

Annual Compliance Report Ichthys LNG Project (EPBC 2008/4208): 2021–2022

Report

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Abbreviations, terms and acronyms

Abbreviation, term or acronym	Meaning
ACC	air cooled condenser system
ALRA	Northern Territory Aboriginal Land Rights Act 1976
BTEX	benzene, toluene, ethylbenzene and xylene
COS	Coastal Offset Strategy (X075-AH-STR-0001)
CPF	central processing facility
CCPP	combined cycle power plant
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth; formally the Department of Agriculture, Water and the Environment)
DIMT	Darwin Incident Management Team
EPBC 2008/4208	the Ichthys LNG Project Commonwealth approval
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (commonwealth)
EPL228 (as varied)	The Ichthys LNG environment protection licence issued by the NT EPA to operate the Ichthys LNG facility.
FPSO	floating production, storage and offloading (facility)
GEP	gas export pipeline
HRSG	heat recovery steam generation units
Ichthys LNG	the Ichthys LNG onshore plant
IPA	Indigenous Protected Area
IMMRP	integrated marine monitoring and research program
INPEX	INPEX Operations Australia Pty Ltd
LDMP	Ichthys Onshore LNG Facilities: Liquid Discharge Management Plan: Operations (L060-AH-PLN-60050)
LDMP Addendum	Onshore Operations Environmental Plan and Liquid Discharge Management Plan: Addendum 1 Firefighting training (L790-AH-PLN-70000)
LOR	limit of reporting

Abbreviation, term or acronym	Meaning
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LRVP	liquid ring vacuum pump
Maintenance DSDMP	Maintenance Dredging and Spoil Disposal Management Plan (L060-AH-PLN-60010)
Nearshore OPEP	Nearshore Oil Pollution Emergency Plan (X060-AH-PLN-60003)
NLC	Northern Land Council
OEMP	Onshore Operations Environmental Management Plan
ORP	redox potential
OSMP	Operational and Scientific Monitoring Program
NATA	National Association of Testing Authorities
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
QA/QC	Quality Assurance and Quality Control
redox	oxygen-reduction
the Operator	INPEX Operations Australia Pty Ltd
the Project	the Ichthys LNG Project
this Compliance Report	Annual Compliance Report Ichthys LNG Project (EPBC 2008/4208): 2021–2022 (0000-AH-REP-70074)
TN	Total nitrogen
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRH	total recoverable hydrocarbons
cfu/100 mL	colony forming units per 100 millilitres
L	litres

Abbreviation, term or acronym	Meaning
mg/kg	milligram per kilogram
mV	millivolts
µg/L	micrograms per litre
µg N/L	micrograms of nitrogen per litre
µg P/L	micrograms of phosphorus per litre
µS/cm	microSeimens per centimetre
°C	degrees Celsius
%	percent

1 INTRODUCTION

INPEX Operations Australia Pty Ltd (INPEX) as proponent for the Ichthys LNG Project, was issued with an approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act; approval EPBC 2008/4208) on 27 June 2011. The EPBC 2008/4208 approval was subsequently amended by variations to conditions 1, 3, 4, 5, 7, 8, 9, 11, 13, 15, 16 and 19 made pursuant to Section 143 of the EPBC Act.

Condition 13 of EPBC 2008/4208 requires INPEX to submit a Compliance Report to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) within 15 months from commencement of operation¹, with each subsequent report submitted within 12 months from the date of the previous report. This is the fourth Compliance Report to be submitted following commencement of operations on 27 July 2018.

Specific Project details are provided in Table 1-1, with an overview and status of activities described in Section 2.

Table 1-1: Ichthys LNG Project details

Item	Project details
EPBC number	EPBC 2008/4208
Project name	Ichthys LNG Project
Approval holder	INPEX Operations Australia Pty Ltd
Approval holder ABN	ABN 48 150 217 262
Approved Action	To develop the Ichthys Field in the Browse Basin to produce liquefied natural gas, liquefied petroleum gas and condensate and including the installation and operation of offshore extraction facilities in Ichthys Field, onshore processing facilities at Bladin Point and 850-935km pipeline from Ichthys Field to Bladin Point, Northern Territory, as described in the referral (EPBC 2008/4208) and the variation to the action dated 11 May 2011.

1.1 Purpose and scope

The purpose of this Compliance Report is to meet the requirements of EPBC 2008/4208 Condition 13 (as varied 27 May 2015), which states:

The person taking the action must submit a Compliance Report detailing compliance with any plan, report, strategy, or program (however described) referred to in relation to this approval. The date of the first Compliance Report must be submitted to the Minister within 15 months from the commencement of operation with each subsequent report submitted within 12 months from the date of the previous report. The Compliance Report must be made publicly available on the person taking the action's Australian website for the operational life of the action.

¹ The Ichthys LNG Project approval (EPBC 2008/4208) defines operations as "the commencement of gas extraction and transfer from subsea wells to the floating liquefied natural gas facility and liquefied natural gas facility and liquefied natural gas tankers". The date reflected is the date the wells were first opened offshore. Onshore operations did not commence until 14 September 2018.

The Compliance Report is not required to include activities conducted within the Commonwealth Marine Area.

The person taking the action may cease complying with condition 13 if they have written agreement from the Minister.

DCCEEW representatives have advised² that the scope of the Compliance Report is limited to the demonstration of compliance with the following EPBC 2008/4208 conditions (as varied) and their associated plans, programs or strategies:

- Condition 1 - Oil Spill Contingency Plan (as varied on 03 February 2015)
- Condition 2 - Operational and Scientific Monitoring Program
- Condition 5 - Decommissioning Management Plan (as varied on 27 May 2015)
- Condition 8 - Liquid Discharge Management Plan (as varied on 03 February 2015)
- Condition 9 - Noise Management Plan (as varied on 06 March 2014)
- Condition 10 - Dredging and Spoil Disposal Management Plan (as varied on 05 April 2013)
- Condition 11 - Offsets (Coastal Offset Strategy) (as varied on 23 June 2021).

This Compliance Report addresses compliance with above conditions and associated plans, programs or strategies during the 27 July 2021 to 26 July 2022 reporting period.

As per EPBC 2008/4208 Condition 13, this report does not address activities occurring in the Commonwealth Marine Area. These activities are regulated by the National Offshore Petroleum Safety and Environment Authority under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and associated regulations.

1.1.1 Variations to EPBC 2008/4208 approval conditions

No variations to EPBC 2008/4208 approval conditions have been approved during the reporting period.

1.1.2 DCCEEW approved plans or strategies

Table 1-2 provides an overview of relevant DCCEEW approved plans or strategies, which were in effect during the 27 July 2021 to 26 July 2022 reporting period.

Table 1-2: DCCEEW approved plans/strategies

Title	Description
Ichthys Onshore LNG Facilities: Liquid Discharge Management Plan: Operations (LDMP; L060-AH-PLN-60050)	The LDMP describes the measures in place to mitigate the potential environmental effect of liquid discharges associated with onshore Ichthys LNG operations activities. The LDMP (Rev 3) was submitted in accordance with EPBC 2008/4208 Condition 8 and approved on 15 March 2021.
Onshore Operations Environmental Plan and Liquid Discharge Management Plan: Addendum 1 Firefighting Training (LDMP Addendum; L790-AH-PLN-70000)	

² Email correspondence received from the DCCEEW Compliance Monitoring Team on 30 July 2019.

Title	Description
	<p>The LDMP Addendum (Rev 1) was approved by DCCEEW on 23 June 2021. The LDMP Addendum was prepared, in lieu of a full revision to the LDMP, to address the requirement to undertake portable/mobile firefighting training utilising PFAS-free training foam at Ichthys LNG. The Addendum includes a description of the activity and controls and monitoring that will be undertaken. The LDMP Addendum forms part of the approved LDMP.</p> <p>No updates to the LDMP or the LDMP Addendum occurred during the 2021–2022 reporting period.</p>
Nearshore Oil Pollution Emergency Plan (Nearshore OPEP; X060-AH-PLN-60003)	<p>The Nearshore OPEP describes the activities, arrangements, and framework for response to oil spills, which may occur within Northern Territory waters as a result of Ichthys LNG activities (EPBC 2008/4208, Condition 1) and the operational scientific monitoring program (EPBC 2008/4208, Condition 2), which would be implemented in the event of a spill.</p> <p>The Nearshore OPEP (Rev 1) was submitted in accordance with EPBC 2008/4208 Conditions 1 and 2 and was approved by DCCEEW on 23 February 2017. Subsequent to this, the Nearshore OPEP was updated in October 2018 (Rev 2) to incorporate administrative amendments. These amendments did not result in a new or increased risk, and as such was submitted to DCCEEW for information only in accordance with Condition 15.</p> <p>No updates to the Nearshore OPEP occurred during the 2021–2022 reporting period.</p>
Maintenance Dredging and Spoil Disposal Management Plan (Maintenance DSDMP; L060-AH-PLN-60010)	<p>The Maintenance DSDMP describes the measures in place to mitigate impacts associated with maintenance dredging. It allows for a maximum volume of 1.5 Mm³ to be dredged within an approved 5-year period.</p> <p>The Maintenance DSDMP (Rev 1) was submitted in accordance with EPBC 2008/4208 Condition 10 and was approved by DCCEEW on 21 June 2018.</p> <p>No updates to the Maintenance DSDMP occurred during the 2021–2022 reporting period.</p>
Coastal Offset Strategy (COS; X075-AH-STR-0001)	<p>The COS provides high-level details of INPEX's environmental offset programs.</p> <p>The COS (Rev 8) was submitted in accordance with EPBC 2008/4208 Condition 15C and was approved by DCCEEW on 22 July 2021.</p> <p>No updates to the COS occurred during the 2021–2022 reporting period.</p>

2 DESCRIPTION OF ACTIVITIES

2.1 Ichthys Project overview

The Ichthys LNG Project (the Project) is a joint venture between INPEX Operations Australia Pty Ltd (as the delegated Operator), major partner TotalEnergies, and the Australian subsidiaries of CPC Corporation Taiwan, Tokyo Gas, Osaka Gas, Kansai Electric Power, JERA and Toho Gas. Drawing on the hydrocarbon resources of the Ichthys gas and condensate field in the Browse Basin at the western edge of the Timor Sea offshore Western Australia, the Project is expected to produce 8.9 Mt of liquefied natural gas (LNG) and 1.6 Mt of liquefied petroleum gases (LPGs) per annum, along with approximately 100 000 barrels of condensate per day at peak.). The Project has an expected operational life of at least 40 years.

