EPL228 Annual Environmental Monitoring Report 2022-2023

Report

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Revision	Section	Amendment
1	2.2.2, 3.2.2 4.1.2 4.1.4	Updated to include information requested by NT EPA representative. As agreed with NT EPA representative, updates do not require a subsequent independent review or declaration.

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	Name
00	Document Control
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	

NOTICE

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

TABLE OF APPENDICES

Abbreviation and definitions

Abbreviation	Description
µg/L	microgram per litre
µm	micrometre
µs/cm	microsiemens per centimetre
AEMR	annual environmental monitoring report
AGI	acid gas incinerator
AGRU	acid gas removal unit
aMDEA	activated methyl diethanolamine
AOC	accidentally oil contaminated
AQMS	air quality monitoring stations
AS	Australian Standard
ASU	artificial settlement unit
BTEX	benzene, toluene, ethylbenzene, xylenes
BTX	benzene, toluene, xylenes
CCPP	combined cycle power plant
CCR	central control room
CFI	calibrated field instrument
CFU	colony-forming unit
cm	centimetre
COA	certificate of analysis
COC	continuously oily contaminated
COD	chemical oxygen demand
DO	dissolved oxygen
EC	electrical conductivity
E. coli	*Escherichia coli*
EPL228	Environment Protection Licence 228 (as amended)
FRP	filterable reactive phosphorus
GEP	gas export pipeline
GTG	gas turbine generator

Abbreviation	Description
H_2S	hydrogen sulphide
Hg	mercury
HM	hinterland margin
HRSG	heat recovery steam generator
Ichthys LNG	collectively, the onshore gas export pipeline and the gas processing plant
INPEX	Ichthys LNG Pty Ltd
km	kilometre
LIMS	laboratory information management system
LNG	liquified natural gas
LOR	limit of reporting
LPG	liquified propane gas
m	metre
mm	millimetres
MEG	mono ethylene glycol
MDEA	methyl diethanolamine
mg/kg	milligram per kilogram
ml	millilitres
m^3/h	cubic metres per hour
MPN	most probable number
NAGD	National Assessment Guidelines for Dredging (Commonwealth of Australia 2009)
NATA	National Association of Testing Authorities, Australia
NCW	non-contaminated water
NGERS	National Greenhouse and Energy Reporting Scheme
NO	nitrogen monoxide
NO_2	nitrogen dioxide
NOx	nitrogen oxide (NO and/or NO_2)
NPI	National Pollutant Inventory
NSW	New South Wales
NT	Northern Territory

Abbreviation	Description
NT DITT	Northern Territory Department of Industry, Tourism and Trade
NT EPA	Northern Territory Environment Protection Authority
O_2	oxygen
OEMP	Onshore Operations Environmental Management Plan (L060-AH-PLN-60005)
PAH	polycyclic aromatic hydrocarbons
PCS	process control system
pH	measure of acidity or alkalinity
$PM_{2.5}$	particulate matter with aerodynamic diameter less than 2.5 µm
PM_{10}	particulate matter with aerodynamic diameter less than 10 µm
ppm	parts per million
ppmv	parts per million by volume
PSD	particle size distribution
QA/QC	quality assurance/quality control
RBL	rating background level
REMP	Receiving Environment Monitoring Program
SFLA	sample for laboratory analysis
SQGV	sediment quality guideline value
SWL	standing water level
TC	tidal creek
TF	tidal flat
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TOC	total organic carbon
TP	total phosphorus
TPH	total petroleum hydrocarbons
TRH	total recoverable hydrocarbons
TSS	total suspended solid
USEPA	United States Environmental Protection Authority
UV	ultraviolet

EXECUTIVE SUMMARY

Ichthys LNG Pty Ltd (INPEX) was issued Environment Protection Licence 228 (as amended from time to time) on 13 December 2017 (EPL228). Activation of EPL228 occurred on 14 September 2018 triggering several EPL228 monitoring conditions and Onshore Operations Environmental Management Plan (OEMP) monitoring commitments.

Condition 86 of EPL228-04/Condition 76 of EPL228-05[1] requires an Annual Environmental Monitoring Report (AEMR) to be submitted to the Northern Territory Environment Protection Authority (NT EPA) for each year of the licence, unless otherwise agreed, for scheduled activities conducted during the preceding 12 months (i.e., the reporting period) from 1 July to 30 June. For this AEMR, the reporting period is defined as 1 July 2022 to 30 June 2023. This AEMR has been developed to meet the requirements of Condition 87 of EPL228-04/Condition 77 of EPL228-05.

Monitoring undertaken during the reporting period found that liquid effluent discharges were typically within EPL228 discharge limits, and these discharges had no discernible impact on Darwin Harbour.

All other terrestrial and marine monitoring programs (e.g. groundwater, mangroves, weeds, etc.) found that monitoring results were consistent with those reported during the previous years' AEMR and construction phase.

Based on monitoring results for the reporting period, there were no adverse effects to the declared beneficial uses and objectives of Darwin Harbour.

The point source emission monitoring reported that all permanent plant and equipment were typically within EPL228 air emission limits, and the emissions had no discernible impact on the ambient air quality of the Darwin Region.

[1] EPL228-05 came into effect on 13 December 2022.

1 INTRODUCTION

Ichthys LNG Pty Ltd (hereafter referred to as INPEX) was issued Environment Protection Licence 228 (as amended and hereafter referred to as the EPL228) for the purposes of:

Operating premises for processing hydrocarbons so as to produce, store and/or despatch liquefied natural gas or methanol, where:

a. the premises are designed to produce more than 500,000 tonnes annually of liquefied natural gas and/or methanol; and

b. no lease, licence or permit under the Petroleum Act or the Petroleum (Submerged lands) Act relates to the land on which the premises are situated.

All the activities in relation to onshore production design capacity of 12.89 million tonnes per annum of hydrocarbons[2], being up to:

- *9.64 million tonnes of liquefied natural gas per annum from two LNG processing trains;*
- *1.65 million tonnes of liquefied petroleum gas per annum; and*
- *20,000 barrels of condensate per day (1.6 million tonnes of condensate per annum).*

Since the 2019/2020 Annual Environmental Monitoring Report, the Ichthys LNG facility has been in steady state operations. The key milestones are shown in Section 1.4.1.

1.1 Purpose

The purpose of the AEMR is to satisfy Condition 86 of EPL228-04[3] and Condition 76 of EPL228-05 for the Licensed Premises (hereafter Ichthys LNG)[4]. The reporting period for this AEMR is 1 July 2022 to 30 June 2023, with amendment EPL228-05 commencing on 13 December 2022.

1.2 AEMR Condition requirements

Table 1-1 provides details of Condition 87 of EPL228-04 and Condition 77 of EPL228-05 as they relate to the AEMR requirements and the relevant section for where the conditions have been addressed within this report.

Table 1-1: Annual environmental monitoring report condition requirements

EPL288 Condition #	Condition detail	Section
EPL228-04		
87	The Annual Environmental Monitoring Report must:	-
87.1	report on monitoring required under this licence;	This AEMR
87.2	summarise performance of the authorised discharge to water, compared to the discharge limits and trigger values specified in Table 3 in Appendix 2;	2.1

[2] As defined in EPL228-05

[3] EPL 228-04 was in effect for this AEMR from 1 July-12 December 2022. EPL 228-05 was in effect for this AEMR from 13 December 2022 – 30 June 2023.

[4] Condition 86/76 reads: *The licensee must submit an Annual Environmental Monitoring Report to the NT EPA by 30 September for each year of this licence unless otherwise authorised, for the Scheduled Activity conducted during the preceding 12 month period from 1 July to 30 June.*

EPL288 Condition #	Condition detail	Section
87.3	summarise performance of the authorised emissions to air, compared to the emission limits and targets specified in Table 5 in Appendix 3, when the fuel burning or combustion facilities for the Scheduled Activity have operated under normal and maximum operating conditions for the annual period;	3
87.4	summarise operating conditions of each emission source and the resulting air emission quality;	3
87.5	provide total emissions to air in tonnes per year for the air quality parameters listed in Table 6 in Appendix 3;	3
87.6	assess the contribution of the authorised emissions on the Darwin region ambient air quality during periods not affected by bushfire smoke for wet and dry seasons;	3
87.7	report on outcomes of the Receiving Environment Monitoring Program (REMP) monitoring and assessment;	This AEMR
87.8	summarise measures taken to reduce waste;	6
87.9	consider the NT EPA Guideline for Reporting on Environmental Monitoring;	APPENDIX A:
87.10	be reviewed by Qualified Professional(s); and	APPENDIX B:
87.11	be provided to the NT EPA with the Qualified Professional(s) written, certified review(s) of the Annual Environmental Monitoring Report.	APPENDIX B:
EPL228-05		
77	The Annual Environmental Monitoring Report must:	-
77.1	report on monitoring required under this licence;	This AEMR
77.2	include a tabulation in Microsoft ® Excel ® format, of all monitoring data required to be collected in accordance with this licence;	Provided to NT EPA separately
77.3	summarise performance of the authorised discharge to water, compared to the discharge limits specified in Table 3 in Appendix 2;	2.1
77.4	summarise performance of the authorised emissions to air, compared to the emission limits and targets specified in Table 5 in Appendix 3, when the fuel burning or combustion facilities for the Scheduled Activity have operated under normal and maximum operating conditions for the annual period;	3
77.5	summarise operating conditions of each emission source and the resulting air emission quality;	3
77.6	provide total emissions to air in tonnes per year for the air quality parameters listed in Table 6 in Appendix 3;	3
77.7	assess the contribution of the authorised emissions on the Darwin region ambient air quality during periods not affected by bushfire smoke for Wet and Dry seasons;	3
77.8	report on outcomes of the REMP monitoring and assessment;	This AEMR
77.9	summarise measures taken to reduce waste;	6

EPL288 Condition #	Condition detail	Section
77.10	consider the NT EPA Guideline for Reporting on Environmental Monitoring;	APPENDIX A:
77.11	be reviewed by Qualified Professional(s); and	APPENDIX B:
77.12	be provided to the NT EPA with the Qualified Professional(s) written, certified review(s) of the Annual Environmental Monitoring Report.	APPENDIX B:

1.3 Program objective

An overview of the environmental monitoring programs, their objectives, and cross-references to sections within the AEMR which provide more detail, are listed in Table 1-2. Monitoring was undertaken in accordance with the Onshore Operations Environmental Management Plan (OEMP) and EPL228 requirements.

Table 1-2: Monitoring program objectives

Program	Objective	Section
Commingled treated effluent (750-SC-003)	To ensure commingled treated effluent does not exceed discharge criteria specified in EPL228.	2.1
Harbour sediment	To detect changes in surficial sediment quality in the vicinity of the jetty outfall and determine if changes are attributable to Ichthys LNG operations.	2.2
Point source emissions to air	To determine if air emissions from stationary point sources are within acceptable limits	3.2
Dark-smoke events	To determine if air emissions from the flare systems are within acceptable limits.	3.4
Groundwater quality	To detect changes in groundwater quality and determine if these changes are attributable to Ichthys LNG operations.	4.1
Nearshore marine pests	To assess the presence/absence of invasive marine pest at the Ichthys LNG product loading jetties, through a coordinated approach with the Northern Territory (NT) Biosecurity Unit.	5.2
Introduced terrestrial fauna	To determine the presence, location and methods used to control nuisance species.	5.3
Weed survey	To identify the abundance and spatial distribution of known and new emergent weed populations, especially in areas susceptible to weed invasion, to inform weed management control activities.	5.4
Weed management	To manage invasive weeds onsite.	5.5
Vegetation rehabilitation monitoring	To determine if vegetation recovery through natural processes has occurred.	5.6
Cultural heritage	To determine if there has been any interference to cultural heritage sites.	5.7

1.4 Site information

1.4.1 Ichthys LNG operational milestones

Table 1-3 provides an overview of the Ichthys LNG key milestones for the reporting period. A general Ichthys LNG site layout is shown in Figure 1-1.

Table 1-3: Ichthys LNG key milestones during the reporting period

Date	Report
July 2022- August 2022	Shutdown on both trains 26th June – 12 August 2022.
November 2022	Annual environmental audit undertaken by a qualified auditor in accordance with EPL228-04 Condition 34
December 2022	EPL228-04 amended to EPL228-05. Amendments included removal/consolidation of ten conditions from EPL228, a number of which related to completed plant start-up activities.
April 2023	Two heating medium loss of containment incidents resulting in shut down of Train 1 for four weeks and Train 2 for two weeks.

Figure 1-1: Ichthys LNG layout

1.4.2 Environmental context

Ichthys LNG is located on Bladin Point, on the northern side of Middle Arm Peninsula in Darwin Harbour (Figure 1-2). Bladin Point is a low-lying peninsula in Darwin Harbour, which is separated from the mainland by a mudflat. Ichthys LNG is approximately 4 km from Palmerston (the nearest residential zone) and approximately 10 km south-east of the Darwin central business district, across Darwin Harbour.

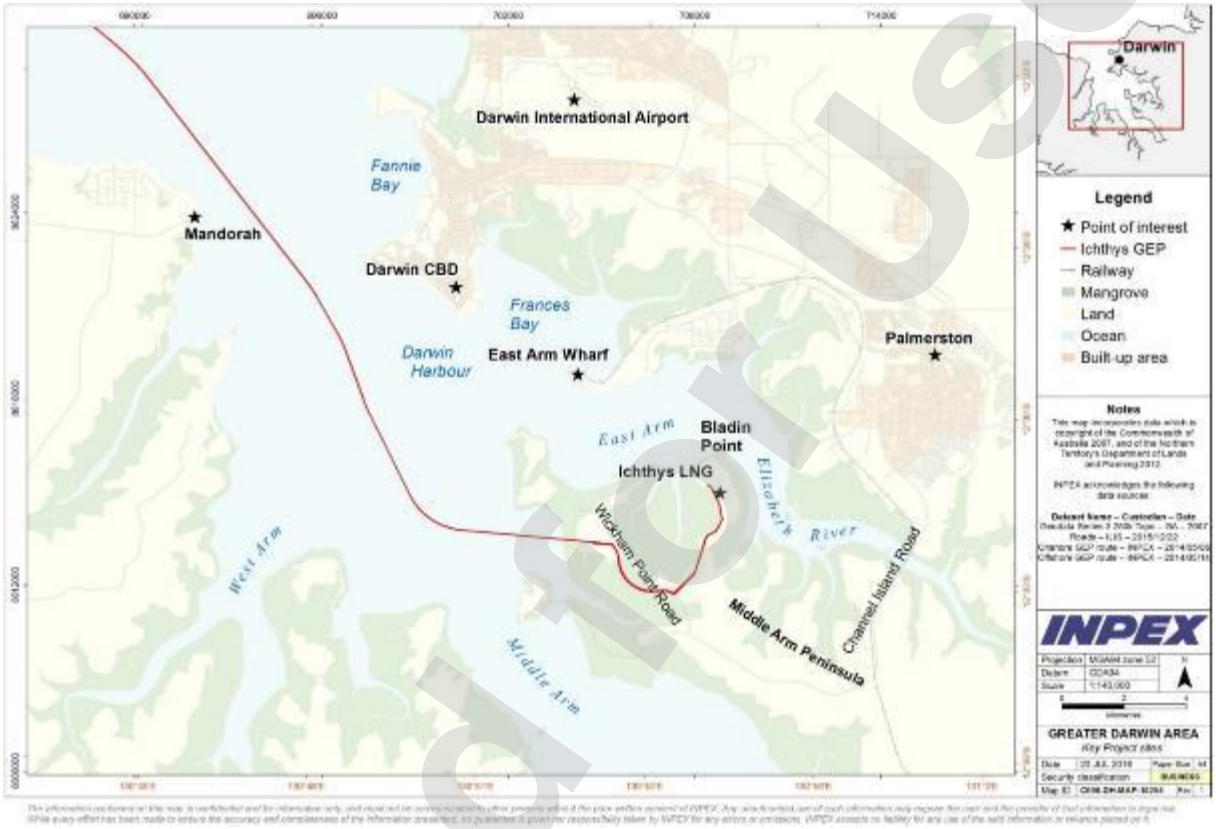

Figure 1-2: Location of Ichthys LNG

Ichthys LNG 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 experiences an overall mean annual rainfall of ~1,730 mm, the majority of which occurs during the wet season. The 2022/23 wet season was the wettest since 2017/2018, with 1,399.4 mm of rainfall recorded (Table 1-4 and Figure 1-3).

Table 1-4: Bladin Point wet season and transitional months rainfall (mm)

Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
Darwin average	70.6	141.7	250.8	426.3	374.6	319.0	102.2	1,685.2
2012/2013	36.8	199.8	232.4	282.8	291.2	415.2	141.6	1,599.8
2013/2014	134.8	352	268	780	335	14.4	111	1,995.2
2014/2015	13	226.4	175.4	630	492.2	233.8	54.2	1,825.0
2015/2016	12.6	140.6	709.4	243.2	213.4	231.8	63.8	1,614.8
2016/2017	83.8	265.4	469.8	614.2	736	515.8	220.6	2,905.6
2017/2018	93	249.2	125.4	1,031.6	380.4	423.4	39	2,342.0
2018/2019	2.6	183.8	91.6	311.4	159.6	147.8	125.8	1,022.6
2019/2020	24.0	71.2	51.5	327.2	217.7	179.9	72.9	944.3
2020/2021	69.1	87.8	343.5	333.5	194.7	163.4	55.6	1,247.5
2021/2022	67.9	131.9	282.0	357.0	222.2	121.2	89.6	1,271.7
2022/2023	155.9	177.9	341.3	196.2	228.2	207.8	92.1	1,399.4

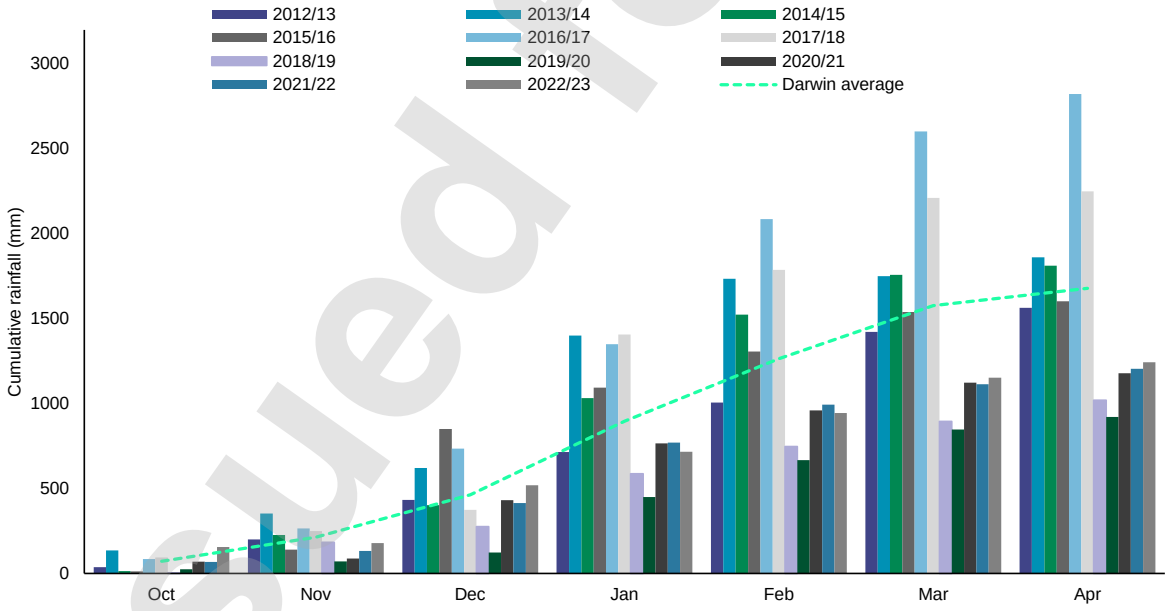

Figure 1-3: Bladin Point cumulative wet seasons

2 DISCHARGES TO WATER

This section describes the outcomes of the comingled treated effluent wastewater monitoring program.

2.1 Commingled treated effluent

The key objective of commingled treated effluent sampling (sampling point 750-SC-003) is to ensure discharge criteria specified in Table 3, Appendix 2 of EPL228 is not exceeded for wastewater discharged from Ichthys LNG.

The monitoring frequency, as specified in Table 3, Appendix 2 of EPL228 was implemented, with sampling occurring monthly (refer to Table 2-1).

Table 2-1: Commingled treated effluent sampling dates

Sample month	Sample collection date(s)
Jul-2022	12
Aug-2022	9
Sep-2022	13
Oct-2022	10, 14*, 16*, 20**, 25*
Nov-2022	8
Dec-2022	14, 16*,18*20*
Jan-2023	10,12*,14*,18*,24*
Feb-2023	8*,14,16**,20*,24*
Mar-2023	14, 15*, 18*, 21*, 23*, 25*, 27*, 28*,30*
Apr-2023	4*, 7*, 11
May-2023	9,18*
Jun-2023	13

* Additional sampling following an exceedance at location 750-SC-003.

** Subsequent sampling from initial monthly sampling event due to lab sampling error

2.1.1 Method overview

All samples for the monitoring of the comingled effluent were taken from the nominated sampling point 750-SC-003 in accidence with INPEX's sample schedule (document number L290-A1-LIS-60006). All testing equipment passed QC requirements during the 2022-2023 audit period with all calibration records maintained by INPEX's NATA certified onsite laboratory. The commingled treated effluent sampling point (750-SC-003) is located downstream of treated effluent observation basin and upstream of the jetty outfall. Samples collected from 750-SC-003 represent liquid effluent that is discharged to Darwin Harbour via the jetty outfall. The sampling point consists of two valves, an isolation valve, and a sample needle valve, with the latter used to regulate flow for sample collection. Sampling from the commingled treated effluent sample point was conducted by trained laboratory analysts using National Association of Testing Authorities, Australia (NATA) accredited analysis methods by both the INPEX onshore laboratory and external third-party laboratories.

The parameters, sampling methods, limit of reporting (LOR) and discharge limits for the commingled treated effluent monitoring program are provided in Table 2-2.

All results are reported through the INPEX onshore laboratory database systems (laboratory information management system; (LIMS) that produce sample Certificates of Analysis (COA) inclusive of the laboratory NATA accreditation number. To enable the identification of an exceedance, the discharge limits specified in Table 3, Appendix 2 of EPL228 (refer to Table 2-2) have been entered into the LIMS. Sample results are compared to their respective discharge limits in the COA. If a result exceeds the discharge limit, it is highlighted in the COA and the onshore laboratory generate an out of specification report.

