Santos

Darwin Pipeline Duplication Project

Supplementary Environmental Report – Executive Summary

May 2023

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Executive Summary

Purpose

This document provides an overview of the Santos Darwin Pipeline Duplication (DPD) Project Supplementary Environmental Report (SER) required for assessment by the Northern Territory (NT) Environment Protection Authority (EPA) under the NT *Environment Protection Act 2019* (EP Act).

Project Overview

The Darwin Pipeline Duplication (DPD) Project will extend the Barossa Gas Export Pipeline to the Santos-operated Darwin Liquified Natural Gas (DLNG) facility and allow for the repurposing of the existing Bayu-Undan to Darwin pipeline to facilitate carbon capture and storage (CCS) options. It will effectively be a 'duplication' of a portion of the Bayu-Undan to Darwin pipeline to allow gas from the Barossa field to be transported to, and processed at, the existing DLNG facility.

Importantly, duplicating, rather than tying into the existing Santos Bayu-Undan to Darwin pipeline, allows continued supply of gas to the DLNG facility and preserves the existing Santos Bayu-Undan to Darwin pipeline for carbon capture and storage (CCS) at Bayu-Undan, subject to all regulatory approvals. The Bayu-Undan CCS project (**Figure 1**) has the potential to capture and store up to 10 million tonnes (Mt) of carbon dioxide (CO_2) per annum, equivalent to about 2 per cent of Australia's carbon emissions (or four times the Barossa Development's estimated annual Scope 1 emissions), each year from other projects, customers and other hard to abate industries and has the potential to be the largest CCS project in the world. Importantly the DPD Project acts as a key enabler for the Barossa Development to reach net zero reservoir CO_2 emissions as per the stated intention of the recently amended Safeguard Mechanism. Bayu-Undan CCS would be able to manage the reservoir CO_2 emissions from the Barossa gas field. The regulatory approvals for the Bayu-Undan CCS project will be subject to separate regulatory approval processes. The Bayu-Undan CCS project is not being assessed in this DPD Project SER and is provided for context.

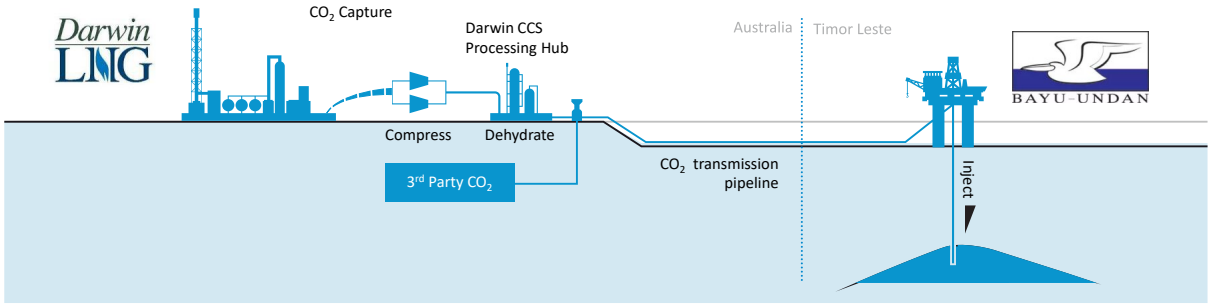

Figure 1 Proposed Bayu-Undan CCS project (uses the existing Bayu-Undan to Darwin gas pipeline)

CCS is the process where CO_2 is captured from an emission source, then dehydrated and compressed for transportation via pipeline to a storage site. The CO_2 is then injected into a geological formation that provides safe and permanent storage deep underground. This process applies technology that has been used in the industry for decades, injecting the gas back into the depleted underground reservoirs.

CCS is proven technology, with more than 27 commercial CCS facilities operating around the world today, with a storage capacity of over 36 million tonnes of CO_2 per year (Global CCS Institute, 2021).

The International Energy Agency (IEA) Roadmap to Net Zero by 2050 (IEA, 2021b) envisages carbon capture, utilisation and storage growing to 7.6 billion tonnes of CO_2 per year by 2050 from around 40 Mt per year today. CCS is recognised by the IEA, the Intergovernmental Panel on Climate Change, and the Australian Government as technology to achieve the world's climate goals.

The DPD Project that has been referred to the NT EPA includes the construction, operation and decommissioning of the ~100 km section of DPD Project pipeline in NT jurisdiction (**Figure 2**). Approximately 23 km of the pipeline in Commonwealth waters is outside of the scope of the referral and this SER.

The DPD Project will be located generally parallel to Santos' existing Bayu-Undan to Darwin pipeline (**Figure 2**), with the exception of where the DPD pipeline will cross-over the Bayu-Undan to Darwin pipeline at two locations to avoid encroachment into the Darwin Harbour shipping channel. The effective 'duplication' of the existing Bayu-Undan to Darwin pipeline is considered the optimal route to minimise potential environmental and social impacts.

The Project area proposed for the DPD Project consists of three distinct areas (**Figure 2**):

- Offshore NT waters (i.e. NT waters outside Darwin Harbour Region Management Area). This includes the proposed location for spoil disposal;
- Darwin Harbour (i.e. waters within the Darwin Harbour Region Management Area); and
- Shore crossing and onshore location (where the pipeline crosses the shoreline within the existing DLNG disturbance footprint).

Key construction elements of the DPD Project include:

- Pre-lay trenching and spoil disposal – requiring approximately 12.5 km of trenching along the pipeline route in Darwin Harbour using trenching vessels, with an expected ~255,000 m^3 (up to a maximum of 500,000 m^3) of spoil disposed at an offshore spoil disposal ground (**Figure 2**);
- Pipeline installation – undertaken using an anchored shallow water pipelay barge (within shallow waters including Darwin Harbour) and a deepwater pipe lay vessel, with the pipeline pulled through a trenched shore-crossing at the DLNG facility. Supporting structures, such as concrete mattresses may be required in some areas;
- Onshore works – including trenching and pipeline installation and site works to support pipe pull and pipeline pre-commissioning within the existing DLNG facility disturbance footprint;
- Rock installation – rock installed over sections of the pipeline for protection and stability where required. Temporary rock causeways will be installed at the DLNG facility to assist with trenching of the shore-crossing;

- Flushing, cleaning, gauging and testing – the cleaning, testing and dewatering of the pipeline from the DLNG facility with planned dewatering at the pipeline end in Commonwealth waters; and
- Associated vessel activities – including vessels for trenching, pipelay and rock installation and vessel supporting these activities.

The construction activities will span a nominal cumulative period of ~15-months in the field. The actual construction sequence and schedule of the DPD Project will be subject to the timely receipt of all regulatory approvals and drivers such as vessel availability, operational issues, and weather.

A referral for the DPD Project was submitted to the NT EPA on 10 December 2021 and was accepted on 14 January 2022. The NT EPA published a statutory notice to invite public comment on the referral on 18 January 2022 with the submission period closing 15 February 2022. A total of 318 submissions were received on the referral from the public and NT Government agencies. The NT EPA provided a Notice of Decision and Statement of Reasons on 7 April 2022 determining that the DPD Project required a Tier 2 assessment under the NT EP Act by way of an SER. The SER responds to the NT EPA's Direction to Provide Additional Information issued on the 12 January 2023 and submissions received from the public and government agency review period.

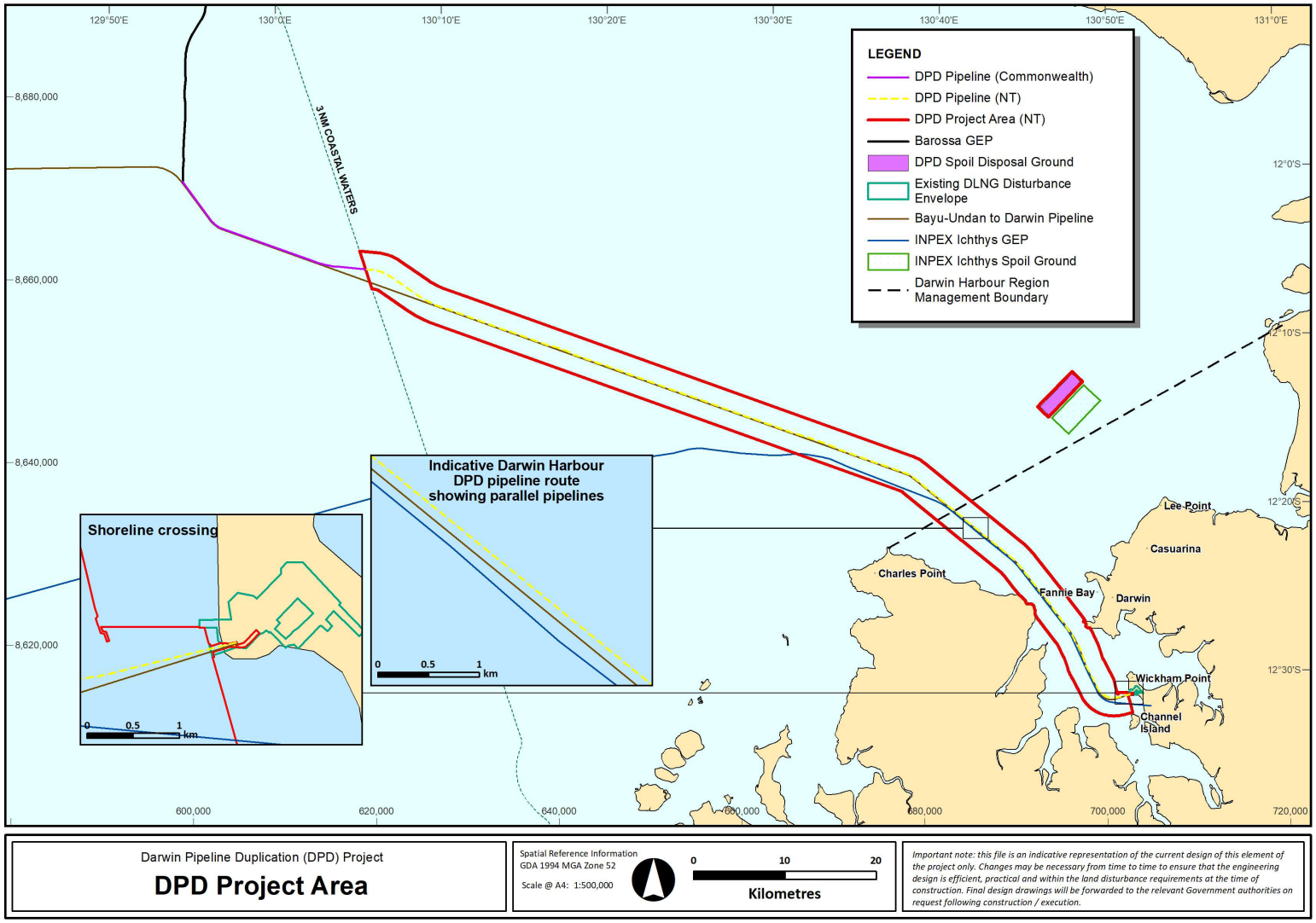

Figure 2: DPD Project area

Justification

A duplicate pipeline into the DLNG facility is required to allow continued supply of gas into the DLNG facility and will enable the existing Santos Bayu-Undan to Darwin pipeline to be re-purposed for the transport of CO_2 for CCS at Bayu-Undan, subject to all regulatory approvals.

