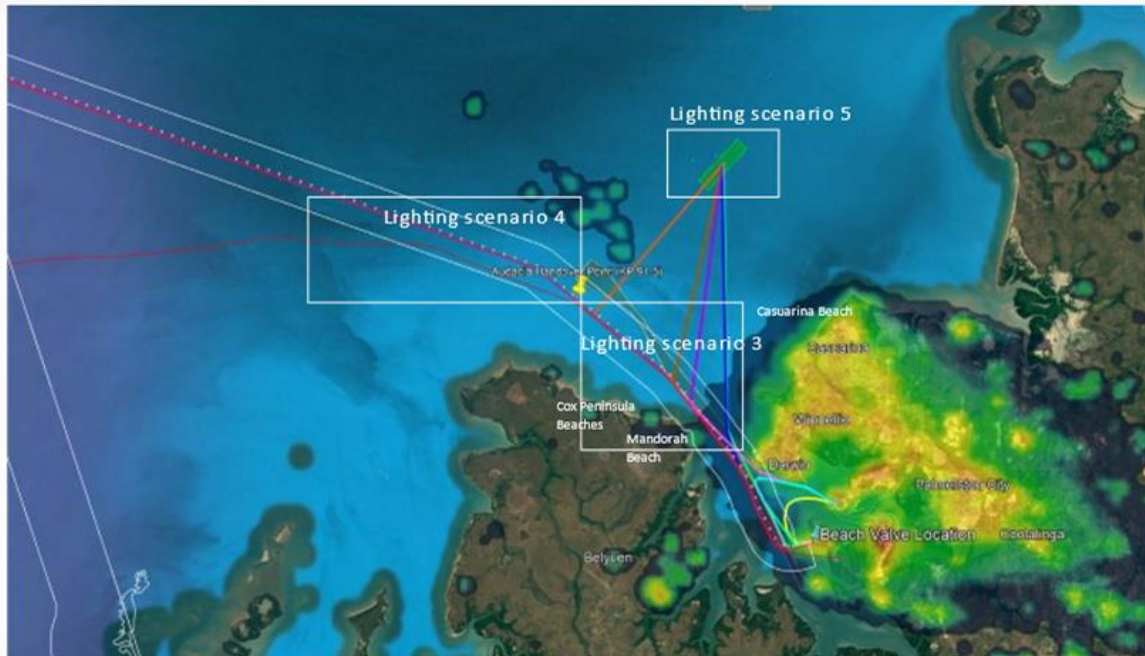


Appendix 14: Darwin Harbour Lighting Impact Assessment

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SANTOS

BAROSSA PIPELAY, DARWIN HARBOUR LIGHTING TECHNICAL NOTE



Prepared by

Pendoley Environmental Pty Ltd

For

Santos

27 May 2022



PENDOLEY ENVIRONMENTAL



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1 BACKGROUND

Santos proposes to construct and operate the Darwin Pipeline Duplication (DPD) Project, to allow gas from the Barossa gas field in the Timor Sea to be transported to Darwin LNG facility. As part of the referral process to obtain approval to dredge and install the Barossa pipeline, the Department of Agriculture, Water and the Environment (DAWE) has requested Santos provide further information on listed threatened and migratory species in the Darwin region, in particular, marine turtles nesting on beaches potentially exposed to lighting from Project vessels in the Darwin Harbour.

Santos has requested a Subject Matter Expert (SME) desktop assessment to determine the presence and significance of marine turtle nesting activity on beaches surrounding Darwin Harbour. This Technical Note compiles the available information on regional marine turtle nesting and assesses the likely level of impact the DPD Project will have on the Arafura Sea genetic stock of flatback turtles (*Natator depressus*).

1.1 Data sources

Information on the local (Darwin environs) and regional (Northern Territory) has been derived from several sources including:

- Online
 - Northern Territory Natural Resource Maps: <https://nrmaps.nt.gov.au/>
 - Atlas of Living Australia: <https://www.ala.org.au/>
- Grey Literature
 - Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017)
 - Proceedings of the Australian Marine Turtle Conservation Workshop (ANCA 1994)
 - Marine Turtle Conservation and Management in Northern Australia (Centre for Indigenous Natural and Cultural Resource Management 1998)
 - A Biological Review of Australian Marine Turtles (QEPA 2009)
- Published, peer-reviewed literature.