Table 2-2: Commingled treated effluent discharge monitoring, methods, and discharge limits

Parameter	Sampling method*	Unit	LOR	Discharge limit
Volumetric flow rate	CFI	m^3/hr	n/a	180
pH	INPEX Lab	pH Unit	n/a	6.0 - 9.0
Electrical conductivity (EC)	INPEX Lab	µS/cm	10	n/a
Temperature	CFI	°C	-	35°C
Turbidity	INPEX Lab	NTU	0.5	n/a
Dissolved oxygen	CFI	%	-	n/a
TPH as oil and grease	INPEX Lab	mg/L	1.0	6
Total recoverable hydrocarbons (TRH; C10-C40)	External lab	µg/L	100	n/a
Total suspended solids (TSS)	INPEX Lab	mg/L	5	10
Biochemical oxygen demand (BOD)	External lab	mg/L	2	20
Chemical oxygen demand (COD)	INPEX Lab	mg O_2/L	10	125
Free Chlorine	INPEX Lab	mg/L	0.02	2
Ammonia	INPEX Lab	mg N/L	2	n/a
Total nitrogen (TN)[†]	Calculation	mg N/L	2	10
Total phosphorus (TP)	INPEX Lab	mg P/L	0.5	2
Filterable reactive phosphorus (FRP)	INPEX Lab	mg P/L	0.2 and 0.5	n/a
Cadmium (total)	External lab	µg/L	0.1	n/a
Chromium (total)	External lab	µg/L	1	n/a
Copper (total)	External lab	µg/L	1	n/a
Lead (total)	External lab	µg/L	1	n/a
Mercury (total)	External lab	µg/L	0.1	n/a
Nickel (total)	External lab	µg/L	1	n/a

Parameter	Sampling method*	Unit	LOR	Discharge limit
Silver (total)	External lab	µg/L	1	n/a
Zinc (total)	External lab	µg/L	5	n/a
Enterococci	External lab	cfu/100mL	1	n/a
Escherichia coli	External lab	cfu/100mL	1	100
Faecal coliforms	External lab	cfu/100mL	1	400
Anionic surfactants	External lab	mg/L	0.1	n/a
Activated methyl diethanolamine (aMDEA)	External lab/INPEX lab	mg/L	0.001 and 5	n/a
Glycol	External lab/INPEX lab	mg/L	2 and 5	n/a

* CFI = calibrated field instrument

† Total nitrogen is a sum of Nitrite, Nitrate and total Kjeldahl nitrogen (TKN). TKN analysis was completed by both INPEX onshore laboratory and external laboratory interchangeable, depending on INPEX onshore laboratory equipment availability. Nitrate and nitrite were measured by INPEX onshore laboratory.

2.1.2 Results and discussion

Routine monitoring results

The results for 750-SC-003 sampling for the reporting period are presented in APPENDIX C:.

During the reporting period, there were ten occurrences where wastewater quality was above discharge limits, these are further discussed in Section 2.1.3. Note, following an initial exceedance, further sampling at 750-SC-003 was undertaken to confirm the results as part of an investigation. Any elevated results during the investigation sampling process are considered part of an ongoing original event and the results are included in APPENDIX C:.

Overall, there was little variability of the wastewater quality, with most results below EPL228 discharge limits. This demonstrates the wastewater treatment systems were operating effectively. The main sampling considerations for the reporting period were total nitrogen exceedances (four events) and faecal coliform exceedances (five events). These will be discussed further in Table 2-3.

Volumetric flow rate data for the reporting period is shown in Figure 2-1. The data confirms that the volumetric flow rate throughout the period remained well below the 180 m^3/h discharge limit.

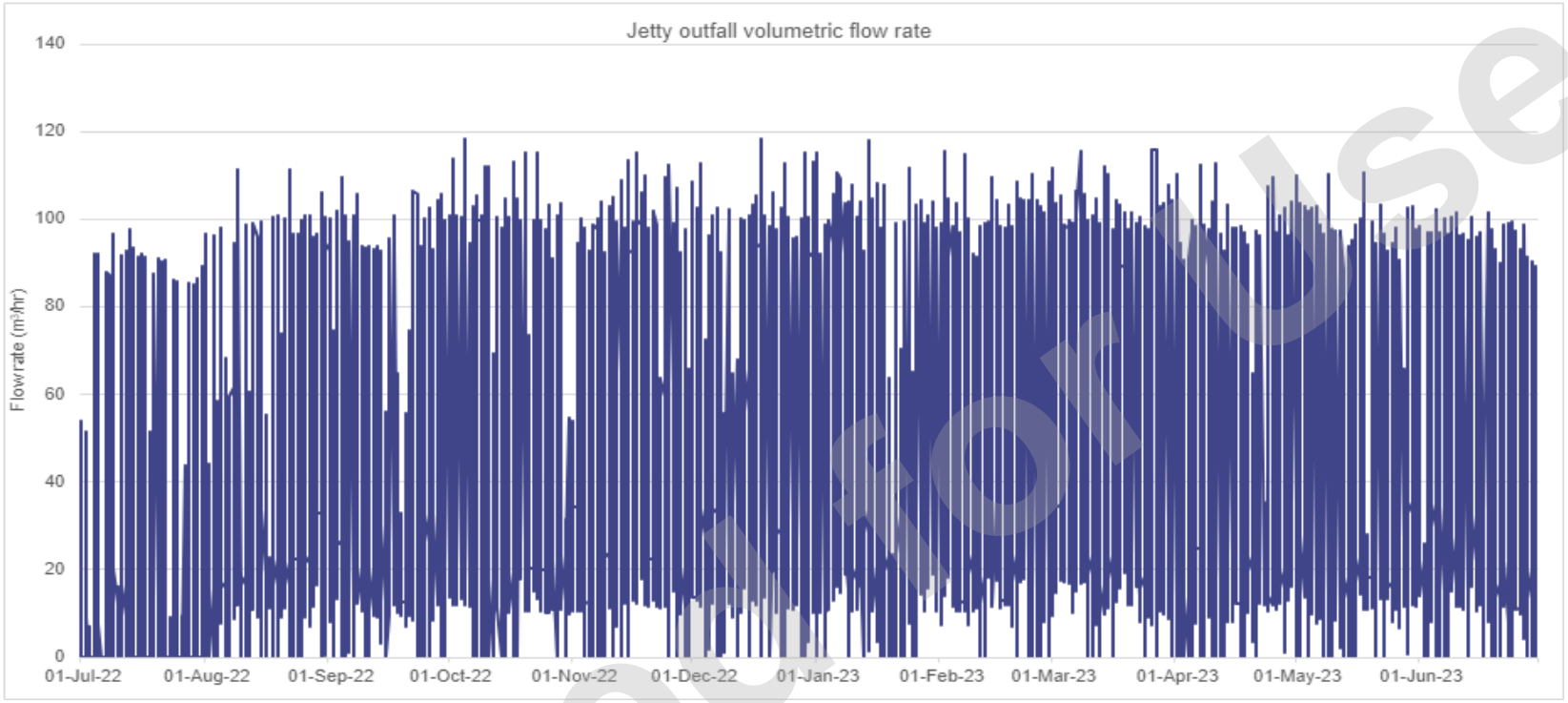

Figure 2-1: Flow rate measured at L-750-FI-0002 flow meter

Quality assurance/quality control

The quality assurance/quality control (QA/QC) procedures specific to the collection and analysis of samples from sample location 750-SC-003 included:

- NATA accredited analytical laboratories were used for all analysis, or a test method managed under a NATA accredited quality management system
- laboratory designated sample holding times met
- chain of custody forms was completed and accompanied the samples
- INPEX laboratory QA/QC procedures were completed as follows:
  - laboratory blanks
  - replicates/duplicate
  - spikes
  - calibration against standard reference materials
  - INPEX laboratory review of external laboratory QA/QC analysis reports
  - annual sampling verification, which involves the collection of two samples and trip blanks
- calibration of all field-testing equipment using the INPEX standard method(s) was undertaken.

2.1.3 Limit exceedances assessment outcomes

Throughout the reporting period, and displayed on the COAs, there were ten discharge limit exceedances (refer to APPENDIX C:). A summary table of all discharge limit exceedances, including corrective actions is provided in Table 2-3.

Table 2-3: Summary of commingled treated effluent sample point exceedance events

Date sampled	Exceedance reported	Parameter	Result	Limit	Cause and/or contributing factors	Corrective actions
10-October -2022	11-October-2022	TN	TN 12 mg/L	TN 10 mg/L	The investigation considered whether the elevated TN was originating from the steam plant within the combined cycle power plant (CCPP), due to the TN comprising mostly of ammonia. Sampling up-stream in the steam plant of the CCPP confirmed the off-specification wastewater was originating from this location. The investigation team subsequently noted, that in late September 2022 (prior to exceedance event) the location of ammonia dosing in the steam system changed from the dosing pumps located at the steam condensate manifolds, to the boiler feedwater manifold. This occurred due to faults on chemical injection pumps located in the condensate manifolds, which required them to be taken offline for maintenance. Following the change in the dosing location, the investigation identified that there was a moderate increase in the amount of ammonia being consumed in the steam system, compared to chemical injection into the condensate manifold. An inspection of the boiler feedwater chemical injection pump subsequently identified that the pump was faulty and overdosing ammonia into the steam system, during a draw down test the dosing rate did not reduce with a reduction of stroke. The change in the ammonia dosing location combined with the impact of the faulty injection pump, resulted in increased TN levels in the wastewater stream being discharged from the CCPP steam system	Inpex was able to undertake a maintenance campaign on all ammonia injection pumps at the site to improve the reliability of the pumps.
20-October-2022	24-October - 2022	Faecal Coliforms	2800 CFU/100ml	400 CFU/100ml	A discharge limit exceedance for treated wastewater was detected above the limit specified in column 5 of Table 3 in Appendix 2 of the EPL228. A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Thursday 20 October 2022. The NATA accredited interim testing results issued on Monday 24 October 2022 reported a Faecal Coliform value of 2800 CFU/100mL, which exceeds the discharge limit of 400 CFU/100mL. Inspections and a further review of the performance of the sewage treatment plant (including additional sampling) confirmed that the plant is operational and producing on-specification treated effluent. INPEX considers that the Faecal Coliform contamination was likely due to a species of Faecal Coliform (not present in domestic sewage) entering into the combined jetty outfall, most likely via the open drain accidently oily contaminated (AOC) wastewater system, as both the *E. coli* and Enterococci levels were very low in the original sample collected on 20 October 2022 (1 and 10 CFU/100mL), both faecal coliform and Enterococci are used as indicators of human faecal contamination which is not the case in this scenario as confirmed by subsequent testing for e.coli.	INPEX conducted further sampling on 25 October 2022, at both the sewage treatment plant (sample location 750-SC-009) and the combined jetty outfall stream (sample location 750-SC-003). All results from the sampling conducted on 25 October were below the EPL 228 limits for Faecal Coliforms and *E. coli*. Parameter / E.coli / Faecal Coliform / Enterococci Units / cfu/100ml / cfu/100ml / cfu/100ml Discharge Limit / 100 / 400 / N/A 750-SC-009 / 1 / 17 / 3 750-SC-003 / 1 / 1 / 1 INPEX considers that there was no risk of environmental harm associated with Faecal Coliform exceedance, as the source of contamination was not originating from the sewage treatment plant, nor were there direct indicators of human domestic sewage contamination (*E. coli* and Enterococci). Further sampling was unable to verify the Faecal Coliform result from 20 October 2022 or locate a source. No further additional actions are proposed to be undertaken as the treated wastewater is now back in specification, at the jetty outfall and the sewage treatment plant.

<table>
<tr><th>Date sampled</th><th>Exceedance reported</th><th>Parameter</th><th>Result</th><th>Limit</th><th>Cause and/or contributing factors</th><th>Corrective actions</th></tr>
<tr><td>14-December-2022</td><td>20-December-2022</td><td>Faecal Coliforms</td><td>37000 CFU/100ml</td><td>400 CFU/100ml</td><td>A discharge limit exceedance for treated wastewater was detected above the limit specified in column 5 of Table 3 in Appendix 2 of the EPL228-05. A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Wednesday 14 December 2022. The NATA accredited interim testing results issued on Tuesday 20 December 2022 reported a Faecal Coliform value of 37,000 CFU/100mL, which exceeds the discharge limit of 400 CFU/100mL. Verification sampling was conducted by an external laboratory verified an E.coli result of 11 CFU/100ml and Enterococci result of 9 CFU/100ml. INPEX considers that the Faecal Coliform and E. coli values should be similar, as E. coli is the predominant species found in Faecal Coliform. The company who operates the sewage treatment plant for INPEX, Permeate Partners, has also been contacted, and the plant is processing effluent with no identified issues, they commented that if the plant was not processing effluent properly then the E. coli values would also be elevated.</td><td>INPEX determined that the Faecal Coliform exceedance, 14 December 2022, is considered an inaccurate result, which was unable to be replicated. Inspections and a further review of the performance of the sewage treatment plant (including additional sampling) confirmed that the plant was operational and producing on-specification treated effluent.
INPEX considers that the result is inaccurate as the Faecal Coliform is extremely high (37,000 CFU/100mL), compared to both the E. coli and Enterococci levels, which were very low in the original sample collected on 14 December 2022 (11 and 9 CFU/100mL), both E. coli and Enterococci are used as indicators of human faecal contamination. In addition, both the turbidity and total suspended solid (TSS) values were low (1.0 NTU and < 5 mg/L respectively) indicating that there was very little material in the wastewater, for such a high Faecal Coliform result it would be expected that the sample would also return high turbidity and TSS results, which the sample did not.
INPEX conducted further sampling on 20 December 2022, at both the sewage treatment plant (sample location 750-SC-009) and the combined jetty outfall stream (sample location 750-SC-003). With results coming within specification.
<table>
<tr><td>Parameter</td><td>Faecal Coliform</td></tr>
<tr><td>Units</td><td>cfu/100ml</td></tr>
<tr><td>Discharge Limit</td><td>400</td></tr>
<tr><td>750-SC-009</td><td><1</td></tr>
<tr><td>750-SC-003</td><td>8</td></tr>
</table>
INPEX considers that there was no risk of environmental harm associated with Faecal Coliform exceedance, as the source of contamination was not originating from the sewage treatment plant, nor were there direct indicators of human domestic sewage contamination (E. coli and Enterococci). Further sampling was unable to verify the Faecal Coliform result from 14 December 2022 or locate a source. The investigation also confirmed that the sample was collected and transported following standard practise, and no cross contamination occurred.</td></tr>
<tr><td>14-December-2022</td><td>20-December-2022</td><td>TN</td><td>TN 12 mg/L</td><td>TN 10 mg/L</td><td>A discharge limit exceedance for treated wastewater was detected above the limit specified in column 5 of Table 3 in Appendix 2 of the EPL228-05. A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Wednesday 14 December 2022. The NATA accredited interim testing results issued on Wednesday 14 December 2022 reported a total nitrogen (TN) concentration of 12 mg/L, which exceeds the discharge limit of 10 mg/L

The investigation identified that several of the chemical injection dosing pumps were faulty, resulting in overdosing of ammonia into the system. To reduce the ammonia levels the following occurred:
additional service water was added into the system, where possible, upstream of the neutralisation plant;’ and
the main faulty injection pump (L630-P-904-A) was taken offline, and dosing transferred to the standby injection pump (L630-P-904-B).</td><td>Dosing pump L630-P902-B was repaired and returned back to service. Following the addition of the flush, TN levels returned below the EPL228 limit. Maintenance works associated with the reliability improvement program are continuing and the program was completed Q1 2023.
Through the incident investigation, INPEX identified that continued implementation of the reliability improvement program on all ammonia injection pumps at the site to improve the performance of the pumps, through maintenance works and replacement of pumps as an action. .</td></tr>
</table>

Date sampled	Exceedance reported	Parameter	Result	Limit	Cause and/or contributing factors	Corrective actions
10-Jan-2023	11-Jan-2023	Total Suspended Solids	22mg/L	10mg/L	A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Tuesday 10 January 2023. The NATA accredited interim testing results issued on Wednesday 11 January 2023 reported a TSS concentration of 22 mg/L, which exceeds the discharge limit of 10 mg/L. As standard practice, the INPEX laboratory collect a duplicate sample when undertaking the required monthly sampling from location 750-SC-003. The duplicate was collected approximately 15 minutes after the primary TSS sample (following the sample collection protocol) and reported a TSS value of <5 mg/L, which is below the discharge limit of 10 mg/L.	INPEX considers that there was no risk of environmental harm associated with the TSS exceedance, as: • Further sampling reported TSS values below the EPL limit. • Any elevated concentration of TSS would have rapidly been dispersed following discharge within the mixing zone (The maximum expected concentration at the boundary of the 50 m mixing zone is ~0.26 mg/L, which is below the Darwin Harbour water quality objective trigger value of 10 mg/L). • Measured concentration is within the range of background concentrations that can occur naturally within Darwin Harbour
24-Jan-2023	3-Feb-2023	Faecal Coliforms	1500 CFU/100ml	400 CFU/100ml	A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Tuesday 24 January 2023. The NATA accredited testing results issued on Friday 3 February 2023 reported a Faecal Coliform value of 1500 CFU/100mL, which exceeds the discharge limit of 400 CFU/100mL. The sample reported an *E. coli* result of 40 CFU/100mL, which is below the EPL228-05 limit of 100 CFU/100mL. INPEX considers that the Faecal Coliform and *E. coli* values should be similar, as *E. coli* is the predominant species found in Faecal Coliform, in sewage treatment plants. Following the Faecal Coliform exceedance in December 2022, the sampling frequency was increased to fortnightly, sampling conducted on 10 January 2023 reported a Faecal Coliform value of 31 CFU/100mL, which is below the licence limit.	Through the incident investigation, INPEX identified the following actions: • Initiate a six-month program of monthly sampling from locations upstream of the combined discharge, 750-SC-009 and 750-SU-403 Inlet, with testing for Faecal Coliforms (ongoing at time of writing of report)
14-Feb-2023	14-Feb-2023	TN	TN 11 mg/L	TN 10 mg/L	A discharge limit exceedance for treated wastewater was detected above the limit specified in column 5 of Table 3 in Appendix 2 of the EPL228-05. A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Tuesday 14 February 2023. The NATA accredited interim testing results issued on Tuesday 14 February 2023 reported a total nitrogen (TN) concentration of 11 mg/L, which exceeds the discharge limit of 10 mg/L.	Through the incident investigation the following actions were identified to prevent reoccurrence: • The cause was identified as the unplanned trip of the Gas Turbine Generator (GTG). A repair has been implemented to prevent the re-occurrence of the event.
14-March-2023	22-March-2023	Faecal Coliforms	760 CFU/100ml	400 CFU/100ml	A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Tuesday March 14 January 2023. The NATA accredited testing results issued on Wednesday 22 March 2023 reported a Faecal Coliform value of 760 CFU/100mL, which exceeds the discharge limit of 400 CFU/100mL. The sample reported an *E. coli* result of 44 CFU/100mL, which is below the EPL228-05 limit of 100 CFU/100mL. INPEX considers that the Faecal Coliform and *E. coli* values should be similar, as *E. coli* is the predominant species found in Faecal Coliform, in sewage treatment plants.	Based on the results of the additional sampling no further actions have been undertaken. The source of contamination is through the AOC drainage system, and not related to domestic sewage. Through the incident investigation, INPEX identified the following actions: • Investigated if a simple pool chlorine float can be installed in the inlet of the AOC holding basins to treat the water. This suggestion was not implemented due to the additional issues that can be introduced • Following the recent Faecal Coliform exceedances in late 2022 and early 2023, sampling is now occurring of both the treated sewage stream and at the inlet of accidentally oily contaminated holding basin, at the same time as the monthly sample for 750-SC-003.
14-March-2023	16-March-2023	TN	TN 16 mg/L	TN 10 mg/L	A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Tuesday 14 March 2023. The NATA accredited interim testing results issued on Thursday 16 March 2023 reported a total nitrogen (TN) concentration of 16 mg/L, which exceeds the discharge EPL228-05 limit of 10 mg/L.	Through the incident investigation the following actions were identified to prevent reoccurrence: • INPEX to investigate options to reduce the ammonia levels from the CCPP being treated at the neutralisation plant. • Implement a long-term ammonia monitoring program at the CCPP which is yet to be implemented at time of writing of report

Date sampled	Exceedance reported	Parameter	Result	Limit	Cause and/or contributing factors	Corrective actions
9-May-2023	13-May-2023	Faecal Coliforms	570 CFU/100ml	400 CFU/100ml	A sample was taken from the combined jetty outfall discharge line, sampling location 750-SC-003 on Tuesday 9 May 2023. The NATA accredited interim testing results issued on Saturday 13 May 2023 reported a Faecal Coliform value of 570 CFU/100mL, which exceeds the discharge limit of 400 CFU/100mL. The sample reported an *E. coli* result of 1 CFU/100mL, which is below the EPL228-05 limit of 100 CFU/100mL. INPEX considers that the Faecal Coliform and *E. coli* values should be similar, as *E. coli* is the predominant species found in Faecal Coliform, in sewage treatment plants.	Based on the results of the additional sampling already carried out, no further actions have been undertaken. The source of contamination is through the AOC drainage system, and not related to domestic sewage. Through the incident investigation, INPEX identified the following actions: • Maintain current additional testing regime currently in place

In general, the total nitrogen discharge limit exceedances reported in Table 2-3, have been related to maintenance issues associated with chemical dosing pumps and trips of the GTG equipment. The original manufacturer of the dosing pumps is no longer available which has contributed to the challenges of introducing the proposed replacement pumps.

The main consideration relating to the five faecal coliforms exceedance events has been focusing on the subsequent *E. coli* sample results to ensure ongoing compliance. The faecal coliforms exceedance events have provided a platform to review and improve existing controls measures to ensure *E. coli* mitigation measures are adequate. The primary source of faecal coliforms exceedance(s) has been identified as the AOC holding basin.

Initial corrective actions looked at implementing a chorine float to mitigate and treat the AOC holding basin; however, subsequent testing identified the issue is intermittent and the introduction of a chlorine float would impact on other EPL228 discharge parameters. The implementation of a chorine float will not address the source of the exceedance, which is likely to be matter such as weed growth which, following further investigations, is likely to be related to presence of vegetation within the drain system. This will be managed through drain clearance preventative maintenance work. Aligning the testing schedule for AOC basin (L-750-SU-403) and sewage treatment plant (L-750-SU-009) for a period of six months (January - July 2023) has clarified that the *E. coli* parameter exceedance has not been at risk for the sewage treatment plant, despite the exceedance of indicator parameters such as faecal coliforms.

Further clarification was sought from ALS Testing laboratory which provided the following:

"If the client is looking for the best species in the coliform group for faecal indicators, this would be E. coli. The test of faecal coliforms (thermotolerant) does report some species that may not be of faecal origin"

This identifies the challenges in using faecal coliform parameters as an indicator for *E. coli*, which has been experienced during the recent testing period.

2.1.4 Program rationalisation

Sampling is to remain as per EPL228 requirements, no changes are proposed.

2.2 Harbour sediment

The purpose of the harbour sediment quality monitoring program is to provide an early warning of potential accumulation of contaminants from Ichthys LNG wastewater discharges, in surficial sediments surrounding the jetty outfall. The key objective is to determine if changes are attributable to Ichthys LNG operations.

As per the OEMP (L060-AH-PLN-60005), harbour sediment quality is required to be monitoring biennially. One survey (Survey No. 4) was undertaken within the reporting period. Associated reporting is summarised in Table 2-4.

Table 2-4: Harbour sediment quality survey details

Survey	Date	Report	INPEX Dox #
4	1 July 2022	Harbour Sediment Quality Monitoring – Trigger Assessment Report No. 4	L290-AH-REP-70042
		Harbour Sediment Quality Monitoring – Interpretative Report No. 4	L290-AH-REP-70043

2.2.1 Method overview

The harbour sediment quality survey was performed in accordance with the Harbour Sediment Quality Monitoring Plan (L290-AH-PLN-70003). Surficial sediment samples were collected using a grab sampler from 16 potential impact sites radiating away from the jetty outfall and two control sites in East Arm (Figure 2-2). The sediment grab sampler and QA/QC procedures followed were in accordance with the Harbour Sediment Quality Monitoring Plan, which was developed in consideration of the National Assessment Guidelines for Dredging (NAGD; Commonwealth of Australia 2009). The use of NAGD ensures consistency in sediment characterisation programs and is largely adopted for use in the Northern Territory (NT EPA 2013).

Following collection, surficial sediment samples were sent to a NATA accredited laboratory for analysis of parameters listed in Table 2-5. Laboratory results were then compared to benchmark levels to ascertain whether a trigger exceedance had occurred.