The Bayu-Undan CCS project (**Figure 1**) would store CO_2 in the depleted Bayu-Undan field and, subject to all approvals, would offer safe and permanent storage of up to 10 Mt of CO_2 per annum, equivalent to about 2 per cent of Australia's carbon emissions each year (or four times the Barossa Development's estimated annual Scope 1 emissions). The project would be one of the largest CCS projects in the world and one of the many that will be critical to assist in meeting the world's climate goals. The IEA Roadmap to Net Zero by 2050 (IEA, 2021b) envisages carbon capture, utilisation and storage growing to 7.6 billion tonnes of CO_2 per year by 2050 from around 40 Mt per year today.

Santos' Barossa Development is one of several potential CO_2 sources for Bayu-Undan CCS, but importantly the Bayu-Undan CCS project offers a 'whole of region' carbon solution delivered through a Darwin CCS Processing Hub (**Figure 1**). Potential CO_2 sources could also include existing and/or future NT industry along with international imports.

The Bayu-Undan CCS project is currently working towards final investment decision (FID), with key activities including:

- Front End Engineering & Design (FEED) studies, which will further define the scope of the project along with the plan which will be used to deliver it; and
- Engaging with a range of stakeholders (including the Timor-Leste, Commonwealth and NT Governments, as well as the various Joint Venture partners) to establish the necessary agreements and regulatory framework required for the project.

CCS is proven technology, with more than 27 commercial CCS facilities operating around the world today, with a storage capacity of over 36 million tonnes of CO_2 per year (Global CCS Institute, 2021). The Bayu-Undan CCS project proposes to re-use existing infrastructure, which combined with economies of scale is expected to make the project highly competitive in terms of cost.

The Bayu-Undan reservoir is well understood and has the capacity to store large volumes of CO_2. Santos has a strong understanding of both reservoir seal and injectivity, supported by over 18 years of production data at Bayu-Undan. At Bayu-Undan project start-up, over 1 bcf of gas a day was injected into these high permeability reservoirs.

As part of the FEED activities the Bayu-Undan pipeline is being assessed for feasibility in CCS service. These activities are being independently verified by De Norske Veritas (DNV), an independent verification body, who will be issuing a *Statement of Conformity* which Santos expects will confirm:

- The design verification and requalification studies have been conducted in compliance with the correct and applicable Australian and International codes and standards;
- The pipeline design along with the operating and maintenance strategies are suitable to maintain the safe operability of the pipeline in CO_2 service conditions until 2050; and
- There are no impediments to the pipeline aspects of the project progressing from FEED to the Execute Project Phase.

Santos continues to work closely with the Timor-Leste regulator, the National Petroleum and Minerals Authority (ANPM), towards the necessary agreements and regulatory framework that will be required for the Bayu-Undan CCS project, with a Memorandum of Understanding (MOU) having been signed between the two parties.

Santos is firmly committed to CCS, with the DPD Project representing a commitment in excess of US $600M towards the CCS development.

A CO_2 transmission pipeline is a key piece of infrastructure required for the Bayu-Undan CCS project. By constructing the DPD pipeline to export gas from the Barossa gas field, the Bayu-Undan to Darwin pipeline (approximate 502 km) is left intact and preserved for future use in the Bayu-Undan CCS project. The key benefits of this include:

- Earlier realisation of the CO_2 storage benefits from CCS (up to two years earlier), compared to having to construct a new CO_2 pipeline;
- Health, safety and environmental risks associated with the subsea tie-in of the Barossa Development pipeline to the Bayu-Undan to Darwin pipeline are eliminated. This would typically be a high-risk activity involving the use of subsea saturation divers; and
- The cost competitiveness of the Bayu-Undan CCS project is improved, strengthening the likelihood of future CCS environmental benefits being realised. This is largely due to the costs associated with the subsea tie-in being eliminated along with eliminating future costs to construct a pipeline from the DLNG facility to a tie-in point.

Alternatives

Santos selected a Darwin Harbour pipeline route over onshore pipeline routes (Cox Peninsula and Gunn Point routes) on the basis of having lower environmental, community, cultural heritage and economic impacts.

The Cox Peninsula route was not considered suitable as the northern part of the peninsula, which belongs to the Kenbi Aboriginal Land Trust, has numerous sacred sites where access is not permitted, including some areas where there is no beach access, and anchoring or other seabed disturbance is not permitted, e.g. at Charles Point. Consequently, further evaluation of potential pipeline routes was only conducted for the proposed Darwin Harbour route and the alternative Gunn Point route.

The potential for significant environmental impacts for the Darwin Harbour and Gunn Point route options are associated primarily with the short-term construction phase of the projects. In comparing the two route options, the Gunn Point route is considered to have greater potential for significant environmental impacts to Marine Environmental Quality, Marine Ecosystems and Coastal Processes due to greater disturbance to coastal morphology, sensitive habitats (including seagrasses) and associated fauna and turtle nesting. The Gunn Point route also has greater potential for significant impacts to the NT EPA Factor of Terrestrial Environmental Quality and Terrestrial Ecosystems, with over 70km of the pipeline being constructed underground across land. By comparison, the Darwin Harbour route requires less than 1km of pipeline to be constructed onshore and its alignment allows the pipeline to cross the shoreline within the existing disturbance footprint of the DLNG facility. The Gunn Point route is also considered to have greater potential for significant impacts to Community and Economy through the required installation of underground pipeline through the Darwin suburban area.

Santos considered various options (a northern, central and southern route) for the routing of the DPD Project pipeline within Darwin Harbour, factoring in the positioning of existing pipelines and landfall

locations. The final preferred route for the DPD Project pipeline within NT waters lies predominantly parallel and north of the existing Bayu-Undan to Darwin pipeline but makes two crossings of the Bayu-Undan to Darwin pipeline in the inner Darwin Harbour. The DPD Project makes landfall immediately north of the Bayu-Undan to Darwin pipeline within the DLNG facility disturbance footprint.

The final DPD alignment was agreed in consultation with the Department of Infrastructure Planning and Logistics (DIPL) and Darwin Ports and avoids pipeline route encroachment in the shipping channel while also reducing trenching requirements.

Stakeholder Engagement

Stakeholder engagement has continued throughout the DPD Project lifecycle. The first stage of the DPD Project stakeholder engagement process was undertaken from 8 October to 20 December 2021 prior to the initial submission of a Project referral to the NT EPA.

During this period, Santos sought meetings with a range of government agencies, private organisations, representative bodies and businesses identified as key stakeholders with interests that would be relevant to the proposed DPD Project activities. This included the Wickham Point Deed Reference Group (WPDRG) (including Larrakia Traditional Owners), the Tiwi clan groups Malawu and Wurrumiyanga, the Northern Land Council (NLC), the Tiwi Land Council (TLC) and the Aboriginal Areas Protection Authority (AAPA).

A total of 33 meetings were held during this period. Feedback was used to inform the referral and identify issues and concerns to be considered by Santos as part of the DPD Project management framework and subsequent preparation of approvals documentation. Following submission of the referral, Santos continued to proactively engage with stakeholders to discuss their issues and concerns as well as the environmental assessment process. From 12 January to 4 April 2022 a further 21 meetings were undertaken. This included with the WPDRG, the TLC and the Tiwi clan group Jikilaruwu.

A total of 318 submissions were received in response to the publication of the referral between 18 January and 15 February 2022. This included group public submissions by 284 individuals with the same wording.

Key concerns raised during the DPD Project referral public submission process can be summarised under the following themes:

- Increasing GHG/air emissions from the DPD Project and associated Barossa Development and impacts to climate change;
- Feasibility of CCS;
- Impacts to the marine ecosystem and supporting evidence used to assess impacts, including:
  - Benthic habitats (including seagrass and coral habitats);
  - Protected marine megafauna (including dolphins, dugongs and turtles);
  - Fish and Fisheries; and
  - Mangroves.

- Impacts to coastal processes and marine environmental quality, associated with trenching, spoil disposal and rock placement;
- Assessment of potential impacts to cultural heritage;
- Industrialisation of Darwin Harbour and cumulative impacts;
- Reliance on INPEX Ichthys data and the lack of evidence around long-term impacts associated with the INPEX Ichthys construction activities;
- Santos' engagement with potentially affected communities and request for further details on Santos' stakeholder engagement plan;
- Impacts to recreational fishers (including use of the spoil ground) and existing shipping traffic; and
- Impacts to the broader community including job security, tourism and overall health impacts.

In preparing the SER, Santos has considered and assessed each submission individually and taken into consideration the issues raised when assessing DPD Project impacts and risks and management measures.

Following the NT EPA's Notice of Decision and Statement of Reasons on 7 April 2022, a further 68 stakeholder meetings were undertaken up to 31 January 2023. A full list of the meetings is provided in the Stakeholder Engagement Plan attached to the SER.