1.2 Review on Darwin area nesting

Potential impact beaches with evidence of marine turtle nesting activity that are likely to be exposed to Project vessel lighting include Casuarina Beach in Darwin, and beaches on Cox Peninsula, including Wagait Beach and Mandorah (**Figure 1**).

The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017) identifies the known important habitat critical to the survival of all marine turtle species in Australia. The Arafura Sea genetic stock, which includes the Darwin area nesting beaches, is the largest genetic stock for flatback turtles in Australia and covers the largest geographic area (FitzSimmons et al 2020). The Recovery Plan does not recognise any of the potential impact beaches as significant nesting sites for the Arafura Sea genetic stock.

The threats identified for this stock include: marine debris entanglement (very high); climate change, terrestrial predators and indigenous take (high); international take, fisheries bycatch, noise, dredging, disease and pathogens, habitat modification and human recreation (low) (Commonwealth of Australia 2017). Light pollution was not identified as a threat for the Arafura Sea stock. Unlike smaller and more geographically constrained genetic stocks, the size and wide geographic distribution of the Arafura Sea flatback stock provides greater resilience to threats or impacts on the stock.

A number of species reviews and nesting distribution studies for Northern Territory stocks have been conducted which consistently identify regional rookeries remote from the Darwin Harbour as significant nesting sites, while the beaches surrounding Darwin Harbour, when they are acknowledged at all, are reported as supporting a relatively insignificant nesting effort (Chatto 1998; Chatto and Baker 2008; Guinea 1994a; Guinea 1994b; Parmenter 1994).

Chatto (1998) conducted a series of aerial surveys to identify hotspot nesting sites for subsequent ground truthing found flatback turtles are the most common nesting species in the Northern Territory and were widespread on island and mainland beaches. He identified low-level flatback nesting (1 – 10 track/nests) on Cox Peninsula and at Casuarina Beach near Darwin (**Figure 1**). This finding was further confirmed in Chatto and Baker (2008) who reported on data from regional snap shot surveys between 1990 and 2004 which also found turtle activity (tracks and nests) fell into the 1 – 10 range and were not recognised as significant rookeries. Significant flatback rookeries nearest to Darwin Harbour are located at Quail Island and Bare Sand Island off the western coast of the Cox Peninsula and ~40 km west of Darwin (**Figure 1**). Nest/track activity ranged from 100 – 200 events over the same sampling period at these locations (1991 – 2004). Whiting and Guinea (2003), reporting on systematic tagging surveys at Bare Sand Island, found 6 – 10 nests per night over a 14-day standardised survey period.

Chatto and Baker (2008) have identified the most important turtle nesting areas in the Northern Territory as: Turtle Point in Joseph Bonaparte Gulf, Bare Sand and Quail Islands near Darwin, the southwest of Bathurst Island, a number of beaches along the northern coastline of Melville Island, the Smith Point area of Cobourg Peninsula, islands to the north and east of Croker Island, the Goulburn Islands, NW Crocodile Island, many of the outer islands of the numerous island chains off northeast Arnhem Land, the mainland coast and islands between Cape Arnhem and Blue Mud Bay, the eastern part of Groote Eylandt and its associated islands, and some of the outer islands in the Sir Edward Pellew Group.

No systematic tagging or census surveys have been carried out on Cox Peninsula. Records held by the Atlas of Living Australia (ALA) include records submitted by the public and reports by local rangers between 2011 and 2019. Nine records exist for flatback turtles on the Cox Peninsula, and include one nesting event, three reports of individual hatchlings found on the beach, one floating animal unable to dive and four miscellaneous records with no further detail. These records further support the low level of nesting activity reported for beaches, including Wagait Beach and Mandorah beaches, on the peninsula. Furthermore, eight records exist for hawksbill (three records) and green turtles (five records) in the area, all of which were reports of stranded animals either found floating or washed ashore emaciated, with boat strike injuries or entangled in marine debris. No hawksbill or green turtle nesting has been reported at potential impact beaches. While the records are likely limited by several factors including low survey effort, low reporting effort and the lack of a systemic approach, the results are consistent with the reported low levels of nesting effort for this area (Chatto and Baker 2008), who also acknowledged similar limitations in their survey methods and data.