The Ichthys Field covers an area of around 800 km² and drilling studies suggest that its hydrocarbon resources are 12.8 trillion cubic feet of sales gas and around 527 million barrels of condensate.

The extraction of natural gas and condensate is carried out via a floating semisubmersible central processing facility (CPF) at the Ichthys Field. This removes water and most of the condensate from the reservoir fluids and the separated condensate is transferred to a floating production, storage and offloading (FPSO) facility moored approximately 3.5 km from the CPF. After further processing on the FPSO, the condensate is exported directly from the field at an average rate of up to 85 000 barrels per day.

The dehydrated gas and the remainder of the condensate is compressed and exported through an approximately 890 km long gas export pipeline (GEP) to the Project's onshore processing plant at Bladin Point in Darwin Harbour in the Northern Territory (NT; see Figure 2-1).

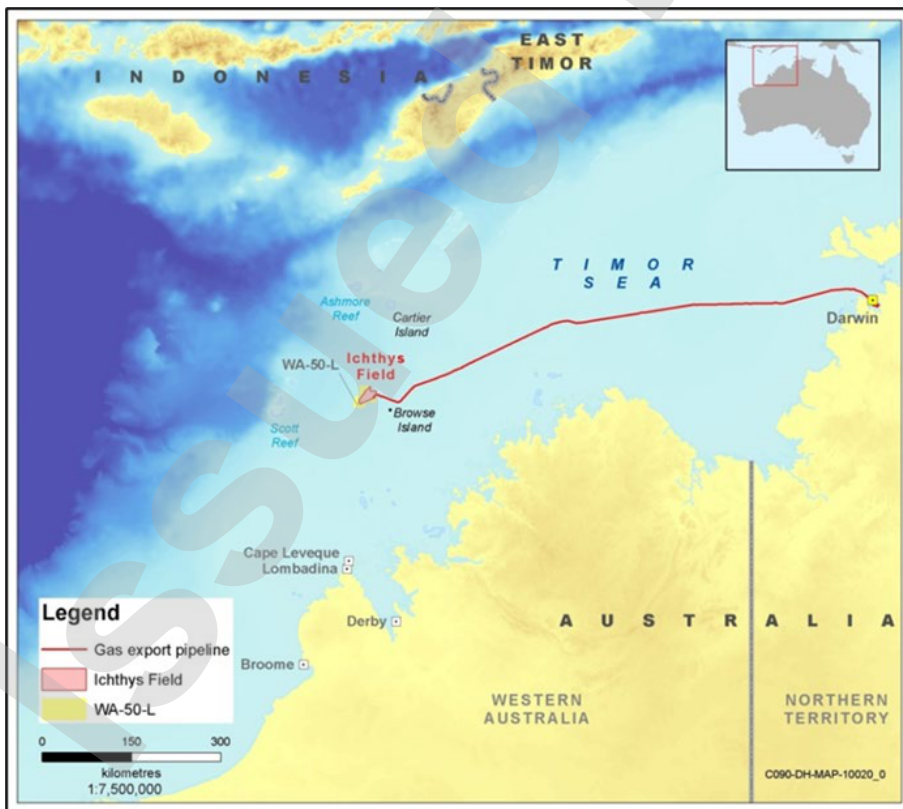


Figure 2-1: Project location

2.2 Current status of activities

Key operations activities undertaken at Ichthys LNG onshore plant (Ichthys LNG) during the reporting period were as follows:

- activities associated with the product (LNG, LPG and condensate) processing, storage, loading and offtake.
- activities associated with routine and shutdown maintenance of the onshore facilities.
- environment monitoring activities.

The COVID-19 pandemic had an impact on operations and scheduled training activities and exercises. Impacts occurred throughout the reporting period. Border travel restrictions and lockdowns were imposed by the NT Government and INPEX's Pandemic Plan remained active, resulting in several access restrictions for non-essential personnel working at Ichthys LNG.

3 COMPLIANCE WITH EPBC 2008/4208 APPROVAL CONDITIONS

As per the requirements of DoE (2014) the terms and definitions provided in Table 3-1 have been used to indicate the status of compliance with relevant EPBC 2008/4208 approval conditions.

A summary of the compliance status with relevant EPBC 2008/4208 approval conditions (Section 1.1), applicable timeframes and reference to evidence supporting the compliance status (as applicable) is provided in Table 3-3.

Table 3-1: Compliance status terms, acronyms and definitions

Term	Acronym	Definition
Compliant	C	"Compliance" is achieved when all the requirements of a condition have been met, including the implementation of management plans or other measures required by those conditions.
Non-compliant	NC	A designation of "non-compliance" should be given where the requirements of a condition or elements of a condition, including the implementation of management plans and other measures, have not been met.
Not applicable	NA	A designation of "not applicable" should be given where the requirements of a condition or elements of a condition fall outside of the scope of the current reporting period. For example, a condition which applies to activity that has not yet commenced.

3.1 Audit, reviews and exercises

A summary of the audits, reviews and exercises, as relevant to EPBC 2008/4208 conditions, undertaken during the reporting period is provided in Table 3-2. Outcomes of audits as applicable to EPBC 2008/4208 conditions are presented in Table 3-3.

Table 3-2: Summary of audits, reviews and exercises

Audit/review/exercise title	Scope	Date
Annual Onshore Operations Environmental Compliance Audit (External third-party audit – Jacobs on behalf of Northern Territory Environment Protection Authority (NT EPA))	The audit assessed compliance with the Onshore Operations Environmental Management Plan (OEMP; inclusive of liquid discharge management) and NT EPA issued operations environmental protection licence (EPL228).	11-15 October 2021
Annual Onshore Operations Environmental Compliance Audit (Internal audit)	The audit assessed compliance with the LDMP, OEMP and the NT EPA issued operations licence (EPL228).	10-12 August 2022

Audit/review/exercise title	Scope	Date
Annual level 2 Oil Spill Exercise	The exercise scenario was a loss of containment from the GEP within Darwin Harbour and involved live participation from the Darwin Incident Management Team and Ichthys LNG Central Control Room primarily to practice source control and stakeholder management objectives.	28 September 2021
Oil spill boom deployment exercise and training	This event involved the deployment of containment boom from boats for the purpose of practicing methods of containing the spread of oil on water and confirming functionality of equipment.	22 June 2022

Table 3-3: EPBC 2008/4208 approval conditions compliance table

Condition No.	Condition	Timing	Status	Evidence/Comments
1.	<p>Oil Spill Contingency Plan</p> <p>The person taking the action must develop and submit to the Minister for approval, an Oil Spill Contingency Plan that demonstrates the response preparedness of the person taking the action for any hydrocarbon spills, including the capacity to respond to a spill and mitigate the environmental impacts on the Commonwealth marine area and listed species habitat within offshore areas and Darwin Harbour. The Plan must include, but is not limited to:</p> <ol style="list-style-type: none"> Oil spill trajectory modelling for potential spills from the action. This should include consideration of a well blow out or uncontrolled release. The modelling should be specific to the characteristics of the hydrocarbons contained in the Ichthys gas field, the likely volumes released in a worst case scenario spill, and the potential time over which the oil may be released in a worst case scenario spill, including a scenario of a minimum eleven (11) week uncontained spill; A description of resources available for use in containing and minimising impacts in the event of a spill and arrangements for accessing them; A demonstrated capacity to respond to a spill at the site, including application of dispersants, if required and appropriate, and measures that can feasibly be applied within the first 12 hours of a spill occurring; Identification of sensitive areas that may be impacted by a potential spill, in particular, Browse Island, specific response measures for those areas and prioritisation of those areas during a response; Details of the insurance arrangements that have been made in respect of paying the costs associated with operational and scientific monitoring, as outlined in the Operational and Scientific Monitoring Program required under condition 2 and repairing any environmental damage arising from potential oil spills, as determined necessary from the results of the Operational and Scientific Monitoring Program; Training of staff in spill response measures and identifying roles and responsibilities of personnel during a spill response; and Procedures for reporting oil spill incidents to the Department. <p>The person taking the action must not commence drilling activities until the Oil Spill Contingency Plan is approved. The approved Oil Spill Contingency Plan must be implemented.</p>	Ongoing	Compliant	<p>During the reporting period there were no spill events which required activation of the Nearshore OPEP.</p> <p>An oil spill response related exercise was conducted in September 2021 (Refer to Table 3-2). The exercise scenario was a loss of containment from the GEP within Darwin Harbour and involved live participation from the Darwin Incident Management Team (DIMIT), Ichthys LNG Central Control Room and Darwin Port Authority.</p> <p>The exercise objectives were to:</p> <ul style="list-style-type: none"> Validate whether information flow, coordination and liaison across the emergency communications network is effective. Validate the DIMIT capability to support nearshore oil spill response and implements coordinated actions to manage a significant emergency event in the Northern Territory Waters. Validate that effective alignment and interfaces are in place with agencies and stakeholders involved in responding and managing an nearshore oil spill event. Validate actions undertaken by DIMIT align with requirements of the Nearshore OPEP. <p>All objectives were satisfied. The main finding was to improve the usability and familiarity of the Nearshore OPEP.</p> <p>An oil spill response training and exercise activity was conducted in June 2022 (Table 3-2). This exercise/training involved the access, mobilisation and deployment of containment boom from its storage location. No adverse findings were reported.</p> <p>Insurance arrangements were maintained in accordance with the Insurance Plan described in the Nearshore OPEP during the reporting period.</p> <p>Note, the Nearshore OPEP is currently undergoing a comprehensive revision due to the following influences:</p> <ul style="list-style-type: none"> changes to Northern Territory oil spill response regulatory arrangements findings from periodic risk and capability review findings from the level 2 exercise conducted in September 2021 re-structuring to align with other internal oil spill emergency plan arrangements and expectations. <p>The plan is expected to be re-issued to DCCEEW for approval in late-2022/early-2023.</p>
2.	<p>Operational and Scientific Monitoring Program</p> <p>The person taking the action must develop and submit to the Minister for approval, an Operational and Scientific Monitoring Program that will be implemented in the event of an oil spill to determine the potential extent and ecosystem consequences of such a spill, including, but not limited to:</p> <ol style="list-style-type: none"> Triggers for the initiation and termination of the Operational and Scientific Monitoring Program, including, but not limited to, spill volume, composition, extent, duration and detection of impacts; A description of the studies that will be undertaken to determine the operational response, potential extent of impacts, ecosystem consequences and potential environmental reparations required as a result of the oil spill; Details of the insurance arrangements that have been made in respect of paying the costs associated with operational and scientific monitoring, as outlined in the Operational and Scientific Monitoring Program, and repairing any environmental damage arising from potential oil spills, as determined necessary from the results of the Operational and Scientific Monitoring Program; 	Ongoing	Compliant	<p>The Operational and Scientific Monitoring Program (OSMP) is incorporated into the Nearshore OPEP, which address the requirements of EPBC 2008/4208 Conditions 1 and 2 (refer above).</p> <p>During the reporting period there were no spill events which required activation of the OSMP. INPEX continues to maintain a contract with an external contractor to ensure OSMP readiness, in the event this is required to be implemented.</p>