Engagement by Santos during preparation of the SER, from 7 April 2022 to 31 January 2023, has focused on the following areas:

- With specific government agencies or organisations, gather additional information and/or hold further discussion on matters raised in submissions on the referral;
- With specific government agencies or organisations, prepare information for the SER, e.g. development of Environmental Management Plans and monitoring programs;
- With specific government agencies or organisations, execute environmental studies/surveys providing information for the SER;
- With Indigenous Groups and Representative bodies, gather information and provide forums for further discussions to allow Traditional Owners and Custodians the opportunity to provide input and gain clarification;
- With proponents of other planned projects within Darwin Harbour i.e., NT Department of Infrastructure, Planning and Logistics, Department of Defence and INPEX to help determine the potential for cumulative impacts with the DPD Project; and
- With previously identified and/or new stakeholders, share information on the DPD Project, e.g. representative tourism groups, and discuss how issues raised in submissions are/will be addressed.

Environmental Impact Assessment

The assessment of the DPD Project referral by the NT EPA determined that the DPD Project has the potential to have a significant impact on three environmental factors: Marine Environmental Quality, Marine Ecosystems, and Atmospheric Processes. Therefore, potential impacts to those environmental values required further assessment. The NT EPA considered other environmental factors during its assessment of the referral, however, the impact on those factors was not considered to be significant. Nonetheless, Santos has assessed in the SER the additional environmental factors of Coastal Processes, Community and Economy and Culture and Heritage in response to public and/or NT Government submissions that raised these factors.

Santos undertook additional studies and modelling to inform a revised assessment of potential impacts and risks to these factors, identify appropriate management measures and to prepare Environmental Management Plans (EMPs) provided with the SER. This revised information was also used to respond to individual submissions.

As part of the revised impact and risk assessment, Santos applied a sustainable development decision-making hierarchy, that evaluated all reasonable and practicable measures that could be applied to avoid and/or reduce impacts and risks, including those from emissions, through best practice design, technology selection and management. The additional studies and modelling comprised:

- A maritime heritage survey and assessment to determine presence and significance of maritime heritage objects along the proposed pipeline route and within the shallow water pipelay barge anchoring corridor;
- Additional benthic habitat surveys of the DPD Project footprint and potential sensitive habitat locations in Darwin Harbour and a revised assessment of potential impacts to benthic habitats, both direct and indirect;
- A turtle nesting and lighting impact assessment – a desktop study to determine the presence and significance of marine turtle nesting activity on beaches within and around Darwin Harbour and the potential for DPD Project lighting impacts;
- Traffic impact assessment – a desktop study to assess the impact of DPD Project-related traffic on the local road network, intersection capacity and performance as requested by DIPL in their referral submission;
- Sediment dispersion/plume modelling to quantify the potential magnitude, intensity and spatial distribution of suspended sediment concentrations (SSC) and sedimentation from trenching and spoil disposal activities;
- Underwater noise modelling, including modelling of key DPD Project noise generating trenching and construction activities within Darwin Harbour;
- Treated seawater dispersion modelling to determine the potential impacts and area of exposure from the contingency discharge of treated seawater following an unplanned ‘wet buckle’ event; and

- Hydrocarbon spill modelling to determine the potential area that may be affected from an unplanned marine diesel oil spill from a vessel during DPD Project activities.

The information derived from the studies, modelling and revised impact and risk assessment was used to prepare EMPs attached to the SER, detailing how DPD Project activities will be managed to reduce impacts and risks to a level that is both acceptable and as low as reasonably practicable. These are:

- An Offshore Construction Environment Management Plan (CEMP) providing the overarching environmental management approach and measures for DPD Project construction activities within NT waters, Darwin Harbour and at the shore-crossing;
- A Trenching and Spoil Disposal Management and Monitoring Plan (TSDMMP) for trenching and spoil disposal activities, including an adaptive monitoring and management program;
- A Marine Megafauna Noise Management Plan (MMNMP) for construction activities detailing measures in place to prevent significant impacts to marine megafauna from underwater noise;
- An Onshore CEMP detailing the environmental management approach and measures for the construction of a short onshore section of pipeline; and
- An Acid Sulfate Soil Dewatering Management Plan (ASSDMP) detailing measures to reduce the risk of impact from acid sulfate soil or acidic groundwater encountered during onshore construction.

The SER also provides Greenhouse Gas (GHG) emissions estimates from the DPD Project and associated larger Barossa Development, an overarching long-term GHG emissions target and proposed interim targets, and the measures and methods that will be used to meet these targets have also been provided.

The environmental impact and risk assessment undertaken for the three key environmental factors of Marine Environmental Quality, Marine Ecosystems, and Atmospheric Processes is outlined below.

Marine Environmental Quality

Santos is committed to meeting the NT EPA's objective for Marine Environmental Quality by protecting the quality and productivity of water, sediment and biota so that environmental values are maintained.

Water and sediment baseline quality

A pipeline route benthic survey was undertaken in October 2021 and January 2022 by RPS (2023a) to record baseline water and sediment quality parameters (including presence of metals, hydrocarbons, other contaminants, infauna composition and particle size distribution) from sampling locations along the pipeline footprint (including proposed trenching areas) and within the proposed spoil ground. Sediment samples were screened against relevant National Assessment Guidelines for Dredging (NAGD) screening levels (CoA, 2009). Overall, no contaminants of concern were found in the sediments along the pipeline route or at the proposed spoil disposal ground, with elevated levels of arsenic

considered to be naturally occurring. Therefore, the sediments along the pipeline route are suitable for unconfined ocean disposal, as per the NAGD (CoA, 2009) and NT EPA (2013) guidelines for dredging.

Potential significant impacts

The impact and risk assessment process considered all planned and unplanned events resulting from DPD Project activities and identified those events that have the potential to significantly impact the marine environmental quality. The SER only presents those events that have the potential for significant impact. These are:

- Seabed disturbance;
- Contingency treated seawater discharge;
- Discharging water from onshore backflushing activities during pipeline pre-commissioning;
- Invasive marine species introduction; and
- Hydrocarbon spill – marine diesel oil.

Seabed disturbance

Trenching and spoil disposal activities may temporarily decrease water quality through increased turbidity from suspended sediments. Impacts to water quality from trenching and spoil disposal were identified as a key aspect of the DPD Project requiring further modelling and assessment. The material to be trenched from the pipeline route will comprise sediments and rock material. A conservative trenched spoil volume of 306,000m^3 was modelled. The expected trenched spoil volume is ~255,000m^3.

Increased suspended sediment concentration and increased sedimentation has the potential to indirectly impact benthic habitats through reduced light for photosynthesis, and/or smothering of habitats from sedimentation.

Sediment dispersion modelling undertaken by RPS (RPS, 2023b), and attached to the SER, was used to evaluate the potential impacts to marine environmental quality from trenching and spoil disposal. The modelling report was reviewed and improved through a third-party expert review undertaken by the Australian Institute of Marine Science (AIMS). Modelling results were compared against turbidity and sedimentation thresholds for zones of influence and zones of impact derived from baseline water quality data at sensitive receptor sites (hard coral and seagrass) from the INPEX Ichthys project.

The modelling predicted no exceedance of impact thresholds (Zone of Moderate Impact, or ZoMI) for turbidity or sedimentation outside of trenching/spoil disposal footprints for either of the modelled scenarios (wet season and dry season). Consequently, no impact from increased suspended sediment concentrations (SSC) or sedimentation outside of areas already directly impacted from trenching/spoil disposal is predicted to occur.

The predicted Zone of Influence (ZoI) for sedimentation from spoil disposal operations for both seasonal modelled scenarios was restricted to the spoil disposal footprints i.e. where direct impact will occur. For the trenching operations, the ZoI for sedimentation is largely restricted to the trenching

footprints, but the modelling has predicted in one area that the ZoI may extend a short distance (up to 95 m) beyond the trenching footprint but not over sensitive benthic habitats.

Based on the results of the sediment dispersion modelling, and applying the SSC thresholds for different benthic habitats, locations and seasons (dry or wet) the impacts to marine environment quality from turbidity and sedimentation associated with trenching and spoil disposal are predicted to be temporary, localised and not significant.

To manage and monitor potential impacts from trenching and spoil disposal activities a Trenching and Spoil Disposal Management and Monitoring Plan (TSDMMP) has been prepared for trenching and spoil disposal activities in accordance with NT EPA requirements, including an adaptive monitoring and management program. The monitoring and adaptive management plan, including real time monitoring of water quality, will be implemented to ensure that impacts to marine environmental quality will be kept to an acceptable level as predicted by modelling.

Contingency treated seawater discharge

In the unlikely event of a pipeline wet buckle (i.e. failure of the pipeline during pipelay), treated seawater may need to be used (and subsequently discharged) to preserve the pipeline in the period before pipelay can continue. In this instance, seawater will need to be treated with a preservation chemical consisting of a biocide, corrosion inhibitor and oxygen scavenger to preserve the pipeline. In the marine environment, due to the corrosive nature of seawater, maritime industries use and rely on a range of chemicals including corrosion inhibitors, biocides, and oxygen scavengers to protect the integrity of assets and infrastructure and prevent microbial growth. For chemicals discharged to the environment, Santos preferentially selects for use those chemicals which are rated as Gold/Silver through the Offshore Chemical Notification Scheme (OCNS) Chemical Hazard and Risk Management (CHARM) or OCNS group rating of D/E (if not CHARM rated).

Treated seawater dispersion modelling conducted by RPS (RPS, 2022a), and attached to the SER, was undertaken to determine the potential impacts and area of exposure from the contingency discharge of treated seawater following an unplanned wet buckle event. This modelling considered release scenarios within and outside Darwin Harbour. The modelling demonstrated rapid dilution and decreasing concentrations of the preservation chemical with increasing distance from the release location. This resulted in concentrations not exceeding conservative no observable effect concentration (NOEC) levels (protecting 99% of species) for a period where effects would be expected to be observed (>48 hours).

Therefore, while the release of treated seawater would result in localised and temporary effect on water quality around the discharge location, the chemicals that would be used are inherently biodegradable with low potential for bioaccumulation and are not expected to exceed conservative species protection threshold over a period where significant effects could be expected.