Exceedance of a benchmark level is defined as a measured analyte exceeding its relevant sediment quality guideline value (SQGV; also referred to as guideline value) as per ANZG (2018) and the same analyte also exceeding the background level for Darwin Harbour sediment. Background levels were calculated based on results presented in 2012 Darwin Harbour baseline sediment survey (Munksgaard et al. 2013). Note, where measured metal or metalloids exceeded SQGVs, results where possible are normalised for aluminium concentrations based on methods described in Munksgaard (2013) and Munksgaard et al. (2013)[5] and compared to background levels (i.e. baseline or reference levels).

2.2.2 Quality control assessment

All samples arrived at laboratories within the required holding times for all analytes and chemical compounds with trigger values.

Sediment blanks

Analyte concentrations measured in blank samples were below laboratory LORs, with the following exceptions:

- Aluminium in the field blank sample and the trip blank sample, with measurements of 300 mg/kg and 320 mg/kg respectively
- Arsenic in the field blank sample and the trip blank sample with measurements of 2.7 mg/kg and 3.2 mg/kg respectively

Aluminium concentrations in field and trip blanks (300 mg/kg and 320 mg/kg) were significantly lower than concentrations in samples, which ranged from 2,400 mg/kg to 21,000 mg/kg. Contamination from sampling procedure is a possible explanation for blank results, however the small range of aluminium concentrations in blanks suggest the analyte was present within the silica-washed sand blank samples prior to sampling. DGVs do not exist for aluminium, therefore these results do not affect the trigger assessment.

Arsenic levels in the field blank and trip blank samples (2.7 mg/kg and 3.2 mg/kg) were significantly lower than concentrations in samples which ranged from 9.8 mg/kg to 20 mg/kg. Contamination from sampling procedure is a possible explanation for blank results, however the small range of arsenic concentrations in blanks suggest the analyte was present within the silica-washed sand blank samples prior to sampling.

[5] Aluminium normalised metal concentrations can be calculated as the equivalent metal concentration at an aluminium concentration of 10,000 mg/kg (1% by weight).

Replicate samples

Analysis of field split samples revealed that the relative percentage differences (RPD) achieved the performance criteria of <35%%, with the following exceptions:

- I12 and QA01
  - Aluminium (RPD = 48)
  - Zinc (RPD = 47)
  - Total organic carbon (TOC) (RPD = 39).
- I12 and QA02
  - TOC (RPD = 125)

Sample QA02 was analysed by the secondary laboratory.

Analysis of the triplicate samples (QA03 and QA04) revealed that the relative percentage differences were all within the performance criteria of <50%.

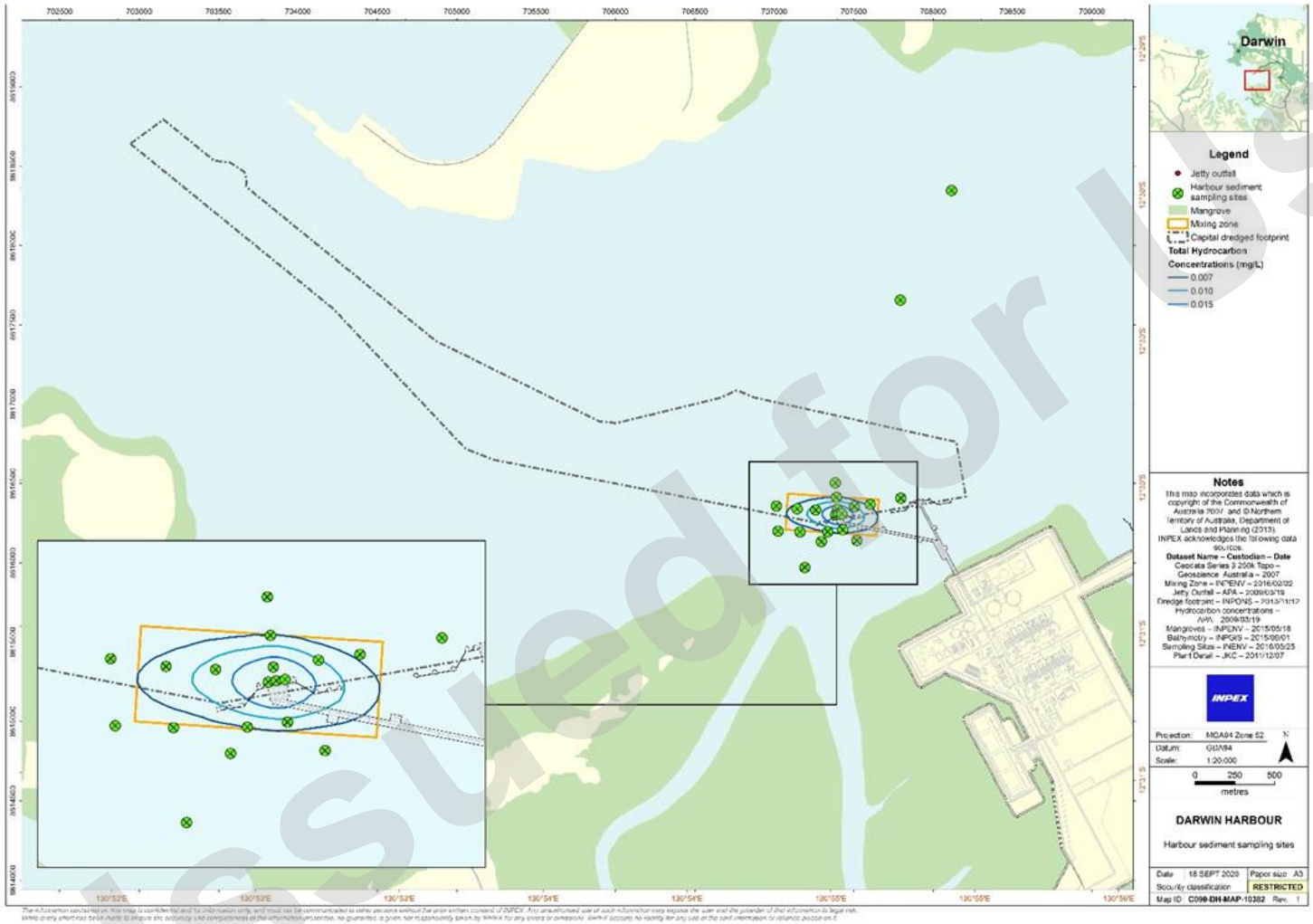

Figure 2-2: Harbour sediment quality sampling locations

Table 2-5: Harbour sediment quality monitoring parameters, trigger, and background values

Parameter	Unit	Trigger value*	Background value†
Total organic carbon (TOC)	%	n/a	n/a
TPH / TRH	mg/kg	280	n/a
Benzene, toluene, ethylbenzene, and xylene (BTEX)	mg/kg	n/a	n/a
Aluminium	mg/kg	n/a	n/a
Antimony	mg/kg	2	n/a
Arsenic	mg/kg	20	16.0
Cadmium	mg/kg	1.5	0.07
Chromium	mg/kg	80	17.5
Copper	mg/kg	65	4.7
Lead	mg/kg	50	8.8
Mercury	mg/kg	0.15	n/a
Nickel	mg/kg	21	8.7
Zinc	mg/kg	200	21.4
Particle size distribution (PSD)	µm	n/a	n/a

* ANZG (2018) sediment quality guideline value.

† Background levels are from Munksgaard et al. (2013), using the average of non-normalised sediment samples collected from intertidal (n=247) areas within the Darwin Harbour.

2.2.3 Results and discussion

Monitoring sites

Metal and metalloid results for harbour sediment quality are presented in Table 2-6. No metal or metalloid exceedances were reported at Impact sites.

All impact and control locations were below the laboratory LOR for Benzene, Toluene, Ethylbenzene and Xylene (BTEX) (Table 2-7). Total recoverable hydrocarbons (TRH) and total petroleum hydrocarbons (TPH) were detected above the LOR at one site (I11; 57 mg/kg); however, the guideline value (280 mg/kg) was not exceeded. The presence of TPH in this sample likely indicates the presence of non-petrogenic hydrocarbons of biological origin (e.g. vegetable/animal oils and greases, humic and fatty acids). Non-petrogenic hydrocarbons of biological origin are known to occur in Darwin Harbour with mangrove sediment samples analysed during the construction and operational phases returning positive results for TPH.

Table 2-6: Harbour sediment quality survey metal and metalloid results (mg/kg)

Site*	Aluminium	Antimony	Arsenic †	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	Mercury
Trigger values	**n/a**	**2**	**20**	**1.5**	**80**	**65**	**50**	**21**	**200**	**0.15**
Background level	**n/a**	**n/a**	**16.0**	**0.071**	**17.5**	**4.7**	**8.8**	**8.7**	**21.4**	**n/a**
I1	9,000	<0.5	9.8	<0.1	23	5.3	7.8	7.7	17	<0.1
I2	11,000	<0.5	11	<0.1	28	6.9	9.3	10	21	<0.1
I3	13,000	<0.5	11	<0.1	31	6.7	9.5	10	23	<0.1
I4	9,800	<0.5	11	<0.1	26	5.6	8.2	8.9	17	<0.1
I5	14,000	<0.5	11	<0.1	34	6.8	10	11	23	<0.1
I6	13,000	<0.5	11	<0.1	31	6.9	9.6	11	22	<0.1
I7	21,000	<0.5	12	<0.1	44	11	12	14	41	<0.1
I8	17,000	<0.5	12	<0.1	37	9.6	11	13	34	<0.1
I9	17,000	<0.5	14	<0.1	38	9	12	12	34	<0.1
I10	14,000	<0.5	10	<0.1	32	7.1	9.5	9.8	30	<0.1
I11	16,000	<0.5	12	<0.1	34	8.6	10	11	32	<0.1
I12	11,000	<0.5	11	<0.1	28	6.5	8.9	10	21	<0.1
I13	10,000	<0.5	15	<0.1	25	5.4	8.6	8.2	16	<0.1
I14	6,100	<0.5	11	<0.1	21	12	6.8	15	30	<0.1
I15	15,000	<0.5	14	<0.1	35	7.4	12	11	24	<0.1
I16	9,900	<0.5	15	<0.1	27	5.7	9.2	8.6	18	<0.1
C1	2,400	<0.5	20	<0.1	17	2.5	3.8	2.4	7.8	<0.1
C2	19,000	<0.5	16	<0.1	39	9.2	12	12	37	<0.1

* C = Control Site, I = Impact site.

† Bold values indicate trigger exceedance and results in brackets have been normalised for aluminium concentrations as per Munksgaard (2013)

Table 2-7: Harbour sediment quality survey organic results

Site*	TOC (mg/kg)	TPH (mg/kg)	BTEX (mg/kg)
Trigger values	**n/a**	**280**	**n/a**
Background level	**n/a**	**n/a**	**n/a**
I1	31,000	<50	<0.1
I2	28,000	<50	<0.1

Site*	TOC (mg/kg)	TPH (mg/kg)	BTEX (mg/kg)
I3	29,000	<50	<0.1
I4	24,000	<50	<0.1
I5	34,000	<50	<0.1
I6	22,000	<50	<0.1
I7	25,000	<50	<0.1
I8	26,000	<50	<0.1
I9	25,000	<50	<0.1
I10	31,000	<50	<0.1
I11	30,000	57	<0.1
I12	46,000	<50	<0.1
I13	28,000	<50	<0.1
I14	20,000	<50	<0.1
I15	<1,000	<50	<0.1
I16	34,000	<50	<0.1
C1	12,000	<50	<0.1
C2	28,000	<50	<0.1

* C = Control Site, I = Impact site

2.2.4 Trigger assessment outcomes

There were no exceedance of trigger levels for the reporting period.

2.2.5 Program rationalisation

Given there has been no trigger exceedance in harbour sediment monitoring attributable to Ichthys LNG operations, no changes to the monitoring frequency are proposed.

3 EMISSIONS TO AIR

This section includes the outcomes of the following monitoring programs:

- point source emissions (Section 3.2)
- dark smoke events (Section 3.4).

This section also summarises the operating condition of each emission source and the resulting air emission quality (Section 3.3) and provides a summary of total emissions to air in tonnes per year for the main parameters outlined in EPL228 (Section 3.1).

3.1 Total emissions to air

INPEX is required to provide total emissions to air (tonnes/year) for air quality parameters (Condition 87.4 of EPL228-04/Condition 77.5 of EPL228-05 listed in Table 6, Appendix 3 of EPL228). Estimated total emissions to air for the reporting period are provided in Table 3-1, which are based on INPEX's Commonwealth emission reporting requirements for National Pollutant Inventory (NPI) and National Greenhouse and Energy Reporting Scheme (NGERS).

Table 3-1: Estimated total emissions to air for reporting period

Parameter	Emissions (t/yr)
NOx as nitrogen dioxide (NO_2)	1752.32
Nitrous oxide (N_2O)	19.64
Mercury (Hg)	0
Particle matter 2.5 ($PM_{2.5}$)	92.75
Particle matter 10 (PM_{10})	92.75
Carbon monoxide (CO)	2908.86
Benzene	5.51
Toluene	5.33
Ethylbenzene	0.82
Xylenes	3.26
Hydrogen sulphide (H_2S)	190.06

3.2 Point source emissions to air

The key objective of the point source emission monitoring (commonly referred to as stack sampling) is to ensure air emissions do not exceed the concentration limit criteria as specified in Table 5, Appendix 3 of EPL228. The frequency of monitoring is outlined in EPL228, which requires annual monitoring of most emission points, monthly monitoring of hot venting, and hydrocarbons monitoring for all flare events .

Annual monitoring is being undertaken in accordance with the requirements of EPL228.

Table 3-2 provides a summary of the point source emission monitoring conducted for the reporting period.

Table 3-2: Point source emissions survey dates

Survey	Start date	End Date
Survey 8 Q4 2022	October 2022	October 2022

3.2.1 Method overview

Stationary source emissions monitoring is undertaken at 13point sources (with a total of 18 stacks) on the Frame 7 compression turbines, CCPP Frame 6 power generation turbines, CCPP utility boilers, acid gas removal unit (AGRU) incinerators and heating medium furnaces.

For the CCPP Frame 6 turbines, each turbine has two stacks, one which allows for normal operation of the turbine (with exhaust emissions directed to a conventional stack) and a separate stack with an associated heat recovery steam generator (HRSG), allowing for steam to be generated through the duct burning of fuel. The two stacks cannot be operated together so stack monitoring is dependent on which stack is in use at the time of sampling.

Table 3-3 and Table 3-4 show the EPL228 air emission target and limits plus the constituents that are required to be monitored at the point source locations as per Appendix 3, Table 5 and Table 6 respectively, of EPL228-05. Figure 3-1 shows the locations of the stationary source emissions monitoring locations at Ichthys LNG.

The following locations are inline gas sampling points (not ports) and as such are exempt from the standard methods for point source emissions sampling:

- 551-SC-003 (release point number A13-2);
- 552-SC-003 (release point number A14-2);
- 541-SC-001 (release point number A13-3); and
- 542-SC-001 (release point number A14-3).

INPEX conducts inhouse gas sampling and analysis from these locations for BTEX, hydrogen sulphide (H_2S) and mercury (Hg) using conventional industry methods which are not NATA accredited. The analysis of these gases is conducted using test methods that are managed under a NATA accredited Quality Management System.

Stationary source and gas samples are either collected by INPEX laboratory technicians and tested in the on-site NATA-accredited laboratory or are collected by an external NATA-accredited contractor and analysed in the field or by external laboratories.

All stack sampling ports have been installed in accordance with AS4323.1-1995 stationary source emissions – selection of sampling ports.

All stack sampling, where applicable, is undertaken in accordance with:

- New South Wales (NSW) Environment Protection Authority (formerly the Department of Environment and Conservation) Approved Methods for the Sampling and Analysis of Air Pollutants in NSW; or
- USEPA Method 30B for mercury emissions.

However, currently there are no approved NSW test methods for the sampling and analysis of nitrous oxide, nor any approved Australian Standard or USEPA methods.

For the sampling and analysis of nitrous oxide, INPEX and the stack emission monitoring Contractor, Ektimo, have followed the procedures as listed in NSW Test Method 11, which cross references to USEPA Method 7E *Determination of Nitrogen Oxide Emission from Stationary Sources (Instrumental Analyser Procedure)*. This lists comprehensive quality control and calibration procedures that must be followed to ensure accurate and reliable results. The analysis of nitrous oxide is also managed under a NATA accredited Quality Management System.

Table 3-3: Contaminant release limits to air at authorised stationary emission release points

Release point number	Source	Pollutant	Concentration target		Concentration limit	
			mg/Nm^3	ppmv	mg/Nm^3	ppmv
A1, A2, A3, A4	LNG Refrigerant Compressor Driver Gas Turbines (GE Frame 7s)	NO_x as NO_2	50 @ 15% O_2 dry	25 @ 15% O_2 dry	70@ 15% O_2 dry	35 @ 15% O_2 dry
A5-1, A6-1, A7-1, A8 1, A9-1	CCPP Gas Turbine Generators (GE Frame 6s, 38 MW)	NOx as NO_2	50 @ 15% O_2 dry	25 @ 15% O_2 dry	70@ 15% O_2 dry	35 @ 15% O_2 dry
A5-2, A6-2, A7-2, A8 2, A9-2	CCPP Gas Turbine Generators (GE Frame 6s, 38 MW) also burning vaporised iso-pentane in duct burners	NO_x as NO_2	150 @ 15% O_2 dry	75 @ 15% O_2 dry	350@ 15% O_2 dry	175 @ 15% O_2 dry
A13-1, A14-1	AGRU Incinerators	NO_x	320 @ 3% O_2 dry	160 @ 3% O_2 dry	350@ 3% O_2 dry	175 @ 15% O_2 dry
A15, A16	Heating Medium Furnaces	NO_x	160 @ 3% O_2 dry	80 @ 3% O_2 dry	350@ 3% O_2 dry	175 @ 3% O_2 dry

Table 3-4: Air emission monitoring program

Release Point Number	Sampling Location Number	Source	Monitoring Frequency	Parameter
A1	L-641-A-001	LNG Train 1 Refrigerant Compressor Driver Gas Turbine (GE Frame 7)	annually	NO_x as NO_2, N_2O, Hg, $PM_{2.5}$, PM_{10}, CO, temperature, efflux velocity, volumetric flow rate
A2	L-642-A-001	LNG Train 2 Refrigerant Compressor Driver Gas Turbine (GE Frame 7)		
A3	L-641-A-002	LNG Train 1 Refrigerant Compressor Driver Gas Turbine (GE Frame 7)		
A4	L-642-A-002	LNG Train 2 Refrigerant Compressor Driver Gas Turbine (GE Frame 7)		
A5-1	L-780-GT-001	CCPP Gas Turbine Generator #1 (GE Frame 6) – conventional stack	annually	NO_x as NO_2, N_2O, Hg, $PM_{2.5}$, PM_{10}, CO, temperature, efflux velocity, volumetric flow rate
A6-1	L-780-GT-002	CCPP Gas Turbine Generator #2 (GE Frame 6) – conventional stack		
A7-1	L-780-GT-003	CCPP Gas Turbine Generator #3 (GE Frame 6) – conventional stack		
A8-1	L-780-GT-004	CCPP Gas Turbine Generator #4 (GE Frame 6) – conventional stack		
A9-1	L-780-GT-005	CCPP Gas Turbine Generator #5 (GE Frame 6) – conventional stack		
A5-2	L-630-F-001	CCPP Gas Turbine Generator #1 (GE Frame 6) – HRSG stack		
A6-2	L-630-F-002	CCPP Gas Turbine Generator #2 (GE Frame 6) – HRSG stack		
A7-2	L-630-F-003	CCPP Gas Turbine Generator #3 (GE Frame 6) – HRSG stack		
A8-2	L-630-F-004	CCPP Gas Turbine Generator #4 (GE Frame 6) – HRSG stack		
A9-2	L-630-F-005	CCPP Gas Turbine Generator #5 (GE Frame 6) – HRSG stack	annually	NO_x as NO_2, N_2O, Hg, $PM_{2.5}$, PM_{10}, CO, temperature, efflux velocity, volumetric flow rate
A13-1	L-551-FT-031	AGRU Incinerator – LNG Train 1	annually	NO_x as NO_2, N_2O, Hg, $PM_{2.5}$, PM_{10}, CO, temperature, efflux velocity, volumetric flow rate
A13-2	551-SC-003	AGRU Hot Vent – LNG Train 1, prior to release at A3	monthly	BTEX, H_2S, volumetric flow rate
A13-3	541-SC-001	Feed gas to AGRU – LNG Train 1 – prior to release at A3	monthly	Hg
A14-1	L-552-FT-031	AGRU Incinerator – LNG Train 2	annually	NO_x as NO_2, N_2O, Hg, $PM_{2.5}$, PM_{10}, CO, temperature, efflux velocity, volumetric flow rate
A14-2	552-SC-003	AGRU Hot Vent – LNG Train 2, prior to release at A4	monthly	BTEX, H_2S, volumetric flow rate
A14-3	542-SC-001	Feed gas to AGRU – LNG Train 2 – prior to release at A4	monthly	Hg
A15	L-640-A-001-A	Heating Medium Furnaces	annually	NO_x as NO_2, N_2O, Hg, $PM_{2.5}$, $PM_{10,}$, CO, temperature, efflux velocity, volumetric flow rate
A16	L-640-A-001-B	Heating Medium Furnaces	annually	NO_x as NO_2, N_2O, Hg, $PM_{2.5}$, PM_{10}, CO, temperature, efflux velocity, volumetric flow rate
A17	L-700-F-002	Ground flare #5 warm	all flare events	mass of hydrocarbons flared
A18	L-700-F-001-A/B	Ground flare #2 cold		
A19	L-700-F-003	Ground flare #1 spare		
A20	L-700-F-005-A/B	Tank flare #1 LNG		
A21	L-700-F-006-A/B	Tank flare #2 LPG		
A22	L-700-F-007	Tank flare #3 LNG/LPG		
A23	L-700-F-004	Liquid flare		

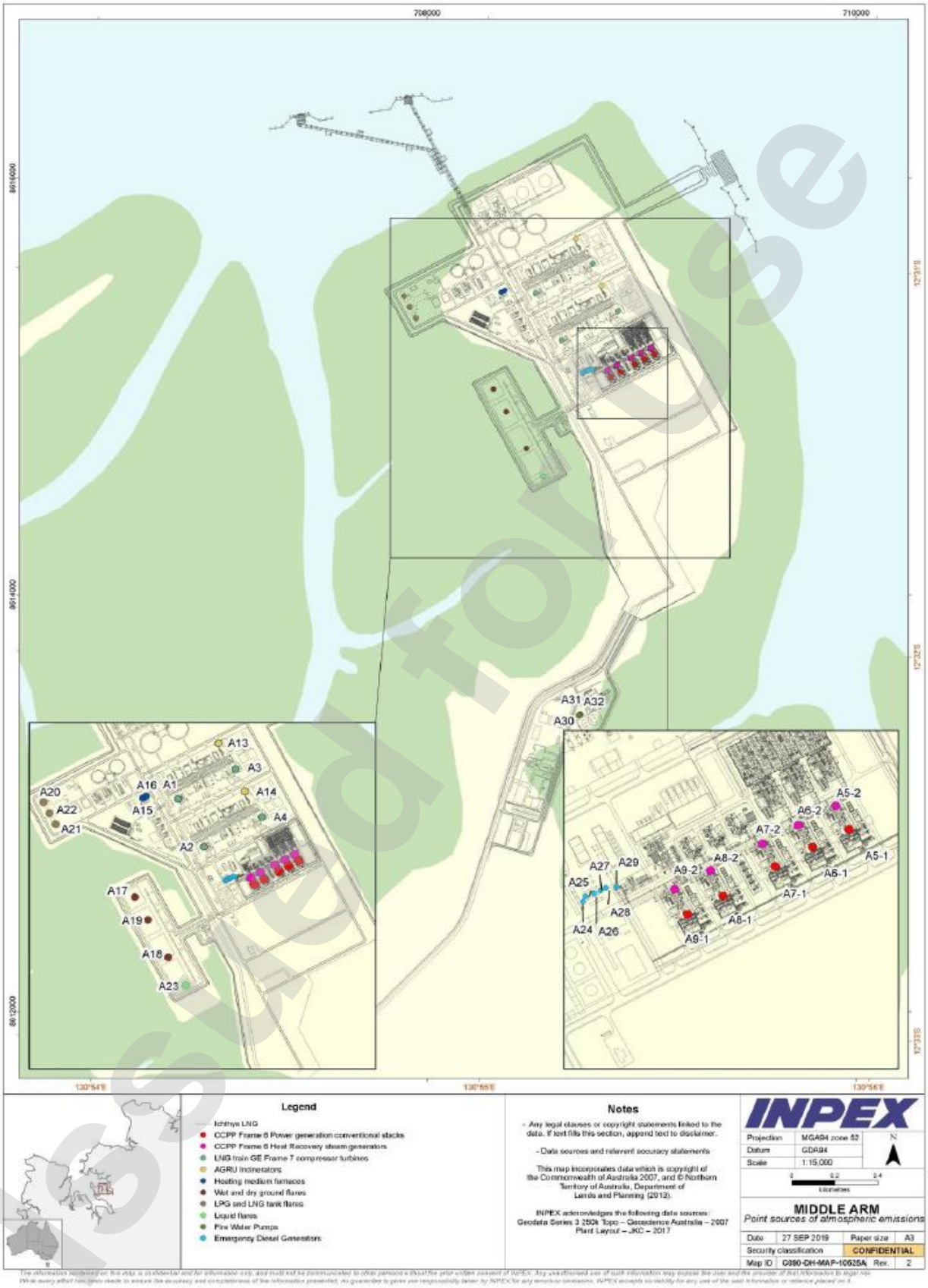

Figure 3-1: Location of authorised stationary emission release points

3.2.2 Quality control assessment

Stationary source emissions testing undertaken in October 2022, were carried out as per the nominated test method within EPL228-04 license condition 64 following the NSW Department of Environment and Conservation Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales or USEPA Method 30B for mercury emissions. This was completed in conjunction with Appendix 3, Table 6 of EPL 228-04. All samples were collected and sampled as per above conditions. NATA accredited environmental consultants Ektimo were engaged to carry out onsite stationary source testing as INPEX's NATA accreditation is still pending.