ALA records from the Casuarina Beach section of coastline show a similar result. Of the 10 hawksbill and 15 green turtle records, none were for nesting activity, and all were attributed to strandings (eight hawksbill, two green) and indigenous take (two hawksbill, 13 green). Flatback activity dominated the records over the nine years between 2011 and 2020, with a total of 47 records ranging from 1 – 12 reports per year for flatback turtles within 5 km of Lee Point, including Casuarina Beach. Given Casuarina is a popular beach for recreation, we can conclude this survey effort is consistently high, particularly in the southern half of the beach.

Systemic and intensive turtle monitoring conducted on Casuarina Beach between 1997 and 2006 recorded 107 nests along 8 km of beach: 104 flatback, two olive ridley and one green (Chatto and Baker 2008). The number of nests recorded ranged from 7 to 20 each year, peaking between May and October, and confirms this as a low-density nesting beach (Chatto and Baker 2008). This beach is recognised for its value as a public education program and not as a significant turtle nesting site (Chatto and Baker 2008).

No data is available on the orientation of hatchlings leaving beaches on the Cox Peninsula, or Casuarina Beach. The ALA database does not address this, nor is this data collected by the Northern Territory Department of Environment Parks and Water Security. Hatchlings use several cues to find the ocean, including horizon elevation and brightness, and beach slope. In the absence of orientation data, it can be assumed that some misorientation would be occurring as a result of the urban lights from the City of Darwin (**Figure 2**). Vehicle headlights and campfires on beaches may also misorient hatchlings under certain conditions.

Available records covering at least the last 30 years are consistent in demonstrating the low importance of beaches surrounding Darwin Harbour to nesting turtles, including Wagait Beach and Mandorah on Cox Peninsula, and Casuarina Beach in Darwin, to nesting turtles and specifically to flatback turtles within the wider Arafura Sea genetic stock. Current pressures on the few flatback turtles that use the potential impact beaches for nesting include substantial light pollution from Darwin (**Figure 2**), disturbance from recreational beach use, and indigenous take of turtles or eggs. Local aboriginals harvest eggs of all species from accessible mainland beaches throughout the Northern Territory (Chatto 1998), which are highly sought after for food (Kennett, Munungurritj, Yunupingu 1998, Winderlich, 1998). Illegal turtle egg harvest by non-Aboriginal people has also been reported in the Northern Territory (Risk and Browne 1998). Green turtles are the most hunted turtle species in Australia as they are the most favoured for food, whilst flatback turtles are not as well favoured and so not targeted by indigenous hunters (Kowarsky, 1982; Kennett, Munungurritj, Yunupingu 1998). The ALA includes records of turtle carcass dumps in Darwin which are dominated by green turtles and confirms the local indigenous take.

Human recreation, including presence of people, campfires and vehicles, will disturb turtles. Females coming ashore to nest can be forced to go elsewhere when exposed to human activity onshore, vehicles can crush nests or hatchlings, and tyre ruts can obstruct the hatchlings seaward crawl (Lutcavage et al , 1997). Furthermore, campfires have been known to attract emerging hatchlings, which have been observed to crawl into the flames. High recreational use of Casuarina Beach has been confirmed by R Chatto (Northern Territory Department of Environment Parks and Water Security), in communications with Santos staff on 4 April 2022, who provided the following advice on turtle nesting at Casuarina Beach:

- Artificial lighting is considered less of a problem than the amount of human (and dog) traffic on Casuarina Beach – Casuarina Beach is a very popular recreational area for Darwin residents.
- At least half of the turtle nests encountered are relocated to other areas like Lee Point.
- Artificial lighting at sea is considered less of a problem than lighting on land.
- R Chatto could not comment on the specifics of turtle nesting at Mandorah and Cox Peninsula but believed they attracted fewer numbers of nesting turtles than Casuarina Beach
- Information on the number of turtles, nests and re-locations, are available from the Northern Territory Fauna Atlas.