Discharge of backflush water during flood, clean, gauge testing (FCGT)

Water will be extracted from Darwin Harbour to provide water for pipeline FCGT activities. An indicative volume of 56,000m^3 will be required. As filtering is required to remove the suspended solids from the extracted water, the water will be filtered, and regular cleaning of the filters via backflushing will be

required. It is expected that approximately 300 m^3 of filter backflush water will be discharged over a period of approximately three days. Backflush water will be discharged onto the existing disturbed shore crossing construction site at the DLNG facility, and where possible, and dependent on the progress of shore crossing rock installation at time of FCGT activities, backflush water will be discharged onto installed rock, to diffuse the flow of the discharged backflush and reduce sediment load returning to Darwin Harbour. Any increased sediment load is expected to rapidly dilute and disperse with the tidal movement. Given it will occur at the existing disturbance site, and due to the lack of sensitive benthic communities and habitats in that location, no significant impact from discharging backflush water is expected.

Invasive marine species

Vessels are the most common vector for the translocation of Invasive Marine Species (IMS) in the marine environment. IMS can be introduced or spread when vessels are mobilised to the operational area, particularly if the vessels originate from international waters with similar water temperatures (e.g., south-east Asia). IMS may result in considerable modification of the environment through out-competing native species and modifying existing habitats.

Risks of IMS are monitored and managed by the Aquatic Biosecurity Unit of NT Fisheries. This includes monitoring for early detection, inspections and treatment of high-risk vessels entering Darwin and responding to reported sightings of IMS. Its current monitoring focuses on locations where IMS are most likely to occur, such as marinas, wharves and ports (NT Government, 2022).

The DPD Project activities are not considered to have any higher risk of introducing IMS into the area than regular activities within the harbour and the proposed controls are considered effective and appropriate to reduce the risk of introducing IMS and impacting marine environmental quality to a low level.

Hydrocarbon spill – marine diesel oil (MDO)

While considered an unlikely event, as it is for other commercial vessels that use Darwin Harbour, a hydrocarbon spill could occur from a vessel collision with sufficient force to rupture a fuel tank and release marine diesel oil (MDO) to the environment. MDO is categorized as a light 'group II' hydrocarbon that disperse and evaporates quickly. In the marine environment, a 5% residual of the total quantity of MDO spilt will remain after the volatilisation and solubilisation processes associated with weathering. There will be no heavier, more persistent, fuel oils used on DPD Project vessels (i.e. no Intermediate or Heavy Fuel Oils).

Spill modelling was conducted by RPS (RPS, 2022b), and attached to the SER, for worst-case fuel tank rupture and refuelling release scenarios. This included modelling vessel fuel tank spill scenarios up to 700m^3. The outputs of this modelling showed a number of different possible outcomes of a spill, which were then analysed to determine the probability of contact and concentration at contact of hydrocarbons at receptor locations.

A surface release of MDO to the marine environment would result in a temporary reduction in water quality in the upper surface waters of the water column and potentially to shallow coastal waters with

associated impacts to marine fauna and flora. There may be potential for impacts to sediment quality should hydrocarbons reach shorelines, intertidal platforms and/or shallow sub-tidal soft sediments.

In order to prevent DPD Project vessel collisions and refuelling incidents, standard maritime and DPD Project specific management measures will apply as outlined within the Offshore Construction Environmental Management Plan (CEMP) attached to the SER. Vessel and DPD Project hydrocarbon spill plans will be in place to manage hydrocarbon spills. With avoidance and mitigation measures in place, the risk of a hydrocarbon spill is considered low and reduced to as low as practicable.

Environmental management and residual impacts and risks

The management actions outlined in **Table 1** will be implemented to ensure the DPD Project meets the objective for the NT EPA factor of Marine Environmental Quality. Residual impacts and risks were assessed to be Minor and Low, respectively, following Santos' impact and risk assessment process. Management actions have been informed by referral commitments and subsequent referral feedback from Government and public submissions. Management actions have been carried through to Environmental Management Plans (EMPs) attached to the SER.

Table 1 Management actions for Marine Environmental Quality

Potential Impact/Risk	Management Actions
Seabed disturbance	**Avoidance**
	The pipeline route has been surveyed (geophysical and geotechnical) to evaluate seabed in conjunction with engineering design requirements. Trenching, stabilisation and freespan correction/ prevention will only be undertaken at identified areas (using standard positional accuracy measures used in the industry).
	In shallower waters, anchor exclusion areas will be implemented to avoid sensitive habitats and heritage sites.
	Placement of pipe to be based on subsea heritage and habitat assessment studies to enable the avoidance of designated sensitive benthic habitats, and heritage and culturally sensitive areas.
	Mitigation
	Adaptive management process is defined within the Trenching and Spoil Disposal Management Plan. Environmental monitoring of water quality with management measures applied if water quality exceeds trigger levels.
	Overflow from the TSHD will be undertaken through the adaptive management processes. There will be an 'environmental valve', 'green valve' or Anti-Pollution Valve (APV) where available (attached to O/F to reduce air entrained, to reduce billowing and facilitates sediment sinking) as standard which will be used as a first step to capture fine sediment from disposal at the TSHD.
	Standard operating procedure for spoil disposal will be used. Spoil will not be disposed of in a single location, so will avoid developing a single large mound at the spoil disposal ground.
	Dynamically Positioned (DP) pipelay vessel will be used to install the pipeline in deeper waters. The DP vessel can be used in deeper water from KP23 (Territorial water boundary) to approx. KP91.5 where shallow water (<20 m) occurs, and will not require anchoring.
	An Anchor Management Plan will be developed to allow safe anchoring of vessels undertaking pipelay, trenching and pile driving activities in the vicinity of nearshore heritage or sacred sites.

Potential Impact/Risk	Management Actions
	Use of trained and competent anchor handling operators.
	Differential Global Positioning System (DGPS) for pipelay vessel to maintain accurate vessel position during installation.
	Checks prior to installation to confirm: + DGPS used to confirm ILT foundation structure position during installation; and + Underwater positioning system (USBL/transponders) and ROV to confirm installation location and positioning of pipeline (within required location accuracy to reduce disturbance to the seabed).
	Installation plan developed and includes: + requirement for trained and experienced vessel crews; and + trenching will be restricted to only areas where required.
	Based on subsea heritage and habitat assessment studies, span-specific rectification plans developed that include: + Pre-span method selection; + Real-time monitoring of span rectification; + Post-rectification inspections; and + Permanent rock installation will be limited to only those pipeline sections requiring stabilisation and/or anchor protection.
	Monitoring
	Continuous monitoring of anchor wire tensions to prevent anchor drag on seabed. Additionally wire length measurement of the winch will be monitored. Based on experience this parameter is a good indicator to prevent anchor drag. These two parameters are monitored to act as mitigation to prevent anchor drag.
	Adaptive management process as defined within a Trenching and Spoil Disposal Management Plan. Environmental monitoring of water quality with management measures applied if water quality exceeds trigger levels.
	Avoidance

Potential Impact/Risk	Management Actions
Contingency treated seawater discharge- from wet buckle scenario	Pipeline installation procedures to be prepared and followed.
	Maintenance requirements for pipelaying to minimise risk of operational failure.
	Shallow water pipelay barge has redundancy in its anchors for stability.
	Deep water pipelay vessel has redundancy in its station keeping abilities and operates in accordance with approved activity specific operating guidelines.
	Mitigation
	Chemical selection procedure for all chemicals, including treated seawater, discharged to the marine environment.
	Calibrated chemical dosing system in place to ensure accuracy.
	If contingency use and discharge of treated seawater is required, the lowest required concentration of treatment chemical will be evaluated and used (up to a maximum of 550 ppm) in order to meet pipeline preservation requirements.
	Monitoring
	In the unlikely event that the pipeline requires contingency filling and subsequent dewatering of treated seawater in response to a wet buckle event and prolonged repair, water quality monitoring of the dewatering at the discharge location will be conducted to confirm the concentration and dispersion of treatment chemicals.
Hydrocarbon spill	**Avoidance**
	No Intermediate Fuel Oil and Heavy Fuel Oil will be used in in the operational area.
	Vessel equipped and crewed in accordance with Australian maritime requirements.
	A Notice to Mariners will be issued for offshore works advising all major shipping traffic formally. In addition, pipelay vessels will have attendant vessels that may act as guard vessels for work within the harbour.
	Chemicals and hydrocarbons will be transferred and stored in accordance with standard maritime practices as per vessel SOPEP.

Potential Impact/Risk	Management Actions
	Vessel-specific bunkering procedures and equipment consistent with Santos marine vessel vetting requirements including: + Use of bulk hoses that have quick connect 'dry break' couplings; + Correct valve line-up; + Defined roles and responsibilities, and the specific requirement for bunkering to be completed by trained personnel only; + Visual inspection of hoses prior to bunkering to confirm they are in good condition; + Testing of the emergency shutdown mechanism on the transfer pumps; + Assessment of weather/sea state; + Maintenance of radio contact with Vessel during bunkering operations; + Bunkering checklist; and + Visual monitoring during bunkering.
	Mitigation
	Spill clean-up kits available in all areas, including high risk areas
	Implement tiered spill response in the event of a hydrocarbon spill as outlined in an oil pollution emergency plan for DPD Project construction and operations.
	Oil spill tracking buoys will be made available on primary DPD Project vessel/s with Santos CSR/s and/or at local supply base for immediate deployment to assist with tracking of an oil spill.
	Monitoring
	Operational and scientific monitoring to be undertaken in event of a hydrocarbon spill as outlined in an oil pollution emergency plan for DPD Project construction and operations.

Marine Ecosystems

Santos is committed to meeting the NT EPA's objective for Marine Ecosystems `by protecting marine habitats, and maintaining environmental values including biodiversity, ecological integrity and ecological functioning.

Benthic habitats

There have been a number of studies undertaken to investigate, describe and map the distribution of benthic habitats across the Darwin Harbour and Bynoe Harbour regions. Santos completed benthic habitat surveys along the proposed DPD route, dredge spoil disposal ground and surrounding areas in both 2021 and 2022 to verify the benthic habitats present (RPS, 2023a). The Australian Institute of Marine Science (AIMS) undertook habitat modelling and mapping for the Darwin and Bynoe Harbour regions (Galaiduk et al., 2019) and then revised the predictive mapping in 2021 (Udyawer et al., 2021) to extend the spatial coverage of the benthic community models by using additional shallow water bathymetry data, data from additional benthic community surveys, and data (mainly from the intertidal zone) provided by the Department of Environment, Parks and Water Security (Case et al., 2021).

