INPEX Ichthys Project

# Ichthys Development Drilling Campaign WA-50-L Environment Plan

Document No.: 0000-AD-PLN-60003
Security Classification: Public

| Rev | Date | Description | Prepared | Checked | Endorsed | Approved |
|---|---|---|---|---|---|---|
| 0 | 17 Sept 2019 | Issued to NOPSEMA | S. Cook | E. Law | T. Lee | M. Sessink |
| | | | | | | |

## Environment plan summary

The WA-50-L environment plan summary has been prepared from material provided in this environment plan (EP). The summary consists of the following as required by Regulation 11(4) of the OPGGS (E) Regulations 2009:

| EP summary and material requirement | Relevant section of EP containing EP summary material |
|---|---|
| The location of the activity | Section 3.1 |
| A description of the receiving environment | Section 4 |
| A description of the activity | Section 3 |
| Details of the environmental impacts and risks | Sections 7 and 8 |
| The control measures for the activity | Sections 7 and 8 |
| The arrangements for ongoing monitoring of the titleholders environmental performance | Sections 9.11, 9.12 and 9.13 |
| Response arrangements in the oil pollution emergency plan | Sections 8.5, 8.6 and Appendix D |
| Consultation already undertaken and plans for ongoing consultation | Sections 5 and 9.8.3 |
| Details of the titleholders nominated liaison person for the activity | Section 1.5 |

## DOCUMENT DISTRIBUTION

| Copy no. | Name | Hard copy | Electronic copy |
|---|---|---|---|
| 00 | Document Control | ☑ | ☑ |
| 01 | | ☐ | ☐ |
| 02 | | ☐ | ☐ |
| 03 | | ☐ | ☐ |
| 04 | | ☐ | ☐ |
| 05 | | ☐ | ☐ |
| 06 | | ☐ | ☐ |
| 07 | | ☐ | ☐ |
| 08 | | ☐ | ☐ |
| 09 | | ☐ | ☐ |
| 10 | | ☐ | ☐ |

## NOTICE

All information contained within this document has been classified by INPEX as public and must only be used in accordance with that classification. Any use contrary to this document's classification may expose the recipient and subsequent user(s) to legal action. If you are unsure of restrictions on use imposed by the classification of this document you must refer to 0000-A9-STD-60008, Sensitive Information Protection Standard or seek clarification from INPEX.

**Uncontrolled when printed.**

**TABLE OF CONTENTS**


**1 INTRODUCTION ........ 19**
1.1 Background ........ 19
1.2 Scope ........ 21
1.3 Objectives ........ 21
1.4 Overview of activity description ........ 22
1.5 Titleholder details ........ 23
1.5.1 Notification arrangements ........ 23
1.6 Financial assurance ........ 23
**2 ENVIRONMENTAL MANAGEMENT FRAMEWORK ........ 24**
2.1 Corporate framework ........ 24
2.2 Legislative framework ........ 24
**3 ACTIVITY DESCRIPTION ........ 34**
3.1 Location and timing ........ 34
3.2 Drilling activities ........ 35
3.2.1 Indicative drilling method ........ 35
3.2.2 Gas venting ........ 43
3.2.3 Vertical seismic profile (VSP) ........ 43
3.2.4 Contingent drilling activities ........ 44
3.2.5 Other drilling related activities ........ 48
3.3 Semi-submersible MODU, supporting vessels (including IMR/LWI vessels) and aircraft ........ 49
3.3.1 Anchoring and dynamic positioning ........ 49
3.3.2 Remotely operated vehicle (ROV) ........ 50
3.4 Summary of emissions, discharges and wastes ........ 50
**4 EXISTING ENVIRONMENT ........ 55**
4.1 Regional setting ........ 55
4.1.1 Australian waters ........ 55
4.1.2 International waters ........ 56
4.2 Key ecological features ........ 56
4.2.1 Continental slope demersal fish communities ........ 56
4.2.2 Ancient coastline at 125 m depth contour ........ 57
4.2.3 Ashmore Reef and Cartier Island and surrounding Commonwealth waters ........ 57
4.2.4 Canyons linking the Argo Abyssal Plain with the Scott Plateau ........ 57
4.2.5 Carbonate Bank and Terrace System of the Sahul Shelf ........ 59
4.2.6 Mermaid Reef and Commonwealth waters surrounding Rowley Shoals ........ 59
4.2.7 Pinnacles of the Bonaparte Basin ........ 59
4.2.8 Seringapatam Reef and Commonwealth waters in the Scott Reef Complex ........ 60
4.3 Australian marine parks ........ 60
4.3.1 Argo-Rowley Terrace MP ........ 64

4.3.2 Ashmore Reef MP ... 64
4.3.3 Cartier Island MP ... 64
4.3.4 Kimberley MP ... 65
4.3.5 Mermaid Reef MP ... 65
4.3.6 Oceanic Shoals MP ... 65
4.4 State reserves and marine parks ... 65
4.4.1 Adele Island Nature Reserve ... 66
4.4.2 Browse Island Nature Reserve ... 67
4.4.3 Lacepede Islands ... 67
4.4.4 Scott Reef Nature Reserve ... 68
4.4.5 Lalang-garram/Camden Sound Marine Park ... 68
4.4.6 North Kimberley Marine Park ... 69
4.4.7 North Lalang-garram Marine Park ... 69
4.5 International marine parks ... 69
4.5.1 Savu Sea Marine National Park ... 69
4.6 Wetlands of conservational significance ... 70
4.6.1 Ashmore Reef National Nature Reserve ... 70
4.6.2 Mermaid Reef ... 70
4.7 Physical environment ... 70
4.7.1 Climate ... 70
4.7.2 Oceanography ... 71
4.7.3 Bathymetry and seabed habitats ... 73
4.7.4 Water quality ... 73
4.7.5 Sediment quality ... 76
4.7.6 Underwater noise ... 77
4.8 Biological environment ... 77
4.8.1 Planktonic communities ... 77
4.8.2 Benthic communities ... 78
4.8.3 Shoreline habitats ... 81
4.8.4 Marine fauna ... 82
4.9 Socioeconomic and cultural environment ... 99
4.9.1 World heritage areas ... 99
4.9.2 National heritage places ... 99
4.9.3 Fishing ... 99
4.9.4 Aquaculture ... 105
4.9.5 Shipping and ports ... 105
4.9.6 Oil and gas industry ... 105
4.10 Summary of values and sensitivities ... 108
4.10.1 WA-50-L ... 108
4.10.2 EMBA ... 109

**5 STAKEHOLDER CONSULTATION ..... 111**
5.1 Regulatory requirements and guidelines ..... 111
5.2 Stakeholder identification and classification ..... 112
5.2.1 Definition of 'relevant persons'/relevant stakeholders ..... 112
5.2.2 Relevant activity ..... 113
5.2.3 Commercial fishery stakeholder identification and classification ..... 114
5.2.4 Stakeholder classification ..... 117
5.3 Stakeholder engagement ..... 117
5.4 Stakeholder monitoring and reporting ..... 118
5.4.1 Relevant matters, objections and claims ..... 118
5.5 Stakeholder grievance management ..... 120
5.6 Ongoing consultation ..... 120
**6 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT METHODOLOGY ..... 121**
6.1 Establishment of context ..... 121
6.2 Identification of aspects, hazards and threats ..... 121
6.3 Identify potential consequence ..... 123
6.4 Identify existing design safeguards/controls ..... 123
6.5 Propose additional safeguards (ALARP evaluation) ..... 123
6.6 Assess the likelihood ..... 123
6.7 Assess residual risk ..... 123
6.8 Assess residual risk acceptability ..... 125
6.9 Definition of performance outcomes, standards and measurement criteria ..... 126
**7 IMPACT AND RISK ASSESSMENT ..... 127**
7.1 Emissions and discharges ..... 128
7.1.1 Light emissions ..... 128
7.1.2 Atmospheric emissions ..... 134
7.1.3 Routine discharges to sea ..... 141
7.2 Waste management ..... 177
7.3 Noise and vibration ..... 180
7.4 Loss of containment ..... 187
7.4.1 Accidental release ..... 190
7.5 Biodiversity and conservation protection ..... 196
7.5.1 Introduction of invasive marine species (IMS) ..... 196
7.5.2 Interaction with marine fauna ..... 207
7.6 Seabed disturbance ..... 212
7.7 Social and cultural heritage protection ..... 217
7.7.1 Physical presence - disruption to other marine users ..... 217
**8 EMERGENCY CONDITIONS ..... 223**
8.1 EMBA based on oil spill modelling ..... 223
8.2 Loss of containment – well or SPS ..... 227

8.2.1 Location ..... 227
8.2.2 Volume and duration ..... 227
8.2.3 Hydrocarbon properties ..... 227
8.2.4 Modelling results ..... 228
8.2.5 Impact and risk evaluation ..... 233
8.3 Vessel collision ..... 251
8.3.1 Location ..... 251
8.3.2 Volume and duration ..... 251
8.3.3 Hydrocarbon properties ..... 251
8.3.4 Modelling results ..... 251
8.3.5 Impact and risk evaluation ..... 256
8.4 Spill Impact Mitigation Assessment ..... 265
8.4.1 SIMA process ..... 265
8.5 Oil spill response arrangements and capability evaluation ..... 267
8.6 Oil spill response strategies ..... 301
8.6.1 Primary response strategy ..... 301
8.6.2 Secondary response strategy ..... 301
8.7 Source control arrangements and capability ..... 315
8.7.1 Summary of relief well analysis ..... 315
8.7.2 Relief well supply base capabilities and mud requirements ..... 316
8.7.3 Summary of capping stack feasibility analysis ..... 316
8.7.4 Assessment of capping stack deployment duration ..... 317
**9 ENVIRONMENTAL MANAGEMENT IMPLEMENTATION STRATEGY ..... 345**
9.1 Overview ..... 345
9.2 Leadership and commitment ..... 346
9.3 Capability and competence ..... 348
9.3.1 Organisation ..... 348
9.3.2 Roles and responsibilities ..... 349
9.3.3 Inductions ..... 351
9.4 Documentation, information and data ..... 351
9.5 Risk Management ..... 352
9.6 Operate and maintain ..... 352
9.6.1 Chemical assessment and approval ..... 352
9.6.2 Biofouling risk assessment for domestic movements ..... 353
9.7 Management of change ..... 355
9.8 Stakeholder engagement ..... 355
9.8.1 Legislative and other requirements ..... 355
9.8.2 Communication ..... 355
9.8.3 Ongoing stakeholder consultation ..... 356
9.9 Contractors and suppliers ..... 357

9.10 Security and emergency management ....................................... 357
9.10.1 Arrangements and capability ....................................... 358
9.10.2 Emergency response training ....................................... 361
9.10.3 Testing, drills and exercises ....................................... 363
9.10.4 Updating the OPEP ....................................... 365
9.11 Incident investigation and lessons learned ....................................... 365
9.11.1 HSEQ performance measurement and reporting ....................................... 365
9.11.2 Environmental incident reporting – internal ....................................... 365
9.11.3 Environmental incident reporting – external ....................................... 366
9.11.4 Annual performance reporting – external ....................................... 368
9.12 Monitor, review and audit ....................................... 368
9.12.1 Management system audit ....................................... 368
9.12.2 MODU and vessel inspections ....................................... 368
9.13 Management review ....................................... 369
**10 REFERENCES ....................................... 370**

**LIST OF TABLES**

Table 1-1: INPEX Ichthys LNG Project environment plans ....................................... 20
Table 1-2: Overview of the activity description ....................................... 22
Table 1-3: Titleholder details ....................................... 23
Table 1-4: Titleholder nominated liaison person ....................................... 23
Table 2-1: Summary of applicable legislation ....................................... 25
Table 2-2: Summary of applicable industry standards and guidelines ....................................... 32
Table 3-1: Well details ....................................... 35
Table 3-2: 44", 26" and 17½" hole section: water-based formulation – provisional additives ....................................... 39
Table 3-3: 12¼", 8½" hole section: synthetic-based formulation - provisional additives 40
Table 3-4: Well completion fluids and additives ....................................... 41
Table 3-5: Examples of well intervention activities ....................................... 45
Table 3-6: Drilling contingencies ....................................... 46
Table 3-7: Emissions (E), discharges (D) and wastes (W) generated during the petroleum activity ....................................... 50
Table 4-1: AMP and IUCN categories ....................................... 62
Table 4-2: Summary of water quality parameters in the vicinity of WA-50-L ....................................... 74
Table 4-3: Summary of sediment quality parameters in the vicinity of WA-50-L ....................................... 76
Table 4-4: Listed threatened and/or migratory species under the EPBC Act potentially occurring within the EMBA ....................................... 82
Table 4-5: BIAs intersecting the EMBA ....................................... 86
Table 4-6: Commercially significant fish species ....................................... 99
Table 4-7: Commonwealth-managed commercial fisheries (AFMA-managed) ....................................... 100
Table 4-8: State-managed commercial fisheries (WA DPIRD) ....................................... 101
Table 4-9: Particular values and sensitivities potentially within WA-50-L ....................................... 108
Table 4-10: Particular values and sensitivities potentially within the EMBA ....................................... 109

Table 5-1: Classification and method of engagement with stakeholders in relation to an unplanned oil spill event and oil spill response ........................................ 114
Table 5-2: Classification of commercial fishery licence holders ................................ 115
Table 5-3: Engagement classification ................................................................ 117
Table 5-4: Summary of relevant matters, objections, claims or concerns from stakeholder consultation ........................................................................ 119
Table 6-1: Principles of ecological sustainable development (ESD) ........................... 125
Table 7-1: Impact and risk evaluation – change in ambient light levels from flaring and navigational lighting on MODU and vessels ........................................... 128
Table 7-2: Impact and risk evaluation – atmospheric emissions from flaring, MODU and vessels ........................................................................ 134
Table 7-3: Impact and evaluation – MODU and vessels sewage, grey water and food waste discharges ........................................................................ 141
Table 7-4: Impact and evaluation – MODU and vessels deck drainage, bilge and firefighting foam discharges ........................................................................ 145
Table 7-5: Impact and evaluation – MODU and vessels cooling water discharges ........ 152
Table 7-6: Impact and evaluation – MODU and vessels desalination brine discharges .. 156
Table 7-7: Impact and evaluation – discharges of drill fluids, well completion fluids and drill cuttings ........................................................................ 159
Table 7-8: Impact and evaluation – discharges of cement, cementing fluids and additives ........................................................................ 167
Table 7-9: Impact and evaluation – subsea discharges .......................................... 172
Table 7-10: Impact and evaluation – waste management ....................................... 177
Table 7-11: Impact and risk evaluation – underwater noise .................................... 180
Table 7-12: Representative loss of containment events and emergency conditions identified for the petroleum activity ..................................................... 187
Table 7-13: Impact and evaluation – loss of containment: accidental release ............ 190
Table 7-14: Impact and evaluation – Introduction of invasive marine species ............ 196
Table 7-15: Impact and risk evaluation – Physical presence of vessels and interaction with marine fauna (vessel strike) ........................................................ 207
Table 7-16: Impact and risk evaluation – Seabed disturbance from anchoring, moorings and IMR equipment ........................................................................ 212
Table 7-17: Impact and risk evaluation – Physical presence of MODU and vessels resulting in disruption to marine users ................................................ 217
Table 8-1: Potential emergency conditions ........................................................ 223
Table 8-2: Hydrocarbon exposure threshold for impact and risk evaluation ................ 223
Table 8-3: Group I condensate properties .......................................................... 228
Table 8-4: Loss of well containment modelling results summary .............................. 228
Table 8-5: Impact and evaluation – Loss of containment – well or SPS resulting in a Group I (condensate) spill ........................................................................ 233
Table 8-6: Group II diesel properties ................................................................ 251
Table 8-7: Vessel collision stochastic modelling results summary ............................ 252
Table 8-8: Impact and evaluation – Vessel collision resulting in a Group II (diesel) spill ........................................................................ 256
Table 8-9: Evaluation of the applicability of spill response strategies identified in the SIMA ........................................................................ 268
Table 8-10: Response strategy element identification .......................................... 273

Table 8-11: Oil spill response arrangements and capability evaluation....................... 277
Table 8-12: Impact and risk evaluation – implementation of response strategies........ 302
Table 8-13: Time to contain well – deployment of capping stack.............................. 317
Table 8-14: Evaluation of applicability of source control response options.................. 318
Table 8-15: Source control arrangements and capability evaluation .......................... 322
Table 8-16: Impact and risk evaluation – source control......................................... 331
Table 9-1: Key personnel and support roles and responsibilities .............................. 349
Table 9-2: INPEX chemical assessment tool ........................................................ 353
Table 9-3: Ongoing stakeholder consultation....................................................... 356
Table 9-4: Environmental performance outcome, standards and measurement criteria for maintenance of emergency response arrangements and capability............ 360
Table 9-5: Environmental performance outcome, standards and measurement criteria for emergency response training ............................................................ 362
Table 9-6: Environmental performance outcome, standards and measurement criteria for testing response arrangements.......................................................... 363
Table 9-7: Environmental performance outcome, standards and measurement criteria for updating the OPEP ......................................................................... 365

**LIST OF FIGURES**

Figure 1-1: Location of the Ichthys LNG Project......................................................19
Figure 3-1: Location and coordinates of WA-50-L ...................................................34
Figure 4-1: Key ecological features in north-west Australia (showing EMBA) ................58
Figure 4-2: Australian and state marine parks, reserves, banks and shoals..................63
Figure 4-3: Surface currents for Western Australian waters .....................................72
Figure 4-4: Biologically important areas associated with whales ................................89
Figure 4-5: Biologically important areas associated with dugongs and dolphins ............91
Figure 4-6: Biologically important areas associated with marine turtles .......................93
Figure 4-7: Biologically important areas associated with fishes and sharks...................96
Figure 4-8: Biologically important areas associated with marine avifauna ....................98
Figure 4-9: Vessel tracking data in the Browse Basin (May 2019) ............................ 107
Figure 5-1: Process for stakeholder engagement (consultation) for development and implementation of an EP ................................................................ 111
Figure 6-1: INPEX risk matrix.......................................................................... 124
Figure 6-2: ALARP options preferences ............................................................. 125
Figure 8-1: Cross-section transects of predicted maximum entrained oil concentration for 50 replicates (summer) from a subsurface release of Plover condensate. (RPS 2019c) ..................................................................................... 230
Figure 8-2: Cross-section transects of predicted maximum dissolved aromatic hydrocarbon concentration for 50 replicates (summer) from a subsurface release of Plover condensate. (RPS 2019c)........................................... 231
Figure 8-3: Example of time-series of oil exposure for floating oil (≥ 1 g/m$^2$), entrained oil (≥ 100 ppb), dissolved aromatic hydrocarbons (≥ 100 ppb) and shoreline oil (≥ 100 g/m$^2$) for a Plover well blow-out replicate in summer season (RPS 2019c). .......................................................................................... 232

Figure 8-4: Cross-section transects of predicted maximum entrained hydrocarbon concentration for 100 replicates (summer) from a surface release of diesel. (RPS 2019c). ..... 253
Figure 8-5: Cross-section transects of predicted maximum dissolved aromatic hydrocarbon concentration for 100 replicates (summer) from a surface release of diesel. (RPS 2019c). ..... 254
Figure 8-6: Example of time-series of oil exposure for floating oil (≥ 1 $g/m^2$), entrained/dissolved oil (≥ 500 ppb) and shoreline oil (≥ 100 $g/m^2$) for a replicate in transitional season (RPS 2019c). ..... 255
Figure 9-1: The INPEX health, safety, environment and quality management system ..... 346
Figure 9-2: INPEX environmental policy ..... 347
Figure 9-3: Organisational structure ..... 348
Figure 9-4: INPEX biofouling risk assessment for domestic movements ..... 354
Figure 9-5: INPEX emergency response structure ..... 359

**TABLE OF APPENDICES**

APPENDIX A: EPBC ACT APPROVAL (2008/4208) MINISTERIAL CONDITIONS ..... 391
APPENDIX B: EPBC ACT PROTECTED MATTERS REPORT AND SPECIES RISK EVALUATION ..... 392
APPENDIX C: STAKEHOLDER CONSULTATION LOG ..... 394
APPENDIX D: OIL POLLUTION EMERGENCY PLAN ..... 395
APPENDIX E: SPILL IMPACT MITIGATION ASSESSMENT ..... 396

## Terms, abbreviations and acronyms

| Term, abbreviation or acronym | Meaning |
|---|---|
| °C | degrees Celsius |
| AFMA | Australian Fisheries Management Authority (Cwlth) |
| AHO | Australian Hydrographic Office |
| AHSV(s) | anchor-handling supply vessel(s) |
| AIMS | Australian Institute of Marine Science |
| AIS | automatic identification system |
| ALARP | as low as reasonably practicable |
| AMOSC | Australian Marine Oil Spill Centre |
| AMP | Australian marine park formerly Commonwealth marine reserve |
| AMSA | Australian Maritime Safety Authority (Cwlth) |
| APASA | Asia-Pacific Applied Science Associates |
| API | American Petroleum Institute |
| APPEA | Australian Petroleum Production and Exploration Association |
| ARP | applied research program |
| AS/NZS | Australian/New Zealand Standard |
| ASV | accommodation support vessel |
| bbl | barrel(s) |
| BIA | Biologically Important Area |
| BoM | Bureau of Meteorology |
| BOP | blow-out preventer |
| BWM | ballast water management |
| CAMBA | China-Australia Migratory Bird Agreement |
| CASA | Civil Aviation Safety Authority |
| CHARM | chemical hazard assessment and risk management |
| ChemAlert | INPEX operated chemical management system, which provides information on a chemical product's environmental criteria. |
| CMST | Centre for Marine Science and Technology |

| Term, abbreviation or acronym | Meaning |
|---|---|
| CMT | crisis management team |
| COLREGs | International Regulations for Preventing Collisions at Sea 1972 |
| CSV | construction support vessel |
| Cwlth | Commonwealth |
| CWOR | completion workover riser |
| DA | Department of Agriculture (Cwlth) formerly Department of Agriculture and Water Resources |
| dB | decibel |
| DBCA | Department of Biodiversity, Conservation and Attractions (WA) formerly the Department of Parks and Wildlife (DPaW) |
| DEE | Department of the Environment and Energy (Cwlth) (formerly the Cwlth Department of the Environment) |
| DEWHA | Department of the Environment, Water, Heritage and the Arts |
| DWER | Department of Water, Environment Regulation (WA) |
| DIIS | Department of Industry, Innovation and Science |
| DMIRS | Department of Mines, Industry Regulation and Safety WA (formerly Department of Mines and Petroleum) |
| DP | dynamically positioned |
| DPaW | Department of Parks and Wildlife now known as DBCA |
| DPIRD | Department of Primary Industries and Regional Development (WA) |
| DSEWPaC | Department of Sustainability, Environment, Water, Population and Communities |
| EEZ | exclusive economic zone |
| EHS | environment, health and safety |
| EIAPP | Engine International Air Pollution Prevention |
| EIS | environmental impact statement |
| EMBA | environment that may be affected |
| ENVID | environmental impact identification |
| EP | environment plan |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) |

| Term, abbreviation or acronym | Meaning |
|---|---|
| ERP | emergency response plan |
| ERT | emergency response team |
| ESD | ecological sustainable development |
| ESTB | electronic surface tracker buoys |
| FLNG | floating liquified natural gas |
| $g/m^2$ | grams per square metre |
| $g/m^3$ | grams per cubic metre |
| GHG | greenhouse gas |
| GT | gross tonnes |
| ha | hectare |
| HAZID | identification of drilling operations risks and hazards |
| hi-vis | high viscosity |
| HLV | heavy lift vessel |
| HQ | hazard quotient |
| HSE | health, safety and environment |
| HSEQ-MS | health, safety, environment and quality management system |
| Hz | hertz |
| IAP | incident action plan |
| IAPP | International Air Pollution Prevention |
| IBA | important bird area |
| IMCRA | Integrated Marine and Coastal Regionalisation of Australia |
| IMO | International Maritime Organization |
| IMS | invasive marine species |
| IMT | incident management team |
| INPEX | INPEX Ichthys Pty Ltd |
| IOGP | International Association of Oil and Gas Producers |
| IOPP | International Oil Pollution Prevention |

| Term, abbreviation or acronym | Meaning |
|---|---|
| ISPPC | International Sewage Pollution Prevention Certificate |
| ISO | International Organization for Standardization |
| ITOPF | International Tanker Owners Pollution Federation Limited |
| IUCN | International Union for Conservation of Nature |
| KEF | key ecological feature |
| $kg/m^3$ | kilograms per cubic metre |
| kHz | kilohertz |
| km | kilometre(s) |
| L | litre(s) |
| LAO | linear alpha olefins |
| LAT | lowest astronomical tide |
| $LC_{50}$ | Lethal concentration 50. Lethal concentration in which 50% of the population will be killed in a given period of time |
| LLI | long lead item |
| LLR | lower limits of reporting |
| LNG | liquefied natural gas |
| $m^2$ | square metres |
| $m^3$ | cubic metres |
| $m^3/d$ | cubic metres per day |
| m/s | metres per second |
| MARPOL 73/78 | International Convention for the Prevention of Pollution from Ships, 1973/1978 |
| mg/L | milligrams per litre |
| MMscf | million standard cubic feet |
| MMO | marine mammal observer |
| MNES | Matters of National Environmental Significance |
| MNP | marine national park |
| MoC | management of change |

| Term, abbreviation or acronym | Meaning |
|---|---|
| MODU | mobile offshore drilling unit |
| MoU | memorandum of understanding |
| MP | marine park |
| MSI | Maritime Safety Information |
| NatPlan | National Plan for Maritime Environmental Emergencies |
| nm | nautical miles |
| NMR | north marine region |
| NOPSEMA | National Offshore Petroleum Safety and Environmental Management Authority |
| NOPTA | National Offshore Petroleum Titles Administrator |
| NOx | mono-nitrogen oxides |
| NT DIPL | Northern Territory Department of Infrastructure, Planning and Logistics |
| NWMR | north-west marine region |
| OCNS | Offshore Chemical Notification Scheme |
| ODS(s) | ozone-depleting substance(s) |
| OEM | original equipment manufacturer |
| OIE | offset installation equipment |
| OIM | offshore installation manager |
| OOC | oil-on-cuttings |
| OPEP | oil pollution emergency plan |
| OPGGS Act | *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cwlth) |
| OPGGS (E) Regulations | Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cwlth) |
| OSMP | operational and scientific monitoring program |
| OSPAR | The 1992 OSPAR Convention (“Convention for the protection of the marine environment of the north-east Atlantic”) |
| OSRL | Oil Spill Response Limited |
| OSTM | oil spill trajectory modelling |
| OWD | oil-in-water dispersions |

| Term, abbreviation or acronym | Meaning |
|---|---|
| OWS | oil-water separator |
| PAH(s) | polycyclic aromatic hydrocarbon(s) |
| licence area | WA-50-L |
| PDCA | plan, do check, act |
| PLONOR | pose little or no risk (to the environment) |
| POLREP | (marine) pollution report |
| POTS Act | *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* |
| ppb | parts per billion |
| ppm | parts per million |
| ppt | parts per thousand |
| PSI | pounds per square inch |
| PSV | platform supply vessel |
| PSZ | petroleum safety zone |
| PTW | permit to work |
| QA/QC | quality assurance and quality control |
| Ramsar Convention | The Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention) |
| RCC | rescue coordination centre |
| RMR | riserless mud return |
| RO | reverse osmosis |
| ROKAMBA | Republic of Korea- Australia Migratory Bird Agreement |
| ROV | remotely operated (underwater) vehicle |
| RWIS | relief well injection spool |
| SBM | synthetic-based mud |
| SCE | solids control equipment |
| SCSSV | surface controlled subsurface safety salve |
| SEEMP | Ship Energy Efficiency Management Plan |
| SIMA | spill impact mitigation assessment |

| Term, abbreviation or acronym | Meaning |
|---|---|
| SIMOPs | simultaneous operations |
| SIP | SIMOPs interface plan |
| SITREP | situation report |
| SME | subject matter expert |
| SOPEP | shipboard oil pollution emergency plan |
| SPL | sound pressure level |
| SPS | subsea production system |
| SSDI | subsea dispersant injection |
| SSTT | subsea test tree |
| STP | sewage treatment plant |
| T | tonne |
| TD | total depth |
| t/d | tonnes per day |
| UNEP | United Nations Environment Programme |
| VOC(s) | volatile organic compound(s) |
| VSP | vertical seismic profiling |
| WA | Western Australia |
| WA-50-L | Production licence area within the Browse basin |
| WA DoT | Department of Transport (WA) |
| WAFIC | Western Australian Fishing Industry Council |
| WBM | water-based mud |
| WOMP | well operations management plan |
| WSF | water-soluble fraction |
| wt/wt | weight per weight |
| WWCI | Wild Well Control Inc |
| XT | christmas tree |
| μPa | micropascal |

# 1 INTRODUCTION

## 1.1 Background

INPEX Ichthys Pty Ltd, on behalf of the Ichthys Upstream Unincorporated Joint Venture Participants, is developing the Ichthys Field in the Browse Basin off the north west coast of Western Australia to produce condensate offshore for export to markets in Japan and elsewhere, and export gas for further processing at the Ichthys liquefied natural gas (LNG) plant in Darwin (Figure 1-1).

INPEX is preparing to expand capacity with further development of the Ichthys Field, as approved under the Ichthys LNG Project Commonwealth approval decision EPBC 4208/2008, with approval granted for up to 50 wells across 12 – 15 drill centres.

Initial development wells were drilled and the Ichthys LNG offshore facilities were installed and commissioned from 2014 through to 2018. The assets commenced production in July 2018 and now routinely ship cargoes of condensate from the FPSO to international customers and send gas to the Darwin plant via the Gas Export Pipeline.

The existing facilities consist of a subsea production system (SPS) (e.g. xmas trees (XT), manifolds, subsea control systems and umbilicals, risers and flowlines (URF), and the gas export riser base (GERB), which connect the wells to the Central Processing Platform (CPF Explorer) and Floating Production Storage Offtake – FPSO Venturer).