Condition No.	Condition	Timing	Status	Evidence/Comments
	<p>d. Inclusion of sufficient baseline information on the biota and the environment that may be impacted by a potential hydrocarbon spill, to enable an assessment of the impacts of such a spill;</p> <p>e. A strategy to implement the Operational and Scientific Monitoring Program, including timelines for delivery of results and mechanisms for the timely peer review of studies;</p> <p>f. In the event of an oil spill the person taking the action must pay all costs associated with all operational and scientific monitoring undertaken in response to the spill, as outlined in the approved Operational and Scientific Monitoring Program and any environmental remediation determined necessary by the results of the approved Operational and Scientific Monitoring Program; and</p> <p>g. Provision for periodic review of the program.</p> <p>The Operational and Scientific Monitoring Program must be submitted at least three months prior to the commencement of drilling activities.</p> <p>The person taking the action must not commence drilling activities until the Operational and Scientific Monitoring Program is approved. The approved Operational and Scientific Monitoring Program must be implemented.</p>			
5.	<p>Decommissioning Management Plan</p> <p>The person taking the action must submit for the Minister's approval a Decommissioning Management Plan to mitigate the environmental effects of decommissioning the proposal within the Commonwealth marine area. The Decommissioning Management Plan must include a detailed risk assessment to justify leaving any infrastructure on the seafloor of the Commonwealth marine area and must be consistent with any published Commonwealth Government policy or legislation prevailing at the time. Decommissioning cannot commence until the plan is approved. The approved plan must be implemented.</p>	Prior to decommissioning activities	Not applicable	This condition was not applicable during the reporting period.
8.	<p>Liquid Discharge Management Plan</p> <p>The person taking the action must submit for the Minister's approval a Liquid Discharge Management Plan or plans to mitigate the environmental effects of any liquid discharge from the proposal, including sewerage and surface water runoff. The Liquid Discharge Management Plan(s) must be for the protection of the Commonwealth marine area and habitat for listed species in Darwin Harbour and must:</p> <p>a. identify all sources of liquid discharge;</p> <p>b. describe any impacts associated with the discharge of liquids, including the cumulative impacts associated with the discharge of sewerage;</p> <p>c. clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these;</p> <p>d. outline measures to avoid impacts;</p> <p>e. where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts;</p> <p>f. demonstrate how any discharges into Darwin Harbour are consistent with the guidelines for discharges, and the water quality objectives for Darwin Harbour, developed under the National Water Quality Management Strategy;</p> <p>g. identify all regulatory requirements relating to the discharge of liquids and how these will be met;</p> <p>h. include a monitoring regime to determine achievement of objectives and success of measures used;</p> <p>i. outline reporting and auditing arrangements; and</p>	Ongoing	Compliant	<p>During the reporting period, the following compliance monitoring activities were undertaken:</p> <ul style="list-style-type: none"> monthly commingled treated effluent (in-pipe) monitoring (August 2020 to July 2021) annual harbour sediment monitoring (July 2022) biannual groundwater quality monitoring (October 2021 and April 2022) mangrove health and intertidal sediment monitoring (June 2022). <p>Results of monitoring programs demonstrate that liquid discharges associated with Ichthys LNG activities have not adversely affected the declared beneficial uses or objectives for Darwin Harbour. A description of the monitoring programs and locations is described in Section 7 of the LDMP, with a summary of the outcomes of each of these monitoring programs provided in Appendix A.</p> <p>There were no changes to the frequency of the monitoring programs during the reporting period. Jetty outfall monitoring ceased in 2021, in accordance with the requirements of EPL228 and the LDMP.</p> <p>To assess compliance with the LDMP both an external audit conducted by a third-party (Jacobs on behalf of the NT EPA) and an internal audit were undertaken during the reporting period (refer to Table 3-2). In both audits, a non-conformance was recorded where specified commingled treated effluent (in-pipe) discharge limits had been exceeded during the reporting period. Note, in all cases discharge limit exceedances were investigated and corrective actions implemented at the time of the event, in accordance with the LDMP. All exceedances were minor in nature, and did not result in any environmental harm or impact. Appendix A provides a summary of these exceedances.</p>

Condition No.	Condition	Timing	Status	Evidence/Comments
	<p>j. describe how the plan will apply the principles of adaptive management.</p> <p>The plan(s) must be submitted prior to the commencement of the relevant activity to which they apply. The relevant activity may not commence until the plan is approved. Separate Liquid Discharge Management plans can be submitted for the management of liquid discharges in the Commonwealth Marine Area and Darwin Harbour. The approved plan(s) must be implemented.</p>			<p>There were no events during the reporting period, which resulted in a material non-compliance with the LDMP or a significant impact to matters of national environmental significance.</p> <p>Portable/mobile firefighting training activities (the subject of the LDMP Addendum) were undertaken during September 2021 in compliance with the LDMP Addendum, using a fluorine-free training foam. As per the LDMP Addendum requirements, laboratory results confirming the training foam was fluorine-free prior to use onsite, were provided to the DCCEEW (email on 11 August 2021).</p>
9.	<p>Noise Management Plan</p> <p>The person taking the action must submit for the Minister's approval a Noise Management Plan (or multiple plans) to avoid and mitigate the noise impacts on marine fauna associated with construction activities in Darwin Harbour or the Commonwealth marine area. The Noise Management Plan/s must be for the protection of listed species in Darwin Harbour or the Commonwealth marine area (whichever area the construction activities are to be undertaken) and must:</p> <ol style="list-style-type: none"> identify all sources of noise that may adversely impact fauna in Darwin Harbour or the Commonwealth marine area; describe any impacts associated with noise generated by pile driving and blasting; provide a schedule of expected pile driving and blasting activities; clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these; outline measures to avoid impacts; where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts; include a monitoring regime to determine achievement of objectives and success of measures used; provide for the involvement of an expert panel in the development of the plan and monitoring program required to detect and manage impacts; outline reporting and auditing arrangements; and describe how the plan will apply the principles of adaptive management. <p>In addition, the person taking the action is not permitted to undertake any blasting unless it can be demonstrated that all prudent and feasible alternatives have been ruled out and the Minister has given specific permission to allow blasting. If permission is granted the person taking the action must not undertake blasting activities for more than 28 days in total, without written approval from the Minister, and must not undertake blasting before sunrise or after sunset on any of these days.</p> <p>The plan/s must be submitted at least three months prior to the commencement of any pile driving or blasting activities to which the plan applies. Pile driving or blasting activities may not commence until the plan is approved. The approved plan must be implemented.</p>	Construction phase	Not applicable	No construction activities requiring a noise management plan occurred during the reporting period.
10.	<p>Dredging and Spoil Disposal Management Plan</p> <p>The person taking the action must submit for the Minister's approval a Dredging and Spoil Disposal Management Plan (DSDMP) for the protection of inshore dolphins, marine turtles and Dugong occupying Darwin Harbour. The DSDMP must include, but is not limited to, the following:</p> <ol style="list-style-type: none"> final methodologies for dredging including the method and timing of dredging activities; a schedule for dredging activities; 	Ongoing	Compliant	The approved Maintenance DSDMP is not yet activated, as there has been no requirement for a maintenance dredging campaign since the approval of the plan.

Condition No.	Condition	Timing	Status	Evidence/Comments
	<p>c. a comparison of dredging methodologies proposed based on potential impacts on dolphins, turtles and Dugongs associated with individual methods, including noise and sediment plumes;</p> <p>d. justification of the dredging option/s chosen based on best practice at the time;</p> <p>e. mitigation measures, including measures for each type of dredge to avoid entrapment of marine turtles;</p> <p>f. methods to prevent, detect and respond to impacts on any number of marine turtles;</p> <p>g. measures that allow the alteration of dredging activities and/or implement mitigation methods in an adaptive management framework to ensure the protection of turtles, Dugongs and dolphins;</p> <p>h. the outcomes of hydrodynamic and sediment transport modelling required to predict impacts and finalise the design of the dredging campaign;</p> <p>i. contingencies to manage dredging if there is a significant departure from predicted impacts;</p> <p>j. an ecological monitoring program, which must exist either in full within the DSDMP, or as a standalone document (see Note 1 below) that is appropriately referenced in the DSDMP;</p> <p>k. the involvement of an expert panel in the development of the plan and monitoring program required to detect and manage impacts; and</p> <p>l. reporting and auditing arrangements.</p> <p>The DSDMP must be submitted at least three months prior to the commencement of dredging. Dredging for which the DSDMP has been prepared must not commence until the DSDMP is approved. The approved DSDMP must be implemented.</p> <p>Note 1: Regarding condition 10(j); if the person taking the action wishes to prepare the ecological monitoring program as a standalone document, then the ecological monitoring program must be approved in writing by the Minister. The approved ecological program must be implemented.</p>			
11.	<p>Offsets</p> <p>The person taking the action must submit for the Minister's approval a Coastal Offset Strategy for the protection of listed threatened species and listed migratory species impacted by the proposal in Darwin Harbour. The Coastal Offset Strategy must include:</p> <p>a. High level details on the implementation of the following offsets outlined in the Northern Territory Government's letter to the Acting Secretary of the Department of Sustainability, Environment, Water, Population and Communities dated 23 May 2011, including a commitment and indicative schedule for the development of detailed sub-plans for each offset program</p> <ul style="list-style-type: none"> • Publication of data collected for the Browse Basin and Kimberley coastline; • an integrated monitoring and research program for Darwin Harbour; • habitat mapping for Darwin Harbour Region (including Bynoe Harbour); • funding of Australian Research Council Linkage projects; • conservation management of dugongs, cetaceans and threatened marine matters of national environmental significance in the Top End; and • research on the conservation status, distribution and habitat use of coastal dolphins. <p>b. Provision for the permanent protection of approximately 2000 ha of terrestrial vegetation and mangroves, or of an area as otherwise agreed by the Minister and provision for the management of the protected area(s) for the life of the project;</p>	Ongoing	Compliant	<p>Scientific reports, data and maps, which have been produced as result of execution of programs required under Condition 11, are available at https://www.inpex.com.au/projects/ichthys-lng/our-commitments/.</p> <p>Condition 11a</p> <p>Condition 11a offset programs which have been completed and were reported on in previous Compliance Reports have been excluded from this Compliance Report. The following Condition 11a programs remain ongoing during the 2020/2021 reporting period:</p> <ul style="list-style-type: none"> • Darwin Harbour integrated marine monitoring and research program (IMMRP) • Conservation management of dugongs, cetaceans and threatened marine matters of national environmental significance in the Top End. <p><u>Darwin Harbour integrated marine monitoring and research program</u></p> <p>During the reporting period a number of field activities and reports were completed, including:</p> <ul style="list-style-type: none"> • Sediment Monitoring: <ul style="list-style-type: none"> • Final report on rod surface-elevation table measurements between 2014 and 2021 including recommendations for long-term monitoring. • Additional sediment sampling for analysis of hydrocarbons in East Arm in April 2022. • Optimisation study completed to inform final site selection for Benthic Sediment Monitoring Plan for Darwin Harbour.