An additional video transect survey was conducted by Santos between 6 and 10 June 2022 to collect remote operated vehicle (ROV) benthic imagery. The objective for this survey was to further ground-truth the 2019 and 2021 AIMS benthic habitat data around the pipeline route offshore and within Darwin Harbour.

Results from these surveys confirmed the presence/absence of macroalgae, hard corals and seagrass that were closest to the proposed pipeline route and therefore had the greatest potential to be influenced by the DPD Project construction activities, including trenching.

There are no unique habitats along the DPD pipeline route, with the majority of the habitat along the pipeline route consisting of bare ground, low density sponge or sponge/filterer/octocoral habitats, with a small amount of macroalgae in the nearshore area. These habitats are expansive across Darwin Harbour and well represented in other locations, both within the harbour and regionally.

Marine fauna

A desktop assessment was undertaken to determine the likelihood of threatened and migratory marine species identified from the Commonwealth Protected Matters Search Tool (PMST) occurring within the Project area. this assessment has been revised and updated post-submission of the referral to the NT EPA.

The following *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed threatened and migratory marine megafauna are known, likely or have potential to occur within the DPD Project area:

- Australian humpback dolphin (*Sousa sahulensis*);
- Australian snubfin dolphin (*Orcaella heinsohni*);

- Dugong (*Dugong dugon*);
- Flatback turtle (*Chelonia mydas*);
- Green turtle (*Chelonia mydas*);
- Hawksbill turtle (*Eretmochelys imbricata*);
- Leatherback turtle (*Dermochelys coriacea*);
- Loggerhead turtle (*Caretta Caretta*);
- Olive ridley turtle (*Lepidochelys olivacea*);
- Saltwater crocodile (*Crocodylus porosus*); and
- Spotted bottle nose dolphin (*Tursiops aduncus*).

Potential significant impacts

The impact and risk assessment process considered all planned and unplanned events resulting from DPD Project activities and identified those events that have the potential to significantly impact Marine Ecosystems. The SER only presents those events that have the potential for significant impact, or which were not presented and assessed in the NT referral. These include:

- Seabed disturbance;
- Noise emissions;
- Light emissions;
- Treated seawater discharge;
- Marine fauna interaction; and
- Hydrocarbon spill – dry gas release and marine diesel oil.

Seabed disturbance

DPD Project activities including, trenching, pipeline installation, spoil disposal and anchoring have the potential to cause direct and indirect impacts to the seabed and benthic habitats.

Activities that may have a direct impact on benthic habitat include:

- Trenching activities, including trenching, spoil disposal, pre-sweeps, and sand wave rectification;
- Installation of the pipeline and supporting infrastructure, including concrete mattresses and rock backfill;
- Anchoring by the nearshore pipelay vessel in shallower water; and
- Construction of temporary causeways at the shoreline.

The proposed DPD Project pipeline route traverses through the Charles Point Wide Reef Fish Protection Area (RFPA), a no-fishing zone which covers a significant fish aggregation site and which aims to aid the recovery of the key recreational fishing species of golden snapper and black jewfish. In consultation with NT Fisheries, Santos has identified that the known fish aggregation area within the RFPA is over 2.5 km from the pipeline route and therefore will not be impacted from any seabed disturbance resulting from the DPD Project activities.

The total area of the Charles Point Wide RFPA is approximately 88 km². Approximately 11.5 km of pipeline alignment is proposed within the Charles Point Wide RFPA with the area of disturbance within the RFPA approximately 0.06 km² (based on a 5 m wide disturbance footprint for the pipeline, i.e., 2.5 m either side of the pipeline alignment). There will not be any trenching or anchoring in the Charles Point Wide RFPA. Benthic surveys supported by geophysical data collected along the pipeline route within the RFPA showed mostly flat, relatively featureless seabed with the occasional change in topography.

Based on trenching and infrastructure footprint calculations, the DPD Project will directly impact less than 1% of the benthic habitats across Darwin Harbour and more specifically, < 0.18% of the sponge or sponges/filterers/octocoral habitat, < 0.12% of the macroalgae habitat and ~0.12% of the bare ground habitat found across Darwin Harbour. Therefore, the DPD Project is unlikely to result in changes to the composition of benthic habitats across Darwin Harbour, nor have wider impacts on the marine fauna that rely on those habitats. There is no predicted disturbance to rarer, and more sensitive, hard coral or seagrass habitat which can support higher fauna abundance and provide foraging ground for listed marine species (e.g. dugongs, turtles). While direct disturbance from DPD Project activities and infrastructure will result in some permanent loss of natural habitat which may support recreational fish species, and could be used as foraging areas by marine megafauna (e.g. turtles), the presence of installed infrastructure will provide structure and new habitat for marine flora and fauna. Studies have shown that diversity on and around pipelines can be higher than adjacent areas (e.g. McLean et al., 2021).

The increase in turbidity and sedimentation from trenching and spoil disposal activities has the potential to indirectly impact benthic habitats through reduced light availability for photosynthesis by benthic primary producers, and/or smothering of habitats from sedimentation. Sediment dispersion modelling predicts impacts to be restricted to within the trenching and spoil disposal footprints. In order to reduce the degree of disturbance to the seabed, studies have been undertaken to optimise pipeline routing, avoid raised seabed features and minimise requirements for trenching. Operational measures to reduce seabed disturbance, as outlined within the Offshore CEMP, attached to the SER, include no anchoring zones to avoid anchoring disturbance to sensitive seabed features during the shallow water pipelay process. With measures in place, seabed disturbance has been reduced to as far as practicable and to a level that is not considered significant.

Underwater noise

Underwater noise emissions from DPD Project activities have the potential to affect marine fauna within the DPD Project area including marine mammals, reptiles, sharks/rays and other fish. Activities that will create the most significant underwater noise include trenching, rock breaking, pipelay installation, vessel activities and helicopter noise. Santos completed underwater noise modelling (Talis,

2022; Connell et al., 2023) (both studies attached to the SER) to quantify underwater noise emissions and exposures from the greatest noise generating construction activities (i.e. trenching) to inform marine fauna impact assessment and marine megafauna noise management measures, as included in a Marine Megafauna Noise Management Plan (MMNMP) (attached to SER). Noise modelling was undertaken at three locations to determine the noise impact from DPD Project related activities. These were:

- Location 1 – Backhoe dredge (BHD) excavating and rock breaking (using Xcentric Ripper or hydraulic hammer tools) in an area of hard rock;
- Location 2 – Trailing suction hopper dredge (TSHD) operating at a middle harbour trenching zone. This area was also relatively close to Weed Reef compared to other trenching zones. Weed Reef is a known hard reef area supporting greater diversity of biota (including hard corals) and may support higher marine fauna abundance; and
- Location 3 – TSHD (alone) and TSHD/ Cutter suction dredge (CSD) (operating together) operating in an outer harbour trenching zone. This zone was relatively close to Cox Peninsula shallow water and shorelines which support a higher diversity of biota and may support higher marine fauna abundance.

The modelling considered noise from the TSHD and the CSD as continuous, non-impulsive noise. The modelling also considered BHD excavating (digging) and Xcentric Ripper noise as non-impulsive noise but BHD hydraulic hammering as impulsive noise.

Animals can be physiologically affected from noise impacts and may include auditory threshold shift (temporary and permanent hearing loss). Marine fauna exposed to intense sound may experience a loss of hearing sensitivity, or even potentially mortal injury. Hearing loss may be in the form of a temporary threshold shift (TTS) from which an animal recovers within minutes or hours, or a permanent threshold shift (PTS) from which the animal does not recover.

The modelling followed industry best practice and determined 24-hour sound exposure levels (SELs) which allow a conservative determination of PTS and TTS ranges from the cumulative effect of noise to marine fauna of interest over a 24-hour period. Results have been presented at mean sea level (MSL), considered the most appropriate representation of average water level over 24 hours.

Modelling of sound pressure level (SPL) which represents an instantaneous level of noise (in contrast to SEL) has been used for determining behavioural impact ranges to fauna. For SPL modelling, modelled results at high and low tide (as well as MSL) were considered appropriate given SPL is an instantaneous level. Highest astronomical tide (HAT) and Lowest astronomical tide (LAT) were conservatively used as water levels to represent high and low tide states, respectively, although these extremes are rarely reached.

Marine fauna use sound for a range of functions such as social interaction, foraging and orientation. Marine fauna respond variably when exposed to underwater noise from anthropogenic sources, with effects dependent on a number of factors, including distance from the sound source, water depth and bathymetry, the animal's hearing sensitivity, type and duration of sound exposure and the animal's activity at time of exposure. Best practice underwater noise thresholds for physiological injury (PTS and TTS) and behavioural response were applied to key marine megafauna groups of dolphins, dugongs

and turtles, in order to determine impact/response ranges and inform impact assessment and management measures.

The distances from the sound source at which the behavioural and physiological thresholds were predicted to be exceeded for each location and activity were assessed. For all scenarios and fauna groups, PTS SEL (24 hour) threshold ranges were below 50 m with the exception of the BHD impulsive noise (hydraulic hammering) scenario where PTS threshold ranges were 130 m, 160 m and 100 m for dolphins, dugongs and turtles, respectively. Given the mobility of these species, and the threshold ranges for behavioural response being greater than the PTS range for all species, it is unlikely that these species would remain within the predicted PTS ranges for a period of 24 hours. The potential of PTS injury is therefore considered unlikely for dolphins, dugongs and turtles from DPD Project trenching activities.

TTS SEL (24 hour) threshold ranges at MSL varied across scenarios and fauna groups. For continuous noise source scenarios of TSHD, CSD and BHD trenching and BHD rock breaking using an Xcentric Ripper, TTS threshold ranges varied between 40 m and 350 m and were highest for dolphins (100-350 m), followed by dugongs (70-210 m) and then marine turtles (40-160 m).

