse Gas
Gorgon Gas Development	Gorgon Gas Development and Jansz Feed Gas Pipeline
GPS	Global Positioning System
GTG	Gas Turbine Generator
GTP	Gas Treatment Plant
ha	Hectare
Hatchling	Newly hatched marine turtle
Hatchling disorientation	The range of dispersion (nest fan spread angle) of marine turtle hatchling tracks from the emergence point
Hatchling emergence probability	The median emergence success of hatchlings from clutches

Term	Definition
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
ID	Identifier/identification
ind/ha	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.
JIC	Jansz–Io Compression
kHz	Kilohertz
km	Kilometre
LCGT	Liquefaction Compressor Gas Turbine
LFA	Landscape Function Analysis
LNG	Liquefied Natural Gas
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
Management trigger	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
mg	Milligram
MHWS	Mean High Water Springs (tide)
mm	Millimetre
MOF	Materials Offloading Facility
MS	(Western Australian) Ministerial Statement
MS 1198	Western Australian Ministerial Statement 1198, (for the Gorgon Gas Development), as amended from time to time
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

Term	Definition
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
NO_x	Nitrogen oxides (NO and NO_2)
O_3	Ozone
OBIA	Object-based Image Analysis
P	The p-value is a number between 0 and 1 representing the probability that this data would have arisen if the null hypothesis were true.
PCRP	Post-Construction Rehabilitation Plan
Performance Standards	Developed for assessing performance, not compliance, and are quantitative targets or if that is demonstrated to be not practicable, qualitative targets, against which progress towards achievement of the objectives of conditions can be measured.
PM_{10}	Airborne particulate matter, less than 10 microns
Potential Impact beaches	Those beaches on the east coast of Barrow Island, adjacent to the marine infrastructure, that modelling predicted most likely to be impacted as a consequence of the presence of the marine infrastructure.
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 plant (excluding those considered to be naturalised) proliferation: an increase in the distribution of NIS plants producing propagules outside existing Weed Hygiene Zones. • NIS animal proliferation: an increase in reproductively capable offspring dispersing outside the known distribution. • Marine Pest proliferation: an increase in reproductively capable offspring dispersing outside the known distribution in the waters surrounding Barrow Island.
Proposal	Gorgon Gas Development, as expanded and revised by the Revised and Expanded Gorgon Gas Development
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.

Term	Definition
	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 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. **Marine Pest**: The detection, containment, and removal of a Marine Pest on a vessel's (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.
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

Term	Definition
Remigrant turtle	A tagged Flatback Turtle returning and 'recaptured', as opposed to a new (untagged) turtle that is tagged for the first time.
Reporting Period	The period from 10 August 2023 to 9 August 2024 covered by this EPR
Reservoir Carbon Dioxide	GHG Emissions that are separated (from natural gas or the products produced from extracted hydrocarbons) in the acid gas removal units and expected to be subsequently injected underground (as per MS 1198).
RPA	Remotely Piloted Aircraft
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
SME	Subject Matter Expert
SO_2	Sulfur dioxide
SO_4	Sulfate ion
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
SSE	South-south-east (compass direction)
Stressor	An environmental condition or influence that stresses an organism
SVL	Sparse Vegetation Line
tCO_2e	Tonnes of carbon dioxide equivalent
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
TSEMP	Terrestrial and Subterranean Environment Monitoring Program
vs	Versus
WA	Western Australia
Waters surrounding Barrow Island	Refers to the waters of the Barrow Island Marine Park and Barrow Island Marine Management Area (~4,169 ha and 114,693 ha respectively), as well as the Port of Barrow Island representing the Pilbara Offshore Marine Bioregion

Term	Definition
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
WWFW	White-winged Fairy-wren
YCN	Yacht Club North (beach)
YCS	Yacht Club South (beach)

13 References

Table 13-1 lists the documentation referenced in this EPR.

Table 13-1: References

Ref. No.	Description	Document ID
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