



# **Ichthys LNG AGRU Upgrades and CCS Preparedness Project: Referral Report**



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**Terms, abbreviations and acronyms**

<b>Term, abbreviation or acronym</b>	<b>Meaning</b>
AAPA	Aboriginal Areas Protection Authority
AGRU	acid gas removal unit
AHD	Australian height datum
Air NEPM	Ambient Air Quality National Environment Protection Measure
AOC	accidentally contaminated drain
AS 2885	AS 2885: the standard for high pressure pipeline systems
AS/NZS 2885.1	AS/NZS 2885.1: Pipelines - Gas and liquid petroleum
ASS	acid sulphate soils
BESS	battery energy storage system
BIA	biological important areas
BTEX	benzene, toluene, ethylbenzene and xylenes
CBD	central business district
CCES	CO <sub>2</sub> compression export system
CCS	carbon capture and storage
CFA	continuously flight augured
CO <sub>2</sub>	carbon dioxide
COC	continuously oil contaminated drain
CPF	central processing facility
DAFF	Department of Agriculture, Fisheries and Forestry (Commonwealth)
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)

<b>Term, abbreviation or acronym</b>	<b>Meaning</b>
Draft CCEMP	Draft Ichthys LNG AGRU Upgrades and CCS Preparedness Project Construction and Commissioning Environment Management Plan (L075-AH-PLN-70005)
DLPE	Department of Lands, Planning and the Environment (Northern Territory)
ESCP	erosion and sediment control plan
EIS	environmental impact statement
EP Act	<i>Environment Protection Act 2019</i> (Northern Territory)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
FIFO	fly-in and fly-out
FPSO	floating production, storage and offloading facility
GEP	gas export pipeline
INPEX	INPEX Operations Australia Pty Ltd
LER	local and electrical room
LIR	local instrument room
LNG	liquefied natural gas
LOR	limits of reporting
LPG	liquefied petroleum gas
MNES	matters of national environmental significance
MOF	module offloading facility
NCW	Non-contaminated water drain also referred to as the stormwater drain
NO <sub>2</sub>	nitrogen dioxide
NO <sub>x</sub>	nitrogen oxides (NO and/or NO <sub>2</sub> )
NT	Northern Territory

Term, abbreviation or acronym	Meaning
NT EPA	Northern Territory Environment Protection Authority
O <sub>3</sub>	ozone
OCPs	organochlorine pesticide
OPPs	organophosphate pesticides
PAHs	polycyclic aromatic hydrocarbons
PASS	potential acid sulphate soils
PCBs	polychlorinated biphenyls
PFASs	per- and polyfluoroalkyl substances
PIG	pipeline inspection gauge
Project Area	The area where activities associated with the Project may occur. It encompasses areas which may be utilised for laydown, siting of plant equipment required for construction, temporary offices, the module offloading facility, etc. in addition to the area where civil construction activities would occur.
Project footprint	The area that would be disturbed as result of the civil construction activities required to support the installation of new infrastructure within the Ichthys LNG facility. This includes the Bulk Area, CO <sub>2</sub> pipeline ROW, the supplementary power area and the power cable ROW.
ROW	right of way
SEC	NT EPA Stakeholder Engagement and Consultation: Environmental Impact Assessment Guidance for Proponents (NT EPA 2021)
SO <sub>2</sub>	sulphur dioxide
SPMT	self-propelled modular transport
SQGV	sediment quality guideline value
TBT	tributyltin
TRHs	total recoverable hydrocarbons

Term, abbreviation or acronym	Meaning
WMPC Act	<i>Waste Management and Pollution Control Act 1998 (NT)</i>

**Measurement/units**

Measurement/unit	meaning
°C	degrees Celsius
%	percentage
µg/L	micrograms per litre
AHD	Australian height datum
bbl	barrel
Bq/g	becquerel per gram (radionuclides)
dB	decibels
dBA	A-weighted decibels, a measurement of sound level that takes into account the human ear's varying sensitivity to different frequencies.
g/L	grams per litre
kL	kilolitres
km	kilometres
m	metres
m <sup>3</sup>	cubic metres
mm	millimetres
Mm <sup>3</sup>	million cubic metres
m <sup>3</sup> /hr	cubic metres per hour
Mtpa	megatonnes per annum
NTU	measure of turbidity
pH	Quantitative measure (logarithmic scale) of the acidity or basicity of an aqueous solution.

<b>Measurement/unit</b>	<b>meaning</b>
ppt	parts per thousand; a unit of measurement for salinity, specifically indicating the number of grams of salt per kilogram of seawater.

## EXECUTIVE SUMMARY

### Proposal description

INPEX Operations Australia Pty Ltd (INPEX) is actively working to decarbonise its operations, to provide a stable supply of diverse and clean energy sources. Key to the planned decarbonisation of the INPEX-operated Ichthys liquid natural gas (LNG) facility is the development of a carbon dioxide (CO<sub>2</sub>) compression and export system at Bladin Point, near Darwin.

To support this, upgrades are required to the existing acid gas removal units (AGRUs) to improve their capability to separate CO<sub>2</sub> from reservoir feed gas. In addition, a new CO<sub>2</sub> compression and export system (CCES) and CO<sub>2</sub> export pipeline are proposed to be integrated into the existing Ichthys LNG facility processing systems (located in LNG Train 1 and Train 2 areas). This would enable CO<sub>2</sub> extracted during processing to be compressed and transported to an offshore storage location (the subject of separate referrals).

The following new infrastructure/equipment is proposed to be installed at the Ichthys LNG facility:

- modularised equipment to upgrade the two existing AGRUs
- CO<sub>2</sub> compressor modules (including auxiliary vents)
- an in-plant section of CO<sub>2</sub> export pipeline, export metering, and PIG (pipeline inspection gauge) launcher
- a modular building with combined electrical and control equipment to power and control the new facilities
- a common dehydration module
- a water treatment system/s, including water tanks, to treat and re-use water recovered from the CO<sub>2</sub> stream
- supplementary power infrastructure (i.e. a small battery energy storage system, electrical power distribution system and cabling).

Activities required to be undertaken to support the proposed AGRU upgrades and installation of the new CCES include:

- site-preparation
- construction (civil works, piling, drainage installation, etc.)
- installation/connection (i.e. module delivery/installation, installation of the CO<sub>2</sub> pipeline and cabling, and brownfield upgrades within the Ichthys LNG facility)
- pre-commissioning and cold commissioning\* of the upgraded AGRUs and CCES equipment/infrastructure
- preservation of the CO<sub>2</sub> pipeline, upgraded AGRUs and CCES infrastructure/equipment.

Once cold commissioning has been performed, the new CCES equipment/infrastructure would remain in place and preserved until such time it could be connected to future offsite carbon capture and storage (CCS) infrastructure. The upgraded AGRUs would be preserved until such time Plover gas wells are brought on-line and the CO<sub>2</sub> capacity exceeds the existing AGRU system design.

All works associated with the proposal would occur within the existing Ichthys LNG facility perimeter fence line (Refer to Figure ES-1). The entire Project footprint was cleared of vegetation and was subject to standard cut and fill activities as part site preparation activities undertaken during the construction of the Ichthys LNG facility (2013-2016), and no further vegetation clearing is required.

### **Environmental assessment and management**

An assessment of the potential impacts of the proposed Ichthys LNG AGRU Upgrade and CCS Readiness Project on the Northern Territory Environment Protection Authority (NT EPA) environmental factors identified five of the listed 14 environmental factors may be impacted (Table ES-1).

A systematic risk assessment process was adopted for the environmental management of the activities required under this proposal. This process aligns with INPEX's Environmental Policy, which requires the identification of environmental hazards and risks associated with business activities, and management of these to levels that are 'as low as reasonably practicable' (ALARP). Environmental management frameworks have been developed and proposed to be implemented to manage potential impacts to ALARP; and include a suite of management actions/controls. A summary of proposed management actions/controls applicable to each of the three environmental factors is provided in Table ES-1.



Figure ES-1: Location of proposed activities

**Table ES-1: Environmental factors potentially impacted by proposed activities**

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
Land – terrestrial environmental quality	Quality of soils, including chemical, physical, biological and aesthetic qualities that support life	Erosion and soil loss during civil construction activities, impacting soil quality and structural integrity and resulting in sedimentation to receiving environment.	<ul style="list-style-type: none"> <li>• A site-specific Erosion and Sediment Control Plan (ESCP) will be prepared in accordance with the IECA Best Practice Erosion and Sediment Control Guidelines (IECA 2008) and endorsed by a Certified Professional Erosion and Control Specialist, to manage erosion risk. The ESCP will include:                             <ul style="list-style-type: none"> <li>- temporary and permanent control measures</li> <li>- protection of stockpiles and exposed soil areas</li> <li>- ongoing inspection and maintenance of controls when in effect.</li> </ul> </li> <li>• All stormwater discharge from within the construction area will be in accordance with water quality criteria within the ESCP.</li> </ul>
		Construction activities disturbing unknown acid sulphate soils (ASS) or potential acid sulphate soils (ASS) resulting in contamination of adjacent soils or receiving waters (acidic and metalliferous drainage).	<ul style="list-style-type: none"> <li>• Based on previous studies ASS/PASS is highly unlikely to be encountered within the Bulk Area.</li> <li>• While the chance of encountering ASS/PASS within the pipeline ROW within Ichthys LNG is considered highly unlikely, a geotechnical program will be undertaken to confirm the presence/absence of ASS/PASS, prior to commencement of construction.</li> <li>• Where suspected ASS/PASS is encountered during excavations it will be kept separate from other spoil material. Any suspected ASS/PASS will be transferred to a dedicated treatment pad for stockpiling.</li> </ul>
		Unplanned loss/spills of chemicals, hydrocarbons, and hazardous substances resulting in contamination of soils within and adjacent to proposed activities	<ul style="list-style-type: none"> <li>• Personnel who routinely handle hazardous materials or wastes (e.g. refuelling personnel, pump operators, mechanics, and stores personnel) will receive training in handling, transporting and storing hazardous materials or wastes; in reporting and documentation requirements; and in spill clean-up techniques and practices.</li> <li>• Use, handling, storage and disposal of all hazardous materials and dangerous goods will be in accordance with the <i>Dangerous Goods Act 1998</i> and the <i>Waste Management and Pollution Control Act 1998</i>.</li> <li>• A variety of temporary bunding will be available for use around the site, including bunded pallets and drip trays.</li> <li>• Refuelling of vehicles will occur within dedicated areas.</li> <li>• Chemicals and substances used during the Project will be selected in accordance with the INPEX chemical selection process.</li> <li>• Spill kits will be located on site in accessible locations and will be regularly inspected and maintained.</li> </ul>
Land – terrestrial ecosystems	Migratory or threatened species utilising mangrove areas adjacent to the Ichthys LNG facility.	Construction or commissioning activities producing noise emissions resulting in displacement of migratory or threatened species that may utilise mangrove communities adjacent to the proposed Ichthys LNG facility.	<ul style="list-style-type: none"> <li>• Piling method (bored) selected that minimise impacts of noise and vibration to sensitive receptors.</li> <li>• Acoustic barriers or enclosures will be installed around noisy activities, as required.</li> <li>• Machinery and vehicles will be maintained and operated to minimise noise and vibration generation (e.g. noise-attenuation devices, vibration dampening).</li> <li>• Noise monitoring will be undertaken at the Ichthys LNG facility boundary to validate Project noise modelling outcomes.</li> </ul>
Sea – marine environmental quality	Quality of the marine waters, sediment and biota. Ecosystem health condition.	Wastewater discharge modelling indicating that the Darwin Harbour Water Quality Objectives cannot be met within modelled mixing zone	<p>Hydrotest water management (If the option to dispose of wastewater via a temporary MOF outfall is pursued):</p> <ul style="list-style-type: none"> <li>• The outfall design will incorporate use of a multiport diffuse to allow for sufficient near-field dilution within proximity of the discharge point.</li> <li>• Modelling will be undertaken to determine the extent of the required mixing zone, to enable effective dispersion of wastewater.</li> <li>• A waste discharge licence will be applied for under the <i>Water Act 1992</i> (NT).</li> <li>• Any wastewater discharged via the MOF outfall will comply with WDL wastewater quality limits.</li> <li>• A receiving environment water quality monitoring program will be implemented to verify modelling outputs and determine if receiving water is being adversely impacted.</li> <li>• Wastewater generated during Project activities (e.g. hydrotest water) will be re-used where it remains fit for purpose.</li> </ul>

NT EPA factor	Environmental values and sensitivities	Potential impact	Key management controls
		Unplanned loss/spills of chemicals, hydrocarbons, and hazardous substances resulting in contamination of the marine environment within and adjacent to the proposed activities	See Land – terrestrial environmental quality above.
People – culture and heritage.	Sacred sites. Previously unidentified heritage objects/sites.	Damage to sacred sites Civil and earthworks – damage to previously unidentified heritage object/s	<ul style="list-style-type: none"> <li>• An AAPA Authority Certificate relevant to the civil and earthworks required for the Project within the existing Ichthys LNG has been obtained.</li> <li>• An AAPA Authority Certificate relevant to potential monitoring activities has been obtained.</li> <li>• There are no known Aboriginal heritage sites within the fence line of the existing Ichthys LNG facility, where Project activities are planned to be undertaken.</li> <li>• A chance find procedure will be implemented in the event of discovery of previously unidentified heritage object during civil and earthworks activities in accordance with the INPEX Aboriginal Heritage and Sacred Site Management Plan applicable to Ichthys LNG.</li> </ul>
People – community and economy	Community receptors adjacent to the Ichthys LNG facility.	Construction activities producing noise and vibration emissions affecting surrounding community sensitive receptors	<ul style="list-style-type: none"> <li>• The piling method (bored) selected minimises impacts of noise and vibration to sensitive receptors.</li> <li>• Acoustic barriers or enclosures will be installed around noisy activities, as required.</li> <li>• Machinery and vehicles will be maintained and operated to minimise noise and vibration generation (e.g. noise-attenuation devices, vibration dampening).</li> <li>• As required stakeholders will be notified about dates, times, and nature of potential noise-generating activities and mitigation measures to be implemented.</li> <li>• An enquiries hotline will be maintained and monitored.</li> <li>• A transport management plan will be implemented to manage the movement of construction vehicles and plant to and from the Project site.</li> <li>• Noise monitoring will be undertaken at the Ichthys LNG facility boundary to validate Project noise modelling outcomes.</li> </ul>

**Stakeholder engagement**

Pre-referral stakeholder consultation for the proposed Ichthys LNG AGRU Upgrade and CCS Preparedness Project to inform the development of the referral and the Draft Construction and Commissioning Environment Management Plan. Once the proposed project activities have commenced, ongoing engagement will be undertaken to:

- Provide sufficient notice to key stakeholders prior to the commencement of upgrades, construction and commissioning works to ensure effective communication of the timing of works, and the associated safety and environmental measures
- Provide information throughout the proposed activities, to support safe outcomes and where possible, minimise and reduce impacts to stakeholders active in the receiving environment
- Communicate project outcomes to stakeholders, including completion of work scopes.

**Conclusion**

Based on the systematic risk assessment process, the residual risk for the majority of potential impacts associated with the proposed activities are considered low. Only two potential impacts have a residual risk of “moderate”, and these are associated with unplanned events (Table ES-2).

**Table ES-2: Summary of potential impacts with residual risk moderate**

Potential impact	Consequence	Likelihood	Residual risk
Unplanned loss/spills of chemicals, hydrocarbons, and hazardous substances resulting in contamination of soils within and adjacent to Project activities	Minor (E)	Unlikely (4)	Moderate (8)
Unplanned loss/spills of chemicals, hydrocarbons, and hazardous substances resulting in contamination of the marine environment adjacent to Project activities	Minor (E)	Unlikely (4)	Moderate (8)

# 1 INTRODUCTION

INPEX Operations Australia Pty Ltd (INPEX) is actively working to decarbonise its operations, to provide a stable supply of diverse and clean energy sources. Key to the planned decarbonisation of the INPEX-operated Ichthys liquid natural gas (LNG) facility is the development of a carbon dioxide (CO<sub>2</sub>) compression and export system at Bladin Point, near Darwin.

To support this, upgrades are required to the existing acid gas removal units (AGRUs) to improve their capability to separate CO<sub>2</sub> from reservoir feed gas. In addition, a new CO<sub>2</sub> compression and export system and CO<sub>2</sub> export pipeline are proposed to be integrated into the existing Ichthys LNG facility processing systems (located in LNG Train 1 and Train 2 areas). This would enable CO<sub>2</sub> extracted during processing to be compressed and transported to an offshore storage location (the subject of separate referrals).

## 1.1 Overview of the proposed action

The proposed action that will be assessed as part of this referral submission under the Northern Territory (NT) *Environment Protection Act 2019* (EP Act) is the upgrade of AGRUs, the installation of a new CO<sub>2</sub> compression and export system and the installation of a CO<sub>2</sub> pipeline within the existing Ichthys LNG facility boundary (herein referred to as the Project). Once constructed and cold-commissioned, infrastructure would be preserved until such time it could be connected to future offsite carbon, capture and storage (CCS) infrastructure.

A high-level summary of the Project is provided in Table 1-1, with a detailed description provided in Section 2.

**Table 1-1: Summary of the Project**

Element	Details
Location	All works associated with the Project would occur within the existing Ichthys LNG facility perimeter fence line (refer to Section 2.2).
Schedule	Works are indicatively scheduled to commence in Q4 2026. Works would progressively occur until completed; provisionally estimated to be sometime in either Q4 2030 or early Q1 2031 (refer to Section 2.1).
Activities	<p>The following new infrastructure/equipment is proposed to be installed at the Ichthys LNG facility:</p> <ul style="list-style-type: none"> <li>• modularised equipment to upgrade the two existing AGRUs</li> <li>• CO<sub>2</sub> compressor modules (including auxiliary vents)</li> <li>• an in-plant section of CO<sub>2</sub> export pipeline, export metering, and PIG (pipeline inspection gauge) launcher</li> <li>• a modular building with combined electrical and control equipment to power and control the new facilities</li> <li>• a common dehydration module</li> <li>• a water treatment system/s, including water tanks, to treat and re-use water recovered from the CO<sub>2</sub> stream</li> <li>• supplementary power infrastructure (i.e. a small battery energy storage system (BESS), electrical power distribution system and cabling).</li> </ul> <p>Refer to Section 2.3 for further details.</p> <p>The Project covers the following phases:</p>

Element	Details
	<ul style="list-style-type: none"> <li>• site-preparation</li> <li>• construction (civil works, piling, drainage installation, etc.)</li> <li>• installation/connection (i.e. module delivery/installation, installation of the CO<sub>2</sub> pipeline and cabling, and brownfield upgrades within the Ichthys LNG facility)</li> <li>• pre-commissioning and cold commissioning* of the upgraded AGRUs and CCES equipment/infrastructure</li> <li>• preservation of the CO<sub>2</sub> pipeline, upgraded AGRUs and CCES infrastructure/equipment.</li> </ul> <p>Refer to Section 2.4 for further details.</p> <p>Once cold-commissioning has been performed, the new CCES equipment/infrastructure would remain in place and preserved until such time it could be connected to future offsite CCS infrastructure (refer to Associated Projects – Section 1.4.2). The upgraded AGRUs would be preserved until such time Plover gas wells are brought on-line and the CO<sub>2</sub> capacity exceeds the existing AGRU system design (refer to Associated Projects – Section 1.4.2).</p> <p>Drainage systems associated with the proposed new infrastructure/equipment, would be operational once installed (refer to <i>Drainage</i>).</p> <p>In addition to the above permanent facilities, temporary facilities and laydown areas may be established to support construction and installation activities (Refer to Section 2.3.5 for further details).</p>
Module and materials transport	<p>Prefabricated modules would be delivered to the site via specialised vessels/barges and offloaded at the module offloading facility (MOF). Up to ten modules and a series of pipe rack modules are expected to be delivered at various stages during 2028 and 2029.</p> <p>Specialised pipeline materials could either be delivered to East Arm and transported to site via road or may be delivered to the site via vessel and offloaded at the MOF.</p> <p>Refer to Section 2.4.3 for further details.</p>
Utilities	<p>It is estimated that ~63,000 m<sup>3</sup> of scheme water would be required for construction, pre-commissioning, and cold commissioning activities.</p> <p>A combination of grid power (via existing Ichthys LNG facility arrangements) and temporary power (e.g. diesel-powered generators) would be required throughout the execution of the Project.</p> <p>The sewage management requirements may be met by the existing permanent sewage treatment plant (sized to cater for shutdown workforce requirements) or self-contained septic tank systems or ablution blocks.</p> <p>Refer to Section 2.3.6 for further details.</p>
Workforce	<p>The workforce required to support Project activities would fluctuate over time. Peak workforce is estimated to be between 600-800 persons.</p> <p>Refer to Section 2.3.7 for further details.</p>

\* Cold commissioning is defined as any commissioning activities which could be completed prior to the introduction of hydrocarbons or CO<sub>2</sub>.

## 1.2 Proponent details

INPEX Operations Australia Pty Ltd (INPEX), a wholly owned subsidiary of INPEX CORPORATION, is the proponent and operator for the Project on behalf of Ichthys LNG Pty Ltd (an incorporated joint venture).

The addresses of INPEX offices in Australia are as follows:

Perth office	Darwin office
INPEX Operations Australia Pty Ltd Level 22, ENEX 100 100 St Georges Terrace PERTH WA 6000	INPEX Operations Australia Pty Ltd Level 8, Mitchell Centre 59 Mitchell Street Darwin NT 0800

### 1.3 Publication statement

This Referral Report has been prepared by suitably qualified persons as outlined in Table 1-2.

**Table 1-2: Suitably qualified persons involved in the preparation of the referral and impact assessment**

Name	Experience
Obelia Akerman	Ms Akerman is a Senior Environmental Approvals Advisor at INPEX with 17 years of experience of developing, implementing and managing offshore and onshore state/territory and Commonwealth environmental approvals. Ms Akerman has worked on the Ichthys LNG project for over a decade and has a comprehensive knowledge of the NT environmental approvals processes and requirements playing a key role in the majority of onshore and nearshore approvals for the Ichthys LNG project to date, including but not limited to: <ul style="list-style-type: none"> <li>• environmental impact statement</li> <li>• 16.1 Mm<sup>3</sup> capital dredging campaign and maintenance dredging approvals</li> <li>• onshore construction and operations approvals</li> <li>• offshore construction, commissioning and operations approvals.</li> </ul>
Jake Prout	Mr Prout is an environmental professional with 20 years' experience in the mining, oil and gas sector. He is a capable project manager with demonstrated experience delivering environmental approvals, establishing environmental management systems and implementing them in offshore and onshore environments. Jake has worked in various capacities such as an independent consultant, a member of an engineering, procurement and construction team with INPEX in its role as the Ichthys LNG project operator for the last 13 years.

Name	Experience
Ben Davis	Mr Davis is a marine scientist and senior environment advisor with 15 years' experience managing and implementing marine and environmental projects, across both western and northern Australia. His technical expertise is focused on State/Territory and Commonwealth environmental approvals, licensing and permitting, writing and implementing environmental impact assessment and management plans. Mr Davis also specialises in field scientific operations, emissions monitoring and reporting, and environmental offsets for conservation.

## 1.4 Background

### 1.4.1 Ichthys LNG Development Project

#### Primary approvals

The Ichthys LNG Development Project was referred for environmental approval under the Northern Territory *Environmental Assessment Act 1982* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2007 and 2008, respectively, and the level of assessment was set as an environmental impact statement (EIS).

The Ichthys LNG Development Project involved the full development of the Ichthys Field (comprising the Brewster and Plover reservoirs). The Ichthys LNG Development Project offshore infrastructure falls under Commonwealth jurisdiction, and is made up of the following components:

- approximately 50 subsea production wells in the Ichthys Field, drilled from between 12 and 15 drill centres and developed over a period of 40 years
- a central processing facility (CPF) permanently moored for the life of operations at the Ichthys Field
- subsea wellheads and manifolds and the wet gas, corrosion resistant infield flowlines connecting them to the CPF
- control umbilicals and service lines
- a floating production, storage and offloading facility (FPSO) permanently moored 3.5 km from the CPF for the life of operations
- subsea flowlines connecting the CPF to the FPSO
- that portion of the subsea gas export pipeline (GEP) from underneath the CPF to the entrance to Darwin Harbour, some 856 km long.

The Ichthys LNG Development Project nearshore and onshore infrastructure, which lies within NT Government jurisdiction, is made up of the following components:

- approximately 27 km of the subsea GEP from the mouth of Darwin Harbour to the pipeline shore crossing on the western side of Middle Arm Peninsula north of Channel Island
- a MOF on the north-eastern side of Bladin Point

- a two-berth product offloading jetty at the north-western end of Bladin Point
- a dredged shipping channel (including the approach area and a turning basin) and the jetty pocket berthing area and jetty pocket for the product tankers.
- two gas liquefaction trains, each capable of producing approximately 4.45 Mtpa of LNG
- liquified petroleum gas (LPG; propane and butane) recovery units and fractionation units
- condensate stabilisation units
- seven product storage tanks (two cryogenic tanks for LNG, one cryogenic tank for propane, one cryogenic tank for butane, and three ambient-temperature tanks for condensate)
- a combined-cycle power plant
- flare systems
- a wastewater treatment system
- an operations complex
- laydown areas, warehousing facilities, field workshops and hazardous material storage areas
- temporary office facilities.

INPEX prepared the Ichthys Gas Field Development Project: Draft EIS, which was submitted to the NT and Commonwealth governments on 15 July 2010. After a period of public and government review, the Ichthys Gas Field Development Project: Supplement to the Draft EIS, was developed and submitted on 5 April 2011 for a final approval decision by the Commonwealth Minister and assessment by the NT Minister. Collectively, the Draft EIS and the EIS Supplement documents are referred to as the Final EIS.

The NT Department of Natural Resources, Environment, the Arts and Sport issued an Environmental Assessment Report and Recommendations (Assessment Report 65) for the Ichthys Project on 17 May 2011. Assessment Report 65 documents the findings of the environmental assessment completed under the *Environmental Assessment Act 1982* (NT).

Commonwealth approval was granted under the EPBC Act by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities on 27 June 2011 (Commonwealth Ministerial approval EPBC 2008/4208).

### **Ichthys LNG facility secondary approvals**

Existing operations at the Ichthys LNG facility are undertaken in accordance with:

- [EPBC 2008/4208](#) (Commonwealth) approval conditions (as applicable) and the following approved management plans:
  - Ichthys Onshore LNG Facilities Liquid Discharge Management Plan: Operations
  - Ichthys LNG Project Nearshore Operations Oil Pollution Emergency Plan
- the Ichthys ILNG facility environment protection licence (NT; [EPL228](#) as amended) conditions
- commitments within the [Onshore Operations Environmental Management Plan](#).

## **Current status of Ichthys LNG Development Project**

As part of the approved Ichthys reservoir development sequence, the produced reservoir fluids sent to the Ichthys LNG facility are expected to progressively increase in CO<sub>2</sub> composition (from a current peak of 10 % up to a maximum near 14 % as the Plover reservoir is progressively brought online). To accommodate the resulting feed gas CO<sub>2</sub> composition, modifications are required to the AGRU system. The operating conditions of Ichthys LNG facility would remain unchanged (regardless of modifications), until the introduction of additional Plover gas (currently forecast to occur in early 2030).

Since the approval of the Ichthys LNG Development Project, the Australian Government introduced the transition to a “net zero” economy under the Safeguard Mechanism Policy.

Refer to Section 4 for further details on current Ichthys LNG facility infrastructure and activities.

### **1.4.2 Associated activities/projects**

The following sections describe other activities/projects associated with this Project.

#### **Module offloading facility maintenance dredging**

Over time, sediment has naturally accumulated within areas of the existing dredged module offloading facility (MOF) footprint berth pockets. This has the potential to impact on the MOFs operability, in terms of restricting safe clearance of vessels which would be used to import modules to support the Project.

To support the Project, a small maintenance dredging campaign is required to be undertaken within the existing berth pockets of the MOF.

Maintenance dredging was assessed as part of the larger Ichthys LNG Development Project Commonwealth approval under the EPBC Act, as such EPBC 2008/4208 Condition 10 of the Ichthys LNG Development Project applies. In contrast, in the NT, any dredging activity needs to be referred to the Minister for consideration under the EP Act (NT). As such, a referral would be made under the EP Act and a management plan submitted to meet the requirements of EPBC 2008/4208 Condition 10.

#### **Ichthys CCS Project**

INPEX on behalf of Ichthys LNG Pty Ltd, is proposing to develop a buried onshore pipeline system between Ichthys LNG and the inlet to potential CO<sub>2</sub> sequestration projects. Furthermore, it will operate capture, dehydration and compression facilities within Ichthys LNG facility as part of an integrated CCS system.

The proposed onshore pipeline system would be comprised of two sections. The first section would extend from the Ichthys LNG facility boundary on Bladin Point to the proposed Bonaparte CCS Project onshore inlet station. The subsequent section would extend from the Bonaparte CCS Project onshore inlet station to a proposed CCS tie in/inlet station located adjacent to the Darwin LNG facility on Wickham Point.

In addition to the pipeline system on Middle Arm, the proposal includes the hot commissioning of the Ichthys LNG facility CCES and upgraded AGRUs, and the operations of the integrated CCS system to the point of custody transfer at a CCS sequestration project CO<sub>2</sub> onshore inlet station within the region.

A referral application supporting this project is planned to be submitted in Quarter 3 2025.

## **Bonaparte CCS Project**

INPEX, as operator of the Bonaparte CCS Assessment Joint Venture is proposing to develop the Bonaparte CCS Project, a large-scale multi-user CCS facility partly located in the Northern Territory of Australia.

The Bonaparte CCS Project is proposing to develop infrastructure to receive, transport and permanently sequester CO<sub>2</sub> within a geological formation located approximately 2,000 m below the seabed.

The proposed infrastructure for permanent sequestration would be located approximately 250 km west of Darwin in the Joseph Bonaparte Gulf. The transport infrastructure would comprise of a CO<sub>2</sub> pipeline and control cable extending between the Joseph Bonaparte Gulf and the Middle Arm peninsula in Darwin where the onshore inlet station is proposed to be developed.

CO<sub>2</sub> emissions are intended to be collected from a range of potential customers in the region, including reservoir CO<sub>2</sub> from Ichthys LNG facility.

A referral application supporting this project is planned to be submitted in Quarter 3 2025.

## 2 PROJECT DESCRIPTION

### 2.1 Schedule

An indicative schedule of proposed activities associated with the Project, subject to approvals being obtained, is presented in Figure 2-1.

Activity	2026				2027				2028				2029				2030				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Site establishment and civils works																					
Brownfields modifications																					
Module installation																					
Pre-/cold commissioning																					
Pipeline installation (On-plot)																					

**Figure 2-1: Indicative schedule of proposed activities**

### 2.2 Project location

All new infrastructure, equipment and activities associated with the Project would occur wholly within the perimeter fence line of the existing Ichthys LNG facility.

The Ichthys LNG facility is located on Bladin Point, on the northern side of Middle Arm Peninsula in Darwin Harbour (refer Figure 2-2), approximately:

- 4 km from Palmerston (the nearest residential zone)
- 10 km south-east of the Darwin central business district (CBD), across Darwin Harbour waters; and
- 35 km by road (or 4 km by sea) from East Arm Wharf.

The existing Santos operated Darwin LNG processing and export facility is located on the west side of the Peninsula on Wickham Point.

In addition, an existing offsite laydown area (Section 1949; refer to Figure 4-1) located on Middle Arm Peninsular and currently utilised by the Ichthys LNG facility, may also be used in accordance with Crown Land Licence terms and conditions.



**Figure 2-2: Location of the Ichthys LNG facility relative to the greater Darwin Area**

### 2.2.1 Project footprint

The "Project Area" is defined as the area where activities associated with the Project may occur (Figure 2-3; the Project Area is indicated by a dashed yellow line). The Project Area encompasses areas which may be utilised for laydown, siting of plant equipment required for construction, temporary offices, the MOF, etc. in addition to the area where civil construction activities would occur.

The "Project footprint" is defined as the area that would be disturbed as a result of the civil construction activities required to support the installation of new infrastructure within the Ichthys LNG facility. All construction work associated with AGRU upgrades, and the CO<sub>2</sub> compression and export system would be completed in an area of vacant land, situated to the east of Ichthys LNG Trains 1 and 2 and positioned within the perimeter fence line of the existing facility, in Bulk Areas A and B, collectively referred to as the 'Bulk Area' (Figure 2-4). All construction works for the pipeline would occur in a right of way (ROW), which extends from the Bulk Area, continues along the eastern boundary of Ichthys LNG facility and terminates at the western boundary of Ichthys LNG facility (Figure 2-4). All construction works associated with installation of the supplementary power infrastructure would occur in vacant land east of the combined cycle power plant and main power substation (Figure 2-4). Associated cables to support of importation of power would be located within a proposed supplementary power cable ROW (Figure 2-4). This follows the route of the CO<sub>2</sub> pipeline within the Ichthys LNG facility; however, the width varies in areas due to operational restrictions or presence of existing infrastructure.

The Project footprint comprises a total disturbance area of approximately 17 ha. The entire Project footprint was cleared of vegetation and was subject to standard cut and fill activities as part site preparation activities undertaken during the construction of the Ichthys LNG facility (2013-2016); approved as part of the Ichthys LNG Development Project (refer to Section 1.4.1). No further vegetation clearing is required for the scope covered in this Referral report.

The Project footprint is largely located in hardstand areas that are covered by either concrete, sealed handstand, crushed rock material or asphalt roads. Supporting temporary offices, facilities and internal roads would be located within existing handstand areas.