One erroneous result for mercury was observed for sample point A13-1, during the October 2022 stationary source emissions sampling. Following an initial investigation, it was confirmed that the third-party laboratory internal acceptance criteria for relative differences between test 1 and test 2 results (i.e. the two tests which inform the averaged result) were greater than the laboratory validity acceptance criteria of <24%. Therefore, in accordance with the INPEX laboratory accreditation, a non-conformance was raised and the result was deemed invalid.

3.2.3 Results and discussion

All results for the permanent plant were below limit criteria provided in Appendix 3, Table 6 of EPL228 (Table 3-3). The stationary source emission monitoring results are provided in APPENDIX D:

Due to equipment being offline for planned maintenance and extended unplanned equipment fault outages, release point number A6-2 (L-630-F-002 & L-780-GT-002 was unable to be tested during the Q4 2022 survey. Noting that in normal operations for the CCPP only 4 of the 5 turbines will be online, with one generally on standby or offline for planned maintenance. As previously mentioned in section 3.2.1, CCPP frame 6 turbines have two stacks with only one of the two stacks running at a time. As such, release port numbers A5 1 to A9 1 (conventional stack series) were not tested in this reporting period as they were not online. The "HRSG stack series" frame 6 sampling locations were utilised in this survey.

The mass of hydrocarbons flared for the reporting period for each flare source is presented in Table 3-5.

Table 3-5: Mass of hydrocarbons flared

Release Point number	Location Number	Source	Mass of hydrocarbons flared (tonnes)
A17 / A19	L-700-F-002 / L-700-F-003	Ground flare #5 warm/ Ground flare #1 spare	30,686
A18 / A19	L-700-F-001-A/B / L-700-F-003	Ground flare #2 cold / Ground flare #1 spare	35,161
A20	L-700-F-005-A/B	Tank flare #1 LNG	3.8
A21	L-700-F-006-A/B	Tank flare #2 LPG	9,485
A22	L-700-F-007	Tank flare #3 LNG/LPG	11,702
A23	L-700-F-004	Liquid flare	0

Figure 3-2 and Figure 3-3 show the vented acid gas flow rates in m^3/h for Train 1 and Train 2. During the time the acid gas incinerators were offline, the acid gas was hot vented when the LNG trains were online. Figure 3-4 and Figure 3-5 provide the flow rate of acid gas to the Train 1 and Train 2 acid gas incinerators, while the incinerator was in service.

While the acid gas incinerators were offline and venting was occurring, gas sampling was undertaken in accordance with EPL228-5 condition 58.1 In December 2022, Inpex experienced an issue with train 1 & 2 AGI's relating to a valve by-passing hydrocarbons which resulted in a subsequent trip of both AGI's. Both train 1 & train 2 AGI's were taken offline for a full review and Management of Change process before being re-implemented.

At time of writing of this report, Management of Change corrective actions are yet to be finalised prior to coming back online.

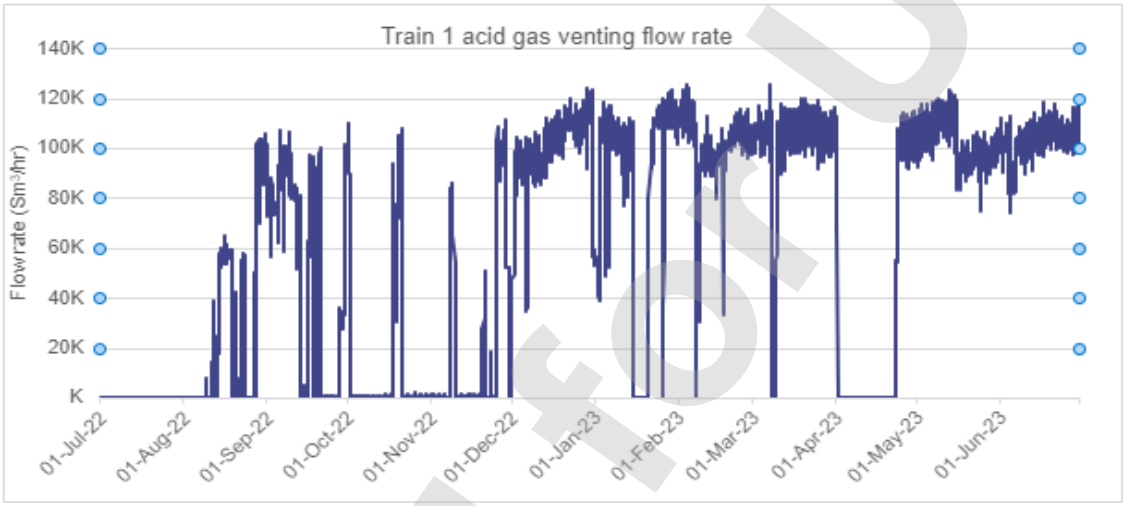

Figure 3-2 Train 1 acid gas venting flow rates

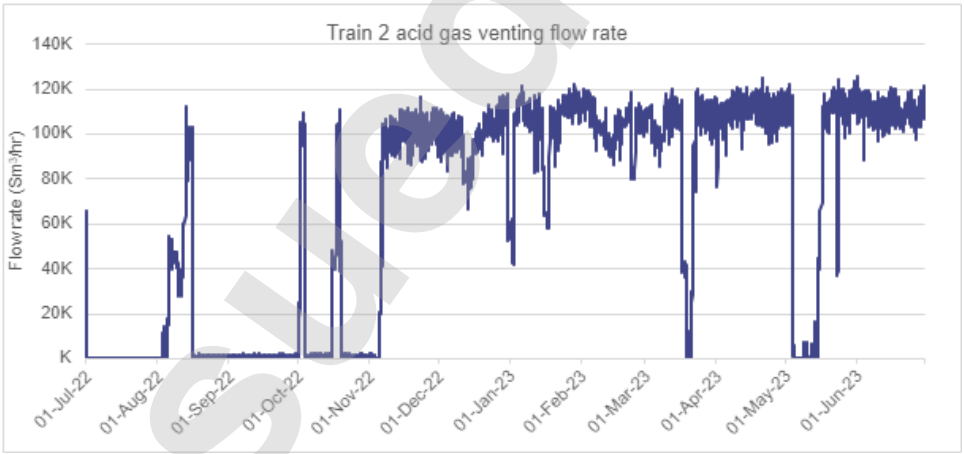

Figure 3-3 Train 2 acid gas venting flow rate

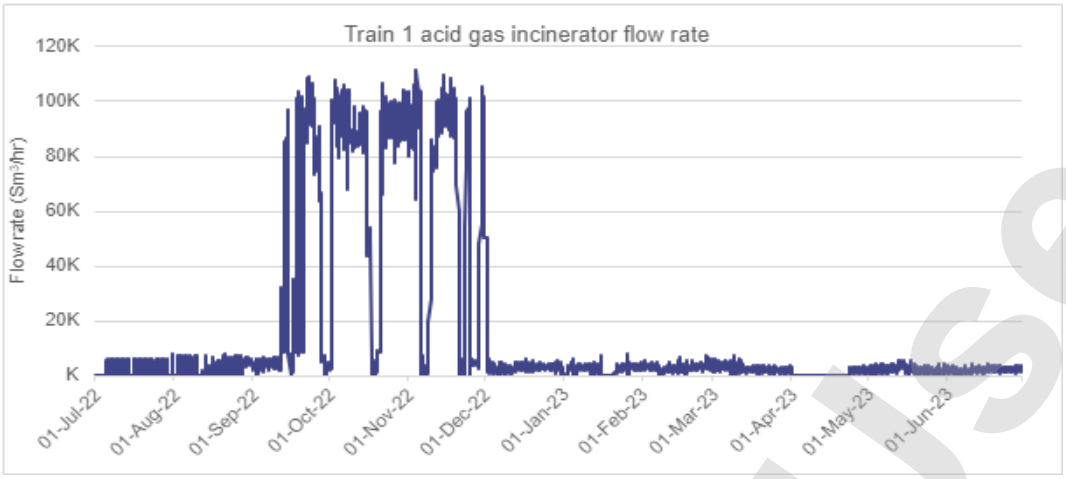

Figure 3-4 Train 1 acid gas incinerator flow rates

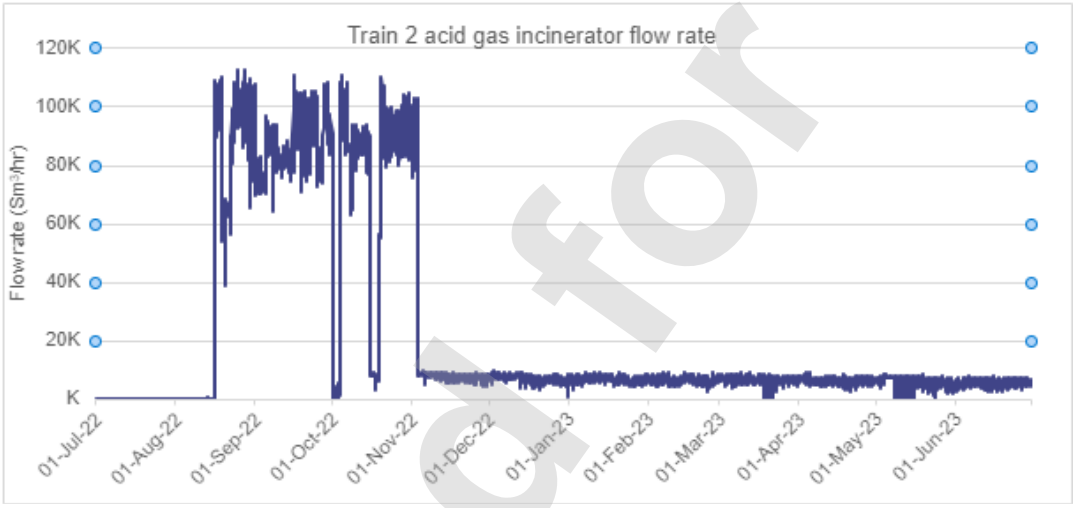

Figure 3-5 Train 2 acid gas incinerator flow rates

3.2.4 Program rationalisation

No rationalisation is currently proposed, and monitoring will be conducted as per the EPL228 requirements.

3.3 Overall summary of performance of stationary emission sources

The status of the stationary point source emissions at Ichthys LNG is provided in Table 3-6 based on information presented in Sections 3.1 and 3.2. As stated above the acid gas incinerators for both LNG Train 1 and LNG Train 2 was offline from December 2022. During the period that the acid gas incinerators were offline, sampling of the vented gas occurred as per EPL228-05 condition 58.1.

Table 3-6: Stack emission status and air quality

Release point number	Emission source	Status	Air emissions
A1	Compressor turbine WHRU West 1 (Frame 7)	Operational	Acceptable

Release point number	Emission source	Status	Air emissions
A2	Compressor turbine WHRU West 2 (Frame 7)	Operational	Acceptable
A3	Compressor turbine WHRU East 1 (Frame 7)	Operational	Acceptable
A4	Compressor turbine WHRU East 2 (Frame 7)	Operational	Acceptable
A5-1	Power generation turbine 1 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A6-1	Power generation turbine 2 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A7-1	Power generation turbine 3 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A8-1	Power generation turbine 4 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A9-1	Power generation turbine 5 (Frame 6)	Intermittent use, when HRSG offline	Not tested in this survey
A5-2	Power generation turbine 1 HRSG (Frame 6)	Operational	Acceptable
A6-2	Power generation turbine 2 HRSG (Frame 6)	Off-line during survey	Not tested in this survey
A7-2	Power generation turbine 3 HRSG (Frame 6)	Operational	Acceptable
A8-2	Power generation turbine 4 HRSG (Frame 6)	Operational	Acceptable
A9-2	Power generation turbine 5 HRSG (Frame 6)	Operational	Acceptable
A13-1	AGRU Incinerator – LNG Train 1	Offline since December 2022	Acceptable while online
A13-2	AGRU Hot Vent – LNG Train 1, prior to release at A3	Operational	Acceptable
A14-1	AGRU Incinerator – LNG Train 2	Offline since December 2022	Acceptable while online
A14-2	AGRU Hot Vent – LNG Train 2, prior to release at A4	Operational	Acceptable
A15	Heating medium furnace 1	Operational	Acceptable
A16	Heating medium furnace 2	Operational	Acceptable

3.4 Dark smoke events

Ichthys LNG has been designed to minimise dark-smoke events; however, dark smoke can result during flaring due to incomplete combustion of hydrocarbons. The environmental impacts from smoke emitted from Ichthys LNG are considered negligible, though smoke could become a cause of visual amenity impact and community concern.

3.4.1 Method overview

Visual monitoring and closed-circuit television monitoring of flares is undertaken to detect possible dark smoke events. If dark smoke is produced during operations, the shade (or darkness) of the smoke is estimated using the Australian Miniature Smoke Chart (AS 3543:2014), which uses Ringelmann shades. The shade and duration of the dark-smoke event is recorded. Dark smoke monitoring targets and limits for all the flare systems are provided in Table 3-7.

Table 3-7: Dark smoke monitoring targets and limits

Emission source	Pollutant	Target	Limit
Flares	Smoke	<Ringelmann 1	Visible smoke emissions darker than Ringelmann shade 1

Flaring and other data is stored in the sites Process Control System (PCS). The PCS serves as the primary means to control and monitor Ichthys LNG and automatically maintains operating pressures, temperatures, liquid levels, and flow rates within the normal operating envelope with minimal intervention from operator consoles in the central control room (CCR). The system has built-in redundancy in communication, control, and human interface. Information from the PCS is displayed on visual display units in the CCR. During process upset conditions, the system has detailed alarm handling and interrogation functions to minimise operator overload. The PCS is also equipped with a database function that permits operations personnel to investigate a historical sequence of events. In addition, volatile organic compound emissions are estimated by use of the NPI and NGERS reporting tools.

3.4.2 Results and discussion

On 25 November 2022 during the restart of Train 1, black smoke was reported to be observed coming from the Train 1 acid gas incinerator (AGI). The observed smoke was not a result of flaring.

This smoke event was not charted on the Ringelmann smoke chart as the causation of the event did not allow this information to be captured in time. This event led to both AGI's taken offline from December 2022 to prevent further reoccurrence.

3.4.3 Program rationalisation

No program rationalisation is proposed.

4 UNPLANNED DISCHARGES TO LAND

4.1 Groundwater quality

The key objective of the groundwater monitoring program is to detect changes in groundwater quality and determine if these changes are attributable to Ichthys LNG operations. Note there are no planned discharges directly to groundwater, other than rainfall and non-contaminated water (NCW); however, there is potential for groundwater to become contaminated as a result of an accidental spill, leak, or rupture during Ichthys LNG operations.

As per the OEMP, groundwater quality is required to be monitored biannually (e.g. twice yearly at 15 sites). Table 4-1 provides a summary of the groundwater quality surveys completed during the reporting period.

Table 4-1: Groundwater quality monitoring survey details

Survey	Sampling period	Report	INPEX Doc #
10	24-26 October 2022	Groundwater Quality Monitoring – Trigger Assessment: Report No 10	L290-AH-REP-70031
		Groundwater Quality Interpretive Report No 10	L290-AH-REP-70032
11	18-20 April 2023	Groundwater Quality Monitoring – Trigger Assessment: Report No 11	L290-AH-REP-70052
		Groundwater Quality Interpretive Report No 11	L290-AH-REP-70051

4.1.1 Method overview

The groundwater quality monitoring surveys were undertaken in accordance with the Groundwater Quality Monitoring Plan (L290-AH-PLN-70000). The Groundwater Quality Monitoring Plan was developed in consideration of Australian, State and Territory groundwater sampling standards and guidelines. A high-level summary of methods is provided below.

Prior to sampling, groundwater wells were gauged with an interface probe to determine the standing water level (SWL). Following gauging, groundwater wells were purged using a low flow micro purge pump with SWL and in situ parameters being measured every three to five minutes. Once the well had been purged and in-situ parameters were stable, groundwater samples were then collected for analysis.

Following collection, groundwater samples were sent to NATA accredited laboratories for analysis of parameters listed in Table 4-2. Results were then compared to benchmark levels to ascertain whether a trigger exceedance had occurred.

Exceedance of a benchmark level is defined as a measured analyte exceeding its relevant trigger value (see Table 4-2) and the same analyte also exceeding the background level for each groundwater well. While specific background level trigger values were calculated using the approach described in ANZG (2018). The 80th and/or 20th percentile value for each parameter was determined using the monthly groundwater data collected during the construction phase of Ichthys LNG between 2013 and 2018.

Table 4-2: Groundwater quality monitoring parameters, methods, and trigger values

Parameter	Unit	Sampling method*	Trigger value	Trigger value reference
pH	pH units	CFI	Outside 6.0 and 8.5	NRETAS 2010
EC	µS/cm	CFI	n/a	n/a
Dissolved oxygen	%	CFI	n/a	
Oxygen reduction potential	mV	CFI	n/a	
Temperature	°C	CFI	n/a	
Total dissolved solids	mg/L	SFLA	n/a	
Oxides of nitrogen	µg N/L	SFLA	20	NRETAS 2010
Ammonia	µg N/L	SFLA	20	
TN	µg N/L	SFLA	300	
TP	µg P/L	SFLA	30	
FRP	µg/L	SFLA	10	
Phenols	µg/L	SFLA	n/a	n/a
TRH‡	µg/L	SFLA	600	Ministry of Infrastructure and the Environment (2009)
Benzene	µg/L	SFLA	500	ANZG 2018
Toluene	µg/L	SFLA	180	
Ethylbenzene	µg/L	SFLA	5	
Xylenes	µg/L	SFLA	75	
Aluminium	µg/L	SFLA	24	Golding et al. 2015
Arsenic	µg/L	SFLA	2.3	ANZG 2018
Cadmium	µg/L	SFLA	0.7	
Chromium III	µg/L	SFLA	10	
Chromium VI	µg/L	SFLA	4.4	
Cobalt	µg/L	SFLA	1	
Copper	µg/L	SFLA	1.3	
Lead	µg/L	SFLA	4.4	
Manganese	µg/L	SFLA	390	J. Stauber and R. Van Dam Pers.Com. 23 March 2015 cited in Greencap (2016)
Mercury	µg/L	SFLA	0.1	ANZG 2018
Nickel	µg/L	SFLA	7	

Parameter	Unit	Sampling method*	Trigger value	Trigger value reference
Silver	µg/L	SFLA	1.4	
Vanadium	µg/L	SFLA	100	
Zinc	µg/L	SFLA	15	
Biological oxygen demand (BOD)†	mg/L	SFLA	n/a	n/a
Faecal coliform†	cfu-100mL	SFLA	n/a	
Escherichia coli†	cfu-100mL	SFLA	n/a	

* SFLA = sample for laboratory analysis, CFI = calibrated field instrument

† Only at BPGW19A and BPGW27A

‡ Where TRH is detected over the prescribed limits a silica gel clean-up will be undertaken and reanalysed to remove false positive natural oil results

Figure 4-1: Groundwater quality sampling locations

4.1.2 Quality Control Assessment

Laboratory holding times

All samples arrived at the laboratories within the required holding times for all analytes and chemical compounds with trigger values, for both survey 10 and 11.

Blank samples

Analyte concentrations measured in rinsate and field blank samples reported below the laboratory LORs, with the following exceptions:

- Survey 10
  - Manganese in the field blank (25 µg/L) and rinsate (50 µg/L) collected on 24 October.
  - Arsenic in the rinsate (2 µg/L) collected on 24 October.

It should be noted that the two manganese and single arsenic exceedances were recorded in samples collected on 24 October 2022. The blank sample results indicate that these exceedances may have been affected by contamination during sampling procedures.

Duplicate and triplicate samples

Analyses of duplicate samples revealed that the relative percentage differences (RPD) achieved the performance criteria of <30 % for most analytes, with the following exceptions:

- Survey 10
  - Nitrate as N (RPD = 67)
  - Total Kjeldahl Nitrogen (TKN) (RPD = 67)
  - Oxides of Nitrogen (RPD = 67)
  - Total Nitrogen (RPD = 67)

Analyses of triplicate samples revealed that the relative percentage differences (RPD) achieved the performance criteria of <30 % for the majority of analytes, with the following exceptions:

- Survey 10
  - Filtered nickel (RPD = 67)
  - Nitrate (as N) (RPD = 67)
  - FRP (RPD = 160)
- Survey 11
  - Total dissolved solids (RPD = 87)
  - Ammonia (as N) (RPD = 86)

For survey 10, there is no trigger value for TKN. None of the analyte concentrations in the primary sample, duplicate or triplicate sample that recorded RPDs above the performance criteria were above both the trigger and background levels (i.e. do not comprise a trigger exceedance). The high RPDs therefore do not affect the results of the monitoring program.