For the BHD hydraulic hammering scenario, TTS threshold ranges were significantly larger than those predicted for the other modelled scenarios; threshold ranges for dolphins, dugongs and turtles were predicted to be 1,830 m, 2,500 m and 950 m, respectively. Given the relatively large size of these ranges and the fact that behavioural response thresholds were predicted to be within these ranges, it is possible that dolphins, dugongs and turtles could remain within the threshold TTS ranges for a period of 24 hours and receive TTS impact, if management measures were not in place to prevent this from occurring.

Management measures proposed to avoid and mitigate noise impacts to marine fauna, and included within the MMNMP, are considered best practice and have been informed by underwater noise modelling. They include monitoring of Observation and Exclusion Zones by marine fauna observers, with associated adaptive management measures, and use of soft starts where practicable. If use of a hydraulic hammer is required (expected as a contingency only), additional measures have been outlined to prevent physiological injury to marine fauna. The behavioural impacts from DPD Project vessel noise are expected to be on the same scale as that from commercial vessels using Darwin Harbour on a daily basis and are considered short-term. With measures in place to manage physiological injury to marine fauna the impacts from underwater noise are assessed as acceptable.

Light emissions

DPD Project lighting will create light spill, which has the potential to impact on marine fauna that show avoidance or attraction to lights. Given marine turtles are known to be affected by light spill during key life-cycle stages (nesting, hatching) and the DPD Project area overlaps a Biologically Important Area (BIA) for flatback turtle inter-nesting and habitat critical to the survival of flatback turtle, the SER focused on impacts to marine turtles.

Light spill modelling was completed (Pendoley, 2022a) using the lighting characteristics of the deepwater pipelay and construction vessels since these were considered to have the greatest source of light emissions for all DPD Project vessels. This work determined that biologically relevant light (i.e.

where there could possibly be an effect on marine turtles) was limited to a 4.5km radius for the worst case scenario of the deepwater pipelay vessel and construction vessel operating side by side (or <3.3km for vessels individually). The range where an effect was likely, rather than possible, was much less at <200m. An expert desktop assessment was conducted (Pendoley, 2022b) to assess the likely impacts of DPD Project vessel lighting to turtles, and in particular the regional population of flatback turtles, based on DPD Project vessel lighting/activity scenarios and records of flatback turtle nesting from the closest nesting beaches to the DPD Project area, i.e. Casuarina Beach and Cox Peninsula beaches. The greatest risk of exposure was determined to occur if vessels are operating in the harbour mouth during the May to October nesting season peak. Vessels on the pipeline route (which would include vessels involved in consecutive trenching, pipelay and rock installation activities) in this zone will be ~12 km away from Casuarina Beach, ~4 km away from Wagait Beach, and less than 2 km from Mandorah beach. These beaches were assessed as supporting very low numbers of flatback turtles on a regional scale and relative to the size of the Arafura genetic stock. Given the low numbers of turtles using these areas, the short duration of vessel activities, the distance of activities from Casuarina Beach and the likely merging of vessel lights with Darwin light sources when viewed from Cox Peninsula beaches, the assessment concluded that DPD Project lighting was unlikely to have any significant effect on nesting turtles or hatchlings.

Contingency treated seawater discharge

The seawater treatment chemicals that would be used and discharged as a contingency following an unlikely wet buckle event are inherently biodegradable with low potential for bioaccumulation. Modelling has shown that dispersion of discharged treated seawater will be rapid with concentrations not predicted to exceed conservative species protection thresholds over a duration where effects would be expected to be observed. Therefore, significant impacts to marine ecosystems are not expected.

Marine fauna interactions

The risk of vessel strike to marine megafauna is inherent to movements of all vessel types. The impact from vessel interactions with marine megafauna can range from temporary behavioural changes, to more severe impacts such as injury or even mortality in the event of a vessel strike.

Most DPD Project vessels will be stationary (for extended periods) or slow moving due to operational and safety requirements (e.g., pipelaying, trenching). Vessels transiting within the harbour or in/out of the harbour (for example transiting to/from the spoil disposal ground or transferring crew) will operate at greater speeds, however, all vessels will be governed by Port of Darwin commercial vessel speed restrictions.

DPD Project vessel activities are not considered to have any higher risk of fauna interactions than regular activities within the harbour and the proposed controls are considered effective and appropriate to reduce the risk of having a significant impact.

Hydrocarbon release – marine diesel oil (MDO)

In the unlikely event of a spill of marine diesel oil (MDO) from DPD Project vessels, impacts to conservation significant areas, benthic habitats and marine fauna could occur.

Spill modelling was undertaken to assess the potential impacts and risks from a surface MDO spill following a refuelling incident or vessel collision. The modelling predicted concentrations above impact thresholds were restricted to the 0-10 m depth range. An MDO spill could therefore impact marine fauna using surface waters, including air-breathing megafauna such as dolphins, dugongs and turtles. Demersal fish species living and feeding on or near the seabed in deeper waters are not likely to be affected by a surface spill of MDO, including demersal species using Charles Point Wide RFPA.

Impacts to benthic habitats and benthic fauna are most likely in shallow coastal waters <10m if exposed to MDO above impacts threshold concentrations. Modelling indicates shoreline loading and exposure to floating and entrained MDO above impact thresholds could occur within Darwin Harbour and at the mouth of the harbour, in the unlikely event of a vessel collision and tank rupture. Dissolved hydrocarbon above an impact threshold is less likely to reach shallow waters.

Vessel collisions are unlikely events, and even less likely are incidents leading to fuel tank ruptures. With management measures in place, including standard maritime practices and DPD Project controls, the risk of an MDO spill is considered to be low and reduced as far as practicable.

Hydrocarbon release – dry gas

Another source of a hydrocarbon spill risk is the release of dry gas release from a pipeline. If there was a significant dropped object event during DPD Project construction, there is a possibility that this could impact and damage the Bayu-Undan to Darwin pipeline or the Ichthys pipeline. Additionally, a third-party dropped object has the potential to damage the DPD Project pipeline (once in operation) resulting in the release of dry gas. Anchor drop/drag is the most likely dropped object. Rock protection for at-risk sections of the DPD pipeline has been designed to ensure the fluke of a 21.5 tonne anchor cannot penetrate through to the pipeline. Given the very low potential for toxic effects in the marine environment from a dry gas release and the rapid rise and dispersion of gas at the water's surface, there is a low potential for significant impacts to marine ecosystems from a pipeline rupture and dry gas release. Santos will manage the risk of damage to the existing pipelines in the harbour during construction through a combination of procedural and physical controls.

Environmental management and residual impacts and risk

The management actions outlined in **Table 2** will be implemented to ensure the DPD Project meets the objective for the NT EPA factor of Marine Ecosystems. Residual impacts and risks were assessed to be Negligible/ Minor and Very Low/ Low, respectively, following Santos' impact and risk assessment process. Management actions have been informed by referral commitments and subsequent referral feedback from Government and public submissions. Management actions have been carried through to Environmental Management Plans (EMPs) attached to the SER.

Table 2 Management actions for Marine Ecosystems

Potential Impact/Risk	Management Actions
Seabed disturbance	**Avoidance**
	The pipeline route has been surveyed (geophysical and geotechnical) to evaluate seabed in conjunction with engineering design requirements. Trenching, stabilisation and freespan correction/ prevention will only be undertaken at identified areas (using standard positional accuracy measures used in the industry).
	In shallower waters, anchor exclusion areas will be implemented to avoid sensitive habitats and heritage sites.
	Placement of pipe to be based on subsea heritage and habitat assessment studies to enable the avoidance of designated sensitive benthic habitats, and heritage and culturally sensitive areas.
	Mitigation
	Adaptive management process is defined within the Trenching and Spoil Disposal Management Plan. Environmental monitoring of water quality with management measures applied if water quality exceeds trigger levels.
	Overflow from the TSHD will be undertaken through the adaptive management processes. There will be an 'environmental valve', 'green valve' or Anti-Pollution Valve (APV) where available (attached to O/F to reduce air entrained, to reduce billowing and facilitates sediment sinking) as standard which will be used as a first step to capture fine sediment from disposal at dredge.
	Standard operating procedure for spoil disposal will be used. Spoil will not be disposed of in a single location, so will avoid developing a single large mound at the spoil disposal ground.
	Dynamically Positioned (DP) pipelay vessel will be used to install the pipeline in deeper waters. The DP vessel can be used in deeper water from KP23 (Territorial water boundary) to approx. KP91.5 where shallow water (<20 m) occurs, and will not require anchoring.
	An Anchor Management Plan will be developed to allow safe anchoring of vessels undertaking pipelay, trenching and pile driving activities in the vicinity of nearshore heritage or sacred sites.

Potential Impact/Risk	Management Actions
	Use of trained and competent anchor handling operators.
	Differential Global Positioning System (DGPS) for pipelay vessel to maintain accurate vessel position during installation.
	Checks prior to installation to confirm: + DGPS used to confirm ILT foundation structure position during installation; and + Underwater positioning system (USBL/transponders) and ROV to confirm installation location and positioning of pipeline (within required location accuracy to reduce disturbance to the seabed).
	Installation plan developed and includes: + requirement for trained and experienced vessel crews; and + trenching will be restricted to only areas where required.
	Based on subsea heritage and habitat assessment studies, span-specific rectification plans developed that include: + Pre-span method selection; + Real-time monitoring of span rectification; + Post-rectification inspections; and + Permanent rock installation will be limited to only those pipeline sections requiring stabilisation and/or anchor protection.
	Monitoring
	Continuous monitoring of anchor wire tensions to prevent anchor drag on seabed. Additionally wire length measurement of the winch will be monitored. Based on experience this parameter is a good indicator to prevent anchor drag. These two parameters are monitored to act as mitigation to prevent anchor drag.
	Adaptive management process as defined within a Trenching and Spoil Disposal Management Plan. Environmental monitoring of water quality with management measures applied if water quality exceeds trigger levels.
	Avoidance