#### Land tenure, planning and use

The Project is located entirely within the existing Ichthys LNG facility perimeter fence line (NT Portion 7002) and is zoned under the NT Planning Scheme 2020 as "Development" (Figure 2-5).

All areas of work, including laydown areas, were previously developed during construction of the Ichthys LNG facility. An overview of the existing Ichthys LNG facility systems and activities is presented in Section 4.

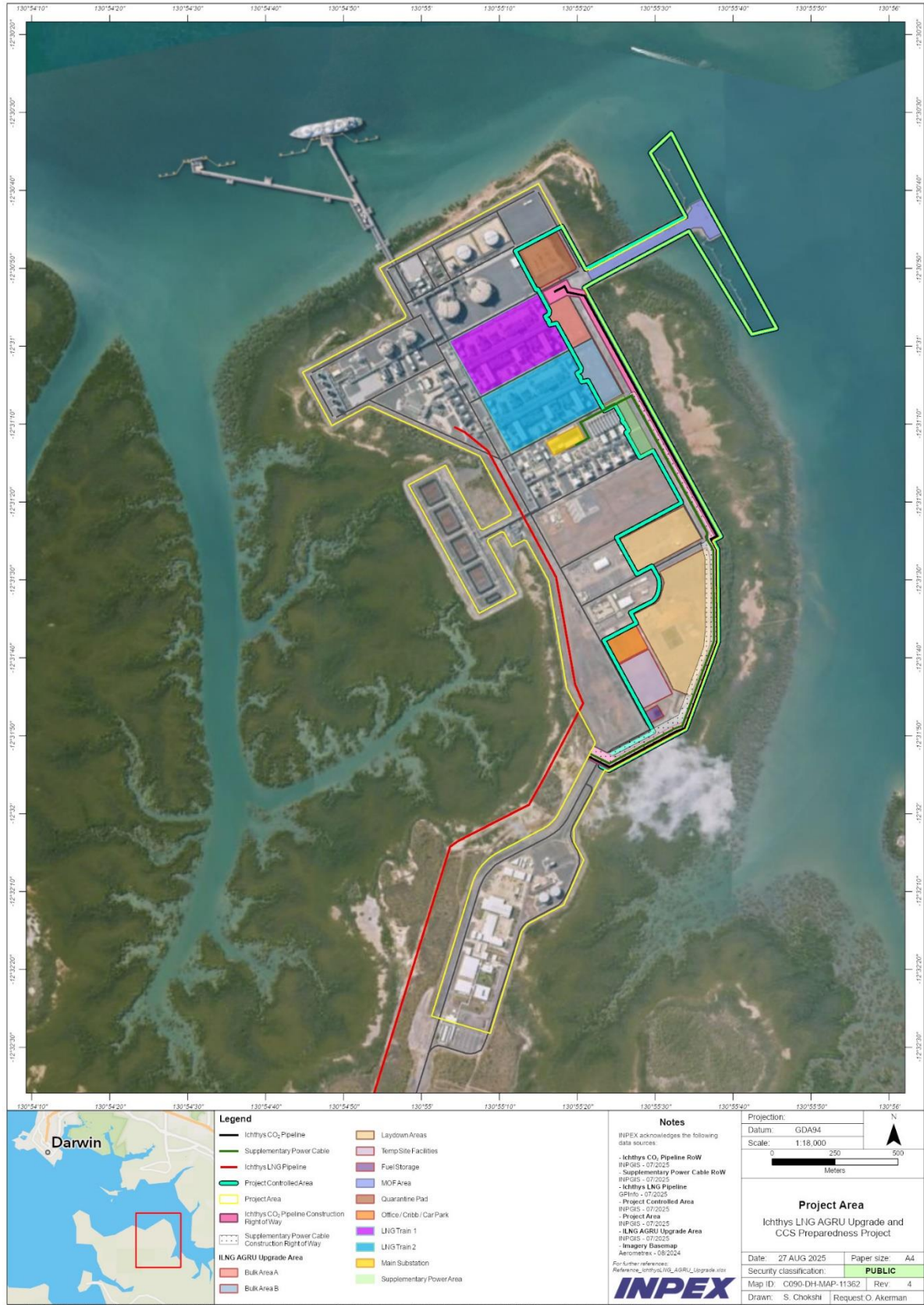


Figure 2-3: Project Area



Figure 2-4: Project footprint



### 2.3 Project infrastructure, utilities and workforce

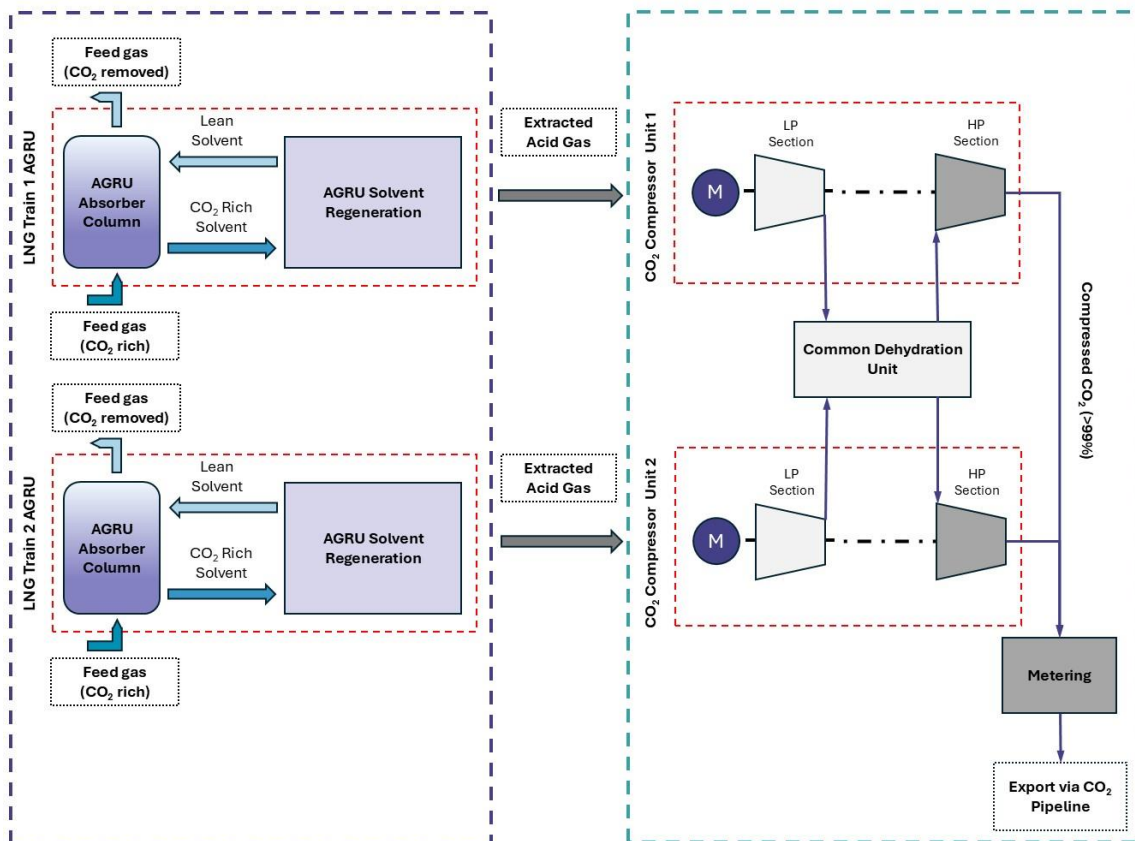
The following sections provide an overview of the Project infrastructure required to be installed or upgraded to support AGRU upgrades and CCS preparedness and the temporary facilities, utilities and workforce required to support the Project during execution.

#### 2.3.1 Overview of proposed infrastructure interfaces

An overview of the proposed Ichthys LNG facility CO<sub>2</sub> compression and export system (CCES) and the interface with the AGRU systems is shown in Figure 2-6.

The purpose of the AGRUs is to remove acid gases (primarily reservoir CO<sub>2</sub>, as well as trace quantities of hydrogen sulphide and mercaptans) from the feed gas received at the Ichthys LNG facility. Each AGRU comprises two subsystems; the first absorbs the acid gases into the AGRU solvent (i.e. aMDEA) and the second is a solvent regeneration system that uses a combination of pressure reduction and higher-temperature to separate the acid gases back out of the AGRU solvent to enable solvent re-use within the closed-loop system.

It is proposed that acid gases removed by the AGRUs would be sent to a CCES where the CO<sub>2</sub> would be compressed, prior to being sent to a common dehydration unit where water vapour would be removed to achieve the CO<sub>2</sub> pipeline entry specification. Following dehydration, the gas is directed back to the compressor for further compression (high-pressure). The treated CO<sub>2</sub> (i.e. compressed/dehydrated) would then be metered and transported via a pipeline from the Ichthys LNG facility to an offshore storage site for sequestration.



**Figure 2-6: Overview of proposed infrastructure interfaces (the blue dashed line indicates existing operating AGRU infrastructure that is required to be upgraded; the green dashed line indicates new CCES infrastructure)**

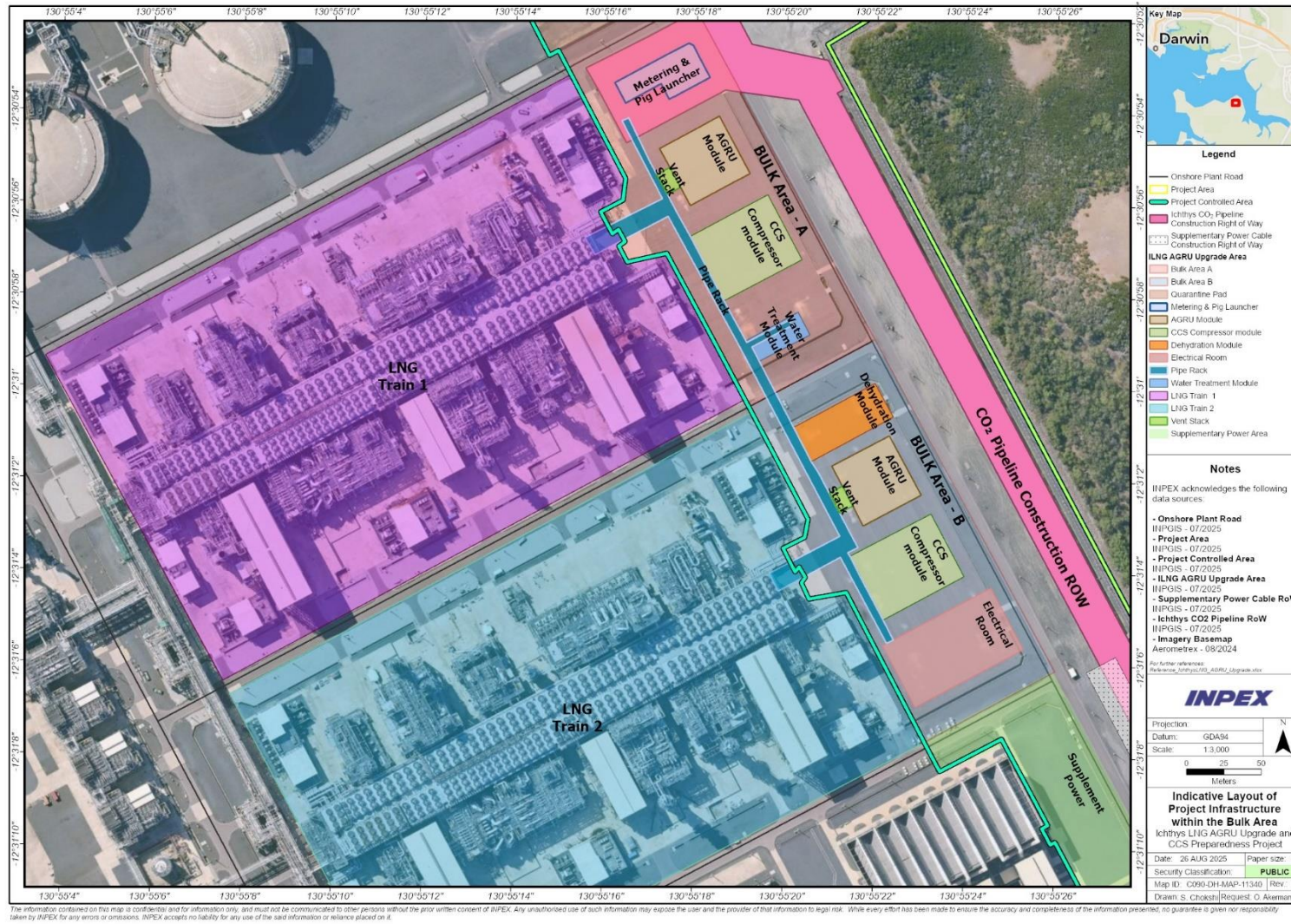
### **2.3.2 Project infrastructure**

The description of infrastructure within this section represents the Project “base-case” and the worst-case for assessing the potential impacts of the Project. As the Project progresses through the detailed design phase several optimisation opportunities are being considered, which may alter the layout of infrastructure/equipment within the Bulk Area or the pipeline right of way.

For context purposes, Figure 2-7 presents the indicative base-case layout of the proposed new infrastructure within the Bulk Area, while Figure 2-4 denotes the location of the pipeline ROW, the supplementary power BESS and the cabling associated with this.

Where proposed optimisation opportunities have the potential impact on the layout of infrastructure within the Bulk Area or the location of the pipeline right of way these have been described in Section 2.3.3.

The operations of infrastructure/equipment presented in this section will be subject to future referrals (refer Section 1.4.2).



**Figure 2-7: Indicative layout of proposed location of new infrastructure within the Bulk Area**

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## **AGRU upgrades**

As described in Section 1.4.1, an upgrade to the existing Ichthys LNG facility AGRUs are required to accommodate the gradual introduction of higher CO<sub>2</sub> feed gas from the approved Ichthys LNG Development Project (i.e. gas from Plover wells). The AGRU upgrade scope would involve the following:

- brownfield interconnection to allow installation of supplementary equipment that would enable an increase in AGRU solvent regeneration capacity and circulation flowrates (refer to Section 2.3.4)
- installation of two new compact modules within the Bulk Area (one adjacent to LNG Train 1 and one adjacent to LNG Train 2; Figure 2-7), each containing additional equipment required for increasing AGRU solvent circulation flowrates.

Once operational (subject to separate approvals refer to Section 1.4.2), this would increase the AGRU capability to remove reservoir CO<sub>2</sub> from the feed gas received at the Ichthys LNG facility.

The location of the AGRU compact modules is subject to optimisation opportunities; these are further described in Section 2.3.3.

## **AGRU design efficiencies**

### AGRU upgrade design

An upgrade to the existing AGRU was selected as the recommended option from several alternatives examined during concept screening. This option utilises the existing AGRU facilities equipment, minimises the disturbance footprint, and focuses on enhancing the operational capacity of the AGRU without the requirement to construct an entirely new system.

From a design perspective the required capacity of the AGRU equipment upgrades to process the proposed increase in feed gas CO<sub>2</sub> concentrations have been considered in conjunction with the amount of power required to operate the system. The capacity of equipment and the energy requirements have been considered and selected based on maximising energy efficiency and reducing the quantity of unnecessary additional energy requirements.

### Improved water recovery

AGRU units historically are significant users of water as much water is carried with the vented acid gas (as steam vapour). The integration of adding a CCES allows virtually all of this water to be recovered and re-used (up to 95%).

## **CO<sub>2</sub> compression and export system**

Under existing operational conditions at the Ichthys LNG facility, captured reservoir CO<sub>2</sub> is either vented via the acid gas incinerator or via a dedicated hot vent (refer to Section 4). To support INPEX's activities to decarbonise its operations, a CCES is proposed to be installed at the Ichthys LNG facility. Once installed the CCES would allow for the treatment of CO<sub>2</sub> through compression and dehydration, prior to export metering and transportation via a CO<sub>2</sub> pipeline from the Ichthys LNG facility to an offshore storage site for sequestration (subject to separate approvals refer Section 1.4.2).

The CCES would be designed to manage current and forecast quantities of extracted reservoir CO<sub>2</sub> and deliver it, at a suitable pressure and condition, into the onshore CO<sub>2</sub> pipeline.

New CCES infrastructure/equipment proposed to be installed, is as follows:

- a common inlet manifold which transports CO<sub>2</sub> rich feed gas from the AGRU's associated with Ichthys LNG Train 1 and Train 2 to the CCES
- two compressors each driven by electrical motors (including associated cooling modules)
  - associated local vents (two – three) to support operational requirements (sampling or machine protection – See *Vent arrangements*)
- a common dehydration unit
- a common recovered water treatment unit
  - an associated single local vent to support operational requirements (waste gas from the recovered water treatment – refer to *Vent arrangements*)
- a compressor outlet manifolding, export metering station and PIG launcher
- two vent stacks, each with multiple vents per stack to serve specific operating modes
- a combined local electrical/instrument room building local and electrical room (LER)/local instrument room (LIR)) and transformers
- interconnecting pipe racks and other various small structures and equipment to support the above.

When the CCES is not operating, or is operating at reduced capacity, then any AGRU acid gas produced that exceeds the CCES capacity at the time would continue to be vented via the existing vents associated with the AGRUs.

A description of key elements of the CCES infrastructure is provided in the following sub-sections. It should be noted, a number of the elements of the CCES are currently subject to optimisation opportunities; these are further described in Section 2.3.3.

### **CO<sub>2</sub> compressor units**

A CO<sub>2</sub> compressor unit (each sized for 50% of maximum duty) would be installed in the Bulk Area at the east end locations of both the Ichthys LNG Train (1 and 2) locations. CO<sub>2</sub> extracted via the AGRUs would be directed to the associated CO<sub>2</sub> compression unit. Once received at the compressor unit the CO<sub>2</sub> stream would be initially compressed under low pressure. At entry to this stage the AGRU acid gas contains significant water. As it progresses through this initial compression over 95% of this water is recovered and sent to the common recovered water treatment unit. At the end of this stage the compressed CO<sub>2</sub> still contains water vapour (~99.7% CO<sub>2</sub>: ~0.3% water vapour). From here, the CO<sub>2</sub> stream is directed to a common dehydration unit to remove residual water, to achieve the necessary gas entry specification into the CO<sub>2</sub> pipeline. Once the water is removed the dry CO<sub>2</sub> is directed back to the compressor and further compressed (under high-pressure), resulting in a dry dense phase gas which can be exported.

### **Common dehydration unit**

Acid gas received at the common dehydration unit from the AGRU is water saturated (~8% water vapour). As described previously (refer *CO<sub>2</sub> compressor units*), most of the water is removed by physical processes during the low-pressure compression stage: however, some remains. The purpose of the dehydration unit is to remove residual water vapour from the CO<sub>2</sub> stream, to achieve the necessary gas entry specification into the CO<sub>2</sub> pipeline. It is necessary to dehydrate CO<sub>2</sub> streams prior to transporting these via carbon steel pipelines, as any moisture within the streams can result in corrosion and hydrate formation. As such, the dehydration unit plays an important role in maintaining the integrity of the CO<sub>2</sub> pipeline, which is predominantly made from carbon steel.

The dehydration unit consists of three parallel beds (i.e. pressure beds each containing a bed of a solid proprietary absorbent media) configured as two in operation and one in regeneration mode. The feed CO<sub>2</sub> from both compressors is comingled in a common manifold before entering the online beds where the media absorbs the water vapour. The dehydrated CO<sub>2</sub> discharge flow is analysed for moisture specification and filtered to remove dust, etc. prior to being directed to the final compression stage (i.e. high-pressure). After the final compression stage, the dry dense phase (high-pressure) gas from each compressor unit is comingled and directed via a common exported manifold to the export metering station and CO<sub>2</sub> pipeline.

### ***Common recovered water treatment unit***

Extracted water from the compression and dehydration processes is recovered, which is then directed to the common recovered water treatment unit. Water entering the unit is collected in an "untreated water" buffer tank prior to being directed to a stripper column. The stripper column uses nitrogen gas to remove contaminants (e.g. dissolved CO<sub>2</sub>) from the water. Once contaminants are removed, the treated recovered water is then directed to a treated water tank prior to being pumped back to the operational AGRUs for re-use.

The common recovered water treatment unit is subject to optimisation opportunities; these are further described in Section 2.3.3.

### ***CO<sub>2</sub> export metering***

Dry compressed CO<sub>2</sub> from the compression unit is directed to export metering location. Metering includes online analysis of stream composition for critical incidental contaminant elements. This data is used to safeguard the CO<sub>2</sub> pipeline (i.e. alerts the operations team to any unacceptable deviations to export requirements, and allowing for the appropriate corrective action to be taken) In addition, metering is required to measure equipment performance as a means of demonstrating compliance with environmental regulations, and to provide a basis for payment under future transportation and sequestration commercial arrangements. The National Greenhouse and Energy Reporting (Measurement) Determination 2008 is the mandatory reference that defines the metering requirements for greenhouse gas reporting purposes.

The location of the export metering station within the Bulk Area is subject to optimisation opportunities; these are further described in Section 2.3.3.

### ***Vent arrangements***

Under existing operational conditions at the Ichthys LNG facility, captured reservoir CO<sub>2</sub> is either vented via the acid gas incinerator or via a dedicated hot vent (refer to Section 4). With the integration of CCES and the CO<sub>2</sub> pipeline into the existing systems, this CO<sub>2</sub> is now proposed to be sequestered at an offshore storage location. However, under certain circumstances CO<sub>2</sub> would still need to be vented (either continuously or non-continuously) as a result of either operational or safeguard protection reasons (refer to Table 2-1).

While existing vents would be utilised to serve some of the venting needs, additional localised small vents (associated with specific equipment) and two new vent stacks (each with multiple vents) are required to be installed.

Small vents associated with specific equipment include vents associated with operational analysers, the compressors and the water treatment unit.

Vents associated with the two new vent stacks would serve the following specific operational modes:

- pressure safety valve relief as part of the CCES system process safeguarding

- blowdown system equipment and pipework associated with either a CCES unit shutdown or planned maintenance, where the venting quantity is relatively small, due to either being a short-term event limited to constrained source volumes, or the rate is relatively small
- blow-off systems to rapidly depressurise each CO<sub>2</sub> compressor system during a planned shutdown or trip, as a machinery protection measure
- pressure relief systems on water cooled heat exchangers for compressed CO<sub>2</sub> as part of process safeguarding
- purging of CCES on start-up whilst systems like dehydration are re-started from a shutdown condition to achieve specification for CO<sub>2</sub> export.

The proposed new vents would be cold vents (as the acid gas temperature after depressurisation from the CCES is typically low). Vents would be operational during periods of start-up or shutdown when small volumes of CO<sub>2</sub> over a short- period would need to be vented. The vent stacks are designed, by necessity, to accommodate the greatest emission load scenario (e.g. emergency blowdown of CCES). This results in much lower exit velocities for other lower emission load scenarios. Consequently, to achieve effective dispersion and avoid on-site health and safety risks to onsite personnel in these lower emission load scenarios, the vent stacks need to be higher (i.e. driven by the worst performing vent). The preliminary height expected for the new vent stacks is 55 m (smaller than existing stacks at the Ichthys LNG facility; Figure 2-8).

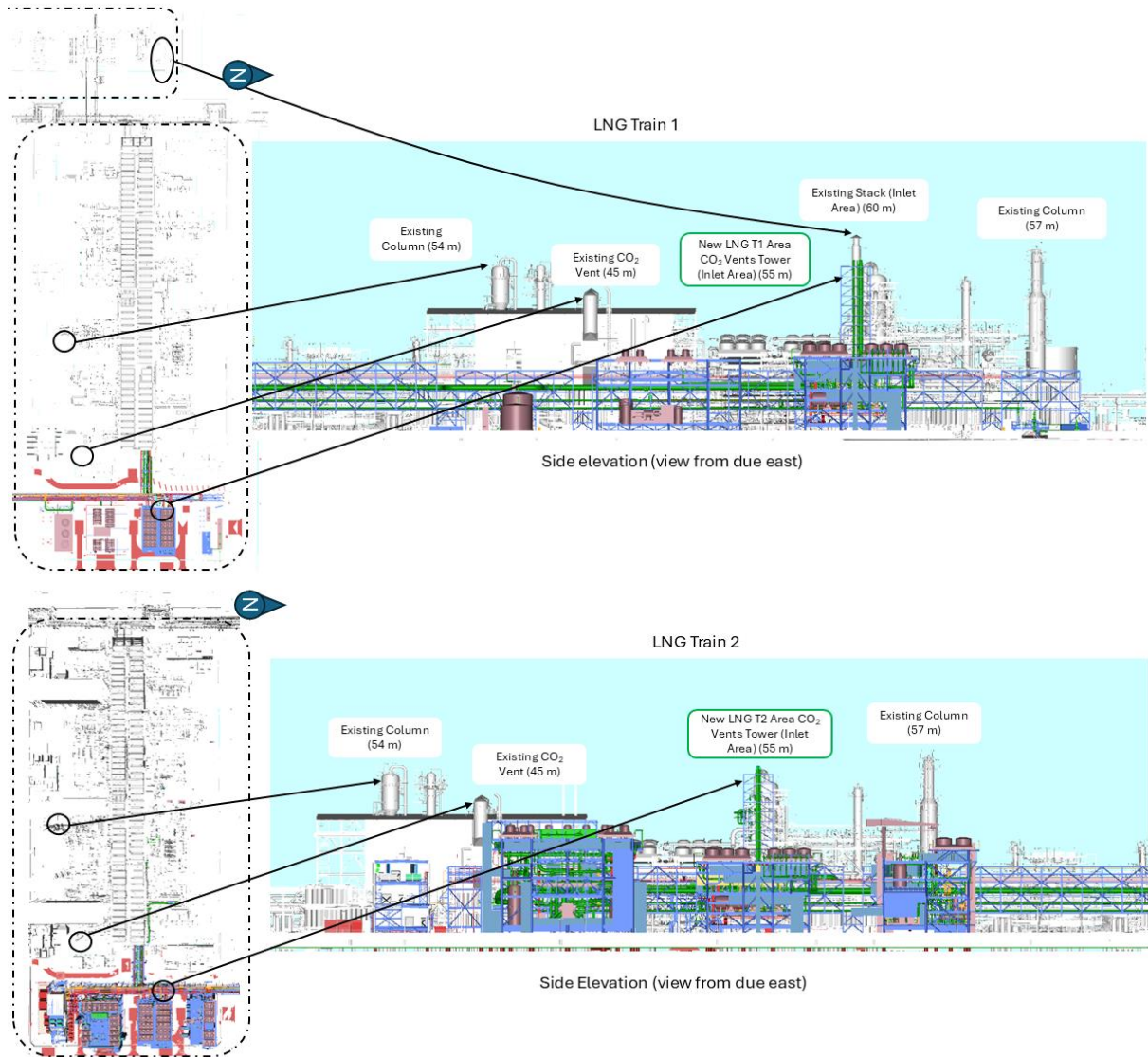
Table 2-1 describes the venting arrangements, purpose and estimated emissions associated with proposed new infrastructure/equipment. Note, information presented in Table 2-1 is provided for context purposes only. The operation of the CCES system and associated infrastructure (including vents) is subject to separate referrals (refer to Section 1.4.2). Once the CCES is connected to a future CCS project, this would result in an estimated reduction of up to 3.3 million tonnes of CO<sub>2</sub> emitted annually at the Ichthys LNG facility.

Vent arrangements are subject to optimisation opportunities; these are further described in Section 2.3.3.

**Table 2-1: Venting arrangements associated with new infrastructure/equipment**

Operational mode	Release location	Requirement	Estimated events	Duration	Estimated total emissions
<b>Continuous</b>					
Operational sampling	Local vent – AGRU analyser	Low continuous flow.	N/A	365 days per year.	4.2 tonnes per year.
Operational sampling	New vent stacks	Low continuous flow.	N/A	365 days per year.	10.5 tonnes per year.
Operational sampling	New vent stacks	Low continuous flow.	N/A	365 days per year.	12.6 tonnes per year.
Operational	Local vent – Compressor seals	Low continuous flow.	N/A	325 days per year.	31,356 tonnes per year.
Operational	Local vent – Water treatment package	Low continuous flow.	N/A	325 days per year.	1,560 tonnes per year.
<b>Non-continuous</b>					
Machine protection	New vent stacks	Blow off valve release	8 per year.	5 minutes per event.	3,312 tonnes per year.
Operational	New vent stacks	Only required during CCES start-up, following a system trip or in preparation for maintenance.	Events range between 4 and 8 per year.	Durations range between 1 minute and 1 hour.	905.4 tonnes per year.
	New vent stacks	Only required when CCES regen compressor is offline.	16 per year.	40 days per year.	126,000 tonnes per year.

Operational mode	Release location	Requirement	Estimated events	Duration	Estimated total emissions
	Existing vents associated with the AGRU.	Only when the CCES system is unavailable. Note, this scenario reflects existing operations.	8 per year.	40 days per year.	504,576 tonnes per year.
Safeguard protection	New vent stack.	Emergency shutdown only.	4 per year.	Durations range between 1 hour and 5 hours.	2,399 tonnes per year.
	New vent stack.	Emergency relief only.	Once every 10 years.	Durations range between 10 minutes and 1 hour.	1,775.6 tonnes per 10 years.



**Figure 2-8: New vent stack height comparison to existing Ichthys LNG Train 1 and 2 infrastructure**

**Combined LER/LIR**

A new LER/LIR building, housing both electrical and instrumentation equipment, associated with the operations of the upgraded AGRU, the CCES and common dehydration unit is required to be installed. The LER/LIR would be prefabricated and pre-commissioned offsite and installed as modules.

The LER/LIR is subject to optimisation opportunities; these are further described in Section 2.3.3.

**CO<sub>2</sub> pipeline**

In preparation for connection to a future CCS Project, a ~2.5 km long section of CO<sub>2</sub> pipeline is proposed to be installed within the perimeter fence of the Ichthys LNG facility.

The CO<sub>2</sub> pipeline would be laid within a trench, approximately 2-3 m deep, during the initial earth and civil works (refer Section 2.4.2). The pipeline would be constructed inside a ROW corridor which commences within the Bulk Area (after the export metering station), continues along the eastern boundary of the Ichthys LNG facility and terminates at the Ichthys LNG facility western boundary (refer to Figure 2-4). The width of the ROW would range between 20 m and 40 m, dependant on the existing services present in adjacent areas.

The CO<sub>2</sub> pipeline would be constructed from carbon steel DN400 (16 inch, subject to optimisation) high-pressure gas pipe capable of transporting compressed CO<sub>2</sub>. The pipeline has been sized to accommodate the Ichthys LNG facility's current and potential future CO<sub>2</sub> flow rates.

The CO<sub>2</sub> pipeline would be fitted with a "PIG launcher" facility (Figure 2-4) to support commissioning, and future inspection and maintenance activities once operational. This facility would also include a localised vent system to allow for safe depressurisation during a pigging campaign<sup>1</sup>.

The location of the export metering station within the Bulk Area is subject to optimisation opportunities. If pursued this would result in the PIG launcher facility and the commencement location of the pipeline ROW within the Bulk Area being relocated, this is further described in Section 2.3.3.

Once the CO<sub>2</sub> pipeline has been installed, it would be capped and preserved, until such time it can be connected to future offsite CCS project infrastructure (refer to Section 1.4.2).

### **CO<sub>2</sub> pipeline detailed design requirements**

INPEX has confirmed with the Northern Territory Department of Mining and Energy, that the construction of the CO<sub>2</sub> pipeline within Ichthys LNG facility boundary is not subject to any approvals under the *Energy Pipelines Act 1981* (refer to Section 6); however, INPEX has considered the minimum requirements of the relevant prescribed standards when designing the proposed CO<sub>2</sub> pipeline.

For existing onshore high-pressure gas pipelines in the NT, AS/NZS 2885.1: Pipelines - Gas and liquid petroleum (AS/NZS 2885.1) has been used as the prescribed standard for the construction of pipelines. More recently, this standard has been updated to include specific requirements for CO<sub>2</sub> pipelines. The design of the proposed CO<sub>2</sub> pipeline has been refined to include specifications and guidance under the AS/NZS 2885.1 (i.e. pipeline diameter and wall thickness, damage prevention controls such as signage, marker tape, etc.).

In addition to AS/NZS 2885.1, other factors and standards were considered during design, including:

- interactions between changes in groundwater levels and the pipeline
- general risk assessment along the full length of the pipeline would be undertaken to consider location scenarios (i.e. road crossings, remote areas, areas approaching other infrastructure, etc.).

In consideration of the above the following were incorporated into the design:

- The pipeline would be buried at a depth and weighted as required to ensure sufficient buoyancy control under all operating and installed conditions.
- To account for all the location scenarios above the design applies relevant issued specific criteria, for example:

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<sup>1</sup> "Pigging" is an activity undertaken to perform various maintenance and inspection operations.

- buried at a depth that meets the minimum backfill cover requirements specified in AS 2885: the standard for high pressure pipeline systems (AS 2885)
- meet the minimum wall thickness of a pipeline under a road (as determined by the road vehicle load limit) as specified in AS 2885 and API RP 1102: Steel Pipelines Crossing Railroads and Highways.

## Other infrastructure

### Drainage

The Bulk Area, where new infrastructure is proposed to be installed, currently drains to the non-contaminated water (NCW) drainage catchment area under existing operational conditions.