For survey 11, there are no trigger values for total dissolved solids. The ammonium concentrations in the primary sample (240 µg/L) was above the trigger level of 20 µg/L but below the background level of 288 µg/L. The triplicate sample (600 µg/L) was above the trigger value and background value. This elevated RPD therefore places some uncertainty on the accuracy of ammonia concentrations recorded in the primary sample from BPGW26.

Limit of reporting

Survey 10

Several samples were analysed to LOR higher than the trigger values specified in Table 7-8 of the OEMP. The primary laboratory (ALS) advised that the raised LORs in several samples are due to high salinity. The monitoring contractor requested that the samples be re-tested to achieve lower LORs but was advised that this was not possible as the samples had been disposed. ALS standard practice is to dispose of water samples after three weeks. INPEX then placed project controls on the monitoring contractor to ensure results are reviewed and assessed for issues within 5 business days of being received by the monitoring contractor.

The following observations were made regarding the limit of reporting (LOR) for analytes measured at ALS:

- Aluminium was analysed to a LOR of 100 µg/L in six primary samples. This is higher than the trigger value of 24 µg/L required for the groundwater monitoring program.
- Arsenic was analysed to a LOR of 10 µg/L in three primary samples. This is higher than the trigger level of 2.3 µg/L required for the groundwater monitoring program.
- Cadmium was analysed to a LOR of 1 µg/L in six primary samples, which is higher than the trigger value of 0.7 µg/L required for the groundwater monitoring program.
- All 15 primary samples were analysed to a LOR of 10 µg/L for hexavalent chromium. This is higher than the trigger value of 4.4 µg/L required for the groundwater monitoring program.
- Cobalt was analysed to a LOR of 10 µg/L in four primary samples. This is higher than the trigger value of 1 µg/L required for the groundwater monitoring program.
- Copper was analysed to a LOR of 10 µg/L in seven primary samples. This is higher than the trigger value of 1.3 µg/L required for the groundwater monitoring program.
- Lead was analysed to a LOR of 10 µg/L in seven primary samples. This is higher than the trigger value of 4.4 µg/L required for the groundwater monitoring program.
- Nickel was analysed to a LOR of 10 µg/L in four primary samples. This is higher than the trigger value of 7 µg/L required for the groundwater monitoring program.
- Silver was analysed to a LOR of 10 µg/L in seven primary samples. This is higher than the trigger value of 1.4 µg/L required for the groundwater monitoring program.
- Zinc was analysed to a LOR of 50 µg/L in five primary samples. This is higher than the trigger value of 15 µg/L required for the groundwater monitoring program.
- Nitrogen was analysed to a LOR of 1,000 µg/L in five primary samples, and a LOR of 500 µg/L in one primary sample. This is higher than the trigger value of 30 µg/L required for the groundwater monitoring program.
- Oxides of nitrogen was analysed to a LOR of 100 µg/L in three primary samples, which is higher than the trigger value of 20 µg/L required for the groundwater monitoring program.

- Phosphorus was analysed to LORs of 200 µg/L in one primary sample, 100 µg/L in one primary sample, and 50 µg/L in one primary sample. This is higher than the trigger value of 30 µg/L required for the groundwater monitoring program.

The raised LORs have impacted the quality of the groundwater monitoring program, predominantly due to the instances in which the LOR was higher than the trigger and background levels, resulting in technical trigger exceedances.

Survey 11

The following observations were made regarding the LORs higher than the trigger values specified in Table 7-8 of the OEMP for analytes measured at the primary laboratory (ALS Global) for Survey 11 :

- Hexavalent chromium was analysed to an LOR of 10 µg/L in two primary samples. This is higher than the trigger value of 4.4 µg/L required for the groundwater monitoring program.
- Total nitrogen was analysed to an LOR of 500 µg/L in a primary sample from bore VWP328. This is higher than the trigger value (300 µg/L) required for the groundwater monitoring program, although less than the background value of 790 µg/L for VWP328; therefore, this result does not impact the trigger assessment.
- Total nitrogen was analysed to an LOR of 1,250 µg/L in a primary sample from bore VWP341. This is higher than the trigger value (300 µg/L) required for the groundwater monitoring program, and higher than the background value (490 µg/L). As such, these results should be considered an estimate.
- Total phosphorus was analysed to an LOR of 50 µg/L in two primary samples. This is higher than the trigger value of 30 µg/L. The LOR is less than the background value at both bores therefore this result does not impact the trigger assessment.

The raised LORs have impacted the quality of the groundwater monitoring program, predominantly due to the instances in which the LOR was higher than the trigger and background levels, resulting in three technical trigger exceedances.

Discussion with ALS have indicated that raised LORs for nutrients are due to incorrect sample containers being used, specifically the failure to use ultra-trace sample containers designated for analytical testing at low concentration levels. ALS will provide an updated itinerary of sample containers to be used for future groundwater monitoring events at the Ichthys LNG facility.

Raised LORs for metals occur in some instances because the samples are saline, as the laboratory uses different testing methods for metals in freshwater and saline water. This issue arises due to the varying salinity of groundwater across the Ichthys LNG facility. Testing has been conducted on the basis that samples within a batch are either all freshwater, or all saline water, when usually there is a mixture of both types of water within a sample batch.

The monitoring contractor has, with ALS, determined criteria to establish which testing methods are to be requested on future COCs submitted to the laboratory. This criterion will include electrical conductivity thresholds to determine the specific testing method to be requested.

4.1.3 Results and discussion

A high-level summary of groundwater results and trends is provided in the following sections, with detailed results discussion and data collected during the reporting period provided in APPENDIX E:. Note, presentation of groundwater data trends include data collected during the construction phase. Groundwater surveys undertaken during the reporting period are specified in Table 4-1. To date, groundwater monitoring during the operations phase of Ichthys LNG shows that there has been no change in groundwater quality.

Survey 10: October 2022

Thirty-one exceedances against both the trigger and background concentrations were recorded in the tenth groundwater monitoring event in October 2022. Exceedances include one for pH, 17 for nutrients and 13 for dissolved metals. No exceedances were recorded for hydrocarbons. This is less than the 47 exceedances recorded during the eighth groundwater monitoring event undertaken during October 2021.

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.

A single exceedance of pH was recorded during the October 2022 monitoring event (VWP341). Whilst historic data indicates that pH fluctuates at VWP341, a decreasing trend in pH is apparent at this bore.

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

- Ammonia: Increasing trends at BPGW40, BPGW41 and VWP341.

Visual assessment of time plotted data for metal exceedances has confirmed the following trends that were also identified by the Mann-Kendall analysis:

- Arsenic: increasing trend at BPGW09
- Cobalt: Increasing trend at VWP341
- Zinc: Increasing trend at VWP341.

The following historical maximum values were recorded during the October 2022 monitoring event:

- Phosphorus at BPGW18 (850 µg/L)
- Cadmium at BPGW08A (1.1 µg/L)
- Cobalt at BPGW07 (38 µg/L), BPGW08A (77 µg/L) and VWP341 (112 µg/L)
- Nickel at BPGW09 (17 µg/L)
- Zinc at VWP341 (145 µg/L).

Results of the investigation into each of the exceedances are described in Section 4.1.4.

Survey 11: April 2023

Thirty-two exceedances against both the trigger and background concentrations were recorded in the eleventh groundwater monitoring event in April 2023. Exceedances include five for pH, 13 for nutrients and 14 for dissolved metals. No exceedances were recorded for hydrocarbons and mercury.

Exceedances have been plotted on time series graph to compare to pre-construction and construction data and discern trends in the data.

The five pH exceedance recorded during the eleventh groundwater monitoring event represent an increase from the one trigger exceedance recorded during the April 2022 monitoring event. Overall, April 2023 monitoring event results showed a slight increase in pH (i.e. less acidic) across all sites when compared to April 2022.

A review of the 13 nutrient exceedances from April 2023 monitoring event found that six of the exceedances were consecutive for at least three surveys. Trend analysis completed by the monitoring contractor indicates:

- Ammonia:
  - Increasing trends for ammonia at VWP341, BPGW40 and BPGW41
  - Fluctuating trends for ammonia at BPGW20, BPGW27A and BPGW28
- Nitrogen: Fluctuating long-term trend for total nitrogen at BPGW40 and BPGW41
- Oxides of nitrogen: Consistent fluctuating trend of oxides of nitrogen, with concentrations increasing in the wet season and decreasing in the dry season at BPGW38A.
- Phosphorus: Stable and short-term spike in phosphorus concentrations at BPGW40, BPGW41 and VWP328.

Trend analysis of the 14 metals exceedances completed by the monitoring contractor indicates that:

- Arsenic: Increasing long-term trend at BPGW09 and VWP328.
- Cobalt: Stable but fluctuating at BPGW26; and increasing trend at VWP328, BPGW40 and VWP341.
- Zinc: Increasing trend at VWP341.
- Copper: Increasing trend at BPGW07.
- Manganese: Short-term spike at VWP341 and fluctuation at BPGW09.
- Nickel: Stable overall but fluctuate at VWP341.
- Zinc: Fluctuations at BPGW07 and VWP341 and short-term spike in concentrations at BPGW28.

The following historical maximum values were recorded during the April 2023 monitoring event:

- Cobalt (6.6 µg/L) and manganese (673 µg/L) at BPGW09
- Cobalt (1.6 µg/L) and FRP (11 µg/L) at BPGW40
- Cobalt (146 µg/L) at VWP341
- Nitrogen (500 µg/L) at BPGW26.

Results of the investigation into each of the exceedances are described in Section 4.1.4.

4.1.4 Trend analysis and trigger exceedance investigation outcomes

Trend analysis

Positive trends were determined across groundwater surveys 10 and 11 for pH (VWP341), Ammonia (BPGW40, BPGW41, VWP341), Arsenic (BPGW09 and VWP328), Cobalt (VWP341, VWP328 and BPGW40), Zinc (VWP341) and Copper (BPGW07). Note analytes that were trending positive in survey 10 but not survey 11 have not been included in this analysis.

pH

Analysis of pH at site VWP341 over time demonstrates that there is a long term, stable and slightly downward trend in pH (Figure 4-2). However, pH values at VWP341 are within the range of pH across all sites at Bladin Point (Figure 4-2), and therefore the downward trend is not of concern.

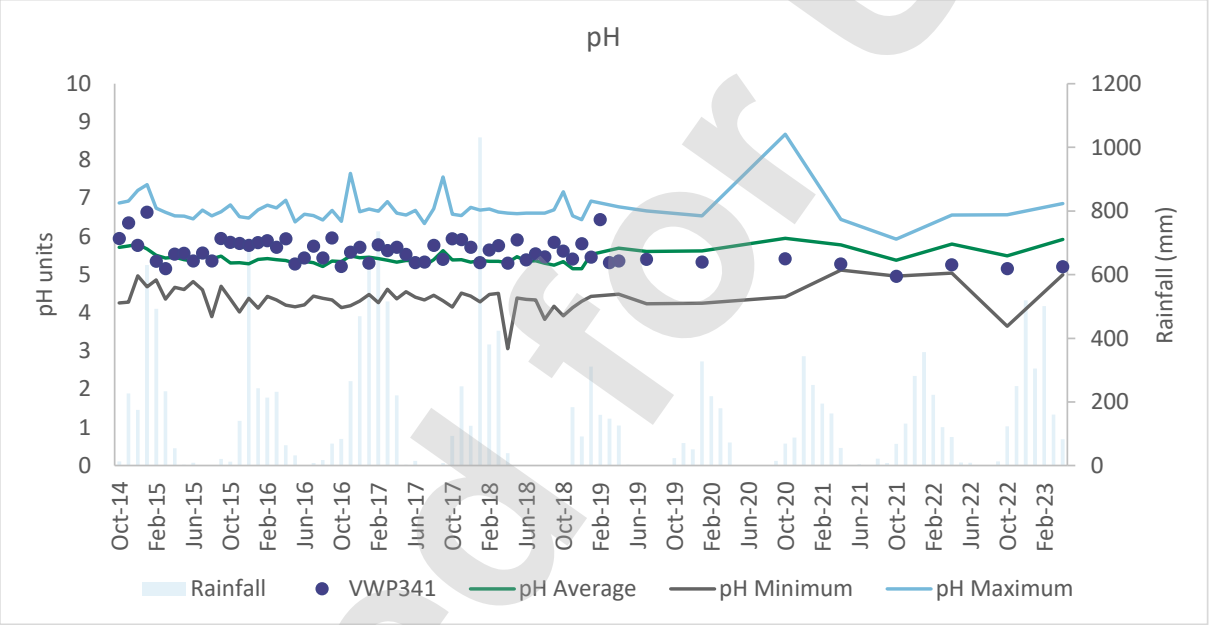

Figure 4-2: pH at VWP341 and the average, minimum and maximum pH of all operational monitoring wells from October 2014 to April 2023

Ammonia

Ammonia concentrations showed some long term variability with a slightly increasing trend across sites BPGW40, BPGW41 and VWP341 (Figure 4-3). Despite increasing trends, ammonia concentrations are within the range of concentrations at all monitoring wells. It is noted that monitoring during the construction stage of the project (2012-2015) identified that ammonia concentrations were regularly recorded above the trigger value of 20 µg/L across the site (AEC Environmental, 2015). Investigations into the ammonia trigger exceedances did not determine any potential sources of ammonia on site (refer Section 4.1.4), therefore the increasing trends are considered to be as a result of natural variation.

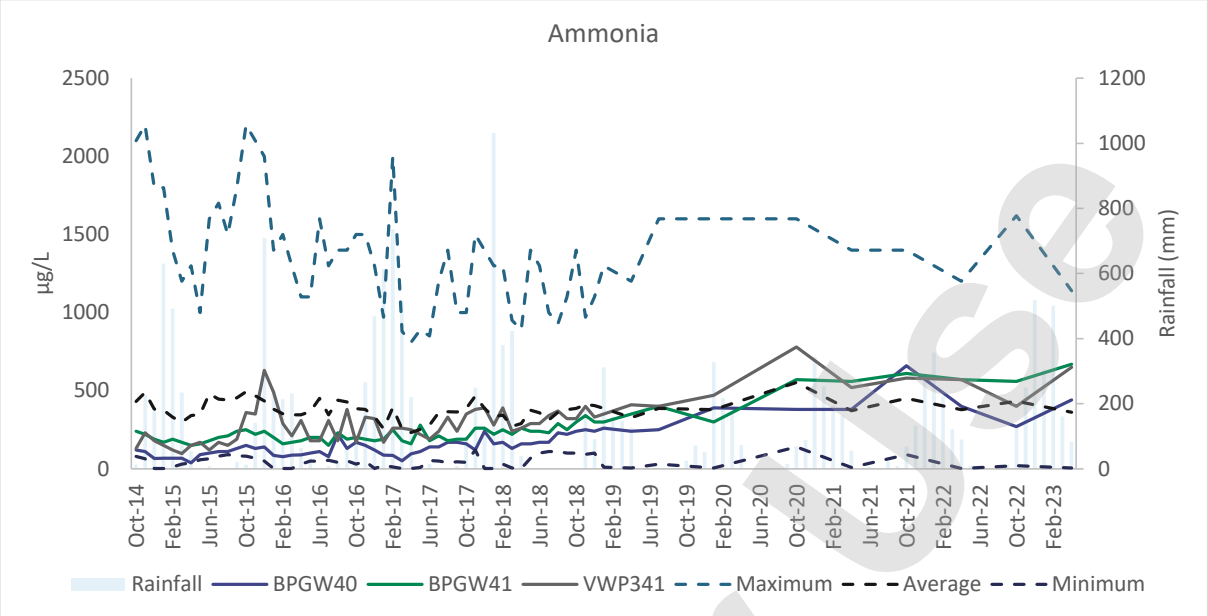

Figure 4-3: Ammonia concentrations at BPGW40, BPGW41 and VWP341, and the average, minimum and maximum pH of all operational monitoring wells from October 2014 to April 2023

Arsenic

Arsenic concentrations recorded at BPGW09 and VWP328 from October 2014 to April 2023 are displayed below in Figure 4-4. Arsenic concentrations at BPGW09 and VWP328 fluctuate, with concentration increases correlating with increased rainfall. Arsenic concentrations have increased since the construction period of 2014-2015; however, the long-term trend appears to be stable.

High levels of arsenic are known to occur within the coastal strata of Darwin Harbour and are likely a reflection of local geology rather than anthropogenic sources (Padovan, 2003). The April 2023 exceedance is likely due to seasonal factors.

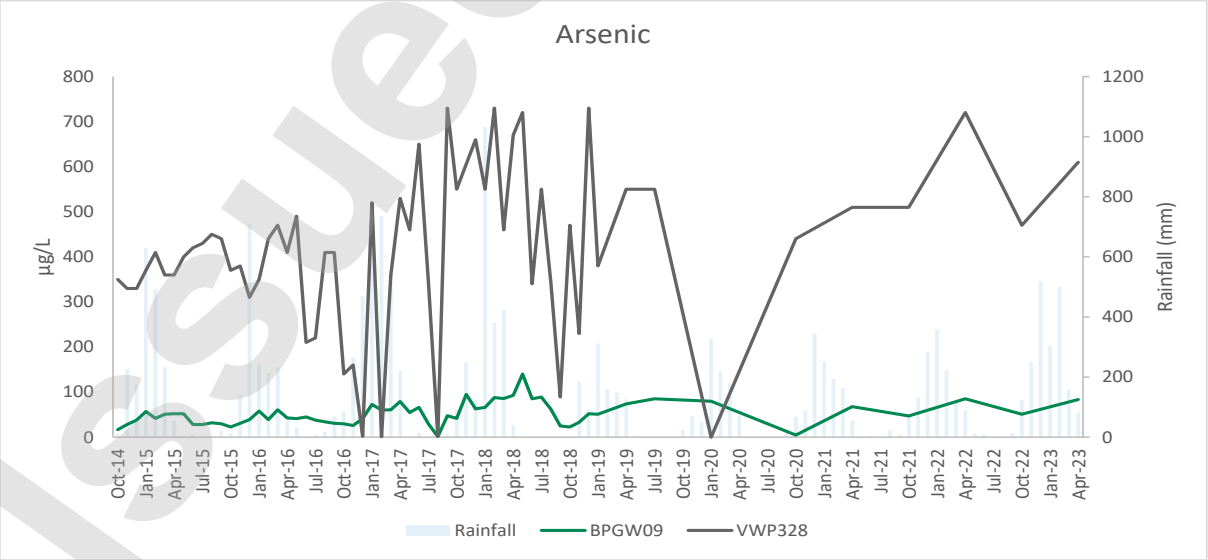

Figure 4-4: Arsenic concentrations recorded at BPGW09 and VWP328 from October 2014 to April 2023

Cobalt

Cobalt concentrations at BPGW40 and VWP341 are increasing, with the April 2023 results representing historical maxima at both bores. Exceedances at BPGW40 appear to be fluctuating seasonally at or just above the trigger value (1 µg/L), with higher trends potentially linked to an increasing rainfall (Figure 4-5), and therefore are likely a result of natural variation.

Figure 4-5 demonstrates that VWP341 cobalt concentrations have consistently trended at the top of cobalt concentrations across operational groundwater bores. Investigations into trigger exceedances did not determine any potential sources of cobalt on site (refer Section 4.1.4), therefore the increasing trends are considered to be likely as a result of natural variation.

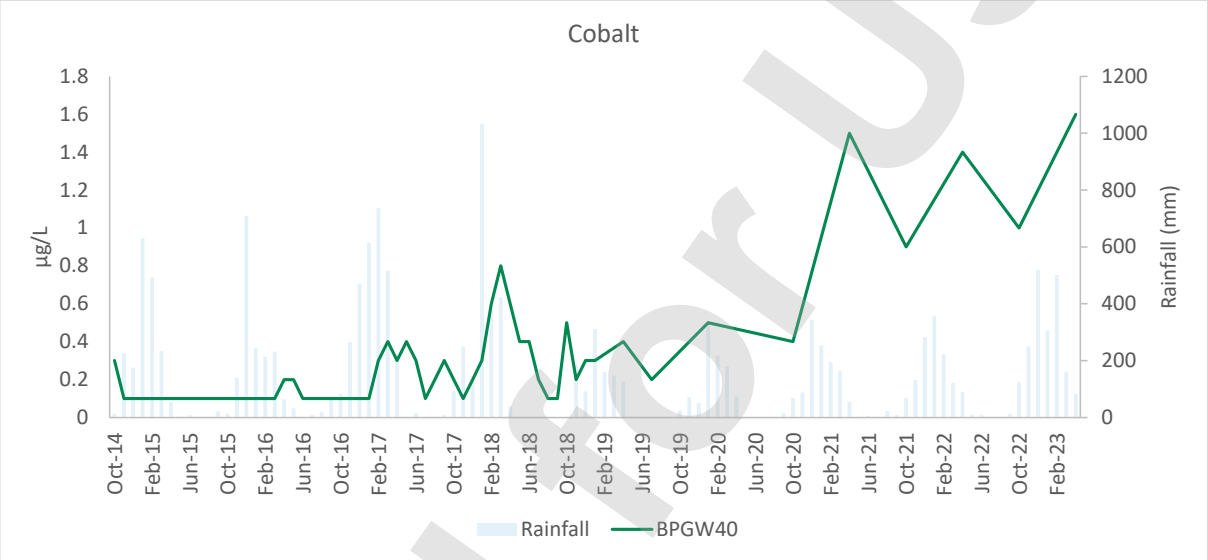

Figure 4-5: Cobalt concentrations recorded at BPGW40 from October 2014 to April 2023

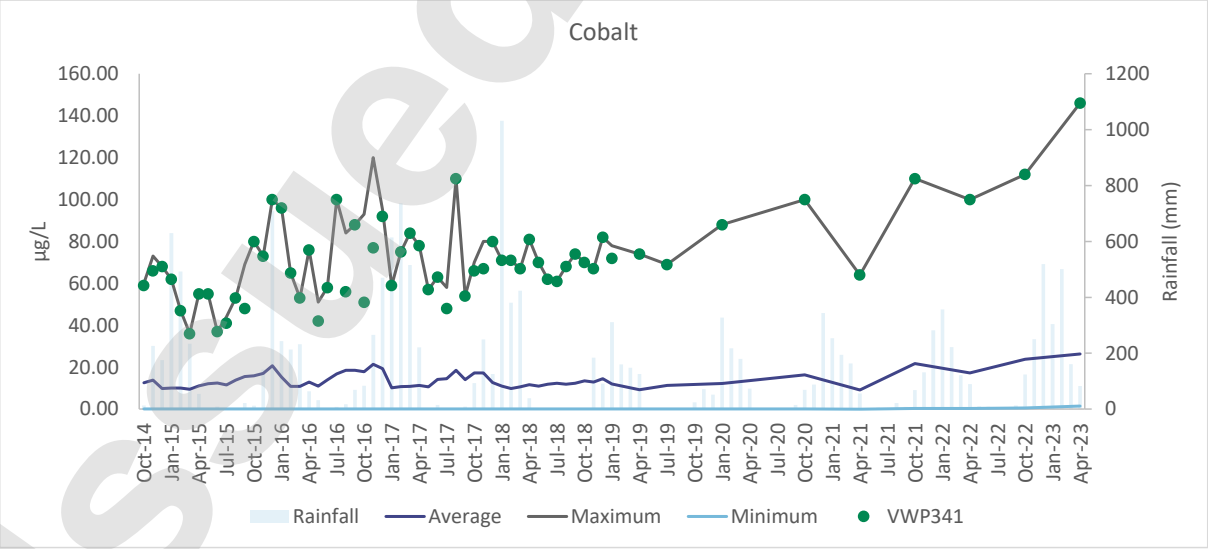

Figure 4-6: Cobalt concentrations recorded at VWP341 and the average, minimum and maximum pH of all operational monitoring wells from October 2014 to April 2023

Zinc

Zinc concentrations frequently fluctuate at VWP341 (Figure 4-7). These fluctuations do not appear to be related to seasonal factors, as concentrations peak in both the wet and dry seasons. Zinc concentrations appear to have steadily increased at VWP341 since 2016. The 171 µg/L of zinc recorded at VWP341 during April 2023 is an historical maximum. Investigations into trigger exceedances did not determine any potential sources of zinc on site (refer Section 4.1.4), therefore the increasing trends are considered to be likely as a result of natural variation.