Condition No.	Condition	Timing	Status	Evidence/Comments
	<p>Note 1: Permanent protection can include the acquisition and inclusion of an area in the conservation estate, covenanting arrangements on private land, other formal agreements with private landholders, or permanent changes to management regimes on Crown or Aboriginal land.</p> <p>Note 2: This condition does not limit the provision of these offsets in synergy with any conditions of any other approving party.</p> <p>c. Provision for the permanent protection of marine habitat for inshore dolphins, marine turtles and Dugong that is preferably, but not necessarily, adjacent to the protected mangrove vegetation and provision for the management of the protected area(s) for the life of the project.</p> <p>Note 1: Permanent protection can include the acquisition and inclusion of an area in the conservation estate, covenanting arrangements on private land, other formal agreements with private landholders, or permanent changes to management regimes on Crown or Aboriginal land.</p> <p>Note 2: This condition does not limit the provision of these offsets in synergy with any conditions of any other approving party</p> <p>The Coastal Offset Strategy must include commitments to timeframes and funding arrangements and be made available on the proponent's website. The strategy must be submitted for approval at least three months before construction activities commence in Darwin Harbour. No construction activities may commence in Darwin Harbour until the Coastal Offset Strategy is approved.</p>			<ul style="list-style-type: none"> • Draft Benthic Sediment Monitoring Plan for Darwin Harbour prepared and reviewed. • Pressure Monitoring: <ul style="list-style-type: none"> • 2020/21 report on Anthropogenic Pressures on Darwin Harbour completed. • 2021/22 report on Anthropogenic Pressures on Darwin Harbour drafted and reviewed. • Mangrove Monitoring: <ul style="list-style-type: none"> • Mangrove condition and extent analysis using satellite imagery for 2016 to 2021 completed. • Field work to validate satellite based mangrove extent and condition results completed. • First draft report on the long-term mangrove monitoring program for Darwin Harbour near completion by Northern Territory Government. • Darwin Harbour Integrated Monitoring and Research Coordination Committee meetings held 28 July 2021 and 25 May 2022. <p><u>Conservation management of dugongs, cetaceans and threatened marine matters of national environmental significance in the Top End</u></p> <p>Applications for the offset program commenced in late July 2021 as part of the Northern Territory Governments Aboriginal Ranger Grants Program call for funding. Following review of applications in accordance with the Northern Territory Government's Aboriginal Ranger Grants Program Guideline, eight grants totalling \$877,446 were awarded in quarter two 2022. The eight grants comprised four conservation projects and four capital grants, which are summarised below. As grant funding was awarded just before the end of the reporting period, there are no outcomes to report for the reporting period as projects have only just commenced or capital items ordered.</p> <p>Conservation Projects:</p> <ul style="list-style-type: none"> • <i>Larrakia Kenbi Mardbalk Tiwi Marthakal Marine Megafauna Project</i> – three year project to bring together several ranger groups in a combined effort to further marine megafauna research studies and ranger exchanges/ learning opportunities. • <i>Mapping Yanyuwa Sea Country</i> – three year project to bring together Traditional Owners, sea rangers and scientists to map benthic habitats, develop a ranger-led monitoring program and determine priority areas for management. • <i>Larrakia Rangers Darwin Harbour Biodiversity Project</i> – three year Darwin Harbour based project to continue annual dolphin surveys, monthly shorebird surveys, weekly turtle surveys (increased to daily peak nesting times) and annual shorebird marine/megafauna helicopter surveys. • <i>Yolŋu Sea Country Facilitator role and mentoring</i> – two year project to support the establishment of a Yolŋu Sea Country Facilitator, development and implementation of Sea Country Plan including mapping of matters of cultural significance, including but not limited to culturally significant dugong and marine turtle breeding and feeding habitats. <p>Capital:</p> <ul style="list-style-type: none"> • <i>Kenbi Surveyed Vessel Tow Vehicle</i> – purchase of vehicle so Kenbi Rangers can safely conduct megafauna research (see above project titled Larrakia Kenbi Mardbalk Tiwi Marthakal Marine Megafauna Project). • <i>Outboards for Yirralka Vessel Yarrowarri</i> – purchase of outboards so ranger vessel (Yarrowarri) can be brought back into operation, recommencing monthly sea patrols, support sea country mapping of cultural significance, includes critical seagrass habitat, breeding and feeding grounds for dugong and turtle as well as offshore islands.

Condition No.	Condition	Timing	Status	Evidence/Comments
				<ul style="list-style-type: none"> • <i>Marthakal Homelands Indigenous Protected Area (IPA) barge mooring, car, all-terrain vehicles and trailers</i> – purchase of equipment to facilitate management of Marthakal IPA, especially remote areas such as marine debris collection and removal capability and capacity, feral animal management and supporting partnerships with scientists in their research and monitoring of endangered species in the IPA. • <i>Garngi Ranger vehicle replacement and offroad boat trailer</i> – purchase of equipment to increase access to remote areas increasing capacity for ghost net and marine debris removal, biosecurity patrols, monitor fishing and other vessel movements in and around the island particularly marine sacred sites. <p>Condition 11b and 11c</p> <p>During the reporting period, Steps 5 to 6 were completed in accordance with Section 4.3 and 4.5 (Table 4-1) of the approved COS, while Step 7 commenced. Specifically:</p> <ul style="list-style-type: none"> • <i>Step 5: Engage with relevant land owners</i> - a Letter of Intent was executed between INPEX and Bawinanga Aboriginal Corporation on 19 August 2021. Engagement with landowners is now ongoing through INPEX anthropologists engaged by INPEX, and through the Northern Land Council's (NLC) free, prior and informed consent decision making process, under the <i>Northern Territory Aboriginal Land Rights Act 1976</i> (ALRA). • <i>Step 6: Develop an Execution Plan</i> - a Project Execution Plan (0000-AH-PLN-70015) was finalised on 13 September 2021. • <i>Step 7: Select Terrestrial and Marine Conservation sites</i> – a number of field surveys (land-based, marine and aerial) were undertaken during the reporting period to identify suitable habitat to satisfy condition 11b/11c. A proposed conservation area has been identified, which will inform the NLC stakeholder consultation process through the ALRA 1976. <p>Project information related to this offset condition is available at <https://www.inpex.com.au/projects/ichthys-lng/our-commitments/>.</p>

4 REFERENCES

ANZG—see Australian and New Zealand Governments and Australian State and Territory Governments

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Munksgaard, N.C., Kaestli, M., Gibb, K., Dostine, P. and Townsend, S. 2013. *Darwin Harbour sediment survey 2012*. Environmental Chemistry and Microbiology Unit (ECMU) Research Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, NT.

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APPENDIX A: SUMMARY OF OPERATIONS MONITORING PROGRAM RESULTS

A.1 Commingled treated effluent (in-pipe) monitoring

Commingled treated effluent (in-pipe) sampling was undertaken on a monthly basis throughout the reporting period. Where an exceedance was detected additional sampling was undertaken where required. In addition to routine monthly sampling, ad hoc sampling was undertaken as part of the onsite laboratory National Association of Testing Authorities (NATA) Australia accreditation Quality Assurance and Quality Control (QA/QC) processes.

The results for in-pipe monitoring at sample location 750-SC-003 for the reporting period are presented in Table A.1-1. Results that exceeded discharge limits are shaded and shown in bold text.

During the reporting period, there were three occurrences where wastewater quality was above discharge limits, which are further discussed in Section A.1.1.

Overall, there was generally little variability of the wastewater quality, with the majority of results below discharge limits described in the LDMP. This demonstrates the wastewater treatment systems were operating effectively.

A.1.1 Limit exceedance assessment outcomes

Throughout the reporting period there were three discharge limit exceedances. A summary table of all discharge limit exceedances including corrective actions is provided in Table A.1-2.

In general, the total nitrogen (TN) discharge limit exceedances reported in Table A.1-2, relate to ammonia dosing into the steam system of the combined cycle power plant (CCPP). There are four ammonia dosing locations (each location primary pump and a spare pump on standby) into the steam system.

Following the identification of a faulty ammonia dosing pump, the pump was taken offline, and the spare pump was brought online into service. This allowed for the faulty pump to be removed for repairs either at the INPEX workshop or offsite at a maintenance contractor's workshop.

In addition to improving the reliability of the dosing pumps, in March 2022, INPEX also changed the location of ammonia dosing, from the feedwater manifold, to direct into steam condensate manifold of the steam system. This allows for better control of the dosing into the steam system.

With the change in dosing location and improved management of the pumps, there has been a reduction in the consumption rate of ammonia, which has reduced the risk of overdosing in the system. In October 2021, 9,000 L of ammonia was consumed, compare to 7,000 L/per month which is the current consumption rate.

There have been no exceedances of total nitrogen in the discharge wastewater at location 750-SC-003 since 18 October 2021 to the end of the reporting period.