With the proposed installation of new infrastructure in the Bulk Area, new water runoff systems would be designed (including bunding and catchment) to accommodate specific contamination risks presented by new infrastructure (e.g. potential contaminated rainwater runoff). These would be connected into the existing Ichthys LNG facility systems for treatment (i.e. either to the existing stormwater drain (NCW) drain where contamination risk is negligible), accidentally oil contaminated drain (AOC), chemical sewers or the continuously oil contaminated drain (COC); refer Section 4).

Any new drainage systems would be required to be operational upon installation as the catchment requirement is weather dependent. The operation of such drains would not significantly impact on the existing flows to the existing wastewater treatment plant or NCW. There is a worst-case<sup>2</sup> net loss to the existing stormwater flows to the NCW of 26,866 m<sup>3</sup>, as a result of most new equipment being bunded and flows directed to either the existing AOC or chemical sewer system.

The rate AOC flows are fed to the existing wastewater treatment plant would remain unchanged (i.e. 243 m<sup>3</sup>/hr); however, the additional volumes could result in temporary capacity exceedance during very high rainfall events. To ensure the existing wastewater treatment system is not impacted a new AOC holding tank (450 m<sup>3</sup> capacity) is proposed to be installed to allow for temporary diversion of AOC wastewater from the new infrastructure/equipment catchment areas, allowing for the first flush flows from existing AOC systems to occur prior to introduction of these new streams. This temporary diversion would allow for the regulation of the flow and volumes to the existing wastewater treatment system, ensuring the wastewater treatment plant, jetty outfall flows, and water quality remain within current environmental protection licence (EPL228 as amended) limits/requirements.

All rainwater run-off from the new supplementary power area would be directed to the stormwater (NCW) system, as there is no risk presented from electrical equipment proposed to be installed in this area.

Table 2-2 summarises the anticipated changes to drainage system catchment areas and the wastewater volumes (both increase/net loss), following the installation of new infrastructure.

Drainage associated with new infrastructure/equipment is subject to optimisation opportunities, these are further described in Section 2.3.3.

<sup>2</sup> Based on peak annual rainfall 2,776.6 mm/year

**Table 2-2: Changes to existing drainage system catchment areas and wastewater runoff volumes as a result of base case design**

Existing Ichthys LNG facility drain system	Changes to existing drainage system catchment area (m <sup>2</sup> )	Annual forecast volumes (m <sup>3</sup> )		Comments
		Average annual rainfall*	Peak annual rainfall <sup>†</sup>	
NCW drain	Reduction in catchment area of 9,678 m <sup>2</sup> .	Reduction in runoff volume of 16,683 m <sup>3</sup> .	Reduction in runoff volume of 26,866 m <sup>3</sup> .	<ul style="list-style-type: none"> <li>Overall reduction in catchment area due to new equipment being bunded and water directed to either AOC or chemical sewer.</li> <li>Runoff entering drainage system limited to paved areas between modules and from roofs of new buildings (e.g. LER/LIR).</li> </ul>
AOC drain	Increase in catchment area of 1,425 m <sup>2</sup> .	Increase in runoff volume of 2,456 m <sup>3</sup> .	Increase in runoff volume of 3,956 m <sup>3</sup> .	<ul style="list-style-type: none"> <li>Jetty outfall rates remain unchanged (i.e. 243m<sup>3</sup>/hr), due to installation and use of a new AOC holding tank. This would act as a temporary storage area, prior to introduction into the existing system to avoid overload of the system at first flush.</li> </ul>
Chemical sewers	Increase in catchment area of 8,253 m <sup>2</sup> .	Increase in runoff volume of 14,227 m <sup>3</sup> .	Increase in runoff volume of 22,910 m <sup>3</sup> .	<ul style="list-style-type: none"> <li>All wastewater is tested prior to determining disposal methods. Where testing indicates wastewater is not contaminated it is sent to the wastewater treatment plant via the AOC.</li> </ul>
COC drain	Increase in catchment area of 75 m <sup>2</sup> .	Increase in runoff volume of 129 m <sup>3</sup> .	Increase in runoff volume of 208 m <sup>3</sup> .	<ul style="list-style-type: none"> <li>No impact on existing drainage systems, as total quantities are small relative to the system.</li> </ul>

\* Average annual rainfall 1,723.8 mm/year

† Peak annual rainfall 2,776.6 mm/year

### **Supplementary power infrastructure**

Supplementary power will be required to support future operations of the upgraded AGRUs and CCES. The supplementary power scope would involve the following:

- installation of a small BESS, to provide virtual spinning reserve
- installation of supporting infrastructure (i.e. transformers, switchgear, LER/LIR, etc.)
- modifications to the existing combined cycle power plant control system and operational procedures.

To support the future connection to an offsite power import facility, two high voltage cable circuits would be installed within the supplementary power cable ROW, offset from the CO<sub>2</sub> pipeline (refer to Figure 2-4). The cabling would commence at the Ichthys LNG facility main substation and fundamentally follow the proposed CO<sub>2</sub> pipeline alignment, before terminating at the Ichthys LNG facility western boundary, ready for future connection to an import facility supporting the Ichthys LNG facility's transition to green power.

The location of the proposed supplementary power infrastructure within the Ichthys LNG facility is shown on Figure 2-3 and Figure 2-4.

### **2.3.3 Optimisation opportunities**

As noted in Section 2.3.2, a number of optimisation opportunities are being considered during the detailed design phase of the Project to support either or both improved operability and maintainability, and overall Project cost effectiveness. These opportunities are described more in the following sub-sections.

#### **Infrastructure layout modifications within the Bulk Area**

As identified in Section 2.3.2, the indicative layout of the Project "base-case" proposed infrastructure shown in Figure 2-4 and Figure 2-7 is subject to further refinement during the detailed design phase.

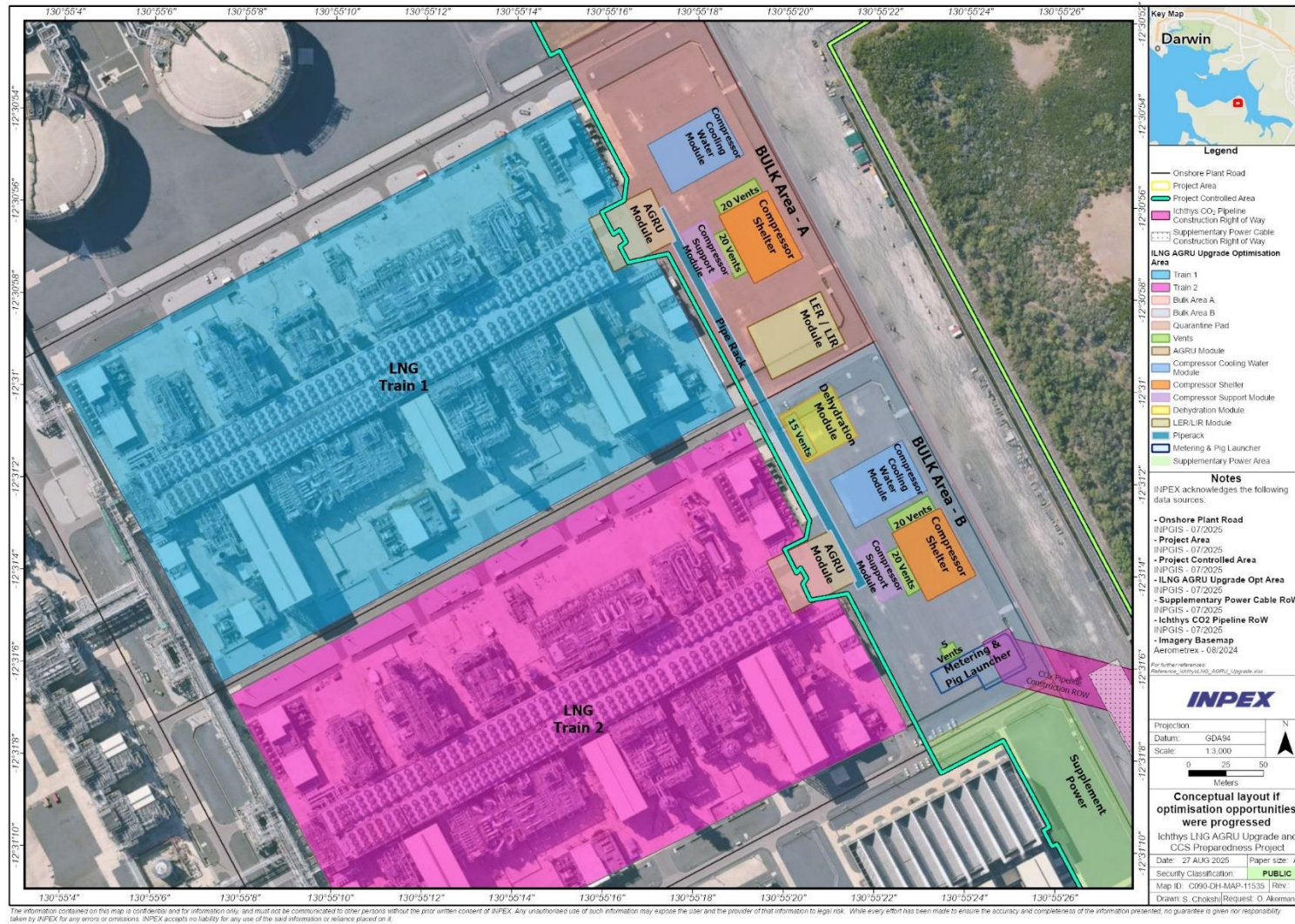
Layout changes associated with optimisation opportunities may result due to:

- splitting or de-stacking of modules into smaller localised modules associated with specific LNG train equipment/infrastructure or to allow the separated elements to be laid in different locations of the Bulk Area.
- relocation of infrastructure/equipment described in Section 2.3.2 within the Bulk Area.

Proposed optimisation opportunities would not result in new areas being required beyond the defined Bulk Area or CO<sub>2</sub> pipeline ROW described in Section 2.2.1.

Further detail on some of the potential layout optimisation opportunities are described in the following sub-sections. A conceptual layout of how the Bulk Area may be utilised, assuming all optimisation opportunities were progressed, is shown in Figure 2-9.

It is important to note, that not all layout optimisation opportunities may be incorporated into the final design, and the layout of infrastructure/equipment within the Bulk Area may vary subject to this. Decisions on whether to pursue an optimisation opportunity would be determined during the detailed design phase.



**Figure 2-9: Conceptual layout if all optimisation opportunities were progressed**

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**AGRU compact modules**

The AGRU compact modules proposed in Section 2.3.2 and shown in Figure 2-7, may be relocated to the end of each existing LNG train pipe racks to create space within the Bulk Area.

The key benefits of the proposed optimisation opportunity are:

- It would allow for splitting /de-stacking of other modules for relocation to other areas within the Bulk Area and/or allow for further optimisation of other infrastructure/equipment located within the Bulk Area location.
- It would reduce the volume of hydrotest water required ( $\sim 700 \text{ m}^3$ ) to test pipework, and its ultimate disposal.

**Common recovered water treatment unit**

The common water treatment unit (comprising two tanks and a stripper column) described in Section 2.3.2 and shown in Figure 2-7, may be simplified. The base-case design currently includes tanks as buffer storage for both untreated and treated recovered water to improve reliability of the water recovery and processing. However, initial evaluation of the benefits associated with this design are considered insignificant. Given this, the reconfiguring of the recovered water treatment system is considered possible, which would result in removal of buffer tanks. This would not result in any impact to the overall functional performance of the recovered water treatment system; and there would be minimal impacts to overall system availability.

The key benefits of the proposed optimisation opportunity are:

- It would reduce the volume of hydrotest water ( $\sim 1,200 \text{ m}^3$ ) required to test tank systems during pre-commissioning.
- It would reduce the number of modules (two) required to be transported.
- It would reduce wastewater volumes directed to the chemical sewer catchment area/drain system (necessary for tank spill risk management) and disposal of this.
- It would create of additional available space within the Bulk Area.

**Common dehydration unit**

The common dehydration unit described in Section 2.3.2 and shown in Figure 2-7, may be functionally split. The functionality split may be applied either of the following ways:

- across two separate units (i.e. two x 50% units), with each unit dedicated to one of the compressor units (location within the Bulk Area remains unchanged); or
- the common dehydration unit module may be split into two separate (smaller) modules and each of these could be relocated closer to their associated LNG train  $\text{CO}_2$  compressor units.

Key benefits of the proposed optimisation opportunity are:

- It would allow for improved CCES availability as single point constraint is removed.
- It allows for consideration of other dehydration technology options (e.g. tri-ethylene glycol-based technologies) that may be more cost effective.

**Combined LER/LIR**

The common LER/LIR described in Section 2.3.2 and shown in Figure 2-7, may be split by either:

- separating the LER from the LIR; or

- extracting and relocating electrical power distribution and/or instrument and control system hardware to smaller “sub-buildings” (with some aspects potentially incorporated within infrastructure equipment modules).

Key benefits of the proposed optimisation opportunity are:

- It would reduce the overall footprint of the CCES LER/LIR enabling relocation to a more optimal location within the Bulk Area.
- It would potentially reduce the number of transformers, and consequently the AOC catchment area required.
- It would allow for additional layout flexibility/optimisation within the Bulk Area.

### ***Relocation of export metering station and PIG launcher***

The export metering station and PIG launcher described in Section 2.3.2 and shown in Figure 2-7 may be relocated within the Bulk Area. This would need to occur in conjunction with (and is dependent on) other infrastructure/equipment relocation opportunities described in previous sections, as these facilitate the relocation of the export metering station and PIG launcher.

If relocated, the export metering station and PIG launcher would move to the southern end of the Bulk Area and the CO<sub>2</sub> pipeline would also relocate to commence at this location.

Key benefits of the proposed optimisation opportunity are:

- It would shorten the length of the CO<sub>2</sub> pipeline by ~ 450 m. this results in:
  - A reduction in the amount of trenching required.
  - A reduction in the amount of hydrotest water demand (~ 60 m<sup>3</sup>; outside the scope of this referral).
- It would avoid the need to disturb the haul road adjacent to the Bulk Area.

### **Vent rationalisation**

The venting arrangements described in Section 2.3.2 and shown in Figure 2-7 may be broken up into a larger number of smaller equipment-specific vents. This would allow for better handling of various cold venting scenarios associated with CCES operations.

The change in venting arrangements would not alter the ultimate volume of CO<sub>2</sub> emissions (and trace contaminants) required to be vented under various scenarios, as the same source volumes are accounted for. However, this would increase the number of emission source points associated with the CCES within the Bulk Area. It is important to note, that in most cases these vents are not normally flowing, as their purpose relates to a safeguard function (e.g. emergency relief only) or they have a specific operational requirement (e.g. machine protection, operational sampling, etc.).

Most of these vents operate for short periods only on demand (< 1 hour); and even when accounting for all demand events these would only operate for up to a few hours (< 10 hours) total per year. Some of these vents are continuous when equipment is operating, but these are all low or very low flow rate emissions associated with operationally necessary functions (e.g. compressor seal and analyser sampling venting).

All new vents would be reduced in sized and lower in height (ranging between 27 and 38 m), than the two vent stacks (consisting of multiple vents) proposed in the base-case (Section 2.3.2). The reduction in the size and height of the optimised vents results in these being less visually distinguishable, to the point of being indistinguishable when the Ichthys LNG facility is viewed from the Darwin Harbour.

Table 2-3 describes the venting arrangements, their purpose and estimated emissions associated with proposed new infrastructure/equipment. Note, information presented in Table 2-3 is provided for context purposes only. The operation of the CCES system and associated infrastructure (including vents) is subject to separate referrals (refer to Section 1.4.2).

Key benefits of this optimisation opportunity include:

- Emissions dispersion is either equal to or better than the base-case design (Section 2.3.2).
  - The two consolidated vent stacks (i.e. base-case design) are designed, by necessity, to accommodate the greatest emission load scenario (e.g. emergency blowdown of CCES). This results in much lower exit velocities for other lower emission load scenarios. Consequently, to achieve effective dispersion and avoid on-site health and safety risks to onsite personnel in these lower emission load scenarios, the vent stacks need to be higher (i.e. driven by the worst performing vent).

By localising vents near their source (and making them dedicated to specific equipment and each designed for its' specific scenarios) the dispersion performance of each is significantly improved, which in turn would reduce both the size and height of such vents.
- It removes the potential for dry ice (i.e. solid CO<sub>2</sub>) blockages within the vent system.
  - The base-case design for vents presents a potential risk (albeit low) of dry ice blockages forming within piping used to direct CO<sub>2</sub> to the vent stacks in emergency blowdown scenarios. This is associated with CO<sub>2</sub> phase behaviour under rapid depressurisation. If dry ice blockages did occur this could compromise the overall protective or safeguard function of the system. By localising vents stacks (dedicated to specific equipment and designed for specific scenarios), this potential risk is completely negated.
- It reduces the volume of hydrotest water (~ 300 m<sup>3</sup>) required during pre-commissioning and the overall number of modules (two) required to be transported.

**Table 2-3: Optimisation opportunity venting arrangements**

Vent type/operational mode	Requirement	Number of vents	Estimated events	Duration	Estimated total emissions (Tonnes)
<b>Continuous</b>					
Operational sampling vents	Low continuous flow	11	N/A	365 days per year	27.3 tonnes per year
Operational vents	Low continuous flow	6	N/A	325 days per year	32,916 tonnes per year
<b>Non-continuous</b>					
Machine protection vents	Blow off valve release	14	8 per year	5 minutes per event	3,312 tonnes per year
Operational vents	Only required during CCES start-up, following a system trip or in preparation for maintenance	20	Events range between 4 and 8 per year	Durations range between 1 minute and 1 hour	905.4 tonnes per year
	Only when the CCES system is unavailable. Note, this scenario reflects existing operations.	No new vent. Existing vents associated with the AGRU used.	8 per year.	40 days per year.	504,576 tonnes per year.
Safeguard protection vents	Emergency shutdown only	2	Four per year	Durations range between 1 hour and 5 hours	2,399 tonnes per year

Vent type/operational mode	Requirement	Number of vents	Estimated events	Duration	Estimated total emissions (Tonnes)
	Emergency relief only	32 (This total includes 9 spare vents*)	Once every 10 years	Durations range between 10 minutes and 1 hour	1,740.6 tonnes per 10 years

\* Spare vents are only utilised where one of the other associated vents are out of service; in all other scenarios these vents are not producing emissions.

## Drainage rationalisation

Section 2.3.2 (*Drainage*) describes the anticipated changes to drainage catchment areas and wastewater volumes in context of the base-case design. The base-case design currently results in rainfall run-off in the Bulk Area location largely being directed to either the AOC or chemical sewer drainage systems. This design is considered overly conservative as it incorporates large catchment areas which do not present a loss of containment risk.

If proposed infrastructure layout modifications (refer to *Infrastructure layout modifications within the Bulk Area*) are pursued, there is the potential to rationalise the base-case drainage design. This would involve localisation of bunding and containment to only those areas where infrastructure/equipment presented a loss of containment risk. This would result in a reduction to the AOC and chemical sewer catchment areas and subsequently the volume of wastewater directed to these systems.

Any change to the drainage design as a result of optimisation opportunities, would not impact on the catchment protective function (i.e. preventing loss of containment of potentially contaminated water).

Key benefits of reducing the size of AOC and chemical sewer catchment areas include:

- It would negate the need to for the AOC holding tank (refer Section 2.3.2.)
  - Reduced wastewater volumes directed to the AOC negates the need for the AOC holding tank as wastewater volumes would remain within the existing wastewater treatment system capacity.
  - If retained AOC holding tank would be required to be bunded (as it presents a loss of containment risk), its removal would further reduce the catchment AOC catchment area and potential wastewater volumes.
- It would reduce the overall size of the AOC and chemical sewer catchment areas and subsequently would result in the existing NCW catchment area being less impacted from the installation of proposed infrastructure/equipment.
  - Larger volumes of non-contaminated water would be directed to the NCW catchment area, allowing for on-plant rainwater infiltration into the soil (groundwater recharge) or discharge via the existing perimeter drain to land/natural drainage features directly adjacent to the Ichthys LNG facility.

Table 2-4 summarises the anticipated changes to drainage system catchment areas and the wastewater volumes (both increase/net loss) directed to the existing drainage systems at the Ichthys LNG facility. Note, information presented in Table 2-4 assumes all optimisation opportunities described in *Infrastructure layout modifications within the Bulk Area* were pursued.

**Table 2-4: Changes to existing drainage system catchment areas and wastewater runoff volumes as a result of implementation of optimisation opportunities**

Existing Ichthys LNG facility drain system	Changes to existing drainage system catchment area (m <sup>2</sup> )	Annual forecast volumes (m <sup>3</sup> )		Comments
		Average annual rainfall*	Peak annual rainfall†	
NCW drain	Reduction in catchment area of 5,070 m <sup>2</sup> .	Reduction in runoff volume of 8,740 m <sup>3</sup> .	Reduction in runoff volume of 14,074 m <sup>3</sup> .	<ul style="list-style-type: none"> <li>Overall reduction in catchment area due to new equipment being bunded and water directed to either AOC or chemical sewer.</li> <li>Runoff entering drainage system limited to paved areas between modules and from roofs of new buildings (e.g. LER/LIR).</li> </ul>
AOC drain	Increase in catchment area of 1,135 m <sup>2</sup> .	Increase in runoff volume of 1,957 m <sup>3</sup> .	Increase in runoff volume of 3,151 m <sup>3</sup> .	<ul style="list-style-type: none"> <li>Jetty outfall rates remain unchanged (i.e. 243m<sup>3</sup>/hr). System load is within the existing Ichthys LNG facility wastewater treatment plant capacity.</li> </ul>
Chemical sewers	Increase in catchment area of 3,935 m <sup>2</sup> .	Increase in runoff volume of 6,783 m <sup>3</sup> .	Increase in runoff volume of 10,924 m <sup>3</sup> .	<ul style="list-style-type: none"> <li>All wastewater is tested prior to determining disposal methods. Where testing indicates wastewater is not contaminated it is sent to the wastewater treatment plant via the AOC.</li> </ul>
COC drain	Increase in catchment area of 75 m <sup>2</sup> .	Increase in runoff volume of 129 m <sup>3</sup> .	Increase in runoff volume of 208 m <sup>3</sup> .	<ul style="list-style-type: none"> <li>No impact on existing drainage systems, as total quantities are small relative to the system.</li> </ul>

\* Average annual rainfall 1,723.8 mm/year

† Peak annual rainfall 2,776.6 mm/year

### 2.3.4 Brownfields modifications

Brownfield modifications are required within each of the existing Ichthys LNG trains (1 and 2), located within the "operations-controlled area" (refer Section 2.4.1.). Works associated with brownfields modifications are not dissimilar to those undertaken during routine shutdown activities. Brownfield modifications include:

- replacement of internals of various vessels within the AGRU units
- upgrades to existing pumps and the addition of new pumps
- installation of new piping and modification of existing piping systems
- installation of new electrical distribution equipment and cabling
- replacement of heat exchangers.

Brownfield modifications/tie ins would be scheduled around planned maintenance shutdowns at the Ichthys LNG facility, where existing systems are impacted. Any brownfield modifications would be managed in accordance with requirements of the Onshore Operations Environmental Management Plan and the processes and procedures outlined in the developed Site Management Plan (refer Section 2.4.1.).

Brownfield modifications would not result in changes to existing operating conditions at the Ichthys LNG facility during the Project, but are required to enable operation of upgraded capacity when the supplemental equipment in the Bulk Area and supplementary power infrastructure/equipment is hot commissioned and started up (subject to separate approvals; refer Section 1.4.2).

### 2.3.5 Temporary facilities and laydown areas

From the commencement of site preparation and throughout the construction phase, areas within the Ichthys LNG facility would be needed for laydown or to cater for other temporary facilities. These may include, but are not limited to, storage areas for equipment and materials (piping materials, cables, steel, etc.), temporary offices and cribs, temporary workshops, ablution facilities and parking areas (i.e. vehicle and mobile plant).

Further, existing offsite laydown areas, currently utilised by the Ichthys LNG facility, may also be utilised for storage of construction materials in accordance with Crown Land Licence arrangements.

Other temporary facilities include a water storage facility required to support construction and pre- and cold commissioning activities (e.g. hydrotesting and flushing activities refer Sections 2.4.4 and 2.4.6). INPEX is currently considering two 1000 m<sup>3</sup> tanks to support these activities.

The indicative temporary facilities/laydown area within the Ichthys LNG facility is shown on Figure 2-3.

### 2.3.6 Utilities

#### Power demand and supply

Power will be required for temporary offices, laydown facilities and temporary equipment spreads. A combination of grid power (via existing Ichthys LNG facility arrangements) and temporary power (e.g. diesel-powered generators) would be required throughout the execution of the Project. Temporary power usage is dependent on the location of Project activities/equipment within the Project controlled area and their proximity to existing electrical services with available capacity for distribution.

## **Water demand and supply**

Water is required to support construction and commissioning activities described in Section 2.4. It is anticipated that both scheme water (i.e. PWC water) and demineralised water would be required dependent on the activity requirements.

Where scheme water is appropriate for use (e.g. temporary facilities, construction water, hydrotesting), this would be sourced via the existing Ichthys LNG facility system. Demineralised water that is required for commissioning activities would be generated on site via the existing demineralisation plant system (using scheme water).

It is estimated that ~63,000 m<sup>3</sup> of scheme water would be required for construction, pre-commissioning, and cold commissioning activities.

## **Sewage and greywater management**

The sewage management requirements for the Project temporary workforce would fluctuate over time, requirements for these may be met by the existing Ichthys LNG facility permanent sewage treatment plant (sized to cater for operational shutdown workforce requirements) at the Ichthys LNG facility or self-contained ablution blocks. Where this cannot be achieved, the surplus sewage would be temporarily stored onsite, for transport and disposal offsite via suitability licenced contractor.

### **2.3.7 Temporary workforce**

The workforce required to support the construction, installation and commissioning activities would fluctuate over time. Peak workforce requirements are anticipated to occur gradually increase from early civil works and peak during module installation activities, when an estimated workforce of approximately 600-800 persons may be required.

The workforce would consist of a mix of appropriately skilled local employees and fly-in and fly-out (FIFO) workforce which would be resourced based on skill set availability and applicability through key execution stages of the Project.

It is currently proposed that the existing Bladin Village accommodation facility (located four kilometres from the Ichthys LNG facility) would be utilised to accommodate the temporary FIFO workforce. Further, Bladin Village would incorporate a park and ride facility which would be used, in conjunction with other localised park and ride facilities, by local workforce. A shuttle service would be established for the transport of workers from Bladin Village to, and within, the Project site.

## **2.4 Activities required to support AGRU upgrades and new CO<sub>2</sub> compression and export system**

The following sections described the activities required to be undertaken to support the AGRU upgrades, installation of the new CO<sub>2</sub> compression and export system and supplementary power.

### **2.4.1 Project interface with Ichthys LNG operations**

The Project is wholly located within the existing fence line of the Ichthys LNG facility and would be executed during both normal operations and routine facility shutdowns. In order to safely manage concurrent/simultaneous Project activities and Ichthys LNG operations during execution of the Project scopes, a Site Management Plan would be developed.

The Site Management Plan would outline the INPEX Health, Safety and Environment Management System requirements including a matrix of permissible activities/operations, the SIMOPS (simultaneous operations) process to be used, and the controls to be applied by the Project contractors/sub-contractors, vendors, etc. during execution of the Project.

During execution of the Project the Ichthys LNG site would be separated into INPEX Operations-controlled areas and a Project controlled area (i.e. where major construction activities and supporting temporary Project infrastructure would be located). The Project controlled area is shown in Figure 2-10, all areas outside of this are considered to be Operations-controlled areas.



**Figure 2-10: Project controlled area**

## 2.4.2 Construction

The following site preparation and civil works are required to be undertaken:

- earthworks to prepare the installation of foundations.
- trenching for preparation of installation of the CO<sub>2</sub> pipeline and underground services/cabling.
- installation of new foundations, including the installation of bored type piles (e.g. CFA or cased type) to support foundations.
- preparation of new drainage system and tie-back to the existing drainage system
- temporary infill of the internal stormwater/NCW drainage infrastructure surrounding the Bulk Area<sup>3</sup>
- preparation of crossing for underground service
- dewatering activities (as required).

The water requirements to support various construction activities (e.g. dust suppressant, civil works and concrete works) are estimated to be ~20,500 m<sup>3</sup>.

These are further described in the following sub-sections.

### **Excavation, trenching and compaction (earthworks)**

#### ***Bulk Area and CO<sub>2</sub> pipeline ROW***

Site preparation and civil works would occur within the Bulk Area and the CO<sub>2</sub> pipeline ROW located within the existing perimeter fence line of the Ichthys LNG facility. This would be undertaken using a variety of different earthmoving equipment (dependent on the task being performed). These include, but are not limited to, excavators, trenchers, graders and water trucks.

It is estimated that approximately 21,000 m<sup>3</sup> of spoil would be excavated during earthwork activities. A large volume of the excavated material would be targeted for re-use as backfill, with an estimated volume of 10,000 m<sup>3</sup> forecast as spoil requiring disposal. Spoil may be temporarily stored onsite, prior to being disposed offsite by a suitable licenced contractor.

The Bulk Area and CO<sub>2</sub> pipeline ROW were established during initial Ichthys LNG facility construction. The current finished ground surface consists of "cut and fill". The cut areas are largely covered by a layer of compacted general fill up to 2.5 m deep, which is underlain (in places) by aggregate rocks and low permeable geofabric material. Some filled areas located along the edges of the Project Area underwent significant ground improvement works.

It is not anticipated excavations within the Bulk Area are likely to encounter acid sulphate soils (ASS) or Potential ASS (PASS); however, there is a low likelihood that ASS/PASS may be encountered in some areas within the CO<sub>2</sub> pipeline ROW (refer to Section 5.1.4).

In the event that ASS/PASS is encountered any affected spoil would be removed and replaced with engineered fill. The affected ASS/PASS spoil would then be treated/neutralised at a suitable treatment pad located within the Project Area prior to being disposed offsite by a suitably licenced contractor. A conservative estimate of the volumes of ASS/PASS spoil that may need to be treated/neutralised is ~500 m<sup>3</sup>.

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<sup>3</sup> The infill of the internal stormwater drainage infrastructure surrounding the Bulk Area, is required to support the transport of modules from the MOF to their position in the Bulk Area, which requires heavy lift equipment to cross the existing stormwater drainage structure.

### **Supplementary Power Area and cabling**

Site preparation and civil works would be required at the supplementary power, associated cable locations (Figure 2-4). The works would include earthwork for excavation and modification of cable routes and trenches. This would be undertaken using a variety of different earthmoving equipment (dependent on the task being performed). These include, but are not limited to, excavators and trenchers.

The supplementary power location requires extensive trenching to accommodate underground power and controls cables. In addition to this, trenching, conduits and concrete pits for cable pulling and jointing would be required for the cables for future green power import within the supplementary power cable ROW (Figure 2-4). Trenching methods for these are currently being assessed and multiple methods might be used dependent on the location of the cable in proximity to other assets. Methods being considered include open-cut shoring, benching and battering trenching methods as well as more conservative methods such as high-pressure water excavation and hand digging.

Excavations works would be required for the installation of the supplementary power earth grid. The depth of the earth grid would be ~ 500 mm deep with earth rods driven or drilled at various locations within this area.

### **Foundation installation**

#### **Bulk Area**

Up to 350 (bored) piles (15 m deep with a 900-1200 mm diameter), would be installed during the construction of foundations required for modules. Several piling methods were considered, with the most suitable method being "continuously flight augered (CFA)" piles and secondary means of "bored in-situ non-displacement piling" (Refer to Section 2.4.9 for considered alternative piling methods).

CFA piling and bored piling techniques are very similar. CFA piles utilise of cast-in-place concrete pile formed by drilling with a hollow-stemmed auger, then pumping concrete through the stem as the auger is withdrawn and finally inserting a steel reinforcement cage.

Alternatively, the bored piling technique is completed with a separate drill piece allowing a steel reinforced cage to be installed and final concreting to be completed separately.

Piling would result in approximately 4,000 m<sup>3</sup> of spoil being generated. Spoil would be temporarily stored, prior to being disposed offsite by a suitably licenced contractor. Spoil may be re-used for fill purposes, subject to the outcomes of a suitability assessment.

#### **Supplementary Power Area**

Concrete foundations for the BESS facility may be either installed via in-situ pouring of concrete or these may be pre-cast and then installed.

### **Other construction activities**

#### **Temporary infill of Ichthys LNG facility stormwater drain**

The temporary modification of the internal stormwater drainage (also referred to as the non-contaminated water drain; Section 4) infrastructure surrounding the Bulk Area is required to enable the transport of modules from the MOF face to their position in the Bulk Area. Heavy movement or lift equipment (e.g. self-propelled modular transport (SPMT) spreads, large heavy lift cranes, etc.) transporting modules would be required to cross the existing stormwater (NCW) drainage structure.

The temporary modification of the drain would involve the placement of temporary infrastructure within the drain system. The indicative locations where this may be required is shown in Figure 2-11. Any temporary installation of infrastructure would be designed such that it does not adversely affect the functionality of the drainage system. Prior to demobilisation (refer to Section 2.4.8) the stormwater drainage system would be reinstated as per current design/operations.

### ***Underground service crossings***

Where SPMT movements and large heavy machinery will cross underground services, preparations would be made to ensure these are not impacted.

### **Dewatering activities**

Dewatering is the process of removing water from a construction site and disposing of it at another location, ensuring construction work can occur safely. During the Project dewatering activities may be required to remove water within open excavations/trenches due to groundwater seepage or storm events.