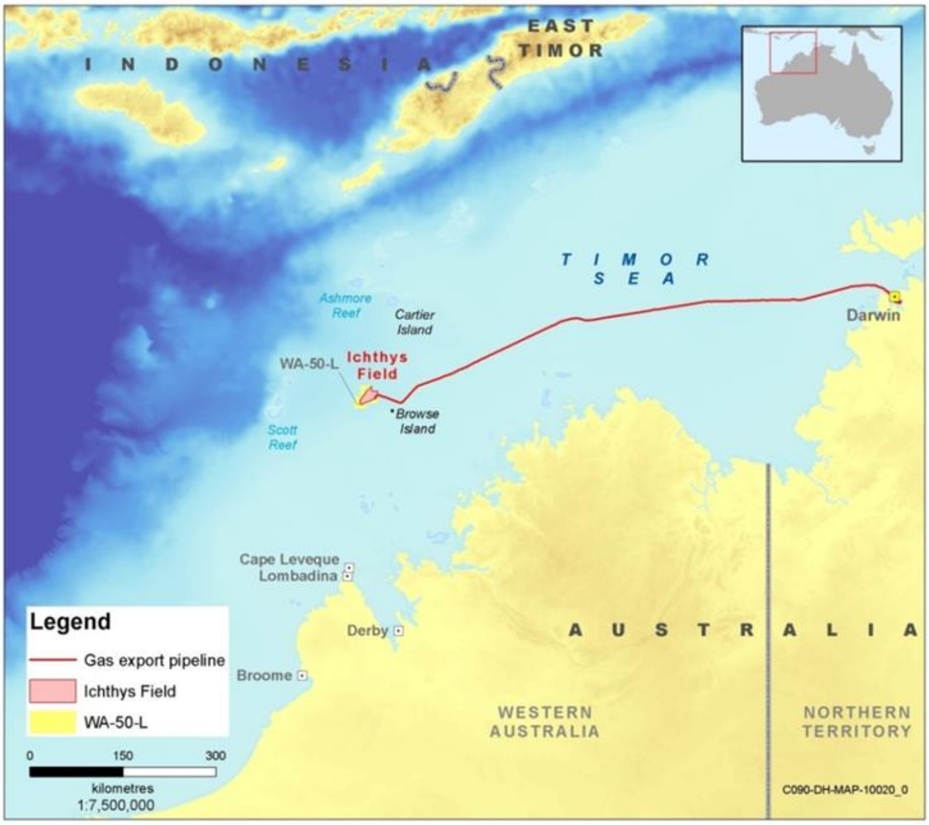



**Figure 1-1: Location of the Ichthys LNG Project**

The various scopes of work (or petroleum activities) occurring in WA-50-L under in force Environment Plans (EPs) or proposed future EPs are described in Table 1-1, that also details estimated schedules. The activities described in these other plans and potential future submissions, are out of the scope of this EP.

**Table 1-1: INPEX Ichthys LNG Project environment plans**

| Title | Activities | Indicative timing |
|---|---|---|
| *Ichthys Development Drilling Campaign WA-50-L Environment Plan* (D020-AD-PLN-10116)<br>(Accepted) | • 20-well program using semisubmersible drilling rigs<br>• installation of well infrastructure and xmas trees (XTs)<br>• well clean-up and completions<br>• support activities, including equipment transfers, refuelling, crew transfers, and transfer of waste and general supplies to and from logistics support vessels<br>• control and maintenance of well integrity<br>• Oil Pollution Emergency Plan (OPEP), including Operational and Scientific Monitoring Programs to address emergency response and monitoring arrangements in place for a loss of well containment (blowout scenario) | Nov 2015 – Nov 2020<br>• *Note this plan will be withdrawn once this EP is accepted.* |
| *Ichthys Project Offshore Facility (Operation) Environment Plan*<br>(X075-AH-PLN-100015)<br>(Accepted) | Operation of the interlinked facility including:<br>• CPF (*Ichthys Explorer*) which is used to separate the reservoir fluid received from the gathering systems into liquid and gaseous phases, and export gas onshore for further processing.<br>• FPSO (*Ichthys Venturer*) which supports hydrocarbon processing systems and utilities by processing liquid hydrocarbons received from the CPF to produce a stabilised hydrocarbon condensate, which is then temporarily stored within the FPSO hull and, periodically, offloaded to tankers for export to market.<br>• SPS infrastructure (e.g. XTs, manifolds, subsea control systems and umbilicals, risers and flowlines (URF), and the gas export riser base (GERB), which connect the wells to the CPF and FPSO). | Dec 2016 – Dec 2021 |
| *Ichthys Project Gas Export Pipeline (Operation) Environment Plan*<br>(F075-AH-PLN-10001)<br>(Accepted) | • operation of the GEP from the GERB to the boundary of Commonwealth waters (NT)<br>• IMR of GEP infrastructure during the Operations stage<br>• deployment of a pipeline repair system during a repair scenario<br>• post-repair discharges of residual hydrocarbon, air, nitrogen gas, filtered inhibited seawater (FIS) or monoethylene glycol (MEG) to the environment. | Jan 2017 – Jan 2022 |

| Title | Activities | Indicative timing |
|---|---|---|
| *Ichthys URF and SOS Installation Environment Plan*<br>(E075-AH-PLN-7000)<br>(In preparation) | • The expansion of the SPS includes installation of an additional gathering system and new infrastructure required to connect new production wells to the other existing gathering systems already in production.<br>• Hydrotesting<br>• Pre-commissioning<br>• Installation of subsea infrastructure. | 2020 - 2025 |

## 1.2 Scope

Drilling, completion and well flow back operations for the first phase (up to 20 wells) of the Ichthys Development Drilling Campaign (hereafter referred to as the drilling campaign) are currently addressed by the in-force Ichthys Development Drilling Campaign WA-50-L Environment Plan (EP) (D020-AD-PLN-10116) accepted in October 2015, under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations), as administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

The scope of this EP is to address the next stage of the drilling campaign which will consist of the drilling, completion and flow back of at least 12-15 additional development wells within the Ichthys Field in the next 5 years. The scope also includes the potential for workovers and well intervention of existing and planned development wells in WA-50-L.

Drilling campaign activities will be conducted using a semi-submersible mobile offshore drilling unit (MODU)[1], which will be anchored to the seabed and/or dynamically positioned (DP). It is anticipated that two anchor handling supply vessels (AHSVs) and one platform supply vessel (PSV) will provide support for the drilling campaign including the installation and recovery of pre-lay anchors. Personnel transfers to and from the MODU will be by helicopter several times per week. Reference to "supply vessels" in this EP refers to either an AHSV or a PSV, unless referenced specifically. Inspection, maintenance and repair (IMR) or light well intervention (LWI) vessels may be used to undertake additional well related activities (see Section 3.2.4) during the drilling campaign.

Drilling is expected to commence in the first half (H1) of 2020; however, the start date is subject to MODU availability, operational efficiencies and weather.

The scope of this EP does not include the movement of vessels, helicopters or MODUs outside of the production licence area (e.g. travel to and from WA-50-L). These activities will be undertaken in accordance with other relevant maritime and aviation legislation; most notably, the *Navigation Act 2012* (Cwlth) and *Civil Aviation Act 1988* (Cwlth).

## 1.3 Objectives

The objectives of this EP are to:

- demonstrate that the environmental impacts and risks associated with the petroleum activity have been reduced to 'as low as reasonably practicable' (ALARP) and are of an acceptable level

[1] More than one MODU may undertake the activities described in this EP. Any MODU or supply vessels undertaking these activities will be required to comply with the relevant requirements of this EP and accompanying Oil Pollution Emergency Plan (OPEP).

- establish appropriate environmental performance outcomes, environmental performance standards and measurement criteria in relation to the operation of the facility
- define an appropriate implementation strategy and monitoring, recording and reporting arrangements, whereby compliance with this EP, the OPGGS (E) Regulations, and other relevant legislative requirements, can be demonstrated
- demonstrate that INPEX has carried out the consultations required by the OPGGS (E) Regulations
- demonstrate that the measures adopted by INPEX, arising from the consultation process, are appropriate
- demonstrate that the petroleum activity complies with the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and the OPGGS (E) Regulations.

## 1.4 Overview of activity description

Table 1-2 provides an overview of the drilling campaign activities to be undertaken under this EP.

**Table 1-2: Overview of the activity description**

| Item | Description |
|---|---|
| Petroleum production licence area | WA-50-L |
| Basin | Browse |
| Gas field | Ichthys Field |
| Reservoirs | Brewster<br>Plover |
| Activity location | Wholly located within Commonwealth waters approximately 390 km north of Derby, Western Australia in the North West Marine Region (NWMR) of the Timor Sea. |
| Well type | Development (i.e. subsea production wells) |
| Hydrocarbon type | Gas and condensate |
| Water depth | 235–275 m at Lowest Astronomical Tide (LAT) |
| MODU(s) and vessels | MODU(s) (semi-submersible, moored or DP), AHSVs, PSVs, IMR /LWI vessel(s) and other support vessels. |
| Activities | Drilling and completion of at least 12- 15 development wells targeting the Brewster and Plover reservoirs in the WA-50-L production licence area. Well intervention and well work over activities may also be conducted on existing and planned development wells in WA-50-L. |
| Activity commencement | H1 2020 |

| Item | Description |
|---|---|
| Duration | Continual operations up to 5 years, 24 hours a day |

## 1.5 Titleholder details

INPEX Ichthys Pty Ltd is a joint titleholder of production licence WA-50-L but has been nominated as the single titleholder for the purposes of taking eligible voluntary actions under subsection 775B of the OPGGS Act, such as making submissions.

In accordance with Regulation 15(1) of the OPGGS (E) Regulations, details of the titleholder are described in Table 1-3. INPEX will be responsible for ensuring that activities covered in this EP are carried out in accordance with the OPGGS (E) Regulations, this EP and other applicable Australian legislation.

In accordance with Regulation 15(2) of the OPGGS (E) Regulations, details of the titleholder's nominated liaison person are provided in Table 1-4.

**Table 1-3: Titleholder details**

| | |
|---|---|
| **Name** | INPEX Ichthys Pty Ltd (INPEX) |
| **Business address** | Level 22, 100 St Georges Tce, Perth, WA 6000 |
| **Telephone number** | +61 8 6213 6000 |
| **Fax number** | +61 8 6213 6455 |
| **Email address** | enquiries@inpex.com.au |
| **ABN** | 46 150 217 253 |

**Table 1-4: Titleholder nominated liaison person**

| | |
|---|---|
| **Name** | Bill Townsend |
| **Position** | INPEX Deputy Vice President Corporate Coordination |
| **Business address** | Level 22, 100 St Georges Tce, Perth, WA 6000 |
| **Telephone number** | +61 8 6213 6000 |
| **Email address** | enquiries@inpex.com.au |

### 1.5.1 Notification arrangements

In the event that the titleholder, nominated liaison person or contact details for the nominated liaison person change, INPEX will notify the regulator in accordance with Regulation 15(3) of the OPGGS (E) Regulations.

## 1.6 Financial assurance

Financial assurance for the titleholder's liabilities for cleaning up, remediating and monitoring the impact of a petroleum release has been calculated using the APPEA methodology for estimating levels of financial assurance (2018), based on the maximum credible loss scenario from a loss of well containment.

Declarations of financial assurance will be provided in relation to title WA-50-L prior to acceptance of the Environment Plan by NOPSEMA.

# 2 ENVIRONMENTAL MANAGEMENT FRAMEWORK

In accordance with Regulation 13(4) of the OPGGS (E) Regulations 2009, the requirements, including legislative requirements that apply to the activity and are relevant to environmental management, are described in this section with reference to demonstration of how those requirements will be met.

## 2.1 Corporate framework

The INPEX Australia health safety, environment and quality management system (HSEQ-MS) is part of the INPEX's Business Management System, an integrated framework of policies, standards and procedures that describe how business activities at INPEX are governed and managed.

The INPEX Environmental Policy sets the direction and minimum expectations for environmental performance, and is implemented through the standards and procedures of the HSEQ-MS. This system and policy are further described in Section 9 in accordance with Regulation 16(a) of the OPGGS (E) Regulations.

## 2.2 Legislative framework

In accordance with Regulation 13(4) of the OPGGS (E) Regulations, the legislative framework relevant to the petroleum activity is listed in Table 2-1. A summary of applicable industry standards and guidelines is also presented in Table 2-2. Ongoing management of legislative and other requirements is described further in in Section 9.8.1.

**Table 2-1: Summary of applicable legislation**

| Legislation | Description | Requirements | Demonstration of how requirements are met in EP |
|---|---|---|---|
| *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act; Cwlth)<br>and<br>Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations) | Provides for the protection and management of nationally and internationally important flora, fauna, ecological communities, and heritage places. | The OPGGS (E) Regulations were revised in February 2014 to include the requirement that matters protected under Part 3 of the EPBC Act are considered and any impacts are at acceptable levels.<br>Part 8 of the EPBC Regulations outlines requirements for vessel when interacting with cetaceans.<br>In accordance with Regulation 9 of the OPGGS Regulations 2009, the activities described in this EP were approved by the Commonwealth Environment Minister under Part 9 of the EPBC Act (EPBC Approval Decision 2008/4208).<br>EPBC Act Policy statement 2.1 provides a framework for minimising the risk of injury to whales by outlining requirements for vertical seismic profiling.<br>The EPBC Act provides for protection of 'matters of national environmental significance' including not only listed species but also heritage properties and Ramsar wetlands. There are exemptions covering provisions of Part 3 and 13 of the EPBC Act, for the undertaking of activities when responding to maritime environmental emergencies, in accordance with the National Plan (NatPlan).<br>Australian Marine Parks (AMPs) are proclaimed under this Act and associated management plans are enacted under this legislation. | Relevant approval conditions within approval decision EPBC 2008/4208 have been addressed in this EP and are summarised in Appendix A.<br>Section 4.3 – Australian marine parks<br>Section 7.7.1 – Physical presence of vessels and Section 7.5.2 interaction with marine fauna.<br>Section 7.3 – Noise and vibration.<br>Section 8 – Emergency conditions.<br>OPEP (Appendix D)<br>A demonstration of how this EP addresses the relevant conservation management documents related to EPBC-listed species has been presented in Appendix B. |
| OPGGS Act<br>and<br>OPGGS (E) Regulations (Cwlth) | The OPGGS Act (Section 616) details the requirement for a Petroleum Safety Zone (PSZ). | The PSZ is in place for the purposes of protecting a well, structure or any equipment, in an offshore area, by notice published in the Gazette, administered by NOPSEMA.<br>The OPGGS (E) Regulations require that the petroleum activity is undertaken in an ecologically sustainable manner, and in accordance with an accepted EP. | Throughout this EP.<br>Implementation of the HSEQ-MS. |

| Legislation | Description | Requirements | Demonstration of how requirements are met in EP |
|---|---|---|---|
| | The OPGGS (E) Regulations under the OPGGS Act require a titleholder to have an accepted plan in place for a petroleum activity. | | |
| *Navigation Act 2012* (Cwlth) | The primary legislation that regulates ship and seafarer safety, shipboard aspects of protection of the marine environment, and employment conditions for Australian seafarers. | The *Navigation Act 2012* includes specific requirements for safe navigation, including systems, equipment and practices consistent with the International Convention for the Safety of Life at Sea (SOLAS) and the International Regulations for Preventing Collisions at Sea (COLREGS), as implemented as maritime law in Australia through a series of Marine Orders, including Marine Orders – Part 21 – Safety of navigation and emergency procedures and Marine Orders – Part 30 – Prevention of collisions.<br>The *Navigation Act 2012*, in conjunction with the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and through legislative Marine Orders, also requires vessels to have pollution prevention certificates (see below). | Section 7.7.1 – Physical presence – disruption to other marine users<br>Section 8.3 - Vessel collision<br>Implementation of the HSEQ-MS. |
| *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* (POTS Act; Cwlth) | The POTS Act provides for the prevention of pollution from vessels, including pollution by oil, noxious liquid substances, packaged harmful substances, sewage, garbage, and air pollution.<br>In conjunction with Chapter 4 of the *Navigation Act 2012*, the POTS Act gives effect to relevant requirements of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL 73/78) in Australia. | The requirements of the POTS Act and the *Navigation Act 2012* are implemented as maritime law in Australia through a series of Marine Orders and legislative instruments, made and administered by the Australian Maritime Safety Authority (AMSA). The requirements of each Marine Order made under the POTS Act and the *Navigation Act 2012* and their relevance to the activity are outlined separately below. | Section 7 and Section 8<br>Implementation of the HSEQ-MS. |

| Legislation | Description | Requirements | Demonstration of how requirements are met in EP |
|---|---|---|---|
| Marine Orders Part 91 – Marine pollution prevention — oil | Marine Orders Part 91 implements Part II of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex I of MARPOL 73/78 (oil pollution).<br>The Marine Orders provide standards for the discharge of certain oily mixtures or oily residues and associated equipment and include duties to manage bunkering and transfers of oil between vessels; to maintain Oil Record Books and Shipboard Oil Pollution Emergency Plans (SOPEPs); and to report oil pollution. | The MODU and support vessels ≥400 gross tonnes (GT) are required to maintain:<br>• International Oil Pollution Prevention (IOPP) certificates to demonstrate that the vessel or facility and onboard equipment comply with the requirements of Annex I of MARPOL 73/78 (as applicable to vessel size, type and class).<br>• Oil Record Books to record activities, such as fuel/oil bunkering and discharges of oil, oily water, mixtures and residues.<br>• SOPEPs outlining the procedures to be followed during an oil pollution incident.<br>• Discharges must also comply with Annex I of MARPOL 73/78, and oil pollution incidents must also be reported to AMSA. | Section 7.1.3 – Routine discharges<br>Section 7.4.1 – Accidental release<br>Section 8 - Emergency Conditions - Impact and Risk Evaluation<br>OPEP (Appendix D)<br>Implementation of the HSEQ-MS. |
| Marine Orders Part 94 – Marine pollution prevention — packaged harmful substances | Marine Orders Part 94, – Marine pollution prevention — packaged harmful substances, and the POTS Act relating to packaged harmful substances as defined by Annex III of MARPOL 73/78. | INPEX and MODU/vessel contractor will comply with the *Navigation Act 2012* – Marine Orders – Part 94: Marine Pollution Prevention– Packaged Harmful Substances (as appropriate to vessel class), through reporting the loss or discharge to sea of any harmful materials. | Section 7.2 – Waste management |
| Marine Orders Part 95 – Marine pollution prevention — garbage | Marine Orders Part 95 – Marine pollution prevention — garbage implements Part IIIC of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex V of MARPOL 73/78 (garbage). | MODU and support vessels ≥100 GT, or vessels certified to carry 15 persons or more, are required to maintain a Garbage Management Plan.<br>MODU and support vessels ≥400 GT are required to maintain a Garbage Record Book.<br>The requirements will apply to the MODU and vessels (as appropriate to their size, type and class) at all times. | Section 7.2 – Waste Management.<br>Implementation of the HSEQ-MS. |

| Legislation | Description | Requirements | Demonstration of how requirements are met in EP |
|---|---|---|---|
| | The Marine Orders provide for the discharge of certain types of garbage at sea, waste storage, waste incineration, and the comminution and discharge of food waste. They also set out requirements for garbage management and recording. | | |
| Marine Orders Part 96 – Marine pollution prevention — sewage | Marine Orders Part 96 – Marine pollution prevention — sewage implements Part IIIB of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex IV of MARPOL 73/78 (sewage).<br>The Marine Orders include requirements for the treatment, storage and discharge of sewage and associated sewage systems, and for an International Sewage Pollution Prevention (ISPP) certificate to be maintained on board. | MODU & support vessels ≥400 GT are required to maintain International Sewage Pollution Prevention (ISPP) certificates to demonstrate that vessels and their onboard sewage systems comply with the requirements of Annex IV of MARPOL 73/78.<br>Discharges of sewage must also comply with Annex I of MARPOL 73/78, and oil pollution incidents must also be reported to AMSA. | Section 7.1.3 – Routine discharges<br>Implementation of the HSEQ-MS. |
| Marine Orders Part 97 – Marine pollution prevention — air pollution | Marine Orders Part 97 – Marine pollution prevention — air pollution implements Part IIID of the POTS Act, Chapter 4 of the *Navigation Act 2012*, and Annex VI of MARPOL 73/78 (air pollution). | MODU and support vessels ≥400 GT are required to have International Air Pollution Prevention (IAPP) certificates and Engine International Air Pollution Prevention (EIAPP) certificates to demonstrate that the vessel or facility and onboard marine diesel engines comply with the requirements of Annex VI of MARPOL 73/78.<br>Low-sulphur fuel oil / marine diesel with 0.5% mass-for-mass (m/m) sulphur content is required to be used in engines after 31 December 2019. | Section 7.1.2 – Atmospheric emissions.<br>Implementation of the HSEQ-MS. |

| Legislation | Description | Requirements | Demonstration of how requirements are met in EP |
|---|---|---|---|
| | The Marine Orders set requirements for marine diesel engines and associated emissions, waste incineration on board vessels, engine fuel quality, and equipment and systems containing ozone-depleting substances (ODS). | In accordance with Annex VI of MARPOL 73/78, the requirements do not apply to the following:<br>• emissions resulting from the incineration of substances that are solely and directly the result of the exploitation and offshore processing of seabed mineral resources (i.e. hydrocarbons), including but not limited to flaring during well completion and testing operations and flaring arising from upset conditions<br>• emissions associated solely and directly with the treatment, handling, or storage of seabed minerals (i.e. hydrocarbons)<br>• emissions from marine diesel engines that are solely dedicated to the exploration, exploitation and associated offshore processing of seabed mineral resources (i.e. hydrocarbons)<br>• vessels ≥400 GT are required to have an International Maritime Organization (IMO)-approved waste incinerator, as confirmed by the IAPP certificate<br>• vessels ≥400 GT with rechargeable systems containing ODS to maintain an ODS Record Book<br>• vessels ≥400 GT to have an International Energy Efficiency (IEE) certificate (as applicable to the vessel and engine size, type and class)<br>• vessels ≥400 GT to have a Ship Energy Efficiency Management Plan (SEEMP) (as applicable to the vessel and engine size, type and class). | |

| Legislation | Description | Requirements | Demonstration of how requirements are met in EP |
|---|---|---|---|
| *Biosecurity Act 2015* (Cwlth) | The Act and its supporting legislation are the primary legislative means for managing risk of pests and diseases entering into Australian territory and causing harm to animal, plant and human health, the environment and/or the economy. | Of specific relevance to this EP, the Act requires that ballast is managed within Australian seas; as such the Biosecurity Act now defines Australian seas as:<br>• for domestic and international vessels whose Flag State Administration is party to the BWM Convention – the waters (including the internal waters of Australia) that are within the outer limits of the exclusive economic zone (EEZ) of Australia (all waters within 200 nm) or<br>• for all other international vessels – the Australian territorial seas (all waters within 12 nm). | Section 7.5.1 - Invasive marine species<br>Implementation of the HSEQ-MS. |
| *Biodiversity Conservation Act 2018* (WA)<br>*Animal Welfare Act 2002* (WA) | Ensures the protection of biodiversity and humane treatment of native fauna.<br>Ensures appropriate treatment and management of wildlife in the event of a potential hydrocarbon spill and response activities. | Consult with WA Department of Biodiversity, Conservation and Attractions (DBCA) and obtain relevant permit(s) before a wildlife hazing and post-contact wildlife response. | Section 8 – Emergency conditions<br>OPEP (Appendix D) |
| *Fish Resources Management Act 1994* (WA)* | The *Fish Resources Management Act* is administered by the WA Department of Primary Industry and Regional Development (DPIRD) that has powers to deal with incursions of marine pests. | INPEX will manage its operations in accordance with the Act and the associated Fish Resources Management Regulations (1995) with respect to managing potential invasive marine species (IMS) risks. | Section 7.5.1 - Invasive marine species<br>Implementation of the HSEQ-MS. |

| Legislation | Description | Requirements | Demonstration of how requirements are met in EP |
|---|---|---|---|
| * The *Aquatic Management Resources Act 2016* (ARMA) will supersede this Act as the primary legislation used to manage fishing, aquaculture, pearling and aquatic resources in WA. This EP will be updated to reflect this once the ARMA comes into effect. | | | |

**Table 2-2: Summary of applicable industry standards and guidelines**

| Guideline | Description |
|---|---|
| Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2000) | These guidelines provide a framework for water resource management and state specific water quality guidelines for environmental values, and the context within which they should be applied. |
| International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL 73/78) | This convention is designed to reduce pollution of the seas, including dumping, oil and exhaust pollution. MARPOL 73/78 currently includes six technical annexes. Special areas with strict controls on operational discharges are included in most annexes. |
| International Convention on the Control of Harmful Anti-fouling Systems | This convention prohibits the use of harmful organotins in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. |
| International Convention for the Safety of Life at Sea (SOLAS) 1974 | In the event of an offshore emergency event that endangers the life of personnel, the International Convention for the Safety of Life at Sea (SOLAS) 1974 may take precedence over environmental management. |
| Bonn Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil and other harmful substances (Bonn Agreement) | The Bonn Agreement is the mechanism by which the North Sea states, and the European Union (the Contracting Parties), work together to help each other in combating pollution in the North Sea area from maritime disasters and chronic pollution from ships and offshore installations; and to carry out surveillance as an aid to detecting and combating pollution at sea.<br>The Bonn Agreement Oil Appearance Code may be used during spill response activities. |
| The Australian Petroleum Production and Exploration Association (APPEA) *Code of Environmental Practice* (APPEA 2008) | Recognising the need to avoid or minimise and manage impacts to the environment, this code of environmental practice includes four basic recommendations to APPEA members undertaking activities:<br>• Assess the risks to, and impacts on, the environment as an integral part of the planning process.<br>• Reduce the impact of operations on the environment, public health and safety to as low as reasonably practicable (ALARP) and to an acceptable level by using the best available technology and management practices.<br>• Consult with stakeholders regarding industry activities.<br>• Develop and maintain a corporate culture of environmental awareness and commitment that supports the necessary management practices and technology, and their continuous improvement. |
| Australian Ballast Water Requirements, Version 7 (DAWR 2017) | Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing harmful aquatic organisms into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the *Biosecurity Act 2015*. |

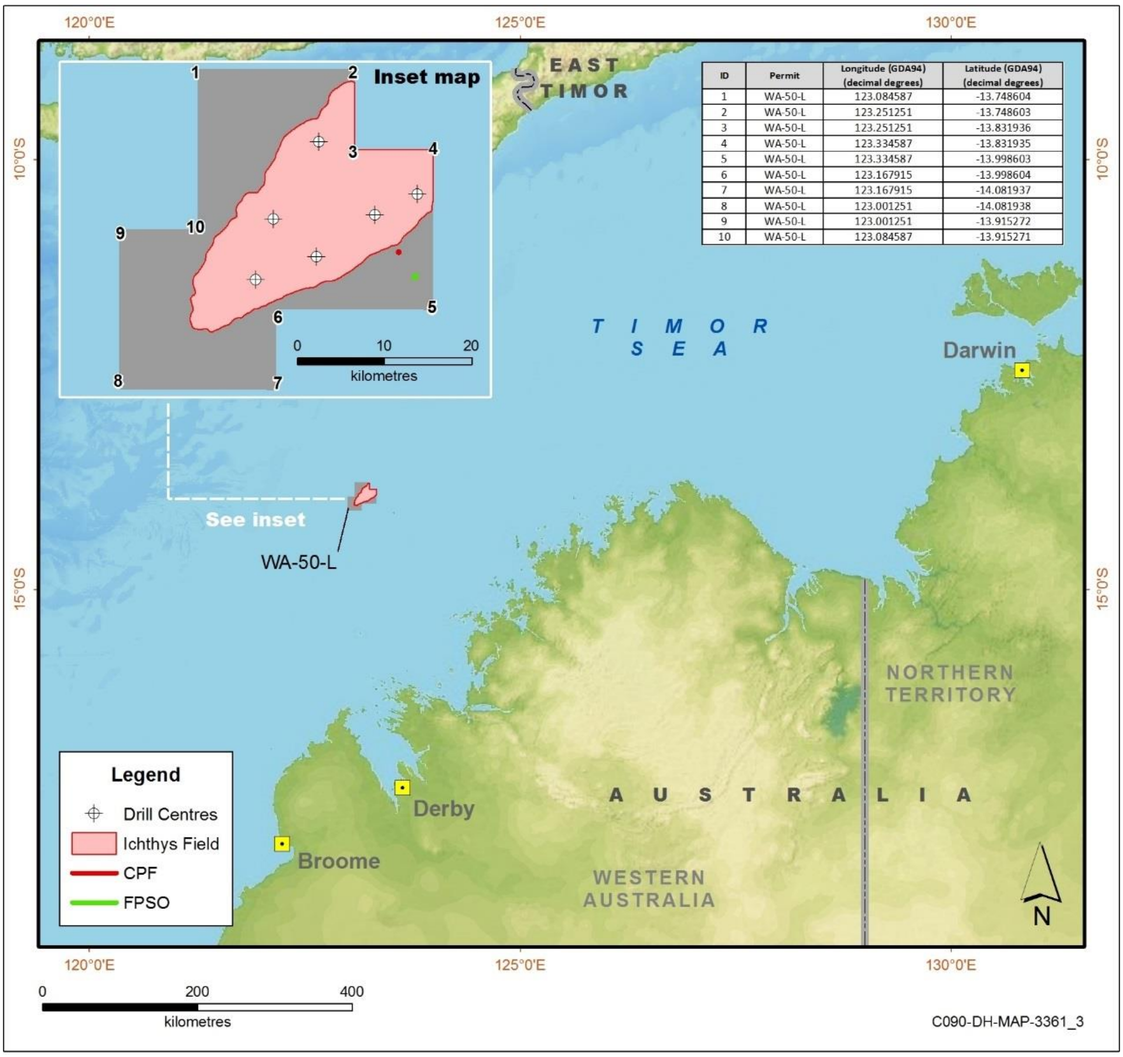
| Guideline | Description |
|---|---|
| National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2018) | A voluntary biofouling management guidance document developed under the National System for the Prevention and management of Marine Pest Incursions. Its purpose is to provide tools to operators to minimise the amount of biofouling accumulating on their vessels, infrastructure and submersible equipment and thereby to minimise the risk of spreading marine pests. |
| International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) (IMO 2009) | All vessels are required to manage their ballast water and sediments in accordance with the Convention and *Biosecurity Act 2015*. The convention came into force on 8 September 2017 and Australia's ballast water policy and legislation align with the convention. |
| Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (IMO 2012) | The guidelines provide a globally consistent approach to the management of biofouling. They aim to reduce the risk of translocation of marine pests from biofouling present on immersed areas of vessels. It was adopted by IMO marine environment committee in the form of Resolution MEPC.207 (62) in 2011. |

# 3 ACTIVITY DESCRIPTION

## 3.1 Location and timing

Production licence WA-50-L is located within the Browse Basin in Commonwealth waters within Western Australia (Figure 3-1). It is approximately 230 km north-west of the Kimberley coastline, at its closest point. Water depths at the proposed well locations range between 235 m and 275 m at lowest astronomical tide (LAT). The closest major town is Derby, located approximately 390 km south of the southern boundary of the licence area.