Table A.1-1: Monthly sampling results for 750-SC-003 (shaded bold values indicate an exceedance)

Date	LIMS Sample ID	pH	Electrical conductivity	Temperature	Turbidity	Dissolved oxygen	TPH as oil & grease	TRH (C6-C10)	TRH C10-C40	TSS	BOD	COD	Free Chlorine	Ammonia	Total nitrogen	Total phosphorus	Filterable Reactive Phosphorus	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Enterococci	E coli	Faecal coliforms	Anionic surfactants	aMDEA	Glycol (MEG)	Glycol (TEG)	
Unit		pH units	µS/cm	°C	NTU	%	mg/L	µg/L	µg/L	mg/L	mg/L	mg/L	mg/L	µg N/L	mg N/L	mg P/L	mg P/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	cfu/100 mL	cfu/100 mL	cfu/100 mL	mg/L	mg/L	mg/L	mg/L	
Discharge limit		6 to 9	n/a	35	n/a	n/a	6	n/a	n/a	10	20	125	2	n/a	10	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100	400	n/a	n/a	n/a	n/a	
6/07/21	L2102932001														4																		
20/07/21	L2103198001	9.0	670	27.2	1.0	91	< 1	<20	<100	< 5	<2	12	< 0.02	19	19	< 0.5	< 0.5	<0.1	<1	6	<1	<0.1	<1	<1	40	<1	<1	<1	<0.1	< 5	< 5	< 5	
20/07/21	L2103219001													43																			
23/07/21	L2103273001	8.1												< 2	2																		
25/07/21	L2103306001	8.1												< 2	< 2																		
17/08/21	L2103538001	8.8	610	27.9	0.5	87	< 1	<20	<100	< 5	<2	19	< 0.02	10	12	< 0.5	< 0.5	<0.1	<1	9	<1	<0.1	<1	<1	37	33	<1	<1	<0.1	< 5	< 5	< 5	
19/08/21	L2103708001													4	4																		
14/09/21	L2104092001	8.6	379	30.2	1.5	97	< 1	<20	<100	< 5	<2	15	< 0.02	< 2	< 2	< 0.5	< 0.5	<0.1	<1	7	<1	<0.1	2	<1	260	10	7	8	<0.1	< 5	< 5	< 5	
12/10/21	L2104550001	8.8	365	31.2	4.5	97				6		15	< 0.02	10	13	< 0.5	< 0.5													< 5	< 5	< 5	
18/10/21	L2104699001	8.4	404	31.3	1.5	94	< 1	<20	<100	< 5	2	12	0.02	4	4	< 0.5	< 0.5	<0.1	<1	5	<1	<0.1	5	<1	766	<1	<1	<1	<0.1	< 5	< 5	< 5	
9/11/21	L2105020001	8.2	513	32.1	1.0	94	< 1	<20	<100	< 5	5	8	< 0.02	5	10	< 0.5	< 0.5	<0.1	<1	4	<1	<0.1	<1	<1	30	<1	<1	<1	<0.1	< 5	< 5	< 5	
7/12/21	L2105392001	8.1	294	30.0	2.0	95	< 1	<20	<100	< 5	<2	11	< 0.02	7	8	0.6	< 0.5	<0.1	<1	<1	<1	<0.1	2	<1	739	<1	<1	<1	<0.1	< 5	< 5	< 5	
11/01/22	L2200144001	8.3	234	33.2	2.5	90	< 1	<20	<100	< 5	2	11	< 0.02	5	6	< 0.5	< 0.5	<0.1	<1	<1	<1	<0.1	1	<1	275	2	<1	<1	<0.1	< 5	< 5	< 5	
8/02/22	L2200531001	8.7	235	29.0	1.5	94	< 1	<20	<100	< 5	<2	11	< 0.02	6	6	< 0.5	< 0.5	<0.1	<1	1	<1	<0.1	<1	<1	278				<0.1	< 5	< 5	< 5	

Date	LIMS Sample ID	pH	Electrical conductivity	Temperature	Turbidity	Dissolved oxygen	TPH as oil & grease	TRH (C6-C10)	TRH C10-C40)	TSS	BOD	COD	Free Chlorine	Ammonia	Total nitrogen	Total phosphorus	Filterable Reactive Phosphorus	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Enterococci	E coli	Faecal coliforms	Anionic surfactants	aMDEA	Glycol (MEG)	Glycol (TEG)
14/02/22	L2200583001																									2	4	4				
8/03/22	L2200957001	8.2	310	29.1	1.0	90	< 1	<20	<100	< 5	3	11	0.02	5	6	< 0.5	< 0.5	<0.1	<1	3	<1	<0.1	3	<1	411	4	1	1	<0.1	< 5	< 5	< 5
13/04/22	L2201552001	8.1	269	29.9	1.5	92	2	<20	<100	< 5	3	8	< 0.02	< 2	3	< 0.5	< 0.5	<0.1	<1	2	<1	<0.1	1	<1	540	44	60	80	<0.1	< 5	< 5	< 5
26/04/22	L2201923001																									10	15	15				
10/05/22	L2202127001	8.1	257	28.4	2.5	91	1	<20	<100	<5	2	18	0.02	<2	<2	<0.5	<0.5	<0.1	<1	1	<1	<0.1	1	<1	588	42	<1	<1	<0.1	< 5	< 5	< 5
14/06/22	L2202662001	8.6	396	24.6	0.5	88	<1	<20	<100	<5	<2	10	0.03	6	8	<0.5	<0.5	<0.1	<1	1	<1	<0.1	<1	<1	92	4	5	12	<0.1	< 5	< 5	< 5

Table A.1-2: Summary of commingled treated effluent sample point exceedance results

Date sampled	Parameter	Result	Limit	Cause and/or contributing factors	Corrective actions
20-July-21	Total Nitrogen (TN)	TN 19 mg/L	TN 10 mg/L	<p>During the sampling events on 20 July 2021, only three of the four wastewater streams were flowing into the combined jetty discharge outfall line, being treated steam blowdown, demineralised reject brine and treated sewage.</p> <p>Previous routine sampling undertaken on 19 July 2021 upstream at the treated sewage plant (sample location 750-SC-009), reported that the sewage treatment plant was working effectively with nitrate results of 1.3 mg/L and it was not the source of the elevated TN. Further sampling on 23 Jul 2021 confirmed the sewage plant was operating in a stable condition.</p> <p>The investigation considered whether the elevated TN was originating from the steam plant within the combine cycle power plant (CCPP), due to the TN comprising mostly of ammonia. A low flow sampling event at location 750-SC-003 (with only the treated steam blowdown and demineralised reject brine) was undertaken, and sampling up-stream in the steam plant of the CCPP confirmed the off-specification waste water was originating from the steam plant.</p> <p>INPEX subsequently identified in the early evening of 20 July 2021, that the ammonia dosing pump (which injects ammonia into the steam header) was faulty and overdosing ammonia into the steam system, with the pump still operational with a zero percentage stroke rate (at a zero percent stroke rate no dosing should be occurring). The pump was taken offline for repair, and dosing was switched across to an alternative pump.</p>	<p>The faulty dosing pump was taken offline in the afternoon of 20 July 2021 and dosing undertaken from the secondary ammonia dosing pump. In addition, an additional service water flush was added into the jetty outfall discharge pipe to reduce the ammonia levels on the evening of 20 July 2021.</p> <p>Through the incident investigation the following action was identified to prevent reoccurrence:</p> <ul style="list-style-type: none"> • The faulty ammonia dosing pump is to be repaired and recalibrated. • The reliability of the ammonia dosing pumps will be reviewed.
17-Aug-21	TN	TN 12 mg/L	TN 10 mg/L	<p>During the sampling events on 17 August 2021, only three of the four wastewater streams were flowing into the combined jetty discharge outfall line, being treated steam blowdown, demineralised reject brine and treated sewage.</p> <p>Sampling undertaken on 18 August 2021 upstream at the treated sewage (sample location 750-SC-009), reported that the sewage treatment plant was working effectively with a TN results of <2 mg/L and it was not the source of the elevated TN.</p> <p>The investigation considered whether the elevated TN was originating from the steam plant within the CCPP, due to the TN comprising mostly of ammonia. Sampling up-stream in the steam plant of the CCPP confirmed the off-specification waste water was originating from this location.</p> <p>It was subsequently identified that ammonia is potentially being concentrated in the discharge of the seal flush wastewater stream of the liquid ring vacuum pump (LRVP), in a separator tank, located in the steam air cooled condenser system (ACC) (this waste stream is then treated in a flash tank prior to then flowing to the CCPP blowdown neutralisation plant). In addition, repair works are still ongoing with the ammonia dosing pumps (which injects ammonia into the steam header) so there is potential that overdosing into the steam system is still ongoing. Repair works on the dosing pumps will likely be completed by the end of October 2021.</p>	<p>Through the incident investigation the following actions were identified to prevent reoccurrence:</p> <ul style="list-style-type: none"> • A trial will be undertaken where the flush wastewater from the ACC LRVP on steam generator 2, will be redirected and captured in a standalone 20 m³ isotainer with the waste to be taken to either the evaporation basin or offsite for disposal by a licenced waste contractor. • Repairs will continue on the faulty ammonia dosing pumps.
12-Oct-21	TN	TN 13 mg/L	TN 10 mg/L	<p>During the sampling events on 12 October 2021, all four wastewater streams were flowing into the combined jetty discharge outfall line, being treated steam blowdown, demineralised reject brine, treated sewage and treated accidentally oily contaminated wastewater.</p> <p>Sampling undertaken on 13 October 2021 upstream at the treated sewage (sample location 750-SC-009), reported that the sewage treatment plant was working effectively with a TN results of 8 mg/L and it was not the source of the elevated TN.</p>	<p>To reduce the ammonia levels, additional service water was added into the system, where possible, upstream of the neutralisation plant.</p> <p>Blowdown volumes are now decreasing to normal levels as the contaminates are gradually being removed from the system.</p> <p>Through the incident investigation, the following actions were identified to prevent reoccurrence:</p> <ul style="list-style-type: none"> • Investigate the installation of a condensate water polisher (to remove impurities/contaminates from return condensate) in the steam system.