Dewatering may involve relatively simple removal of small amounts of water at bottom of an excavation by diesel driven sludge pumps or flex drive pumps or may involve large volumes of water where the excavation/penetration is situated below the level of water table or during significant deluge events resulting in increased run-off. However, for large volumes of water, a de-watering system consisting of large diesel driven pumps may be required.

Several options are being considered for the management of construction wastewater (including wastewater generated from dewatering activities) during Project execution. These include, but are not limited, the following:

- transfer to the existing Ichthys LNG facility evaporation basin (where seasonal conditions permit)
- transfer to a temporary holding pond (i.e. constructed of earth berm walls and a liner, which can be progressively moved)
- discharge via a temporary outfall at the MOF (subject to separate approvals and discharge criteria)
- temporary onsite storage for offsite disposal by a suitably licenced contractor.



**Figure 2-11: Indicative locations where temporary infill of the Ichthys LNG facility stormwater (NCW) drain may be required**

### 2.4.3 Installation of upgraded and new equipment/infrastructure

#### Transport, installation and connection of modules and other equipment to the Bulk Area

##### **Module transport**

Prefabricated modules would be delivered to the site via specialised vessels/barges and offloaded at the MOF. Up to ten modules and a series of pipe rack modules (~12) are expected to be delivered at various stages between 2028 and 2029. Further, subsequent standard cargo materials are likely to be delivered to East Arm Port and transported to site via road or may be brought in over the MOF.

INPEX has engaged with the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF), to confirm the approvals required to receive international imports directly over the MOF face (Refer to Section 6).

Once modules or equipment is offloaded at the MOF, they are inspected and either moved using heavy lift equipment (e.g. SPMT) to the final location or temporarily kept in the MOF area. Note, smaller modules maybe placed in their final location using heavy lift cranes. In some cases, modules may need to be transported to the designated DAFF Pad (biosecurity pad) and subjected to a biosecurity control before being mobilised to their final location.

The existing haul roads installed during the construction phase of the Ichthys LNG facility are designed to enable the transportation of heavy module structures from the MOF to the hardstand within the Ichthys LNG facility (e.g. they are wide bitumen sprayed seal roads). As described in *Other construction activities*, a small section of the existing stormwater drainage system would need to be temporarily infilled to allow for the movement of heavy movement/lift equipment transporting modules/equipment from the MOF face to their position in the Bulk Area.

Module movements would be sequenced to optimise construction efficiency within Bulk Area and simultaneous operations associated with the CO<sub>2</sub> pipeline construction.

##### **Module installation/connection**

Once modules are positioned and secured on the pre-installed foundations, transportation appurtenances will be removed and then mechanical, electrical and instrumentation connections would be completed in a sequenced order. During installation and connection activities, each major system would undergo a series of checks to confirm they have been adequately prepared in readiness for pre-commissioning activities (Section 2.4.4).

Key installation/connection activities would include:

- completion of cable trays and supports linking modules, pipe racks and existing/new LER's
- completion of process pipework and utility connections
- installation of power, instrumentations and telecommunications cabling including, as applicable, cable connections between other systems (e.g. between new and existing LIR/LER termination points and module receival points)
- connection of process and utilities pipework to existing Train 1 and Train 2 tie-in points
- connection to localised drainage systems
- completion of roads and paving not able to be completed till module installation.

For each module the following installation/connection activities would be required:

- removal of packing/preservation utilised during marine transportation
- removal of transportation appurtenances (e.g. temporary bracing, etc.)
- removal of module preservation fluids and first fill oils and lubricants
- installation of shipped loose items, including installation of major and minor access ways (if these are shipped loose)
- installation/adjustment of key pipework assemblies
- installation of safety systems
- completion/check of packaged equipment assemblies
- completion of final instrumentation and electrical connections
- cleaning of module critical systems
- coating (painting) and insulation activities.

### **Installation of supplementary power and cabling**

Cables would be laid at the bottom of excavated trenches on a sand bedding or would utilise buried conduits for later cable pull-through. Trenches would be progressively backfilled following pre-commissioning testing activities.

Heavy infrastructure/equipment (e.g. batteries containers and power converters) within the supplementary power area would be installed using cranes.

#### **2.4.4 Pre-commissioning of AGRUs and CCES**

Pre-commissioning is a set of static and de-energised checks and tests carried out on each item of the plant equipment and pipework to ensure that the facilities have been constructed in compliance with Project specifications and standards. Pre-commissioning activities include:

- cleaning and treatment (e.g. water cleaning (e.g. flushing, jetting), air cleaning (blowing/flushing), steam cleaning, mechanical cleaning, chemical cleaning)
- hydrostatic pressure testing.

These are described further in the following sub-sections.

#### **Cleaning and treatment – water cleaning**

Water cleaning may be used to remove debris and loose material within pipework or tanks/vessels. Methods that may be used during pre-commissioning activities include:

- circulation of water at high velocity
- low-pressure water spray
- high-pressure water spray (i.e. jetting).

The cleaning of systems would result in an estimated 5,000 m<sup>3</sup> of wastewater being generated. All of the wastewater and cleaning solutions generated from these activities would be recaptured on completion and disposed of by a suitably licenced contractor.

#### **Cleaning and treatment – air cleaning**

Air cleaning involving the introduction of high velocities of air into pipework may be used to dislodge and carry away debris within pipework. Two methods that may be used during pre-commissioning activities include:

- Continuous: air blown high pressure source, typically a high-capacity compressor or reticulation network
- Rapid depressurisation: air blown high pressure source, which is released at a high velocity.

### **Cleaning and treatment – steam cleaning**

Steam cleaning involves high temperature blowing and thermal cycling between blows to aid in dislodgement of debris.

### **Cleaning and treatment – mechanical cleaning**

The following mechanical cleaning methods may be used during pre-commissioning:

- Hand cleaning: vessels/tanks are cleaned using suitable tools (brushes, scrapers, etc.) and debris is removed by vacuum or blow.
- Blasting: vessels/tanks are cleaned using sand/grit/garnet blasting.

Any wastes associated with blasting activities would be captured and disposed of in accordance with the legislative requirements.

### **Cleaning and treatment – chemical cleaning**

Chemical cleaning uses an acid solution to remove free iron and other contaminants from the surface. One of the main systems which would require chemical cleaning is the AGRU which is described in further detail below.

#### ***AGRU system cleaning***

Cleaning of the AGRU system is required to remove traces of oil contamination within new equipment prior to first process energisation. The following steps are generally applied:

- dilute weak acid (citric) flush
- dilute weak acid (citric) flush
- dilute weak alkali solution flush to perform de-greasing. (Sodium Hydroxide or other suitable de-greasing alkali)
- demineralised water flush.

The cleaning of the AGRU system would result in an estimated 3,000 m<sup>3</sup> of wastewater being generated. All wastewater and cleaning solutions generated from these activities would be recaptured on completion and disposed of offsite by a suitably licenced contractor.

### **Hydrostatic pressure testing**

All new/upgraded equipment/infrastructure and pipework would be hydrostatic pressure tested. The testing of the pipework and equipment would be undertaken using potable water as a test medium.

Hydrotest water volumes would vary over time, with the total volume of water required for pre-commissioning activities estimated to be 15,000 m<sup>3</sup>. Hydrotest water would be re-used where it remains fit for purpose.

A number of options are being considered for disposal of wastewater generated during hydrostatic testing of equipment/infrastructure and pipework, these are further described in *Construction, pre-, cold-commissioning wastewater management*.

## 2.4.5 Pre-commissioning of supplementary power

Pre-commissioning checks and tests would be undertaken following construction; this would involve electrical integrity and function testing. No emissions or discharges are associated with pre-commissioning activities required for the supplementary power.

Commissioning of the power transmission circuits for green power import would be undertaken only once an offsite interface facility was connected, this is subject to separate approvals.

## 2.4.6 Cold commissioning of AGRUs and CCES

Commissioning is a series of dynamic and energised checks and tests that need to be carried out to demonstrate and ensure that the facilities are ready to operate safely and steadily in compliance with Project specifications and standards. There are two types of commissioning, cold and hot, with only cold commissioning being considered in this referral.

Cold commissioning focuses on testing if equipment is mechanically sound from a functionality perspective without introducing any process fluids/materials or power required during operations.

The cold commissioning includes the following:

- leak testing
- pump system testing
- dehydration system testing.

These activities are further described in the following sub-sections, with water usage and wastewater management described in Section 2.3.6 and *Construction, pre-, cold-commissioning wastewater management*, respectively.

### Nitrogen leak testing

This type of testing enables infrastructure to be tested close to their expected operating pressure, detecting any leaks and repairs required prior to operation.

High pressure nitrogen is used as the test medium for leak testing of infrastructure/equipment. Nitrogen would be sourced from the atmosphere (membrane separation) or supplied in cryogenic liquid form by tankers. Helium would be added as 1% of the test fluid, supplied in compressed gas cylinders by an external supplier, as required.

This testing provides added checks to ensure the integrity of new pipework prior to hot commissioning/operations.

### Pump, vessels and pipework system testing

New pumping equipment, vessels and pipework systems would be tested using water as a test medium in an open circuit format. Water used for testing would be sourced from the existing demineralisation plant at Ichthys LNG facility. In addition, pump testing water may be treated with standard chemicals (e.g. biocide, oxygen scavenger, corrosion inhibitor, etc.).

It is estimated that pump, vessel and pipework system testing would result in ~400 m<sup>3</sup> of wastewater (~200 m<sup>3</sup> per LNG train). Wastewater and cleaning solutions generated from these activities would be recaptured on completion and disposed of by a suitably licenced contractor.

## Dehydration system testing

System pressurisation using dry nitrogen would be undertaken to allow compressor and full system function testing prior to introduction of process fluids. The system would be depressurised to atmosphere on activity completion.

### 2.4.7 Preservation of AGRU, CCES and CO<sub>2</sub> pipeline

Once pre-commissioning activities are completed, CCES equipment/infrastructure and piping (located within the existing Ichthys LNG facility and Bulk Area) and the CO<sub>2</sub> pipeline would be put into preservation until such time it could be connected to future offsite CCS project infrastructure (refer to Associated Projects – Section 1.4.2).

In addition, the upgraded AGRU would also be put into preservation until such time Plover gas wells are brought on-line, and the CO<sub>2</sub> capacity exceeds the existing AGRU system design (refer to Associated Projects – Section 1.4.2).

### 2.4.8 Demobilisation

All temporary facilities required for construction, installation, pre-commissioning or cold-commissioning purposes would be demobilised once deemed no longer required for such purposes. Where temporary facilities are required to support future commissioning activities (subject to separate referrals) these would remain on-site.

### 2.4.9 Considered alternative construction methods

#### Modularised versus stick built construction

The selected construction method of new plant facilities required for the Project is based on a modularisation approach versus stick built approach (i.e. plant facilities/systems that are constructed entirely on site with no pre-assembly of parts). Modularised construction is defined as a process where plant facilities are packaged on a systems basis so that they can be fabricated off site and efficiently transported, installed, connected and commissioned onsite with as few interconnections as possible.

The key advantages of modular construction versus stick built construction are as follows:

- Improved safety: Modular construction offers enhanced safety by reducing the number of workers and equipment required on-site. Off-site fabrication in a factory setting is generally a safer environment compared to an active major hazard facility.
- Reduced construction timeframes: Onsite construction timeframes are reduced as modules are prefabricated offsite and transported to the Ichthys LNG facility for installation. Traditional stick-built construction requires the synchronisation of various tasks onsite, often resulting in delays due to weather, logistical challenges, or resource shortages. Modularisation, on the other hand, enables simultaneous construction activities at different locations (i.e. while the site is being prepared, modules can be fabricated in a controlled environment, cutting down on lead times and allowing faster assembly once modules arrive onsite).

## Onshore piling method

Two types of piling methodologies were considered for installation of required pile foundations. These included bored/CFA concrete poured piles and conventional driven piling requiring hammering. Following an assessment, bored/CFA concrete poured piles were selected as the preferred method. The key advantage of bored/CFA piles are they result in reduced airborne noise and ground vibration; thereby reducing likelihood of noise impacts on adjacent sensitive communities (ecological and societal).

## 2.5 Wastes, emissions and discharges

The following sections describe the wastes, emissions and discharges associated with the Project and disposal options (where applicable).

### Waste management

Solid non-hazardous and hazardous waste would be generated throughout the life of the Project activities (see Section 2.4). The waste streams expected to be generated during the Project can be categorised into four broad categories:

- recyclable (non-hazardous) waste: where cost effective recyclable opportunities can be achieved, recyclable non-hazardous wastes are segregated from other waste types and sent to appropriate recycling facilities.
- non-recyclable (non-hazardous) waste: all non-recyclable, non-hazardous waste can be disposed at licensed facilities in the NT. These wastes are segregated and transferred to a licensed waste contractor for disposal at a licensed landfill waste facility.
- recyclable (hazardous) waste: these wastes are handled and treated as a hazardous waste and are segregated from non-hazardous wastes. Where cost effective recyclable opportunities can be achieved, recyclable hazardous wastes are transferred to a licensed waste contractor for treatment and recycling at a licensed waste facility.
- non-recyclable (hazardous) waste: these waste streams are typically sent to appropriately classed landfills, or for high temperature incineration. Non-recyclable hazardous wastes are segregated and transferred to a licensed waste contractor for treatment to comply with threshold criteria for acceptance to landfill at a licensed waste facility, or for direct disposal to a licensed waste facility.

"Listed" wastes are those waste streams classified under Schedule 2 of the Waste Management and Pollution Control (Administration) Regulations (NT). Listed (controlled) wastes are subject to special monitoring and reporting requirements and can only be disposed of at licensed landfill sites or sent for treatment or destruction.

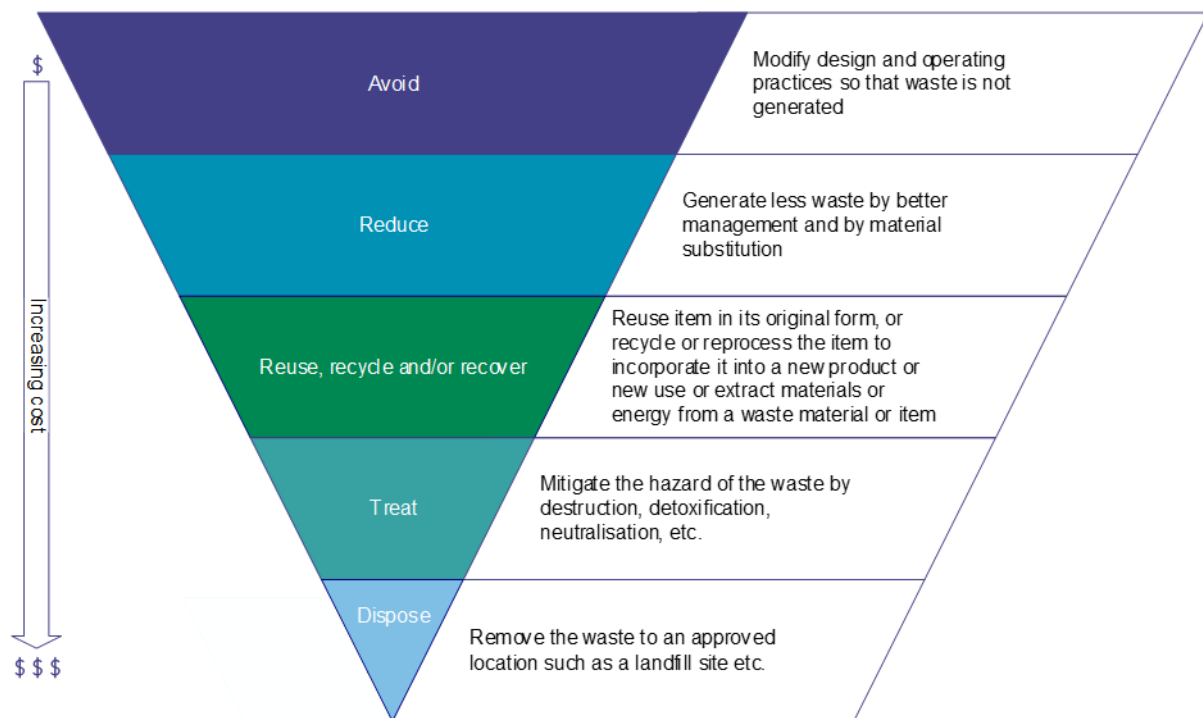
Types of waste that may be generated include but are not limited to scrap sections of redundant equipment, packing and preservation materials used to protect equipment during transportation to site, wood pelleting, soft plastics, cardboard, garnet/sand blasting wastes, spent chemicals and food refuse. All waste would be segregated and removed from site by a licenced waste contractor to be recycled or disposed of locally.

The waste control hierarchy (Figure 2-12) would be applied to ensure the sustainable management of waste generated during the Project. The hierarchy entails the following practices (in order of preference):

1. Avoid - modify design and construction practices so that waste is not generated. Waste prevention is achieved through the consideration of alternative products, the implementation of alternative technologies, engagement of companies that

encourage sustainable waste management practices, and the procurement of prefabricated materials.

2. Reduce - generate less waste by better management and by material substitution or choose the least hazardous chemicals (if not cost prohibitive) fit for purpose. Waste minimisation is typically applied in the procurement stage (i.e. the tendering and contracting process) and aims to reduce consumption of resources by minimising the amount of packaging material purchased and by increasing demand for recycled content.
3. Reuse, recycle and/or recover – re-use item in its original form, or recycle or reprocess the item to incorporate it into a new product or new use, or extract materials or energy from a waste material or item. Re-use is achieved initially by identifying re-use opportunities and subsequently through identifying the market demand for various waste items. To maximise re-use opportunities, wastes are segregated according to type. Recycling represents an important component of the waste management strategy, and wastes are segregated to enable recycling.
4. Treat - mitigate the hazard of the waste by destruction, detoxification, neutralisation, etc. Waste treatment aims to mitigate hazards posed by the waste through means such as destruction, detoxification or neutralisation of residues through processing.
5. Dispose - remove the waste to an approved location such as a landfill site or disposal facility. Waste is disposed of to landfill where no other practical option is available.



**Figure 2-12: Waste control hierarchy**

**Construction, pre-, cold-commissioning wastewater management**

Wastewater would be generated throughout the execution of the Project (refer to sections 2.3.6, 2.4.2, 2.4.4 and 2.4.6).

Wastewater generated during Project activities may be treated (e.g. neutralised) on site prior to disposal. All wastewater would be tested to determine the appropriate disposal option.

Several options are being considered for the management of wastewater generated during Project activities (i.e. construction, pre-commissioning, cold commissioning). These include, but are not limited, the following:

- transfer to the existing Ichthys LNG facility evaporation basin (where seasonal conditions permit) for concentration prior to offsite disposal of the resulting liquor by a suitably licenced contractor.
- discharge via a temporary outfall at the MOF (subject to issuance of a waste discharge licence under the *Water Act 1992* (NT))
- temporary onsite storage for treatment (as required), transport and disposal by a suitably licenced contractor (subject to testing to determine the appropriate disposal method).

Black/grey wastewater associated with temporary ablution blocks, would be collected and disposed of offsite via suitability licenced contractor.

### Emissions

Dust and particulates commissioning be generated, as result of:

- civil construction activities (earthworks, trenching and stockpiling of spoil)
- operations of concrete batching plants
- operation of diesel-powered generators to support temporary office/laydown areas and specialist temporary equipment spreads
- operation of vehicles and machinery.
- In addition to dust and particulates, during cold-commissioning leak testing activities inert gases (e.g. nitrogen and helium) commissioning be used as a test medium during and Inergen (inert gas fire suppressant) may be used for deluge testing. During these activities such gases commissioning, be released to atmosphere.

### Summary of wastes and discharges requiring disposal

A summary of estimated quantities/volumes of wastes, emissions and discharges associated with the Project which may require disposal are presented in Table 2-5.

**Table 2-5: Summary of wastes, emissions and discharges**

Waste, emission or discharge	Activity	Disposal options	Estimated quantities
Spoil	Civil construction - Earthworks	<ul style="list-style-type: none"> <li>• Re-use of spoil where it meets appropriate re-purpose requirements.</li> <li>• Offsite disposal.</li> </ul>	10,000 m <sup>3</sup>
	Civil construction - Piling	<ul style="list-style-type: none"> <li>• Re-use of spoil where it meets appropriate re-purpose requirements.</li> <li>• Offsite disposal</li> </ul>	4,000 m <sup>3</sup>

<b>Waste, emission or discharge</b>	<b>Activity</b>	<b>Disposal options</b>	<b>Estimated quantities</b>
Spoil (treated/neutralised ASS/PASS)	Civil construction - Earthworks	Treatment and offsite disposal	500 m <sup>3</sup>
AGRU system cleaning wastewater	Pre-commissioning	<ul style="list-style-type: none"> <li>• Offsite disposal</li> </ul>	3,000 m <sup>3</sup>
Hydrotest water	Pre-commissioning	<ul style="list-style-type: none"> <li>• Ichthys LNG facility evaporation basin.</li> <li>• Temporary MOF discharge outfall.</li> <li>• Offsite disposal.</li> </ul>	15,000 m <sup>3</sup>
Pump, vessels and pipework system testing wastewater	Cold commissioning	<ul style="list-style-type: none"> <li>• Ichthys LNG facility evaporation basin.</li> <li>• Temporary MOF discharge outfall.</li> <li>• Offsite disposal.</li> </ul>	400 m <sup>3</sup>
Black/grey water	Throughout the execution of the Project	<ul style="list-style-type: none"> <li>• Permanent wastewater treatment system.</li> <li>• Offsite disposal.</li> </ul>	24,000 m <sup>3</sup>
Solid waste – hazardous (recyclable and non-recyclable)	Throughout the execution of the Project	Offsite disposal	10,000 m <sup>3</sup>
Solid waste – non-hazardous (recyclable and non-recyclable)	Throughout the execution of the Project	Offsite disposal	20,000 m <sup>3</sup>

### 3 RELEVANT LEGISLATION

Table 3-1 describes the relevant legislation applicable to the Project.

**Table 3-1: Legislation applicable to the Project**

Legislation	Regulator	Relevance to the Project
<b>Commonwealth</b>		
<i>Biosecurity Act 2015</i>	DAFF	The Act and its supporting legislation are the primary legislative means for managing risk of pests and diseases entering Australian territory and causing harm to animal, plant and human health, the environment and/or the economy. Approval is required from DAFF to re-establish the MOF as a first point of entry of ships entering from international waters and to unload modules and other equipment. INPEX has commenced engagement with DAFF on this matter (refer Section 6).
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Department of Climate Change, Energy, the Environment and Water (DCCEEW)	The Act provides for the protection and management of nationally and internationally important flora, fauna, ecological communities, and heritage places. Matters of National Environmental Significance (MNES) are protected under Part 3 of the Act and projects require approval under the Act if they are likely to result in a significant impact on MNES. While INPEX does not believe the Project will have a significant impact on MNES, a referral will be submitted to DCCEEW in parallel with this Referral Report.
<b>Northern Territory</b>		
<i>Environment Protection Act 2019</i>	Northern Territory Environment Protection Authority (NT EPA)	The Act aims to promote ecological sustainable development, manage significant disturbances through an environmental approval process, provide for broader community involvement and recognise the importance of participation of Aboriginal people and communities in environmental decisions. Under the Act, the NT EPA regulates the environment impact assessment process to identify potential environmental impacts of development proposals. Pre-referral screening determined the Project has the potential to impact on five environmental factors: terrestrial environmental quality; terrestrial ecosystems; marine environmental quality; community and economy; and culture and heritage (refer to Appendix A). As such, the Project is being referred to the NT EPA to determine whether formal assessment is required.

Legislation	Regulator	Relevance to the Project
<i>Waste Management and Pollution Control Act 1998 (WMPC Act)</i>	NT EPA	<p>The Act provides for the protection, and where practicable the restoration and enhancement of the quality of, the Territory environment. Specifically, by preventing pollution, reducing the likelihood of pollution occurring, effectively responding to pollution, avoiding and reducing the generation of waste, increasing the re-use and recycling of waste, and effectively managing waste disposal. It also to encourages ecologically sustainable development and facilitates the implementation of national environment protection measures.</p> <p>Schedule 2 of Act outlines activities that require an approval or licence under the Act, which requires approvals and licences for activities that relate to processing of hydrocarbons to produce, store and/or despatch liquefied natural gas or methanol. INPEX will engage with the NT EPA on the requirement for approvals under the WMPC Act for construction activities associated with the Project. Waste management during the Project will be in compliance with the requirements of the Act.</p>
<i>Water Act 1992</i>	NT EPA	<p>The Act Provides for the investigation, allocation, use, control, protection, management and administration of water resources, including extraction of ground water, wastewater management and water pollution. Under the Act waste discharge licences are required where an activity could affect a declared beneficial use of a water resource.</p> <p>A waste discharge licence may be required if wastewater associated with pre-commissioning activities is required to be discharged to Darwin Harbour.</p>
<i>Weeds Management Act 2001</i>	Department of Lands, Planning and Environment (DLPE)	<p>The Act allows for the declaration of weeds into classifications for the purposes of preventing a plant entering into, or managing the plant in, the Territory or a part of the Territory. The Act provides for statutory weed management plans, which prescribe management actions for high priority weeds. The Act also gives powers to authorised officers, including the power to order certain activities in relation to declared weeds.</p>
<i>Territory Parks and Wildlife Conservation Act 1976 (TPWC Act)</i>	DLPE	<p>The Act forms a framework for the establishment and management of parks and reserves and declaration of protected wildlife.</p> <p>This Act has been considered with regard to the potential interactions with protected wildlife.</p>

Legislation	Regulator	Relevance to the Project
<i>Heritage Act 2011</i>	DLPE	<p>The Act provides for the conservation of the Northern Territory's cultural and natural heritage. All Aboriginal or Macassan archaeological places or objects are automatically declared heritage places or objects under the Act. Other places or objects can be nominated, and if accepted, can be declared heritage places or objects under the Act. A works approval is required to carry out work on a heritage place or object.</p> <p>No heritage objects/places are known to exist within the fence line of Ichthys LNG facility, where the Project would occur. In the event a previously unidentified object is discovered during construction, an unexpected/chance finds procedure will be implemented.</p>
<i>Northern Territory Aboriginal Sacred Sites Act 1989</i>	Aboriginal Areas Protection Authority (AAPA)	<p>The Act provides protection from unauthorised entry or damage to all sacred sites in the Northern Territory. Under the Act those wishing to undertake works on land or sea are required to obtain an Authority Certificate.</p> <p>Authority Certificates are a legal document that protects sacred sites from damage by setting out the conditions for carrying out specific works on an area of land and/or sea.</p> <p>INPEX has been issued an AAPA Authority for the area where Project activities would occur (refer to Section 5.3.2).</p>
<i>Planning Act 1999</i>	DLPE	<p>The Act regulates how land in the Northern Territory can be developed and used. This includes the establishment of planning schemes, development consent authority and planning commission.</p> <p>The Project is located entirely within the existing Ichthys LNG facility boundary (NT Portion 7002) and is zoned "Development". For all new development at Ichthys LNG facility a new development permit is required, where this constitutes &gt;5% change to the existing site.</p>
<i>Ports Management Act 2015</i>	Department of Logistics and Infrastructure	<p>The Act provides for the control, management and operation of ports, and for related purposes.</p> <p>A safety exclusion zone around the MOF is likely to be required during MOF offloading activities.</p>

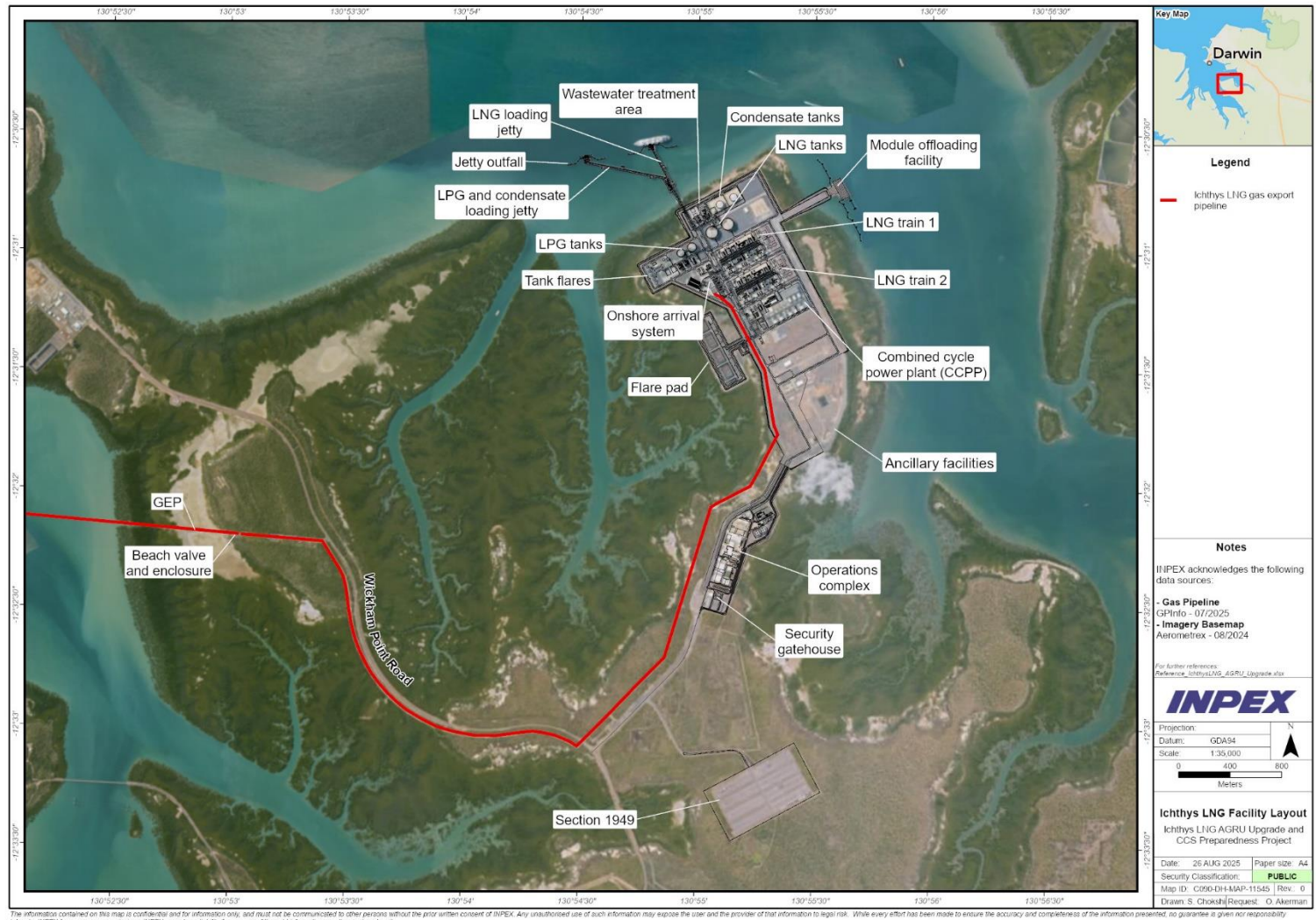
## 4 EXISTING ICHTHYS LNG FACILITY ACTIVITIES AND SYSTEMS OVERVIEW

The Ichthys LNG facility receives processed reservoir fluids (feed gas) from offshore facilities located approximately 890 km away via the GEP. The GEP crosses the shore south of Wickham Point, Middle Arm Peninsula, and travels approximately 7 km on land to Ichthys LNG's onshore arrival system at Bladin Point. The feed gas received is then processed through a two train LNG processing plant to produce LNG. In addition to LPGs and condensate.

The Ichthys LNG facility has a footprint of approximately 275 hectares and comprises the following major components:

- Onshore arrival system: this consists of an inlet throttling station, a slug catcher, pressure letdown stations (to ensure feed to LNG Trains is at required conditions), and associated gas/liquids separation.
- Condensate processing: this consists of condensate stabilisation units and condensate mercury removal units.
- LNG and LPG processing: the key hydrocarbon processing units consist of two LNG trains, and include feed gas pre-treatment such as mercury removal, acid gas removal, dehydration, LPG recovery, fractionation, and refrigeration and liquefaction to LNG.
- Product storage and loading: Ichthys LNG produces condensate, LPGs (propane and butane) and LNG which are stored in tanks prior to products being loaded onto tankers. The product storage system includes boil off gas recovery systems for LPGs and LNG.
- Utilities: key utility systems include the flare and vent systems, a combined cycle power plant which produces the power required to run Ichthys LNG, and drainage and wastewater treatment system. Other utility systems include demineralised water and firefighting water, fuel gas, compressed air, nitrogen, heating medium and cooling medium.
- Ancillary facilities: ancillary facilities are located in the operations complex, and areas of site not used for processing and include a security gatehouse, permanent and semi-permanent offices, central control building, kitchen and canteen, training facilities, medical centre, a laboratory, hazardous goods storage areas, permanent and field warehouses and workshops, refuelling area, a waste management area and laydown areas.

A layout of the facility is shown in Figure 4-1, with a summary of the key characteristics of Ichthys LNG facility provided in Table 4-1. A detailed description of the Ichthys LNG operations and facilities can be found at [https://ntepa.nt.gov.au/data/assets/pdf\\_file/0020/931232/onshore-operations-environmental-management-plan.pdf](https://ntepa.nt.gov.au/data/assets/pdf_file/0020/931232/onshore-operations-environmental-management-plan.pdf).