J06063 Barossa Pipelay, Darwin Harbour Lighting

Figure 1: Location Map

Drawn: B. Moore
 Date: 25/05/2022
 Drawing File Ref:
 PENV-J06063-1181-A
 Coordinate System: GDA 1994 MGA Zone 52



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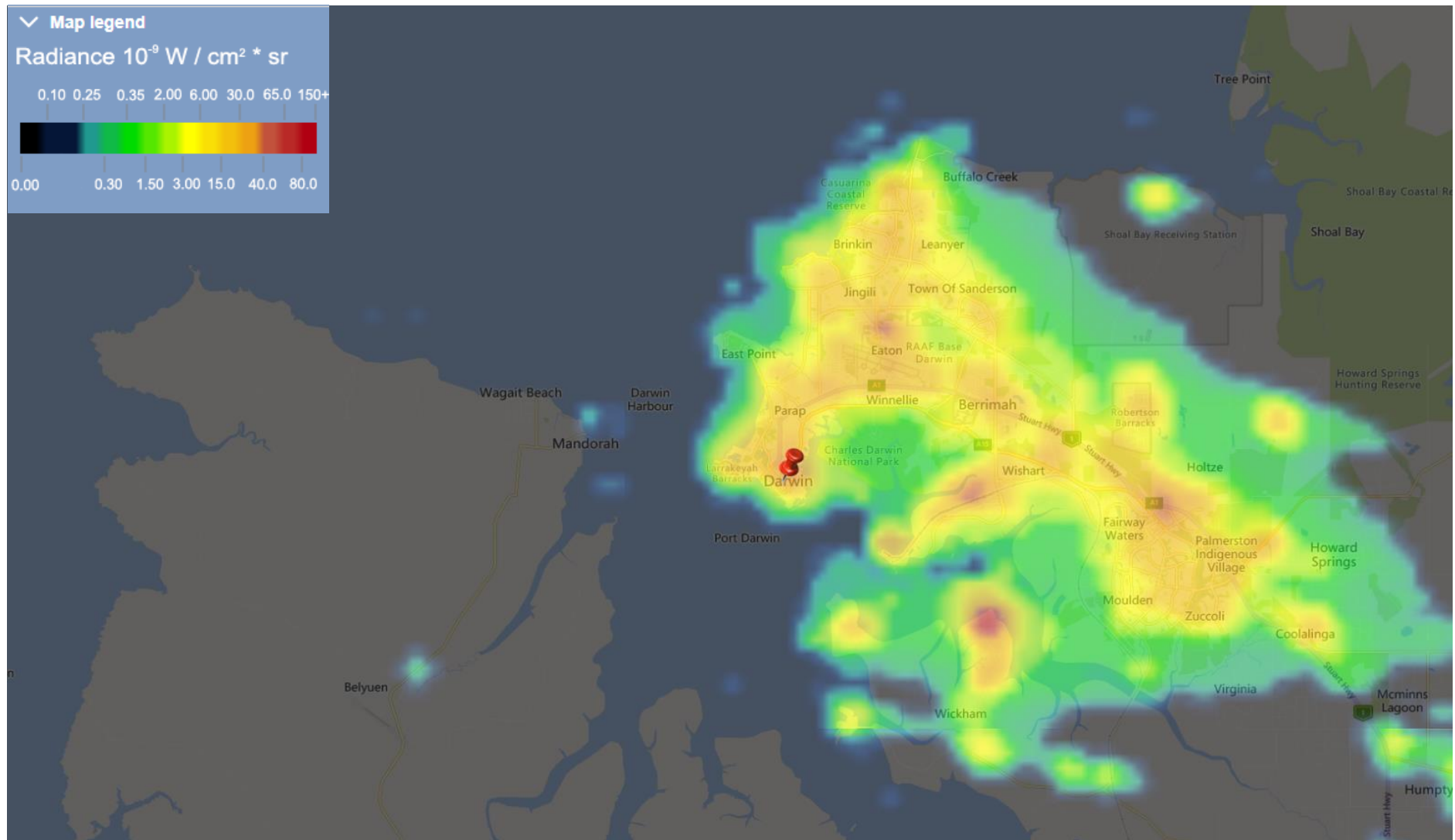