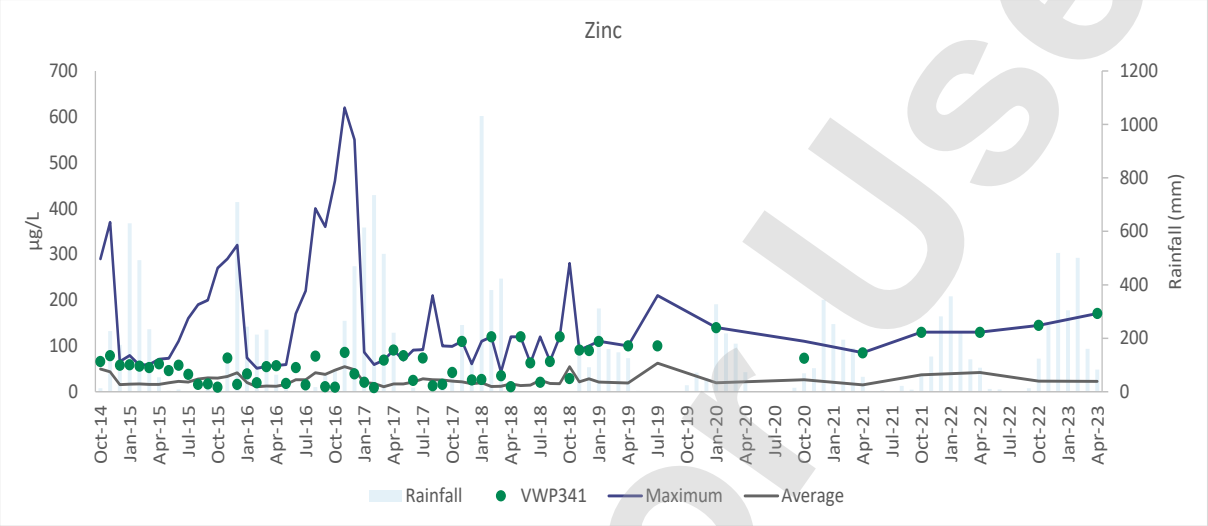

Figure 4-7: Zinc concentrations recorded at VWP341 and the average, minimum and maximum pH of all operational monitoring wells from October 2014 to April 2023

Copper

Copper concentrations at BPGW07 have remained stable with occasional short-term spikes (Figure 4-8). The historical maxima for copper was recorded during the previous monitoring round, therefore the April 2023 exceedance represents the second consecutive exceedance for copper at this bore. However, the trend for copper is decreasing and it is likely that the last two results are the result of a spike in concentrations.

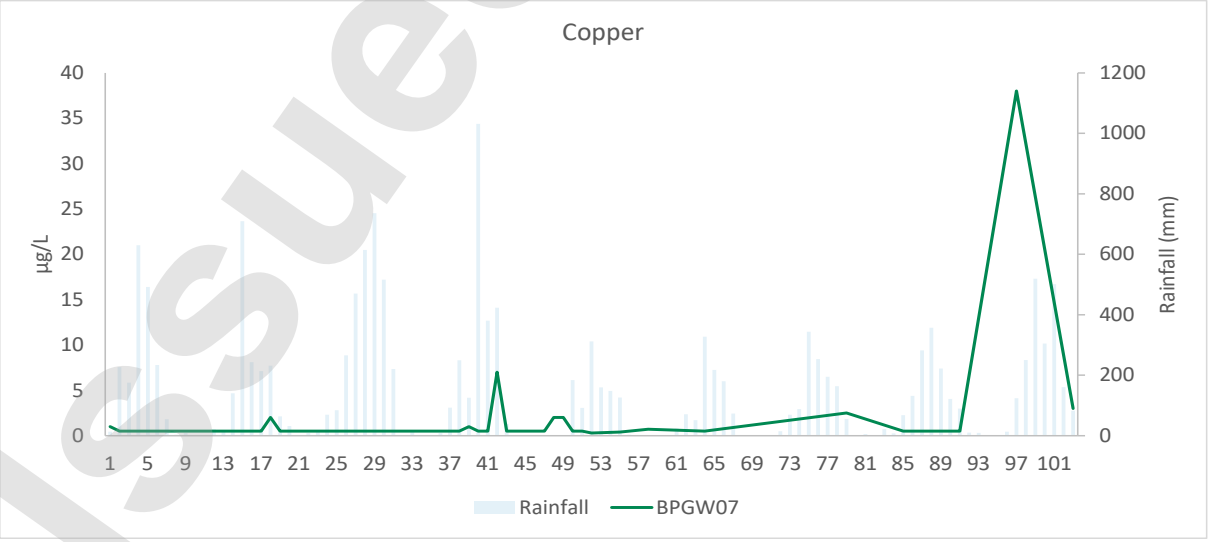

Figure 4-8: Copper concentrations recorded at BPGW07 from October 2014 to April 2023

Trigger exceedance investigations

In accordance with the receiving environment adaptive management process outlined in Section 7.5 of the OEMP, groundwater trigger exceedances were investigated (i.e. results that exceeded benchmark levels, see Section 4.1.1). A summary of the number of trigger exceedances by survey is provided in Table 4-3 with corresponding investigation reports listed below:

- Groundwater Survey 10 – Trigger Investigation Report (L290-AH-REP-70049)
- Groundwater Survey 11 – Trigger Investigation Report (L290-AH-REP-70067).

Investigations were completed for all trigger exceedances. Investigations considered multiple lines of evidence, such as rainfall, seasonal factors, Ichthys LNG operational activities and any spill events, to determine if increasing trends in groundwater analytes were likely to be as a result of Ichthys LNG.

Investigations completed following the October 2022 and April 2023 monitoring events concluded that the reported trigger exceedances were not as a result of Ichthys LNG operations, and were likely natural (e.g. represent seasonal trends and natural variability). Therefore, no further evaluation or management response was required.

Table 4-3: Summary of groundwater trigger exceedances

Date	Month	Physio-chemical	Nutrients	Metals
Survey 10†	Oct	1	17	13
Survey 11†	April	5	13	14

† 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 (RPD) of QA/QC samples above the performance criteria of <30%.

4.1.5 Program rationalisation

No changes to groundwater monitoring at Ichthys LNG are proposed, as the current biannual monitoring is appropriate to capture seasonal impacts from unplanned discharges to ground.

5 FLORA, FAUNA, AND HERITAGE

5.1 Mangrove health and intertidal sediment

As per the OEMP (L060-AH-PLN-60005), mangrove health and intertidal sediments are monitored biennially. Mangrove health and intertidal sediments were monitored last in June 2022 and, therefore, were not monitored in this reporting period.

5.2 Nearshore marine pests

5.2.1 Method overview

Nearshore monitoring is undertaken to assess the presence/absence of invasive marine species at the Ichthys LNG LPG/condensate product loading jetties (Figure 5-1). The two sites located on the product loading jetties have been incorporated in the wider Darwin Harbour program, managed by NT Aquatic Biosecurity Unit, within the Fisheries Division of the Northern Territory Department of Industry, Tourism and Trade (NT DITT). NT DITT provide the artificial settlement units (ASUs; Figure 5-2) for INPEX to deploy at the jetties. Each ASU consists of four settlement plates (back-to-back) and two rope mops.

Photo-monitoring of ASUs is undertaken monthly with ASUs collected and replaced every fourth month (an example of monitoring photographs is shown in Figure 5-3). Collected ASUs and monthly photos of the traps are sent to NT DITT for species identification.

The ASUs were installed in September 2018 with monthly monitoring commencing in October 2018. During the reporting period monthly photo inspections occurred and the traps were collected and provided to NT DITT every four months for identification of species.

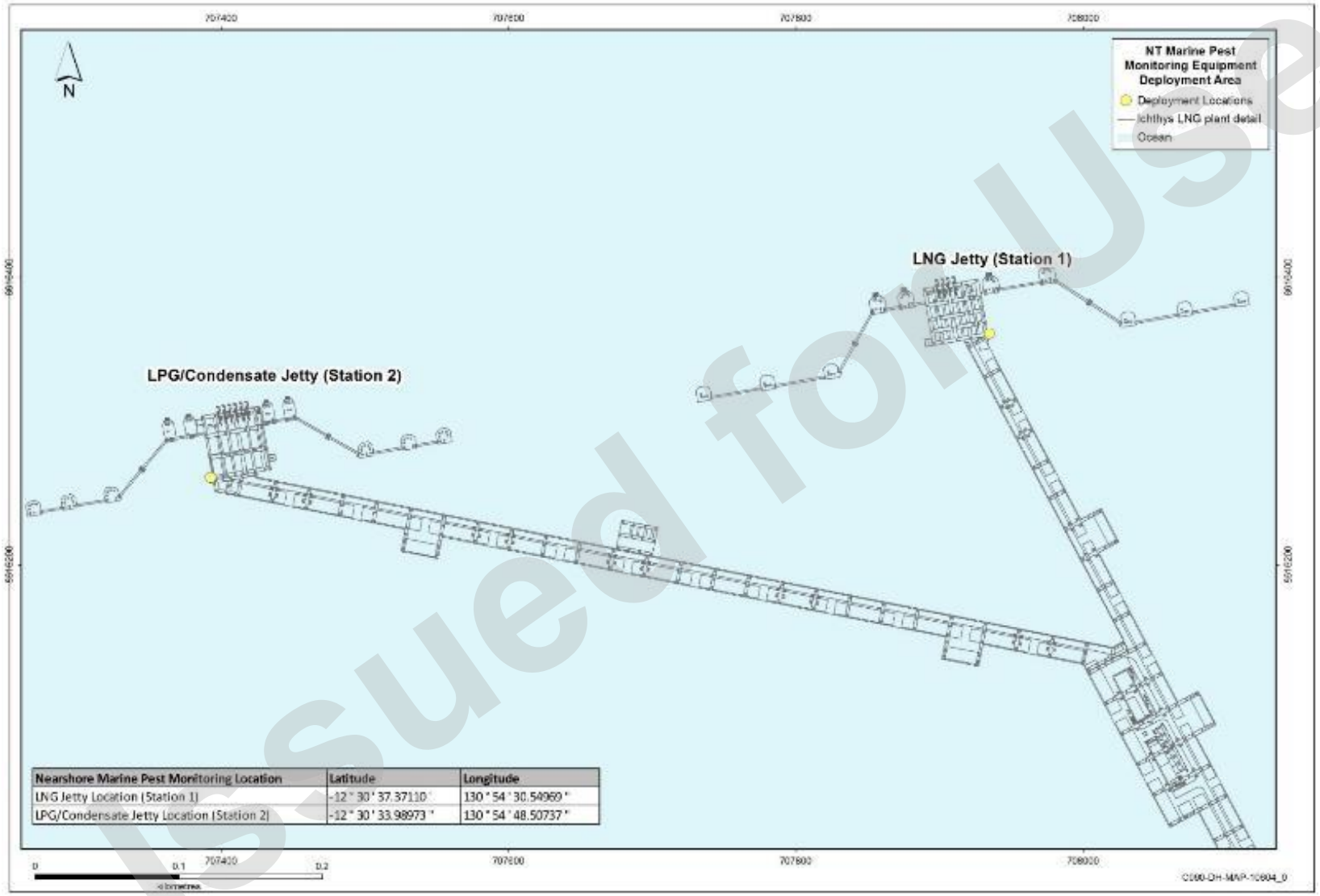

Figure 5-1: Nearshore marine pest monitoring locations

Figure 5-2: Nearshore marine pest ASU

Figure 5-3: Example of monitoring photographs taken during monthly inspection a) rope mop, b) inside the plates and c) plates surface biofouling conditions

5.2.2 Results and discussion

NT DITT did not identify any invasive marine species on settlement devices deployed as part of the Darwin Harbour marine pest monitoring program. NT DITT examined plates and rope mops on submission every four months, and photos submitted after monthly inspections.

5.2.3 Program rationalisation

No change proposed to the marine pest monitoring.

5.3 Introduced terrestrial fauna

Introduced terrestrial fauna may be monitored to determine the presence, location and methods used to control nuisance species.

5.3.1 Method overview

In the event introduced terrestrial fauna are deemed to be a nuisance at Ichthys LNG, INPEX will undertake an annual survey using a third-party licenced pest management contractor.

5.3.2 Results and discussion

During the reporting period there were no reports of introduced terrestrial fauna being deemed a nuisance, as such, no annual survey was undertaken. The routine and ad-hoc pest management programs including baiting and trapping adequately managed introduced terrestrial fauna at Ichthys LNG.

5.3.3 Program rationalisation

No change to the current program is proposed.

5.4 Weed mapping

The key objectives of the weed mapping program are to:

- identify the abundance and spatial distribution of known and new emergent weed populations; and
- inform weed management and control activities.

Weed surveys are undertaken annually at the end of the wet season (nominally in April). Table 5-1 provides a summary of surveys completed during the reporting period.

Table 5-1: Weed survey details

Survey	Date	Report	INPEX Doc #
Survey 8	May 2023	Weed Management Report No. 8	L290-AH-REP-70057

5.4.1 Method overview

Weed surveys were performed in accordance with the INPEX LNG Weed Mapping and Vegetation Surveillance Monitoring Plan (L290-AH-PLN-70001). The area surveyed is shown in Figure 5-4. Parameters monitored during the weed surveys are listed in

Table 5-2. Where identification of a species was not possible in the field, a voucher sample, together with photographs were taken to facilitate post survey identification.

Figure 5-4: Weed survey area

Table 5-2: Weed survey parameters

Key Parameter	Descriptor
Weed names	Scientific and common names
Physical locations	Coordinates of localised outbreaks, polygons for larger occurrences
Abundance	Individual numbers and/or percentage cover, enabling comparison with previous and historic monitoring events
Date	Date of data collection for future and historic comparison

5.4.2 Results and discussion

Survey 8: May 2023

Two new declared weed species were recorded during the May 2023 survey. A single *Lantana camara* (lantana) plant was detected just outside of the perimeter fence along the south-east boundary of the production area and a single *Senna obtusifolia* (sicklepod) plant was recorded along the beach valve within the GEP Corridor.

No other new declared or non-declared weed species were recorded at Ichthys LNG during the reporting period. Declared weed species previously identified during weed surveys include:

- perennial mission grass (not detected in 2023)
- neem tree
- flannel weed (not detected in 2023)
- gamba grass
- hyptis/horehound.

Non-declared weed species recorded during the 2023 survey were annual mission grass, stylo, stinking passionfruit, chloris grass and physalis. It is noted that annual mission grass is abundant within the GEP corridor and Section 1888.

The results of the May 2023 weed survey show a slight decrease in the density and distribution of gamba grass across the site since the April 2022 survey. However, whilst the total infestation of gamba grass within Section 1888 had reduced from 7,087 m^2 in 2022 to 5,263 m^2 in 2023, the density of the infestation within some areas of Section 1888 has increased to dense monocultures.

Gamba grass distribution has reduced within the Bladin Point road corridor and GEP corridor. Whilst hyptis had decreased considerably within the GEP corridor, infestations within the Bladin Point road corridor had increased since the 2022 survey, from 280 m^2 to 410 m^2 in 2023. Weed maps covering surveyed areas can be found in the weed survey report (Table 5-1).

These findings are generally consistent with operations phase weed monitoring surveys in 2020/21, which recorded gamba grass, annual mission grass, and horehound/hyptis as the weeds with the highest abundance. These weeds were also recorded in the highest abundance during the construction phase weeds monitoring, indicating no significant change in weed species present on the site.

Weeds identified during the weed mapping surveys were communicated to the weed management contractor and managed accordingly (see Section 5.5).

Declared weed infestation trend analysis

A trend analysis for weed results from all surveys was completed (Figure 5-5). Gamba grass infestations decreased slightly during the 2022-2023 wet season. There has been a decrease in both individual gamba grass plants and multi-plant infestations (Survey 8 compared to Survey 7).

Favourable growth conditions over the 2021-22 wet season had resulted in significant patches of hyptis establishing with the GEP corridor and Bladin Point road corridor (reflected in Survey 6 results; Figure 5-5). However, Survey 7 and Survey 8 have recorded a steady decrease in multi-plant infestation. However, individual hyptis plants have increased significantly in Survey 8.

Notably, no perennial mission grass was recorded in Survey 8. Patches of this species are a very high priority for control.

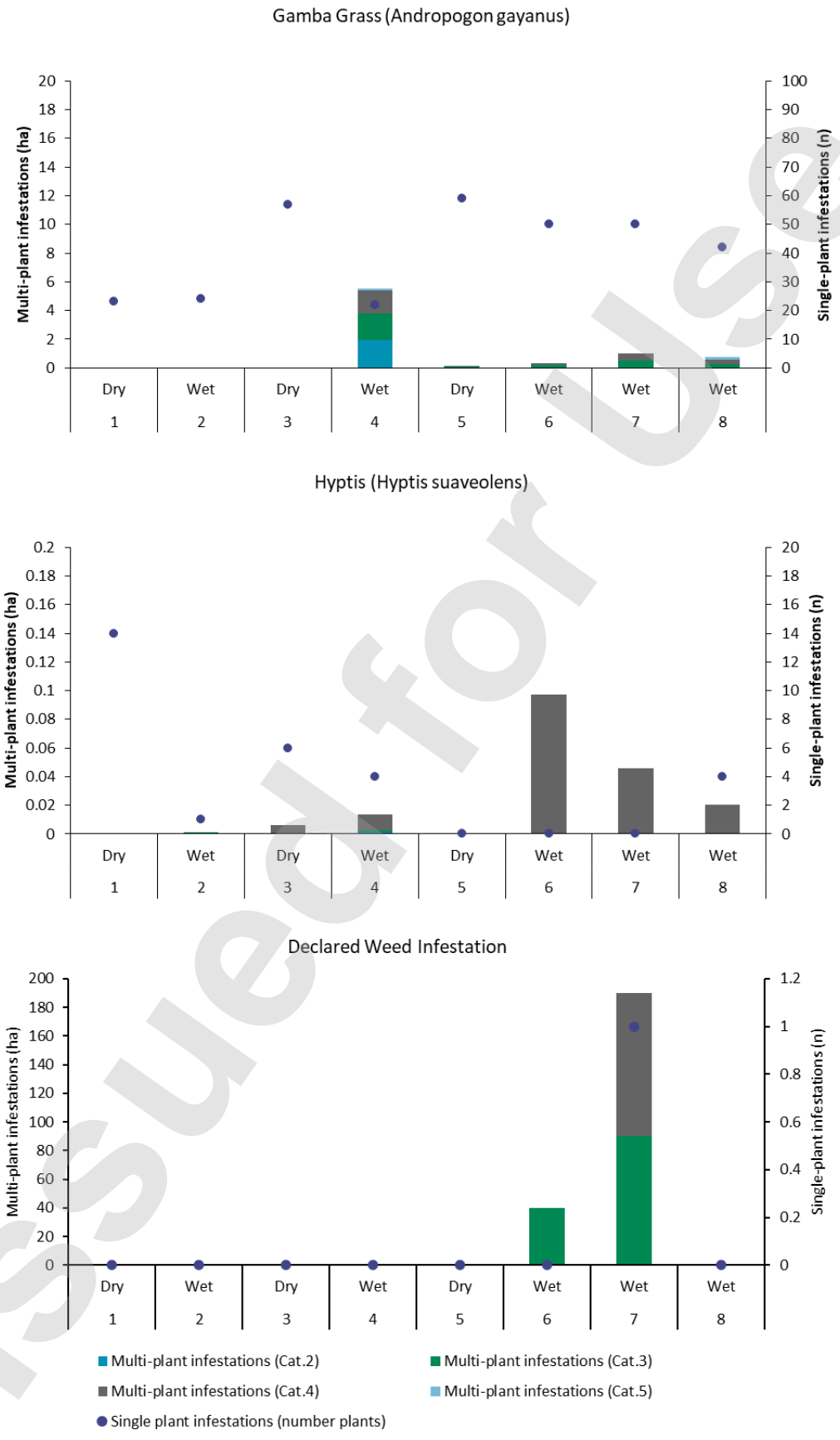

Figure 5-5: Comparison of declared weed infestations between AEMR reporting periods

5.4.3 Program rationalisation

No changes to weed surveys is proposed. The current annual weed surveys will still allow INPEX to fulfil its commitments under the OEMP and *Weeds Management Act* (NT).

5.5 Weed management

5.5.1 Method overview

Weed control at the site was undertaken and managed by a weed management contractor during the reporting period. Vegetation control at the site occurred along the fence lines, drains, inside the facility and along the GEP corridor, including the Section 1888 laydown yard. Weed control was conducted in the wet season through spray application of herbicides, boom spray, quick-spray handguns, and backpacks.

Total vegetation and woody weed control was undertaken through hand pulling and slashing along the GEP corridor.

5.5.2 Results and discussion

Overall weed management measures undertaken during the reporting period were adequate. It is recommended that a gamba grass treatment program is implemented in Section 1888, the operations area and the production area immediately following each wet season until it has been sufficiently controlled.

5.5.3 Program rationalisation

No changes are proposed to weed management at Ichthys LNG.

5.6 Vegetation rehabilitation monitoring

The key objectives of the vegetation rehabilitation monitoring were to:

- monitor native vegetation recovery; and
- provide management advice to ensure the establishment of stable, self-sustaining vegetation communities.

A summary of the vegetation rehabilitation monitoring (also known as vegetation surveillance) for the reporting period is detailed in Section 5.6.2. Table 5-1 provides a summary of surveys completed during the reporting period.

Table 5-3: Vegetation rehabilitation survey details

Survey	Date	Report	INPEX Doc #
Survey 4	14-15 June 2023	Vegetation Surveillance Report No. 4	L290-AH-REP-70058

5.6.1 Method overview

A vegetation surveillance survey (Survey 4) was performed in accordance with the Northern Territory guidelines and field methodology for vegetation survey and mapping (Brocklehurst et al. 2007). Key parameters assessed during the surveillance survey are shown in Table 5-4. Rehabilitation categories (discussed in Section 5.6.2) are provided in Table 5-5. The area surveyed are shown in Figure 5-6.

Table 5-4: Vegetation surveillance parameters

Key Parameter	Descriptor
Vegetation community description	Describing remnant vegetation communities immediately adjacent to the GEP corridor
Physical locations	Mapping the distribution of vegetation communities within the GEP corridor
Rehabilitation progress	Assessing and classifying rehabilitation progress of areas within the GEP corridor
Soil erosion	Recording any areas of active soil erosion in rehabilitation areas
Vegetation on rehabilitated areas (VS01 – VS05 and VS10)	Observations recorded at each site included: • Plant species composition, cover, and abundance (including weeds) • Vegetation structure • Recruitment of perennial species • Soil and land surface characteristics • Disturbances such as grazing, erosion and fire.