**Figure 4-1: Ichthys LNG facility layout**

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**Table 4-1: Key characteristics of the existing Ichthys LNG facility**

<b>Key characteristics</b>	<b>Description</b>
GEP (onshore section)	A 42-inch diameter gas pipeline which extends ~7 km from the beach valve (located on Middle Arm) to the Ichthys LNG facility.
Section 1949	Offsite 35-hectare hardstand laydown storage area.
Nominal production for export	<ul style="list-style-type: none"> <li>• 20,000 bbls/day condensate</li> <li>• 1.65 Mtpa LPG</li> <li>• 9.64 Mtpa LNG</li> </ul>
Product storage	<ul style="list-style-type: none"> <li>• Condensate Storage: Two x 60 000 m<sup>3</sup> floating roof storage tanks and one 6,500 m<sup>3</sup> buffer tank</li> <li>• LPG Storage – Propane: One x 85,000 m<sup>3</sup> full containment storage tank</li> <li>• LPG Storage – Butane: One x 60,000 m<sup>3</sup> full containment storage tank</li> <li>• LNG Storage: Two x 165,000 m<sup>3</sup> full containment storage tanks.</li> </ul>
Relief flares	<ul style="list-style-type: none"> <li>• Ground flare systems (warm/cold)</li> <li>• Tankage flare systems (LNG/LPG)</li> <li>• Liquid flare system.</li> </ul>
Combined cycle power plant	<ul style="list-style-type: none"> <li>• Five gas turbine generators with heat recovery steam generators having supplementary duct firing.</li> <li>• Three steam turbine generators.</li> <li>• Boiler feedwater circulation and treatment system.</li> </ul>
Drainage and effluent treatment	<ul style="list-style-type: none"> <li>• COC/AOC drains and treatment system</li> <li>• Sewage and grey water treatment system</li> <li>• Demineralisation plant brine</li> <li>• Combined cycle power plant steam blowdown</li> <li>• NCW drain</li> <li>• Chemical sewer.</li> </ul>
Utility systems	<ul style="list-style-type: none"> <li>• High-pressure and low-pressure fuel gas system</li> <li>• Isopentane and diesel fuel system</li> <li>• Heating medium system</li> <li>• Water supply (service water and drinking water) and demineralised water</li> <li>• Cooling medium system</li> <li>• Firefighting system</li> <li>• Compressed air</li> <li>• Nitrogen</li> <li>• Refrigeration and refrigerant storage</li> <li>• Solvent (aMDEA) storage.</li> </ul>

Key characteristics	Description
Operations complex and ancillary facilities	<ul style="list-style-type: none"> <li>• Security gatehouse</li> <li>• Reception and offices</li> <li>• Central control building</li> <li>• Kitchen, canteen and training facilities</li> <li>• Laboratory</li> <li>• Permanent and field workshops</li> <li>• Permanent and field warehouses (including hazardous goods storage areas)</li> <li>• Fire station</li> <li>• Medical centre and ambulance</li> <li>• Waste management area</li> <li>• Refuelling area</li> <li>• Permanent and semi-permanent office facilities.</li> </ul>
Jetty berths	<ul style="list-style-type: none"> <li>• One for LPG/condensate tankers and one for LNG tankers.</li> </ul>

## 5 DESCRIPTION OF EXISTING ENVIRONMENT

The following sections describe the existing and surrounding physical, biological and socio-economic environment relative to Project Area.

### 5.1 Physical environment

#### 5.1.1 Climate and meteorology

The Ichthys LNG facility lies in the monsoonal tropics of northern Australia, which has two distinct seasons: a hot wet season from November to April and a warm dry season from May to October. April and October are transitional months between the wet and dry seasons. Darwin has a mean annual rainfall of 1,724 mm, with rain falling on an average of 113 days (mainly in the wet season). The mean annual evaporation rate is 2,444 mm. The average monthly conditions for Darwin are presented in Table 5-1.

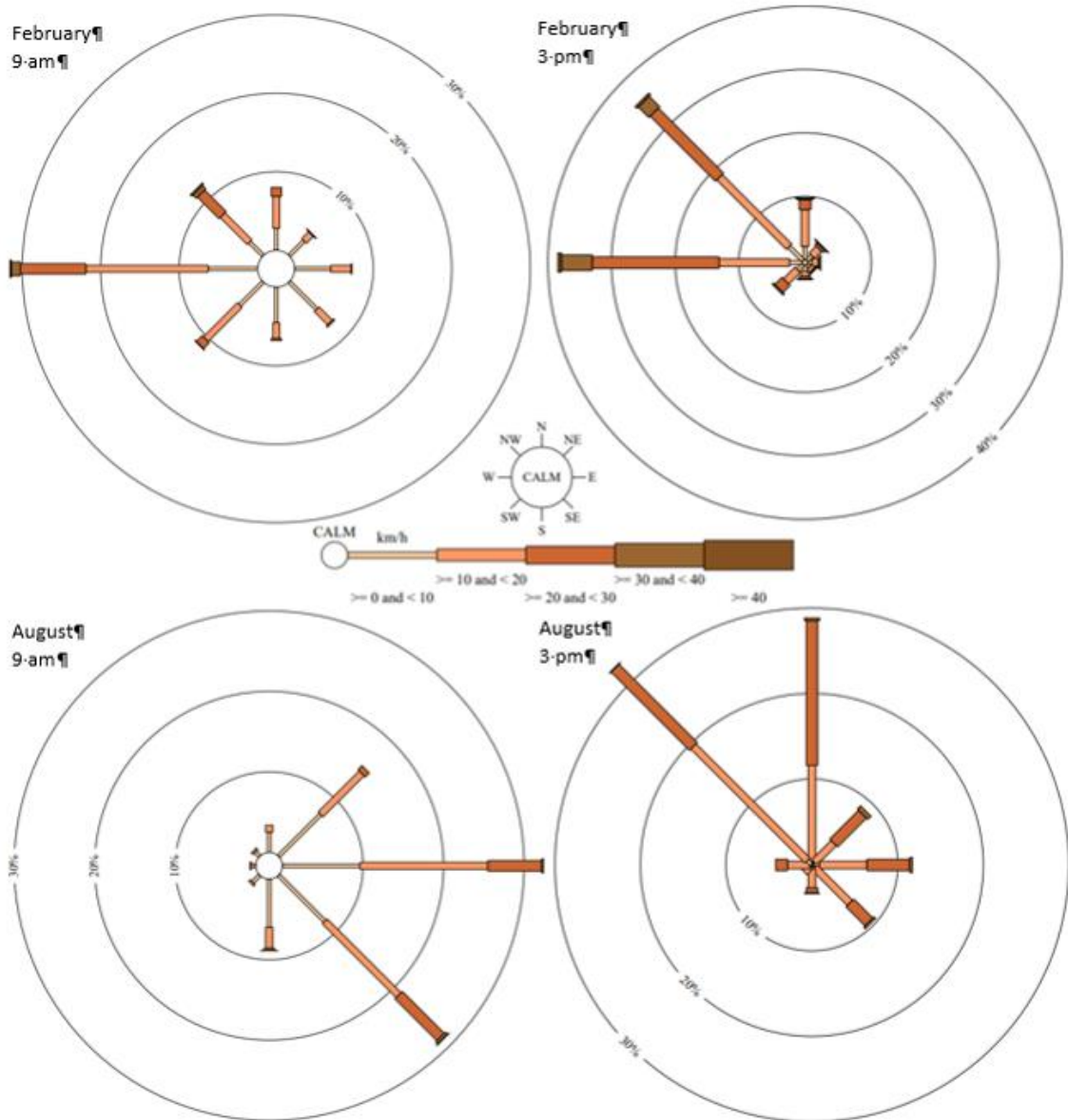
During the wet season, which has an official start date of 1 November each year, prevailing winds are westerly and west-north-westerly. Winds in the dry season, which has an official start date of 1 May each year, vary from south-easterly to northerly. Wind roses for Darwin are shown in Figure 5-1.

The area is subject to tropical low-pressure systems and cyclones, particularly from November to April. Tropical cyclones bring strong winds, heavy/squally rainfall, local flooding and storm surges. Damage from cyclones can occur up to 50 km inland from the coast.

**Table 5-1: Average monthly weather conditions for Darwin (BOM 2022)**

Month	Average maximum temperature (°C)	Average minimum temperature (°C)	Average monthly rainfall (mm)	Average relative humidity (9 am; %)	Average relative humidity (3 pm; %)
January	31.8	24.9	431.3	81	70
February	31.5	24.8	369.0	83	72
March	32.0	24.6	310.8	82	67
April	32.8	24.1	101.7	74	52
May	32.1	22.2	20.4	65	43
June	30.7	20.0	1.8	60	38
July	30.7	19.3	1.1	60	37
August	31.5	20.3	4.6	64	40
September	32.7	23.0	16.53	68	47
October	33.3	24.9	71.2	69	52
November	33.4	25.3	143.2	72	58

Month	Average maximum temperature (°C)	Average minimum temperature (°C)	Average monthly rainfall (mm)	Average relative humidity (9 am; %)	Average relative humidity (3 pm; %)
December	32.7	25.3	252.0	76	65



**Figure 5-1: Wet season (February) and dry season (August) indicative wind roses for the Darwin area (BOM 2022)**

### 5.1.2 Noise

Given the location of the Ichthys LNG facility on Bladin Point, there are limited off-site noise sensitive receptors in close proximity to the facility. Nonetheless, as part of good industry practice, noise has been monitored and assessed during the project planning, construction and operation phases.

Ambient noise levels were measured prior to construction of the Ichthys LNG facility at O'Farrell's Road, Bayview Haven and Constance Court, Palmerston (SVT Engineering Consultants 2009). During construction, continuous airborne noise monitoring was undertaken at Ichthys LNG project site as well as at Palmerston. Minor noise exceedances were recorded in Palmerston; however, none of the exceedances were considered to be project-attributable (URS 2013; AEC Environmental 2014, 2015a). The ambient and construction noise level measurements provide a baseline for the operational phase. Noise monitoring undertaken during operations has confirmed measured noise levels at the Ichthys LNG facility boundary are within the permissible noise limits (70dB(A)) for industrial premises.

### 5.1.3 Air quality

Ambient air quality in the Darwin airshed is influenced by several sources, including biogenic sources (soil, natural and agricultural vegetation), smoke from bushfires, vehicles and industrial sources. Generally, the concentrations of nitrogen dioxide (NO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>) and photochemical oxidants (as measured by ozone (O<sub>3</sub>)) in the Darwin airshed are relatively low. Particulate levels in the Darwin airshed vary seasonally due to annual backburning and bushfires; the 2024 Darwin Harbour Integrated Report Card (DHIRC 2024) reported that 94% of days in the wet season were below the PM<sub>2.5</sub> good air quality indicator, compared to only 39% of days in the dry season.

The nearest sensitive receptors for air emissions from the Ichthys LNG facility are the residential areas of Palmerston. The Ambient Air Quality National Environment Protection Measure (Air NEPM) specifies maximum acceptable ground-level concentrations for a range of common parameters relevant to airsheds across Australia. Of these, the parameters relevant to Ichthys LNG context in Darwin are NO<sub>2</sub>, O<sub>3</sub>, SO<sub>2</sub> and particulates (measured as PM<sub>2.5</sub> and PM<sub>10</sub>). A cumulative air quality assessment was undertaken for the Draft EIS in 2010 (SKM 2010) and updated to incorporate revised plant configuration in 2014 (Pacific Environment 2014).

The 2010 air quality assessment included establishment of the background air quality using air emissions from biogenic sources (soil and vegetation), vehicles, shipping traffic and industrial sources already present on Middle Arm Peninsula prior to construction of the Ichthys LNG facility (ConocoPhillips Darwin LNG plant, Channel Island power station and Weddell power station) (SKM 2010). The background air quality was found to be good; the maximum ground level pollutant concentrations for NO<sub>2</sub> (1 hr average), O<sub>3</sub> (1 hr average), SO<sub>2</sub> (1 hr average) and PM<sub>10</sub> (1 day average) were found to be 27%, 20%, 12% and 22% of the Air NEPM criteria, respectively. Ambient air quality monitoring completed for compliance against the Ichthys LNG facility environmental protection licence has primarily detected seasonal exceedances of Air NEPM criteria for particulates, related to planned and unplanned burning activities. No exceedance of Air NEPM at receptors has been attributed to Ichthys LNG operations.

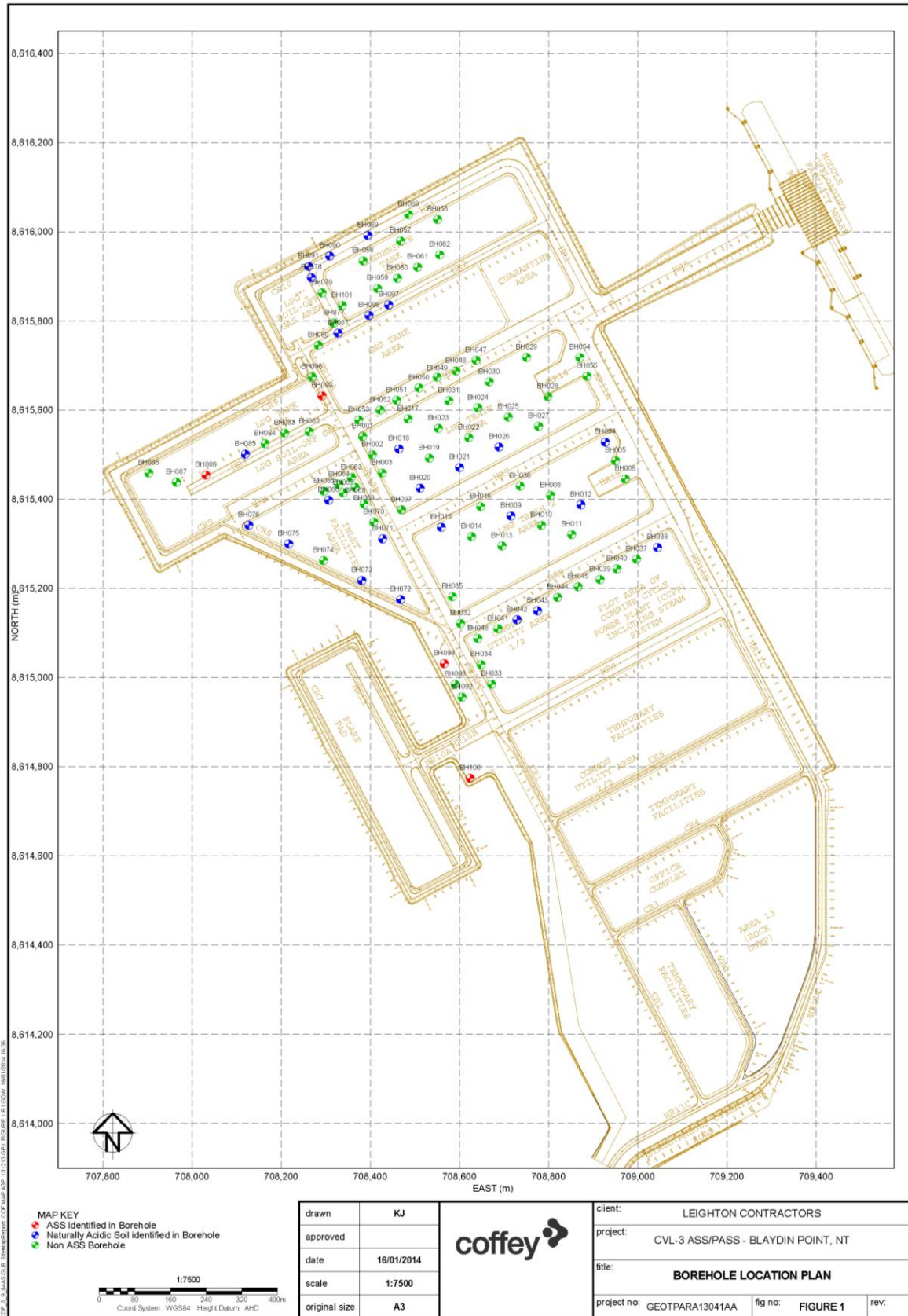
#### 5.1.4 Geology and geomorphology

Bladin Point is a low-lying peninsula, which is separated from the mainland by a mudflat. The area is underlain by Early Proterozoic and Burrell Creek Formation rocks, with some Cretaceous Darwin Formation rocks along the shoreline. Soils over half of the site are very gravelly, massive earths that range in depth from shallow (<0.25 m) to moderately deep (0.25 to <0.5 m) (Fogarty et al. 1984).

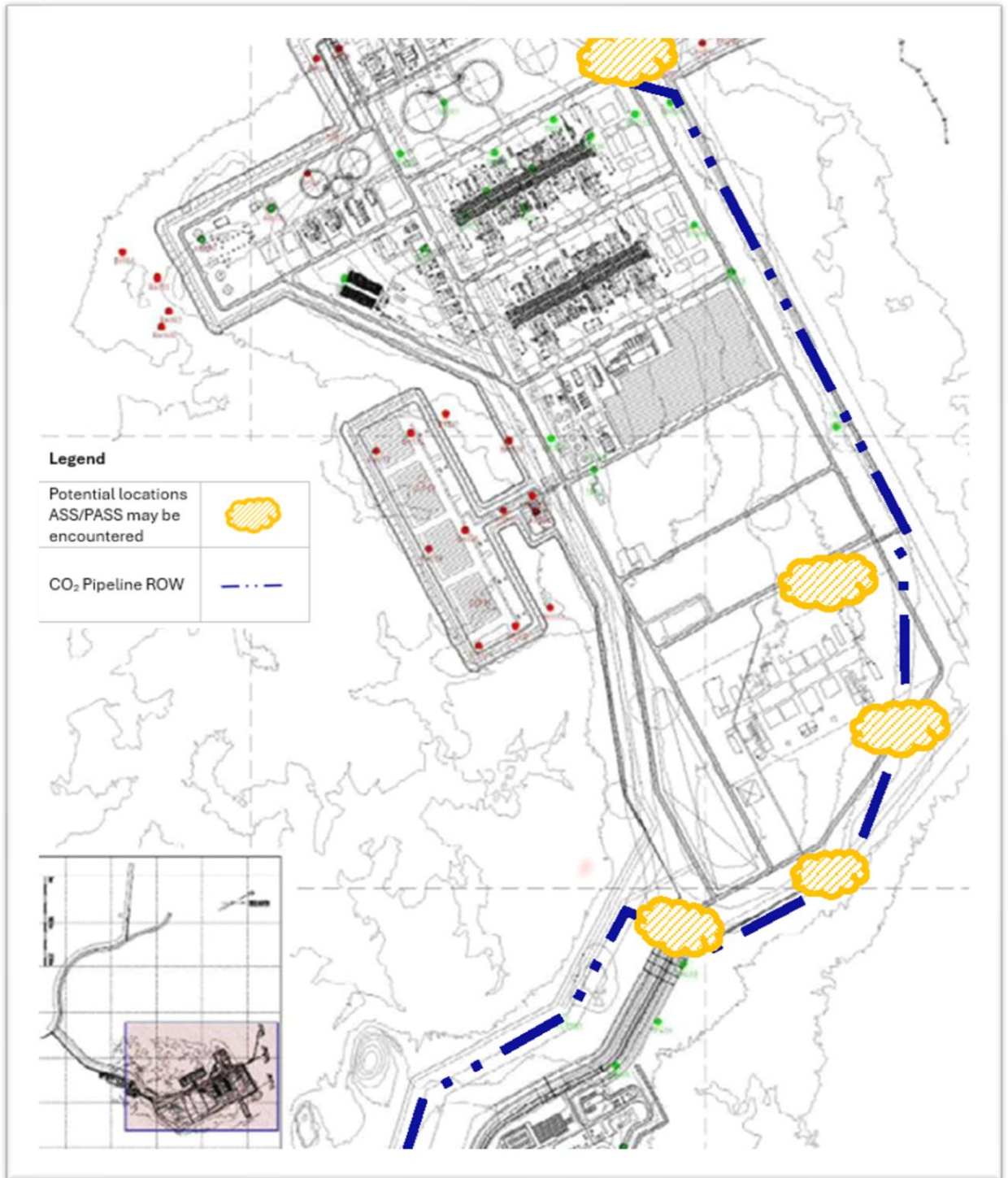
The following soil families have been identified at Bladin Point: Bladin (red, fine sandy clay loam); Hotham (brown, massive, fine sandy loam with medium gravel); Koolpinyah (yellow sandy loam over sandy clay loam); Mullalgah (deep, peaty soils on marine sediments); Euro (hydrosols on intertidal flats); Maand (poorly drained marine muds); and Rinamatta (siliceous sands).

The Mullalgah, Euro, Maand and Rinamatta soil families contain varying levels of ASS. Geotechnical investigations for Ichthys LNG construction phase identified areas of ASS within Ichthys LNG footprint, with key areas being the ground flare pad, tankage flare, condensate tank area, MOF causeway and tidal area of the haul road (JKC 2014; Coffey 2014). In addition to areas of ASS, geotechnical investigations also reported soils with natural non sulphuric acidity (pH levels as 3.4 to 6.8); natural acidity formed through hydrolysis reactions where the anions are leached and replaced with hydrogen soils. No boreholes containing ASS were reported from within the Bulk Area (Figure 5-2); however, there is a low likelihood that ASS/PASS may be encountered in some areas within the CO<sub>2</sub> pipeline ROW (Figure 5-3).

The current finished ground surface consists of 'cut and fill'. The cut areas are generally covered by a layer of compacted general fill up to 2.5 m deep, which is underlain (in places) by aggregate rocks and low permeable geofabric material. Some filled areas located along the edges of the Site underwent significant ground improvement works.



**Figure 5-2: Acid sulphate soils borehole investigation plan and presence of acid sulphate soils (Coffey 2014)**



**Figure 5-3: Locations where potential acid sulphate soils may be encountered within the CO<sub>2</sub> pipeline ROW**

### 5.1.5 Hydrology and hydrogeology

Bladin Point is generally flat and varies only 10 m in topography. After rainfall, the majority of surface water flows east into the Elizabeth River and west into Lightning Creek, with some surface water discharging north into Darwin Harbour and south towards the isthmus and a tidal salt flat.

Groundwater levels are generally shallow, with recharge mainly occurring by rainfall infiltration during the wet season. A semi-confined aquifer in the clayey sand/gravel horizons of the Darwin Formation generally follows the original topography of the site with the lowest levels located near the coast. The groundwater levels in this aquifer fluctuate seasonally between 0.5 and 5 m and are also influenced by the Darwin Harbour tides in coastal areas. Groundwater level contours indicate that groundwater flows radially from the central part of Ichthys LNG site towards low lying area typically inundated by tides (AEC Environmental 2015b). Construction of the Ichthys LNG facility has altered the topography of Bladin Point and subsequent recharge of groundwater through decreased permeability associated with compacted soil and fill, sealed surfaces and storm water drainage system. Ongoing groundwater monitoring throughout operations has measured both increases and decreases in seasonal groundwater levels compared to baseline (AECOM 2024). The 100-year storm surge level at Bladin Point is estimated at 4.9 m AHD and the 500-year storm surge level is estimated at 5.6 m AHD. Most Ichthys LNG facilities (including all critical facilities) are located above 6.5 m AHD, with some non-critical support infrastructure located above 5.8 m AHD which provides 0.2 m above the estimated 500-year storm surge level to account for potential sea level increase.

### 5.1.6 Groundwater quality

Aquifers in the Darwin Formation are typically acidic to neutral, with a pH ranging from 4.1 to 7.6 (Radke et al. 1998). Sampling of groundwater at Ichthys LNG site prior to construction recorded fresh to saline water with pH levels of 4.6 to 6.4. The natural acidity of groundwater reflects the natural acidic soils found at Bladin Point. Reported concentrations of aluminium, arsenic, cadmium, copper, manganese, nickel and zinc were higher than ANZG (2018) trigger values prior to commencement of construction. Reported concentrations are a likely result of historic groundwater interaction at different depths within the aquifer with soil stratigraphy for some time under acidic conditions resulting in metal mobilisation. Nutrients have likely been released into the uppermost aquifer by rainwater interaction with organic rich surface material, organic muds and inorganic minerals in rocks and soils (AEC Environmental 2015b).

Under the *Water Act 1992* (NT), beneficial uses for groundwater have been declared for the Darwin Rural Adelaide River Water Control District which includes Ichthys LNG site. These are listed as agriculture, aquaculture, public water supply, cultural, industry, rural stock and domestic, mining activity and petroleum activity. Water quality objectives for groundwater in the region have been set as listed in Table 5-2.

Groundwater monitoring carried out throughout Ichthys LNG construction phase analysed a large number of bores and parameters. Groundwater parameters were not uniform across Ichthys LNG site, with natural pockets of acidic groundwater and variable metal concentrations. Natural groundwater pH values were consistently lower than pH 7 (median of 5.5) and in some cases were as low as pH 3, with no notable decreasing trend over the construction monitoring (AEC Environmental 2018). The groundwater levels during construction rose and fell in accordance with the season, with the lowest levels in in October (dry season end) and the peak levels being reached in late-March/early-April (wet season end) (AEC Environmental 2018). Measured salinity levels also indicated that majority of bores are brackish to hypersaline. Naturally elevated concentrations of metals and nutrients were consistently reported throughout construction. Majority of nutrient samples (88% of ammonia, 73% of total nitrogen, 67% of total phosphorus and 61% of oxides of

nitrogen) exceeded water quality objectives for Darwin Harbour (NRETAS 2010). Similarly, metals frequently exceeded their relevant trigger values (41% of aluminium, 63% of arsenic, 25% of cadmium, 80% of cobalt, 22% of copper, 66% of manganese, 52% of nickel, 58% of zinc).

Post construction groundwater monitoring results have been consistent with those of construction and baseline, with sporadic exceedances of triggers at individual bores. These have not been attributed to any Ichthys LNG operational activity or event. In 2024 the monitoring contractor completed a review of several sites that were showing increasing trends in groundwater analytes (AECOM 2024). Of particular note were sites VWP 341, BPGW40 and BPGW41, which occur along the eastern site boundary. The review noted that concentrations of manganese, cobalt, zinc, and ammonia at the three bore sites are likely increasing because of a combination of reduced recharge (less water in), lower aquifer permeability (less water flowing), and lower rates of dispersion (more accumulation of solutes). The accumulation mechanisms are the result of long-term and permanent changes to the local hydrogeology and presence of source materials (i.e., fill and/or mangrove mud). They do not appear to be the result of a point source such as a leak of spill within the LNG facility (AECOM 2024).

**Table 5-2: Groundwater quality objectives**

Indicator	Upper estuary water quality objectives
Indicator for environmental use: aquatic ecosystem protection	
pH	Maintain between 7 – 8.5
Conductivity	Maintain <400 µS/cm
Toxicants	Refer to ANZG (2018)
Indicator for Protection of Cultural Use: Aquatic Foods	
Toxicants	Refer to Australian Drinking Water Guidelines (NHMRC 2011)

### 5.1.7 Harbour hydrodynamics and metocean conditions

Darwin Harbour is classed as a macro-tidal estuary, with maximum tidal range reaching 7.8 m (Padovan 2003; Li 2013). The Darwin region experiences a semidiurnal tidal cycle (i.e. two highs and two lows per day) with a slight diurnal inequality between the successive tides (INPEX 2010). The daily tidal range is characterised by a pronounced variation in magnitude, repeating approximately every 15 days (spring-neap tide cycle). The average daily tidal range is ~6 m during the spring phase and ~3 m during neap phase of the tidal cycle (Cardno 2014). There is also considerable annual variability, with the largest spring tides typically occurring in March and September/October.

Tidal excursions range from 8 to 15 km during spring tides and 2 to 8 km during neap tides (Hanley & Caswell 1995; Semeniuk 1985). The large tidal ranges produce strong currents that peak at speeds of up to 2-2.5 m/s.

Darwin Harbour is considered well protected from waves, with most waves generated within the Harbour or in Beagle Gulf. Waves during the wet season can reach heights of up to 1 m, although average wave height are generally less than 0.5 m with short mean periods of 2-5 s. Average wave heights and periods during the dry season are even lower. Tsunamis and swell waves (long-period waves) are unlikely to occur in Darwin Harbour due to its orientation and the protection from ocean swells by the Tiwi Islands.

### 5.1.8 Harbour sediment quality

Numerous sediment quality surveys have been undertaken in Darwin Harbour (RHDHV 2022; Cardno 2022; Radke et al. 2020a, 2020 b, 2021, 2023, 2024; AECOM 2020; INPEX 2019, 2020, 2021, 2023; GHD 2019; Munksgaard et al 2013; URS 2009; Fortune 2006). Results from published monitoring studies in East Arm have found the sediment to be primarily comprised of sand with varying amounts of gravel, silt and clay, depending on the sample location (e.g. intertidal areas or channels). Sampling of deposited material within the jetty pockets adjacent to Ichthys facilities was found to be predominantly silts and clay (INPEX 2016, 2019, 2020,2023).

Analysis of potential inorganic contaminants in Darwin Harbour such as metals (including metalloids) found that arsenic concentrations commonly exceed the ANZG (2018) sediment quality guideline value (SQGV) of 20 mg/kg. However, these high concentrations have been attributed to local geology (weathering of arsenic rich coastal substrata) rather than anthropogenic sources (Fortune 2006). Furthermore, previous bioavailability testing has indicated that only a small proportion is bioavailable indicating that it is unlikely to be toxic in the marine environment.

A range of other metals (e.g. antimony, chromium, copper, lead, mercury, nickel and silver) have also been recorded to infrequently exceed SQGVs; however, their mean concentrations have always remained below SQGVs. Exceedances are typically associated with individual samples or samples collected adjacent to urbanised or developed areas. Notably, sampling near the MOF (INPEX 2023) indicated no exceedances of the SQGV for any tested analyte.

Until recently few sediment sampling programs have analysed samples for other contaminants such as organic compounds. Sediment sampling to inform dredging activities at Coonawarra (GHD 2019), Mandorah (Cardno 2022), the proposed ship lifts in East Arm (AECOM 2020) and Middle Arm Sustainable Development Precinct (RHDHV 2022) have all included various analysis of organics. However, the most recent comprehensive surveys were undertaken by the NT Government in 2019, 2020 and 2023 (Radke et al. 2020a, 2020b, 2021, 2023, 2024), as part of the Ichthys LNG Darwin Harbour Integrated Marine Monitoring and Research Program environmental offset. These surveys cover the entire Darwin Harbour extent and include tributyltin (TBT), per- and polyfluoroalkyl substances (PFASs), polychlorinated biphenyls (PCBs), organophosphate pesticides (OPPs), organochlorine pesticide (OCPs), polycyclic aromatic hydrocarbons (PAHs), total recoverable hydrocarbons (TRHs) and benzene, toluene, ethylbenzene and xylenes (BTEX). INPEX (2023) also tested the MOF berth pockets for organics (total petroleum hydrocarbons, TRH, PAH, BTEX).

Of the aforementioned organics, PCBs, OPPs and BTEX have been below laboratory limits of reporting (LORs) in all surveys for which they have been analysed. Results for TBT were all below LOR in East Arm in Radke et al. (2020a) and RHDHV (2022), while a single TBT result was reported in AECOM (2020) adjacent to the multi-user barge ramp facility in East Arm. Sampling at Coonawarra (GHD 2019) and Mandorah (Cardno 2022) reported eight and two samples with TBT respectively. Coonawarra is known to contain legacy TBT contaminated sediments, with TBT identified in all previous sediment surveys (GHD 2019). Following detection of TBT at Mandorah, twelve additional targeted TBT samples were collected, all of which were below LOR (Cardno 2022), indicating highly localised source.

Widespread occurrence of PFASs in Darwin Harbour was reported in Radke et al. (2023), with 15 different PFASs detected across 32 sites with detection frequencies highest adjacent urban catchments. Sampling sites within tidal creeks contiguous with Royal Australian Air Force Base Darwin had the largest number of PFASs and the highest concentrations. Dieldrin was the only OCP identified in Radke et al. (2021) and was reported at two locations: the highly urbanised Rapid Creek and adjacent to Fisherman's Wharf. In all other surveys, OCPs have been below LOR (URS 2009; GHD 2019; RHDHV 2022). Polycyclic aromatic hydrocarbons have been reported sporadically in Darwin Harbour, with PAH concentrations well below SQGVs. Elevated PAH concentrations have typically been associated with urbanised or developed areas (e.g. Coonawarra, Rapid Creek, Fisherman's Wharf). Similar to PAH, some elevated TRHs concentrations have been associated with urbanised or developed areas with a single reported exceedance of SQGVs in Buffalo Creek. However, unlike other organic contaminants, trace levels of TRHs have been reported at the majority of sites throughout Darwin Harbour and likely reflect the presence of biogenic hydrocarbons throughout Darwin Harbour. No organic compounds were detected above SQGVs within the MOF berth pockets (INPEX 2023)

Three surveys have included analysis for radionuclides, URS (2009), AECOM (2020) and RHDHV (2022), with all results well below interim sediment quality guideline values from the National Assessment Guidelines for Dredging 2009 (35 Bq/g; Commonwealth of Australia 2009) with average concentrations of 0.6, 1.2 and 0.9 Bq/g respectively.

### 5.1.9 Harbour water quality

Darwin Harbour is a naturally turbid environment due to the large tidal ranges and associated currents, with clearest water occurring during neap tides while the spring tides are associated with increased turbidity due to increased current velocities.

During the wet season, monsoonal troughs and tropical cyclones (events) significantly influence water quality, in particular turbidity. These events increase metocean conditions (wind and waves) which suspend sediments resulting in high turbidity levels (>150 NTU daily average) in coastal waters outside the Harbour, while waters within the Harbour are typically sheltered. If these events coincide with spring tides, the tidal currents can advect the highly turbid coastal waters into the Harbour resulting in increased turbidity (>100 NTU daily average) (Cardno 2015a; URS 2009). Turbidity inside the Harbour will also be increased by increased sediment loading from surface runoff associated with increased rainfall during such events.