The next stage of the Ichthys development drilling campaign will target both Brewster and Plover reservoirs in the Ichthys Field and is planned to commence in H1 2020. The total duration of the drilling campaign (at least 12 - 15 wells including potential workovers and/or well intervention operations in WA-50-L) is expected to take up to five years, noting that the exact timing for commencement and completion will be dependent upon approvals, MODU availability, vessel availability, operational efficiencies and weather conditions. This timeframe takes into account more than one MODU under contract and allows for foreseeable delays. Operations will be conducted 24 hours per day.




| ID | Permit | Longitude (GDA94) (decimal degrees) | Latitude (GDA94) (decimal degrees) |
|---|---|---|---|
| 1 | WA-50-L | 123.084587 | -13.748604 |
| 2 | WA-50-L | 123.251251 | -13.748603 |
| 3 | WA-50-L | 123.251251 | -13.831936 |
| 4 | WA-50-L | 123.334587 | -13.831935 |
| 5 | WA-50-L | 123.334587 | -13.998603 |
| 6 | WA-50-L | 123.167915 | -13.998604 |
| 7 | WA-50-L | 123.167915 | -14.081937 |
| 8 | WA-50-L | 123.001251 | -14.081938 |
| 9 | WA-50-L | 123.001251 | -13.915272 |
| 10 | WA-50-L | 123.084587 | -13.915271 |

**Figure 3-1: Location and coordinates of WA-50-L**

Drilling, completion and well flow back activities (including in field MODU moves and anchoring) are expected to take 90 to 120 days per well, noting that drilling activities only occur for a portion of this time. In some cases, development wells may be suspended and at a later date, re-entered and remaining work/stages completed. This will be determined subject to operational, construction and production requirements.

Exact well locations will be confirmed in advance of drilling activities and determined from geophysical and geological data interpretation and production analysis. All wells will be located within the boundaries of WA-50-L. Updates to timing and sequencing will be routinely reported internally for planning and reporting purposes.

## 3.2 Drilling activities

### 3.2.1 Indicative drilling method

The Brewster and Plover well design is detailed in Table 3-1. The wells will be drilled using both water-based mud (WBM) and synthetic-based mud (SBM) systems.

**Table 3-1: Well details**

| Well section description | Drilling fluid type | Volume of fluid disposed with cuttings ($m^3$) | Volume of cuttings discharged ($m^3$) |
|---|---|---|---|
| 44" well-bore diameter;<br>36" conductor complete with a low-pressure wellhead housing | WBM, sea water and high-viscosity (hi-vis) gel sweeps.<br>At total depth (TD) the hole will be displaced with hi-vis gel mud.<br>While drilling riserless, all returns will be to the seabed.<br>Fluid remaining at the end of these hole sections will be used on the next hole section. | 240 | 60 |
| 30 ½" well-bore diameter;<br>26" non-pressure containing surface casing in sub-mudline hanger | | 715 | 180 |
| 17 ½" well-bore diameter;<br>13 $\frac{3}{8}$" intermediate casing complete with high pressure wellhead housing | WBM, gel polymer.<br>This hole section will be drilled riserless with a semi-closed circulating system, (i.e. returns from the well will be circulated back to the MODU via a riserless fluid return system and then pumped back down the well).<br>At the end of this section all remaining WBM will discharged overboard. | 1350 | 300 |
| 12 ¼" well-bore diameter;<br>10-$\frac{3}{4}$" x 9 $\frac{7}{8}$" production casing | Low toxicity SBM. | 225 | 190 |

| Well section description | Drilling fluid type | Volume of fluid disposed with cuttings ($m^3$) | Volume of cuttings discharged ($m^3$) |
|---|---|---|---|
| | Technical justification for SBM use: This hole section will penetrate massive claystone sections including the Jamieson, Echuca Shoals and Lower Echuca Shoals formations. These formations, particularly the Jamieson formation, are known to contain highly reactive claystones. The use of WBM in these formations is known to result in borehole breakout and well-bore collapse which will possibly result in the loss of the hole section and compromising the well objectives. SBM has much lower levels of reactivity with shales and as such is much less likely to cause destabilisation during drilling, tripping and running casing.<br>SBM containment management systems, shale shakers and cuttings dryers will be used to minimise the amount of SBM discharged to the environment as residual oil-on-cuttings.<br>At the end of the section, the mud will be retained and used on the next hole section and/or future wells.<br>At the end of drilling, all the recaptured SBM will be returned to the vendor for reuse. | | |
| 8 ½" well-bore diameter (Brewster);<br>7" production liner | Low toxicity SBM.<br>Anticipated bottom hole temperatures when drilling the Brewster reservoir section are expected to be approximately 155°C. Both the SBM and the WBM systems have been tested to anticipated bottom hole conditions and found to be stable.<br>Additionally, both mud systems have been tested and confirmed to minimise reservoir damage and maximise productivity. | 120 | 40 |
| 8 ½" well-bore diameter (Plover);<br>7" production liner | Low toxicity SBM.<br>The Plover reservoir section will be drilled in two sections; initially through Brewster before isolating the Brewtser reservoir with expandable casing; and, then deeper into the Plover reservoir. SBM is required for the high anticipated temperature (175°C) and to prevent formation damage across the Plover reservoir interval. | 80 | 35 |

The top section of each well (44" and 30 ½") will be drilled using sea water and high-viscosity "sweeps" (comprising prehydrated bentonite, i.e. WBMs) to circulate drilled cuttings from the hole for discharge at the seabed. Prehydrated bentonite consists of up to 98% water, the remainder being drilling fluid additives that are either completely inert in the marine environment, or naturally occurring benign materials. Bentonite is a naturally occurring clay of low toxicity (World Health Organization 2005).

After the setting of the 26" non-pressure containing surface casing, the 17 ½" section of each well will be drilled using WBM, utilising a riserless mud return (RMR) system. The RMR is installed on the wellhead and includes a pump and hose on the seabed. It enables drilling fluids and drilled cuttings to be either discharged from the well at the seabed (conventional riser-less drilling) or circulated back to the MODU, via the RMR.

13 $^{3}/_{8}$" casing will then be cemented in place and the blowout preventer (BOP) and marine riser installed. This closed-system facilitates the transfer of drilling fluids and drilled cuttings back to the MODU for all subsequent drilling operations.

The 12 $^{1}/_{4}$" hole will then be drilled using SBM and a 10 ¾" x 9 $^{7}/_{8}$" or 10 ¾" x 9 $^{5}/_{8}$" production casing cemented in place. Up until this point, the well design is the same regardless of whether the target is the Brewster or Plover reservoir.

For Brewster wells, the next section is 8 ½"; drilled using either a SBM or WBM formulation followed by the setting and cementing of the 7" production liner.

For Plover wells, the next section is drilled out through Brewster in 8 ½" hole size and under-reamed out to approximately 9 ¾". A 7 $^{5}/_{8}$" expandable liner is then run and expanded out to provide an 8 ½" drift and to isolate the Brewster interval. The final section is then drilled out through Plover in 8 ½" hole size followed by installation and cementing of the 7" production liner which is set in 9 $^{7}/_{8}$" casing.

Both Brewster and Plover sections will be drilled using SBM given high anticipated temperature (155 - 175°C) and to prevent formation damage across the Plover reservoir interval. SBM section drill cuttings will be processed by a cuttings dryer to reduce the amount of oil-on-cuttings to no greater than 7% by dry weight of cuttings. The dried cuttings will be discharged overboard. The reclaimed SBM will be retained on board for disposal onshore, or recycled into the mud system. At the end of drilling, all recaptured SBM will be returned to the vendor for reuse.

**Completions**

Well completion activities will be undertaken in both Brewster and Plover development wells after drilling to depth and installing the 7" production liner.

Both Brewster and Plover wells are planned as cased and perforated completions. The upper completion consists of: production packer; down hole pressure and temperature gauges; 7" or 5 ½" production tubing; tubing retrievable surface controlled subsurface safety valve (SCSSV); and a series of nipple profiles to allow suspension plugs or contingency tooling to be installed. The SCSSV is designed to automatically close in the event of an emergency shutdown during production. In Brewster wells, perforating guns will be deployed in advance of the upper completion, fired after installation of the upper completion and will remain in hole across the reservoir interval throughout well life. In Plover wells, the guns will be deployed, fired and recovered using intervention techniques (e.g. wireline or coil tubing) after upper completion installation.

### Well flow back

Following upper completion installation, a well flow back will be performed to remove completion fluids and debris from the well. The well flow back will be performed using specialised well flow back equipment on the MODU which will be supplied by a third-party service contractor. Each well will be flowed at gas rates of up to 3.68 $Mm^3/d$ (130 MMscf/day) with produced fluids flared through a high efficiency burner head via a high rate separator.

Following well clean-up, a multi-rate well test will be conducted at various flow rates to establish baseline well deliverability; to obtain reservoir fluid samples and estimate key formation parameters. All well flow back operations will be conducted in accordance with the MODU's safety case accepted by NOPSEMA.

Overall estimated time for well flow back operations is 24 hours per well, although this will be subject to the precise reservoir characteristics and other factors.

### Well suspension and subsea infrastructure installation

Following well flow back, wells will be suspended in accordance with the INPEX Well Integrity Standard (0000-AD-STD-60003). Leaving the wells shut-in with gas prevents any formation damage during the temporary suspension period until commencement of production start-up.

In some circumstances, drilling may cease before the hydrocarbon reservoir is penetrated and the well will be suspended for re-entry at a later date. Suspension for re-entry may occur at any stage of the well, although typically it takes place after the 13 $^3/_8$" casing, 9 $^7/_8$" casing or 7" production liner has been installed.

The method of post-well flow back well suspension depends on the mode in which the well flow back is performed, and subsea infrastructure installed. This will be either:

1. In-riser Completion Workover Riser (CWOR) mode.

   This mode is typically utilised if a 'Christmas tree' (XT) is not available for immediate installation. In this mode the drilling BOP remains installed on the tubing head spool (THS) during the well flow back. The subsea test tree (SSTT) and high CWOR form a conduit from the well to the MODU for all produced fluids. Upon conclusion of the well flow back, the wells will be suspended using two tested barriers (typically suspension plugs) in accordance with the INPEX Well Integrity Standard (0000-AD-STD-60003). This allows recovery of the BOP and installation of the XT (on the THS). A re-entry activity (well intervention) is subsequently required to remove the suspension plugs (or equivalent) in advance of production; or

2. Open-water CWOR mode.

   In this mode, the BOP is recovered after upper completion installation and prior to well flow back. Two tested barriers are in place for BOP recovery as per the INPEX Well Integrity Standard (0000-AD-STD-60003). After BOP recovery, the XT is installed (on the THS) and the emergency disconnect package (EDP)/lower riser package (LRP) and high-pressure open water CWOR is deployed and connected to the XT. The well flow back is then performed with the high-pressure open water CWOR forming the conduit from the well to the MODU for all produced fluids. Open-water CWOR mode does not require subsequent suspension plug recovery since the XT valves can be closed and tested thereby providing the necessary well barriers. No subsequent well intervention activity is required in advance of production.

No environmental impacts have been identified with well suspension and subsea infrastructure installation operations, excepting the discharge of well suspension fluid (brine, MEG and control fluid) and control fluid discharges to sea from BOP, XT and EDP/LRP functions. A water-based subsea control fluid will be used to test THS and XT connectors and to function the XT valves. In addition to discharges from valve functioning, the XT internal body will also be flushed with hydraulic control fluid. The hydraulic control fluid is a water/glycol mixture containing additives to protect against wear, corrosion and bacterial degradation, with a fluorescein dye as evidence of fluid displacement or to facilitate leak detection. This operation is performed using a remote operated vehicle (ROV). Water-based subsea control fluid will be discharged from the ROV and XT valves to the marine environment. ROV tooling equipment may be temporarily placed on the seabed in the vicinity of the well during XT and THS installation operations. The area of seabed occupied by such ROV tooling baskets is typically 2 -3 $m^2$ in size.

### Drilling fluids and chemical selection

A description of the chemical selection procedure for drilling fluids is presented in Section 9.6.1. The proposed formulations and chemicals to be used are listed in Table 3-2 (WBM) and Table 3-3 (SBM).

The listed products are only proposed and may change during the activity as new products are required. Indicative OCNS or CHARM HQ rankings have been included where possible. Any new products will be selected in accordance with the selection and approval process, and the list will be reviewed periodically and updated.

**Table 3-2: 44", 26" and 17½" hole section: water-based formulation – provisional additives**

| Generic product name | Function | OCNS or CHARM HQ |
|---|---|---|
| Sea water | Continuous phase | n/a |
| Biocide | Bacteria control | Gold |
| Bentonite | Viscosifier | E |
| Caustic soda | Alkalinity control | E |
| Glycol medium Cloud Point | Clay inhibition | Gold |
| PAC Low Vis | Fluid loss control | E |
| PAC Hi Vis | Fluid loss control | E |
| Potassium chloride | Clay inhibition | E |
| Soda ash | Alkalinity control | E |
| Soltex (Sodium) | Clay inhibition | Gold |
| Sized cellulose | Lost circulation | E |
| Desco CF | Dispersion | Gold |

| Generic product name | Function | OCNS or CHARM HQ |
|---|---|---|
| Xanthan gum | Viscosifier | E |

**Table 3-3: 12¼", 8½" hole section: synthetic-based formulation - provisional additives**

| Generic product name | Function | OCNS or CHARM HQ |
|---|---|---|
| Primary emulsifier | Primary emulsifier | Gold |
| Secondary emulsifier | Secondary emulsifier | Gold |
| Option A: linear alpha olefins (LAO) synthetic base oil [1] | Continuous emulsion phase | E |
| Option B: Saraline 185V synthetic base oil [1] | Continuous emulsion phase | E |
| Organophillic clay HT | Viscosifier | E |
| Organophillic clay | Viscosifier | E |
| Lime | Alkalinity control | E |
| Calcium chloride | Internal water phase salinity | E |
| Fluid loss additive powder | Fluid loss control | E |
| Fluid loss additive liquid | Fluid loss control | Gold |
| Calcium carbonate | Reservoir bridging | E |
| Barite | Density control | E |

[1] Note: Option A base oil will be the default for formulating SBM. If, as a consequence of operational problems, (e.g. lost circulation, resulting in depletion supplies of Option A base oil), Option B base oil will be used until further supplies of Option A base oil are available.

### Drill cuttings

WBM drill cuttings will either be discharged directly to the seabed (while drilling the riserless 44" and 30 ½" diameter sections) or brought up to the MODU (while drilling the subsequent 17 ½" diameter section). Cuttings brought up to the MODU will be directed over solids control equipment (SCE), which comprises vibrating screens (shale shakers), and to centrifuges, and then discharged overboard. Where SBM is used, SCE will also include cuttings dryers. Except for residual fluid on drill cuttings, no SBM will be discharged to the marine environment. Details of the SCE equipment are provided below.

Shale shakers

Shale shakers primarily remove large amounts of cuttings from drilling mud by directing it from the well to flow over vibrating wire-cloth screens. The screens remove the cuttings after which the mud is directed back to the MODU mud-storage pits.

Centrifuges

Following the processing by shale shakers, the mud will be directed to centrifuges which are used to separate barite and remove fine solids (those below 4.5 to 6 microns). Centrifuges use a rotating bowl to create high centrifugal forces to affect the separation of coarse and fine particles from the mud. Solids from the centrifuge are discharged to sea and the mud recirculated into the fluid system.

Cuttings dryer and dryer centrifuge

While using SBM, a circulating system will be active that processes the SBM over shale shakers and through centrifuges. These allow the SBM fluid component to be separated from the cuttings and captured for continuous recirculation into the fluid system during drilling.

Table 3-1 provides a summary of estimated fluid and cuttings volumes to be discharged. The cuttings dryer will aid in ensuring the volume of SBM retained on cuttings is ≤7% weight per weight (wt/wt).

**Well completion fluids**

Completion operations commence by displacing the entire wellbore contents of SBM or WBM drilling fluids with filtered and inhibited sodium chloride brine. The brine contains subsea control fluids, MEG, several inhibitors such as a biocide, oxygen scavenger and lubricant. A base oil spacer and a surfactant pill will be used to remove oil film from the pipe and casing in the wellbore. This fluid combination is re-captured in the MODU pit storage tanks upon return to surface. All oil-contaminated fluids (approximately <15 $m^3$ per well) will be contained and returned to shore for suitable disposal. Any of the surfactant pill that is not contaminated with oil will be discharged overboard to the marine environment.

Sodium chloride brine will be used to displace the surfactant pills. A closed circulating system will be used to ensure no brine is discharged. Oil-contaminated brine will be quarantined and processed to remove the oil. All the removed oil will be sent onshore for disposal.

Remaining brine will be filtered to remove solids and reused on subsequent wells. At the end of the drilling campaign, the brine will be discharged to the marine environment.

After deployment of the upper completion, prior to setting of the production packer, the tubing and annulus contents will be displaced from the brine to base oil (leaving brine in the 7” liner). Base oil will be burned through the oil burner head flare boom. No base oil will be discharged to the marine environment. At the end of the drilling campaign, all remaining base oil will be returned to shore for reuse.

Indicative well completion additives are summarised in Table 3-4.

**Table 3-4: Well completion fluids and additives**

| Generic Product name | Function | OCNS or CHARM HQ |
|---|---|---|
| Xanthan gum | Viscosity | E |

| Generic Product name | Function | OCNS or CHARM HQ |
|---|---|---|
| Solvent/Surfactant | SBM removal | Gold |
| Sodium chloride | Density | E |
| Sodium bromide | Density | E |
| Corrosion inhibitor | Oxygen scavenger | Gold |
| Bactericide | Biocide | Gold |
| Option A: LAO synthetic base oil | Underbalance and packer fluid | D or E |
| Option B: Saraline 185V synthetic base oil | Underbalance and packer fluid | E |
| Lubricant | Lubricant | Gold |
| Citric acid | Alkalinity control | E |
| Caustic soda | Alkalinity control | E |
| Sodium carbonate | Alkalinity control | E |
| Sodium bicarbonate | Alkalinity control | E |

**Cementing**

Cementing operations are undertaken to ensure well integrity, through the following mechanisms:

- cementing the casing and conductors in place
- sealing the annulus between the casing string and the formation
- sealing lost circulation zones
- setting plugs in an existing well from which to sidetrack
- suspending the well
- plugging and abandoning the well, if required due to unforeseen circumstances.

Cement is transported as dry bulk to the MODU by the support vessels and is mixed with water and additives in the cementing unit immediately before use to form a cement slurry which is then injected down the well by high-pressure pumps.

It is standard practice to allow some excess cement slurry to overflow to the sea floor when cementing the top-hole section as this provides visual evidence that the annular space between the hole and the casing has been filled. This typically covers an area of seabed of up to 10 m from the well. Small volumes of cement slurry may also be discharged to the sea surface when testing the cementing unit or disposing of excess slurry before it sets at the end of a cementing job. Excess cement will be retained for use on the next well, at the end of the drilling campaign, should any bulk cement remain, INPEX will aim to transfer the excess volume to the vessel for onshore disposal/reuse. The bulk transfer (MODU to vessel) will be dependent on the transfer capability of the contracted MODU. Should this option not be available, the remaining cement will be mixed and operationally discharged to the marine environment.

In accordance with the Section 9.6.1, cement products used will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold. If not OCNS registered, all chemicals will be assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria.

**Blow-out preventer**

A BOP plays a critical role in assuring safe operations in the event of a loss of primary well control. As part of ongoing drilling operations, the BOP stack is required to be regularly function-tested when subsea (typically weekly/fortnightly), as defined by the INPEX Well Operations Standard (0000-AD-STD-60004) and Well Operations Manual (0000-AD-MAN-60002). During testing, volumes of water-based BOP control fluid will be released to the marine environment.

**Open-water CWOR**

The EDP and LRP plays a critical role in providing well barriers when performing well intervention activities in open-water CWOR mode e.g. during suspension plug installation and well flow back from the MODU.

During a typical well intervention or well flow back, the EDP/LRP is function-tested during assembly and maintenance, with regular function-testing and pressure-testing. During testing and regularly while operating, water-based subsea control fluid will be discharged to the marine environment.

### 3.2.2 Gas venting

During drilling operations, minor quantities of drill gas will be separated and safely discharged from mud processing equipment. Additionally, it is possible that a well kick may occur resulting in an undesirable influx of formation fluid into the well-bore. The resultant effect would be a release of gas via the mud-gas separator to the atmosphere during well control operations. During well flow back operations, venting may also occur from vessel surge tanks. Gas will not be vented near any ignition sources.

### 3.2.3 Vertical seismic profile (VSP)

VSP uses a sound source suspended in the water column and recorders located down-hole to provide a high-resolution seismic image of the immediate vicinity of the well. VSP measurements are used primarily for correlation of existing seismic data.

The sound source used for VSP is similar to, but much smaller than, those used during seismic surveys. Typically, an acoustic source with a total array volume of 0.012 $m^3$ (~750 cubic inches) is employed. The sound pressure level will be 238 dB re 1 µPa@1m with a frequency range of 5–125 Hz.

The airgun source array is discharged 5–10 m below the sea surface approximately five times at roughly 20-second intervals, with recordings taken down-hole at a specific depth. Additional recordings are made at 5–7 minute intervals as the down-hole tool is repositioned within the well. VSP is planned for the drilling campaign with the total duration of VSP activities (excluding soft starts) estimated to take approximately 7–10 hours per well (but will be dependent on the results of the well which is being profiled and the schedule of activities). VSP is planned for up to 2 wells.

### 3.2.4 Contingent drilling activities

**Well inspection, maintenance and repair (IMR) activities**

In order to maintain the integrity of completed, suspended or abandoned development wells, INPEX may undertake an inspection program, with provision for maintenance and repair as required to ensure that risks to well integrity are reduced to ALARP.

Activities associated with well IMR may include (but are not limited to):

- vessel operations – transport of equipment and personnel to the drilling campaign area to be used as a platform for subsea activities such as the installation of subsea equipment and ROV operations.
- ROV operations – ROV surveys may be undertaken as required as a means to visually monitor the well head, XT and other subsea infrastructure associated with the SPS within WA-50-L.
- installation of leak detection systems – leak detection systems may be considered for use to remotely monitor potential leaks from the well heads and XTs. These systems may utilise hydrophones to detect pressure waves or sound, generated by a rupture and would be alarmed to trigger further investigation using an ROV. Transponders and battery pack would sit on the seabed and occupy a small area, in the order of a 4-5 $m^2$, and will be removed at the end of the IMR activity.
- subsea cleaning – subsea cleaning and marine growth removal using ROVs may be undertaken as required on the external surface of the well head, XT and related subsea infrastructure to allow for visibility of, access to or restore functionality of well head or XT components.) Initially, physical removal with high pressure or cavitation jets may be used to remove as much marine growth or calcium deposits as possible. If physical removal is unsuccessful (i.e. due to access issues) weak acids such as acetic or sulfamic acid may be used to remove residual marine growth / calcium deposits.
- installation and upkeep of cathodic protection systems – cathodic protection may be installed in order to control the corrosion of metal surfaces on the well head. This may involve the deployment of skids containing the required number of anodes around the wellhead occupying a small area of seabed. Typically these systems cover an area of seabed of approximately 2-3 $m^2$ and will be removed at the end of the IMR activity.

**Well intervention**

Well intervention activities are those conducted in already completed wells. Often, well intervention is required as a result of well integrity or performance issues requiring investigation or repair. In Ichthys wells, well intervention may also be undertaken as a planned construction operation to recover suspension plugs from the completion following XT installation if a well has been flowed back via in-water CWOR mode (Section 3.2.1 *Well suspension and subsea infrastructure installation*).

Typically, well intervention involves the use of slick-line, wire-line or coiled tubing to conduct various activities within the wellbore (usually through the installed XT). They are undertaken with a MODU or light well intervention (LWI) vessel. Examples of these activities are presented in Table 3-5.

**Table 3-5: Examples of well intervention activities**

| Method | Activity |
|---|---|
| Coiled tubing | Mechanical or chemical removal of wellbore obstructions |
| | Chemical removal of near wellbore damage |
| | Recovery of spent TCP gun carriers |
| | Re-perforation of the liner or perforation of additional intervals |
| Slick-line and wire-line | Installation of a wire-line retrievable Surface Controlled Subsurface Safety Valve (SCSSV) |
| | Installation of ceramic sand screens |
| | Installation/retrieval of slick-line or wire-line retrievable suspension plugs |
| | Installation of deep-set mechanical plugs in the completion to isolate leaks prior to a workover |
| | Deployment of wellbore investigation tools to investigate well integrity or productivity issues |

**Well interventions from a MODU**

Well intervention from a MODU can be achieved using in-riser or open-water CWOR to undertake coiled tubing, wire-line and/or slick-line well intervention activities. Well flow back may also be performed.

**Well interventions from a LWI vessel**

As an alternative to a MODU, well interventions can also be achieved from a LWI vessel. LWI does not utilise a high pressure CWOR back to the vessel, instead a well intervention package is used for pressure control. The well intervention package provides the barriers required to maintain well integrity throughout the well intervention activities.

The well intervention package is installed on top of the XT and consists of a number of surface hydraulically actuated, and ROV operated, valves. During a typical well intervention activity, the well intervention package valves are functioned during assembly and maintenance, with routine function-testing and pressure testing performed on a predetermined schedule. Hydraulic control fluid, wire-line grease and fluorescein dye may be discharged to the marine environment.

Slick-line or wire-line tooling are typically deployed in and out of the well via the well intervention package. For deployment into the well, seawater inside the well intervention package is flushed using MEG and nitrogen. A key reason for this flushing activity is to avoid contamination of the reservoir and avoid hydrate formation. Any hydrates that do form, may be removed by the addition of methanol.

On recovery of the slick-line or wire-line tooling, the pressure inside the well intervention package is bled off and flushed with MEG. The pressure, either from well gas, nitrogen, MEG or seawater, is vented and discharged to the marine environment. As an alternative to bleeding off the well intervention package gas pressure subsea, it may be bled off on the vessel via a surface bleed off package to an overboard vent.

A LWI vessel may also be used for XT change-out.

#### Well workover

In the event that well integrity or performance issues are identified requiring investigation and repair, a workover using a MODU may be undertaken. Workovers require removal of the XT and installation of the BOP. Examples of workover activities include:

- replacement of a failed tubing retrievable type SCSSV
- replacement of a failed production packer, completion tubing or completion component
- repair or replacement of failed production casing or casing seal assembly
- XT change-out.

#### Well abandonment

If abandonment of a development well is required, the well will be plugged and abandoned in accordance with the approved Well Operations Management Plan (WOMP). A two-barrier philosophy for permanent abandonment will be maintained in compliance with INPEX barrier standards (INPEX Well Integrity Standard (00-AD-STD-60003) and INPEX Well Operations Manual (00-AD-MAN-60002)).

The timing of this activity will be determined by operational schedules. In the event only part of the well is abandoned, the wellhead may be retained for future access.

Well abandonment activities will also be undertaken in accordance with the requirements of the *OPGGS* Act, the OPGGS (Resource Management and Administration) Regulations 2011.

#### Other contingent drilling activities

A number of other contingencies, detailed in Table 3-6, may be required in the event of operational or technical issues during the drilling campaign.

**Table 3-6: Drilling contingencies**

| Contingency | Contingency establishment | Description | Environmental considerations |
|---|---|---|---|
| Well re-spud | In the event that operational or technical issues are encountered while drilling. | The process of beginning to drill a well.<br>The location of the re-spud would typically be within the immediate area of the original well at a safe location. | The net environmental effect will be limited to an increase in the volume of cuttings generated. In a worst-case scenario, this could be a doubling of the estimated drill cuttings from the first two sections of the well-bore (Table 3-1). |

| Contingency | Contingency establishment | Description | Environmental considerations |
|---|---|---|---|
| | | | There may also be some additional temporary, localised damage to benthic habitat.<br>Should a well re-spud be required, the original well will be permanently plugged and abandoned as described in Section 3.2.4 *Well abandonment*. |
| Sidetrack | In some instances, the option of a sidetrack instead of a re-spud might be pursued when operational issues are encountered.<br>This contingency option (in conjunction with well workover) may be utilised in events such as a failure where the well is producing sand. | The process of drilling a secondary well-bore away from an original well-bore. | The net environmental effect will be limited to an increase in the volume of cuttings generated. The worst case would be equivalent to cuttings generated from a single section of the well. |
| Lost circulation | Circulation is said to be lost when the drilling fluid flows into one or more geological formations instead of returning up the annulus. | A number of contingencies are available when lost circulation occurs, depending on the severity:<br>• minor losses may be controlled with the use of fluid-loss control materials such as bentonite and/or polymers, or other additives<br>• severe losses will require the use of fluid-loss control materials such as bentonite and/or polymers and the addition of bridging agents such as ground calcium carbonate and fibrous material | The net environmental effect would be a change in the water quality at the point of discharge. Depending on the volume of discharge, this could potentially form a temporary plume before it is dispersed back to ambient levels. |

| Contingency | Contingency establishment | Description | Environmental considerations |
|---|---|---|---|
| | | • pull back, cement the zone where the losses occurred, and drill through the cement and recommence drilling the well. | |
| Drilling a contingency 6" section for development wells | In the event that hole conditions deteriorate during development drilling. | If problems are encountered during the 8 ½" section, a 7" liner will be run and cemented. The reservoir will then be drilled as a 6" section with an alternative lower completion run. | None – overall reduction in cuttings due to smaller hole size. |

### 3.2.5 Other drilling related activities

#### Rig acoustic positioning

In order to assist with the rig positioning for the development wells, INPEX may require the deployment and retrieval of Long Base Line (LBL) acoustic positioning arrays at selected drill centres.

Specialist service contractors will be commissioned to provide the services and equipment relating to the LBL array installation including the use of a vessel and crane, and temporary installation of seabed acoustic positioning systems.

Drill centre LBL arrays will generally consist of a number of transponders to be installed temporarily around the wells in fixed stands, standing approximately 2 m above the seabed and covering an area of approximately 2 – 3 $m^2$. There are no emissions or discharges associated with rig acoustic positioning arrays.

#### Simultaneous operations (SIMOPS) activities

In relation to the scope of this EP, SIMOPS are defined as simultaneous operations within drilling-related activities.

The SIMOPS-related environmental risks associated with broader Ichthys LNG Project work scopes that will be occurring in WA-50-L during the course of the proposed drilling schedule will be addressed in activity-specific EPs, which will be submitted to NOPSEMA for assessment and acceptance.

INPEX will manage drilling SIMOPS activities in line with the INPEX SIMOPS Procedure (0000-AH-PRC-60004).