Table 5-5: Rehabilitation categories – assessment criteria

Vegetation Community	Category 1	Category 2	Category 3
Low Eucalypt woodland	• Annual grassland / herb land • Total vegetation cover less than 30% (post wet season, with large bare areas) • Tree or shrub seedlings or juveniles absent • Large continuous areas of bare ground • Low litter levels • Surface structures very sparse or absent • Evidence of accelerated surface run-off	• *Acacia* spp. low sparse shrubland • Scattered individuals or small patches of juveniles and seedings of Acacia and other native shrub species • Evidence of more than one shrub recruitment event i.e., mixed age stands • Moderate litter levels • Stable soil surface	• Mixed Acacia shrubland • Several life forms presenting including shrubs, woody forbs, annual and perennial grasses • Evidence of several recruitment events of perennial species i.e., a range of cohorts • Continuous litter cover • No evidence of accelerated surface water run-off
Low mangrove closed forest	• Seedlings or juvenile mangroves absent or present as very scattered individuals of single age cohort	• Seedlings and juvenile mangroves widespread with canopy cover > 5%	• Moderately dense stands of mangrove juvenile and seedlings with canopy cover >20%

Vegetation Community	Category 1	Category 2	Category 3
		• Usually, evidence of more than one recruitment event, as shown by multiple age-classes	• Evidence of several mangrove recruitment events i.e., a range of age cohorts are present
Low *Melaleuca* sp. open woodland / sedgeland	• Sparse patchy cover of sedges • Melaleuca sp. seedlings or juveniles absent or present as very scattered individuals of single age cohort • Evidence of accelerated surface water run-off	• Open sedgeland with < 50% cover with small discontinuous bare patches. • Scattered individuals or sparse patches of Melaleuca sp. and other native perennials on slightly elevated ground (*Note establishment of native perennial tree and shrub species were not observed during Survey No. 2) • Moderate litter levels	• Elevated areas with Melaleuca shrubland • Evidence of several recruitment events of perennial species i.e., a range of age cohorts • Extensive litter cover • Stable soil surface with no accelerated surface run-off
Low Monsoon vine forest	• Annual grassland/herbland • Total vegetation cover less than 30% (post wet season, with large bare areas) • Tree or shrub seedlings or juveniles absent • Large continuous areas of bare ground • Low litter levels • Surface structures very sparse or absent • Evidence of accelerated surface run-off	• *Acacia* spp. and *Melaleuca* spp. Low sparse shrubland • Scattered individuals or small patches of juveniles and seedings of native shrub species • Evidence of more than one shrub recruitment event i.e., mixed age stands • Moderate litter levels • Stable soil surface	• Mixed *Acacia* spp./*Melaleuca spp*. • shrubland • Several life forms presenting including shrubs, woody forbs, annual grasses, and herbs • Evidence of several recruitment events of perennial species i.e., a range of cohorts • Continuous litter cover • No evidence of accelerated surface water run-off

Figure 5-6: Vegetation surveillance survey area

5.6.2 Results and discussion

The results of Survey 4 indicate that regeneration rates of vegetation within the GEP corridor differs for each of the vegetation communities, as follows:

- *Low eucalyptus woodland (LEW):* When previous survey results (Survey 3) were compared with Survey 4, an increase in the area allocated for category 3 was recorded. Total LEW at categories 1 and 2 have decreased from 0.27 ha (3.5%) to 0.04 ha (0.5%) and 3.27 ha (42.4%) to 2.3 ha (29.5%), respectively; whereas, the total LEW area allocated at category 3 has increased from 4.17 ha (54.1%) to 5.40 ha (69.9%). Since the first survey, category 1 has decreased from 2.76 ha (38.6%) to 0.04 ha (0.5%) and category 3 has increased from 1.55 ha (21.7%) to 5.40 ha (69.9%). This trend of change reveals that there is a successional development occurring within LEW areas. However, Acacia sp. made up most of the new species present, as observed during Survey 2. A small number of Eucalyptus sp. seedlings were observed within the GEP corridor during surveys 3 and 4 and it is anticipated that Eucalyptus sp. will continue to establish from adjacent remnant vegetation. Overall improvement in LEW establishment was recorded along the GEP corridor.
- *Low mangrove closed forest (LMCF):* LMCF rehabilitated communities demonstrated improvement since the previous survey (Survey 3) with categories 2 and 3 increasing from 2.68ha (44.8%) to 3.14 ha (51.4%) and 1.08ha (18.1%) to 1.86ha (30.6%), respectively. Category 1 decreased from 2.22 ha (37.1%) to 1.10 ha (18%), indicating development of the LMCF rehabilitated communities are progressing towards late seral stages (intermediate stage of ecological succession advancing towards the climax community). It is expected that areas originally cleared of the dominant mangrove species, *Ceriops australis*, will remain suitable for the species to re-establish. This is because the environmental conditions associated with the previously cleared land such as salinity, tidal effects, drainage, nutrient and oxygen levels may be suitable for this species to re-establish. This applies also to tidal flat areas that were originally mangroves before clearing of the GEP corridor.
- *Low Melaleuca sp. open woodland/sedgeland*: Results show that the area allocated within rehabilitation category 3 has slightly increased from 0 ha (0%) to 0.12 ha (10.1 %) since Survey 3. In contrast, a decrease in areas of category 2 was recorded in Survey 4 from 0.81 ha (67.5 %) to 0.69 ha (57.4%). This indicates that the area allocated within rehabilitation category 1 did not show a change in structural development to reach the next seral stage (i.e. category 2). Very low seedling recruitment of *Melaleuca* sp. was recorded within areas that most of the rehabilitation areas described as Low Melaleuca sp. Open woodland / sedgeland, and these areas were therefore characterised as category 1. This indicates that rehabilitation areas described as Low Melaleuca sp. open woodland / sedgeland are likely to establish as sedgelands, providing a stable ground cover and opportunity for *Melaleuca* sp. to establish in the future.

- *Low monsoon vine forest:* Results indicate a decrease in category 2 and an increase in category 3 from 0.61 ha (21.7%) to 0.22ha (8.1%) and 1.32 ha (47%) to 1.5 ha (58.6%), respectively. Category 1 has increased slightly from 0.88 ha (31.3%) to 0.89 ha (33.3%). Approximately 68.70 % of the area was allocated within category 2 and 3 in the 2021 survey and the current survey results show that 66.7% of the area were recorded within categories 2 and 3. Therefore, rehabilitation of low monsoon vine forest areas within the GEP corridor has resulted in no change in the area allocated to rehabilitation categories 2 and 3 since the previous survey. New plants of Acacia spp. were the dominant revegetation species recorded within the low monsoon vine forest. Acacia spp. regenerate from long lived dormant soil seed banks and require natural triggers, such high temperature, to break seed dormancy for germination and seedlings recruitment. Therefore, regeneration of Acacia spp. is very slow and there is limited evidence of a successional shift to occur from category 2 to category 3.

The results of Survey No. 4 indicate that natural regeneration is occurring within GEP corridor and that the majority of the GEP corridor is progressing toward a self-sustaining native vegetation community. Since last survey in 2021, there has been an increase from 78.7 % to 86.4% in the total GEP corridor area categorised within either rehabilitation category 2 or category 3. This indicates a progression towards a self-sustaining native vegetation community, dominated by perennial native vegetation species on a stable soil surface. The majority of natural regeneration is within the low eucalypt woodland community, where approximately 99% of area was assessed as either rehabilitation category 2 or category 3.

5.6.3 Program rationalisation

No program rationalisation is proposed for vegetation rehabilitation surveillance. The next proposed survey will occur in 2025.

5.7 Cultural heritage

The objective of cultural heritage surveys is to determine if there has been any interference to cultural heritage sites as a result of Ichthys LNG operations.

5.7.1 Method overview

Visually inspections of cultural heritage sites will be undertaken when required at a frequency determined by the Larrakia Advisory Committee.

5.7.2 Results and discussion

No inspections of heritage site were required during the reporting period. No heritage breaches occurred within the reporting period.

6 WASTE REDUCTION MEASURES

Following the activation of EPL228 in September 2018, the OEMP and supporting waste management documentation were implemented. This involved management of waste in accordance with the INPEX waste management processes and the waste control hierarchy (Figure 6-1).

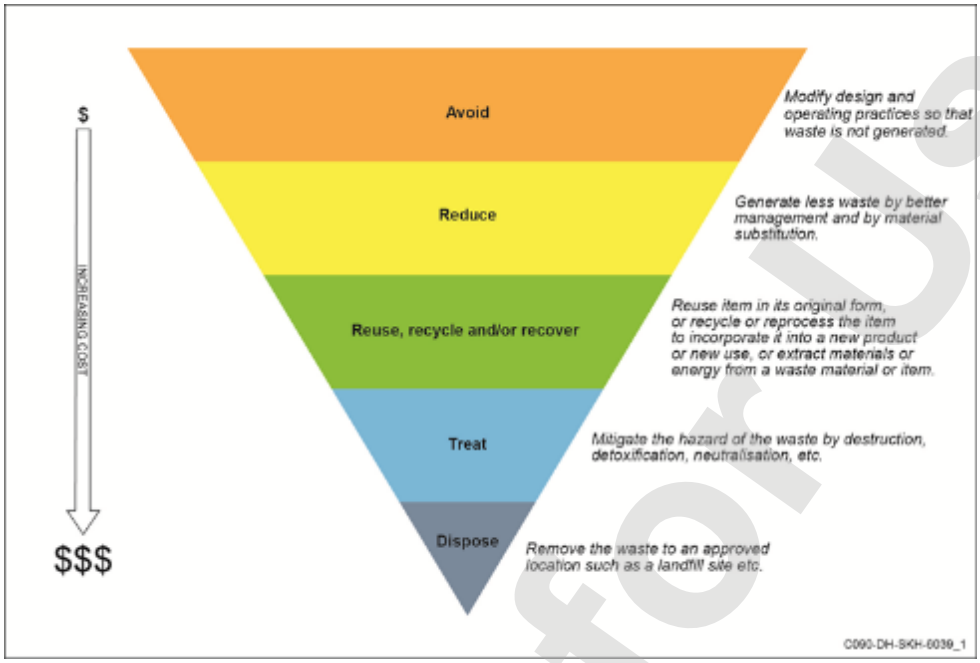

Figure 6-1: INPEX waste control hierarchy

Waste streams at the site are categorised into four broad classes (which include both liquid and solid waste, as outlined in section 3.8.7 of the OEMP):

- recyclable (non-hazardous) waste
- non-recyclable (non-hazardous) waste
- recyclable (hazardous) waste
- non-recyclable (hazardous) waste.

Note, the onsite treatment of wastewater and disposal via the onsite evaporation basin are excluded from reportable waste data (refer to Table 6-1), and only records from licenced waste contractors are used for this waste section.

Solid waste segregation measures involved the placement of various recyclable and non-recyclable waste receptacles around Ichthys LNG, while liquid wastes were segregated into recyclable and non-recyclable streams and then disposed of offsite to suitable treatment and disposal facilities following classification by waste contractors. The expected waste generated by onsite activities and subsequent control measures are detailed further and in Inpex's Onshore Environmental Management Plan L060-AH-PLN-60005 section 3.8.7

Table 6-1 presents a comparison of the waste streams from the 2020-2021 and 2021-2022 reporting periods against the current reporting period (2022-2023). Note, firefighting foam wastewater is included in Table 6-1 as a non-recyclable hazardous waste stream.

Table 6-1: Waste stream data comparison

Waste Stream	2020-2021 (tonnes)	2021-2022 (tonnes)	2022-2023 (tonnes)
Recyclable / non-hazardous	304.4	1126.4	459.7
Recyclable / hazardous	6.4	10.4	15.7
Non-recyclable / non-hazardous	2413.2	2090.5	4328.3
Non-recyclable / hazardous	1122.2	626.0	1196.1

The reporting period 2021-2022 provided an anomality in waste classified as recyclables/non-hazardous as it captured the processing of recyclable steel associated with remedial works onsite during that period. This has is reflected when comparing the 2021-2022 & 2022-2023 reporting period data in the table above. The reporting period 2022-2023 saw a decrease in comparison to 2021-2022 due to the steel recycling event(s) mentioned previously. The 2022-2023 reporting period experienced an increase in non-recyclable waste (both hazardous & non-hazardous) The significant increase of non-recyclable/hazardous waste is related to the shut down at the start of the reporting period and addition of an ablution block requiring removal of waste offsite. The main waste reduction measure implemented during the reporting period (i.e. reduce waste being disposed or treated offsite) was through the use of the onsite evaporation basin. The evaporation basin is designed to handle low level chemical and hydrocarbon contaminated water generated at Ichthys LNG, while inter-site transfers to the wastewater treatment plants took place. Approximately 5,168 tonnes of liquid waste were transferred to the evaporation basin and 652 tonnes of wastewater transferred to the various water treatment plants during the reporting period, which resulted in this liquid waste not being taken offsite for treatment and disposal.

Site wide waste reduction initiatives are implemented via the Waste Management Standard (0000-AH-STD-600047) which applies to all waste streams onsite. For the 2022-2023 reporting period, measures were put in place to minimise the amount of liquid waste being generated at Ichthys LNG. This included the capture and storage of chemical waste streams to avoid the mixture of waste streams and rainwater runoff from Ichthys LNG. This prevents the generation of large volumes of wastewater predominately in the AGRU of each LNG train, where amine is used as a solvent to extract acid gases (including carbon dioxide).

Although not directly related to solid and liquid waste, there was a significant amount energy recovery that occurred at the site through the use of the waste heat recovery systems. Heat recovery units are located on the GE Frame 7 gas turbine stacks, which capture the heat of the turbine exhaust and then transfer the energy to the site heating medium system. A similar heat transfer method is also used in the CCPP, where the exhaust heat form the GE Frame 6 turbine stacks used to generate steam, which is then transferred into energy in the steam turbines. Use of the waste heat recovery systems reduce the overall fuel consumption and air emissions.

7 PROGRAM RATIONALISATION AND FUTURE SURVEYS SUMMARY

There were no proposed recommendations for changes to monitoring programs and future monitoring will be undertaken in accordance with the current OEMP and EPL228. The proposed next survey dates are outlined below in Table 7-1.

Table 7-1 Survey forecast for future monitoring periods

Survey/Data Collection Scope	Frequency	Previous Survey	Next Survey
Commingled treated effluent	Monthly	June 2023	July 2023 – June 2024
Harbour sediment	Biennial	July 2022	July 2024
Total emissions to air	Annual	June 2023	June 2024
Point source emissions to air	Annual	October 2022	October 2023
Dark smoke events	Ad-hoc	n/a	n/a
Groundwater quality	Bi-annual	April 2023	October 2023 April 2024
Mangrove health and intertidal sediments	Biennial	June 2022	April 2024
Nearshore marine pests	Monthly	June 2023	July 2023 – June 2024
Introduced terrestrial fauna	Annual	June 2023	April 2024
Weed mapping	Annual	April 2023	April 2024
Weed management	Annual – as required	June 2023	~April 2024
Vegetation rehabilitation monitoring	Biennial	June 2023	June 2025
Cultural heritage	Ad-hoc	n/a	n/a

8 REFERENCES

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APPENDIX A: NT GUIDELINE FOR ENVIRONMENTAL REPORTING

NT Guideline for Environmental Reporting	NT Guideline Information	AEMR Reference
Title page	The title page should include: • report name • reporting period (e.g., October 2014–October 2015) • date of submission • version number • where relevant, licence/approval number, or reference to other document the report is being submitted in relation to (e.g., environmental impact statement, pollution abatement notice) • details of report author, including company details.	Title page and Section 1.
Executive summary	The executive summary should succinctly summarise each section of the report, and in particular, the findings of the report.	Executive summary.
Monitoring objective	The monitoring objective(s) should be clearly stated in order to enable the results of monitoring to be assessed in the context of the objectives. Note, where monitoring is linked to a licence or approval, the objectives of monitoring: • may already be specified in an approved monitoring plan, or • may simply be the specific conditions on monitoring included in the • licence/approval that state monitoring point locations, analytes, analysis type, frequency, and limits/trigger values.	Each section includes a subsection with monitoring objectives for each monitoring program.
Monitoring method	*Where there is an approved monitoring plan* Provide details of the approved plan (title, version number, date of submission). *Where there is not an approved monitoring plan* Provide details including: • current map showing sampling locations (including control/reference sites), discharge/emission points, major infrastructure, sensitive environmental receptors, key, scale bar and north arrow • a description of the receiving environment, including environmentally sensitive receptors and significant features • a description of sampling and analysis methods, including detail on reasons for selection of sampling locations (e.g., random stratified), assumptions and deviations from standard sampling/analysis methods1	Each section includes a subsection with monitoring methods for each monitoring program.

NT Guideline for Environmental Reporting	NT Guideline Information	AEMR Reference
	• factors that may affect variability in monitoring results (e.g., tidal movement, climate, fauna migration, peak production months).	

Monitoring results–presentation	The clear and concise presentation of monitoring results is a critical component of a monitoring report.
	When presenting results, it is important to ensure that:
	• current results are presented in a table and graph
	• results are presented along with:
	  • units
	  • assessment criteria (e.g., limits/trigger values specified in licences/approvals, or in relevant standards or guidelines2)
	  • analysis type (e.g., for filtered/unfiltered with filter pore size, five-day or
	  • three-day biological oxygen demand, wet or dry weights)
	  • analytical methods
	  • limit of reporting (LOR), or level of precision for results obtained from
	  • field instruments
	  • measures of uncertainty
	• necessary calculations have been made, to compare data with assessment
	• criteria (e.g., calculation of medians, means, running averages and loads)
	• modification calculations (such as for hardness) have been made using the modifying parameter recorded at the time of sampling
	• all results that exceed the assessment criteria are clearly highlighted
	• summary of previous results (sufficient to highlight trends – usually a minimum of 2–5 years data) is included.
		Each section includes a subsection with monitoring results and discussion for each monitoring program.

Monitoring results–quality assurance/ quality control (QA/QC) evaluation	Results presented in the monitoring report should be reviewed for data completeness, accuracy, and precision. Some typical QA/QC questions include: • for completeness – were all samples taken at the correct location and frequency? • for quality control – _ were all samples collected, preserved in accordance with the specified sampling method or standard sampling methods? • were calibration checks made and were results within an acceptable range? • was analysis undertaken in accordance with relevant national standards (such as accredited under the National Association of Testing Authorities)?	Monitoring plans (referenced in the method overview section) include QA/QC processes.

NT Guideline for Environmental Reporting	NT Guideline Information	AEMR Reference
Discussion and interpretation of results	This section should include: • discussion of results in context with the monitoring objective(s) • discussion of results where assessment criteria were exceeded, including likely cause of exceedances and likelihood of further exceedances • discussion of trends (consideration of spatial and temporal trends in comparison to previous monitoring data) • discussion of anomalous results, including likely cause • statistical analysis where appropriate • a table of non-conformances with monitoring method.	Each section includes a subsection with monitoring results and discussion for each monitoring program
Conclusion and proposed actions	In this section the submitter of an environmental monitoring report must confirm that the report is true and accurate. Where the report relates to a licence/approval, confirmation must be provided by a person(s) authorised to legally represent the holder of the licence/approval. The wording for this section should be: *I [NAME AND POSITION], have reviewed this report and I confirm that to the best of my knowledge and ability all the information provided in the report is true and accurate.* Note: significant penalties may apply where it is demonstrated that false or misleading information has been supplied to the NT EPA.	APPENDIX B:
Abbreviations	Use of abbreviation should be minimised. However, if they are used to improve readability, this section should specify all abbreviations used in the report.	Throughout AEMR
References	If information (facts, findings etc.) from external documents is to be included in the report, the information must be referenced. If references are from documents that are not freely available (e.g., internal reports, mine management plans) then such documents will need to be provided to the NT EPA on request.	Throughout AEMR
Appendices	Appendices should be used for information that is too detailed or distracting to be included in the main body of the report (such as raw data tables, laboratory reports, QA/QC data).	Appendices

APPENDIX B: EPL228 AEMR 2022-2023 CERTIFICATION

B.1 INPEX

INPEX	I, Tetsuhiro Murayama (President Director, Ichthys LNG Pty Ltd, Australia) confirm that to the best of my knowledge and ability all the information provided in the *EPL228 Annual Environmental Monitoring Report 2022-2023* (L060-AH-REP-70055) is true and accurate.
Name	Tetsuhiro Murayama
Position	President Director, Ichthys LNG Pty Ltd
Signature	
Date	07 September 2023

B.2 Qualified Professional

APPENDIX C: COMMINGLED TREATED EFFLUENT (750-SC-003) LABORATORY RESULTS

C.1 Monthly sampling results for 750-SC-003

Shaded cells with bold text indicate a trigger exceedance associated with subsequent discharge via jetty outfall. These are further described in Table 2-3. Note: monitoring exceedances are not captured in table-23 as they were not discharged

Date	TIME	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 phosphor	Filterable Reactive	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Enterococci	E coli	Faecal coliforms	Anionic surfactant	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/ 100mL	cfu/ 100mL	cfu/ 100mL	mg/L	mg/L	mg/L	mg/L
Discharge limit			6- 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
12/07/2022	08:00	L2203006001	8.1	337	23.2	0.5	90	< 1	<20	<100	< 5	6	13	< 0.02	< 2	3	< 0.5	< 0.5	<0.1	<1	2	<1	<0.1	<1	<1	48	20	4	4	0.4	< 5	< 5	< 5
09/08/2022	08:01	L2203420001	8.0	156	28.3	1.0	79	3	<20	<100	< 5	<2	14	0.02	< 2	2	< 0.5	< 0.5	<0.1	<1	2	<1	<0.1	<1	<1	136	5	<1	60	<0.1	< 5	< 5	< 5
13/09/2022	08:10	L2203978001	8.4	241	30.3	<0.5	87	< 1	<20	<100	< 5	6	11	< 0.02	8	7	0.6	< 0.5	<0.1	<1	2	<1	<0.1	1	<1	281	6	20	92	<0.1	< 5	< 5	< 5
10/10/2022	09:00	L2204500001	8.9	369	31.3	2.0	91	< 1	<20	<100	< 5	<2	7	< 0.02	12	**12**	< 0.5	< 0.5	<0.1	<1	2	<1	<0.1	1	<1	409				<0.1	< 5	< 5	< 5
14/10/2022	08:50	L2204570001														4																	
16/10/2022	09:20	L2204571001														4																	
20/10/2022	09:05	L2204698001																									10	1	**2800**				
25/10/2022	07:56	L2204760001																									<1	<1	<1				
08/11/2022	07:40	L2204965001	8.3	330	31.7	2.0	98	< 1	<20	<100	< 5	<2	13	0.04	8	8	< 0.5	< 0.5	<0.1	<1	2	<1	<0.1	2	<1	286	5	13	50	<0.1	< 5	< 5	< 5
14/12/2022	08:05	L2205542001	8.8	394	31.1	1.0	92	< 1	<20	<100	< 5	3	11	< 0.02	11	**12**	< 0.5	< 0.5	<0.1	<1	3	<1	<0.1	3	<1	300	9	11	**37000**	<0.1	< 5	< 5	< 5
16/12/2022	09:05	L2205605001													<2	3																	
18/12/2022	08:35	L2205606001													<2	<2																	
20/12/2022	08:10	L2205677001																											8				
10/01/2023	08:05	L2300171001	8.8	128	29.8	6.0	105	3	<20	<100	**22**	4	18	0.03	3	5	< 0.5	< 0.5	<0.1	<1	<1	<1	<0.1	<1	<1	261	3	1	31	<0.1	< 5	< 5	< 5
12/01/2023	10:40	L2300229001				2.0					<5																						
14/01/2023	07:28	L2300234001				1.5					< 5																						
18/01/2023	08:45	L2300236001				1.0					< 5																						
24/01/2023	08:15	L2300126001																										40	**1500**				
08/02/2023	07:50	L2300556001																											23				