Potential Impact/Risk	Management Actions
Contingency treated seawater discharge- from wet buckle scenario	Pipeline installation procedures to be prepared and followed.
	Maintenance requirements for pipelaying to minimise risk of operational failure.
	Shallow water pipelay barge has redundancy in its anchors for stability.
	Deep water pipelay vessel – has redundancy in its station keeping abilities and operates in accordance with approved activity specific operating guidelines.
	Mitigation
	Chemical selection procedure for all chemicals, including treated seawater, discharged to the marine environment.
	Calibrated chemical dosing system in place to ensure accuracy.
	If contingency use and discharge of treated seawater is required, the lowest required concentration of treatment chemical will be evaluated and used (up to a maximum of 550 ppm) in order to meet pipeline preservation requirements.
	Maintenance requirements for pipelaying to minimise risk of operational failure.
	Monitoring
	In the unlikely event that the pipeline requires contingency filling and subsequent dewatering of treated seawater in response to a wet buckle event and prolonged repair, water quality monitoring of the dewatering at the discharge location will be conducted to confirm the concentration and dispersion of treatment chemicals.
Noise emissions	**Avoidance**
	Use of trenching vessels has been reduced as far as practicable
	Mitigation
	Use of trenching vessels (with associated noise emissions) has been reduced as far as practicable

Potential Impact/Risk	Management Actions
	Vessel inductions for all crew to address marine fauna risks and the required management controls
	Vessels and helicopters to abide by Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000, which includes controls for minimising interactions with marine fauna
	Standard protocols for managing trenching vessel noise impacts included within the Marine Megafauna Noise Management Plan.
	Soft start (ramp-up) of hydraulic tools by BHD, where practicable
	Soft start (ramp-up) of trenching equipment, where practicable, will apply to the CSD and TSHD
	Vessels will adhere to Port of Darwin vessel speed limits.
	Vessel engines and DPD Project equipment/machinery maintained as per planned maintenance system
	Personnel trained in marine fauna observation (MFO) present on pipelay, trenching and rock installation vessels during daylight hours, including one crew member with MFO training on the bridge at all times.
	All marine fauna interactions and observations to be appropriately recorded and reported to DEPWS/NT EPA and DCCEEW as required
	Observation and shut-down zones for marine fauna have been developed based on noise modelling results and standard protocols. For trenching activities, excluding hydraulic hammering this includes: + An Observation Zone of 150 m and an Exclusion Zone of 50 m for marine mammals and turtles will be in place around trenching vessels (TSHD, CSD and BHD) for trenching activities; + Observation Zone monitored for 10 minutes prior to commencing trenching during daylight hours only
	Contingency hydraulic hammering management measures (not applicable for Xcentric Ripper tool)
	Contingency hydraulic hammering protocols for managing noise impacts included within the Marine Megafauna Noise Management Plan.

Potential Impact/Risk	Management Actions
	Hydraulic hammering for no greater than 8 hrs over a 24 hr period.
	No hydraulic hammering at night
	Increased Observation and Exclusion Zones for hydraulic hammering based on noise modelling results will be applied.
	A separate vessel with MFO onboard will be required to patrol the Observation Zone prior to and during hydraulic hammering
	Maintenance of equipment/machinery.
Light emissions	**Avoidance**
	The pipelay vessel will have an enclosed pipe welding deck.
	Vessel searchlights will only be operated in an emergency situation.
	Mitigation
	Housekeeping measures will be adopted, including requiring all crew to keep shutters on windows closed at night, to limit light emissions from vessels.
	Orient lights to area of direct work. Reduce overspill where practicable.
	Monitoring
	Santos will document vessel light spill on Darwin Harbour turtle nesting beaches as part of the DPD Project's environmental monitoring program.
Hydrocarbon spill	**Avoidance**
	No Intermediate Fuel Oil and Heavy Fuel Oil will be used in in the operational area.
	Vessel equipped and crewed in accordance with Australian maritime requirements.

Potential Impact/Risk	Management Actions
	A Notice to Mariners will be issued for offshore works advising all major shipping traffic formally. In addition, pipelay vessels will have attendant vessels that may act as guard vessels for work within the harbour.
	Chemicals and hydrocarbons will be transferred and stored in accordance with standard maritime practices as per vessel SOPEP.
	Vessel-specific bunkering procedures and equipment consistent with Santos marine vessel vetting requirements including: + Use of bulk hoses that have quick connect 'dry break' couplings; + Correct valve line-up; + Defined roles and responsibilities, and the specific requirement for bunkering to be completed by trained personnel only; + Visual inspection of hoses prior to bunkering to confirm they are in good condition; + Testing of the emergency shutdown mechanism on the transfer pumps; + Assessment of weather/sea state; + Maintenance of radio contact with Vessel during bunkering operations; + Bunkering checklist; and + Visual monitoring during bunkering.
	Mitigation
	Spill clean-up kits available in all areas, including high risk areas
	Implement tiered spill response in the event of a hydrocarbon spill as outlined in an oil pollution emergency plan for DPD Project construction and operations.
	Oil spill tracking buoys will be made available on primary DPD Project vessel/s with Santos CSR/s and/or at local supply base for immediate deployment to assist with tracking of an oil spill.

Potential Impact/Risk	Management Actions
	Monitoring
	Operational and scientific monitoring to be undertaken in event of a hydrocarbon spill as outlined in an oil pollution emergency plan for DPD project construction and operations.
Dropped objects	**Avoidance**
	Lifting and operational procedures in place and implemented.
	Implementation of Santos approved standards and procedures for outboard lifts.
	All lifting and winching equipment will undergo inspection, testing and certification as per applicable laws and applicable codes and Standards.
	Identification of no lift zones where relevant in proximity to subsea assets and infrastructure as documented in relevant lifting and operational procedure/s.
	Program anchor plots - avoid sites of significance or infrastructure.
	Anchor handling controls - anchor deployment and recovery only in approved safe lifting zones.
	Mitigation
	Dropped objects recovered where safe and practicable to do so.
	Emergency response implemented to minimise potential for impacts in the event of a loss of containment from the Bayu-Undan or other gas pipeline as a result of a dropped object during DPD Project installation.
Invasive marine species	**Avoidance**
	Ballast water management will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) requirements (as applicable to class), *Australian Ballast Water Management Requirements and Biosecurity Act 2015*.

Potential Impact/Risk	Management Actions
	Apply risk-based IMS management for vessels and immersible equipment - vessel and immersible equipment must be assessed as having a low risk of IMS prior to coming onto activity as per Santos IMS procedures.
	Vessels having suitable anti-fouling coating (marine growth prevention system) as required for class and in accordance with the *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006*
Marine fauna interactions	**Mitigation**
	Vessel inductions will address marine fauna risks and the required management controls.
	Vessel movements will comply with Part 8 of the EPBC Regulations 2000.
	Personnel trained in marine fauna observation present on pipelay, trenching and rock installation vessels during daylight hours, including one crew member with MFO training on the bridge at all times.
	An Observation Zone of 150 m and an Exclusion Zone of 50 m for marine mammals and turtles will be in place around trenching vessels (TSHD, CSD and BHD) for trenching activities.
	A Marine Fauna Observation and Management Protocol for Trenching Activities (included in a Trenching and Spoil Disposal Monitoring and Management Plan) will apply to the Observation and Exclusion Zones.
	Use of turtle 'tickler' chains on the trailing arms of the TSHD.
	All marine fauna interactions and observations will be appropriately recorded and reported to relevant authorities.

Atmospheric Processes

Santos is committed to meeting the NT EPA's objective of minimising greenhouse gas emissions and has set a 2040 net zero commitment for Scope 1 and 2 emissions which will support the NT Government's target of achieving net zero greenhouse gas emissions by 2050.

DPD Project and Barossa Development GHG emissions

A GHG emissions study was conducted to determine the Scope 1, 2 and 3 emissions from the DPD Project and the associated Barossa Development over the life of the development from extraction to liquefaction. Within the context of the DPD Project, Scope 1 emissions within the NT jurisdiction are emissions that result directly from the construction and operation of the DPD Project.

DPD Project Scope 1 emissions are predicted at 0.08 Mt $CO_{2\text{-}e}$ which are primarily due to vessel-based construction activities (0.05 Mt $CO_{2\text{-}e}$). These emissions comprise less than 0.2% of the lifecycle Barossa Development Scope 1 GHG emissions (inclusive of DPD Project) (51.6 Mt CO_2-e) noting that other than the DPD Project, these emissions relate to activities in Commonwealth waters.

By way of comparison, the total Scope 1 GHG emissions for the DPD Project represent:

- 1.68% of Santos' Corporate equity annual Scope 1 GHG emissions (2021-2022);
- 0.02% of Australia's annual GHG emissions (2022); and
- 0.46% of NT annual GHG emissions (2020).

Scope 2 emissions for the Barossa Development (including the DPD Project) are limited to electricity purchased for office-based support and onshore supply base activities. These emissions are expected to occur with the NT jurisdiction with total lifecycle emissions of approximately 2.9 kt CO_2-e. The DPD Project's contribution to these emissions is minor.

Scope 3 emissions include the operation of the DLNG plant and the consumption of Barossa products by customers. The Scope 3 emissions directly attributable to the DPD Project (206 kt CO_2-e) are a very minor contribution to the overall Scope 3 emissions of the Barossa Development inclusive of the DPD Project (244,400 kt CO_2-e). Within the context of the DPD Project, Scope 3 emissions include:

- Capital goods for DPD construction - outside of the NT (200 kt CO_2-e); and
- Third party vessel-based inspection, maintenance and repair (IMR) activities (6 kt CO_2-e).

Within the context of the Barossa Development (excluding DPD), Scope 3 emissions include:

- Capital goods (800 kt CO_2-e);
- Business travel (150 kt CO_2-e);
- Processing of LNG (32,300 kt CO_2-e);
- Transport & Use of LNG (191,200 kt CO_2-e); and
- Processing, transport & use of Condensate (19,800 kt CO2-e).

Emissions targets and DPD Project management actions

Santos aims to be a global leader in the energy transition by providing cleaner energy to help the world decarbonise and achieve net zero emissions. Santos has a net-zero Scope 1 and 2 emissions by 2040 target. Santos has 2030 targets of a 30% reduction in absolute Scope 1 and 2 emissions and a 40% reduction in Scope 1 and 2 emissions intensity. It also has a target to reduce customer's emissions (Santos Scope 3) by at least 1.5 Mt CO_2-e per annum by 2030.

Santos has a carbon emissions hierarchy of controls that consists of avoidance first, followed by reduction and offsetting. Due to the lack of alternatives to the use of fossil fuel powered vessels to complete DPD construction works, it is not possible to avoid vessel emissions during this stage of the DPD Project. Emissions will be reduced by planned maintenance regimes to ensure vessel performance is optimised and by vessels maintaining a Ship Energy Efficiency Management Plan as required by vessel class.