Date sampled	Parameter	Result	Limit	Cause and/or contributing factors	Corrective actions
				<p>The investigation considered whether the elevated TN was originating from the steam plant within the CCPP, due to the TN comprising mostly of ammonia. Sampling up-stream in the steam plant of the CCPP confirmed the off-specification waste water was originating from this location.</p> <p>It was subsequently identified that in late September 2021 INPEX increased the operational pressures in the heat recovery steam generation units (HRSGs) due to power limitations (due to a steam turbine being out of service). This then caused a reaction to commence where soluble commissioning contaminants (left over from original commissioning activities, most likely in dead legs of system) such as silica and sodium dissolved and then was identified in much higher concentration levels than in previous operational testing. In an attempt to reduce these contaminant levels, steam blowdown volumes were increased. This had the undesired consequence of adding in higher than normal levels of ammonia to the steam blowdown treatment package.</p> <p>In addition, INPEX also identified that through the improved performance of the recently serviced ammonia dosing pumps (which were previously unreliable) the target pH (9.8) of the boiler feed water was consistently being achieved, this resulted in increased ammonia usage at the site. This, coupled with the increased steam blowdown led to the increased TN levels in the wastewater stream.</p>	<ul style="list-style-type: none"> Transfer of excess blowdown to the evaporation basin and/or offsite for disposal during times of excessive blowdown due to issues with steam chemistry.

A.2 Harbour sediment quality monitoring

An annual harbour sediment quality monitoring survey was completed on 1 July 2022.

Table A.2-1 presents the range of laboratory results of sediment samples, of each analyte for both impact and control sites. These results are compared to trigger values and background levels. Trigger values have been derived from ANZG (2018) while background levels are from Munksgaard et al. (2013). The full suite of metals and physicochemical results are provided in Table A.2-2.

All samples tested for hydrocarbons (total recoverable hydrocarbons (TRHs), total petroleum hydrocarbons (TPHs) and benzene, toluene, ethylbenzene and xylene (BTEX)) recorded concentrations below the limit of reporting (LOR), with the exception of TPH detected within the fraction range of C15-C28 at a concentration of 57 mg/kg at site I11, which is well below the TRH trigger value of 280 mg/kg.

No trigger exceedances were recorded for any analyte at either control or impact sites. Overall, there were no changes to harbour sediment quality associated with Ichthys LNG activities. As such, discharges have not adversely affected the declared beneficial users or harbour sediment objectives for Darwin Harbour.

Table A.2-1: Harbour sediment quality survey results summary

Parameter	Trigger value (mg/kg)	Background level mg/kg	Results	
			Impact sites (mg/kg)	Control sites (mg/kg)
Aluminium	-	-	6,100 – 21,000	2,400 – 19,000
Antimony	2	-	<0.5*	<0.5*
Arsenic	20	19	9.8-15	16-20
Cadmium	1.5	0.041	<0.1*	<0.1*
Chromium	80	18.5	21-44	17-39
Copper	65	8.6	5.3-12	2.5-9.2
Lead	50	15.5	7.8-12	3.8-12
Mercury	0.15	-	<0.1*	<0.1*
Nickel	21	8.9	7.7-15	2.4-12
Zinc	200	44.4	16-41	7.8-37
TRH C10-C36 (total)	280	-	<50-57	<50*
Benzene	-	-	<0.1*	<0.1*
Toluene	-	-	<0.1*	<0.1*

Parameter	Trigger value (mg/kg)	Background level mg/kg	Results	
			Impact sites (mg/kg)	Control sites (mg/kg)
Ethybenzene	-	-	<0.1*	<0.1*
m&p Xylene	-	-	<0.2*	<0.2*
o-Xylene	-	-	<0.1*	<0.1*
Total -Xylenes	-	-	<0.3*	<0.3*
Napthalene (VOC)	-	-	<0.5*	<0.5*
Moisture	-	-	43-60	20-51
total organic carbon (TOC)	-	-	<1,000-46,000	12,000-28,000

* All results for analyte below LOR

Table A.2-2: Harbour sediment quality survey metal and physio-chemical results

Parameter	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Moisture content (dried @ 103 oC)	TOC
Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg
LOR	20	0.5	1	0.1	1	1	1	0.01	1	1	1	1000
Trigger Value	-	2	20	1.5	80	65	50	0.15	21	200	-	-
I1_010722	9,000	<0.5	9.8	<0.1	23	5.3	7.8	<0.1	7.7	17	56	31,000
I2_010722	11,000	<0.5	11	<0.1	28	6.9	9.3	<0.1	10	21	54	28,000
I3_010722	13,000	<0.5	11	<0.1	31	6.7	9.5	<0.1	10	23	58	29,000
I4_010722	9,800	<0.5	11	<0.1	26	5.6	8.2	<0.1	8.9	17	55	24,000
I5_010722	14,000	<0.5	11	<0.1	34	6.8	10	<0.1	11	23	60	34,000
I6_010722	13,000	<0.5	11	<0.1	31	6.9	9.6	<0.1	11	22	58	22,000
I7_010722	21,000	<0.5	12	<0.1	44	11	12	<0.1	14	41	56	25,000
I8_010722	17,000	<0.5	12	<0.1	37	9.6	11	<0.1	13	34	53	26,000
I9_010722	17,000	<0.5	14	<0.1	38	9	12	<0.1	12	34	50	25,000

Parameter	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Moisture content (dried @ 103 oC)	TOC
I10_010722	14,000	<0.5	10	<0.1	32	7.1	9.5	<0.1	9.8	30	55	31,000
I11_010722	16,000	<0.5	12	<0.1	34	8.6	10	<0.1	11	32	54	30,000
I12_010722	11,000	<0.5	11	<0.1	28	6.5	8.9	<0.1	10	21	52	46,000
I13_010722	10,000	<0.5	15	<0.1	25	5.4	8.6	<0.1	8.2	16	58	28,000
I14_010722	6,100	<0.5	11	<0.1	21	12	6.8	<0.1	15	30	43	20,000
I15_010722	15,000	<0.5	14	<0.1	35	7.4	12	<0.1	11	24	58	<1000
I16_010722	9,900	<0.5	15	<0.1	27	5.7	9.2	<0.1	8.6	18	49	34,000
C1_010722	2,400	<0.5	20	<0.1	17	2.5	3.8	<0.1	2.4	7.8	20	12,000
C2_010722	19,000	<0.5	16	<0.1	39	9.2	12	<0.1	12	37	51	28,000

A.2.1 Trigger assessment outcomes

No exceedances were reported during the reporting period.

A.3 Groundwater monitoring

Two groundwater surveys were completed during the reporting period, in October 2021 (Survey 8) and April 2022 (Survey 9). A high-level summary of groundwater results and trends for each of the surveys is provided in Section A.3.1 and A.3.2, with data collected during the reporting period provided in Table A.3-1. Note presentation interpretation of groundwater data trends include data collected during the construction phase.

To date, groundwater monitoring during the operations phase of Ichthys LNG has shown there has been no change in groundwater quality (i.e. Elizabeth-Howard Rivers Region groundwater declared beneficial uses or objectives have not been adversely affected).