Date	TIME	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 phosphor	Filterable Reactive	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc	Enterococci	E coli	Faecal coliforms	Anionic surfactant	aMDEA	Glycol (MEG)	Glycol (TEG)
14/02/2023	07:35	L2300676001	8.8	317	30.2	1.0	86	< 1	<20	<100	< 5	<2	15	0.02	13	**11**	< 0.5	< 0.5	<0.1	<1	2	<1	<0.1	<1	<1	162		4		<0.1	< 5	< 5	< 5
16/02/2023	08:45	L2300709001													14	13											<1	4	18				
20/02/2023	15:55	L2300808001													17	17																	
24/02/2023	09:45	L2300865001													6	6																	
14/03/2023	08:35	L2301251001	7.9	426	30.2	2.0	90	< 1	<20	<100	< 5	<2	9	0.04	18	**16**	< 0.5	< 0.5	<0.1	<1	3	<1	<0.1	2	<1	260	200	44	**760**	<0.1	< 5	< 5	< 5
15/03/2023	13:25	L2301326001														10																	
18/03/2023	12:35	L2301339001													16	16																	
21/03/2023	10:30	L2301412001													20	21																	
23/03/2023	08:30	L2301413001													< 2	< 2												2	10				
25/03/2023	08:16	L2301414001													12	12																	
27/03/2023	08:17	L2301579001																										40	980				
28/03/2023	11:10	L2301579001													17	18																	
30/03/2023	09:45	L2301585001														10																	
04/04/2023	08:05	L2301651001														< 2																	
07/04/2023	08:30	L2301702001														17																	
11/04/2023	07:05	L2301799001	8.3	312	28.2	0.5	88	< 1	<20	<100	< 5	3	14	0.04	6	8	< 0.5	< 0.5	<0.1	<1	3	<1	<0.1	1	<1	481	30	<2	70	<0.1	< 5	< 5	< 5
09/05/2023	07:50	L2302242001	7.9	354	28.0	1.0	79	< 1	<20	<100	< 5	11	15	0.04	3	4	< 0.5	< 0.5	0.1	<1	6	<1	<0.1	1	<1	297	5	1	**570**	<0.1	< 5	< 5	< 5
18/05/2023	08:55	L2302358001																										5	890				
13/06/2023	07:45	L2302816001	8.5	200	27.0	0.5	82	2	<20	<100	< 5	<2	11	0.03	7	8	< 0.5	< 0.5	<0.1	<1	2	<1	<0.1	<1	<1	98	9	2	84	<0.1	< 5	< 5	< 5

APPENDIX D: AUTHORISED STATIONARY SOURCE EMISSION RELEASE RESULTS

D.1 Stationary source emission test results by Ektimo

Sampling Point Number	Sampling Location Number	Date/Time	LIMS Number	NO_x as NO_2 - Concentration Target		NO_x as NO_2 - Concentration Limit		N_2O		Hg - un spiked method USEPA 30B	$PM_{2.5}$	PM_{10}	CO		temperature	efflux velocity	volumetric flow rate
				mg/Nm³	ppm	mg/Nm³	ppm	mg/Nm³	ppm	mg/Nm³	mg/m³	mg/m³	mg/m³	ppm	⁰C	m/s	m³/min
LNG Refrigerant Compressor Driver Gas Turbines (GE Frame 7s)				50 @ 15%O_2	25 @ 15%O_2	70 @ 15% O_2	35 @ 15% O_2	-	-	-	-	-	-	-	-	23	-
A1	L-641-A-001	09/10/2022 08:22	L2202521001	27	13	27	13	1.5	0.79	<0.0057	<0.4	<0.4	36	29.0	178	23	14000
A2	L-642-A-001	08/10/2022 08:00	L2202523001	37	18	37	18	1.1	0.58	<0.000035	<0.4	<0.4	12	9.2	177	24	15000
A3	L-641-A-002	05/10/2022 08:21	L2202522001	8.3	4.0	8.3	4.0	1.1	0.54	<0.00002	<0.4	<0.4	6.9	5.5	170	25	15000
A4	L-642-A-002	07/10/2022 09:15	L2202524001	15	7.1	15	7.1	1.4	0.7	<0.00002	<0.4	<0.4	15	12	170	27	17000
CCPP Gas Turbine Generators (GE Frame 6s, 38MW) - HRSG stack				150 @ 15% O_2	75 @ 15% O_2	350 @ 15% O_2	175 @ 15% O_2	-	-	-	-	-	-	-	-	19	-
A5-2	L-630-F-001	12/10/2022 10:44	L2202525001	9.9	4.8	9.9	4.8	1.1	0.55	<0.0062	<0.7	<0.7	79	64	198	20	6400
A6-2	L-630-F-002	N/A Unit offline at the time of sampling for planned maintenance, no results available															
A7-2	L-630-F-003	12/10/2022 08:05	L2202527001	5.1	2.5	5.1	2.5	<1	<0.5	<0.000025	<0.7	<0.7	6.2	4.9	220	21	6400
A8-2	L-630-F-004	11/10/2022 11:20	L2202528001	13	6.3	13	6.3	1.5	0.76	0.000024	<0.5	<0.5	54	43	221	19	5700
A9-2	L-630-F-005	11/10/2022 08:20	L2202529001	14	6.8	14	6.8	1.1	0.55	0.000028	<0.4	<0.4	25	20	190	20	6400
AGRU Incinerators				320 @3% O_2	160 @3% O_2	350@3% O_2	175 @15% O_2	-	-	-	-	-	-	-	-	19	-
A13-1	L-551-FT-031	05/10/2022 12:55	L2202517001	76	3.7	76	3.7	55	28	Not valid [6]	<0.7	<0.7	45	36	482	21	2800
A14-1	L-552-FT-031	06/10/2022 11:06	L2202516001	24	11	24	11	78	40	<0.00002	<0.5	<0.5	1300	1000	482	25	3600
Heating medium furnaces				160 @3% O_2	80 @3% O_2	350@3% O_2	175 @3% O_2	-	-	-	-	-	-	-	-	-	-
A15	L-640-A-001-A	10/10/2022 09:35	L2202515001	150	75	150	75	<1	<0.5	<0.000027	<0.9	<0.9	140	120	164	4.6	770
A16	L-640-A-001-B	10/10/2022 12:48	L2202514001	160	77	160	77	<1	<0.5	<0.000027	<1	<1	120	94	164	6.2	1000

[6] After a QA/QC investigation carried out by a third-party laboratory, INPEX have confirmed that results for mercury analysis were not valid. In accordance with INPEX Laboratory Accreditation, a Non-Conformance has been raised to address the issue. Further explanation of the quality control assessment process is discussed in Section 3.2.2.

D.2 Gas Sampling Test Results Reported by the INPEX Laboratory

Date	LIMS number	Hydrogen Sulfide (H_2S)	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Mercury
	Unit	ppmV	ppmV	ppmV	ppmV	ppmV	ppmV	µg/Nm³
A13-2 (L-551-SC-003) AGRU Hot Vent - LNG Train1, prior to release at A3								
30/08/2022 11:12	L2203389001	160	200	< 30	< 30	< 30	< 30	-
19/09/2022 09:14	L2203954001	160	40	< 30	< 30	< 30	< 30	-
03/10/2022 10:50	L2204380001	160	290	< 30	< 30	< 30	< 30	-
20/10/2022 10:50	L2204685001	140	40	< 30	< 30	< 30	< 30	-
10/11/2022 12:10	L2204934001	140	30	< 30	< 30	< 30	< 30	-
27/11/2022 10:31	L2205189001	160	40	< 30	< 30	< 30	< 30	-
05/12/2022 09:40	L2205342001	140	< 30	< 30	< 30	< 30	< 30	-
07/01/2023 10:00	L2300119001	160	< 30	< 30	< 30	< 30	< 30	-
11/02/2023 13:39	L2300628001	160	< 30	< 30	< 30	< 30	< 30	-
13/03/2023 08:20	L2301209001	160	40	< 30	< 30	< 30	< 30	-
29/04/2023 14:40	L2301759001	140	< 30	< 30	< 30	< 30	< 30	-
08/05/2023 13:26	L2302204001	140	50	< 30	< 30	< 30	< 30	-
09/06/2023 14:57	L2302731001	150	< 30	< 30	< 30	< 30	< 30	-
A13-3 (L-541-SC-001) Feed gas to AGRU – LNG Train 1 – prior to release at A3								
29/08/2022 09:55	L2203497001	-	-	-	-	-	-	< 0.005
17/09/2022 09:20	L2202523001	-	-	-	-	-	-	< 0.005
09/10/2022 11:15	L2204455001	-	-	-	-	-	-	< 0.005
10/11/2022 09:30	L2204935001	-	-	-	-	-	-	< 0.005

Date	LIMS number	Hydrogen Sulfide (H_2S)	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Mercury
	Unit	ppmV	ppmV	ppmV	ppmV	ppmV	ppmV	µg/Nm³
27/11/2022 11:45	L2205188001	-	-	-	-	-	-	< 0.005
03/12/2022 10:25	L2205341001	-	-	-	-	-	-	< 0.005
27/01/2023 14:30	L2300262001	-	-	-	-	-	-	< 0.005
19/02/2023 09:35	L2300778001	-	-	-	-	-	-	< 0.005
21/03/2023 10:00	L2301395001	-	-	-	-	-	-	< 0.005
25/04/2023 10:00	L2301896001	-	-	-	-	-	-	< 0.005
24/05/2023 11:00	L2302316001	-	-	-	-	-	-	< 0.005
20/06/2023 07:40	L2302913001	-	-	-	-	-	-	< 0.005
A14-2 (L-552-SC-003) AGRU hot Vent Train2, prior to release at A4								
16/08/2022 13:55	L2203390001	140	140	< 30	< 30	< 30	< 30	-
19/09/2022 10:24	L2203955001	140	80	40	< 30	< 30	< 30	-
04/10/2022 14:02	L2204381001	140	240	40	< 30	< 30	< 30	-
17/10/2022 10:26	L2204669001	160	130	40	< 30	< 30	< 30	-
08/11/2022 10:22	L2204912001	160	< 30	< 30	< 30	< 30	< 30	-
05/12/2022 13:50	L2205377001	140	50	< 30	< 30	< 30	< 30	-
07/01/2023 15:12	L2300129001	160	< 30	< 30	< 30	< 30	< 30	-
11/02/2023 15:38	L2300635001	140	40	< 30	< 30	< 30	< 30	-
14/03/2023 09:09	L2301210001	160	40	< 30	< 30	< 30	< 30	-
10/04/2023 10:10	L2301760001	160	< 30	< 30	< 30	< 30	< 30	-

Date	LIMS number	Hydrogen Sulfide (H_2S)	Benzene	Toluene	Ethylbenzene	m/p-Xylene	o-Xylene	Mercury
	Unit	ppmV	ppmV	ppmV	ppmV	ppmV	ppmV	µg/Nm³
22/05/2023 09:10	L2302205001	140	120	70	< 30	< 30	< 30	-
10/06/2023 12:16	L2302732001	150	< 30	< 30	< 30	< 30	< 30	-
A14-3 (L-542-SC-001) Feed gas to AGRU – LNG Train 2 – prior to release at A4								
17/08/2022 11:00	L2203187001	-	-	-	-	-	-	< 0.005
27/09/2022 14:25	L2204221001	-	-	-	-	-	-	< 0.005
11/10/2022 11:30	L2204456001	-	-	-	-	-	-	< 0.005
17/10/2022 10:15	L2204668001	-	-	-	-	-	-	< 0.005
08/11/2022 14:55	L2204913001	-	-	-	-	-	-	< 0.005
03/01/2023 12:00	L2205753001	-	-	-	-	-	-	< 0.005
24/01/2023 14:10	L2300354001	-	-	-	-	-	-	< 0.005
19/02/2023 08:50	L2300862001	-	-	-	-	-	-	< 0.005
24/03/2023 11:00	L2301394001	-	-	-	-	-	-	< 0.005
21/04/2023 07:38	L2301895001	-	-	-	-	-	-	< 0.005
25/05/2023 09:12	L2302315001	-	-	-	-	-	-	< 0.005
20/06/2023 07:20	L2302912001	-	-	-	-	-	-	< 0.005

APPENDIX E: GROUNDWATER QUALITY MONITORING DATA

Table E-1: Groundwater sampling results for all sites, Groundwater Surveys 10 and 11

Monitoring Round	LocCode	Sampled Date-Time	Ammonia as N	Nitrogen (Total)	Oxides of Nitrogen	Phosphate total (P)	Reactive Phosphorus as P	TSS	TDS	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)	E. coli	Dissolved Oxygen (%)	EC (field)	pH (field)	Redox	Temp
Units	n/a	n/a		mg/l																										MPN/ 100mL	% sat	uS/cm	pH_Units	mV	°C
Operations Survey 10	BPGW01	24/10/2022	0.02	1.4	1.25	17	<0.01	-	103	0.02	<0.001	0.0004	<0.01	<0.01	<0.001	<0.001	<0.001	0.051	<0.0001	0.002	<0.001	<0.01	0.018	<1	<2	<2	<2	<100	-	-	-	360	4.82	5.7	31.1
	BPGW07	24/10/2022	0.35	<1	0.06	22	0.01	-	64,800	<0.1	0.016	<0.001	<0.01	<0.01	0.038	<0.01	<0.01	1.29	<0.0001	0.024	<0.01	<0.1	0.073	<1	<2	<2	<2	<100	-	-	-	143,777	4.47	5.4	31.0
	BPGW08A	24/10/2022	0.35	<0.5	0.01	15	0.03	-	17,800	0.22	<0.01	0.0011	<0.01	<0.01	0.077	<0.01	<0.01	6.28	<0.0001	0.043	<0.01	<0.1	0.092	<1	<2	<2	<2	<100	-	-	-	43,462	3.65	0.7	31.5
	BPGW09	24/10/2022	0.31	3.8	<0.1	24	<0.01	-	89,400	<0.1	0.051	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	0.37	<0.0001	0.017	<0.01	<0.1	<0.05	<1	<2	<2	<2	<100	-	-	-	182,567	4.95	9.9	31.2
	BPGW18	26/10/2022	0.8	<1	<0.1	50	<0.01	-	55,700	<0.1	0.015	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	0.081	<0.0001	<0.01	<0.01	<0.1	<0.05	<1	<2	<2	<2	<100	-	-	0.82	87,460	6.24	-242.0	30.3
	BPGW19A	25/10/2022	1.62	2.5	<0.01	44	<0.05	-	47,300	<0.1	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	0.024	<0.0001	<0.01	<0.01	<0.1	<0.05	<1	<2	<2	<2	<100	1.3	<1	1.44	78,804	6.00	-90.8	32.0
	BPGW20	26/10/2022	0.12	0.1	<0.01	5	<0.01	-	597	<0.01	0.002	<0.0001	<0.01	<0.01	0.001	<0.001	<0.001	0.026	<0.0001	0.001	<0.001	<0.01	0.006	<1	<2	<2	<2	<100	-	-	1.48	1,415	5.59	-218.0	33.0
	BPGW26	25/10/2022	0.32	0.3	<0.01	6	<0.01	-	6620	0.02	0.004	<0.0001	<0.01	<0.01	0.007	<0.001	<0.001	2.34	<0.0001	0.001	<0.001	<0.01	0.006	<1	<2	<2	<2	<100	-	-	1.21	14,010	5.40	-65.2	31.9
	BPGW27A	25/10/2022	0.26	0.3	<0.01	12	<0.01	-	1360	<0.01	<0.001	<0.0001	<0.01	<0.01	0.002	<0.001	<0.001	0.023	<0.0001	<0.001	<0.001	<0.01	0.008	<1	<2	<2	<2	<100	1.3	<1	1.62	2,960	5.17	-81.1	33.8
	BPGW28	26/10/2022	0.96	<1	<0.01	38	<0.01	-	82,200	<0.1	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	<0.01	0.2	<0.0001	<0.01	<0.01	<0.1	<0.05	<1	<2	<2	<2	<100	-	-	1.25	123,785	6.57	-180.5	30.8
	BPGW38A	26/10/2022	0.11	0.2	0.01	5	0.01	-	1310	<0.01	<0.001	0.0038	<0.01	<0.01	<0.001	<0.001	<0.001	0.028	<0.0001	0.002	<0.001	<0.01	0.006	<1	<2	<2	<2	<100	-	-	2.83	2,775	6.01	-169.8	31.8
	BPGW40	25/10/2022	0.27	0.7	<0.01	6	<0.05	-	3070	<0.01	0.006	<0.0001	<0.01	<0.01	0.001	<0.001	<0.001	0.154	<0.0001	<0.001	<0.001	<0.01	0.005	<1	<2	<2	<2	<100	-	-	1.91	6,269	5.94	-90.9	30.6
	BPGW41	25/10/2022	0.56	<1	<0.01	13	<0.05	-	13,500	<0.01	0.004	<0.0001	<0.01	<0.01	<0.001	<0.001	<0.001	0.017	<0.0001	<0.001	<0.001	<0.01	<0.005	<1	<2	<2	<2	<100	-	-	1.31	24,944	6.40	-88.9	30.1
	VWP328	26/10/2022	0.04	<1	<0.1	47	<0.01	-	74,900	<0.1	0.47	<0.001	<0.01	<0.01	0.022	<0.01	<0.01	0.489	<0.0001	<0.01	<0.01	<0.1	<0.05	<1	<2	<2	<2	<100	-	-	3.22	111,778	6.06	-197.8	31.4
	VWP341	25/10/2022	0.4	0.6	<0.01	<5.0	<0.01	-	1910	0.02	0.005	<0.0001	<0.01	<0.01	0.112	<0.001	<0.001	1.56	<0.0001	0.014	<0.001	<0.01	0.145	<1	<2	<2	<2	<100	-	-	1.84	4,046	5.16	-105.2	32.7
Operations Survey 11	BPGW01	18/04/2023	0.023	0.163	<0.002	14	-	-	–	0.015	0.0042	<0.00005	<0.01^	0.25	0.0033	<0.0005	0.0012	0.232	<0.00004	0.0009	<0.0001	<0.0002	0.013	<1	<2	<2	<2	<100	-	-	2.4	134.5	5.00	132.2	29.2
	BPGW07	18/04/2023	0.035	0.723	0.046	26	-	-	-	0.007	0.0174	0.0004	0.002	0.5	0.0236	0.003	0.0021	0.987	<0.00004	0.0263	<0.0001	<0.0005	0.059	<1	<2	<2	<2	<100	-	-	10.7	85,805	5.69	81.4	30.6
	BPGW08A	18/04/2023	0.083	0.132	<0.002	18	<0.01	-	2,640	<0.005	0.0296	<0.00005	<0.001	0.25	0.0453	<0.0005	0.0001	2.93	<0.00004	0.0187	<0.0001	<0.0002	0.011	<1	<2	<2	<2	<100	-	-	2.0	4,592	5.62	-12.1	31.3
	BPGW09	18/04/2023	<0.005	0.344	<0.002	26	-	-	-	0.005	0.0837	<0.0002	<0.001	0.5	0.0066	<0.001	0.001	0.673	<0.00004	0.0025	<0.0001	<0.0005	0.013	<1	<2	<2	<2	<100	-	-		270.2	6.15	-20.0	30.5

Monitoring Round	LocCode	Sampled Date-Time	Ammonia as N	Nitrogen (Total)	Oxides of Nitrogen	Phosphate total (P)	Reactive Phosphorus as P	TSS	TDS	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 (6mth)	E. coli	Dissolved Oxygen (%)	EC (field)	pH (field)	Redox	Temp
	BPGW18	20/04/2023	0.501	0.672	<0.02	80	0.006	42	-	<0.005	0.0109	<0.0002	0.004	0.25	<0.0002	<0.001	<0.0002	0.0787	<0.0001	<0.0005	<0.0001	0.0007	0.011	<1	<2	<2	<2	<100	-	-	3.4	71,689	6.27	-30.3	29.5
	BPGW19A	20/04/2023	1.14	1.11	<0.02	<5.0	0.01	55	-	0.006	0.006	<0.0002	0.003	0.6	<0.0002	<0.001	<0.0002	0.0545	<0.0001	<0.0005	<0.0001	0.0031	0.007	<1	<2	<2	<2	<100	<1	<1	2.8	72,758	6.26	-38.3	30.6
	BPGW20	20/04/2023	0.111	<0.25	<0.02	<5.0	0.002	<5	-	<0.005	0.0017	<0.0002	<0.001	0.25	0.0015	<0.001	<0.0002	0.0252	<0.0001	0.0008	<0.0001	<0.0005	0.007	<1	<2	<2	<2	<100	-	-	2.3	1,041	5.47	43.2	32.7
	BPGW26	19/04/2023	0.24	0.5	<0.02	5	<0.01	-	5,110	0.006	0.0037	<0.0002	<0.01	0.25	0.0087	<0.001	<0.0002	3.01	<0.0001	0.001	<0.0001	<0.0005	0.005	<1	<2	<2	<2	<100	-	-	2.3	9,266	5.74	73.0	31.3
	BPGW27A	19/04/2023	0.292	0.329	<0.02	<5.0	0.003	-	1,430	<0.005	0.001	<0.0002	<0.001	0.25	0.0019	<0.001	<0.0002	0.0274	<0.0001	<0.0005	<0.0001	<0.0005	<0.005	<1	<2	<2	<2	<100	<1	<1	3.6	2,588	5.46	77.4	33.4
	BPGW28	20/04/2023	0.861	0.924	0.02	20	<0.001	57	-	<0.005	0.0033	<0.0002	0.002	0.25	<0.0002	<0.001	<0.0002	0.18	<0.0001	<0.0005	<0.0001	0.0006	0.019	<1	<2	<2	<2	<100	-	-	22.8	104,847	6.58	-51.6	30.5
	BPGW38A	19/04/2023	0.005	0.346	0.367	<5.0	0.005	-	200	<0.005	<0.0005	<0.0002	<0.001	24	<0.0002	<0.001	<0.0002	<0.0005	<0.0001	<0.0005	<0.0001	<0.0005	<0.005	<1	<2	<2	<2	<100	-	-	45.2	326.5	6.31	91.1	31.6
	BPGW40	19/04/2023	0.441	0.471	<0.02	8	0.011	-	2,370	<0.005	0.0018	<0.0002	<0.001	0.25	0.0016	<0.001	<0.0002	0.148	<0.0001	<0.0005	<0.0001	<0.0005	<0.005	<1	<2	<2	<2	<100	-	-	2.4	3,949	6.29	-25.1	30.4
	BPGW41	19/04/2023	0.67	0.735	<0.002	14	0.014	-	13,400	<0.005	0.0013	<0.0002	<0.001	0.6	<0.0002	<0.001	<0.0002	0.0187	<0.0001	<0.0005	<0.0001	<0.0005	<0.005	<1	<2	<2	<2	<100	-	-	2.3	20,610	6.86	-68.0	29.8
	VWP328	20/04/2023	0.359	<0.5^	<0.02	14	0.011	684	-	<0.005	0.61	<0.0002	<0.001	0.25	0.0248	<0.001	<0.0002	0.413	<0.0001	0.0043	<0.0001	<0.0005	0.011	<1	<2	<2	<2	<100	-	-	3.0	93,072	5.99	-2.1	30.4
	VWP341	18/04/2023	0.65	<1.25^	<0.002	5	-	-	-	0.016	0.0053	<0.00005	<0.001	0.25	0.146	<0.0005	0.0003	2.13	<0.00004	0.0152	<0.0001	0.0004	0.171	<1	<2	<2	<2	<100	-	-	3.1	3,074	5.21	54.9	32.3

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John Spencer	Offshore Installation Mar	03/11/23 10:13	Approver