Figure 2: Current light pollution in the Darwin region, 2021. Source: lightpollutionmap.info

1.3 Assessment of dredge vessel impact

The location of dredge vessel activity proposed for the DPD Project in Darwin Harbour has been broken into five zones (**Figures 3 and 4**). Project activity is proposed to occur during a single marine turtle nesting season, including the May to October peak of flatback turtle nesting for the region.

It is clear from **Figure 3** that turtles using Casuarina and Wagait beaches will not have line-of-sight visibility of vessels within the harbour (scenarios 1 and 2) and so are at little to no risk from exposure to vessel lighting. Turtles that use beaches at Mandorah on the Cox Peninsula will be at low risk of impact from vessel lighting, due to the low number of turtles, nests and hatchlings likely to be present on these beaches, the short duration of dredging (i.e. limited to one nesting season), and the amount of existing light pollution from Darwin Harbour and City. To a marine turtle, vessel lighting is unlikely to be distinguishable from the background city lighting.

Offshore, the outer harbour approach (scenario 4, **Figure 4**) and spoil disposal area (Scenario 5, **Figure 4**) are 10 – 20 km from potential impact beaches. Over that distance, vessel lights will produce a relatively small amount of sky glow, similar in appearance to the vessels that currently use the offshore vessel anchorage area. If impact is not being currently observed from the vessel anchorage area, then it is unlikely Project vessels will cause any additional detectable impact.

The greatest risk of exposure is likely to occur when vessels are operating in the harbour mouth (scenario 3, **Figure 4**) during the May to October nesting season peak. Vessels at this location will be ~12 km away from Casuarina Beach and 2 – 8 km from the Wagait and Mandorah beaches. However, the risk of impact is again considered low due to the low number of turtles, nests and successfully emerged hatchlings on these beaches, the short duration of dredging (i.e. limited to one nesting season), the large amount of urban and City light between the vessels and Casuarina Beach which is likely to mask the vessel lighting rendering it indistinguishable from the onshore lighting. Furthermore the vessels lights are likely to merge with large amount of light from Darwin and the harbour when viewed from Mandorah and Wagait, also rendering them indistinguishable from the onshore lighting.

Overall, there is no discernible risk of the project causing a significant impact to the Arafura Sea flatback turtle genetic stock based on presently and publicly available data. This is due to the short-term nature of the project, the low nesting effort on potential impact beaches, and their low reproductive value relative to other rookeries within the wider genetic stock.