Conversely, metocean conditions in the dry season are relatively benign, with water quality primarily driven by tides. As a result, clearer waters are measured inside and outside the Harbour, with turbidity typically between 1 and 7 NTU (median daily average).

Water temperature typically varies from 24°C in the dry season to over 30°C in the wet season; however, the timing, duration and frequency of wet season events can significantly influence water temperature causing declines of 2°C to 4°C. The rainfall associated with these events can also drive fluctuations in salinity within Darwin Harbour.

Salinity within Darwin Harbour is generally slightly lower in the wet season when compared to the dry season due to rainfall; however, in either season there can be strong local gradients in salinity. During the wet season, salinity can range from approximately 30 to 35 ppt in the mid-Harbour down to near 0 ppt further up rivers (Makarynska 2019), where there are significant freshwater inflows. During the dry season, a lack of rainfall and increased evaporation can lead to salinities between 35 and 40 ppt in upstream waters where there is limited tidal flushing (Cardno 2014; Makarynska 2019).

Dissolved oxygen in Darwin Harbour typically ranges from 74-96% (mean 84%), with no seasonal effects (INPEX 2011; Padovan 1997).

A seasonal summary of mean water quality is provided in Table 5-3.

**Table 5-3: Mean water quality levels recorded near Bladin Point**

Parameter	Dry season	Wet season
Temperature	24.5°C*	30.6°C*
Salinity	35.5 ppt*	29 ppt*
Dissolved oxygen	(median 35.83 g/L) †	(median 32.37 g/L) †
pH	93.3% of saturation*	87.8% of saturation*
Turbidity	(median 88.3% in July 2017) †	(median 75.9% in February 2017) †

\* URS 2009

† AEC Environmental 2017

The *Water Act 1992* (NT) defines several beneficial uses for water bodies in the NT. Beneficial uses describe how a community values and uses a water resource. These are then used to set water quality objectives relevant to the beneficial uses declared for a particular water body. The declared beneficial uses for the Darwin Harbour Region – High Water Mark and Darwin Harbour Region – Natural Waterways are as follows:

- aquaculture: water for commercial production of aquatic animals, including related research
- environment: water to maintain the health of aquatic ecosystems
- cultural: water to meet aesthetic, recreational and cultural needs.

Water Quality Objectives for Darwin Harbour have been set by the NT government for several water types (DENR 2010); those relevant to the saline waters around Bladin Point are the objectives for upper estuary waters as listed in Table 5-4.

**Table 5-4: Water quality objectives for Darwin Harbour upper estuary**

Indicator	Upper estuary water quality objectives
Indicator for environmental use: aquatic ecosystem protection	
Dissolved oxygen	Maintain dissolved oxygen between 75–100% saturation
pH	Maintain pH between 7–8.5
Total nitrogen	Maintain total nitrogen <300 µg/L
NOx	Maintain NOx <20 µg/L
Ammonia	Maintain Ammonia <20 µg/L
Total phosphorus	Maintain total phosphorus <30 µg/L
Filterable reactive phosphorus	Maintain filterable reactive phosphorus <10 µg/L

Indicator	Upper estuary water quality objectives
Chlorophyll a	Maintain Chlorophyll a <4 µg/L
Total suspended solids	Maintain total suspended solids <10 mg/L
Toxicants	Refer to ANZG (2018)
Indicator for protection of cultural use: recreation primary contact	
Enterococci	All samples to be less than or equal to 50 Enterococci/100 mL
Escherichia coli	No single sample greater than 200 E. coli/100 mL
Pathogenic protozoans	<10 pathogenic protozoans/100 mL
Indicator for protection of cultural use: aquatic foods	
Guideline for water in shellfish growth harvest areas	Median concentration of faecal coliform should not exceed 14 MPN/100 mL (no more than 10% of the samples exceeding 43 MPN/100 mL)
Standard in edible tissue	Fish for human consumption should not exceed a limit of 2.3 MPN E. coli/g of flesh with a standard plate count of 100 000 organisms/g
Toxicants	Refer to ANZG (2018)

## 5.2 Biological environment

### 5.2.1 Conservation values

#### Matters of national environmental significance

An EPBC Protected Matters Search Tool (PMST) report was generated on the 19 August 2025 with a 1 km buffer surrounding the Project Area (refer Appendix B). The report identified the following species as potentially using the Project Area:

- 51 listed threatened species
- 60 listed migratory species
- 95 listed marine species
- 13 whales and other cetaceans.

Twenty-five of the listed species were both threatened and migratory. Other MNES identified in the report relate to the surrounding Darwin Harbour, being:

- a wetland of national significance in the Directory of Important Wetlands in Australia (Port Darwin NT029).

- a biologically important area (BIA) for breeding and foraging, for Australian snubfin dolphin (*O. heinsohni*), Indo-Pacific humpback dolphin (*S. chinensis*) and Indo-Pacific bottlenose dolphin (*T. Aduncus*); and
- considered a BIA for flatback turtle interesting and habitat critical to the species survival.

A likelihood of occurrence assessment has been undertaken on the listed marine, migratory and threatened species identified in the EPBC PMST report (Appendix B), to determine which of the species have the potential to occur in the vicinity (1 km) of the proposed development footprint.

A summary of the species identified in the likelihood of occurrence assessment as being known to or likely to be present in the marine, mangrove and mud flat/salt flat communities adjacent to the Project footprint are presented in Table 5-5.

**Table 5-5: Summary of threatened and listed species known to or likely to occur within 1km of the Ichthys LNG facility**

Common Name	Scientific Name	EPBC Act Listing	TPWC Act	Likelihood of occurrence
<b>Birds</b>				
Asian Dowitcher	<i>Limnodromus semipalmatus</i>	Listed marine species Migratory Vulnerable	-	Likely to occur
Bar-tailed Godwit (two sub-species)	<i>Limosa lapponica baueri &amp; menzbieri</i>	Endangered	-	Known to occur
Great Knot	<i>Calidris tenuirostris</i>	Listed marine species Migratory Vulnerable	Critically Endangered	Known to occur
Greater Sand Plover	<i>Charadrius leschenaultii</i>	Listed marine species Migratory Vulnerable	Vulnerable	Known to occur
Lesser Sand Plover	<i>Charadrius mongolus</i>	Listed marine species Migratory Endangered	Endangered	Known to occur
Eastern/Far Eastern Curlew	<i>Numenius madagascariensis</i>	Listed marine species Migratory Critically Endangered	-	Known to occur
Black-tailed Godwit (3 species)	<i>Limosa limosa</i> <i>Limosa lapponica baueri &amp; menzbieri</i>	Listed marine species Migratory	Vulnerable	Likely to occur

Common Name	Scientific Name	EPBC Act Listing	TPWC Act	Likelihood of occurrence
		Endangered	Critically Endangered	
Common Greenshank	<i>Tringa nebularia</i>	Listed marine species Migratory Endangered	-	Likely to occur
Common Sandpiper	<i>Actitis hypoleucos</i>	Listed marine species Migratory	-	Likely to occur
Curlew Sandpiper	<i>Calidris ferruginea</i>	Listed marine species Migratory Critically Endangered	Critically Endangered	Likely to occur
Red Knot	<i>Calidris canutus</i>	Listed marine species Migratory Vulnerable	Endangered	Likely to occur
Grey Plover	<i>Pluvialis squatarola</i>	Listed marine species Migratory Vulnerable	-	Likely to occur
Osprey	<i>Pandion haliaetus</i>	Listed marine species Migratory	-	Known to occur
Ruddy Turnstone	<i>Arenaria interpres</i>	Listed marine species Migratory Vulnerable	-	Likely to occur
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Listed marine species	-	Likely

Common Name	Scientific Name	EPBC Act Listing	TPWC Act	Likelihood of occurrence
		Migratory Vulnerable		
Terek Sandpiper	<i>Xenus cinereus</i>	Vulnerable	-	Known
Whimbrel	<i>Numenius phaeopus</i>	Listed marine species Migratory	-	Known
<b>Fish</b>				
Beady Pipefish	<i>Hippichthys penicillus</i>	Listed marine species	-	Likely to occur
Bentstick Pipefish	<i>Trachyrhamphus bicoarctatus</i>	Listed marine species	-	Likely to occur
Blue-speckled Pipefish	<i>Hippichthys cyanospilos</i>	Listed marine species	-	Likely to occur
Mud Pipefish	<i>Halicampus grayi</i>	Listed marine species	-	Likely to occur
Short-keel Pipefish	<i>Hippichthys parvicarinatus</i>	Listed marine species	-	Likely to occur
Spotted Seahorse	<i>Hippocampus kuda</i>	Listed marine species	-	Likely to occur
<b>Marine mammals</b>				
Australian/Indo-Pacific Humpback Dolphin	<i>Sousa sahalensis /S. Chinensis</i>	Migratory Listed whales/other cetaceans Vulnerable	-	Known to occur

Common Name	Scientific Name	EPBC Act Listing	TPWC Act	Likelihood of occurrence
Australian Snubfin Dolphin	<i>Orcaella heinsohni</i>	Migratory Listed whales/other cetaceans Vulnerable	-	Known to occur
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	<i>Tursiops aduncus</i> (Arafura/Timor Sea populations)	Migratory Listed whales/other cetaceans	-	Known to occur
<b>Marine reptiles</b>				
Stokes' Sea Snake	<i>Hydrophis stokesii</i>	Listed marine species	-	Likely to occur
Green Turtle	<i>Chelonia mydas</i>	Listed marine species Migratory Vulnerable	-	Known to occur
Saltwater Crocodile	<i>Crocodylus porosus</i>	Listed marine species Migratory	-	Known to occur
Flatback Turtle	<i>Natator depressus</i>	Listed marine species Migratory Vulnerable	-	Known to occur

## Nationally important wetlands

Darwin Harbour is listed as a wetland of national significance in the Directory of Important Wetlands in Australia (Port Darwin NT029) and is a good example of a shallow branching embayment that supports important habitats (e.g. mangrove swamps) and has high cultural significance.

## Biological important areas

Darwin Harbour has been identified as a BIA for breeding and foraging, for Australian snubfin dolphin (*O. heinsohni*), Indo-Pacific humpback dolphin (*S. chinensis*) and Indo-Pacific bottlenose dolphin (*T. aduncus*). Darwin Harbour is also considered a BIA for flatback turtle internesting. While Darwin Harbour is a known BIA for dolphins and the flatback turtle, there are no significant marine turtle nesting beaches or dolphin feeding habitats in the vicinity of the Ichthys LNG facility.

### 5.2.2 Marine Habitats

Darwin Harbour has a complex assemblage of marine habitats and there are large differences in the extent, diversity and significance of the associated biological communities. The most common marine habitat around Bladin Point is soft-bottom benthos and sediment.

There are also small areas of mixed community reef and reef with less than 10% macrobiota in the vicinity of Bladin Point. Other marine communities in Darwin Harbour include communities dominated by macroalgae and filter-feeders. The composition, abundance and/or spatial extent of some communities in Darwin Harbour (such as macroalgae and seagrass) varies between the wet season and dry season. Marine habitats in proximity to the Project Area are shown in Figure 5-4.

## Mangrove communities

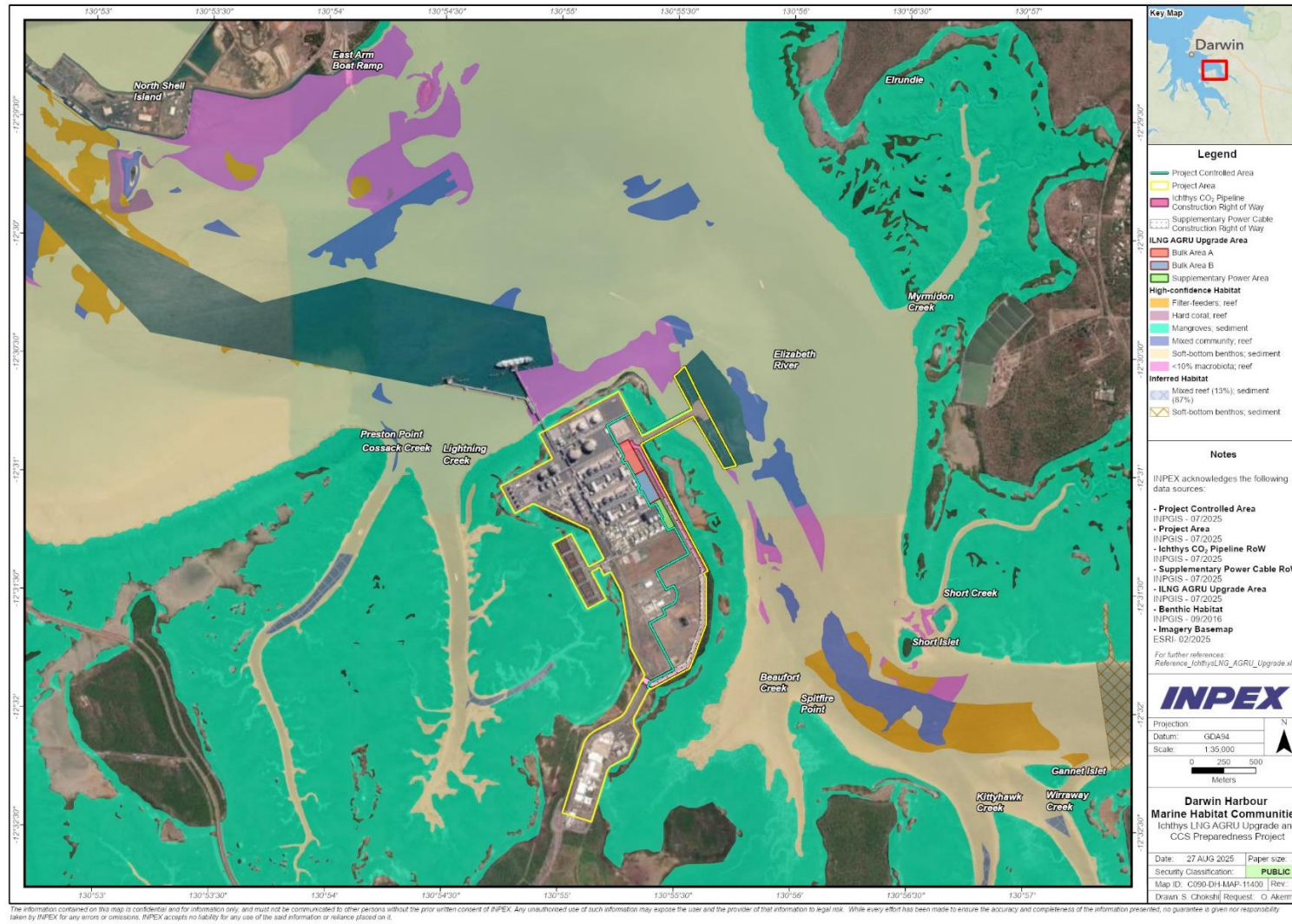
Bladin Point lies within the Darwin Coastal Bioregion, which is characterised by mangroves, monsoon vine forest and tall open eucalypt forest. The mangrove communities around the onshore facilities are considered to have high conservation value in Darwin Harbour for biological and cultural reasons but are considered regionally common (refer to Figure 5-5 for a map of mangrove and salt flat habitat distribution).

Mangrove communities are important to the ecological health of Darwin Harbour and provide food and shelter for a wide range of animals (e.g. nursery grounds for juvenile fish and crabs). Mangroves in the Darwin Harbour area constitute approximately 44% of the mangrove communities in the Darwin Coastal Bioregion and about 5% of the total mangrove area of the NT. Darwin Harbour is also recognised for its mangrove diversity, containing 36 of the 50 known mangrove species worldwide.

Mangrove mapping by Brocklehurst et al (2018) indicates that the mangrove communities present adjacent to the pipeline ROW Corridor include the following species:

- *Rhizophora stylosa/Camptostemon schultzei* low to mid closed-forest/open-forest (shoreline forest and tidal creek forest) (group 1a & 2a)
- *Rhizophora stylosa/Bruguiera spp/Ceriops spp* low closed-forest/low open-forest (transition zone) (group 3a)
- *Ceriops tagal* low closed-forest/low open-forest (tidal flats) (group 4a)
- Mixed species low closed-forest (hinterland) (group 4b)
- *Ceriops tagal* low closed-forest/open-forest (hinterland) (group 4c); and

- *Avicennia marina/Ceriops* spp low open-forest/low closed-forest (group 5b)
- Mixed species low open-forest/low closed-forest (group 5c)
- *Sonneratia alba* low woodland/low open forest (group 8).



**Figure 5-4: Marine habitats in proximity to the Project Area**

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**Figure 5-5: Vegetation communities in proximity to the Project Area**

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### 5.2.3 Terrestrial vegetation

The Project site was cleared during the construction of the Ichthys LNG facility, with no remaining vegetation existing within the Project Area. Annual weed surveys have been undertaken in and around Ichthys LNG facility since 2008. Weed surveys have recorded the following weed species which are listed as declared weeds under the *Weeds Management Act 2001* (NT) within the Ichthys LNG facility boundary:

- Flannel weed (*Sida cordifolia*): located on the southeastern boundary of the operations complex
- Lion's tail (*Leonotis nepetifolia*): located on the southeastern boundary of the operations complex
- Barnyard grass (*Echinochloa colona*): located on the eastern boundary of Ichthys LNG
- Perennial mission grass (*Cenchrus polystachios*; formerly known as *Pennisetum polystachion*): located in the southwestern corner of the operations complex and south of Ichthys LNG.
- Mimosa (*Mimosa pigra*): recorded in small, isolated patches of the site.
- Sicklepod (*Senna obtusifolia*): recorded in small, isolated patches of the site.

### 5.2.4 Fauna

Baseline surveys for the Ichthys LNG project (GHD 2009) recorded 148 vertebrate species, including nine mammal species, 106 bird species, 22 reptile species and 11 frog species (GHD 2009).

A survey of biting insects at Bladin Point found that biting midges were much more abundant than mosquitoes (Department of Health and Families 2009). The most common biting midge recorded was *Culicoides ornatus* (mangrove biting midge) and the most common mosquito species recorded was *Aedes vigilax* (northern salt marsh mosquito).

Introduced terrestrial fauna species recorded on Bladin Point include the cane toad (*Rhinella marina*), feral pigs (*Sus scrofa*), cats (*Felis catus*), black rat (*Rattus rattus*) and insect pest species. The cane toad is the most widely occurring pest species recorded on Bladin Point. Feral cats were recorded along the GEP in December 2013 (AEC Environmental 2014). The tracks of dogs or dingos were also recorded in December 2013; however, no animals were sighted (AEC Environmental 2014).

No fauna habitats exist within the Ichthys LNG facility development footprint, following completion of construction. Where fauna is located within the Ichthys LNG facility fence boundary these are removed and relocated by appropriately trained and qualified site personnel under Ichthys LNG Onshore Operations Environmental Management Plan.

#### Shorebirds

Targeted shorebird survey data available from 2018 to 2022 from the Middle Arm Peninsula and surrounds were compiled as part of the Middle Arm Sustainable Development Precinct (MASDP) environmental assessment (EcOz 2023). A summary of the shorebird surveys completed are presented below.

The shorebird habitat availability and distribution within the Middle Arm Peninsula is relatively well understood (EcOz 2023). The Middle Arm Peninsula is surrounded by an extensive intertidal zone, with previous targeted surveys showing that shorebirds are distributed throughout this zone at low tide in a manner that does not indicate strong preferential use of available foraging habitat (EcOz 2023).

Twelve shorebird species have been recorded within the Middle Arm Peninsula. Of the 12 species recorded, seven migratory shorebird species are currently listed under the EPBC Act or TPWC Act, including (EcOz 2023):

- Far Eastern Curlew (Critically Endangered)
- Bar-tailed Godwit (Endangered<sup>4</sup>)
- Common Greenshank (Endangered)
- Greater Sand Plover (Vulnerable)
- Grey Plover (Vulnerable)
- Sharp-tailed Sandpiper (Vulnerable)
- Terek Sandpiper (Vulnerable).

Shorebird count data for Middle Arm between 2018 and 2022 is presented in Figure 5-6.

The intertidal areas along Middle Arm from Lightning Creek to the north-west of the Peninsula – including Cossack Creek – represent one of three key foraging sites within Darwin Harbour (EcOz 2023). Large congregations of shorebirds have been recorded during low tide aerial surveys on the intertidal mudflat between the Bladin Point (INPEX operations) and the Darwin LNG plant (Lilleyman et al. 2020 in EcOz 2023). However, survey records show that areas immediately surrounding Ichthys LNG (within 1 km buffer) are not core habitat in context to surrounding areas of the Middle Arm Peninsula.

The salt pans (used as roost sites) surrounding Ichthys LNG are not used by the shorebirds and fewer shorebirds have been observed within the intertidal foraging habitat in comparison the surrounding Middle Arm Peninsula.

The threatened shorebird species that have been observed within 1 km of the Ichthys LNG facility (Far Eastern Curlew, Common Greenshank, Greater Sand Plover, and Terek Sandpiper) have been also observed in greater numbers in other areas of the Darwin Harbour. For example:

- The Far Eastern Curlew is shown to predominantly use roost sites within the north, south and west salt pan habitat areas, located further west of the Ichthys LNG facility. During 2019, 14 individuals were recorded off Bladin Point north of the Ichthys LNG site. The extensively available intertidal foraging habitat broadly across the Middle Arm Peninsula, is also used by this species, with annual surveys from 2019 to 2021 recording between 35 and 110 individuals, meeting the threshold for national significance for this species during these surveys.
- Seven Bar-tailed Godwit (sub-species *Limosa lapponica menzbieri*) were recorded within the Middle Arm Peninsula (Wickham Point and the Elizabeth River intertidal zone). There are no known records within 1 km buffer of the Ichthys LNG facility. The threshold for nationally important habitat for Bar-tailed Godwit is not met within any count in Middle Arm Peninsula or elsewhere in the Darwin Harbour (EcOz 2023). Most records of this species are located in the North Darwin region at East Point, Casuarina Coastal Reserve or Lee Point (EcOz 2023).
- The Common Greenshank has a wide spread of foraging and roosting around the harbour (EcOz 2023), with only several records within 1 km buffer of the Ichthys LNG facility.
- The Middle Arm Peninsula supports both roosting and foraging habitat for the Greater Sand Plover (EcOz 2023). Of the 39 individual records on the Middle Arm Peninsula during 2019, six records were within 1 km buffer of the Ichthys LNG facility, five within the Bladin Point intertidal foraging habitat, and one record off Bladin Point. For

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<sup>4</sup> Listed as critically endangered under the TPWC Act

context, most records of this species are located in the north Darwin region at East Point, Casuarina Coastal Reserve and Lee Point. The threshold for nationally important habitat is not met for any count in Middle Arm Peninsula (EcOz 2023).

- Grey Plover habitat use and counts are sparse within the Middle Arm Peninsula and the broader Darwin Harbour area, with only one individual recorded in the Middle Arm Peninsula (EcOz 2023). No Grey Plover species have been recorded within 1 km of the Ichthys LNG facility.
- Four Sharp-tailed Sandpiper individuals have been recorded within the Middle Arm Peninsula. None of this species has been recorded within 1 km of the Ichthys LNG facility.
- The Middle Arm Peninsula supports nationally important habitat for the Terek Sandpiper. The threshold for national importance has been met twice, once in 2019 (100 individuals) and again in 2021 (57 individuals). The count of a flock of 100 birds was on intertidal foraging habitat off Bladin Point, within the 1 km buffer of the Ichthys LNG facility. For context, most records of this species are located in the North Darwin region at East Point, Casuarina Coastal Reserve or Lee Point. The threshold for nationally important habitat has therefore been exceeded six times recently at East Arm Wharf (EcOz 2023).

### Marine reptiles

Six species of marine turtles are known to occur in Northern Territory waters, although the green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*) and flatback (*Natator depressus*) turtles are the only species known to frequent Darwin Harbour regularly.

Green turtles inhabit areas of coral and rocky reefs and inshore seagrass and algal beds. Adult green turtles are herbivorous feeding primarily on seagrasses and algae, while juveniles are carnivorous (NTG 2021a; DCCEEW 2025a). The hawksbill turtle prefers rocky and coral reef habitats where it feeds on a wide variety of plants and animals including sponges, gastropods, seagrass and algae (NTG 2021b; DCCEEW 2025b). Flatback turtles inhabit shallow, soft-bottomed seabeds and feed on soft corals and soft bodied animals such as jellyfish and sea cucumbers (NTG 2021c).

Aerial turtle surveys undertaken by INPEX during the execution of the Ichthys Project estimated a population size of between 500 and 1,000 for the Darwin region (Cardno 2014). Turtles were primarily observed in shallow waters (<10 m), with the highest densities recorded between East Point and Lee Point, and near Gunn Point (Cardno 2015b). Turtles were also sighted throughout Darwin Harbour, although at lower densities. It is likely that the majority of turtles observed in the Harbour during these surveys were green turtles, as they accounted for 74% of sightings during fine scale land-based observations.

No turtle nesting sites are known to occur in Darwin Harbour, with the closest nesting site in the Darwin region located at Casuarina Beach. Other turtle nesting sites include Bare Sand Island and Quail Island located near the mouth of Bynoe Harbour (~50 km from Darwin). Within the Darwin region most turtle nesting is associated with flatback turtles, with only small numbers of other turtle species occasionally nesting in the area. A study undertaken by Chatto and Baker (2008) found that flatback turtle nesting predominately occurred between May and October; however, it was noted that at locations such as Casuarina Beach nesting was recorded in small numbers throughout the year.

The saltwater crocodile (*Crocodylus porosus*) is a common resident of Darwin Harbour and surrounds. In 2020 a total of 246 crocodiles were removed from Northern Territory waters with a majority of these being caught within Darwin Harbour (NTG 2021d). Saltwater crocodiles breed during the wet season between October and May. Preferred nesting habitat of the saltwater crocodile includes elevated, isolated freshwater swamps that do not experience the influence of tidal movements (DCCEEW 2025c). Nesting within Darwin Harbour is limited (INPEX 2010).

### **Marine mammals**

A number of marine mammal species frequent or are known to inhabit Darwin Harbour and its surrounds, including coastal dolphins, dugongs and whales. Of these, the most commonly recorded marine mammals in Darwin Harbour are dolphin species.

The Australian snubfin (*Orcaella heinsohni*), the Australian humpback (*Sousa sahulensis*) and the Indo-Pacific bottlenose (*Tursiops aduncus*) are all dolphin species known to have resident populations within Bynoe Harbour, Darwin Harbour and Shoal Bay. Long-term monitoring (2011 to 2019) highlighted a small, mobile and variable nature of dolphin populations in the Darwin region (Griffiths et al. 2020). Population estimates for the Darwin region between surveys varied between 75 and 169 dolphins with an average of 141 dolphins. Darwin Harbour has been identified as a biological important area (BIA) for breeding and foraging, for all three dolphin species.

Dugongs (*Dugong Dugon*) are also known to occur in the Darwin region. Dugong monitoring using aerial surveys was undertaken during execution of the Ichthys Project, population estimates calculated from sightings observed during these surveys suggest that approximately 180 to 300 individuals inhabit the Darwin region (Cardno 2014). Dugongs feed almost exclusively on seagrass and their distribution is broadly coincident with seagrasses in tropical and sub-tropical waters (DCCEEW 2025d).



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**Figure 5-6: Migratory shorebird count data for Middle Arm between 2018 and 2022 (EcOz 2023)**

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## 5.3 Cultural environment

### 5.3.1 Onshore cultural heritage objects/sites

Middle Arm Peninsula is located within the traditional country of the Larrakia people. During archaeological surveys undertaken to support the construction of the Ichthys LNG facility, a number of Aboriginal heritage sites were identified in and adjacent to the onshore development area. Following consultation with the Larrakia Heritage Management Executive Committee<sup>5</sup> and NT Heritage Branch the following actions were taken:

- sites and objects within the Ichthys LNG fence line were removed or relocated to an agreed location ("Heritage Hill")
- sites and objects outside of the Ichthys LNG fence line have been protected using measures such as the implementation of conservation zones.

Aboriginal heritage sites recorded adjacent to or near the Ichthys LNG facility are protected under the *Heritage Act 2011* (NT), these are described in Table 5-6. There are no known Aboriginal heritage sites within the fence line of the Ichthys LNG facility, where Project activities are planned to be undertaken.

In addition to Aboriginal heritage sites, archaeological surveys undertaken to support the Ichthys LNG Development Project identified World War II objects on Bladin Point. Objects found within the vicinity of Ichthys LNG were deemed to not be of heritage value and were removed following consultation with the NT Heritage Branch. There are no known World War II heritage sites within, where Project activities are planned to be undertaken.

**Table 5-6: Heritage sites in proximity to the Project Area**

Site	Description	Significance
Cultural Heritage Conservation Zone 2	Shell middens and mounds	Low to moderate
Cultural Heritage Conservation Zone 3	Shell midden and mounds	Low to high
Heritage Hill	Shell, stone and glass scatters	Low
ISO2 and ISO3	Relocated material including shell and stone artefact scatters	Low
ISO25	Quartz and three shells	Low
Site 1	Isolated scatter of quartz flakes	Low
Site 3	Shell midden	Low

<sup>5</sup> The Larrakia Heritage Management Executive Committee was established by INPEX prior to the construction of the Ichthys LNG facility. The committee is now referred to as the Ichthys Larrakia Advisory Committee.

### 5.3.2 Sacred sites

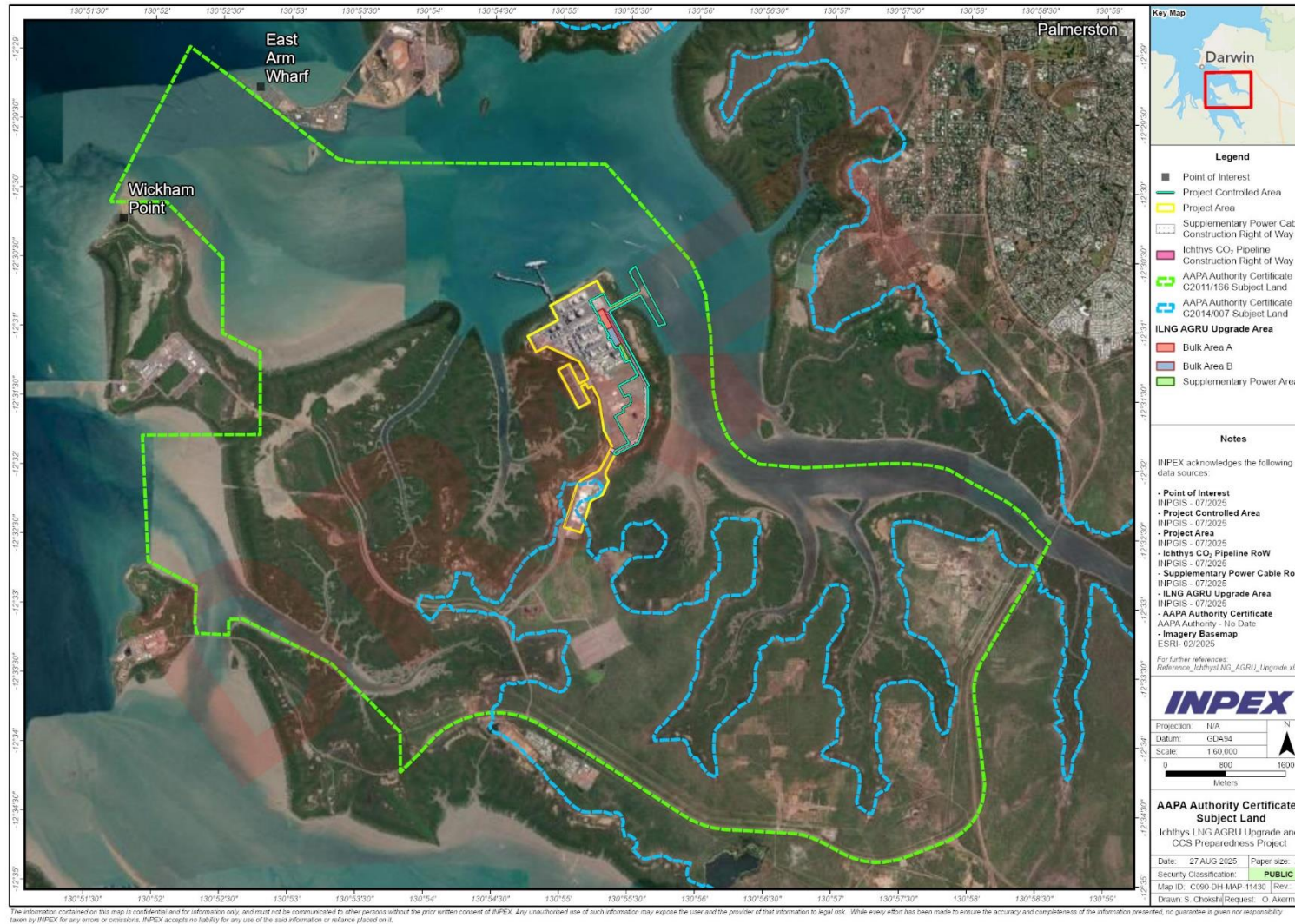
Sacred sites are places within the landscape that have a special meaning or significance under Aboriginal tradition. In coastal and sea areas, sacred sites may include features that lie both below and above the water (AAPA 2025). There are several sacred sites in Darwin Harbour and the surrounding waters. All sacred sites within the NT are protected under the *Northern Territory Aboriginal Sacred Sites Act 1989* (NT).