## 3.3 Semi-submersible MODU, supporting vessels (including IMR/LWI vessels) and aircraft

The MODU contracted to undertake the drilling campaign will be a semi-submersible MODU with an expected complement of 100 to 180 personnel onboard. The MODU will maintain position using either DP or an anchored mooring system. While on location, a petroleum safety zone (PSZ) with a 500 m radius will be maintained around the MODU at all times; to control activities, and to reduce the risk of marine collisions, as required under the *OPGGS* Act. Marine Safety Information (MSI) notifications will be issued via AMSA, while the Australian Hydrographic Office (AHO) will issue a Notice to Mariners. The MODU will be powered by marine diesel with a typical usage of 30,000 L per day for a moored MODU. Fuel usage will increase if the MODU is dynamically positioned (approximately 50,000 L per day).

The MODU will be supported by two to three vessels (i.e. Anchor Handling Supply Vessels (AHSVs) and Platform Supply Vessels (PSVs)), as well as regular helicopter flights from the mainland.

The AHSVs and the PSVs will be used to transport equipment, materials and fuel between the MODU and the port of Broome, the marine supply base for the drilling campaign. The AHSVs will be used to deploy and accurately position anchors for the MODU if required. The vessels will also conduct safety lookouts for helicopter landings and take-offs; monitor the 500 m PSZ maintained around the MODU; and provide support in the event of emergencies. Vessels will remain outside of the PSZ unless undertaking duties. Support vessels will be powered by marine diesel with a typical usage of 5,000 L per day when on standby (Gustavson Associates 2011) and 15,000 L per day when steaming. Each supply vessel will be crewed by up to 25 personnel and bunkering.

LWI vessels are DP operated vessels typically with 80 to 110 personnel onboard and will be powered by marine diesel. The LWI vessel will also maintain a PSZ (500 m radius), as required under the *OPGGS* Act.

Aviation support will be based at Broome International Airport. Helicopters based in Broome will be used to transfer personnel to and from the MODU several times per week. The transfer frequency may vary depending on MODU manning, the operational phase of the well, and the specification (capacity) of the helicopters contracted.

Vessels and helicopters may be refuelled in WA-50-L as operationally required during the drilling campaign.

### 3.3.1 Anchoring and dynamic positioning

A moored MODU will typically have a minimum of eight anchors, deployed by AHSVs and lowered to the seabed. Anchors may be pre-laid in advance of the MODU arriving at each well location. Once in place, the MODU winches in the slack from the mooring lines to the required tension. Anchors are spread in a radial pattern extending from the MODU. The size of the anchor spread will be dependent on the MODU and the MODU specific mooring analysis conducted during the well planning stage. Typically, mooring lines extend approximately 2,000 m from the MODU with approximately 1,000 m of grounded chain. Each anchor typically occupies a total seabed area of approximately 30 $m^2$. Retrieval of anchors is the reverse of the deployment procedures.

A DP MODU will maintain position at the well locations using thrusters and will be capable of transiting between well locations in WA-50-L using its thrusters.

Vessels will not moor at the well locations; they will use DP to maintain position. Vessels may also use temporary moorings which may be installed in the vicinity of the Ichthys Field to reduce marine diesel consumption while vessels are on stand-by. Temporary moorings would likely consist of a single clump weight or drag embedment anchor, a length of chain and cable to a buoy, which would be retrieved at the end of the drilling campaign. The expected area of physical disturbance to the seabed associated with a temporary mooring is approximately 15-30 m$^2$.

### 3.3.2 Remotely operated vehicle (ROV)

The MODU, as well as other specialised vessels will be equipped with a ROV for:

- pre-spud hazard surveys
- monitoring of BOPs/marine riser, EDP/LRP and well intervention package
- monitoring of cementing operations
- monitoring subsurface infrastructure installation, shallow gas, and unplanned discharges
- function and pressure-testing of well THS and XT connectors (if installed)
- functioning of ROV operated valves on THS, XT, BOP, EDP/LRP and well intervention package
- functioning subsea equipment for cleaning marine growth and troubleshooting.

Camera systems (still and video) are also fitted to the ROV to capture permanent records of the environment and operations.

## 3.4 Summary of emissions, discharges and wastes

A summary of the emissions, discharges, and wastes resulting from the activities are described in Table 3-7, including indicative volumes where relevant. Relevant monitoring and measurement conducted on the emissions and discharges are detailed below and further described within the respective subsections of Section 7.

**Table 3-7: Emissions (E), discharges (D) and wastes (W) generated during the petroleum activity**

| Activity/system | E, D, W | Description | |
|---|---|---|---|
| ROV operations | D | MODU or vessel based ROV | Routine subsea discharges of water-based hydraulic fluids and subsea control fluids (< 1 m$^3$). |
| BOP | D | MODU | Water-based BOP control fluids. BOP function/pressure testing results in approximately 250 L of BOP fluid discharged to the marine environment per test. |
| Open-water CWOR | D | MODU | Routine subsea discharges of water-based hydraulic fluids and subsea control fluids (< 1 m$^3$). |
| Well intervention package | D | LWI vessel | Discharges of water-based subsea control fluid (< 1 m$^3$).<br>Methanol used to dissolve hydrates (<200 L) and MEG (< 5 m$^3$). |

| Activity/system | E, D, W | Description | |
|---|---|---|---|
| | | | Hydraulic control fluid, wire-line grease and fluorescein dye may be discharged to the marine environment (< 1 m$^3$). |
| Drilling fluids | D | MODU | Basic WBM system uses low-toxicity drilling fluid that is benign to the environment.<br>Sections of the well will be drilled with SBM for technical reasons (Table 3-1).<br>All drilling fluids selected for use are assessed and approved by the environmental advisor prior to use. |
| Completion fluids | D, E | MODU | All oil-contaminated fluids (approximately <15 m$^3$ per well) will be contained and returned to shore for suitable disposal.<br>Oil-contaminated brine will be processed to remove the oil and reused on subsequent wells. Brine discharged to the marine environment at the end of the campaign.<br>Uncontaminated surfactant pill discharged to the marine environment.<br>Base oil will be burnt through the oil burner head flare boom. |
| Drill cuttings | D | MODU | While drilling riserless, all returns will be to the seabed.<br>For well sections that require SBM, SCE will be used, and cuttings discharged from the surface. No whole SBM will be discharged, only residual fluid on drill cuttings will be discharged (≤7% oil-on-cuttings wt/wt (averaged over the SBM sections)). |
| Cementing | D | MODU | Seabed discharge at well location may cover an area of seabed up to 10 m from the well; plus surface discharge from tank cleaning. Any bulk cement remaining at the end of the campaign is transferred onshore for disposal/reuse. Should this option not be available, the remaining cement will be mixed and operationally discharged to the marine environment. |
| Gas venting | E | MODU or LWI vessel | Atmospheric emissions when venting during drilling (via the mud-gas separator during well control operations) or when venting during LWI activities (via a surface bleed off package to an overboard vent). |
| Well flow back | E | MODU | Flaring of gas, burning of hydrocarbons, cold venting of gases from tank vents. Utilisation of diesel driven air compressors and steam generators. |

| Activity/system | E, D, W | Description | |
|---|---|---|---|
| Well suspension | D | MODU | Well suspension fluids including corrosion inhibitors, biocide and MEG.<br>Routine subsea discharges of water-based hydraulic fluids and subsea control fluids (< 1 $m^3$) from BOP, XT and EDP/LRP activities. |
| VSP | E | MODU | Noise emissions (pulses) from seismic source during VSP (approximate 7-10 hours duration).<br>Typical total array volume of 0.012 $m^3$ (~750 cubic inches). |
| Installation of subsea infrastructure | D | MODU | Routine subsea discharges of water-based hydraulic fluids and subsea control fluids (< 1 $m^3$) associate with XT function testing and ROV use.<br>Discharge of MEG and fluorescein dye (to confirm fluid displacement and facilitate leak detection). |
| IMR activities | D | Vessel | Subsea discharges of water based hydraulic fluids (< 1 $m^3$) from ROV use.<br>Subsea cleaning and marine growth removal chemicals using solutions of weak acetic or sulphamic acid.<br>Contingency discharge of MEG from SPS (manifold/jumper spool flushing) via the MODU infrastructure (< 5 - 20 $m^3$), typically released subsea. |
| Power generation | E | MODU | Combustion emissions from MODU and diesel-powered generators onboard emitted to the atmosphere. |
| | E | MODU | Noise emissions from power generation (and other topside activities) including DP thrusters. |
| | E | Vessels | Combustion emissions from vessels and diesel-powered generators onboard emitted to the atmosphere. |
| | E | Vessels | Noise emissions from vessel engines and propulsion systems (such as DP thrusters). |
| Cooling water | D | MODU<br>Vessels | Seawater used as heat-exchange medium for machinery engines. Return seawater containing residual heat and residual sodium hypochlorite is returned to sea. |

| **Activity/system** | **E, D, W** | **Description** | |
|---|---|---|---|
| Open-drains system | D | MODU | The MODU main deck and moon pool areas will have an open drains system. Deck drainage water will be discharged to sea. Note low toxicity rig wash will be used for washing the main deck of the MODU.<br>MODU floor drainage may be routed for mud recovery and re-used in the active mud system. |
| Closed-drains system | W | MODU | The MODU pump rooms and engine rooms are closed drainage areas. Oily waste material from the closed drains is collected in a holding tank and returned to shore for treatment and disposal.<br>During the use of SBM, all drains in areas exposed to SBM will be plugged. A mud vacuum system (mud-vac) will be used to collect spillages of SBM. The SBM collected by the mud-vac will either be treated and reused or shipped to shore for disposal. |
| Vessel deck drainage | D | Vessels | Vessel deck drainage water will be discharged to sea. |
| Bilge system | D | MODU<br>Vessels | Treated contaminated bilge water with <15 ppm (v) OIW is discharged to sea. |
| Sewage, grey water and macerated food waste effluent | D | MODU<br>Vessels | Treated effluent produced by sewage treatment plants is discharged to sea. |
| Ballast system | D | MODU<br>Vessels | Return ballast is discharged to sea. |
| Foam fire-extinguishing | D | MODU<br>Vessels | Firefighting foam is routed to the open-drains/deck drainage system and may be released to sea in the event of system deployment. Minor quantities of wind-blown foam may also be released. |
| Desalination brine | D | MODU<br>Vessels | Brine produced from the Reverse Osmosis (RO) process will be diluted and discharged to sea. |
| Waste incineration | E | MODU<br>Vessels | Combustion gas emissions from on board incineration of permitted wastes. |
| | W | | Ash from incinerators will be stored as waste for disposal on shore. |
| Miscellaneous | E | MODU | Light emissions from deck and navigation lights on MODU and vessels. |

| **Activity/system** | **E, D, W** | **Description** | |
|---|---|---|---|
| | E | Vessels | Noise emissions resulting from drilling. |
| | W | | Solid and liquid wastes from general maintenance operations, equipment replacement, etc., and domestic wastes are transported to shore for disposal. |

# 4 EXISTING ENVIRONMENT

## 4.1 Regional setting

Production licence area WA-50-L is situated in the northern Browse Basin, approximately 390 km north of Derby, Western Australia. In the event of a worst-case unplanned oil spill, the environment that may be affected (EMBA) covers a considerably larger area than the licence area where planned activities will occur.

The spatial extent of the EMBA was determined using stochastic spill modelling. This considered the worst-case credible hydrocarbon scenarios identified for the activity (refer Section 7.4, Table 7-12) in context of defined hydrocarbon exposure thresholds used to determine impacts to fauna and/or habitats (refer Section 8, Table 8-2) for surface hydrocarbons, entrained oil and dissolved aromatic hydrocarbons.

The resulting EMBA is the sum of 300 overlaid stochastic modelling runs (100 per season) for worst-case spill scenarios, during all seasons (wet, transitional and dry) and under different hydrodynamic conditions (e.g. currents, winds, tides, etc.). As such, the actual area that may be affected from any single spill event would be considerably smaller than represented by the EMBA.

The EMBA has been used to identify relevant values and sensitivities that may be affected and has been used as the basis for the EPBC Protected Matters Database search (Appendix B).

### 4.1.1 Australian waters

Australia’s offshore waters have been divided into six marine regions in order to facilitate their management by the Australian Government under the EPBC Act. The production licence area is located entirely within the North-west Marine Region (NWMR). The EMBA intersects with the NWMR and the North Marine Region (NMR) The relevant key features of the NWMR and NMR in the context of WA-50-L and worst-case EMBA are further described in subsequent sections of this EP.

**North-west Marine Region**

The NWMR comprises Commonwealth waters, from the WA–NT border in the north, to Kalbarri in the south. The NWMR encompasses a number of regionally important marine communities and habitats which support a high biodiversity of marine life and feeding and breeding aggregations (DSEWPaC 2012a).

**North Marine Region**

The NMR comprises Commonwealth waters from the WA–NT border to West Cape York Peninsula. This region is highly influenced by tidal flows and less by ocean currents. The marine environment of the NMR is known for its high diversity of tropical species but relatively low endemism, in contrast to other bioregions (DSEWPaC 2012b).

### 4.1.2 International waters

The EMBA extends into the international waters of the Savu Sea and locations along the Indonesian shoreline. The Indonesian archipelago lies between the Pacific and Indian oceans and bridges the continents of Asia and Australia and comprises of over 17,000 islands (Huffard et al. 2012). The archipelago is divided into several shallow shelves and deep-sea basins (ABD 2014). Indonesian waters, especially the eastern part of the archipelago, play an important role in the global water mass transport system, in which warm water at the surface conveys heat to deeper cold waters. The water mass transport from the Pacific to the Indian Ocean through various channels in Indonesia is known as the Indonesian Throughflow (described in Section 4.7.2).

The Indonesian coastline is rich in tropical marine ecosystems such as sandy beaches, mangroves, coral reefs and seagrasses (Hutomo & Moosa 2005). The majority of the West Timor coastline features a narrow fringing coral reef community with four dense areas of mangrove communities occurring primarily along the south coast (Allen & Erdmann 2013). The Timor-Leste coastline also features mangrove communities surrounding entrances to rivers primarily on the south coast, whilst the north and eastern coasts comprise a higher degree of coral reef communities (Allen & Erdmann 2013).

## 4.2 Key ecological features

The Australian Government has identified parts of the marine ecosystem that are of importance for a marine region's biodiversity or ecosystem function and integrity, referred to as key ecological features (KEFs). The north western corner of WA-50-L overlaps one KEF, and a further 7 are located within the EMBA (Figure 4-1) as follows:

WA-50-L:

- Continental slope demersal fish communities.

EMBA:

- Ancient coastline at 125 m depth contour
- Ashmore Reef and Cartier Island and surrounding Commonwealth waters
- Canyons linking the Argo Abyssal Plain with Scott Plateau
- Carbonate bank and terrace system of the Sahul Shelf
- Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals
- Pinnacles of the Bonaparte Basin
- Seringapatam Reef and Commonwealth waters in the Scott Reef complex.

### 4.2.1 Continental slope demersal fish communities

The north western corner of WA-50-L overlaps a small portion of the continental slope demersal fish community KEF. The level of endemism of demersal fish species in this community is the highest among Australian continental slope environments.

The demersal fish species occupy two distinct demersal community types associated with the upper slope (water depth of 225–500 m) and the mid-slope (750–1,000 m) (DEE 2019a). Although poorly studied, it is suggested that the demersal-slope communities rely on bacteria and detritus-based systems comprised of infauna and epifauna, which in turn become prey for a range of teleost fish, molluscs and crustaceans (Brewer et al. 2007). Higher-order consumers may include carnivorous fish, deep-water sharks, large squid and toothed whales (Brewer et al. 2007). Pelagic production is phytoplankton based, with hot spots around oceanic reefs and islands (Brewer et al. 2007).

Bacteria and fauna present on the continental slope are the basis of the food web for demersal fish and higher-order consumers in this system. Therefore, loss of benthic habitat along the continental slope at depths known to support demersal fish communities could lead to a decline in species richness, diversity and endemism associated with this feature (DSEWPaC 2012a). Other potential concerns with regard to pressure on this KEF include climate change (increasing sea temperature/ocean acidification), habitat modification due to fishing gear and commercial fishing by-catch resulting in the potential to diminish the species richness and diversity of these communities (DEE 2019a).

### 4.2.2 Ancient coastline at 125 m depth contour

The ancient coastline at 125 m depth contour KEF runs diagonally in a north-easterly direction, approximately 20 km south of WA-50-L, at its closest point. Parts of the ancient coastline, particularly where it exists as a rocky escarpment, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments. The topographic complexity of the escarpments may facilitate vertical mixing of the water column, providing relatively nutrient-rich local environments. The ancient coastline is an area of enhanced productivity, attracting baitfish which, in turn, supplies food for migrating species (DSEWPaC 2012a).

While there is little information available on the fauna associated with the hard substrate of the escarpment, it is likely to include sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates representative of hard substrate fauna in the NWMR (DSEWPaC 2012a).

### 4.2.3 Ashmore Reef and Cartier Island and surrounding Commonwealth waters

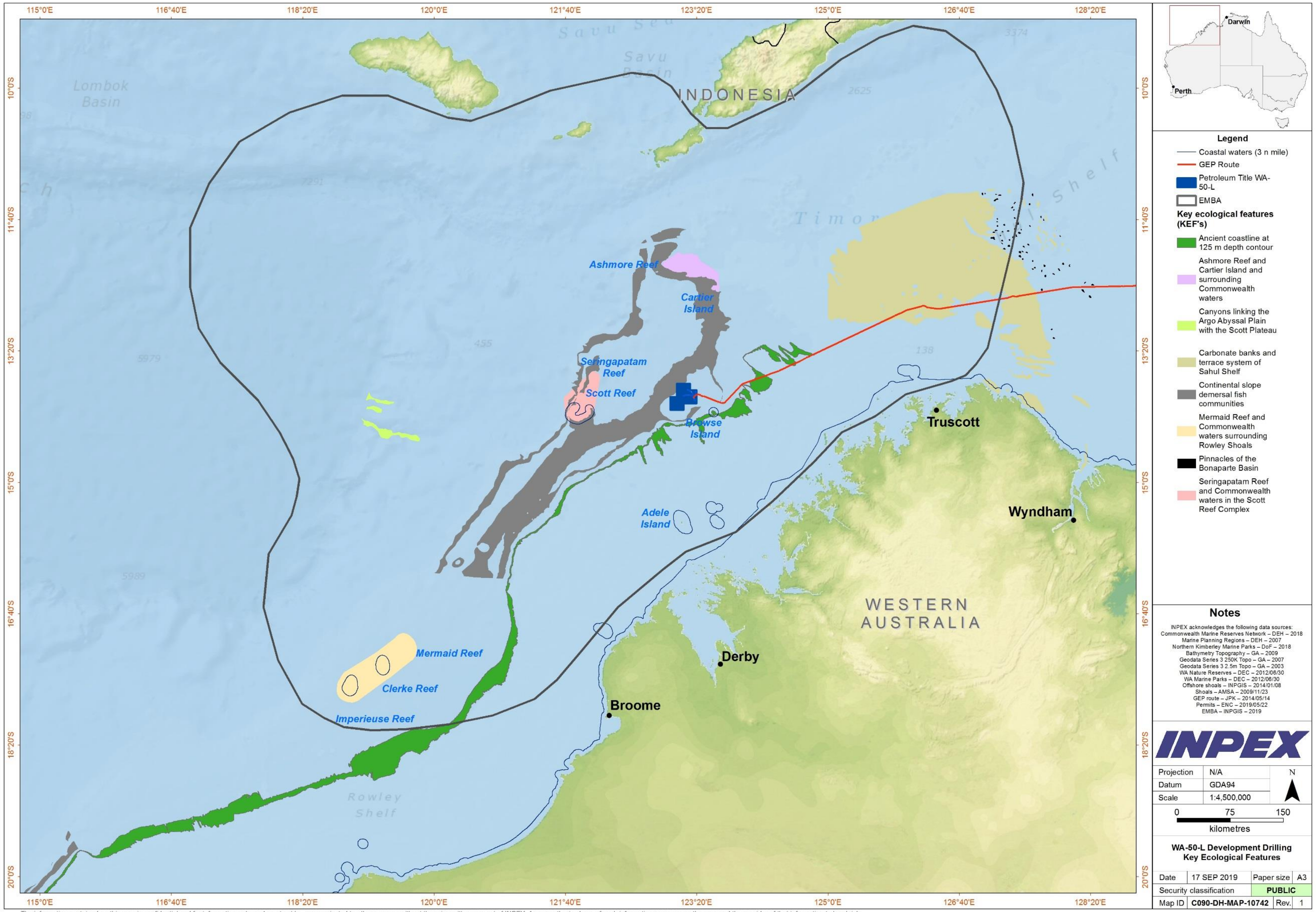
The Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF is located approximately 132 km north of WA-50-L, at its closest point. The KEF is recognised for its ecological functioning and integrity (high productivity), and biodiversity (aggregations of marine life) values, which apply to both the benthic and pelagic habitats within the feature.

Ashmore Reef is the largest of only three emergent oceanic reefs in the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The waters surrounding Ashmore Reef and Cartier Island are important because they are areas of enhanced productivity in relatively unproductive waters (DSEWPaC 2012a).

Further details regarding this KEF are provided in Section 4.3 which describes Australian marine parks.

### 4.2.4 Canyons linking the Argo Abyssal Plain with the Scott Plateau

The canyons linking the Argo Abyssal Plain with the Scott Plateau KEF is located approximately 345 km west of WA-50-L, at its closest point. The Bowers and Oats canyons are major canyons on the slope between the Argo Abyssal Plain and Scott Plateau. The canyons cut deeply into the south-west margin of the Scott Plateau at a depth of approximately 2,000–3,000 m, and act as conduits for transport of sediments to depths of more than 5,500 m on the Argo Abyssal Plain. Benthic communities at these depths are likely to be dependent on particulate matter falling from the pelagic zone to the seafloor. The ocean above the canyons may be an area of moderately enhanced productivity, attracting aggregations of fish and higher order consumers, such as large predatory fish, sharks, toothed whales and dolphins. The canyons linking the Argo Abyssal Plain and Scott Plateau are likely to be important features due to their historical association with sperm whale aggregations (DSEWPaC 2012a).




The information contained on this map is confidential and for information only, and must not be communicated to other persons without the prior written consent of INPEX. Any unauthorised use of such information may expose the user and the provider of that information to legal risk. While every effort has been made to ensure the accuracy and completeness of the information presented, no guarantee is given nor responsibility taken by INPEX for any errors or omissions. INPEX accepts no liability for any use of the said information or reliance placed on it.

**Figure 4-1: Key ecological features in north-west Australia (showing EMBA)**

### 4.2.5 Carbonate Bank and Terrace System of the Sahul Shelf

The carbonate bank and terrace system of the Sahul Shelf KEF is located in the western Joseph Bonaparte Gulf, approximately 207 km north-east of WA-50-L, at its closest point. The KEF is recognised for its biodiversity values (a unique seafloor feature with ecological properties of regional significance), which apply to both its benthic and pelagic habitats. The banks consist of a hard substrate with flat tops. Each bank occupies an area generally less than 10 $km^2$ and is separated from the next bank by narrow sinuous channels up to 150 m deep (DSEWPaC 2012a).

Although little is known about the bank and terrace system of the Sahul Shelf, it is considered to be regionally important due to its continuous and large expanse, as well as the ecological role it is likely to play in the biodiversity and productivity of the Sahul Shelf (DSEWPaC 2012a). The banks support a high diversity of organisms, including reef fish, sponges, soft and hard corals, gorgonians, bryozoans, ascidians and other sessile filter-feeders (Brewer et al. 2007). They are foraging areas for loggerhead, olive ridley and flatback turtles. Humpback whales and green and freshwater sawfish are also likely to occur in the KEF (Donovan et al. 2008). However, due to their ecology, sawfish (generally estuarine rather than open-ocean species), are not expected to be present within open-ocean environments.

### 4.2.6 Mermaid Reef and Commonwealth waters surrounding Rowley Shoals

The Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals KEF is located approximately 476 km south-west of WA-50-L, at its closest point. The Rowley Shoals are a collection of three atoll reefs, Clerke, Imperieuse and Mermaid, which are located approximately 300 km north-west of Broome. The KEF is regionally important in supporting high species richness, higher productivity and aggregations of marine life associated with the adjoining reefs themselves (Done et al. 1994; DSEWPaC 2012a).

The reefs provide a distinctive biophysical environment in the region as there are few offshore reefs in the north-west. They have steep and distinct reef slopes and associated fish communities. Enhanced productivity contributes to species richness due to the mixing and resuspension of nutrients from water depths of 500-700 m into the photic zone (DSEWPaC 2012a). In evolutionary terms, the reefs may play a role in supplying coral and fish larvae to reefs further south via the southward flowing Indonesian Throughflow. Both coral communities and fish assemblages differ from similar habitats in eastern Australia (Done et al. 1994). The reefs associated with the Rowley Shoals are further described in sections 4.3.

### 4.2.7 Pinnacles of the Bonaparte Basin

The Pinnacles of the Bonaparte Basin KEF is located approximately 457 km east of WA-50-L, at its closest point. This KEF consists of an area containing limestone pinnacles, up to 50 m high (above the surrounding seabed) and is located in the western Joseph Bonaparte Gulf on the mid-to-outer edge of the shelf (DSEWPaC 2012b). They represent 61% of the limestone pinnacles in the NWMR and 8% of limestone pinnacles in the Australian EEZ (Baker et al. 2008).

The pinnacles of the Bonaparte Basin are thought to be the eroded remnants of underlying strata. It is likely that the vertical walls generate local upwelling of nutrient-rich water, leading to phytoplankton productivity that attracts aggregations of planktivorous and predatory fish, seabirds and foraging turtles (DSEWPaC 2012b).

As the pinnacles provide areas of hard substrate in an otherwise relatively featureless, soft sediment environment they are presumed to support a high number of species. Associated communities are thought to include sessile benthic invertebrates including hard and soft corals and sponges, and aggregations of demersal fish species such as snapper, emperor and grouper (Brewer et al. 2007). The pinnacles are thought to be a feeding area for flatback, loggerhead and olive ridley turtles, while green turtles may traverse the area. Freshwater and green sawfish as well as humpback whales may also occur in the area (Donovan et al. 2008). However, sawfish are more likely to be found in nearshore and estuarine areas, not within the areas of the KEF that intersect the EMBA.

### 4.2.8 Seringapatam Reef and Commonwealth waters in the Scott Reef Complex

The Seringapatam Reef and Commonwealth waters in the Scott Reef Complex KEF is located approximately 101 km west of WA-50-L, at its closest point. This KEF comprises Seringapatam Reef, Scott Reef North and Scott Reef South. Scott and Seringapatam reefs are part of a series of submerged reef platforms that rise steeply from the seafloor. The total area of this KEF is approximately 2,400 km$^2$ (DSEWPaC 2012a).

Seringapatam Reef is a small circular-shaped reef, the narrow rim of which encloses a relatively deep lagoon. Much of the reef becomes exposed at low tide. There are large boulders around its edges, with a few sandbanks, which rise about 1.8 m above the water, on the west side. The reef covers an area of 55 km$^2$ (including the central lagoon). Scott Reef North is a large circular-shaped reef composed of a narrow crest, backed by broad reef flats, and a deep central lagoon that is connected to the open sea by two channels. The reef and its lagoon cover an area of 106 km$^2$. Scott Reef South is a large crescent-shaped formation with a double reef crest. The reef and its lagoon cover an area of 144 km$^2$.

Scott and Seringapatam reefs are regionally significant because of their high representation of species not found in coastal waters off WA, and for the unusual nature of their fauna which has affinities with the oceanic reef habitats of the Indo-West Pacific, as well as the reefs of the Indonesian region.

The coral communities at Scott and Seringapatam reefs play a key role in maintaining the species richness and subsequent aggregations of marine life identified as conservation values for this KEF. Scott Reef is a particularly biologically diverse system and includes more than 300 species of reef-building corals, approximately 400 mollusc species, 118 crustacean species, 117 echinoderm species, and around 720 fish species (Woodside 2009).

Scott and Seringapatam reefs, and the waters surrounding them, attract aggregations of marine life, including humpback whales and other cetacean species, whale sharks and sea snakes (Donovan et al. 2008; Jenner et al. 2008; Woodside 2009). Two species of marine turtle, the green and hawksbill, nest during the summer months on Sandy Islet (a small sand cay), located on Scott Reef South. These species also internest and forage in the surrounding waters (Guinea 2006). The reef also provides foraging areas for seabird species, such as the lesser frigatebird, wedge-tailed shearwater, brown booby and roseate tern (Donovan et al. 2008).

## 4.3 Australian marine parks

Australian Marine Parks (AMPs) have been established around Australia as part of the National Representative System of Marine Protected Areas (NRSMPA). The primary goal of the NRSMPA is to establish and effectively manage a comprehensive, adequate and representative system of marine reserves to contribute to the long-term conservation of marine ecosystems and protect marine biodiversity.

AMPs under the EPBC Act, and any zones within them, must be assigned to an IUCN Category (Environment Australia 2002). The IUCN categories that are present within the AMPs intersected by the EMBA, as shown in Table 4-1, include:

- IUCN Category Ia – Strict nature reserve – Protected area managed mainly for science.
- IUCN Category II – National Park – Protected area managed mainly for ecosystem conservation and recreation.
- IUCN Category IV – Habitat/species management area – Protected area managed mainly for conservation through management intervention.
- IUCN Category VI – Managed resources protected areas – Protected area managed mainly for the sustainable use of natural ecosystems. Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

The Director of National Parks (2018b) may make, amend and revoke prohibitions, restrictions and determinations under regulations 12.23, 12.23A, 12.26, 12.56 and 12.58 of the EPBC Regulations where it is considered necessary to:

- protect and conserve biodiversity and other natural, cultural and heritage values; or
- to ensure human safety or visitor amenity; or
- where it is otherwise necessary to give effect to the management plan.

At commencement of the North-west Marine Parks Network Management Plan (Director of National Parks 2018a) prohibitions made under regulation 12.23 of the EPBC Regulations are in place prohibiting entry to Ashmore Reef Marine Park, other than parts of West Lagoon and West Island, to protect the fragile habitats and biodiversity, and to Cartier Island Marine Park due to the presence of unexploded ordnance. These have been in place for many years. Determinations made under regulation 12.56 of the EPBC Regulations prohibit anchoring in Mermaid Reef Marine Park and prescribe where vessels must be moored to minimise damage to the reef.

All visitors to Ashmore Reef and Cartier Island (except recreational boat users accessing the Marine National Park Zone of Ashmore Reef) require approval from the Commonwealth Department of the Environment and Energy (DEE). Undertaking other activities in these AMPs may also require approval from the Director of National Parks under Part 13 of the EPBC Act.