Table A.3-1: Groundwater quality monitoring data

Monitoring_Round	LocCode	Sampled_Date-Time	Ammonia as N	Nitrogen (Total)	Oxides of Nitrogen	Phosphate total (P)	Reactive Phosphorus as P	TSS	Aluminium (Filtered)	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (hexavalent) (Filtered)	Chromium (Trivalent) (Filtered)	Cobalt (Filtered)	Copper (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Silver (Filtered)	Vanadium (Filtered)	Zinc (Filtered)	Benzene	Ethylbenzene	Toluene	Xylene Total	TRH C6-C40	Biological oxygen demand (BOD)	Escherichia coli	Enterococci	Dissolved Oxygen (%)	EC (field)	pH (Field)	Redox	Salinity	Temp
Units	n/a	n/a	µg/L																									MPN/100mL	cfu/100mL	% sat	uS/cm	pH_Units	mV	PSU	°C	
Operations Survey 8	BPGW01	18/10/2021	260	<500	10	17	9	1600	5	31	0.4	0.25	0.25	27	<1.0	<0.20	1300	0.05	14	0.05	0.25	63	<1	<1	<1	<3	<100	-	-	-	1.6	3948	5.18	61.8		31.9
	BPGW07	18/10/2021	380	130	130	22	33	65000	5	12	1.5	0.25	0.25	29	<1.0	2.1	1400	0.05	31	0.2	0.25	55	<1	<1	<1	<3	<100	-	-	-	3.78	131025	4.99	82.4		31.6
	BPGW08A	18/10/2021	91	289	3	15	22	12000	5	4.8	0.8	0.25	0.6	61	<1.0	5	5600	0.05	35	0.4	0.25	63	<1	<1	<1	<3	<100	-	-	-	1.7	29852	5.27	164.8		31.3
	BPGW09	18/10/2021	590	470	<2	24	0.5	84000	5	47	0.9	0.25	1.7	2.8	<1.0	0.5	300	0.05	1.7	0.4	0.25	5	<1	<1	<1	<3	<100	-	-	-	1.8	52999	5.24	-52.8		31.6
	BPGW18	20/10/2021	350	750	<2	50	0.5	60000	5	18	<0.20	0.25	0.25	<0.20	2	0.3	79	0.05	0.5	0.05	1.5	15	<1	<1	<1	<3	<100	-	-	-	2.3	91920	5.13	-47.8		30.2
	BPGW19A	20/10/2021	1400	2300	<2	44	11	46000	5	1.6	<0.20	1	0.25	0.3	<1.0	0.7	61	0.05	2.3	0.05	3.7	13	<1	<1	<1	<3	<100	<2	<1	<1	1.5	81889	5.93	-50.5		32.4
	BPGW20	20/10/2021	140	260	<2	5	8	870	5	5.1	<0.20	0.25	0.25	2.7	<1.0	<0.20	53	0.05	1.4	0.05	0.9	6	<1	<1	<1	<3	<100	-	-	-	1	2197	5.38	20.2		33.3
	BPGW26	19/10/2021	310	460	130	6	1	6200	5	4.7	<0.20	0.25	0.25	11	<1.0	<0.20	3100	0.05	1.4	0.05	1.1	<5.0	<1	<1	<1	<3	<100	-	-	-	1.1	16550	5.27	80.7		32
	BPGW27A	20/10/2021	260	270	6	12	5	1500	5	2	<0.20	0.25	0.25	1.9	<1.0	<0.20	41	0.05	0.9	0.05	0.7	6	<1	<1	<1	<3	<100	<2	<1	<1	1.4	2981	5.44	65		33.8
	BPGW28	20/10/2021	1000	1500	<2	38	3	83000	5	3.5	<0.20	0.6	0.25	<0.20	<1.0	0.3	170	0.05	0.25	0.05	1.5	<5.0	<1	<1	<1	<3	<100	-	-	-	1.5	19886	5.71	-60.4		31.2
	BPGW38A	19/10/2021	93	300	36	5	12	1800	5	0.4	4.4	0.25	0.25	1.3	<1.0	<0.20	38	0.05	1.3	0.05	0.7	<5.0	<1	<1	<1	<3	<100	-	-	-	2.9	4831	5.44	75.3		32.4
	BPGW40	19/10/2021	400	660	13	6	4	3500	10	6.2	<0.20	0.25	0.25	0.9	<1.0	<0.20	150	0.05	0.25	0.05	0.7	<5.0	<1	<1	<1	<3	<100	-	-	-	1.6	8931	5.81	-64.1		31.2
	BPGW41	19/10/2021	610	900	13	13	8	8200	5	3.9	<0.20	0.25	0.25	<0.20	<1.0	<0.20	12	0.05	0.25	0.05	0.9	<5.0	<1	<1	<1	<3	<100	-	-	-	14.9	33475	5.68	-68		30.1
	VWP328	20/10/2021	290	760	<2	47	0.5	75000	5	510	<0.20	0.25	0.25	13	1	0.7	490	0.05	3.9	0.05	1.2	10	<1	<1	<1	<3	<100	-	-	-	3.4	11267	5.19	-42		31.2
VWP341	19/10/2021	580	720	<2	<5.0	0.5	2000	5	5.2	<0.20	0.25	0.25	110	<1.0	<0.20	1300	0.05	13	0.05	0.7	130	<1	<1	<1	<3	<100	-	-	-	1.8	5235	4.96	45		32.5	
Operations Survey 9	BPGW01	5/04/2022	57	300	<2	14	9	160	5	7.1	<0.20	0.25	0.25	7.1	<1.0	<0.20	510	0.05	1.8	0.05	0.25	14	<1	<1	<1	<3	<100	-	-	-	9	376.1	5.04	14.9		30.6
	BPGW07	5/04/2022	380	1000	<2	26	28	69000	5	23	0.4	0.25	0.5	15	<1.0	1.7	840	0.05	0.25	0.05	0.25	<5.0	<1	<1	<1	<3	<100	-	-	-	37.5	107641	5.61	82.3		31.0
	BPGW08A	4/04/2022	220	220	<2	18	1	4300	70	49	0.6	1	0.25	35	<1.0	0.3	2200	0.05	0.25	0.05	1	<5.0	<1	<1	<1	<3	<100	-	-	-	75.9	7421	5.54	-49.8		32.0
	BPGW09	5/04/2022	220	300	14	26	0.5	100000	5	85	<0.20	0.25	0.5	4	<1.0	1.6	540	0.05	1.8	0.05	0.25	15	<1	<1	<1	<3	<100	-	-	-	149.6	48207	6	-22.9		30.8
	BPGW18	6/04/2022	320	250	30	80	0.5	8300	5	15	<0.20	0.25	0.25	<0.20	<1.0	0.5	79	0.05	0.25	0.05	0.6	<5.0	<1	<1	<1	<3	<100	-	-	-	205.3	77346	6.14	-38.8		30.2
	BPGW19A	6/04/2022	1200	240	27	<5.0	1	60000	5	8.3	<0.20	0.25	0.6	<0.20	<1.0	0.2	64	0.05	0.25	0.05	3.2	<5.0	<1	<1	<1	<3	<100	<1	<5	<1	163.5	74965	6.14	-31.9		31.3
	BPGW20	6/04/2022	42	120	37	<5.0	1	950	5	2	<0.20	0.25	0.25	1.4	<1.0	<0.20	31	0.05	0.25	0.05	0.25	<5.0	<1	<1	<1	<3	<100	-	-	-	56	1427	5.41	26.3		33.1
BPGW26	4/04/2022	210	220	<2	5	1	5100	5	3.3	<0.20	1	0.25	6.8	<1.0	<0.20	<1.0	0.05	0.9	0.05	0.25	<5.0	<1	<1	<1	<3	<100	-	-	-	25	8249	5.41	52.7		32.2	

Monitoring_Round	LocCode	Sampled_Date-Time	Ammonia as N	Nitrogen (Total)	Oxides of Nitrogen	Phosphate total (P)	Reactive Phosphorus as P	TSS	Aluminium (Filtered)	Arsenic (Filtered)	Cadmium (Filtered)	Chromium (hexavalent) (Filtered)	Chromium (Trivalent) (Filtered)	Cobalt (Filtered)	Copper (Filtered)	Lead (Filtered)	Manganese (Filtered)	Mercury (Filtered)	Nickel (Filtered)	Silver (Filtered)	Vanadium (Filtered)	Zinc (Filtered)	Benzene	Ethylbenzene	Toluene	Xylene Total	TRH C6-C40	Biological oxygen demand (BOD)	Escherichia coli	Enterococci	Dissolved Oxygen (%)	EC (field)	pH (Field)	Redox	Salinity	Temp
	BPGW27A	6/04/2022	230	230	54	<5.0	0.5	1700	5	1.3	<0.20	0.25	0.25	1.3	<1.0	<0.20	23	0.05	0.25	0.05	0.25	<5.0	<1	<1	<1	<3	<100	<1	<5	>100	38.5	2997	5.18	52.4		33.4
	BPGW28	6/04/2022	920	1300	30	20	0.5	2600	5	6.3	<0.20	0.25	0.25	<0.20	<1.0	0.5	190	0.05	0.25	0.05	0.25	<5.0	<1	<1	<1	<3	<100	-	-	-	123.1	102413	6.44	-58.7		31.1
	BPGW38A	4/04/2022	2.5	580	513	<5.0	2	310	20	0.3	<0.20	2	24	0.3	<1.0	<0.20	3	0.05	18	0.05	0.25	<5.0	<1	<1	<1	<3	<100	-	-	-	92.9	561	6.32	49.2		33.2
	BPGW40	5/04/2022	420	400	22	8	3	2200	5	6	<0.20	2	0.25	1.4	<1.0	<0.20	150	0.05	0.25	0.05	0.25	<5.0	<1	<1	<1	<3	<100	-	-	-	84.5	5878	6.07	-57.8		30.9
	BPGW41	5/04/2022	570	600	<2	14	0.5	11000	5	4.7	<0.20	0.25	0.6	<0.20	<1.0	0.3	19	0.1	0.25	0.05	0.25	<5.0	<1	<1	<1	<3	<100	-	-	-	1378.2	27804	6.56	-65.8		30.3
	VWP328	6/04/2022	320	450	765	14	0.5	2700	5	720	<0.20	0.25	0.25	<0.20	<1.0	0.6	<1.0	0.05	2.4	0.05	0.25	8	<1	<1	<1	<3	<100	-	-	-	203.7	96496	5.86	-14.5		31.0
	VWP341	4/04/2022	570	550	<2	5	2	2200	10	5	<0.20	2	0.25	100	<1.0	<0.20	<1.0	0.05	0.25	0.05	0.6	130	<1	<1	<1	<3	<100	-	-	-	80.3	3538	5.26	44.5		33.2

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A.3.1 Survey 8: October 2021

A total of 47 exceedances against benchmark levels³ were recorded in the eighth groundwater monitoring event in October 2021. Exceedances include ten for pH, 19 for nutrients and 18 for dissolved metals. This is less than the 53 exceedances recorded during the sixth groundwater monitoring event undertaken during October 2020.

All exceedances have been compared to data recorded during the dry season months of May to October between May 2016 and October 2021 using Mann-Kendall trend analysis.

Exceedances of pH were recorded at ten monitoring bores. No trends were discernible for pH at eight of these monitoring bores during the operational monitoring phase. The exceptions were at bores BPGW07, where pH is identified as decreasing (becoming more acidic), and BPGW41, where pH is identified as probably increasing (becoming less acidic).

A total of 19 nutrient exceedances were recorded. Visual assessment of time plotted data indicate that several analyte exceedances represent short-term spikes, potentially related to seasonal environmental variables, rather than increasing trends. The following trends were identified by the Mann-Kendall analysis:

- ammonia: increasing trends at BPGW20, BPGW40, BPGW41 and VWP341
- FRP: increasing trends at BPGW07, BPGW19A and VWP341.

A total of 18 metal exceedances were recorded during the eighth groundwater monitoring event. Visual assessment of time plotted data has confirmed the following trends that were also identified by the Mann-Kendall analysis:

- cobalt: increasing trend at VWP341
- zinc: increasing trend at BPGW07, probably increasing at VWP341.

The following historical maximum values were recorded during the eighth groundwater monitoring event:

- cadmium at BPGW07 (1.5 µg/L), BPGW08A (0.8 µg/L) and BPGW09 (0.9 µg/L)
- cobalt at VWP341 (110 µg/L).

Historical minimum values for pH were recorded at the following four bores:

- BPGW09 (5.24)
- BPGW18 (5.13)
- BPGW28 (5.71); and
- BPGW41 (5.68)

Results of the investigation into each of the exceedances are described in Section A.3.3.

A.3.2 Survey 9: April 2022

Twenty exceedances against benchmark levels were recorded in the ninth groundwater monitoring event in April 2022. Exceedances include one for pH, nine for nutrients and 10 for dissolved metals. This is less than the 37 exceedances recorded during the seventh groundwater monitoring event undertaken during April 2021. The one pH exceedance was recorded at VWP341.

³ An exceedance of a benchmark level occurs when a measured analyte exceeds the relevant Darwin Harbour Water Quality Objectives (upper-estuary) or ANZG (2018) for marine waters and site specific background concentrations by applying the 80th or 20th percentile concentration for high or lower stressors respectively in accordance with ANZG (2018)

Visual assessment of time plotted data for the nine nutrient exceedances indicates that some analyte exceedances represent short-term increases in concentration, rather than increasing trends. Assessment of time plotted data has identified the following trends:

- increasing trends for ammonia at VWP341, BPGW40 and BPGW41
- increasing trend for FRP at BPGW07.

Assessment of the ten metal exceedances identified the following trends:

- arsenic: increasing trend at BPGW08
- cobalt: increasing at BPGW40 and VWP341
- zinc: increasing trend at VWP341.