Anyone proposing to use or work on land in the NT may apply to the AAPA for an Authority Certificate to cover their proposed activities. Authority Certificates are issued following consultation with traditional custodians and include conditions on what can and cannot be done in and around identified sacred sites. The Larrakia people are acknowledged as the traditional owners of the area in and around Darwin.

INPEX holds two Authority Certificates, which cover the locations and the activities required to be undertaken by the Project (refer to Table 5-7 and Figure 5-7).

**Table 5-7: AAPA Authority Certificates relevant to Project activities**

Certificate reference	Subject land	Proposed work or use
C2011/166	Section 1813 Hundred of Ayres, Section 1814 Hundred of Ayers, NT Portion. 2367 and Middle Arm, inclusive of adjacent areas of mangroves and Darwin Harbour waters.	All works necessary to plan, develop, operate and maintain an industrial estate for gas-based industry, including but not limited to seabed dredging activities.
C2014/007	Part of Darwin Harbour.	Environmental monitoring programs involving one or more of the following general activities: soft bottom benthos monitoring, water quality and sedimentation, marine pest monitoring, fish and invertebrate monitoring.



**Figure 5-7: Subject land of obtained AAPA Authority Certificates**

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## **5.4 Socio-economic environment**

### **5.4.1 Recreational use of Darwin Harbour**

Darwin Harbour is a prime recreational and tourism resource for the NT, with activities such as fishing, boating, water skiing and beach use being popular activities. Fish species commonly targeted in Darwin Harbour by recreational fishers include snapper, mud crab, barramundi, small bait fish and some game fish. Boat ramps in the inner Darwin Harbour include Channel Island, Dinah Beach, East Arm and Palmerston.

### **5.4.2 Darwin Port operations**

Darwin Harbour is a working port and is developing into a major service centre for the mining and energy sectors. Darwin Port operations consist of marine traffic of non-commercial vessels (e.g. recreational anglers) and trading vessels, including commercial ships carrying cargo and passengers, rig tenders, tankers and bulk-cargo vessels that regularly utilise East Arm Wharf and Hudson Creek.

## 6 STAKEHOLDER CONSULTATION

INPEX believes effective stakeholder consultation is essential in maximising the safety of Company and Contractor personnel, and the community; and in establishing, building and maintaining community support and trust. INPEX works closely with identified stakeholders to provide integrated, timely and effective information to the community and provide mechanisms for feedback and response.

INPEX's approach to integrated stakeholder consultation is based on five key principles:

- regular personal contact with key stakeholders
- consistent, timely, coordinated and responsive communication across all stakeholder groups
- upfront communication about issues and impacts
- easily accessible information; and
- ongoing monitoring and improvement.

Section 43 of the EP Act (NT) outlines the general duty of proponents and includes specific requirements for stakeholder consultation. Specifically, the EP Act requires the following:

*A proponent of an action has the following general duties under an environmental impact assessment process:*

- To provide communities that may be affected by a proposed action with information and opportunities for consultation to assist each community's understanding of the proposed action and its potential impacts and benefits;*
- To consult with affected communities, including Aboriginal communities, in a culturally appropriate manner; and*
- To seek and document community knowledge and understanding (including scientific and traditional knowledge and understanding) of the natural and cultural values of areas that may be impacted by the proposed action.*

In addition to the EP Act requirements, the NT EPA Stakeholder Engagement and Consultation: Environmental Impact Assessment Guidance for Proponents (NT EPA 2021; SEC) outlines the expectations of the NT EPA with regards to stakeholder consultation. The SEC outlines that proponents are responsible for undertaking stakeholder consultation from the earliest stage of the environmental impact assessment process, and that stakeholder consultation would continue throughout the life of an activity.

An overview of INPEX's approach to stakeholder consultation, the stakeholder consultation undertaken to inform the development of the Draft Ichthys LNG AGRU Upgrades and CCS Preparedness Construction and Commissioning Environment Management Plan (Draft CCEMP) and supporting approval applications, and the ongoing stakeholder consultation activities that would be undertaken throughout the execution of the Project is described in the following sections.

### 6.1 Overview of stakeholder consultation process

An overview of INPEX's approach to stakeholder consultation is presented in the following sections. A full description of the approach is provided in the Ichthys LNG AGRU Upgrade and CCS Preparedness Stakeholder Engagement Plan (Appendix C), which has been provided separately to the NT EPA as a standalone document.

### 6.1.1 Stakeholder mapping

INPEX has undertaken a stakeholder mapping exercise to identify relevant stakeholders and ensure they are engaged in the most effective manner with targeted and responsive engagement activities for the purposes of the Project.

Stakeholders were initially screened to establish if their functions or activities could be potentially impacted as result of either overlap with the Project Area or as a result of Project activities. Where there was no perceived effect on a stakeholder's functions or activities the stakeholder was not considered further.

It is acknowledged that through the process of consulting with identified stakeholders, additional stakeholders may be brought to INPEX's attention.

### 6.1.2 Timing

Timing of stakeholder engagement will be implemented during the following key stages, as follows:

- Pre-referral engagement - the purpose of the engagement was to:
  - obtain advice on appropriateness of proposed management controls; and
  - obtain advice on required notifications and ongoing engagement requirements.
- Ongoing engagement – the purpose of this engagement is to:
  - provide sufficient notice to key stakeholders prior to the commencement of the Project to ensure effective communication of the timing of works, and the associated safety and environmental measures
  - provide information throughout the Project, to support safety outcomes and manage potential community impacts; and
  - provide confirmation of completion of the above to communicate the Project outcomes.

### 6.1.3 Engagement tools

A range of tools will be used to target and engage with stakeholder groups in an appropriate manner. INPEX considers industry best practice standards and codes of conduct in designing project specific engagement. These tools build on the successful activities employed by INPEX in the NT since 2009 and are informed by stakeholder needs and requirements. INPEX will continue to maintain and develop stakeholder relationships given the long-term operational life of the Project.

Engagement tools may include formal briefings for stakeholders, public information forums, advertising and media (including social media), fact sheets, INPEX website, INPEX 1800 community feedback line and INPEX enquiries email account.

## 6.2 Stakeholder consultation – Pre-referral

The complete stakeholder register, outlining stakeholders who were consulted during the pre-referral stage and any relevant information that was provided to them for consideration, is presented in Appendix D. Where feedback was received a summary of this and how it has been addressed in the Referral Report and the Draft CCEMP is provided in Table 6-1.

**Table 6-1: Summary material matters raised**

Stakeholder	Summary of material stakeholder feedback	Summary of INPEX response or actions
DAFF	DAFF provided advice that in order to receive modules over at the MOF the location would need to become a “first point of entry” and meet certain DAFF criteria. Personnel directly involved in the import of modules and receipt of modules at the MOF location will complete the DAFF Biosecurity Awareness Learning package	INPEX has incorporated the relevant requirements into the Draft CCEMP (Appendix E; refer to Section 6.5)
DME	DME provided advice that a pipeline licence was not required under the <i>Energy Pipelines Act 1981</i> if it started and terminated within Ichthys LNG boundaries.	Refer to Section 2.3.2 - CO <sub>2</sub> pipeline.
Larrakia Development Corporation	Concerns raised regarding sacred sites and heritage management during Project activities.	INPEX has obtained all relevant AAPA certificates (Refer to Section 5.3.2). The location where Project activities would occur is a previously disturbed site (Refer to Section 2.2 and 5.3.1) INPEX has incorporated a chance find procedure into the Draft CCEMP (Appendix E; refer to Section 6.7)
City of Palmerston	The City of Palmerston raised concerns about workers utilising parking within community areas.	Early consideration in Project planning to manage potential for localised impacts to community parking amenity, traffic, bussing used to minimise traffic (refer to Section 2.3.7)
Department of Logistics and Infrastructure (DoLI) – Regional Harbourmaster	DoLI outlined their ongoing engagement expectations specific to harbour activities associated with the Project.	INPEX has incorporated the relevant requirements into the Draft CCEMP (Appendix E; refer to Section 6.5)

### 6.3 Stakeholder consultation – Ongoing

Stakeholder engagement that will be undertaken throughout the life of the Project is described in the Ichthys LNG AGRU Upgrade and CCS Preparedness Stakeholder Engagement Plan (Appendix C), which has been provided separately to the NT EPA as a standalone document.

## **7 NT EPA ENVIRONMENTAL FACTORS AND VALUES ASSESSMENT**

The NT EPA has identified 14 environmental factors categorised under five themes of Land, Water, Sea, Air and People. These environmental factors are broad divisions of the environment that may be impacted by a proposed action and provide for a systematic approach for organising information for the purpose of environmental impact assessment (NT EPA 2022).

To determine if the proposed Ichthys LNGAGRU upgrade and CCS Readiness Project could impact on any environmental factors identified by the NT EPA, a preliminary assessment (i.e. Pre-referral screening) was undertaken. This assessment was informed by information presented in Section 5 on the existing environment. Outcomes of the preliminary assessment are presented in Appendix A.

In summary, the preliminary assessment identified that the proposed Project had the potential to impact on the following environmental factors:

- Land – terrestrial environmental quality
- Land – terrestrial ecosystems
- Sea – marine environmental quality
- People – culture and heritage
- People – community and economy.

A detailed assessment of the potential impacts and their significance and proposed controls to manage/mitigate these is provided in Section 8.

## 8 POTENTIAL IMPACTS AND MANAGEMENT

The preliminary assessment (Appendix A) identified that the proposed Project had the potential to impact on the following environmental factors:

- Land – terrestrial environmental quality
- Land – terrestrial ecosystems
- Sea – marine environmental quality
- People – culture and heritage
- People – community and economy.

### 8.1 Environmental risk assessment

For the purposes of the risk assessment, an environmental aspect is defined as a feature or characteristic of proposed Project activities that has the potential to affect the environment.

Following the identification of activities, which could result in a particular environmental aspect, the potential environmental impacts associated with each aspect were identified. For each source of environmental risk, control measures were then identified for evaluation. Where the level of risk reduction achieved by these control measures was determined to be grossly disproportionate to the “cost”<sup>6</sup> of implementing them, the control measure was not included, and the risk was considered to be managed too as low as reasonably practicable.

The consequence and likelihood of each impact was then assessed to determine the residual risk that remained after controls to be implemented were taken into consideration.

The consequence is defined as an outcome or impact from an event occurring. For the purposes of the assessment, the consequence level applied was based on the credible worst-case scenario and assumed no control measures were in place.

The likelihood can be described as the level of probability that, or the frequency with which, the described consequence will impact upon the environment. When determining the likelihood of a consequence occurring, any proposed control measures identified to mitigate the potential impact were considered.

The risk matrix used to determine the risk of impact from the Project is provided in Figure 8-1. The outcomes of the risk assessment as they relate to NT EPA environmental factors, are presented in sections 8.2, 8.3, 8.4, 8.5 and 8.6.

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<sup>6</sup> Cost includes financial cost, time or duration, effort, occupational health and safety risks, or environmental impacts associated with implementing the control.



# Risk Matrix

Refer to the Risk Matrix Guideline [0000-A0-GLN-70019] for guidance on how to apply the risk matrix.

LIKELIHOOD TABLE						
Experience History of occurrence in Company or Industry with a similar context and/or timeframe	Unheard of in the industry or in Projects	Has occurred once or twice in the industry or rarely occurs in Projects	Has occurred many times in the industry but not in the company	Has occurred once or twice in the company or Projects	Has occurred frequently in the company or in many Projects	Has occurred frequently at the location or in every Project
Frequency Continuous Operation	Once every 10,000 – 100,000 years at location	Once every 1,000 – 10,000 years at location	Once every 100 – 1,000 years at location	Once every 10 – 100 years at location	Once every 1 – 10 years at location	More than once a year at location or continuously
Qualitative probability* Based on expert judgement	< 1% Less than 1 in 100	1% - 5% Up to 1 in 20	> 5% - 20% Up to 1 in 5	> 20% - 50% Up to 1 in 2	50% - 80% Up to 4 in 5	> 80% Greater than 4 in 5
* Qualitative probability is not to be used for Health & Safety or Environment risk assessments						
CONSEQUENCE TABLE						
Consequences						
Severity	Likelihood Level					
	6 Remote	5 Highly Unlikely	4 Unlikely	3 Possible	2 Likely	1 Highly Likely
A Catastrophic	6	5	4 <b>Critical Risk</b>	3	2	1
B Major	7	6	5	4	3	2
C Significant	8	7	6 <b>High Risk</b>	5	4	3
D Moderate	9	8	7	6	5	4
E Minor	10	9	8 <b>Moderate Risk</b>	7	6	5
F Insignificant	10	10	9 <b>Low Risk</b>	8	7	6

Severity Level	Consequences						
	Financial (USD)	Ichthys Production	Health & Safety	Environment	Reputation	Community	Legal
A	> \$1B	> 30 days Ichthys full shutdown	> 20 fatalities or permanent total disabilities	Regional scale event, permanent impact on environment. Eradication of local populations of protected species	Prolonged international multi-NGO and media condemnation and public protests. Loss of host government support and/or social licence to operate. Company reputation severely tarnished	Catastrophic and long-term impact, and destruction of highly valued social and cultural matters	Prosecution, potential jail sentences for directors and senior officers. Prolonged litigation, heavy fines (>\$50M), threat to license to operate and future approvals
B	\$100M – \$1B	> 10 days Ichthys full shutdown	2 – 20 fatalities or permanent total disabilities	Large scale event, long term impact on environment. Extensive impact on populations of protected species	International multi-NGO and media condemnation. Host government registers concerns. Prolonged large protests. Company reputation seriously impacted	Major and widespread disruption to a number of communities with damage to highly valued social and cultural matters	Prosecution of company, directors or senior officers. Prolonged litigation, heavy fines (<\$50M), significant restrictions on license to operate
C	\$10M – \$100M	3 – 10 days Ichthys full shutdown	Serious injury or fatality	Medium to large scale event, medium term impact on environment. No threat to overall population viability of protected species	Serious public or national media outcry. Damaging NGO campaigns. Large protests. Company reputation impacted	Significant disruption and impact to a community, regional communities, and to social and cultural matters of significant value	Significant, or multiple moderate breaches of legislation, regulation, contract or license conditions. Significant litigation and fines (<\$5M)
D	\$1M – \$10M	1 – 3 days Ichthys full shutdown	Permanent partial disability, serious illness or lost time injury	Local to medium scale event with short to medium term impact on environment. No threat to overall population viability of protected species	Major adverse national media, public or NGO attention. Significant protests. Asset reputation impacted	Regional community concern or disruption with moderate impact on social and cultural values	Moderate breach of legislation, regulation, contract or license condition. Investigation by regulatory authorities. Potential litigation and moderate fines (<\$1M)
E	\$100K – \$1M	Production Trip with immediate restart < 1 day Ichthys full system lost production	Alternate duties injury, medical treatment injury, minor illness	Local scale event with short term impact on the environment. Minor and temporary impact on a small portion of the population of protected species	Attention from regional media with heightened concern of local community. Criticism by community or NGOs	Minor and localised community concern or disruption with limited and short-term impact on social and cultural values	Minor breach of legislation, regulation, contract or license condition. Report provided to regulatory authorities. Potential for minor fines (<\$100K)
F	< \$100K	Insignificant production impact	First aid case	Local scale event with temporary impact on environment. Behavioural responses inconsequential ecological significance to protected species	Short term local concern or complaints. Low level media or regulatory issue – potential for community or union concerns	Isolated community concern with no lasting effect on social and cultural values	Breach of internal standards. Potential scrutiny by regulatory authorities

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Figure 8-1: INPEX Australia risk matrix

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## 8.2 Land – terrestrial environmental quality

As identified in Section 7, Project activities have the potential to impact on the following environmental factor - *terrestrial environmental quality*. Specifically, inappropriate erosion and sediment control during civil construction, ASS/PASS disturbance or accidental loss/spills or mismanagement of chemicals and hazardous substances. The following sub-sections provide a description of the potential impacts and proposed key management controls to mitigate any potential impacts. Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts are described in the Draft CCEMP (Appendix E).

### 8.2.1 Relevant policy and guidelines

The following conventions, legislation, policy and guidelines are relevant:

- WMPC Act (NT)
- *Dangerous Goods Act 1998* (NT)
- IECA Best Practice Erosion and Sediment Control Guidelines (IECA 2008)
- National Acid Sulfate Soils Sampling and Identification Methods Manual (Sullivan et al. 2018)
- National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments (National Guidance; Shand et al. 2018)
- National Strategy for the Management of Coastal Acid Sulfate Soils (National Working Party on Acid Sulfate Soils 2000)
- Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines Version 5.1 (Dear et al. 2024).

### 8.2.2 Environmental context

Soils and geology within the Bulk Area and pipeline ROW are described in Section 5.1.4.

### 8.2.3 Potential impacts

The following activities have the potential to impact on terrestrial environmental quality adjacent to the proposed development footprint if not managed appropriately:

- Civil construction activities may result in erosion and sediment loss.
- Disturbance and exposure of ASS/PASS during excavation or trenching activities, resulting in acidification of soil or water.
- Mishandling of chemicals and hazardous substances resulting in contamination of soil.
- Accidental loss of containment/spills of chemicals and hazardous substances resulting in contamination of soil.

### 8.2.4 Management

***NT EPA environmental objective:***

*Protect the quality and integrity of land and soils so that environmental values are supported and maintained.*

To meet the NT EPA environmental objective for terrestrial environmental quality, the following key management controls will be implemented to minimise/mitigate any potential indirect impacts from ASS/PASS, or accidental loss and/or mishandling of chemicals, hydrocarbons or hazardous substances:

- Erosion and sediment control management:
  - A site-specific Erosion and Sediment Control Plan (ESCP) will be prepared in accordance with the IECA Best Practice Erosion and Sediment Control Guidelines (IECA 2008) and endorsed by a Certified Professional Erosion and Control Specialist, to manage erosion risk. The ESCP will include:
    - temporary and permanent control measures
    - protection of stockpiles and exposed soil areas
    - ongoing inspection and maintenance of controls when in effect.
  - Erosion protection infrastructure (e.g. silt fencing, contouring, etc.) will be installed in accordance with developed ESCP to ensure that sediment is contained within the construction area as far as is practicable.
  - All stormwater discharge from within the construction area will be in accordance with water quality criteria within the ESCP.
- ASS/PASS management:
  - Based on previous studies ASS/PASS is highly unlikely to be encountered within the Bulk Area.
  - While the chance of encountering ASS/PASS within the pipeline ROW within Ichthys LNG is considered highly unlikely, a geotechnical program will be undertaken to confirm the presence/absence of ASS/PASS, prior to commencement of construction.
  - Where suspected ASS/PASS is encountered during excavations it will be kept separate from other spoil material. Any suspected ASS/PASS will be transferred to a dedicated treatment pad for stockpiling.
  - Where onsite stockpiling/treatment of ASS is required, dedicated ASS/PASS treatment pads will be constructed in accordance with National Guidance (Shand et al. 2018).
- Chemicals and hazardous substances management:
  - Personnel who routinely handle hazardous materials or wastes (e.g. refuelling personnel, pump operators, mechanics, and stores personnel) will receive training in handling, transporting and storing hazardous materials or wastes; in reporting and documentation requirements; and in spill clean-up techniques and practices.
  - Use, handling, storage and disposal of all hazardous materials and dangerous goods will be in accordance with the *Dangerous Goods Act 1998* and the WMPC Act.
  - A variety of temporary bunding will be available for use around the site, including banded pallets and drip trays.
  - Refuelling of vehicles will occur within dedicated areas.
  - Chemicals and substances used during the Project will be selected in accordance with the INPEX chemical selection process.
  - Spill kits will be located on site in accessible locations and will be regularly inspected and maintained.

Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts, are described in the Draft CCEMP (Appendix E).

### 8.2.5 Residual risk

Given the proposed mitigation measures to be implemented during construction activities, the expected residual impact associated with terrestrial environmental quality is considered Low (refer Table 8-1).

**Table 8-1: Terrestrial environmental quality**

Potential impact	Consequence	Likelihood	Residual risk
Erosion and soil loss during civil construction activities, impacting soil quality and structural integrity and resulting in sedimentation to receiving environment.	Insignificant (F)	Unlikely (4)	Low (9)
Construction activities disturbing unknown ASS or PASS resulting in contamination of adjacent soils or receiving waters (acidic and metalliferous drainage).	Minor (E)	Highly unlikely (5)	Low (9)
Unplanned loss/spills of chemicals, hydrocarbons, and hazardous substances resulting in contamination of soils within and adjacent to Project activities	Minor (E)	Unlikely (4)	Moderate (8)

### 8.3 Land – terrestrial ecosystems

As identified in Section 7, Project activities have the potential to impact on the following environmental factor - *terrestrial ecosystems*. Specifically, noise emissions associated with construction activities have the potential to affect threatened or migratory species that use the mangrove communities adjacent to Ichthys LNG. The following sub-sections provide a description of the potential impacts and proposed key management controls to mitigate any potential impacts. Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts are described in the Draft CCEMP (Appendix E).

#### 8.3.1 Relevant policy and guidelines

The following conventions, legislation, policy and guidelines are relevant:

- WMPC Act (NT)
- Matters of National Environmental Significance: Significant impact guidelines 1.1 – *Environment Protection and Biodiversity Conservation Act 1999* (DEWHA 2013).
- EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DEE 2017).
- Guidelines for Assessment of Impacts on Terrestrial Biodiversity (NT EPA 2013a)

- Australian Standard (AS2436:2010): Guide to noise and vibration control on construction, maintenance and demolition sites.

### 8.3.2 Environmental context

No vegetation is proposed to be cleared in the proposed development footprint. Adjacent to the pipeline ROW corridor outside of the Ichthys LNG perimeter fence are mangrove communities associated with Darwin Harbour, which are considered regionally common. The potential impact to terrestrial ecosystems is subject to the presence of threatened and migratory species that may utilise the habitat (salt pans, mangroves and intertidal foraging habitat) surrounding the existing Ichthys LNG operations are described in Section 5.2.

### 8.3.3 Potential impacts

The following activities have the potential to impact on terrestrial ecosystems adjacent to the proposed development footprint if not managed appropriately:

Construction activities, including:

- piling activities during earthwork activities in the Bulk Area; to undertake the piling activities within the required duration (one dry season), three drill rigs may be required to be working concurrently
- earthwork activities in the pipeline ROW corridor
- other construction activities: trenching, trucks, earth movers, graders and generators.
- vehicle movement to and from the site may generate noise impacts for sensitive receptors along public traffic road routes.

Cold commissioning activities that could contribute to noise levels are leak testing, pump system testing, AGRU system cleaning, CO<sub>2</sub> compressor testing and deluge testing.

Potential impacts that could indirectly affect threatened or migratory species that use the mangrove communities adjacent to Ichthys LNG, associated with these activities include noise and vibration emissions.

#### Noise emissions

Increased noise and vibration levels that occur as part of construction activities may disturb shorebirds, however, the risk to shorebirds is anticipated to be low.

There are currently no Australian guidelines available for noise impacts on birds. A criterion of 60 dBA has been historically used. This is based on a review of traffic and road construction noise impacts on birds in the USA, which found that noise in the range of 50 to 60 dBA is unlikely to noticeably alter behaviours of birds (California Department of Transportation 2016). An assessment of the impact of road traffic noise on wetlands birds, including migratory shorebirds was undertaken by Phoenix Environmental Sciences (2011) at several sites within Western Australia. Some of the shorebird species in this assessment, also occur on Middle Arm Peninsula. The highest traffic noise reached 62 dBA, and at this limit, there was no observed correlation between noise and bird occupancy within the wetlands. A noise limit of 60 dBA has been adopted for this assessment of potential impacts of noise to shorebirds.

Construction noise and vibration modelling undertaken for the proposed activities at selected human sensitive receivers in the vicinity of Ichthys LNG Onshore (Wood 2024; Appendix F), predicted boundary noise level contours based on the worst-case scenario (driven piles in addition to general construction activities). The noise modelling contours indicate a noise level <70 dB(A) within the existing disturbance footprint of the Ichthys LNG boundary, and 60-70 dB(A) extending immediately to the east of the Ichthys LNG boundary, within the salt pan and mangrove habitat (Figure 8-2). Measured noise levels during Ichthys LNG operations along the boundary adjacent to the Project area have been in the range of 65 to 70 dB(A). The predictive noise modelling of the worst-case scenario is limited to within the Ichthys LNG boundary and does not extend into habitat readily used by shorebirds. The predicted levels of noise are also consistent with existing levels of noise. The noise emissions from Project are unlikely to impact on shorebirds based on the available international literature available.

### **Vibration**

The noise and vibration modelling and assessment (Wood 2024; Appendix F) demonstrates that vibration levels at the nearest shoreline (200m) are expected to be negligible. Therefore, impacts to shoreline and associated fauna from construction vibrations are not anticipated.



**Figure 8-2: Predicted noise level contours associated with bored in-situ non-displacement piling (Wood 2024)**

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### 8.3.4 Management

**NT EPA environmental objective:**

*Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.*

To meet the NT EPA environmental objective for terrestrial ecosystems, the following key management controls will be implemented to minimise/mitigate any potential indirect impacts to migratory and threatened shorebirds that may reside in the mangrove communities adjacent to the proposed development footprint:

- Piling method (bored) selected that minimise impacts of noise and vibration to sensitive receptors.
- Acoustic barriers or enclosures will be installed around noisy activities, as required.
- Machinery and vehicles will be maintained and operated to minimise noise and vibration generation (e.g. noise-attenuation devices, vibration dampening).
- Noise monitoring will be undertaken at the Ichthys LNG facility boundary to validate Project noise modelling outcomes.

Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts, are described in the Draft CCEMP (Appendix E).

### 8.3.5 Residual risk

Given the proposed mitigation measures to be implemented during construction activities, the expected residual impact associated with terrestrial ecosystems is considered Low (refer Table 8-2).

**Table 8-2: Terrestrial ecosystems – residual risk**

Potential impact	Consequence	Likelihood	Residual risk
Construction or commissioning activities producing noise emissions resulting in displacement of migratory or threatened species that may utilise mangrove communities adjacent to the proposed Project footprint.	Insignificant (F)	Unlikely (4)	Low (9)

## 8.4 Sea – marine environmental quality

As identified in Section 7, Project activities have the potential to impact on the following environmental factor – *marine environmental quality*. Specifically, discharge of hydrotest water to Darwin Harbour and accidental loss/spills or mismanagement of chemicals and hazardous substances.

The following sub-sections provide a description of the potential impacts and proposed key management controls to mitigate any potential impacts. Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts are described in the Draft CCEMP (Appendix E).

### 8.4.1 Relevant policy and guidelines

The following legislation, policy and guidelines are relevant:

- WMPC Act (NT)
- *Water Act 1992* (NT)
- Australian and New Zealand guidelines for fresh and marine water quality (ANZG 2018)
- Declaration of Beneficial Uses and Objectives, Darwin Harbour Region, NT Government Gazette No. G27, 7 July 2010
- Water Quality Objectives for the Darwin Harbour Region - Background document (NRETAS 2010)
- Darwin Harbour Water Quality Protection Plan (DLRM 2014)
- Guidelines on Mixing Zones. (NT EPA 2013b).

### 8.4.2 Environmental context

Darwin Harbour water quality is described in Section 5.1.9.

### 8.4.3 Potential impacts

The following activities have the potential to impact on the marine environmental quality in Darwin Harbour if not managed appropriately:

- Discharge of hydrotest water to Darwin Harbour resulting a reduction in local water quality.
- Mishandling of chemicals, hydrocarbons and other hazardous substances resulting in a reduction in water quality.
- Accidental loss of containment/spills to the environment resulting in a reduction in water quality.

#### Hydrotest water discharges to Darwin Harbour

The discharge of hydrotest wastewater (refer sections 2.4.4 and 2.5) into the environment could potentially cause impacts to the beneficial uses of Darwin Harbour – Water Quality (NRETAS 2010). Although hydrotest wastewater is predominantly scheme water (and therefore likely clean), it has the potential to absorb contaminants remaining in pipework and infrastructure. The most likely contaminant is nickel, which was found to be absorbed from infrastructure being hydrotested during Ichthys LNG construction (JKC 2015).

Impacts to the water quality objectives will be minimised through the use of an appropriate diffuser, which will diffuse wastewater (and any contaminants within) to less than the Darwin Harbour Water Quality Objectives (NRETAS 2010) prior to the edge of an approved mixing zone. The wastewater is fresh, and therefore is more buoyant than the receiving water, and will rise up towards the surface which results in enhanced mixing of the wastewater and Darwin Harbour waters. The wastewater plume will also oscillate and change direction with each flood and ebb tide event.

Diffuser design and subsequent plume modelling will be undertaken prior to the generation of hydrotest water. Modelling for Ichthys LNG construction hydrotest water (with volumes of water approximately 5-10 times larger expected for this project) indicated a 65-fold dilution was required, and this was met in the nearfield (approximately 8m 95% of the time). A conservative mixing zone of 50 m surrounding the diffuser was established for monitoring purposes.

#### 8.4.4 Management

***NT EPA environmental objective:***

*Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.*

To meet the NT EPA environmental objective for marine environmental quality, the following key management controls will be implemented to minimise/mitigate any potential impacts to water, sediment and biota quality:

- Hydrotest water management (If the option to dispose of wastewater via a temporary MOF outfall is pursued):
  - The outfall design will incorporate use of a multiport diffuse to allow for sufficient near-field dilution within proximity of the discharge point.
  - Modelling will be undertaken to determine the extent of the required mixing zone, to enable effective dispersion of wastewater.
  - A waste discharge licence will be applied for under the *Water Act 1992* (NT).
  - Any wastewater discharged via the MOF outfall will comply with WDL wastewater quality limits.
  - A receiving environment water quality monitoring program will be implemented to verify modelling outputs and determine if receiving water is being adversely impacted.
  - Wastewater generated during Project activities (e.g. hydrotest water) will be re-used where it remains fit for purpose.
- Chemicals and hazardous substances management:
  - Personnel who routinely handle hazardous materials or wastes (e.g. refuelling personnel, pump operators, mechanics, and stores personnel) will receive training in handling, transporting and storing hazardous materials or wastes; in reporting and documentation requirements; and in spill clean-up techniques and practices.
  - Use, handling, storage and disposal of all hazardous materials and dangerous goods will be in accordance with the Northern Territory *Dangerous Goods Act 1998* and the WMPC Act.
  - A variety of temporary bunding will be available for use around the site, including banded pallets and drip trays.
  - Refuelling of vehicles will occur within dedicated areas.
  - Chemicals and substances used during the Project will be selected in accordance with the INPEX chemical selection process.
  - Spill kits will be located on site in accessible locations and will be regularly inspected and maintained.

Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts, are described in the Draft CCEMP (Appendix E).

**8.4.5 Residual risk**

Given the proposed mitigation measures to be implemented during relevant Project activities, the expected residual risk associated with marine environmental quality is considered low (see Table 8-3).

**Table 8-3: Marine environmental quality - residual risk**

Potential impact	Consequence	Likelihood	Residual risk
Pollution of marine water (Darwin Harbour). Bioaccumulation and toxicity effects. Alteration of the marine environment through wastewater discharges.	Minor (E)	Highly unlikely (5)	Low (9)
Unplanned loss/spills of chemicals, hydrocarbons, and hazardous substances resulting in contamination of marine environment adjacent to Project activities	Minor (E)	Unlikely (4)	Moderate (8)

**8.5 People – Culture and heritage**

As identified in Section 7, Project activities have the potential to impact on the following environmental factor - Culture and heritage. The following sections provide a description of the potential impacts and proposed key management controls to mitigate any potential impacts. Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts are described in the Draft CCEMP (Appendix E).

**8.5.1 Relevant policy and guidelines**

The following legislation, policy and guidelines are relevant:

- *Heritage Act 2011* (NT)
- *Northern Territory Aboriginal Sacred Sites Act 1989* (NT)

**8.5.2 Environmental context**

The cultural and heritage environment relative to Project activities is described in Section 5.3. There are no known protected heritage or sacred sites within the Project footprint.

### 8.5.3 Potential impacts

While any civil and earthworks activities would only occur within the confines of the previously disturbed Ichthys LNG facility fence line, there is still a remote possibility that previously unidentified heritage objects may be discovered. With consideration of this, a chance find procedure will be in place to manage the discovery of potential heritage objects during civil and earthworks activities.

### 8.5.4 Management

***NT EPA environmental objective:***

*Protect sacred sites, culture and heritage*

To meet the NT EPA environmental objective for culture and heritage, the following key management controls will be implemented to minimise/mitigate any potential impacts to protected heritage and sacred sites and previously unidentified heritage objects:

- An AAPA Authority Certificate relevant to the civil and earthworks required for the Project within the existing Ichthys LNG has been obtained.
- An AAPA Authority Certificate relevant to potential monitoring activities and locations where these activities may occur has been obtained.
- There are no known Aboriginal heritage sites within the fence line of the existing Ichthys LNG facility, where Project activities are planned to be undertaken.
- A chance find procedure will be implemented in the event of discovery of previously unidentified heritage object during civil and earthworks activities in accordance with the INPEX Aboriginal Heritage and Sacred Site Management Plan applicable to Ichthys LNG.

Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts, are described in the Draft CCEMP (Appendix E).

### 8.5.5 Residual risk

Given the proposed mitigation measures to be implemented during civil and earthworks activities, the expected residual impact associated with culture and heritage is considered Low (see Table 8-4).