The primary emission source during the operations phase of the DPD Project is Inspection, Maintenance and Repair (IMR) IMR activities. IMR activities are critical to ensure the pipeline retains its integrity and is safe to operate. Santos will implement a risk-based inspection (RBI) schedule, in accordance with industry standards, to optimise vessel activities while ensuring the safe operation and integrity of the pipeline.

The SER provides further detail on Santos corporate and Barossa Development's emissions abatement measures to meet emissions targets.

The Barossa Development's estimated annual (Scope1 and 3) GHG emissions inclusive of onshore processing at the DLNG facility represents 0.86% of Australia's 2022 GHG emissions and 0.042% of 2022 global GHG emissions. The DPD Project is one part of the Barossa Development, representing 0.02% of Australia's 2022 GHG emissions. Therefore, the GHG emissions resulting from the DPD Project are not anticipated to represent a significant contribution to atmospheric GHG concentrations.

Cumulative Impacts

The potential for the DPD Project to contribute to cumulative impacts within Darwin Harbour was an issue raised by the NT EPA and through the public and NT Government submission process and has been addressed in the SER. The degree of cumulative impact between the DPD Project and identified nearby projects and activities was determined based on the potential for spatial and temporal interaction.

The projects and activities considered to have the potential for both spatial and temporal overlap of impacts with the DPD Project are:

+ Department of Infrastructure, Planning and Logistics – Mandorah Marine Facilities;
+ INPEX – Ichthys Maintenance Dredging;
+ Department of Defence – HMAS Coonawarra - Dredging and Dredged Material Management; and
+ Department of Chief Minister and Cabinet – Darwin Ship Lift and Marine Industries Project.

In addition to these projects, existing Darwin Harbour uses and activities and past pipeline projects (e.g. Bayu-Undan to Darwin and Ichthys pipeline) were also considered.

The potential for the DPD Project to contribute to cumulative dredging, seabed disturbance and underwater noise impacts was specifically considered in the SER.

Dredging/trenching cumulative impacts

There are numerous variables which influence the potential magnitude of cumulative dredging and trenching impacts including proximity, duration and dredging methodology, as well as the volumes and type of dredged material. The type, sensitivity and resilience of the different receptors present are also factors that influence the potential for cumulative impacts.

Sediment dispersion modelling and subsequent analysis conducted for the DPD Project predicted no exceedances of SSC impact or influence thresholds, with exceedance of sedimentation impact thresholds restricted to within trenching footprints.

When comparing these zones of influence and impact to those from other identified dredging projects in Darwin Harbour, there was no overlap identified. Therefore, there is low potential for cumulative impacts from turbidity and sedimentation between the DPD Project and other projects. Further detail on the assessment of potential cumulative impacts on water quality from Darwin Harbour dredging projects is provided in the SER and in the Trenching and Spoil Disposal Monitoring and Management Plan (TSDMMP).

Direct seabed disturbance cumulative impacts

Direct impacts to seabed habitats from the DPD Project will be restricted to infrastructure footprints, including the spoil disposal ground which do not overlap with other current project activities. When the benthic loss from other proposed projects is combined (conservatively), less than 5% of the bare ground, and less than 1% of hard coral, seagrass macroalgae and sponges or sponge/filterer/octocoral habitat found across Darwin Harbour, has or will be lost from these developments.

Underwater noise cumulative impacts

Santos has reviewed the noise impacts from projects that are currently undergoing assessment through the NT EPA, and it has been noted that it is not possible to accurately predict the potential cumulative impacts from noise and vibration that may arise from project activities within Darwin Harbour, as they are dependent upon the precise timing and that they are generated by the activities. Given the limited spatial and temporal overlap between projects and the short-term nature of the greatest noise generating activities, a significant cumulative impact is not likely.

Santos has been consulting with the proponents of other planned Darwin Harbour projects identified in the cumulative impact assessment and will continue to consult with these stakeholders to seek collaboration across a range of aspects including the undertaking of environmental studies, data sharing, contracting of vessels and equipment and project schedules.

Summary and Conclusions

Santos is seeking approval for the Darwin Pipeline Duplication (DPD) Project to extend the Barossa Gas Export Pipeline to allow gas from the Barossa field to be transported to and processed at the existing Santos-operated Darwin Liquified Natural Gas (DLNG) facility. The DPD Project involves the construction, operation and decommissioning of the approximately 100 km section of the DPD Project pipeline that is within NT jurisdiction. The approximate 23 km section of the pipeline in Commonwealth waters is outside of the scope of the referral and is subject to assessment by the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The DPD Project was referred to the NT EPA for assessment under the *Environment Protection Act 2019* (NT) in December 2021. The referral was subject to a period of public consultation in early 2022 and a total of 318 submissions were received, including group submissions by 284 individuals with the same wording.

In April 2022, the NT EPA determined that a standard environmental impact assessment was required for the DPD Project and the method of assessment was to be by Supplementary Environmental Report (SER). The EPA's assessment considered the referral in respect of the NT EPA's environmental factors and determined that the DPD Project has the potential to have a significant impact on environmental values associated with three of the environmental factors; being Marine Environmental Quality, Marine Ecosystems and Atmospheric Processes.

In January 2023, the NT EPA gave a Direction to include additional information in the SER in relation to the three environmental factors set out above.

The SER has been developed to address the submissions received on the referral and provide the additional information in response to the EPA's Direction.

The DPD Project effectively duplicates a portion of the existing Santos Bayu-Undan to Darwin pipeline. The benefit of the DPD Project is that it allows for the re-purposing of the existing Bayu-Undan to Darwin pipeline to facilitate a carbon capture and storage (CCS) project at Bayu-Undan, subject to regulatory approvals. The CCS project at Bayu-Undan would not only be able to manage the reservoir carbon dioxide emissions from the Barossa gas field, it has the potential to offer a 'whole of region' carbon solution delivered through a Darwin CCS processing hub.

As a result of over 18 years of gas production activities at Bayu-Undan, the reservoir is well understood and assessed as being suitable for the safe and permanent storage of up to 10 million tonnes of carbon dioxide per annum, equivalent to about 2 per cent of Australia's carbon emissions each year. This reservoir knowledge together with the presence of existing infrastructure, including the existing pipeline that could deliver carbon dioxide directly to the injection site, is expected to make the Bayu-Undan CCS project a highly competitive carbon storage solution in terms of cost, assisting to increase the likelihood of its development.

The alternative to the DPD Project would be to 'tie in' to the existing Bayu-Undan to Darwin pipeline. This would mean the existing pipeline would not be available for future use in the Bayu-Undan CCS project which may significantly impact the ability to develop the CCS project at Bayu-Undan. This is on the basis of the considerable costs and time it would take to construct a pipeline to the tie in point.

There are also safety and environmental risks associated with the alternative 'tie-in' option, primarily the high-risk tie-in activities that are typically required to be undertaken with subsea saturation divers.

In the planning stages for the DPD Project, a number of pipeline route options were considered for the Darwin Harbour area. An alternative route considered was through Gunn Point and involved the construction of over 70 km of onshore underground pipeline. This option was subsequently ruled out due to its greater requirements for trenching and associated spoil, potential for impacts to sensitive marine and coastal environments and sensitive habitats including seagrasses and turtle nesting locations.

As part of the work undertaken to prepare this SER, further environmental surveys and assessments have been undertaken since the referral was submitted. These include baseline marine water quality and seabed (benthic) habitat surveys, assessments in relation to turtle nesting and lighting impacts, sediment plume dispersion modelling, underwater noise modelling. An underwater maritime archaeological heritage assessment and an Aboriginal Areas Protection Authority (AAPA) Certificate for the DPD Project have also informed the SER.

Further consultation with key stakeholders has also been undertaken throughout the preparation of the SER. This has included engagement with government agencies and organisations, specific Indigenous Groups and Representative Bodies, other stakeholders and proponents of other projects to understand concerns, discuss issues raised in submissions and share information. As part of these discussions, consultation with the Darwin Harbourmaster has assisted to optimise the pipeline route alignment through Darwin Harbour to eliminate encroachment into the shipping channel and minimise the potential for impacts to other harbour users and shipping traffic.

Refinements to the DPD Project since the referral have delivered a number of environmental benefits to the DPD Project, including a reduction of around 25% of the trenching distance required. This has contributed to a significant reduction in the maximum volume of spoil that is anticipated from the DPD Project. A minor addition to the DPD Project area within the existing DLNG facility disturbance footprint has been identified as required to allow for a temporary access road to support vehicle and equipment access to the shore crossing site.

The SER assessment has focussed on addressing the three environmental factors assessed by the NT EPA as having the potential for significant impacts and Santos is committed to meeting the environmental objective for the environmental factors. The SER includes a comprehensive set of proposed management measures to avoid and mitigate potential impacts. These have been developed with consideration of the submissions received and in consultation with relevant stakeholders. The SER also includes a number of Environmental Management Plans (EMPs) that will be subject to consultation with relevant stakeholders and further refinement prior to implementation.

The environmental impact and risk assessment presented in the SER has found that the residual impacts and risks to Marine Environmental Quality and Marine Ecosystems from the DPD Project are rated at between Negligible and Minor, for impacts, and Very Low to Low for risks.

The overall Barossa Development (Scope 1 and 3 emissions) represents 0.86% of Australia's 2022 GHG emissions and 0.042% of 2021 global GHG emissions. The DPD Project is one part of the Barossa Development, representing ~0.02% of Australia's 2022 GHG emissions and, as such, are not anticipated to represent a significant contribution to atmospheric GHG concentrations.

In consideration of the findings of the assessment, including the additional environmental surveys and studies undertaken since the referral, the management measures that will be implemented to avoid and mitigate potential impacts and the low residual environmental impacts and risks associated with the DPD Project, it is concluded that the DPD Project would not have a significant impact on the environment.

Further the DPD Project enables significant opportunity for environmental benefits associated with the development of the Bayu-Undan CCS project, subject to all approvals, in addition to the socio-economic benefits of the continued supply of gas to the DLNG facility.

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