The Commonwealth Director of National Parks (DNP) has issued a general approval under Section 359B of the EPBC Act allowing a range of activities to occur within these AMPs. The activities approved including 'mining operations' which, as defined under the EPBC Act, also includes all petroleum activities, including associated emergency response activities. No other approvals relating to this activity are required from the Director of National Parks.

Actions to respond to oil pollution incidents (including environmental monitoring and remediation) in AMPs, can be undertaken without an authorisation issued by the DNP, provided that the actions are undertaken in accordance with an EP that has been accepted by NOPSEMA. However, the DNP is to be notified of the pollution event or proposed spill response actions within AMPs prior to the activity being undertaken where practicable. WA-50-L does not overlap any AMPs (Figure 4-2). The AMPs that overlap the EMBA and their IUCN categories are outlined in Table 4-1 with a further description provided in subsequent sections.

**Table 4-1: AMP and IUCN categories**

| AMP | Sanctuary Zone (IUCN Ia) | (Marine) National Park Zone (IUCN II) | Habitat Protection Zone (IUCN IV) | Recreational Zone (IUCN IV) | Multiple Use Zone (IUCN VI) | Special Purpose Zone (IUCN VI) | Special Purpose Zone (Trawl) (IUCN VI) |
|---|---|---|---|---|---|---|---|
| Argo-Rowley Terrace | | X | | | X | | X |
| Ashmore Reef | X | | | X | | | |
| Cartier Island | X | | | | | | |
| Kimberley | | X | X | | X | | |
| Mermaid Reef | | X | | | | | |
| Oceanic Shoals | | X | X | | X | | X |

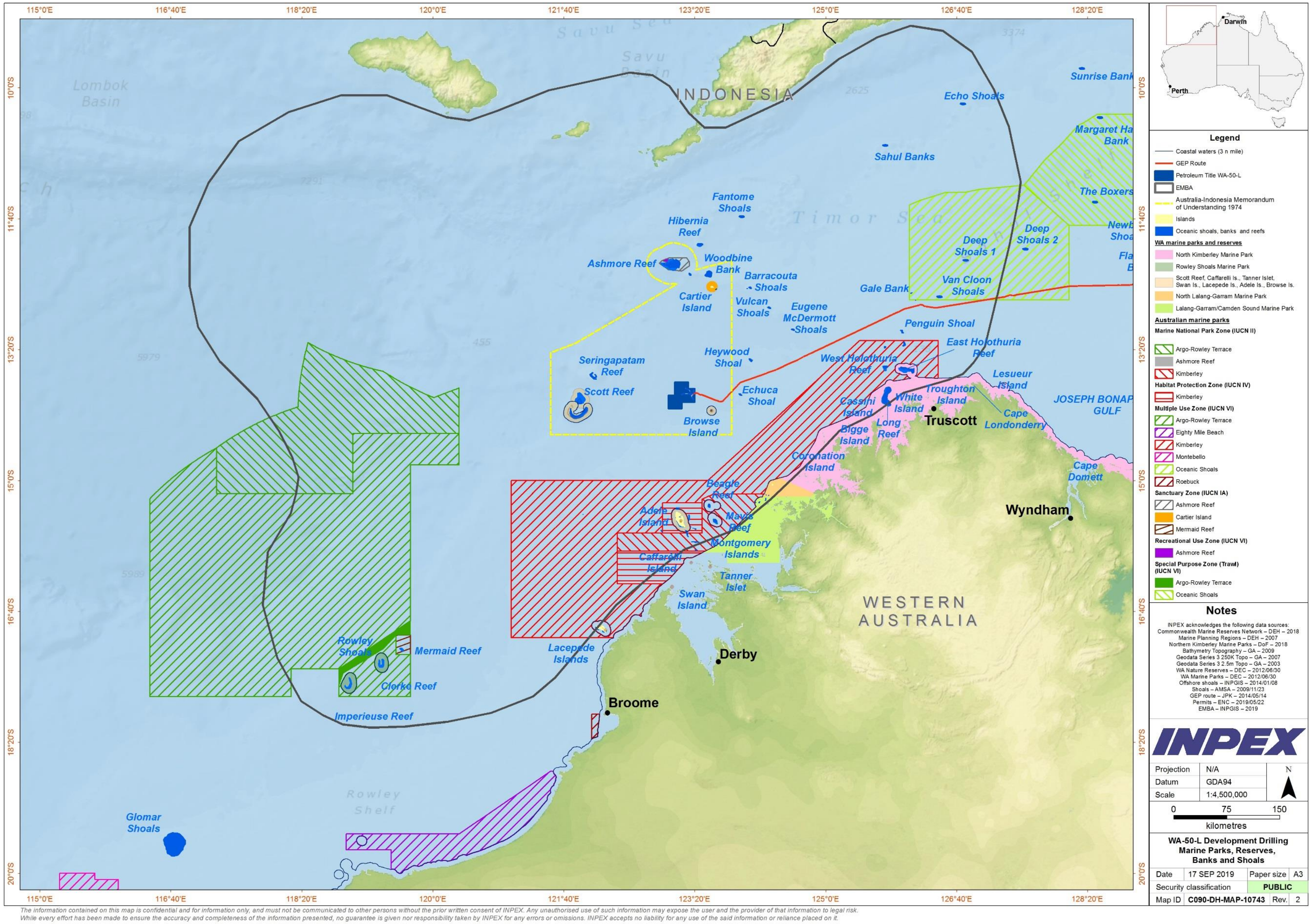



Figure 4-2: Australian and state marine parks, reserves, banks and shoals

### 4.3.1 Argo-Rowley Terrace MP

The Argo-Rowley Terrace MP covers an area of approximately 146,000 km$^2$ and is the largest AMP in the north-west (Parks Australia 2019a). Its eastern boundary is approximately 288 km from WA-50-L.

The reserve is an important area for sharks, which are found in abundance around the Rowley Shoals, and provides important foraging areas for migratory seabirds and the endangered loggerhead turtle (Director of National Parks 2018a).

### 4.3.2 Ashmore Reef MP

Ashmore Reef MP is in the NWMR and is located 156 km north WA-50-L. It covers an area of 583 km$^2$ and the site is also a designated "wetland of international importance" under the Convention on Wetlands of International Importance (Ramsar Convention) especially as Waterfowl Habitat (Parks Australia 2019b) (refer Section 4.6.1).

Ashmore Reef is an atoll-like structure with low, vegetated islands, sand banks, lagoon areas, and surrounding reef. It is the largest of only three emergent oceanic reefs present in the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The reef exhibits a higher diversity of marine habitats compared with other North West Shelf (NWS) reefs, and supports an exceptionally diverse fauna, particularly for corals and molluscs (Director of National Parks 2018a).

The reef and its surrounding Commonwealth waters are regionally important for feeding and breeding aggregations of birds. It has major significance as a staging point for wading birds migrating between Australia and the northern hemisphere, including 43 species listed on one or both of the China–Australia Migratory Bird Agreement (CAMBA) and the Japan–Australia Migratory Bird Agreement (JAMBA).

Ashmore Reef supports some of the most important seabird rookeries on the NWS, including colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red-footed boobies, roseate terns, crested terns and lesser crested terns. It provides important staging points/feeding areas for many migratory seabirds (Parks Australia 2019b; Director of National Parks 2018a).

### 4.3.3 Cartier Island MP

Cartier Island MP is located in the NWMR approximately 132 km north of WA-50-L and covers an area of 172 km$^2$ (Parks Australia 2019c). The reserve includes Cartier Island and the area within a 4-nautical-mile-radius of the centre of the island, to a depth of 1 km below the seafloor. It is an IUCN Category Ia Sanctuary Zone with water depths from less than 15 m to 500 m (Director of National Parks 2018a).

Cartier Island is an unvegetated sandy cay surrounded by a reef platform. The island and its surrounding waters support prolific seabird rookeries, many species of which are migratory and have their main breeding sites on the small isolated islands. Seabirds at Cartier Island include colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red-footed boobies, roseate terns, crested terns and lesser crested terns (Parks Australia 2019c). Much like Ashmore Reef, Cartier Island is an important staging point/feeding area for many migratory seabirds. The island also supports significant populations of feeding and nesting marine turtles and a high abundance and diversity of sea snakes (DSEWPaC 2012a).

Cartier Island is part of the Ashmore Reef and Cartier Island and surrounding Commonwealth waters KEF (Section 4.2.3).

### 4.3.4 Kimberley MP

The Kimberley MP is located approximately 99 km to the south and east of WA-50-L and occupies an area of approximately 74,500 km$^2$ (Parks Australia 2019d).

This MP provides an important migration pathway and nursery areas for the protected humpback whale, and foraging areas for migratory seabirds, migratory dugongs, dolphins and threatened and migratory marine turtles (Director of National Parks 2018a). It is adjacent to important foraging and pupping areas for sawfish and important nesting sites for green turtles (Parks Australia 2019d).

### 4.3.5 Mermaid Reef MP

The Mermaid Reef MP is located approximately 485 km south-west of WA-50-L and is near the edge of Australia's continental slope, surrounded by waters that extend to a depth of over 500 m. Mermaid Reef MP covers an area of approximately 540 km$^2$ and is the most north-easterly of three reef systems forming the Rowley Shoals (Parks Australia 2019e). Mermaid Reef is totally submerged at high tide and therefore falls under Australian Government jurisdiction. The other two reefs of the Rowley Shoals, Clerke Reef and Imperieuse Reef are managed by the WA Government.

Mermaid Reef (and the other Shoals) supports over 200 species of hard corals and 12 classes of soft corals with coral formations in pristine condition. The shoals are an important area for sharks, including the grey reef shark, the whitetip reef shark and the silvertip whaler; important foraging area for marine turtles; toothed whales; dolphins; tuna and billfish; and an important resting and feeding site for migratory seabirds (Parks Australia 2019e; Director of National Parks 2018a).

### 4.3.6 Oceanic Shoals MP

WA-50-L is located approximately 323 km from the Oceanic Shoals MP. The MP occupies an area of approximately 72,000 km$^2$ with water depths from less than 15 m to 500 m (Parks Australia 2019f). The Oceanic Shoals MP is the largest marine park in the NMR.

The reserve is an important resting area for turtles (internesting) for the threatened flatback turtle and olive ridley turtle. It is also an important foraging area for the threatened loggerhead turtle and olive ridley turtle (Director of National Parks 2018b).

## 4.4 State reserves and marine parks

There are no State marine parks/reserves located within WA-50-L.

The EPBC Act Protected Matters search (Appendix B) identified a total of 8 State reserves within the EMBA as listed below, all found within WA. Unnamed locations were identified using the Collaborative Australian Protected Areas Database (CAPAD 2016).

- Adele Island (WA)
- Browse Island (WA)
- Dambimangari (WA)
- Lacepede Islands (WA)
- Unnamed WA41775 (WA) identified as Browse Island
- Unnamed WA44673 (WA) identified as Adele Island
- Unnamed WA44674 (WA) identified as Adele Island
- Uunguu (WA).

Of these reserves, two are Indigenous Protected Areas (IPAs); the Dambimangari IPA and the Uunguu IPA. The most relevant value and sensitivity within the IPAs is traditional fishing, which is practised within these reserves, and is further discussed in Section 4.9.3.

The EPBC Act Protected Matters search identified several named and unnamed state reserves (Appendix B). Further research and investigation of the Collaborative Australian Protected Areas Database (CAPAD 2016) was undertaken, and where sites were considered not relevant to the EMBA they are not discussed further in this EP. This is primarily as there are no 'marine' values or sensitivities which could be impacted by an oil spill, unlike locations where significant turtle and seabird nesting rookeries may be present, and/or associated BIAs have been declared.

The EPBC Act Protected Matters search report (Appendix B) did not identify the following three additional marine parks listed below; however, these have been confirmed through previous stakeholder consultation between INPEX and the DBCA, and therefore they have been described in this EP:

- Scott Reef Nature Reserve
- Lalang-garram / Camden Sound Marine Park
- North Kimberley Marine Park
- North Lalang-garram Marine Park

The relevant State and Territory reserves within the EMBA are described below and displayed on Figure 4-2. Should any new State or Territory marine park/reserve management plans come into effect, the impacts of these changes will be assessed in accordance with Section 9.8.1 and Section 9.7 of this EP.

### 4.4.1 Adele Island Nature Reserve

Adele Island is a declared nature reserve to protect the seabird breeding colonies, and is located approximately 172 km south from WA-50-L.

It is a hook-shaped island off the central Kimberley coast, located around 97 km north-northwest of Cape Leveque. The island covers an area of 2.17 km$^2$. Its surrounding sand banks sit atop a shallow-water limestone platform, surrounded by an extensive reef system (CCWA 2010).

Adele Island is an important site for breeding seabirds with several species listed under the JAMBA, CAMBA and Republic of Korea–Australia Migratory Birds Agreement (ROKAMBA). There are known breeding colonies for masked booby (*Sula dactylatra*), red-footed booby (*Sula sula*), brown booby (*Sula leucogaster*), pied cormorant (Phalacrocorax varius), Australian pelican (*Pelecanus conspicillatus*), greater frigatebird (*Fregata minor*), lesser frigatebird (*Fregata ariel*), Caspian tern and lesser crested tern (CCWA 2010).

The seabird colonies at Adele Island tend to have peak breeding periods from May to July; however, birds may also be present during the non-breeding season (DEWHA 2008). A study undertaken as part of an Applied Research Program (ARP) between INPEX and Shell in the Browse Basin, reported 12 species of seabird were found to breed at Adele Island in the 2014/2015 season. An additional eight species of seabird were considered non-breeding visitors. Twenty-six migratory shorebird species and three Australian resident shorebird species were also reported as using the reserve (Clarke 2015).

### 4.4.2 Browse Island Nature Reserve

Browse Island is the nearest landform to WA-50-L (33 km away) and is a Class 'C' nature reserve. It is an isolated sand cay surrounded by an intertidal reef platform and shallow fringing reef. The purpose of this reserve (#41775) is conservation, navigation (a lighthouse is present on the island), communication, meteorology and survey.

The Browse Island reef complex is an outer shelf, biohermic structure rising from a depth of approximately 200 m. It is a flat-topped, oval-shaped, platform reef with the largest diameter being about 2.2 km. The island is a triangular, vegetated sandy cay, standing just a few metres above high-tide level. It measures approximately 700 m by 400 m.

Reef habitats at Browse Island are not diverse as confirmed by a study undertaken as part of the ARP for INPEX and Shell. In the study, a low level of diversity in invertebrates was reported. Soft corals and sponges were noted but reported levels were not considered abundant (Olsen et al. 2018). Rocky shore habitat on the island is represented only by exposed beach rock, and there are no intertidal sand flats. The lagoon habitat is poorly developed, with poor water circulation, and it shows evidence of recent infill and high mortality. The reef platform, especially on the western side, is high and barren in many places. Only the reef crest and seaward ramp habitats around the edge of the reef support moderately rich assemblages of molluscs. The shallow subtidal zone is narrow and supports relatively small areas of well-developed coral assemblages (INPEX 2010).

Green and flatback turtle (*Chelonia mydas* and *Natator depressus*) nesting occurs during the summer months and Browse Island also provides habitat for seabirds and shorebirds (Section 4.8.4).

Further, the island (inclusive of a 20 km buffer) has been classified as critical habitat for green turtles from November to March under the Recovery Plan for Marine Turtles in Australia (DEE 2017a). It is thought that the Scott-Browse green turtles are a distinct genetic unit, nesting only at Scott Reef (Sandy Islet) and Browse Island.

It is not a regionally significant habitat for seabirds, with previous surveys finding a lack of diversity of seabirds breeding there (Clarke 2010). The DEE has not listed Browse Island as a marine avifauna BIA. However, colonies of nesting crested terns (*Thalasseus bergii*) were observed nesting on the north-western side of the island in a colony of approximately 1,000 birds (Olsen et al. 2018). Browse Island has also been recognised, through stakeholder consultation between INPEX and the DBCA, as an important location for seabirds and specifically green turtles, known to be part of a genetically distinct management unit.

### 4.4.3 Lacepede Islands

The Lacepede Islands are a Class 'C' nature reserve, located 320 km south of WA-50-L, and 120 km north-west of Broome. The purpose of this reserve is the conservation of flora and fauna, navigation, communication, meteorology and survey. The Lacepede Islands are a 12 km long chain of four islands known as West Island, Middle Island, Sandy Island and East Island. They are all small, low spits of coarse sand and coral rubble, lying atop a platform coral reef. They are treeless but support low vegetation.

INPEX (2010) identified these islands as the largest green turtle (*Chelonia mydas*) breeding rookery along the Kimberley coastline. The Recovery Plan for Marine Turtles in Australia recognises these islands as a major important nesting area (DEE 2017a) and confirmed as an important rookery based on track counts (Waples et al. 2019). The Recovery Plan has provided a 60 km interesting buffer around the Lacepede Islands for flatback turtle nesting occurring from October to March, with a peak in December and January. A 20 km interesting buffer has also been provided for green turtle nesting, occurring from November to March each year.

The Lacepede Islands support over 1% of the world populations of brown boobies (*Sula leucogaster*) and roseate terns (*Sterna dougallii*). The breeding colony of brown boobies, of up to 18,000 breeding pairs, is possibly the largest in the world. Core foraging habitat of the brown boobies was reported to range from 50 km – 90 km from the colony with the furthest recorded as approximately 120 km north-west of the Lacepede Islands (Cannell et al. 2018). Up to 20,000 roseate terns have been recorded there (Birdlife International 2019). Other birds breeding on the islands include masked boobies, Australian pelicans, lesser frigatebirds, eastern reef egrets, silver gulls, crested, bridled and lesser crested terns, common noddies, and pied and sooty oystercatchers. Visiting waders include grey-tailed tattlers, ruddy turnstones, great knots and greater sand plovers (Birdlife International 2019).

### 4.4.4 Scott Reef Nature Reserve

Sandy Island is a C class nature reserve (under Western Australian legislation) for the purpose of conservation (No. 42749), declared to Low Water Mark (LWM). It has an approximate area of 11,658 hectares. This encompasses much of the South Scott lagoon, and the south-western reef flat of North Scott Reef. The remainder of the South Scott Reef lagoon and North Scott Reef are Commonwealth waters and Commonwealth jurisdiction applies. The Scott Reef Nature Reserve values and sensitivities are described in Section 4.8.

Scott Reef (including a 20 km buffer) has been classified as habitat critical to the survival of marine turtles in the Recovery Plan for Marine Turtles (2017a) as described in Section 4.8.4.

### 4.4.5 Lalang-garram/Camden Sound Marine Park

The Lalang-garram/Camden Sound Marine Park is located in the Buccaneer Archipelago of the Kimberly coast, approximately 177 km from WA-50-L. The marine park covers an area of approximately 7,050 km$^2$ (DPaW 2013). The marine park is located approximately 150 km north of Derby and 300 km north of Broome and lies within the traditional country of three Aboriginal native title groups. It is under joint management between DBCA and the Traditional Owners.

The marine park includes a principal calving habitat and resting area for the humpback whale (*Megaptera novaeangliae*) and a wide range of other protected species, including marine turtles, snubfin and Indo-Pacific humpback dolphins, dugong, saltwater crocodiles and several species of sawfish. The park also includes a wide range of marine habitats and associated marine life, such as coral reef communities, rocky shoal and extensive mangrove forests (DPaW 2013).

Within the marine park, mangroves and their associated invertebrate-rich mudflats are an important habitat for migratory shorebirds from the northern hemisphere. Up to 35 species of migratory shorebirds potentially occur in the marine park, which are subject to the JAMBA, CAMBA and ROKAMBA migratory bird agreements and are listed as migratory species under the EPBC Act (Appendix B). Many other bird species may also be found in mangrove habitat with nesting occurring in the dense mangrove foliage and birds seeking prey around the roots of mangrove trees. (DPaW 2013).

### 4.4.6 North Kimberley Marine Park

The North Kimberley Marine Park is located approximately 176 km from WA-50-L. This park extends all the way from the northern boundary of the Camden Sound Marine Park to the Northern Territory border (DPaW 2016a). The park was declared in December 2016 and is the second largest marine park in Australia spanning approximately 18,540 km$^2$. This vast area has a complex coastline with many gulfs, headlands, cliff-lined shores and archipelagos. Extensive tidal flats have formed in places, some associated with the mouths of the numerous rivers that drain to the coast. Marine ecosystems include extensive fringing mangrove forests and remote and virtually untouched coral reefs and sponge gardens which in turn support a wide range of marine life (DPaW 2016a).

High densities of dugongs have been recorded in areas of the marine park with extensive seagrass habitat (Waples et al. 2019). The park also supports populations of Manta rays (*Manta* spp.) and six species of threatened marine turtle found in Australia. Cetaceans that are known to utilise the area include humpback whales (*Megaptera novaeangliae*), Indo-Pacific humpback dolphins (*Sousa chinensis*) and snubfin dolphins (*Orcaella heinsohni*) (DPaW 2016a). Saltwater crocodiles (*Crocodylus porosus*), and a variety of fish, sharks, rays and sea snakes also inhabit the waters of this park. A wide variety of seabirds also utilise the offshore islands and intertidal flats for breeding and foraging. Nature based tourism, commercial and recreational fishing and remote seascapes are also identified as values within the park's management plan (DPaW 2016a).

### 4.4.7 North Lalang-garram Marine Park

The North Lalang-garram Marine Park, located approximately 153 km from WA-50-L, includes the waters from the edge of Cape Wellington (WA mainland) to the WA state waters boundary, and several islands, including Booby Island, Duguesclin Island and Jackson Island. Its northern boundary adjoins the North Kimberley Marine Park, and its southern boundary adjoins the Lalang-garram/Camden Sound Marine Park. This parks geology, wide variety of habitats, ecological values and sensitivities (DPaW 2016b) are virtually identical to that described above for the North Kimberley Marine Park (DPaW 2016a).

## 4.5 International marine parks

### 4.5.1 Savu Sea Marine National Park

The Savu Sea (Laut Sawu) Marine National Park (MNP) is located within the Lesser Sunda Ecoregion located to the south of the Coral Triangle and covers approximately 35,000 km$^2$ (MCI 2019; Protected Planet 2019). It was established in 2009 and has an IUCN Category II status (Protected Planet 2019). The MNP is split into three management areas; the Pantar Strait Marine Protected Area, the Sumba Strait Marine Area and the Tirosa-Batek Marine Area.

The Savu Sea MNP acts as a marine corridor and migratory pathway for marine fauna and is also an important upwelling zone in the Indo-Pacific region due to the presence of deep ocean trenches (Perdanahardja & Lionata 2017). The MNP area is a known migration route for several cetacean species, including the blue whale and sperm whale (Huffard et al. 2012). Other cetacean species such as pygmy killer whales, melon-head whales, short-finned pilot whales and numerous dolphin species (including Risso’s dolphin, Fraser’s dolphin, common dolphin, bottlenose dolphin and spinner dolphin) are known to frequent the MNP area (Coral Triangle Atlas 2014). Several species of marine turtle, including the green turtle, hawksbill turtle and leatherback turtle have also been recorded in the MNP area (Huffard et al. 2012).

The Sauv Sea MNP provides productive marine habitats that support large populations of fish and artisanal and commercial fisheries. It is estimated that 65% of the East Nusa Tenggara regional fisheries production comes from the Savu Sea (Perdanahardja & Lionata 2017).

## 4.6 Wetlands of conservational significance

### 4.6.1 Ashmore Reef National Nature Reserve

In addition to being listed as a National Nature Reserve, Ashmore Reef has been designated a Ramsar site due to the importance of the islands in providing a resting place for migratory shorebirds and supporting large breeding colonies of seabirds (Hale & Butcher 2013). Ashmore Reef is located within the EMBA and is approximately 156 km from WA-50-L (Figure 4-8).

The reserve provides a staging point for many migratory wading birds from October to November and March to April as part of the migration between Australia and the northern hemisphere (Commonwealth of Australia 2002). Migratory shorebirds use the reserve’s islands and sand cays as feeding and resting areas during their migration. The values of this wetland (habitat which supports migratory birds) are described above in Section 4.3.2.

### 4.6.2 Mermaid Reef

Although not a Ramsar site, Mermaid Reef is identified as a Nationally Important Wetland in the EPBC Act Protected Matters search (Appendix B). The intertidal and subtidal reef system and associated ecological values and sensitivities are described above in Section 4.3.5. It is considered that marine avifauna which roost on the islands within Clerke and Imperieuse Reef may forage at Mermaid Reef.

## 4.7 Physical environment

### 4.7.1 Climate

#### Air temperature

Air temperatures recorded at Browse Island, the closest Bureau of Meteorology (BOM) climatological station to WA-50-L, shows a maximum temperature of 33.3 degrees Celsius (°C) and a minimum of 21.6 °C (BOM 2019). Air temperatures in the Browse Basin remain warm throughout the year with means and maxima ranging from 26–30 °C and 32–35 °C, respectively (INPEX 2010).

#### Winds

The climate of northern Australia shows two distinct seasons: winter, from April to September; and summer, from October to March. There are rapid transitional periods between the two main seasons, generally in April and September/October (RPS MetOcean Pty Ltd 2011).

The winter season is characterised by steady north-east to south-east winds of 5 metres per second (m/s) to 12 m/s, driven by south-east trade winds. The prevailing south-east winds bring predominantly fine conditions throughout the north of Australia. The summer season is the period of the predominant north-west monsoon. It is characterised by north-west to south-west winds of 5 m/s for periods of five to 10 days with surges in airflow of 8 m/s to 12 m/s for periods of one to three days.

During the summer season, the weather in the north is largely determined by the position of the monsoon trough, which can be in either an active or an inactive phase. The active phase is usually associated with broad areas of cloud and rain, with sustained moderate to fresh north-westerly winds on the north side of the trough. Widespread heavy rainfall can result if the trough is close to, or over, land. An inactive phase occurs when the monsoon trough is temporarily weakened or retreats north of Australia. It is characterised by light winds, isolated showers, and thunderstorm activity, sometimes with gusty squall lines.

Tropical cyclones can also develop off the coast in the northern wet season, usually forming within an active monsoon trough. Heavy rain and strong winds, sometimes of destructive strength, can be experienced along the coast within several hundred km of the centre of the cyclone. The Browse Basin is prone to tropical cyclones, mostly during the tropical wet season from December to March (INPEX 2010). Under extreme cyclone conditions, winds can reach 300 km/h.

**Rainfall**

The region has a pronounced monsoon season between December and March, which brings with it heavy rainfall. Heaviest rainfall is typically associated with tropical cyclones.

Troughton Island located on the Kimberley coastline is the closest location to WA-50-L with a historical rainfall record. Historical rainfall data shows the highest maximum (269.8 mm) and mean (>100 mm) monthly rainfalls occur from December to March (BOM 2019). Rainfall intensity at the Ichthys Field is expected to range from approximately 215 mm/h to 460 mm/h over a 5-minute interval (based on 1-year and 200-year average recurrence intervals) (AMEC Ltd. 2011).

**Air quality**

There is currently no air quality data recorded within the vicinity of WA-50-L. However, given the distance from land, air quality is expected to be relatively high. Potential sources of air pollution associated with anthropogenic influences are expected to be emissions generated by shipping, and oil and gas activities, and therefore considered to be localised in relation to the regional setting.

### 4.7.2 Oceanography

**Currents**

Broad-scale oceanography in the north-west Australian offshore area is complex, with major surface currents influencing the region, including the Indonesian Throughflow, the Leeuwin Current, the South Equatorial Current, and the Eastern Gyral Current (Figure 4-3). The Indonesian Throughflow current is generally strongest during the south-east monsoon from May to September (Qiu et al. 1999). The Indonesian Throughflow is a key link in the global exchange of water and heat between ocean basins. It brings warm, low-nutrient, low-salinity water from the western Pacific Ocean, through the Indonesian archipelago, to the Indian Ocean. It is the primary driver of the oceanographic and ecological processes in the region (DSEWPaC 2012a).

Offshore regions with water depths exceeding 100-200 m tend to experience significant large-scale drift currents. These drift currents tend to be stronger than tidal currents and are the dominant driver of the long term (> several days) transport of effluent plumes (RPS 2019c). Drift currents in the location of the INPEX *Ichthys Venturer* FPSO within WA-50-L are expected to be directed towards the south-west during summer and winter. During the transitional period, drift currents will be variable, predominantly switching between the south-west and north-east directions. Typical drift current speeds range from zero to 0.3 m/s throughout the year (APASA 2015). Tidal current data, also from the FPSO location, indicate that tidal currents are likely to be directed along a north-west to south-east axis throughout the year. Typical tidal current speeds are in the range of 0.2–0.6 m/s (APASA 2015). Wind shear at the surface also generates local-scale currents.

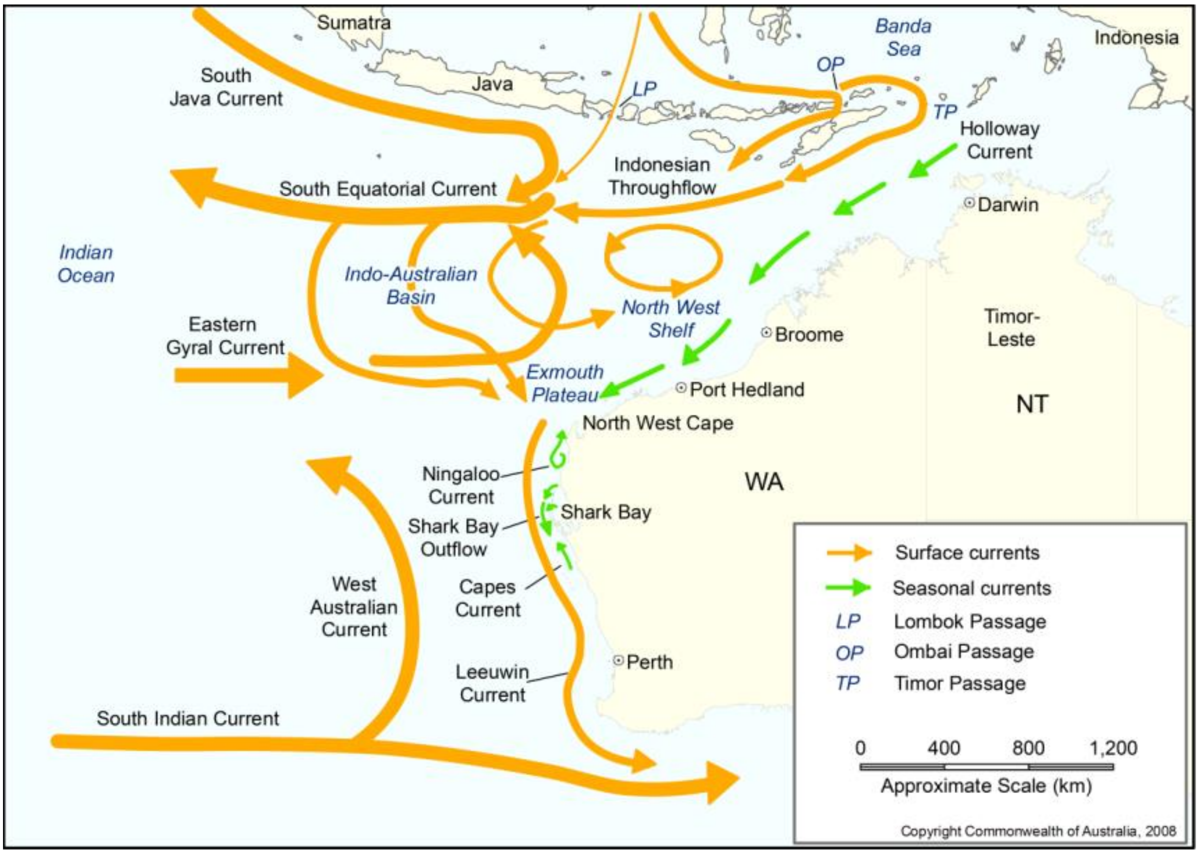



**Figure 4-3: Surface currents for Western Australian waters**

## Tides

The tides are semidiurnal, with two daily high tides and two daily low tides (McLoughlin et al. 1988). Both the semidiurnal and diurnal tides appear to travel north-eastwards in the deep water leading to the Timor Trough before propagation eastwards and southwards across the wide continental shelf. The NWMR experiences some of the largest tides along a coastline adjoining any open ocean in the world.