The following historical maximum value was recorded during the ninth groundwater monitoring event:

- ammonia at BPGW40 (420 µg/L).

Results of the investigation into each of the exceedances are described in Section A.3.3.

A.3.3 Trigger assessment outcomes

In accordance with the receiving environment adaptive management process outlined in Section 7.4 of the LDMP, groundwater trigger exceedances were investigated. A summary of the number of trigger exceedances by survey is provided in Table A.3-2.

Investigation for all trigger exceedances using multiple lines of evidence concluded that the reported trigger exceedances were likely natural (e.g. represent seasonal trends and natural variability) and no further evaluation or management response was required.

Table A.3-2: Summary of groundwater trigger exceedances

Date	Month	Physio-chemical	Nutrients	Metals
Survey 8*	Oct	13	19	18
Survey 9†	April	1	9	10

* Includes one technical trigger exceedance, which occurred as a result of laboratory LOR not being achieved due to matrix interference.

† Includes multiple technical trigger exceedances, which occurred as a result of samples being analysed to LORs higher than those required for the monitoring program, as well trigger exceedances resulting from the relative percentage difference of QA/QC samples above the performance criteria of <30%.

A.4 Mangrove health and intertidal sediments

An annual mangrove health and intertidal sediment monitoring survey was undertaken in June 2022. To date, mangrove health and intertidal sediment monitoring during the operations phase has shown there has been no demonstratable change to mangrove health or intertidal sediment attributable to Ichthys LNG operations.

A.4.1 Canopy cover

Canopy cover across all sites has remained relatively stable over time (Figure A.4-1). During Survey 4, canopy cover at sites BPMC16 and BPMC26 was lower than baseline values. Canopy cover was reduced by 4.6% and 18.8% respectively. No sites showed decreases in canopy cover near to levels considered to indicate ecologically significant change (a 30% decrease in canopy cover).

Trial of the digital percentage cover method (%Cover application) at site CSMC01 indicated that the results differ significantly when compared with the spherical densitometer method. However, it was noted that the results represented a small sample size. Notably, the inability to bring mobile phones onto the Ichthys LNG site under a hot works permit also prevented trial of this method at impact sites.

All sites were classified as healthy in 2022 with no signs of deterioration or abnormal stress based on indices of leaf colour, regeneration (i.e. seedlings and saplings), visible vertebrate fauna and infaunal bioturbation.

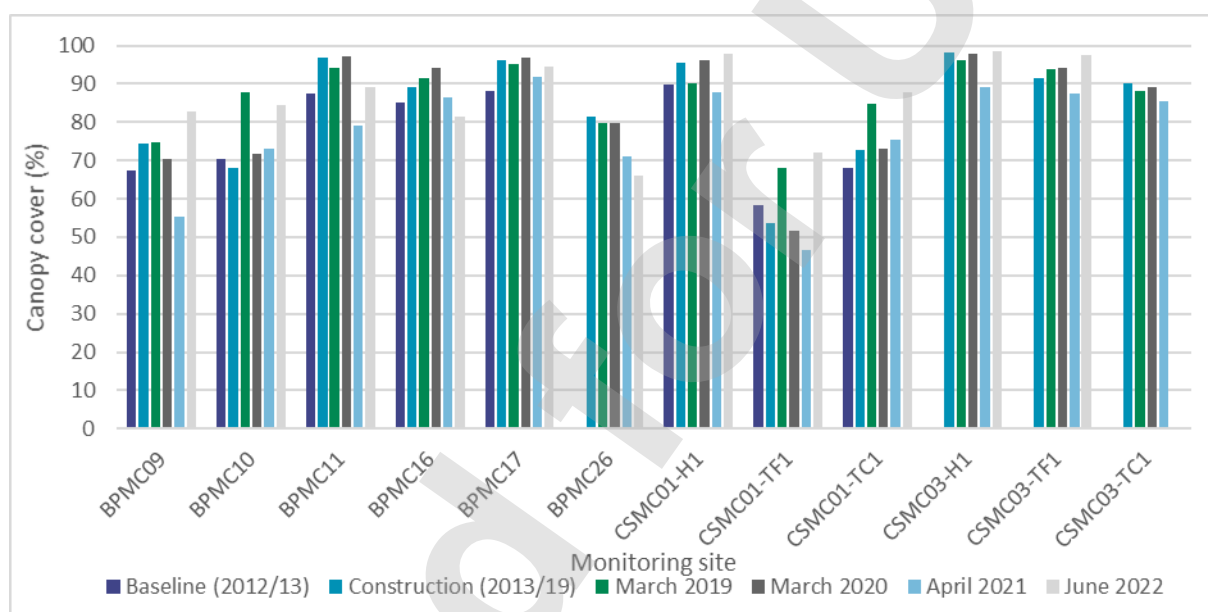


Figure A.4-1: Mangrove canopy cover

A.4.2 Sediment monitoring

In-situ sediment measurements

In-situ measurements of pH and redox are provided in Table A.4-1. In-situ measurements for pH at impact sites ranged from 5.91 to 6.95, with a mean value of 6.38. Measurements of pH at control sites ranged from 6.38 to 7.53 at control sites, with a mean value of 7.13.

The range of pH values recorded reflects the conditions experienced by the surface sediments which are well oxygenated and regularly flushed by tidal waters. The results indicate that mangrove sediments at both impact and control sites range from being slightly alkaline to slightly acidic. Subsurface mangrove soils are typically anaerobic and microbial decomposition takes place through a series of oxygen-reduction (redox) processes. Most mangrove soils are well buffered, having a pH in the range of 6-7, but some have a pH as low as 5.

In-situ measurements for redox potential at impact sites ranged from -5.1 mV to 204.6 mV, with a mean of 105.2. Redox potential at control sites ranged from 34.2 mV to 237.2 mV, with a mean of 158.5 mV. The positive ORP (redox potential) values indicate that mangrove sediments at monitoring sites in the top 5 cm are oxidising.

Table A.4-1: Mangrove sediment in-situ monitoring results

Location	Date	pH	ORP (mV) (redox potential)
Impact sites			
BPMC09	21/06/2022	6.51	-5.1
BPMC10	21/06/2022	6.95	93.2
BPMC11	20/06/2022	6.21	141.1
BPMC16	20/06/2022	5.91	161.5
BPMC17	20/06/2022	6.44	204.6
BPMC25	21/06/2022	6.01	58.9
BPMC26	20/06/2022	6.65	81.9
Mean		6.38	105.15
Control sites			
CSMC01 - H	22/06/2022	6.38	122.5
CSMC01 -TF	22/06/2022	7.07	34.2
CSMC01 -TC	22/06/2022	7.53	122.5
CSMC03 - H	22/06/2022	7.20	208.5
CSMC03 -TF	22/06/2022	7.24	237.2
CSMC03 -TC	22/06/2022	7.37	226.1
Mean		7.13	158.5

Sediment chemistry

A summary of the mangrove sediment chemistry results is provided in Table A.4-2 and Table A.4-3. Elevated arsenic concentrations are consistent with those recorded from the broader Darwin Harbour region and from previous monitoring undertaken during the baseline and construction phases. Elevated concentrations of arsenic in Darwin Harbour sediments have historically been attributed to local geological influence rather than anthropogenic sources (Padovan 2003; Fortune 2006).

Arsenic and chromium exceedances were recorded at both impact and control sites therefore the exceedances are unlikely to be due to Ichthys LNG operations, and further investigation was not warranted.

Total petroleum hydrocarbon (TPH) results were below the limit of reporting for all sites with the exception of control site CSMC03-TF (Table A.4-3). At CSMC03-TF TPH (170 mg/kg) was still below the trigger level (280mg/kg).

Table A.4-2: Summary of inorganic mangrove sediment chemistry

Analyte	Aluminium	Antimony	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Zinc	Moisture Content	Total Organic Carbon
Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	mg/kg
LOR	10	0.5*	1	0.1	1	1	1	0.01*	1	1	1	1000
Trigger value	-	2	20	1.5	80	65	50	0.15	21	200	-	-
BPMC09	8,600	<0.5	7.9	<0.1	22	3.1	5.5	<0.01	3.4	9.8	29	15,000
BPMC10	7,200	<10	5.8	<0.1	16	4.4	5.2	<0.1	4.2	45	36	17,000
BPMC11	1,100	<0.5	5.9	<0.1	7.2	<1	1.6	<0.01	<1	2.3	19	4,000
BPMC16	1,500	0.6	5.3	<0.1	15	1.4	1.0	<0.1	<1	4.3	15	3,000
BPMC17	6,600	1.8	35	<0.1	110	5.5	5.4	<0.1	5	38	23	9,000
BPMC25	19,000	<0.5	23	<0.1	40	8.1	13	0.02	12	72	60	65,000
BPMC26	8,300	<10	9.6	<0.1	17	4.2	5.8	<0.1	4.3	32	48	71,000
CSMC01-TC	20,000	<10	15	<0.1	45	6.8	12	0.02	10	27	24	20,000
CSMC01-H	5,000	<10	1.0	<0.1	9.2	1.9	1.6	<0.1	1.9	5.9	60	55,000
CSMC01-TF	2,100	<10	4.6	<0.1	12	<1	1.9	<0.01	1.0	5.9	17	2,000
CSMC03-TC	20,000	<0.5	34	<0.1	44	8.2	13	0.02	12	33	28	9,000
CSMC03-H	22,000	<10	29	<0.1	110	11	34	0.02	13	38	61	60,000
CSMC03-TF	19,000	<10	23	<0.1	45	7.9	13	0.02	10	30	58	65,000

Table A.4-3: Summary of organic mangrove sediment chemistry (mg/kg)

Site	TPH C10-C36 (sum of total)
Guideline value	280
Background	n/a
BPMC09	<50
BPMC10	<50
BPMC11	<50
BPMC16	<50
BPMC17	<50
BPMC25	<50
BPMC26	<50
CSMC01-HM	<50
CSMC01-TF	<50
CSMC01-TC	<50
CSMC03-HM	<50
CSMC03-TF	170
CSMC03-TC	<50

A.4.3 Trigger assessment outcomes

There were no trigger exceedances for the 2022 mangrove health and intertidal sediment survey attributable to Ichthys LNG operations. Arsenic and chromium exceedances were noted at both control and impact sites, and were representative of wider background elevation and not considered to be due to Ichthys LNG operations, as such no further investigation was undertaken.