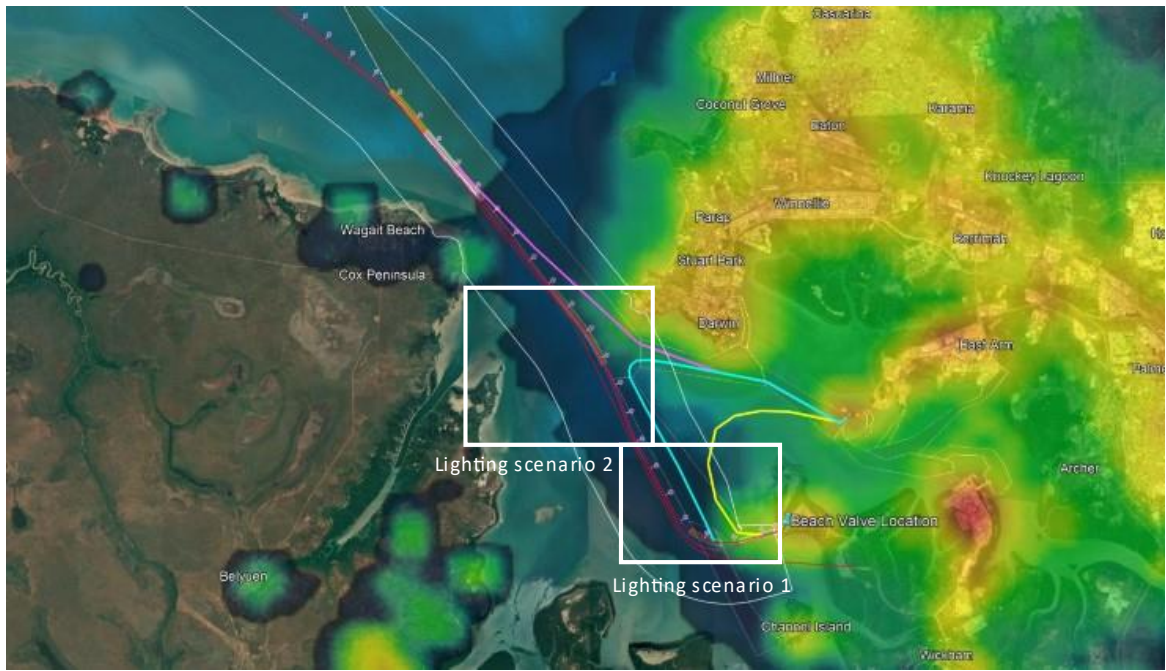


Figure 3: Vessel presence zones in Darwin Harbour

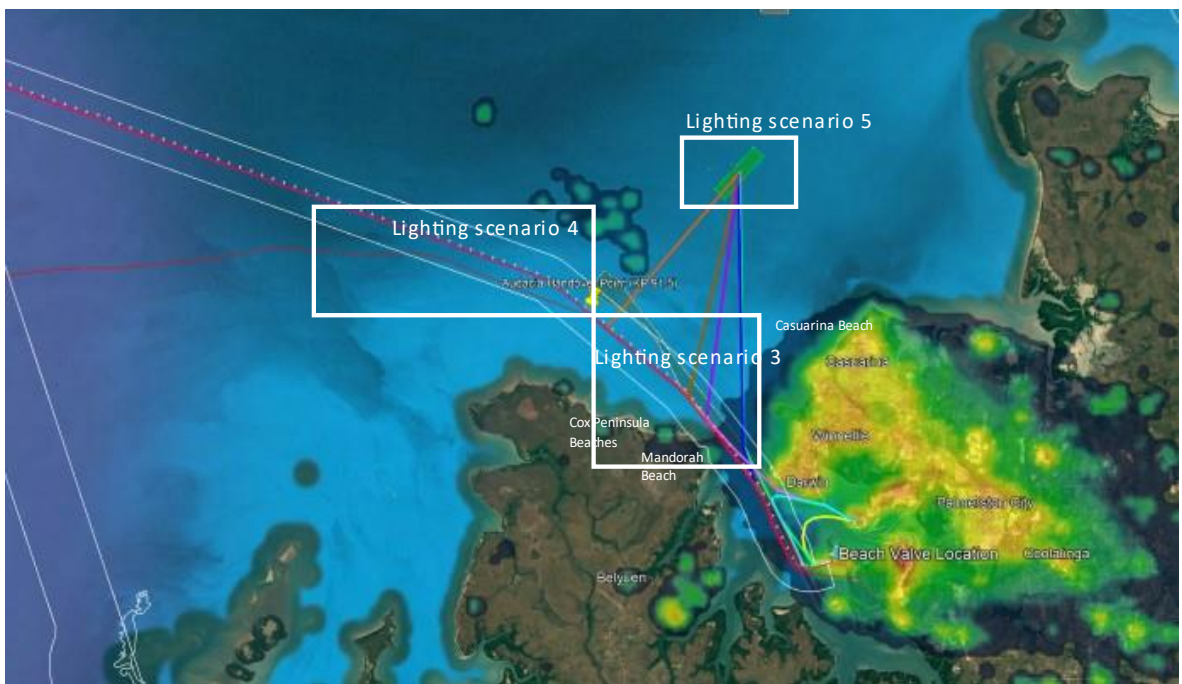


Figure 4: Vessel presence zones approaching Darwin Harbour

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