Mean sea level in the vicinity of WA-50-L is about 2.7 m above lowest astronomical tide (LAT), with a spring tidal range of about 5.0 m.

#### Waves

Summertime tropical cyclones generate waves propagating radially out from the storm centre. Depending upon the storm size, intensity, relative location and forward speed, tropical cyclones may generate swell with periods of 6–10 seconds (s) from any direction and with wave heights of 0.5–9.0 m. During severe tropical cyclones, which can generate major short-term fluctuations in current patterns and coastal sea levels (Fandry & Steedman 1994; Hearn & Holloway 1990), current speeds may reach 1.0 m/s and occasionally exceed 2.0 m/s in the near-surface water layer. Such events are likely to have significant impacts on sediment distributions and other aspects of the benthic habitat.

### 4.7.3 Bathymetry and seabed habitats

Water depths within WA-50-L ranges from 235 m to 275 m at LAT. Studies using sub-bottom profiling, multibeam echo-sounder and sidescan sonar have been undertaken by INPEX at the Ichthys Field and in areas close to Heywood and Echuca shoals and south-east towards the Kimberley coast (INPEX 2010). These studies indicated that seabed topography is relatively flat and featureless, and the geology is generally homogeneous through the region.

Soft substrates in the Browse Basin and continental shelf are typical of deep-sea, outer continental shelf and slope benthic habitats found along the length of the NWS (RPS 2007). This habitat generally supports a diverse infauna dominated by polychaetes and crustaceans typical of the broader region and this is reflected in survey results which indicate the epibenthic fauna is diverse but sparsely distributed (RPS 2008). Deep-sea infaunal assemblages of this kind are very poorly studied on the NSW but are likely to be widely distributed in the region (INPEX 2010).

Areas of mud and fine sand are widespread on the outer shelf and slope in the Browse Basin indicating that it is a depositional area where fine sediments and detritus accumulate. The distribution of seabed type shows some correlation with water depth, with sediments becoming coarser as water depth increases (INPEX 2010). However, there are also large sand waves in parts of the basin, showing that, locally, there are strong seabed currents. The sand waves are likely to move in response to seasonal changes in the currents and the substrate instability is expected to limit the development of infaunal communities in this habitat.

During surveys of the Ichthys Field, no obstructions were noted on the seafloor and no features such as boulders, reef pinnacles or outcropping hard layers were identified (INPEX 2010; Fugro Survey Pty Ltd 2005). In general, the seabed sediments grade from soft featureless sandy silts to gravelly sand suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities.

### 4.7.4 Water quality

Water quality has been measured by INPEX during numerous surveys in order to describe the natural water quality conditions in the Ichthys Field and in surrounding areas including WA-50-L. An overview of the water quality studies undertaken are as follows:

- water quality sampling was conducted at 27 offshore locations near the Ichthys Field, Echuca Shoal and their surrounds between March 2005 to June 2007 as a part of the INPEX Ichthys EIS studies
- near-seabed temperature and salinity profiles were obtained along the proposed pipeline route from the Ichthys Field to Darwin Harbour during geophysical and geotechnical surveys conducted between August and October 2008.

The results of these studies, as relevant to this EP, are summarized in Table 4-2.

Furthermore, as part of the ARP between INPEX and Shell in the Browse Basin, a significant amount of environmental baseline data has been collected. This included 66 water quality profiles and more than 1,300 water samples collected from 56 locations around the Ichthys Field in 2015.

Sampling locations were based on a gradient design away from a central point in the Ichthys Field and also included increased sampling around Browse Island, Echuca and Heywood shoals. Samples were analysed for metals and hydrocarbons. In addition to the May 2015 survey, ad hoc water quality samples have also been collected from sampling locations during other ARP field surveys to increase the dataset and knowledge. An interpretive report of all the aforementioned ARP water quality results was delivered in 2017 (Ross et al. 2017).

Offshore surface waters are typically oligotrophic. This has been confirmed by studies recording low nitrate concentrations and low phytoplankton abundance. In general, the region experiences an influx of comparatively nutrient-rich waters at depth in summer and a variety of processes, such as tidal currents, internal waves and cyclone mixing, are known to carry these nutrients into the bottom waters of the shelf (Hallegraeff 1995).

Inshore coastal waters tend to be more turbid than offshore open ocean waters due to suspension of sediments by wave action and sediment laden runoff from the land. Higher total suspended solids (TSS) concentrations tend to occur during spring tide conditions due to stronger tidal currents and meteorological perturbations, such as periods of strong winds.

**Table 4-2: Summary of water quality parameters in the vicinity of WA-50-L**

| Parameter | Description |
|---|---|
| Surface-water temperature | The surface waters of the region are tropical year-round, with surface temperatures of ~26 °C in summer and ~22 °C in winter (DSEWPaC 2012a). The baseline monitoring in the Ichthys Field area recorded surface water temperatures of ~30 °C in summer (March) and ~26–27 °C in winter (July) (INPEX 2010).<br>Offshore waters in the region are typified by thermal stratification, with the start of the thermocline generally around 60 m below sea surface (but ranging from 30-80 m) (Ross et al 2017). Temperature decays rapidly through the water column to 14 °C at approximately 200 m and then decays more slowly to a minimum of circa 8 °C recorded at the deepest sites (Ross et al. 2017). |
| Salinity | Salinity was spatially and temporally consistent at 34 to 35 parts per thousand (ppt) across all sampling sites and can reasonably be expected to be similar within the wider area, given the distance from major freshwater discharges (INPEX 2010). Minor variations in the salinity profile were identified however data indicated lower salinity values were recorded in the top layer of the water column with higher salinity values corresponding to deeper within the water column (Ross et al. 2017). |

| Parameter | Description |
|---|---|
| Dissolved oxygen | Dissolved oxygen concentrations in the Ichthys Field mirrored water temperatures, with concentrations varying considerably between the surface and subsurface layers. The surface mixed layer was generally well oxygenated throughout; however, below the thermocline (starting at approximately 60 m through to 200 m water depth), the concentration of dissolved oxygen decreased consistently with depth (RPS 2007; Ross et al. 2017). Dissolved oxygen concentrations were recorded at constant levels of 6.0 to 6.5 ppm at or above the thermocline in both summer and winter. In the cooler waters below the thermocline, dissolved oxygen decreased with increasing depth, with levels as low as 4.5 to 5.0 ppm recorded at a depth of 93 m and 3 ppm at a depth of 250 m (INPEX 2010). This indicates that the strong thermal stratification at the offshore locations results in limited oxygen replenishment of subsurface waters due to the lack of regular mixing between water layers (RPS 2007). |
| pH | The average pH of waters was measured at approximately 8.4 (RPS 2007), which is slightly higher (more alkaline) than normally encountered in the marine environment and is above the default criteria given in the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZECC/ARMCANZ 2000). |
| Turbidity and light attenuation | Turbidity is generally higher in the shallow waters of the continental shelf and towards the base of many of the deeper water column profiles. This has been attributed to re- suspension of fine sediments in these higher energy environments (Ross et al. 2017). The re-suspension of materials from the seafloor includes organic material which could comprise a pathway for hydrocarbon materials to become incorporated into sediments.<br>Light attenuation coefficients calculated from photosynthetically active radiation (PAR) measurements ranged from 0.026 to 0.043 in October and December 2006, and 0.048 to 1.09 in June 2007. These were observed to be consistent with reported "typical" levels for the region (RPS 2007). |
| Petroleum hydrocarbons | Baseline sampling has indicated low levels of naturally occurring hydrocarbons released by organic matter decay or higher trophic level organisms. Shallow water sites showed a constant hydrocarbon concentration through the profile. Deep water sites showed a low and constant concentration above the thermocline, with a peak of 0.2-0.25 μg/L at the thermocline before slowly diminishing (Ross et al. 2017). |
| Radionuclides | Water-column sampling for radionuclides in the Ichthys Field area indicated concentrations of radium-226 ranging from below lower limits of reporting (LLR) to 0.034 (±0.012) becquerels per litre (Bq/L) and concentrations of radium-228 ranging from below LLR to 0.167 (±0.128) Bq/L. With the exception of one mid-depth sample, all samples returned gross alpha-particle and gross beta-particle radiation levels below the Australian Drinking Water Guidelines (ADWG) screening criterion of 0.5 Bq/L provided by the National Health and Medical Research Council (NHMRC) and the Natural Resource Management Ministerial Council (NRMMC). |
| Metals | Total metal concentrations in the offshore waters sampled were below the 99% species protection level for marine waters (ANZECC/ARMCANZ 2000), with the exception of zinc and cobalt at one site each. The reason for these two slightly elevated readings is unknown (INPEX 2010). |

| Parameter | Description |
|---|---|
| | Ultra-trace-level analysis methods were used to assess metal concentrations in surface waters because ANZECC/ARMCANZ (2000) guideline trigger values at the 99% species protection level are lower than the limits of standard laboratory methods. Mercury was the only metal not detected above the LLR, while cobalt was marginally above the LLR at only one site. Concentrations of arsenic, nickel, chromium and zinc were consistent across all sites, but the concentrations of cadmium, copper and lead showed greater variability (INPEX 2010). |

Water quality in the Indonesian waters of the EMBA is unknown. However, the Asian Development Bank (2014) reported that approximately 40% of domestic sewage in Indonesia is discharged directly or indirectly via rivers and into the sea without proper treatment. The high organic and nutrient content of untreated sewage can lead to eutrophication or excessive nutrient enrichment, which triggers the growth of phytoplankton in the form of harmful algal blooms, or red tides, in many places in Indonesia.

### 4.7.5 Sediment quality

Similar to water quality, marine sediments have been sampled during numerous surveys in order to characterise the marine sediments in the Ichthys Field and surrounding areas (URS 2009). Overviews of the studies are listed below, with the results as relevant to this EP summarised in Table 4-3:

- Sampling and characterisation of marine sediments in the Ichthys development area was conducted at 10 sites in September 2005 and May 2007. This included five sites within 20 km of the Ichthys Venturer FPSO location and another five sites between 36 km and 134 km away. A further 10 sites were also sampled for particle size distribution (PSD) between 24 km and 66 km of the FPSO location in WA-50-L.
- Seabed sediment sampling along the proposed pipeline route from the Ichthys Field to Darwin Harbour was also conducted at approximately 10 km intervals during geophysical and geotechnical surveys between August and October 2008.

Furthermore, as a part of the ARP, a 133 sediment samples at 56 locations were collected around the Ichthys Field in May 2015. Sampling locations were based on a gradient design away from a central point in the Ichthys Field and also included increased sampling around Browse Island, Echuca and Heywood shoals. Samples have been analysed for metals and hydrocarbons. In addition to the May 2015 survey, ad hoc sediment samples have also been collected from sampling locations during other ARP field surveys to increase the dataset and knowledge. An interpretive report of all the aforementioned ARP sediment sample results was delivered in 2017 (Ross et al. 2017).

**Table 4-3: Summary of sediment quality parameters in the vicinity of WA-50-L**

| Parameter | Description |
|---|---|
| Particle size distribution (PSD) | The seabed in offshore locations on the continental shelf is known to consist of generally flat, relatively featureless plains characterised by soft sandy-silt marine sediments that are easily resuspended. Similarly, the substrate of the Scott Reef – Rowley Shoals Platform, in water depths of 200–600 m, is considered to be a depositional area with predominantly fine and muddy sediments (INPEX 2010).<br>The PSD of sediment at sites located within the Ichthys Field was primarily sand, with some silts. |

| Parameter | Description |
|---|---|
| Petroleum hydrocarbons | Concentrations of BTEX and PAH compounds in sediments in the vicinity of the sampling sites were very low (Ross et al. 2017, RPS 2007). The components of the more prevalent alkane compounds found indicated that the concentrations observed were likely to have originated from biogenic sources (Ross et al. 2017). |
| Radionuclides | Naturally occurring radioactive materials for the majority of results were below or close to LLR. Radium-226 was detected at one site but all other samples were below LLR for each radium isotope. The concentration of uranium and thorium was consistent across all sites (RPS 2007). |
| Metals | Concentrations of all metals were consistent across the sampling sites and well below the interim sediment quality guidelines (ISQG) low screening level (ANZECC/ARMCANZ 2000), with the majority also below their respective LLR (RPS 2007).<br>Organometallics (i.e. tributyltin (TBT)) were below ANZECC/ARMCANZ (2000) guidelines and lower than the LLR at all sampling locations. |

### 4.7.6 Underwater noise

The Centre for Marine Science and Technology (CMST) at Curtin University undertook a study on behalf of INPEX from September 2006 to August 2008 to assess ambient biological and anthropogenic sea noise sources in the Browse Basin. Ambient noise in the Ichthys Field was measured using a sea noise logger deployed at a depth of 240 m on the seabed 45 km north-west of Browse Island. The monitoring revealed an average ambient noise level of 90 dB re 1 μPa under low sea states, with inputs of low frequency energy from the Indian Ocean (INPEX 2010).

Biological noise sources recorded in the Ichthys Field included regular fish choruses (one at >1 kHz and another at around 200 Hz) and several whale calls from humpback whales, pygmy blue whales, minke whales and other unidentified species. Results from this survey are considered to be indicative of typical underwater noise levels and frequencies within the NMR and NWMR bioregions as a whole.

## 4.8 Biological environment

### 4.8.1 Planktonic communities

Plankton communities comprise phytoplankton and zooplankton, including fish eggs and larvae. Phytoplankton and zooplankton are a source of primary and secondary productivity, and key food sources for other organisms in the oceans (Brewer et al. 2007). Eggs and larvae may be dispersed throughout the water column and throughout the region, playing an important role in species recruitment.

Plankton abundance and distribution is patchy, dynamic and strongly linked to localised and seasonal productivity (Evans et al. 2016). The mixing of warm surface waters with deeper, more nutrient-rich waters (i.e. areas of upwelling) generates phytoplankton production and zooplankton blooms. In the offshore waters of north-western Australia, productivity typically follows a ‘boom and bust’ cycle. Productivity booms are thought to be triggered by seasonal changes to physical drivers or episodic events, which result in rapid increases in primary production over short periods, followed by extended periods of lower productivity.

The Indonesian Throughflow has an important effect on biological productivity in the northern areas of Australia and Indonesia. Generally, its deep, warm and low nutrient waters suppress upwelling of deeper, comparatively nutrient-rich waters, thereby forcing the highest rates of primary productivity to occur at depths associated with the thermocline (generally 70 – 100 m depth). When the Indonesian Throughflow is weaker, the thermocline lifts, and brings deeper, more nutrient-rich waters into the photic zone, which results in conditions favourable to increased productivity. Consequently, plankton populations have a high degree of temporal and spatial variability. In tropical regions, higher plankton concentrations generally occur during the winter months (June to August).

In waters surrounding Indonesia, seasonal peaks in phytoplankton biomass are linked to monsoon related changes in wind. When the winds reverse direction (offshore vs. onshore), nutrient concentrations decrease/increase because of the suppression/enhancement of upwelling (NASA 2019). Annual variability of phytoplankton productivity in waters surrounding Indonesia is heavily influenced by the El Niño-Southern Oscillation climate pattern (NASA 2019). For example, phytoplankton productivity around Indonesia increases during El Niño events.

The waters of north-western Australia, encompassing the Ichthys Field (WA-50-L), are generally considered to be of low productivity in comparison with other global oceanic systems. This is largely due to the relatively low-nutrient, shallow water environment. Planktonic community densities recorded in the Ichthys Field are considered to be very sparse and are indicative of offshore waters where no significant nutrient sources exist. The most common plankton classes recorded from the sampling of the Ichthys Field development area were the Prasinophyceae (68%), followed by the Bacillariophyceae (30%), the Dinophyceae (1%) and the Cryptophyceae (<1%), all of which are common throughout the region (INPEX 2010).

### 4.8.2 Benthic communities

**Banks and shoals**

A number of banks, shoals and reefs exist within the Browse Basin (Figure 4-2). The closest to WA-50-L are Echuca and Heywood shoals that are located approximately 79 km and 96 km away respectively. Browse Island is the nearest intertidal habitat which is located 33 km away from WA-50-L (INPEX 2010).

Other representative banks and shoals within the EMBA, with approximate distances from WA-50-L include:

- Vulcan Shoals (173 km)
- Eugene McDermott Shoals (175 km)
- Barracouta Shoals (179 km)
- Woodbine Bank (180 km)
- Fantome Shoals (266 km)
- Penguin Shoal (277 km)
- Gale Bank (350 km)
- Van Cloon Shoals (383 km)
- Rowley Shoals (500 km).

The shoals and banks within the EMBA are characterised by abrupt bathymetry, rising steeply from the surrounding shelf to horizontal plateau areas typically 20–30 m deep (AIMS 2012). Substrate types tend to differ from patches of coarse sand, to extensive fields of rubble and rocks, limited areas of consolidated reef and occasional isolated rock or live coral outcrops.

A detailed study on Echuca and Heywood Shoals, the two closest submerged shoals to WA-50-L, was undertaken as part of the Shell/INPEX ARP comprising of annual field surveys conducted from 2014 to 2016 (Heyward et al. 2018). The focus of the study was the shoal benthic habitats and associated fish communities predominantly on the plateau areas, present as horizontal or gently sloping seabed in depths of 15m to 30 m. The outcome of the study by Heyward et al. (2018) reported that Echuca Shoal's oval shaped and slightly shallower 11 $km^2$ plateau had less unconsolidated substrate, such as sand or rubble, than Heywood Shoal's plateau of approximately 31 $km^2$. The benthic habitats and fish communities were similar, with many species in common. All epibenthic organisms on both shoals appeared normal and healthy throughout the study. Fish abundance and diversity was high but varied over time and between the shoals in a consistent manner. Species richness, abundance and fish community structure were influenced mainly by depth and the abundance of epibenthos, especially hard coral (Heyward et al. 2018). These results are comparable with other shoals throughout the region.

The submerged shoals within the EMBA can support diverse tropical ecosystems, including phototrophic benthos typical of tropical coral reefs. The shoals support a diverse biota, including algae, reef-building corals, hard corals and filter-feeders. In general, the flora and faunal assemblages are typical of the oceanic reefs of the Indo–West Pacific region (INPEX 2010), with many of the species in common with those found at the Ashmore, Cartier and Scott reef complexes. The shoals and banks of the area may therefore act as 'stepping stones' for enhanced biological connectivity between the reef systems of the region. Shoal and bank habitats are thought to provide additional regional habitat for marine fauna, including sharks and sea snakes (AIMS 2012).

The community structure of the banks and shoals is likely to be influenced by a number of processes, including disturbance resulting from storms and cyclones, and localised recruitment due to the limited larval dispersal of some invertebrate species (AIMS 2012). It is unknown how interconnected the individual banks and shoals are in regard to larval recruitment. The majority lie in the path of a south-westerly flowing current originating in the Indonesian Throughflow. However, seasonal reversals of current flow suggest larval recruitment can be supplied from outside this process. Seasonal current patterns, local effects within ocean currents (e.g. reversal of current direction against prevailing winds) and species lifecycle characteristics are all likely to exert an influence over the larval recruitment (and hence biodiversity) of the banks and shoals (INPEX 2010).

**Coral reefs**

Coral reefs within the region can be categorised into three general groups: fringing reefs, large platform reefs, and intertidal reefs. Corals are significant benthic primary producers that play a key ecosystem role in many reef environments and have an iconic status in the environments where they occur.

Coral reefs considered to have significant value within the EMBA include:

- Ashmore Reef
- Cartier Island
- Seringapatam Reef
- Scott Reef
- Hibernia Reef

- Rowley Shoals
- Mermaid Reef
- Ningaloo Reef.

These reefs, in particular Ashmore Reef, are recognised as having the highest richness and diversity of coral species in Western Australia (Mustoe & Edmunds 2008, cited in Department of State Development 2010). Ningaloo Reef is the longest fringing reef in Australia and the Rowley Shoals and Scott Reef also support very high coral species diversity, as discussed in Section 4.2 and Section 4.3. The intertidal reefs surrounding the outer islands of the Bonaparte Archipelago also exhibit very high coral species diversity (INPEX 2010). Coral reefs associated with Browse Island (the nearest coral reef to WA-50-L) are discussed in Section 4.4.2.

Indonesia has the largest coral reef area in Southeast Asia and estimates of the extent of these coral reefs vary, but they likely total about 51,000 km$^2$ (ABD 2014). More than 590 species of corals have been identified in Indonesian waters. The Lesser Sunda Ecoregion which intersects the EMBA is considered important for coral endemism, particularly the areas of Bali-Lombok, Komodo and East Flores. Fringing coral reefs tend to be less developed on the southern, more exposed shorelines (Wilson et al. 2011). Coral species composition is influenced by regional and local scale seasonal upwellings that typically occur from April to May each year on the southern side of the Indonesian islands (DeVantier et al. 2008).

Observations throughout the world indicate that coral spawning on most reefs extends over a few months during the spawning period, typically between late spring and autumn (Stoddart & Gilmour 2005, cited in INPEX 2010). Spawning of corals in the Northern Territory Aquarium has been observed around the full moon period in October and November (TWP 2006, cited in INPEX 2010). In northern Queensland, captive corals have been observed to spawn at the same time as those in the adjacent waters. Coral spawning has been observed at Scott Reef during summer/autumn (March/April; main spawning event) and spring (October/November) (Gilmour et al. 2009). This has been confirmed by AIMS research at Scott Reef, which estimates that 60–75% of community reproductive output occurs in autumn, 15–25% in spring, and 5–15% in summer, with comparatively little reproductive output during winter (Gilmour et al. 2013). Research into coral larval dispersal (Gilmour et al. 2009, 2010, 2011; Underwood et al. 2009, 2017; Cook et al. 2017; Waples et al. 2019) has indicated that dispersal and recruitment is predominately local and limited to within a few kilometres to a few tens of kilometres from natal reef patches.

**Seagrass**

There is no seagrass within WA-50-L due to water depth (approximately 250 m) and lack of suitable habitat.

Seagrasses occur in EMBA with the closest seagrasses to the licence area located at Ashmore Reef, approximately 156 km north of WA-50-L, where a high coverage of seagrass supports a small dugong population (Whiting & Guinea 2005).

The largest known seagrass locations for the NWMR have been reported from around the Buccaneer Archipelago located north of the Dampier Peninsula (Wells et al. 1995). Other important areas include the Lacepede Islands, Browse Island, Scott Reef, Ashmore Island and Cartier Island. Coastal shallow-water seagrass habitats are generally rare in the region, accounting for only 11.5 km or 0.2% of the total coastline surveyed by Duke et al. (2010). The regionally dominant genera in Australia are *Halophila* and *Halodule*.

Seagrass habitats are widely distributed across the Lesser Sunda Ecoregion and within Indonesian waters the lower intertidal and upper subtidal zones are considered important areas for the growth of seagrass (Hutumo & Moosa, 2005). Pioneering vegetation in the intertidal zone is dominated by *Halophila ovalis* and *Halodule pinifolia* while *Thalassodendron ciliatum* dominate the lower subtidal zones (Hutumo & Moosa, 2005). Data from the United Nations Environment Program's (UNEP) World Conservation Monitoring Centre has identified the south-west and west Lombok, Savu and the south coast of Timor-Leste as potential areas of importance for seagrass (DeVantier et al. 2008).

### 4.8.3 Shoreline habitats

There are no islands within WA-50-L, with the closest intertidal habitat located at Browse Island (33 km south-east of the licence area). However, within the EMBA there are many islands that occur including numerous small islands and literally thousands of islands along the Australian and Indonesian coastlines.

In the offshore waters of the EMBA there multiple islands which have an associated Commonwealth or State marine park/reserve status. The values and sensitivities associated with the shorelines of these islands are described in sections 4.3, 4.4, 4.5 and 4.6.

#### Sandy beaches

Sandy beaches are the dominant shoreline habitat on all the offshore islands within the EMBA and provide significant habitat for turtles and seabird nesting above the high tide line (Section 4.8.4). Sandy beaches are present within the EMBA at the sandy cays of Ashmore Reef, Cartier Island, Browse Island and Scott Reef as described in Sections 4.3 and 4.4. The southern coastlines of the islands of the Lesser Sunda Ecoregion of Indonesia and Timor-Leste are known to contain sandy beaches consisting of soft black sand, formed by volcanic activity. Within this region, a number of important sites for turtle nesting beaches have been identified (Huffard et al. 2012).

Generally, sands are highly mobile and therefore do no support a high level of biodiversity. Fauna within sandy beach habitats usually consists of polychaete worms, crustaceans and bivalves. These fauna provide a valuable food source for resident and migratory sea and shorebirds (DEC/MPRA 2005). Natural processes tend to supply fresh sediments and larval stock (food source) with each tidal influx.

#### Mangroves

Mangrove communities make up a common shoreline habitat along the northern Western Australian coastlines with extensive mangrove communities along the Australian and Indonesian coastline within the EMBA and they commonly occur in sheltered coastal areas in tropical and sub-tropical latitudes. Mangroves play an important role in connecting the terrestrial and marine environments and reducing coastal erosion. They also play an important ecosystem role in nutrient cycling and carbon fixing (NOAA 2010).

More than a quarter of the world's species of mangroves can be found along the Kimberley coast, covering an area of approximately 1,400 km$^2$. During 2009, shoreline ecological aerial and ground surveys were conducted from Darwin in the NT to Broome in WA in response to the Montara oil spill (Duke et al. 2010). Approximately 5,100 km of shoreline was surveyed, analysed and mapped to quantitatively characterise coastal ecological features. Mangroves were found to grow along 63% of the surveyed shoreline and salt marshes occurred over 24% of the shoreline.

Within Indonesia, 41 species of mangroves, occupying some 32,000 km$^2$ have been recorded (ABD 2014). The Timor-Leste coastline also features mangrove communities surrounding entrances to rivers, primarily situated on the southern coast.

### 4.8.4 Marine fauna

#### Species of conservation significance

Species of conservation significance within the EMBA were identified through a search of the EPBC Act Protected Matters Database (including a 1 km buffer).

The search identified a total of 28 "listed threatened" species and 65 "listed migratory" species that potentially use, or pass through the EMBA.

In addition, 121 "listed marine" species were identified, of which 29 are "whales and other cetaceans" that may occur at, or immediately adjacent to, the area. The full search results are contained in Appendix B.

Table 4-4 presents the marine species that are "listed threatened" species or "listed migratory species". Note that true terrestrial species have not been listed in Table 4-4 on the basis that the outer extent of the EMBA was defined by entrained and dissolved hydrocarbons in the water column (refer Section 8).