**Table 8-4: Culture and heritage – residual risk**

Potential impact	Consequence	Likelihood	Residual risk
Damage to sacred sites	Moderate (D)	Remote (6)	Low (9)
Civil and earthworks – damage to previously unidentified heritage object/s	Minor (E)	Remote (6)	Low (10)

## 8.6 People – Community and economy

As identified in Section 7, Project activities have the potential to impact on the following environmental factor – community and economy. Specifically, noise emissions associated with construction activities have the potential to affect community receptors adjacent to the Ichthys LNG facility. The following sub-sections provide a description of the potential impacts and proposed key management controls to mitigate any potential impacts. Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts are described in the Draft CCEMP (Appendix E).

### 8.6.1 Relevant policy and guidelines

The following conventions, legislation, policy and guidelines are relevant:

- WMPC Act (NT)
- Northern Territory Noise Management Framework Guidelines (NT EPA 2018)
- Construction noise and vibration guideline (Transport for NSW 2023)
- Australian Standard (AS3671:1989): Acoustics – Road traffic noise intrusion – Building siting and construction
- Australian Standard (AS2436:2010): Guide to noise and vibration control on construction, maintenance and demolition sites.

### 8.6.2 Environmental context

The key sensitive receptors of airborne noise from construction and commissioning activities are the residential suburbs and urban centres around Darwin Harbour. The nearest residential sensitive receptor is Palmerston located approximately 4 km to the east and north-east of the Ichthys LNG facility (as the crow flies). Darwin's CBD is located 10 km to the north-west of Ichthys LNG facility, across the Darwin Harbour waters.

### 8.6.3 Potential impacts

The following activities have the potential to impact on communities and economy adjacent to the proposed development footprint if not managed appropriately:

- Construction activities, including:
  - pile installation (bored piles) during earthwork activities in the Bulk Area
  - earthwork activities in the pipeline ROW corridor
  - other construction activities i.e. trenching activities, operation of trucks, earth movers, graders and gen sets.
- Cold commissioning activities, such as leak testing, pump system testing, AGRU system cleaning, CO<sub>2</sub> compressor testing and deluge testing.

Potential impacts that could affect community sensitive receptors outside the Ichthys LNG facility boundary, associated with these activities are noise and vibration emissions. The potential impacts of visual amenity change, and onshore and offshore traffic are not expected to impact the community sensitive receptors.

Construction noise and vibration predictive modelling has been undertaken for the proposed activities at selected community sensitive receivers in the vicinity of the Ichthys LNG facility (Wood 2024; Appendix F). Predictive noise and vibration modelling of the following construction activity scenarios was undertaken:

- Scenario 1: Construction- Bored Piles at 3 Locations in addition to general construction activities.
- Scenario 2: Cold Commissioning- Includes potentially noisy activities such as leak testing, pump system testing, AGRU system cleaning, CO<sub>2</sub> compressor testing and deluge testing.

A rating background level of 30 dB(A) has been estimated based on sound level survey measurements taken during 2020 (SLR Consulting 2020).

### Noise emissions

Noise modelling results indicated that Scenario 2 is the worst-case scenario, with the greatest noise levels of 30.3 dB(A) recorded at the closest receptor, Bridle Road in Palmerston (refer to Table 8-5, Figure 8-3 and Appendix F).

**Table 8-5: Noise modelling results**

Receptor	Out of recommended hours noise limits (dBA)	Predicted noise level (dBA)	
		Scenario 1: bored piles	Scenario 2: cold commissioning
Berrimah Farm, Berrimah	35	20.9	<20
Bridle Road, Palmerston		30.3	<20
Channel Island Road, Weddell		<20	<20
Constance Court, Palmerston		26.4	<20
Bennett Street, Palmerston		<20	<20
O'Ferrals Road Bayview		<20	<20

The NSW Interim Construction Noise Guideline (DECC 2009)<sup>7</sup> suggests that 5 dB should be added to predicted noise levels for a number of activities which have proven to be particularly annoying to nearby residents. Some of the activities/equipment identified for construction (Scenario 1 in Table 8-5) may exhibit annoying characteristics at source. However, due to the large propagation distances and resultant low predicted noise levels, it is unlikely that these characteristics would be evident at the receptors considered, with the possible exception of the closest noise sensitive receptors in Palmerston. If a 5 dB correction were applied at Palmerston, then the predicted levels, adjusted by adding 5 dB would be very close (+0.3 dB) to the night-time construction assigned noise level (Wood 2024).

<sup>7</sup> The NSW Interim Construction Noise Guideline (DECC 2009) defines the procedures for assessing construction noise which have been adopted by the NT Northern Territory Noise Management Framework Guideline (NT EPA 2018).

## **Vibration**

Ground borne vibration impacts are predicted to be negligible as the vibration modelling indicated that all sensitive human receptors fall outside the minimum set back distance for human comfort and outside the minimum safe working distance for structural integrity (Wood 2024; refer Appendix F).

## **Cumulative impacts**

The potential for cumulative impacts is related to the intensity, duration and frequency of noise from earthwork, construction and commissioning activities occurring concurrently to existing Ichthys LNG facility operations.



**Figure 8-3: Worst-case noise propagation modelling for community receptors (Wood 2024)**

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**8.6.4 Management**

**NT EPA environmental objective:**  
*Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians*

To meet the NT EPA environmental objective for communities and economy, key management controls will be implemented to minimise/mitigate any potential impacts associated with noise emissions.

- The piling method (bored) selected minimises impacts of noise and vibration to sensitive receptors.
- Acoustic barriers or enclosures will be installed around noisy activities, as required.
- Machinery and vehicles will be maintained and operated to minimise noise and vibration generation (e.g. noise-attenuation devices, vibration dampening).
- As required, Project stakeholders and neighbours will be notified about dates, times, and nature of potential noise-generating activities and mitigation measures to be implemented.
- An enquiries hotline will be maintained and monitored.
- A transport management plan will be implemented to manage the movement of construction vehicles and plant to and from the Project site.
- Noise monitoring will be undertaken at the Ichthys LNG facility boundary to validate Project noise modelling outcomes.

Further detail on the key management controls described in this section and additional controls that will be adopted to mitigate impacts, are described in the Draft CCEMP (Appendix E).

**8.6.5 Residual risk**

The construction noise modelling (refer to Appendix F) undertaken, indicates that noise emissions will remain below assigned noise limits at the identified human receivers.

Given the proposed mitigation measures to be implemented during construction and commissioning activities, the expected residual impact associated with Communities and Economy is considered Low (refer Table 8-6).

**Table 8-6: Community and economy – residual risk**

Potential impact	Consequence	Likelihood	Residual risk
Construction activities producing noise and vibration emissions affecting surrounding community sensitive receptors	Insignificant	Unlikely	Low

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## APPENDIX A: PRELIMINARY ASSESSMENT OF POTENTIAL TO IMPACT ENVIRONMENTAL FACTORS OR VALUES

The purpose of the preliminary assessment is to determine whether the Project has the potential for significant environmental impact under the EP Act. A significant environmental impact is defined by Section 11 of the EP Act as:

An impact of major consequence having regard to:

- The context and intensity of the impact
- The sensitivity, value and quality of the environment impacted on, and the duration, magnitude and geographic extent of the impact.

The preliminary assessment was undertaken using the pre-screening tool provided in the *Guideline – Referring a Proposal to the NT EPA* ([Referring a proposal to the NT EPA](#)). Each of the NT EPA identified environmental factors/objectives were assessed in context of the specific questions outlined in the NT EPA guidance document (refer Figure A-1).

The outcomes of the preliminary assessment are presented in Table A-1.

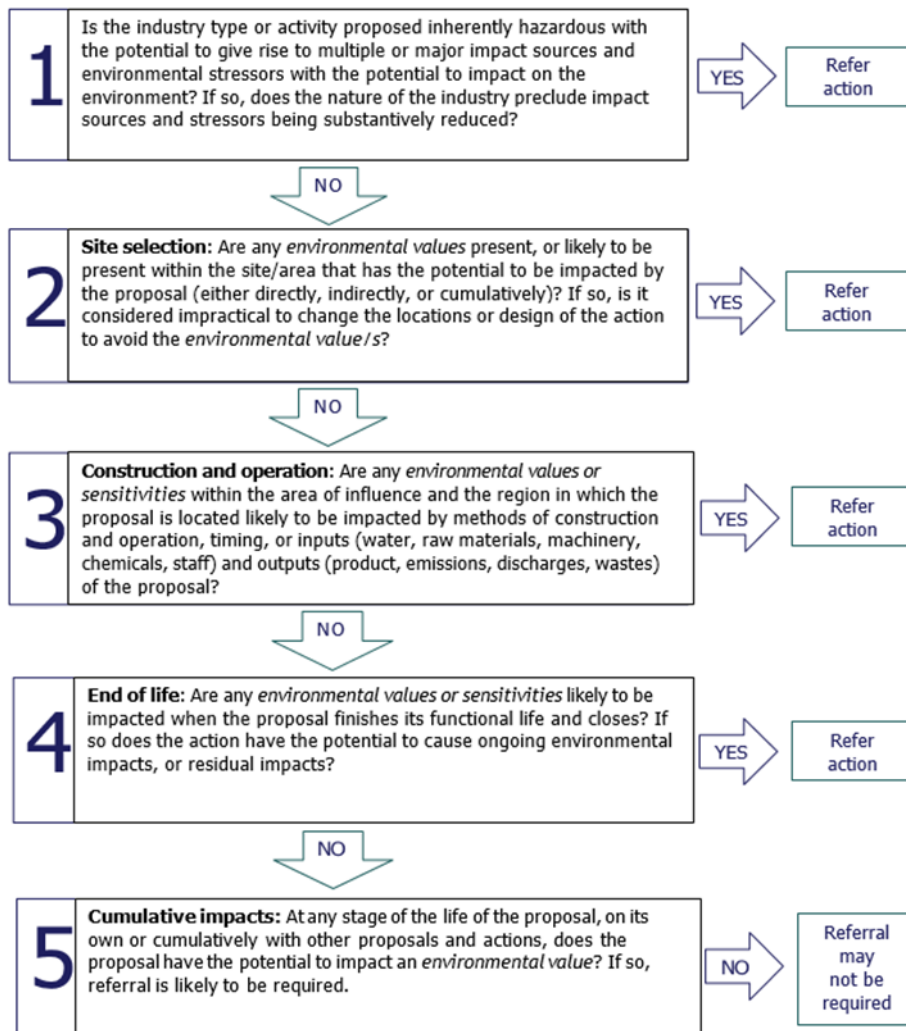


Figure A-1: Preliminary assessment screening questions

**Table A-1: Preliminary assessment of Project activities potential to impact on environmental factors and values**

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)				
					Q2	Q3	Q4	Q5	
Is the industry type or activity proposed inherently hazardous with the potential to give rise to multiple or major impact sources and environmental stressors with the potential to impact on the environment?  If so, does the nature of the industry preclude impact sources and stressors being substantively reduced?					Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>				
					Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>				
Land	Landforms	Conserve the variety and integrity of distinctive physical landforms.	<ul style="list-style-type: none"> <li>distinctive features in the landscape, either geological or anthropogenic</li> <li>subterranean karstic terrain and faults</li> <li>craters, gorges, ranges, caves, massifs, escarpments, plateaus</li> <li>monuments</li> <li>tourism related to landform</li> </ul>	Not applicable	Yes <input type="checkbox"/> No <input type="checkbox"/> Uncertain <input type="checkbox"/> Not applicable <input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Assessment statement:</b> Impacts to landforms from the Project are not applicable as the entire Project footprint was cleared of vegetation and subject to standard cut and fill during the construction of Ichthys LNG facility (approved as part of the Ichthys LNG Development Project (refer to Sections 1.4.1 and 2.2.1)).								
	Terrestrial environmental quality	Protect the quality and integrity of land and soils so that environmental values are supported and maintained.	<ul style="list-style-type: none"> <li>high quality soils, including chemical, physical, biological and aesthetic qualities that support life</li> <li>the biological processes that depend on soil quality</li> </ul>	Refer to Section 5.1.4 - Geology and geomorphology.	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Uncertain <input type="checkbox"/> Not applicable <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<b>Assessment statement:</b> The Project will not significantly impact on terrestrial environmental quality. The entire Project footprint was cleared of vegetation and subject to standard cut and fill during the construction of Ichthys LNG facility (approved as part of the Ichthys LNG Development Project (refer to Section 1.4.1 and Section 2.2.1)).  Based on historical geotechnical data and experience during the construction of the Ichthys LNG facility, potential acid sulphate soils (PASS) or acid sulphate soils (ASS) are unlikely to be encountered within the Bulk Area; however, ASS/PASS may be encountered within the CO <sub>2</sub> pipeline right of way (ROW) or supplementary power cable ROW. If spoil associated with ASS/PASS is not managed appropriately than this could result in localised impacts to land and soil. INPEX is intending to undertake a future geotechnical program to confirm locations of ASS/PASS within the CO <sub>2</sub> pipeline ROW/ supplementary power cable ROW. In the event that ASS/PASS is encountered during excavation activities, any affected spoil would be removed. The spoil would then be treated/neutralised at a suitable treatment pad located within the Project Area prior to being disposed offsite by a suitably licenced contractor (Refer to Section 8.2 and Appendix E: Draft CCEMP).  Unplanned chemical and/or hydrocarbon spills may result in localised impacts to groundwater/surface quality. However, standard controls and procedures (bundling, re-fuelling procedures, spill kits, etc.) will be in place to minimise the risk of spills occurring (Refer to Section 8.2 and Appendix E: Draft CCEMP).  During the Project, erosion and sediment loss may occur as result of civil construction activities (i.e. excavations, trenching, etc.). If erosion and sediment loss is not managed during the wet season, there is the potential to impact on the integrity and quality of the adjacent terrestrial/marine environments (i.e. sedimentation resulting in reduced water quality) as a result of surface water run-off. An appropriate erosion and sediment control measures would be in place prior to the commencement of any wet season (Refer to Section 8.2 and Appendix E: Draft CCEMP).									
Terrestrial ecosystems	Protect terrestrial habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	<ul style="list-style-type: none"> <li>sensitive or significant' vegetation or buffers (as defined in the NT Land Clearing Guidelines)</li> <li>listed threatened species and their habitat (NT and Commonwealth)</li> <li>listed migratory species and their habitat (Commonwealth)</li> </ul>	Refer to Section 5.2.1 – Conservation values, Section 5.2.2 – Marine Habitats, Section 5.2.3 – Terrestrial vegetation, Section 5.2.4 – Fauna and Appendix B.	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Uncertain <input type="checkbox"/> Not applicable <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)					
						Q2	Q3	Q4	Q5	
			<ul style="list-style-type: none"> <li>listed threatened ecological communities (Commonwealth)</li> <li>locally endemic species or species with restricted habitat</li> <li>locally endemic or restricted species and their habitat</li> <li>species that are data deficient with unknown protection status</li> <li>protected area or reserve, including Indigenous Protected Area</li> <li>biosecurity</li> <li>high quality biological and functional diversity, integrity and services</li> </ul>							
<p><b>Assessment statement:</b></p> <p>The entire Project footprint was cleared of vegetation and subject to standard cut and fill during the construction of Ichthys LNG facility (approved as part of the Ichthys LNG Development Project (refer to Section 1.4.1 and Section 2.2.1)). As such, Project activities will not directly impact threatened species habitat. Project activities will result in noise emissions and vibration, which may result in an indirect impact on threatened migratory species that use the mangrove communities adjacent to Project footprint (refer Section 5.2.4). Noise could deter threatened or migratory species from the adjacent mangrove community temporarily.</p> <p>The following threatened migratory shorebird species are known to use the mangrove communities adjacent to Project footprint:</p> <ul style="list-style-type: none"> <li>Common Greenshank (<i>Tringa nebularia</i>)</li> <li>Far Eastern Curlew (<i>Numenius madagascariensis</i>)</li> <li>Greater Sand Plover (<i>Charadrius leschenaultia</i>)</li> <li>Terek Sandpiper (<i>Xenus cinereus</i>).</li> </ul> <p>Three threatened migratory shorebirds are likely to occur within the Project Area:</p> <ul style="list-style-type: none"> <li>Grey Plover (<i>Pluvialis squatarola</i>)</li> <li>Bar-tailed Godwit (two subspecies) (<i>Limosa lapponica baueri</i> and <i>Limosa lapponica menzbieri</i>)</li> <li>Sharp-tailed Sandpiper (<i>Calidris acuminata</i>).</li> </ul> <p>The potential impacts of noise on migratory birds is described in Section 8.3 with key controls presented in Appendix E: Draft CCEMP).</p>										
<b>Water</b>	Hydrological processes	Protect the hydrological regimes of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	<ul style="list-style-type: none"> <li>the supply and quantity of water in surface water features including rivers, lakes, wetlands, swamps, creeks, billabongs, intermittent streams, floodplains, mangroves and drainage lines</li> <li>the supply and quantity of water in groundwater features including aquifers, aquitards and water tables</li> <li>declared beneficial uses</li> <li>present and future uses, and users of water</li> <li>current or potential water supplies, including regional scale aquifers</li> <li>culturally important water features or other features affected by water level</li> </ul>	Refer to Section 5.1.5 – Hydrology and hydrogeology and Section 5.1.6 – Groundwater quality.	Yes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
						No	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
						Uncertain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
						Not applicable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<p><b>Assessment statement:</b></p> <p>The Project will not significantly impact on hydrological processes at Bladin Point, due to the following:</p> <ul style="list-style-type: none"> <li>Extraction of water from natural water sources (as described above) is not required to support Project activities.</li> <li>No culturally important water features are present within the Project footprint (refer to Section 5.3).</li> </ul>										

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)					
					Q2	Q3	Q4	Q5		
			<ul style="list-style-type: none"> <li>Whilst small volumes of water may be required to be extracted from excavations as a part of dewatering activities, these volumes will not be significant (Refer Section 2.4.2 - Dewatering activities). Further, the existing</li> <li>The total volume of scheme water required to support construction, pre-commissioning and cold commissioning activities is estimated to be ~63,000 m<sup>3</sup> (Section 2.3.6, Section 2.4.4, Section 2.4.6 and Section 2.5).</li> <li>There are no planned discharges to land from Project activities.</li> </ul>							
	Inland water environmental quality	Protect the quality of groundwater and surface water so that environmental values including ecological health, land uses and the welfare and amenity of people are maintained.	<ul style="list-style-type: none"> <li>the quality of water in surface water features including rivers, lakes, wetlands, swamps, creeks, billabongs, intermittent streams, floodplains, mangroves and drainage lines</li> <li>the quality of water in groundwater features including aquifers and water tables</li> <li>declared beneficial uses</li> <li>present and future uses and users of water</li> <li>current or potential water supplies, including regional scale aquifers</li> <li>potability / drinkability</li> <li>culturally important water features</li> </ul>	Refer to Section 5.1.5 – Hydrology and hydrogeology and Section 5.1.6 – Groundwater quality.	Yes No Uncertain Not applicable	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
<p><b>Assessment statement:</b>                      The Project will not impact on inland water environmental quality. No freshwater aquatic ecosystems are present in the Project footprint or directly adjacent to the footprint. The Project disturbance footprint is located wholly within the previously developed Ichthys LNG facility boundary (refer to Section 2.2). Project activities will not require the extraction of groundwater and there are no planned discharges to ground. Unplanned chemical and/or hydrocarbon spills may result in localised impacts to groundwater/surface quality. However, standard controls and procedures (bundling, re-fuelling procedures, spill kits, etc.) will be in place to minimise the risk of spills occurring (Refer to Appendix E: Draft CCEMP). Potential impacts to loss of containment and surface water runoff into the mangrove environment have been considered in coastal processes and marine environmental quality.</p>										
	Aquatic ecosystems	Protect aquatic habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	<ul style="list-style-type: none"> <li>threatened species</li> <li>the health of the biota in inland waterways</li> <li>the habitats that support the lifecycle of aquatic biota</li> <li>groundwater dependent ecosystems</li> <li>Ramsar wetlands</li> <li>high quality biological and functional diversity, integrity and services</li> </ul>	Not applicable	Yes No Uncertain Not applicable	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	
<p><b>Assessment statement:</b>                      Impacts to aquatic ecosystems from the Project are not applicable. No freshwater aquatic ecosystems are located within the Project footprint or directly adjacent to the footprint. The Project disturbance footprint is located wholly within the previously developed Ichthys LNG facility boundary (refer to Section 2.2).</p>										
Sea	Coastal processes	Protect the geophysical and hydrological processes that shape coastal morphology so that the environmental values of the coast are maintained.	<ul style="list-style-type: none"> <li>processes that support marine ecosystems such as coral reefs and mangroves</li> <li>processes that support coastal morphology such as beaches, rock bars, and sandbars</li> <li>tidal creeks, deltas and river mouths</li> <li>storm surge protection</li> <li>unique coastal landforms</li> </ul>	Refer to Section 5.2.2 – Marine habitats.	Yes No Uncertain Not applicable	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)				
					Q2	Q3	Q4	Q5	
<p><b>Assessment statement:</b>                      Project activities will not impact on the functionality of the existing Ichthys LNG facility drainage system and therefore no indirect impacts to the coastal process that support the mangroves surrounding the Ichthys LNG facility would be impacted.                      Approximately 15,000 m<sup>3</sup> of scheme water will be used to hydrostatically test the Project infrastructure. One of the options being considered for disposal of hydrotest water is discharge by a temporary outfall located within the existing disturbed MOF dredge footprint (refer to Section 2.4.4). A diffuser would be installed at the discharge point used to facilitate mixing. Modelling completed for similar testing and disposal of scheme water during construction of the Ichthys LNG facility indicated low to no risk to the environment. Given the location of the outfall and small mixing zone (likely to be tens of meters) impacts to coastal processes are not anticipated. Potential impacts to water quality are described in Section 8.4 with management measures presented in Appendix E: Draft CCEMP.</p>									
Marine environmental quality	Protect the quality and productivity of water, sediment and biota so that environmental values are maintained.	<ul style="list-style-type: none"> <li>quality of the water, sediment and biota</li> <li>physical parameters that support fishing and aquaculture</li> <li>physical parameters that support recreation and aesthetics</li> <li>industrial water supply</li> <li>cultural and spiritual values</li> </ul>	Refer to Section 5.1.8 – Harbour sediment quality, Section 5.1.9 – Harbour water quality, Section 5.2.4 – Fauna and Section 5.3 – Cultural environment.	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Uncertain <input type="checkbox"/> Not applicable <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<p><b>Assessment statement:</b>                      The Project may impact marine environmental quality as a result of discharge of hydrotest water from a temporary outfall at the MOF (refer to Section 2.4.4). Approximately 15,000 m<sup>3</sup> of scheme water will be used to hydrostatically test the Project infrastructure (refer Section to 2.4.4). One of the options being considered for disposal of hydrotest water is discharge by a temporary outfall located within the existing disturbed MOF dredge footprint (refer to Section 2.4.4). A diffuser would be installed at the discharge point used to facilitate mixing. Modelling completed for similar testing and disposal of scheme water during construction of the Ichthys LNG facility indicated low to no risk to the environment. Once the diffuser design is determined, modelling will be completed to establish the mixing zone and support a waste discharge licence application. Any impact from the discharge of hydrotest water to the marine environment is expected to be insignificant and any toxicant present in hydrotest water will need to meet Darwin Harbour water quality objectives at the edge of the modelled mixing zone. A monitoring program will be designed to ensure discharges are within acceptable limits and meet Darwin Harbour water quality objectives at the edge of the mixing zone (Refer Section 8.4 and Appendix E: Draft CCEMP).                      Unplanned chemical and/or hydrocarbon spills may result in localised impacts to groundwater/surface quality. However, standard controls and procedures (bundling, re-fuelling procedures, spill kits, etc.) will be in place to minimise the risk of spills occurring (Refer Section 8.4 and Appendix E: Draft CCEMP).</p>									
Marine ecosystems	Protect marine habitats to maintain environmental values including biodiversity, ecological integrity and ecological functioning.	<ul style="list-style-type: none"> <li>conservation significant marine and coastal fauna and critical habitat such as nesting, breeding or foraging habitat</li> <li>conservation significant marine and coastal benthos (seagrass meadows, sponge gardens, coral reefs, mangrove communities and salt marshes)</li> <li>ecological functions and processes</li> <li>high quality biological and functional diversity, integrity and services</li> </ul>	Refer to Section 5.2.1 – Conservation values, 5.2.2 – Marine habitats and Section 5.2.4 – Fauna.	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Uncertain <input type="checkbox"/> Not applicable <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<p><b>Assessment statement:</b>                      The Project will not significantly impact marine ecosystems of Darwin Harbour due to:</p> <ul style="list-style-type: none"> <li>There are no critical marine habitats located within the Project footprint.</li> <li>Impacts to marine environmental quality are expected to be insignificant (refer above) and confined to a small mixing zone associated with a temporary outfall for hydrotest water. Further, the temporary outfall will be located within existing disturbed MOF dredge footprint. Given the location of the temporary outfall and small mixing zone (likely to be tens of meters) impacts to marine habitat/marine fauna are not predicted.</li> <li>Barges transporting modules within Darwin Harbour are slow moving and will be operating under Port controls and will not impact on marine/coastal fauna.</li> </ul>									

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)					
						Q2	Q3	Q4	Q5	
Air	Air quality	Protect air quality and minimise emissions and their impact so that environmental values are maintained.	<ul style="list-style-type: none"> <li>ambient air quality in the local airshed</li> <li>the chemical, physical and biological characteristics of quality air</li> <li>the biological processes that depend on the air quality</li> </ul>	Refer to Section 5.1.3 – Air quality	Yes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	<p><b>Assessment statement:</b> Project activities will result in:</p> <ul style="list-style-type: none"> <li>the generation of small volumes of dust during ground disturbance works</li> <li>the generation of small volumes of exhaust emissions from equipment (e.g. gen-sets, concrete batch plant, etc.) and/or vehicles (cars, trucks, earth moving machinery, etc.) required to support the activities.</li> </ul> <p>These are unlikely to significantly impact on the ambient air quality or local airshed; the chemical, physical and biological characteristics of quality air; or the biological processes that depend on the air quality. Standard controls will be implemented during the Project to minimise potential impacts of dust generation and exhaust emissions (stockpile management, dust suppression measures, maintenance of equipment and vehicles used for Project activities, etc.; Refer to Appendix E Draft CCEMP).</p>					No	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	Atmospheric processes	Minimise greenhouse gas emissions so as to contribute to the NT Government's goal of achieving net zero greenhouse gas emissions by 2050.	<ul style="list-style-type: none"> <li>a contribution to the NT's greenhouse gas emissions through nearing or reaching emission thresholds for:                             <ul style="list-style-type: none"> <li>industrial projects of 100 000 tCO<sub>2-e</sub> scope 1 emissions per year not counting emissions generated from land clearing</li> <li>land use projects of 500 000 tCO<sub>2-e</sub> scope 1 emissions from single or cumulative land clearing actions</li> </ul> </li> </ul>	Not applicable.	Uncertain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<p><b>Assessment statement:</b> A key component of the Project is the installation of equipment to support Ichthys LNG facility CCS readiness. Once CCS systems are operational (subject to other approvals), these will reduce the overall contribution of greenhouse gas emissions generated by Ichthys LNG facility. The construction and pre- and cold-commissioning phases will not significantly contribute to NT greenhouse gas emissions overall.</p>					Not applicable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
People	Community and economy	Enhance communities and the economy for the welfare, amenity and benefit of current and future generations of Territorians.	<ul style="list-style-type: none"> <li>communities, towns and suburbs where people live</li> <li>community aspirations for liveable environment and healthy lifestyles:                             <ul style="list-style-type: none"> <li>affordable access to food, water, electricity, transport and communication networks.</li> <li>good amenity – air quality, noise, aesthetics</li> <li>access to social infrastructure and services including transport and logistics</li> <li>access to natural resources including bush food</li> <li>recreational use of the natural or built environment (e.g. fishing, cycling, sports, picnics)</li> <li>species of social, cultural, livelihood and or economic importance (terrestrial, aquatic and marine biota)</li> </ul> </li> <li>participation in jobs, businesses and education</li> <li>existing industries such as agriculture, pastoralism, tourism, fisheries</li> <li>vulnerable sectors of the community</li> </ul>	Refer to Section 5.4 – Socio-economic environment	Yes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	<p><b>Assessment statement:</b></p>					No	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
					Uncertain	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
					Not applicable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)				
					Q2	Q3	Q4	Q5	
			<p>Communities adjacent to the Project Area may be impacted as a result of:</p> <ul style="list-style-type: none"> <li>increased noise during execution of Project activities</li> <li>increased traffic on public roads utilised by Project staff and supply trucks/couriers</li> <li>restrictions on the use of the marine area surrounding the MOF during Project operations (MOF exclusion zone)</li> <li>increased vessel movements in Darwin Harbour from barges delivering modules.</li> </ul> <p>Any potential impacts would be temporary and of short duration.</p> <p>Noise modelling undertaken to understand the potential impacts of construction activities indicates predicted noise levels received at the closest sensitive community receptors (26.4 dBA) would remain below those recommended for out of hours noise limits (35 dBA; nighttime activities) (Refer to Section 8.6 and Appendix E: Draft CCEMP).</p> <p>The workforce will consist of a mix of appropriately skilled local employees and fly-in and fly-out (FIFO) workforce which will be resourced based on skill set availability and applicability through key stages during execution of the Project. The local Bladin Village accommodation facility will be utilised to accommodate the temporary FIFO workforce. A shuttle service will transport the workforce from Bladin Village to the Project site, with local hire employees using the Bladin Village car parking or other localised park and ride facilities to connect with the shuttle service to avoid park and ride facilities elsewhere in the community. A bussing service will be established between the Darwin Airport and Bladin Village for shift change of FIFO workers. The transport of modules and pipe racks through Darwin Harbour to the MOF location will occur at different times throughout 2028-2029, as such this unlikely to significantly impact on the movement of other port users. The MOF exclusion zone will temporarily exclude recreational users from an area surrounding the MOF; however, this would not be to an extent that movement through the Elizabeth River into Darwin Harbour is disrupted significantly.</p>						
	Culture and heritage	Protect sacred sites, culture and heritage.	<ul style="list-style-type: none"> <li>Aboriginal cultural values</li> <li>sacred sites</li> <li>the Territory's natural and built heritage</li> <li>declared heritage places and objects protected under the <i>Heritage Act 2011</i> (NT) such as:                             <ul style="list-style-type: none"> <li>any Aboriginal or Macassan archaeological place or object (coastal mounds and middens, rock art, stone arrangements, quarries, artefacts, graves, burial sites and ancestral remains)</li> <li>underwater cultural heritage (isolated objects, shipwrecks, plane wrecks,</li> <li>underwater cables and evidence of Aboriginal occupation prior to sea level rise)</li> <li>built heritage (colonial buildings and other historic buildings)</li> <li>defence structures (defensive positions and airfields)</li> <li>natural features (meteorite impact sites, palaeontological sites, springs, trees)</li> <li>world heritage</li> </ul> </li> <li>underwater cultural heritage protected under the <i>Underwater Cultural Heritage Act 2018</i> (Cwth)</li> <li>Aboriginal rights and interests, including right of access</li> </ul>	Refer to Section 5.3 – Cultural environment.	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Uncertain <input type="checkbox"/> Not applicable <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<p><b>Assessment statement:</b></p> <p>The Project disturbance footprint is located wholly within the previously developed Ichthys LNG facility boundary (refer to Section 2.2). There are no known cultural or heritage sites or sacred sites within the Ichthys LNG facility fence line where the Project would be executed. AAPA Authority Certificates have been obtained and cover Project activities and any monitoring that may be required. In the highly unlikely event, a heritage object is discovered during excavations, a chance find procedure will be implemented and the appropriate Authority contacted ((Refer to Section 8.5 and Appendix E: Draft CCEMP).</p>								
	Human health	Protect the health of the Northern Territory population.	<ul style="list-style-type: none"> <li>drinking water</li> <li>air quality</li> <li>bush tucker</li> </ul>	Not applicable	Yes <input type="checkbox"/> No <input type="checkbox"/> Uncertain <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Theme	Factor	Environmental objective	Indicative values and sensitivities relevant to each environmental factor	Environmental context	Potential to be impacted (Proponent's answer to screening questions 1-5)				
						Q2	Q3	Q4	Q5
			<ul style="list-style-type: none"> <li>radiological limits</li> <li>biting insects</li> </ul>		Not applicable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<p><b>Assessment statement:</b>                      The Project will not impact on health of the Northern Territory population. Construction and pre- and cold commissioning activities will not result in:</p> <ul style="list-style-type: none"> <li>changes to the quality of drinking water in the Darwin region</li> <li>changes to the ambient air quality of the Darwin region</li> <li>changes to the ability to collect traditional resources (bush tucker)</li> <li>an increase in radiological limits within the Darwin region</li> <li>creation of new biting insect habitat within the Darwin region.</li> </ul>									

**APPENDIX B: EPBC ACT PROTECTED MATTERS SEARCH AND  
LIKELIHOOD OF OCCURRENCE ASSESSMENT**

*Submitted as a separate appendix to the NT EPA.*

## **APPENDIX C: STAKEHOLDER ENGAGEMENT PLAN**

*Submitted as a separate appendix to the NT EPA.*

## **APPENDIX D: PRE-REFERRAL CONSULTATION**

*Submitted as a separate appendix to the NT EPA.*

**APPENDIX E: DRAFT CONSTRUCTION AND COMMISSIONING ENVIRONMENTAL MANAGEMENT PLAN**

*Submitted as a separate appendix to the NT EPA.*

## **APPENDIX F: NOISE AND VIBRATION MODELLING STUDY**

*Submitted as a separate appendix to the NT EPA.*