**Table 4-4: Listed threatened and/or migratory species under the EPBC Act potentially occurring within the EMBA**

| Species | Common name | Conservation status | Migratory |
|---|---|---|---|
| **Marine mammals** | | | |
| *Balaenoptera borealis* | Sei whale | Vulnerable | Migratory |
| *Balaenoptera edeni* | Bryde's whale | N/A | Migratory |
| *Balaenoptera musculus* | Blue whale | Endangered | Migratory |
| *Balaenoptera physalus* | Fin whale | Vulnerable | Migratory |
| *Megaptera novaeangliae* | Humpback whale | Vulnerable | Migratory |
| *Orcinus orca* | Killer whale | N/A | Migratory |
| *Physeter macrocephalus* | Sperm whale | N/A | Migratory |
| *Dugong dugon* | Dugong | N/A | Migratory |
| *Orcaella heinsohni* | Australian snubfin dolphin | N/A | Migratory |
| *Sousa chinensis* | Indo-Pacific humpback dolphin | N/A | Migratory |
| *Tursiops aduncus* | Spotted bottlenose dolphin | N/A | Migratory |
| **Marine reptiles** | | | |
| *Caretta caretta* | Loggerhead turtle | Endangered | Migratory |
| *Chelonia mydas* | Green turtle | Vulnerable | Migratory |

| Species | Common name | Conservation status | Migratory |
|---|---|---|---|
| *Dermochelys coriacea* | Leatherback turtle | Endangered | Migratory |
| *Eretmochelys imbricata* | Hawksbill turtle | Vulnerable | Migratory |
| *Lepidochelys olivacea* | Olive Ridley turtle | Endangered | Migratory |
| *Natator depressus* | Flatback turtle | Vulnerable | Migratory |
| *Crocodylus porosus* | Saltwater crocodile | N/A | Migratory |
| *Aipysurus apraefrontalis* | Short-nosed seasnake | Critically Endangered | N/A |
| *Aipysurus foliosquama* | Leaf-scaled seasnake | Critically Endangered | N/A |
| **Sharks, fish and rays** | | | |
| *Rhincodon typus* | Whale shark | Vulnerable | Migratory |
| *Carcharodon carcharias* | Great white shark | Vulnerable | Migratory |
| *Glyphis garricki* | Northern river shark | Endangered | N/A |
| *Pristis clavata* | Dwarf sawfish | Vulnerable | Migratory |
| *Pristis pristis* | Northern sawfish, Freshwater sawfish, Largetooth sawfish | Vulnerable | Migratory |
| *Pristis zijsron* | Green sawfish | Vulnerable | Migratory |
| *Anoxypristis cuspidata* | Narrow sawfish | N/A | Migratory |
| *Isurus oxyrinchus* | Shortfin mako | N/A | Migratory |
| *Isurus paucus* | Longfin mako | N/A | Migratory |
| *Manta alfredi* | Reef manta ray | N/A | Migratory |
| *Manta birostris* | Giant manta ray | N/A | Migratory |
| **Marine avifauna** | | | |
| *Anous tenuirostris melanops* | Australian lesser noddy | Vulnerable | N/A |
| *Calidris canutus* | Red Knot | Endangered | Migratory |
| *Calidris ferruginea* | Curlew Sandpiper | Critically Endangered | Migratory |
| *Calidris tenuirostris* | Great Knot | Critically Endangered | Migratory |
| *Charadrius leschenaultii* | Greater Sand Plover | Vulnerable | Migratory |
| *Charadrius mongolus* | Lesser Sand Plover | Endangered | Migratory |

| Species | Common name | Conservation status | Migratory |
|---|---|---|---|
| *Limosa Lapponica baueri* | Bar-tailed Godwit | Vulnerable | Migratory |
| *Limonsa lapponica menzbieri* | Northern Siberian Bar-tailed Godwit | Critically Endangered | Migratory |
| *Numenius madagascariensis* | Eastern curlew | Critically Endangered | N/A |
| *Papasula abbotti* | Abbott's Booby | Endangered | Migratory |
| *Anous stolidus* | Common noddy | N/A | Migratory |
| *Apus pacificus* | Forktailed swift | N/A | Migratory |
| *Ardenna pacifica* | Wedge-tailed Shearwater | N/A | Migratory |
| *Calonectris leucomelas* | Streaked shearwater | N/A | Migratory |
| *Fregata ariel* | Lesser frigatebird | N/A | Migratory |
| *Fregata minor* | Great frigatebird | N/A | Migratory |
| *Hydroprogne caspia* | Caspian tern | N/A | Migratory |
| *Sterna anaethetus* | Bridled tern | N/A | Migratory |
| *Phaethon lepturus* | White-tailed tropicbird | N/A | Migratory |
| *Phaethon rubricauda* | Red-tailed tropicbird | N/A | Migratory |
| *Sterna dougallii* | Roseate tern | N/A | Migratory |
| *Onychoprion anaethetus* | Little tern | N/A | Migratory |
| *Sula dactylatra* | Masked booby | N/A | Migratory |
| *Sula leucogaster* | Brown booby | N/A | Migratory |
| *Sula sula* | Red-footed booby | N/A | Migratory |
| *Acrocephalus orientalis* | Oriental Reed-Warbler | N/A | Migratory |
| *Actitis hypoleucos* | Common Sandpiper | N/A | Migratory |
| *Arenaria interpres* | Ruddy Turnstone | N/A | Migratory |
| *Calidris acuminata* | Sharp-tailed Sandpiper | N/A | Migratory |
| *Calidris alba* | Sanderling | N/A | Migratory |
| *Calidris melanotos* | Pectoral Sandpiper | N/A | Migratory |
| *Calidris ruficollis* | Red-necked Stint | N/A | Migratory |

| Species | Common name | Conservation status | Migratory |
|---|---|---|---|
| *Charadrius veredus* | Oriental Plover | N/A | Migratory |
| *Limosa limosa* | Black-tailed Godwit | N/A | Migratory |
| *Numenius phaeopus* | Whimbrel | N/A | Migratory |
| *Pandion cristatus* | Eastern Osprey | N/A | Migratory |
| *Pluvialis fulva* | Pacific Golden Plover | N/A | Migratory |
| *Pluvialis squatarola* | Grey Plover | N/A | Migratory |
| *Thalasseus bergii* | Crested Tern | N/A | Migratory |
| *Tringa brevipes* | Grey-tailed Tattler | N/A | Migratory |
| *Tringa nebularia* | Common Greenshank | N/A | Migratory |
| *Tringa totanus* | Common Redshank | N/A | Migratory |
| *Xenus cinereus* | Terek Sandpiper | N/A | Migratory |

**Conservation management plans**

In addition to species being identified as threatened or migratory and MNES, depending on the threat classification, the DEE has established management policies, guidelines, plans and other materials for threatened fauna, threatened flora (other than conservation-dependent species) and threatened ecological communities listed under the EPBC Act.

In particular, the objectives of DEE recovery plans and conservation advice, seek to support the long-term recovery of various species outlining research and management measures that must be undertaken to stop the decline of, and support the recovery of a species, including the management of threatening processes.

Species identified during the EPBC Act Protected Matters search that have a conservation advice or a recovery plan in place, as well as any particular relevant actions to assist their recovery and conservation, including threat abatement plans, are summarised in Appendix B.

**Biological important areas**

The DEE has, through the marine bioregional planning program, identified, described and mapped biologically important areas (BIAs) for protected species under the EPBC Act. BIAs spatially and temporally define areas where protected species display biologically important behaviours (including breeding, foraging, resting or migration), based on the best available scientific information. These areas are those parts of a marine region that are particularly important for the conservation of protected species.

Table 4-5 provides an overview of the EPBC-listed species, identified by the EPBC Act Protected Matters search, that are associated with a BIA in the EMBA. The locations of relevant BIAs for EPBC-listed species are shown in Figure 4-4 to Figure 4-8.

Note, there are no BIAs that intersect the licence area, with the closest BIAs being a green turtle internesting buffer at Browse Island and the whale shark foraging BIA located approximately 15 km south-east of WA-50-L at its closest point.

**Table 4-5: BIAs intersecting the EMBA**

| Species | Migration route | Foraging | Internesting | Resting/breeding | Aggregation/calving | Pupping/ nursing |
|---|---|---|---|---|---|---|
| Humpback whale | x | | | | x | |
| Pygmy blue whale | x | | | | | |
| Dugong | | x | | | | |
| Coastal dolphins: Indo-Pacific humpback dolphin, bottlenose dolphin and Australian snubfin dolphin | | x | | | x | |
| Whale shark | | x | | | | |
| Largetooth/freshwater, dwarf and green sawfish | | x | | | | x |
| Avifauna | | x | | x | | |
| Flatback turtle | | x | x | | | |
| Green turtle | | x | x | | | |
| Hawksbill turtle | | x | x | | | |
| Loggerhead turtle | | x | | | | |

**Marine mammals**

Noise logging surveys were undertaken by INPEX to determine the critical areas of use and to establish a baseline of abundance for cetaceans within the Kimberley region. Noise loggers were set on the sea floor at two sites: in the Browse Basin 45 km north west of Browse Island (in 240 m of water) and at an inshore site near the Maret Islands (in 45 m of water) between September 2006 and August 2008. The loggers detected anthropogenic noise signals from vessel activities and seismic surveys, as well as signals from pygmy blue whales, humpback whales, Antarctic and dwarf minke whales, a signal which is believed to be from Bryde’s whales, and several unknown great whale signals, plus a plethora of fish signal types and choruses (McCauley 2009).

There are no identified BIAs for marine mammals within WA-50-L. However, a number of marine mammal BIAs overlap the EMBA as outlined in Table 4-5 and shown in Figures 4-4 and 4-5. Marine mammals associated with a BIA in the EMBA are described in more detail within this subsection.

Humpback whale

There are two humpback whale (Megaptera novaeangliae) BIAs located within the EMBA; a migratory corridor and a breeding and calving area, as shown in Figure 4-4. During their annual northern and southern migrations, transitory humpback whales will pass through the EMBA generally between June and October, with peak ingress during July. The population increases up to mid-August when whales begin to depart on their southern migration. Peak egress occurs around September and the final groups of whales tend to have departed by late October (Jenner et al. 2001; Thums et al. 2018).

The migratory habitat for the humpback whale around mainland Australia is primarily coastal waters less than 200 m in depth and generally within 20 km of the coast (Jenner et al. 2001). Breeding and calving generally occurs between the Lacepede Islands and Camden Sound. Camden Sound is considered the northern most limit and is considered an important calving and breeding area (Jenner et al. 2001). A recent study as part of the Kimberley Marine Research Project (Thums et al. 2018) analysed three decades of satellite, aerial, boat-based sightings and determined that abundance was greatest in nearshore waters in water depths of approximately 35 m. However, whales (including cows and calves) may also occur in lower abundance elsewhere within and further offshore from the BIAs, with whales having been recorded in offshore locations such as Browse Island and Scott Reef (e.g. McCauley 2009). Isolated observations of humpback whales and their calves have been noted within the Ichthys Field. The closest BIA to WA-50-L relates to calving and resting and is located approximately 120 km south-east of the licence area.

Blue Whale

There are two recognised subspecies of blue whale in the southern hemisphere, which are both recorded in Australian waters. They are the southern (or 'true') blue whale (*Balaenoptera musculus intermedia*) and the ‘pygmy' blue whale (*Balaenoptera musculus brevicauda*) (DoE 2015). In general, southern blue whales occur in waters south of 60°S and pygmy blue whales occur in waters north of 55°S (i.e. not in the Antarctic) (DoE 2015). On this basis, any blue whales present within the licence area/EMBA would be expected to be pygmy blue whales.

The 2015 Conservation Management Plan for the Blue Whale (DoE 2015) outlines the distribution of blue whales in Australian waters, and associated BIAs (i.e. migratory corridor and foraging areas). The closest BIA present within the EMBA, is a migratory corridor, located approximately 60 km west of WA-50-L at its closest point, and a foraging BIA at Scott Reef, approximately 98 km west of WA-50-L (Figure 4-4).

Pygmy blue whale migration is thought to follow deep oceanic routes. More recently, the migration route has been defined as along the shelf edge at depths between 500 m to 1,000 m (DoE 2015). Observations suggest most pygmy blue whales pass along the shelf edge out to water depths of 1,000 m but centred near the 500 m depth contour (McCauley & Jenner 2010). Satellite tagging (2009–2011) confirmed that the general distribution of pygmy blue whales was offshore in water depths >200 m and commonly >1,000 m (Double et al. 2014).

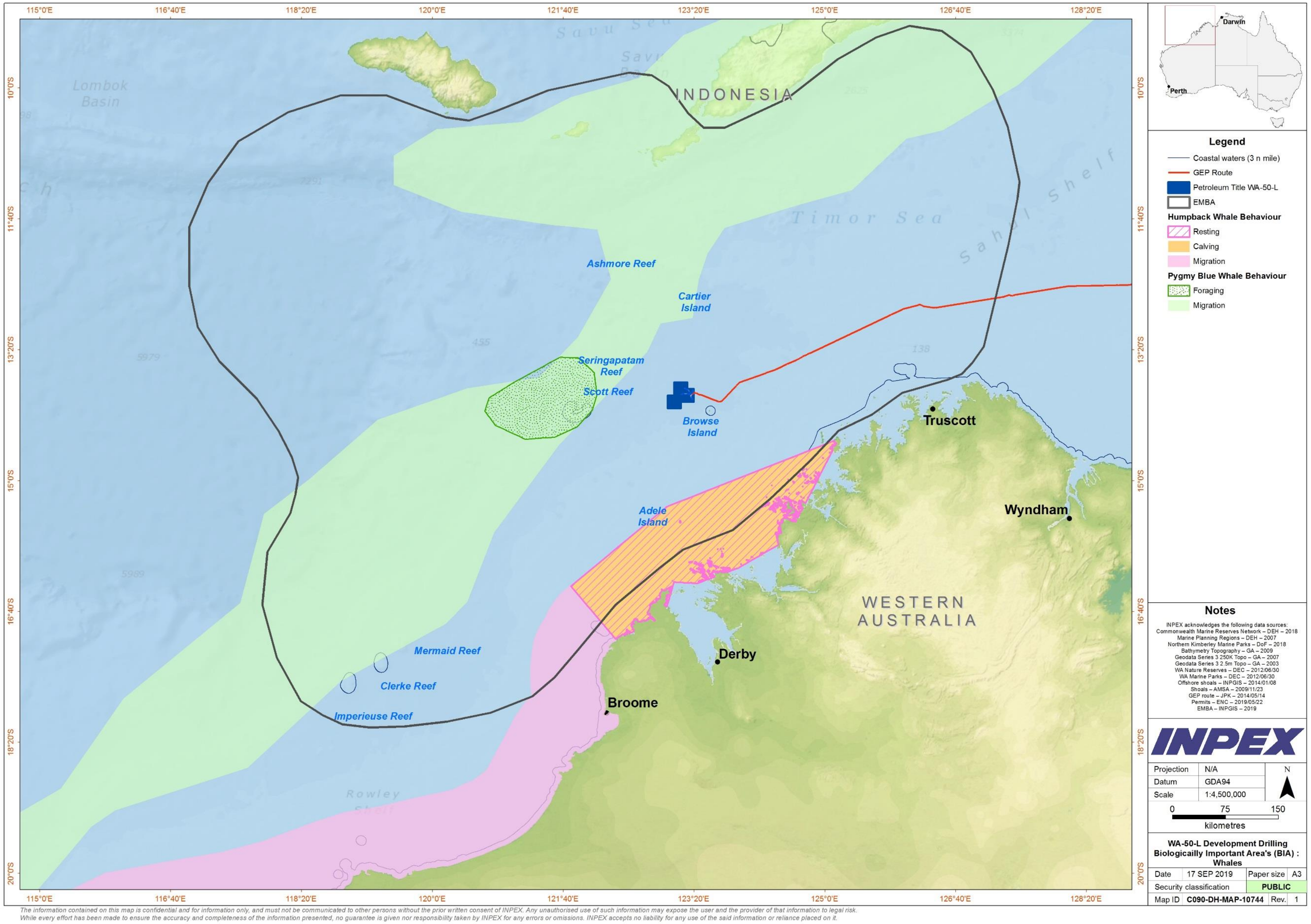



Figure 4-4: Biologically important areas associated with whales

Dugongs

Within the EMBA, there is a dugong foraging BIA at Ashmore Reef (Figure 4-5) which correlates with seagrass habitats (refer Section 4.8.2).

Dugongs are considered Specially Protected under Schedule 4 of the *Biodiversity Conservation Act 2018* (WA) and are listed as migratory species under the EPBC Act. A significant proportion of the world's dugong population occurs in the coastal waters of the west-Pilbara nearshore, as well as Ningaloo Reef and Exmouth Gulf (Marsh et al. 2011). Dugongs generally inhabit shallow waters (around 10 m depth) and are commonly found in mangrove channels of inshore islands and shallow areas near the seagrass habitats on which they feed (DEE 2019b).

Dolphins

Coastal dolphin BIAs for breeding, calving and foraging are located within the EMBA, as shown in Figure 4-5. There are three species of coastal dolphin to which these BIAs relate as discussed below. A recent study of snubfin and humpback dolphins in the Kimberley region (Waples et al. 2019) confirmed these species of dolphins are present at low densities and occur as relatively small populations across the Kimberley.

Indo-Pacific humpback dolphin

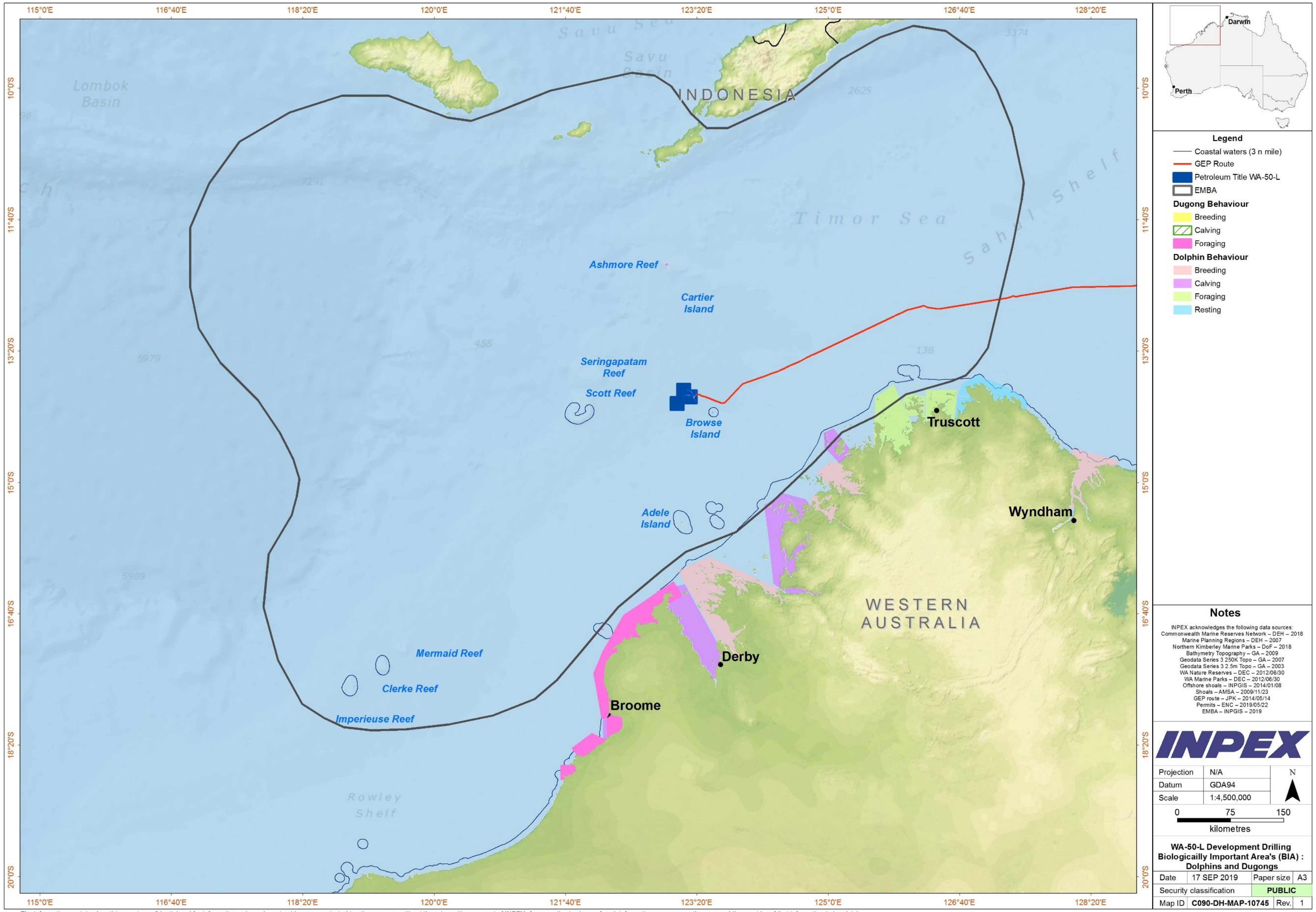
The Indo-Pacific humpback dolphin (*Sousa sahulensis*) occurs along the northern coastline of Australia down to Exmouth on the WA coastline. The total population size of the Indo-Pacific humpback dolphin in Australian waters is unknown. Given that the required shallow habitat preferred by this species occurs continuously throughout its recorded range, the distribution of the Indo-Pacific Humpback Dolphin is considered to represent one continuous location (DEE 2019c).

Indo-Pacific bottlenose dolphin

The Indo-Pacific spotted dolphin (*Tursiops aduncus*) is generally considered to be a warm water subspecies of the common bottlenose dolphin (*Tursiops truncatus*). The Indo-Pacific spotted dolphin appears to occupy inshore waters, often in depths of less than 10 m (Bannister et al. 1996). It is known to occur from Shark Bay, north to the western edge of the Gulf of Carpentaria and is regarded as a migratory species under the EPBC Act (DEE 2019d).

Australian snubfin dolphin

All available data on the distribution and habitat preferences of Australian snubfin dolphin (*Orcaella heinsohni*) indicate that they mainly occur in the shallow coastal and estuarine waters of the NT and north WA (Beasley et al. 2002). There are no data to estimate any past or potential future declines in the area of occupancy for snubfin dolphins in Australia; however, incidental catches in gillnets (albeit at unknown levels), in addition to habitat degradation, may lead to a reduction of area of occupancy over the next three generations for Australian snubfin dolphins. (DEE 2019e).




The information contained on this map is confidential and for information only, and must not be communicated to other persons without the prior written consent of INPEX. Any unauthorised use of such information may expose the user and the provider of that information to legal risk. While every effort has been made to ensure the accuracy and completeness of the information presented, no guarantee is given nor responsibility taken by INPEX for any errors or omissions. INPEX accepts no liability for any use of the said information or reliance placed on it.

**Figure 4-5: Biologically important areas associated with dugongs and dolphins**

**Marine reptiles**

Turtles

The EPBC Act Protected Matters search identified six species of marine turtle which may occur within the EMBA: the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), leatherback turtle (*Dermochelys coriacea*), flatback turtle (*Natator depressus*), hawksbill turtle (*Eretmochelys imbricate*) and olive ridley turtle (*Lepidochelys olivacea*). While there are no known BIAs for marine turtles within WA-50-L, there are a range of BIAs and critical habitats for turtle breeding, foraging and internesting within the EMBA (Figure 4-6). Nesting rookeries within the EMBA include Browse Island, Ashmore Reef, Cartier Island, Cassini Island, Scott Reef and the Lacepede Islands as identified in the Recovery Plan for Marine Turtles in Australia (DEE 2017a). Peak nesting periods for all turtle species within these areas are generally between November and April. Further, 20 km internesting buffers associated with green turtles have been identified for Browse Island, Scott Reef (Sandy Islet), Adele Island and Cassini Island between November and March. Similarly, a 60 km internesting buffer for flatback turtles has been identified at Cassini Island between May and July (DEE 2017a). At Scott Reef there is an interesting BIA (20 km buffer) for hawksbill turtles where internesting occurs in October – February each year, and peaks in December and January (DEE 2017a).

Satellite tagging of nesting female loggerhead turtles from the Ningaloo/Pilbara coast of Western Australia have shown dispersal north-west as far as Indonesia and southern Borneo, north-east as far as the Tiwi Islands and south as far as the Great Australian Bight (Waayers et al. 2015; Whiting et al. 2008). Flatback turtles are known to forage across the Australian continental shelf as far north as Indonesia and Papua New Guinea (DEE 2017a). There is limited tag recovery data for olive ridley turtles, but satellite tracking data indicates that they appear to remain on the Australian continental shelf (Waayers et al. 2015).

Turtles are not expected to be present in high numbers in WA-50-L. However, individual green turtles may occasionally be present associated with the internesting buffer at Browse Island, and other marine turtle species are likely to be present in the waters of the EMBA as it encompasses several locations that support turtle foraging, nesting and internesting behaviours.

Sea snakes

The EPBC search identified 22 sea snakes which may occur within the EMBA. There are no reported BIAs for sea snakes. Most of the knowledge of sea snakes in Australian waters comes from trawler bycatch (Milton et al. 2009; Ward 1996). These studies indicate that sea snakes in northern regions of Australia tend to breed in shallow embayments and estuaries which are only represented in the EMBA. Therefore, these species may be seen in the open waters of WA-50-L, but their presence is unlikely to be common.

Crocodiles

The salt-water crocodile has a tropical distribution that extends across the northern coastline of Australia, where it can be found in coastal waters, estuaries, freshwater lakes, inland swamps and marshes, as well as far out to sea (Webb et al. 1987). There are no reported BIAs for crocodiles. Due to the species preference for estuaries and swamps and coastal waters it is unlikely to occur in the open waters of WA-50-L and is more likely to be observed in the EMBA where these preferred habitats occur.

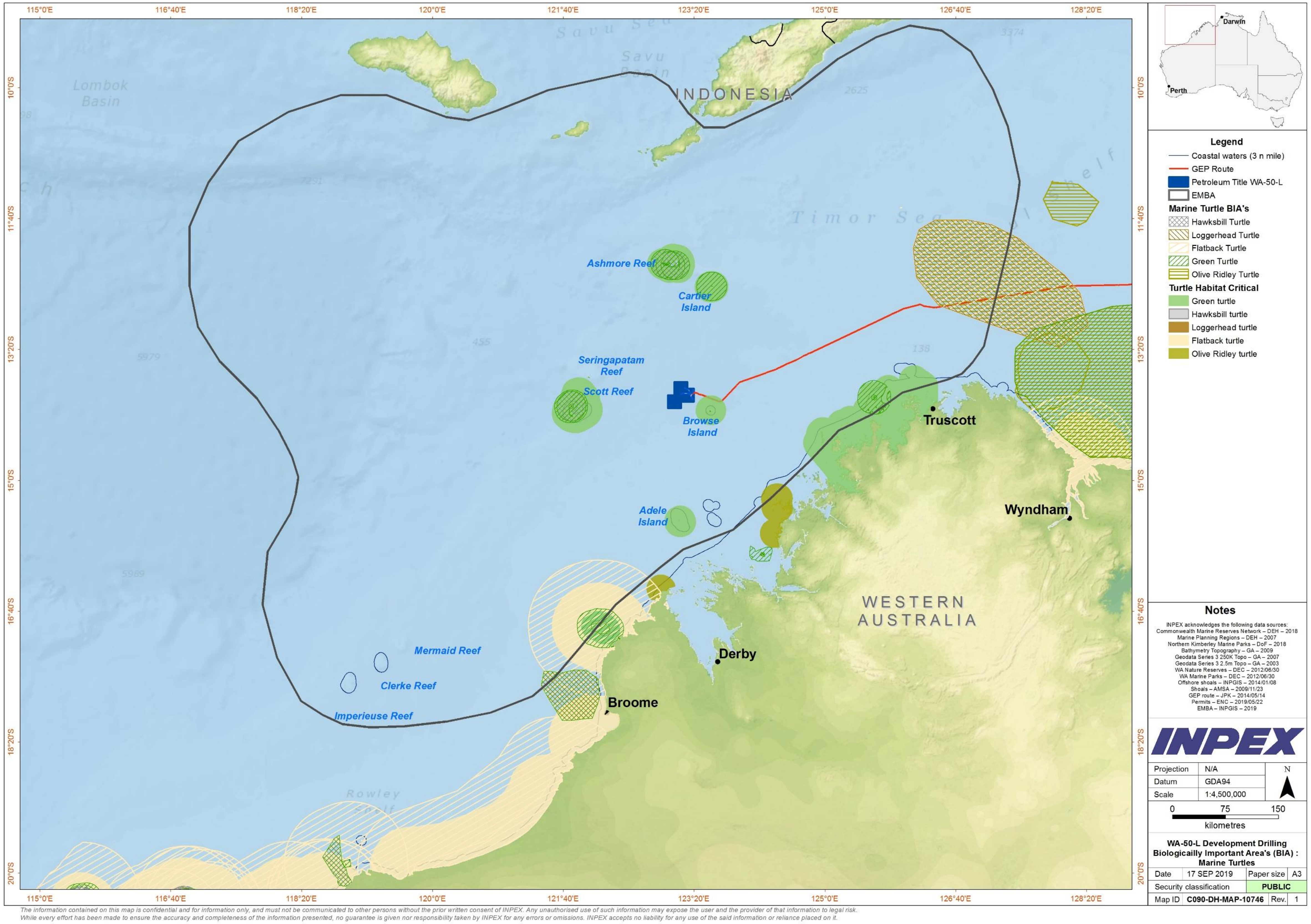



**Figure 4-6: Biologically important areas associated with marine turtles**

**Fishes and sharks**

While there are no BIAs for fishes and sharks within WA-50-L, in the EMBA a BIA exists for whale sharks (foraging area) that largely follows the 125 m ancient coastline and at its closest point is approximately 15 km south-east of WA-50-L as shown in Figure 4-7. There are also BIAs for sawfish (green, dwarf and freshwater) located to the south-west and north-east of Broome.

Although not specifically identified as BIAs, several of the KEFs within the EMBA, as described in Section 4.2, are also known to provide important habitat for diverse fish assemblages.

Whale shark

The whale shark is a solitary planktivorous species that spends the greater part of its foraging time at water depths above 100 m, often near the surface (Brunnschweiler & Sims 2011; Wilson et al. 2006). However, whale sharks are also known to engage in mesopelagic and even bathypelagic diving when in bathymetrically unconstrained habitats (Brunnschweiler et al. 2009; Wilson et al. 2006).

Whale sharks appear to prefer different locations at different times of year, and despite a reasonable understanding of the various whale shark aggregation locations and timings, little is known about the large-scale transoceanic movements in response to seasonal abundance of planktonic prey species (Eckert & Stewart 2001).

It is however understood that whale sharks can travel over vast distances between aggregation sites. One whale shark tagged in the Seychelles was relocated after 42 days having travelled 3,000 km to south of Sri Lanka and then located again 4 months later, a further 5,000 km away in the waters of Thailand (Hsu et al. 2007). Therefore, it is possible that whale sharks may transit through the EMBA in both Australian and International waters.

Whale sharks are widely distributed in tropical Australian waters. Within WA, whale sharks aggregate seasonally (March–June) to feed in coastal waters off Ningaloo Reef (Wilson et al. 2006). Taylor (1996) and Rowat & Gore (2007) examined whale shark movements at Ningaloo Reef and observed that the sharks swim parallel to the reef but found no clear evidence of a north-south migration.

Whilst Ningaloo is the nearest aggregation to the WA-50-L, it is located over 1,300 km to the south. Research on the migration patterns of whale sharks in the western Indian Ocean, indicates that a small number of the WA (Ningaloo) population migrate through the wider vicinity of the Browse Basin region (McKinnon et al. 2002; Wilson et al. 2006; Jenner et al. 2008; Meekan & Radford 2010). Whale sharks from Ningaloo Reef fitted with satellite trackers were observed to travel either north-east towards Timor Leste, or north-west towards the Indonesia islands of Sumatra and Java, with some individuals passing through the broad vicinity of Scott Reef (McKinnon et al. 2002, Wilson et al. 2006, Meekan & Radford 2010; Sleeman et al. 2010). Aerial (Jenner & Jenner 2009a; RPS Environment and Planning Pty Ltd 2010, 2011) and vessel (Jenner et al. 2008; Jenner & Jenner 2009b) surveys conducted in 2008 and 2009, involving over 1,000 hours of observer effort, recorded one whale shark in 2008 and two whale sharks in 2010 in the Browse Basin (Jenner et al. 2008 and RPS Environment and Planning Pty Ltd 2011 respectively).

Within the EMBA, the whale shark BIA largely follows the ancient coastline at 125 m depth contour KEF and at its closest point is located approximately 15 km south-east of WA-50-L. However, based on the levels of whale shark abundance observed in the studies listed above, the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration.

Sawfish

Four species of sawfish (largetooth/freshwater/northern, narrow, dwarf and green sawfish) were identified in the EPBC search (Table 4-4). While sawfish are identified as being found within the EMBA due to their ecology (generally estuarine rather than open-ocean species) it is expected that they will only be present on the periphery of the EMBA (Figure 4-7).

As described in Section 4.3, environments found in the EMBA provide protection for shallow shelf habitats that are important foraging, nursing and pupping areas for freshwater, green and dwarf sawfish. The range of sawfish species overlaps with popular recreational fishing locations in some parts of the NMR (DSEWPaC 2012b) and adjacent areas. Observations of dead discarded sawfish species from recreational fishing highlights that mortality occurs as a direct result of capture and discarding (DSEWPaC 2012b).

Sawfish are not expected to occur within the open ocean location of WA-50-L.

Pipefish and seahorses

The EPBC search identified 33 species of the family Syngnathidae potentially present within the EMBA. Syngnathidae is a group of bony fishes that includes seahorses, pipefishes, pipehorses and sea dragons. Seahorses and pipefishes are a diverse group and occupy a wide range of habitats. However, the species identified in the EPBC search (Appendix B) generally display a preference for shallow water habitats such as seagrass and macroalgal beds, coral reefs, mangroves and sponge gardens that can be found in the shallower areas of the EMBA (Foster & Vincent 2004; Lourie et al. 1999; Scales 2010). In WA-50-L, water depths are approximately 250 m and preclude the presence of seagrass; and hard bottom substrates, which can potentially support coral and macroalgae sponge garden communities. Therefore, pipefish and seahorses are only expected to occur in the EMBA in areas where suitable habitats are present.

Sharks and rays

Five shark species (including whale shark described above) and two ray species were identified as having the potential to occur within the EMBA (Table 4-4; Appendix B).

It is considered possible that larger pelagic sharks such as the great white, whale and mako sharks may transit through the licence area. The likelihood of these species occurring in WA-50-L is expected to be very low as the licence area is not considered to provide habitat that is of breeding or feeding importance. As such, these species are unlikely to be common or resident within WA-50-L.

The majority of recorded great white shark movements in Australian waters are reported to occur between the coast and the 100 m depth contour (DEE 2019f).

Listed manta rays have been observed within the EMBA, but for the same reasons as the large pelagic sharks, are unlikely to be common or resident within WA-50-L.

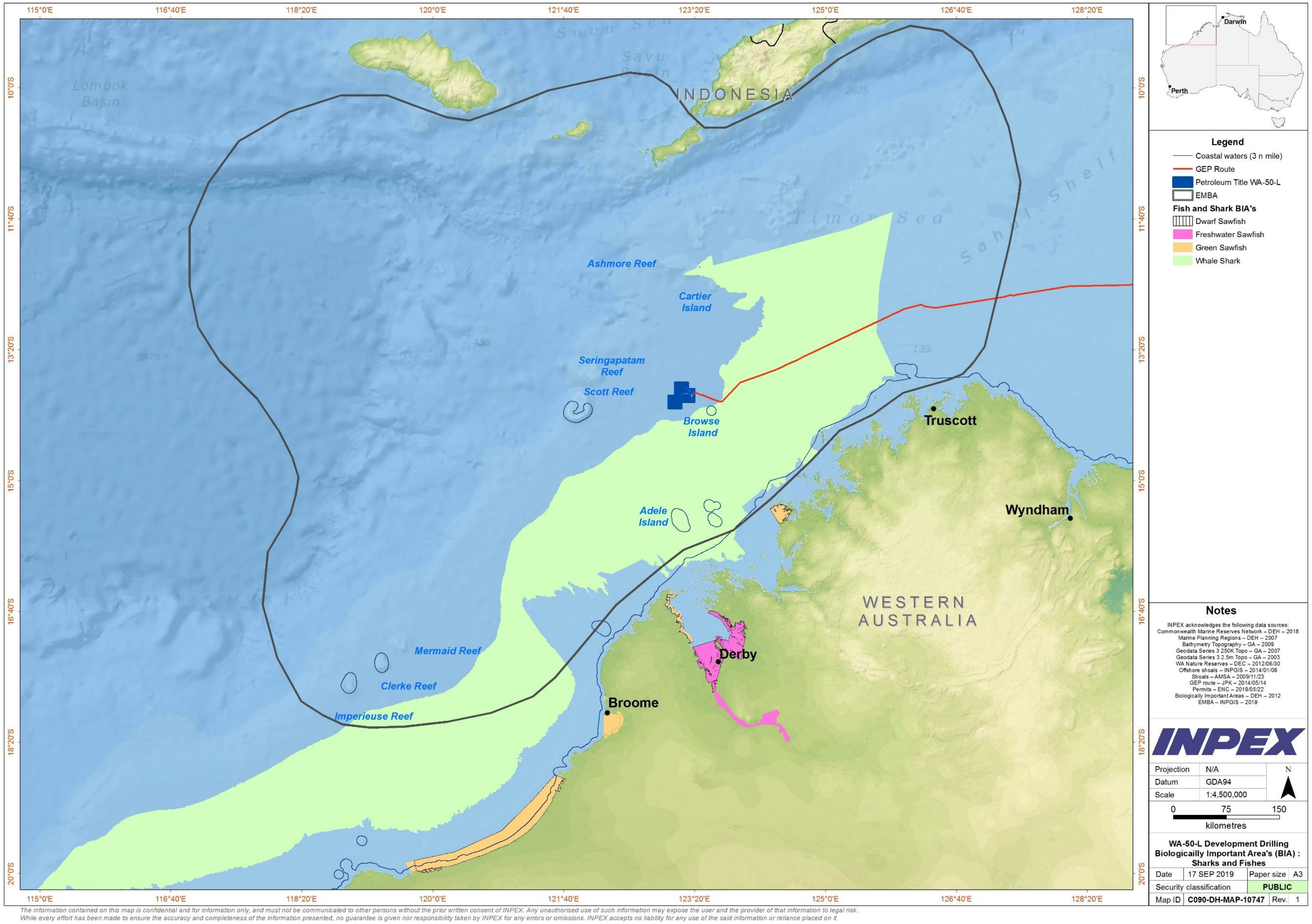



**Figure 4-7: Biologically important areas associated with fishes and sharks**

### Marine avifauna

WA-50-L is located within what is known as the East Asian–Australasian Flyway an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. 'Flyway' is the term used to describe a geographic region that supports a group of populations of migratory waterbirds throughout their annual cycle. There are 54 species of migratory shorebirds that are known to specifically follow migration paths within the EAA Flyway (Bamford et al. 2008). Migratory shorebird species are mostly present in Australia during the non-breeding period, from as early as August to as late as April/May each year. After arrival in Australia at the end of long migrations, they disperse throughout the country to a wide variety of habitats including coastal wetlands, mudflats, reefs and sandy beaches (DEE 2017b).

There are no BIAs for marine avifauna within WA-50-L. However, the EMBA overlaps a large number of BIAs for a number of different marine avifauna species (Figure 4-8). The closest BIAs for marine avifauna relate to foraging around Adele Island, Ashmore Reef and Cartier Island, and Scott Reef. A Ramsar site (Ashmore Reef) and a nationally important wetland (Mermaid Reef) are also present within the EMBA (refer to Section 4.6), these sites provide important habitat for marine avifauna.

Vessel-based surveys conducted around the Ichthys gas field, Browse Island and to the west as far as Scott Reef were conducted by the Centre for Whale Research (CWR) in 2008. Seabirds observed included frigatebirds, boobies, terns, noddies, tropicbirds, petrels, shearwaters and gulls, with the brown booby the most common species recorded. Of the species recorded during the vessel-based surveys, a number are migratory species listed under the EPBC Act, including the streaked shearwater, brown booby, masked booby, lesser frigatebird, bridled tern, lesser crested tern and little tern. These migratory species can be expected to be encountered in low numbers as they are likely to transit through the licence area and the EMBA.

In addition to seabirds, the search of the EPBC database identified 26 species of migratory wetland bird species potentially present within the EMBA. These species may migrate through the EMBA to wetland habitats on the mainland and/or larger coastal islands (DEE 2017b). It is considered unlikely that WA-50-L would provide any significant resources to support these species.

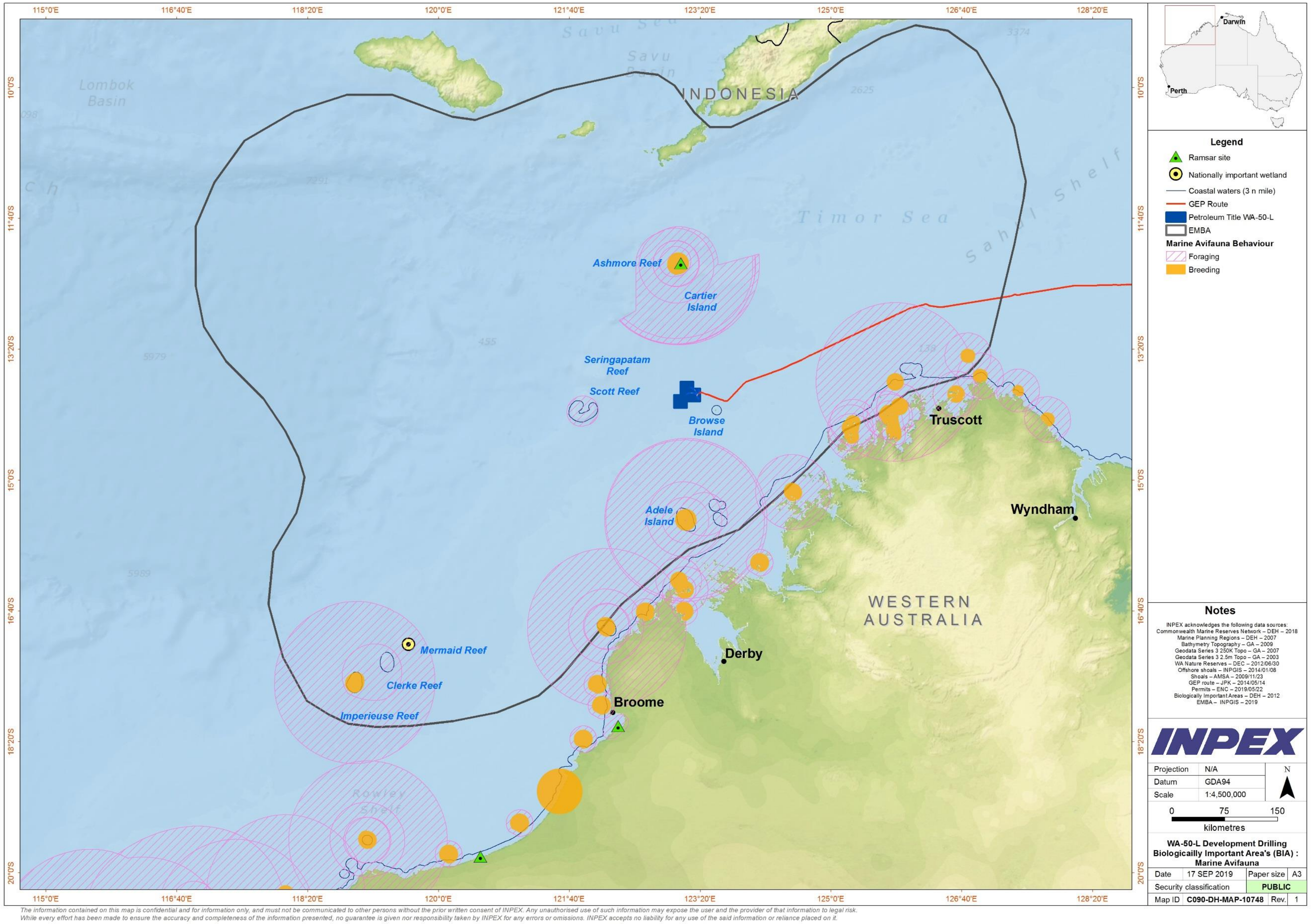



**Figure 4-8: Biologically important areas associated with marine avifauna**

## 4.9 Socioeconomic and cultural environment

### 4.9.1 World heritage areas

No world heritage areas were identified as overlapping WA-50-L or the EMBA.

### 4.9.2 National heritage places

**The West Kimberley**

The West Kimberley was included on the National Heritage List in 2011 and has numerous values which contribute to the significance of the property, including indigenous, historic, aesthetic, cultural and natural heritage values (DEE 2019g). The West Kimberley is characterised by a diversity of landscapes and biological richness found in its cliffs, headlands, sandy beaches, rivers, waterfalls and islands.

### 4.9.3 Fishing

Commercially significant fish stocks, considered to be key indicator species, that may be present in WA-50-L are shown in Table 4-6, including spawning and aggregation times.

**Table 4-6: Commercially significant fish species**

| Key commercial fish species | Spawning/aggregation times |
|---|---|
| Goldband snapper | Goldband snapper typically occur in 50 – 200 m water depths, and often concentrated in depths from 80 – 150 m. They spawn throughout their range (rather than aggregating at specific locations) during November to May (extended peak spawning period). |
| Spanish mackerel | Spanish mackerel occur in continental shelf waters and congregate in coastal waters around reefs, shoals and headlands to feed and spawn, occurring typically in water depths from 1 -50 m. They form spawning schools around inshore reefs with peak spawning period of September to January. |
| Rankin cod | Rankin cod typically occur in water depths of 10 – 150 m. They spawn throughout their range (rather than aggregating at specific locations) during June to December and March (peak spawning period August to October. |
| Red emperor | Red emperor typically occur in 10 – 180 m water depths, and are often concentrated in depths from 60 – 120 m. They spawn throughout their range (rather than aggregating at specific locations) during September to June (with bimodal peaks from September to November and January to March). |
| Bluespotted emperor | Blue spotted emperor typically occur in water depths of 5 – 110 m. They spawn throughout their range (rather than aggregating at specific locations) during July to March (extended peak spawning period). |

**Commercial fisheries– Australian waters**

Within the EMBA, five Commonwealth-managed fisheries have the potential to operate with four of these also overlapping WA-50-L, as summarised in Table 4-7.

In addition to the Commonwealth-managed fisheries, 19 State-managed commercial fisheries have the potential to operate within the EMBA. Of these, five fishery boundaries overlap with WA-50-L (Table 4-8). Fisheries highlighted in bold have potential fishing grounds that overlap with WA-50-L, it does not indicate that they are currently active within the licence area; however, there is a potential that they may be in the future.

**Table 4-7: Commonwealth-managed commercial fisheries (AFMA-managed)**

| **Commercial fishery**<br>**(BOLD denotes overlap with WA-50-L)** | **Fishery summary** |
|---|---|
| **Western Tuna and Billfish Fishery** | The Western Tuna and Billfish Fishery targets bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), broadbill swordfish (*Xiphias gladius*) and striped marlin (*Tetrapturus audax*). The fishery targets areas of reef which are present within the EMBA and mainly use longline fishing gear to catch the targeted species.<br>The Billfish Fishery covers the sea area west from the tip of Cape York in Queensland, around Western Australia, to the border between Victoria and South Australia. Fishing occurs in both the Australian Fishing Zone and adjacent high seas.<br>In the fishery there are currently 95 boats with statutory fishing rights (AFMA 2019a). |
| **Western Skipjack Fishery** | The Western Skipjack Fishery covers the entire sea around WA out to 200 nm from the coast. The fishery targets the skipjack tuna (*Katsuwonus pelamis*) and employs the purse seine, pole and line, and longline methods as its techniques. Although 14 permits are in place, the fishery is not currently active (AFMA 2019b). |
| **North West Slope Trawl Fishery** | The North West Slope Trawl Fishery targets scampi (*Metanephrops australiensis*) and deepwater prawn. The fishery is located in deep water from the coast of the Prince Regent National Park to Exmouth between the 200 m depth contour to the outer limit of the Australian Fishing Zone (AFMA 2019d).<br>There are seven fishing permits (maximum number of vessels active at one time) each with a five year duration in the North West Slope Trawl Fishery. It is the only active fishery in the vicinity of WA-50-L, with reportedly low negligible trawl-fishing in the Ichthys Field; however, catch data is confidential for this fishery (AFMA 2019d). |
| **Southern Bluefin Tuna Fishery** | The Southern Bluefin Tuna Fishery covers the entire sea around Australia, out to 200 nm from the coast. There are 84 statutory fishing right owners in the fishery. This fishery is managed under a quota system to ensure the species is not subject to overfishing as has happened in the past. Commercial fishers mainly use the purse seine fishing method to catch southern bluefin tuna. With the fish being towed closer inshore and transferred to permanent floating pontoons. The major landing port is Port Lincoln in South Australia (AFMA 2019g) and therefore does not overlap the EMBA. No catch is taken from the NWS. |
| Northern Prawn Fishery | The Northern Prawn Fishery targets banana prawns (*Fenneropenaeus merguiensis, F. indicus*) tiger prawns (*Penaeus esculentus, P. semisulcatus*) and endeavour prawns (*Metapenaeus endeavouri, M. ensis*) in northern Australian waters. The fishery occasionally operates from from Cape York in Queensland to Cape Londonderry in WA and is predominantly active in the shallower waters of the EMBA. To manage the fishery, there are 2 fishing seasons (April –June and August to November). There are currently 52 boats with fishing rights in the fishery (maximum number vessels at one time) and bottom trawl fishing gear is used in this fishery (AFMA 2019c). |

**Table 4-8: State-managed commercial fisheries (WA DPIRD)**

| **Commercial fishery**<br>**(BOLD denotes overlap with WA-50-L)** | **Fishery summary** |
|---|---|
| **Northern Demersal Scalefish Managed Fishery (WA) Area 2**<br><br>(Area 1 overlaps EMBA but not WA-50-L) | The Northern Demersal Scalefish Managed Fishery is primarily a trap-based fishery which targets red emperor and gold band snapper. The fishery operates off the north-west coast of WA in the waters east of longitude 120°E and overlaps the EMBA. The typical catch is in the order of 3,000 tonnes annually, making these fisheries the most valuable finfish sector in the State, with an estimated annual value of at least $12 million (Gaughan & Santoro 2018). |
| **Mackerel Managed Fishery (WA) Area 1**<br><br>(Area 2 overlaps EMBA but not WA-50-L) | The Mackerel Managed Fishery uses near-surface trolling gear from vessels in coastal areas around reefs, shoals and headlands (WAFIC 2019b). The fishery targets Spanish mackerel (*Scomberomorus commerson*). There are currently 50 licences in the fishery with 15 active in the Kimberley area where the majority of the catch is taken (Gaughan & Santoro 2018). |
| **North Coast Shark Fishery (Cwlth/WA) Northern Zone**<br><br>(Southern Zone overlaps EMBA but not WA-50-L) | The northern shark fisheries comprise the state-managed WA North Coast Shark Fishery in the Pilbara and western Kimberley, and the Joint Authority Northern Shark Fishery in the eastern Kimberley. Target species of the northern shark fisheries include the sandbar, hammerhead, blacktip and lemon sharks (AFMA 2019e).<br>This fishery has not been active since 2008/2009 (AFMA 2019e). |
| **Pearl Oyster Managed Fishery (WA) Zone 3**<br><br>(Zones 1 and 2 overlap EMBA but not WA-50-L) | The Pearl Oyster Managed Fishery is the only remaining significant wild-stock fishery for pearl oysters. It is a quota-based, dive fishery operating in the shallow coastal waters along the NWS (WAFIC 2019c). The main fishing grounds are off Eighty Mile Beach, with smaller catches being taken around the Lacepede Islands (Gaughan & Santoro 2018).<br>The catch for 2016 was reported to be 541,260 oysters harvested over 19,699 dive hours (Gaughan & Santoro 2018). |
| **West Coast Deep Sea Crustacean Fishery (WA)** | The West Coast Deep Sea Crustacean Fishery operates predominantly around the entrance to Shark Bay in water depths from 150-1,200 m (Gaughan & Santoro 2018). Catch in 2016 was 153 tonnes dominated by crystal crabs. |
| Kimberley Prawn Managed Fishery (WA) | The Kimberley Prawn Managed Fishery predominantly target banana prawns (*Penaeus merguiensis*) and catch also includes tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*). The fishery operates from the north eastern boundary of the Exmouth Gulf Prawn Fishery to Cape Londonderry, in the EMBA (WAFIC 2019a). |

| **Commercial fishery**<br>**(BOLD denotes overlap with WA-50-L)** | **Fishery summary** |
|---|---|
| Trochus Fishery (WA) | The Trochus Fishery is a small fishery based on a single target species (*Trochus niloticus*) harvested by hand. The trochus are found on reef tops and are harvested at low tide. The annual harvest in the past decade has ranged between 2 and 15 tonnes. Fishing grounds are located in the remote Kimberley region (WAFIC 2019d) |
| Specimen Shell Managed Fishery (WA) | The Specimen Shell Managed Fishery is based on the collection of individual shells for the purposes of display, collection, cataloguing, classification and sale. Just over 200 different Specimen Shell species were collected in 2016, using a variety of methods. The main methods are by hand by a small group of divers operating from small boats in shallow coastal waters or by wading along coastal beaches below the high-water mark (Gaughan & Santoro 2018). While the fishery covers the entire WA coastline, there is some concentration of effort in areas adjacent to population centres such as Broome and Exmouth in the EMBA. |
| South West Coast Salmon Managed Fishery (WA) | South West Coast Salmon Managed Fishery targets Western Australian salmon (*Arripis truttaceus*). This fishery uses beach seine nets.<br>In 2015 and 2016 very large schools of salmon were observed in south-western waters and as far north as Exmouth, which is further north than ever previously reported. |
| North Coast Crab Fishery (Including Kimberley Mud Crab and Pilbara Crab) (WA) | The North Coast Crab Fishery is a trap-based fishery which targets blue swimmer crabs in the Pilbara (the Pilbara Developing Crab Fishery) and mud crabs in the Kimberley (the Kimberley Developing Mud Crab Fishery) (WAFIC 2019e). Catch rates in these fisheries is very low. |
| Marine Aquarium Fish Fishery (WA) | This Marine Aquarium Fish Fishery is typically more active in coastal waters between Esperance and Broome with higher levels of effort around the Capes region, Perth, Geraldton, Exmouth and Dampier (Gaughan & Santoro 2018). More than 950 species of marine aquarium fishes may be accessed, with some operators also permitted to take coral, live rock, algae, seagrass and invertebrates. |
| Hermit Crab Fishery (WA) | The Hermit Crab Fishery specifically targets the Australian land hermit crab (*Coenobita variabilis*) for the domestic and international live pet trade. The fishery operates throughout the year and is one of two land-based commercial fisheries in WA. The fishery is currently permitted to fish in waters north of Exmouth Gulf with three active licences in 2016 (Gaughan & Santoro 2018). |
| Broome Prawn Managed Fishery (WA) | The Broome Prawn Fishery predominantly targets banana prawns (*Penaeus merguiensis*) but also catches tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*) (WAFIC 2019f). |

| **Commercial fishery**<br>**(BOLD denotes overlap with WA-50-L)** | **Fishery summary** |
|---|---|
| Abalone Managed Fishery (WA) | The Abalone Managed Fishery includes the West Coast Roe's Abalone resource and the South Coast Greenlip / Brownlip Abalone resource. Roe's abalone is found in commercial quantities from the SA border to Shark Bay. The commercial fishery harvest method is a single diver working off a 'hookah' (surface-supplied breathing apparatus) using an abalone 'iron' to prise the shellfish off rocks (WAFIC 2019g). The fishery operates in shallow coastal waters coinciding with abalone distributions (Gaughan & Santoro 2018). Although the area of the fishery overlaps WA-50-L, no fishing effort occurs in the licence area given the water depth, water temperature and lack of suitable habitat. |
| Nickol Bay Prawn Managed Fishery (WA) | The Nickol Bay Prawn Managed Fishery predominantly target banana prawns (*Penaeus merguiensis*) but also catch tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*)(WAFIC 2019f). |
| Pilbara Fish Trap and Trawl Managed Fishery (WA) | The Pilbara Fish Trap and Trawl Fishery lands the largest component of the catch of demersal finfish in the Pilbara (and North Coast Bioregion) comprising more than 50 scalefish species (Gaughan & Santoro 2018). |
| Pilbara Line | Pilbara line fishery uses drop line fishing method for fish. The indicator species are bluespotted emperor, red emperor, Rankin cod and ruby snapper. Catches around 45 to 50 scalefish species and some deeper offshore species. |
| Kimberley Gillnet and Barramundi Fishery (WA) | The Kimberley Gillnet and Barramundi Fishery operates in the nearshore and estuarine zones of the North coast bioregion from the WA/NT border to the northern end of Eighty Mile Beach, covering the river systems and tidal creek systems of the Cambridge Gulf, the Ria coast of the northern Kimberley, King Sound, Roebuck Bay and the northern end of Eighty Mile Beach. The fishery targets barramundi and other species taken by the fishery include king threadfin (*Polydactylus macrochir*) and blue threadfin (*Eleutheronema tetradactylum*) (WAFIC 2019h). The fishery is limited to five licences. |

**Commercial fisheries – International waters**

Within the international waters of the EMBA, capture fisheries in Indonesia contribute significantly to the national economy's income, foreign exchange, and employment. In 2010, the industry produced 5.4 million tons of fish. To manage the fishery areas, the Indonesian government established 11 fishery management areas covering Indonesia's territorial sea and EEZ (ADB 2014).

Although there are 11 fisheries management areas, lack of enforcement and lack of awareness of the need for sustainable fisheries management have resulted in the degradation of fish stocks in several areas. The use of unsuitable fishing gear has further declined fish stocks in certain areas, especially the coastal zone, which is exploited by 85% of Indonesian fishers. Additionally, foreign fleets threaten fisheries, although it is difficult to obtain accurate data on the number of vessels and their mode of operations (ABD 2014).

**Recreational fishing**

A wide range of recreational activities occur within the NWMR and NMR. Recreational fishing activities peak in winter and are concentrated in coastal waters along the Kimberley and NT coastlines, generally around the population centres of Broome, Wyndham and Darwin. Some of the recreationally important species of the coastal areas include barramundi, mangrove jack, jewfish and bream.

Fishing methods typically involve rod and line gear and approximately three quarters of fish caught by fishing tour operators are released (NTG 2016). While the survivorship of released Barramundi is high, the same is not true for reef-associated species, such Golden Snapper and Black Jewfish. Both species are susceptible to pressure-induced injuries (barotrauma), with the rate of injury and post-release mortality proportional to capture depth. Concerns regarding the impacts of barotrauma on reef fishes (and other factors) have led to the development of new management controls on the harvest of these species (NTG 2016).

Offshore islands, coral reef systems and continental shelf waters are increasingly targeted by fishing-based charter vessels (Gaughan & Santoro 2018). Extended fishing charters are known to operate during certain times of the year to fishing spots off the WA and NT coast, including Scott Reef. Generally, there is little recreational fishing that occurs within WA-50-L because of its distance from land, lack of features of interest and deep waters.

**Traditional fishing**

Aboriginal fishing

Traditional fishing occurs along the majority of the Kimberley coastline. The practice of traditional fishing includes taking turtles, dugong, fish and other marine life (DEE 2019h). The EPBC Act Protected Matters Search (Appendix B) identified the following two IPAs:

- Dambimangari IPA (located in the Buccaneer Archipelago/Prince Regent area)
- Uunguu IPA (600 km north-east of Derby on the far north-west coast of the Kimberley).

These IPAs are all expected to have traditional aboriginal fishing activities ongoing. Other non-designated areas along the WA coastline may also be used for traditional fishing.

The extraction of living resources via illegal, unregulated and unreported fishing along the northern edges of the NWMR is a pressure of potential concern for the carbonate bank and terrace system of the Sahul Shelf, the pinnacles of the Bonaparte Basin, and the Commonwealth waters surrounding Ashmore Reef and Cartier Island (DSEWPaC 2012a).

Indonesian fishing

The Australian and Indonesian governments signed a memorandum of understanding (MoU) in 1974 (DSEWPaC 2012a) which permits fishing by Indonesian and Timorese fishers, using traditional fishing methods only, in an area of Australian waters in the Timor Sea. The MoU area, which has become known as the “MoU Box”, covers Scott Reef and its surrounds, Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks and shoals (Figure 4-2).

The MoU requires fishers to use traditional sail-powered fishing vessels and non-motorised equipment, and prohibits them from taking protected species, such as turtles, dugongs and clams. Fishers target a range of animals, including trepang (bêche-de-mer), *trochus* (topshell), reef fish and sharks. Indonesian fishing effort is high at Scott Reef and also takes place at Browse Island.

Although WA-50-L falls within the MoU Box, due to the nature of traditional fishing activities, the actual fishing effort generally only occurs in the shallow subtidal / intertidal habitats of the reefs and islands within the EMBA.

Traditional Indonesian fishing effort is intense at Seringapatam Reef and Commonwealth waters in the Scott Reef complex. Depending on the intensity of effort and composition of catch, the extraction of living resources from these KEFs may affect trophic structures and ecological functioning (DSEWPaC 2012a). Indigenous harvest of traditional marine resources (e.g. turtles, whale sharks and dugong) in international waters adjacent to the NWMR is also a pressure of potential concern (DSEWPaC 2012a).

### 4.9.4 Aquaculture

There are no aquaculture operations in WA-50-L. Aquaculture development in the region is dominated by the production of pearls from the species *Pinctada maxima.* A large number of pearl oysters for seeding is obtained from wild stocks and supplemented by hatchery-produced oysters with major hatcheries operating at Broome and the Dampier Peninsular; however, these do not lie within the EMBA.

An analysis by WorldFish has indicated that aquaculture will overtake capture fisheries as the major source of fish in Indonesia before 2030 (Phillips et al. 2015). By volume, Indonesian aquatic production is dominated by seaweeds due to the simple farming techniques required, low requirements of capital and material inputs, and short production cycles. However, by value, domestically consumed species such tilapia and milkfish, together with export-orientated commodities such as shrimp and tuna, are of greater importance (Phillips et al. 2015).

### 4.9.5 Shipping and ports

Vessel tracking data from AMSA's Craft Tracking System (CTS) for May 2019 is presented in Figure 4-9. CTS collects vessel traffic data from a variety of sources, including terrestrial and satellite shipborne Automatic Identification System (AIS) data sources. Figure 4-9 highlights the presence of commonly used transit routes in the vicinity of the licence area used by supply vessels routinely supporting offshore developments in the Browse Basin including the INPEX Ichthys within WA-50-L itself, and the nearby Shell Prelude FLNG facility. The major shipping lanes linking WA to Indonesia are situated over 180 km to the west of WA-50-L (Figure 4-9).

The closest ports to WA-50-L are Derby, Broome and Wyndham. These are small ports, exporting nickel, lead, zinc and cattle, and importing products to support their local communities. The Port of Broome provides supply facilities for the petroleum industry operating in the Browse Basin.

By comparison, the ports along the north-west and north coast, such as Onslow, Dampier, Cape Lambert, Port Hedland, and Darwin handle much larger tonnages of iron ore, and petroleum exports, with shipping routes throughout the region.

### 4.9.6 Oil and gas industry

The existing INPEX producing asset (subsea and on the surface) is present within WA-50-L consisting of an interlinked facility comprising SPS, CPF Explorer and FPSO Venturer.

The next closest operational production facility to WA-50-L, is the Shell Prelude FLNG facility located approximately 17 km to the north east.

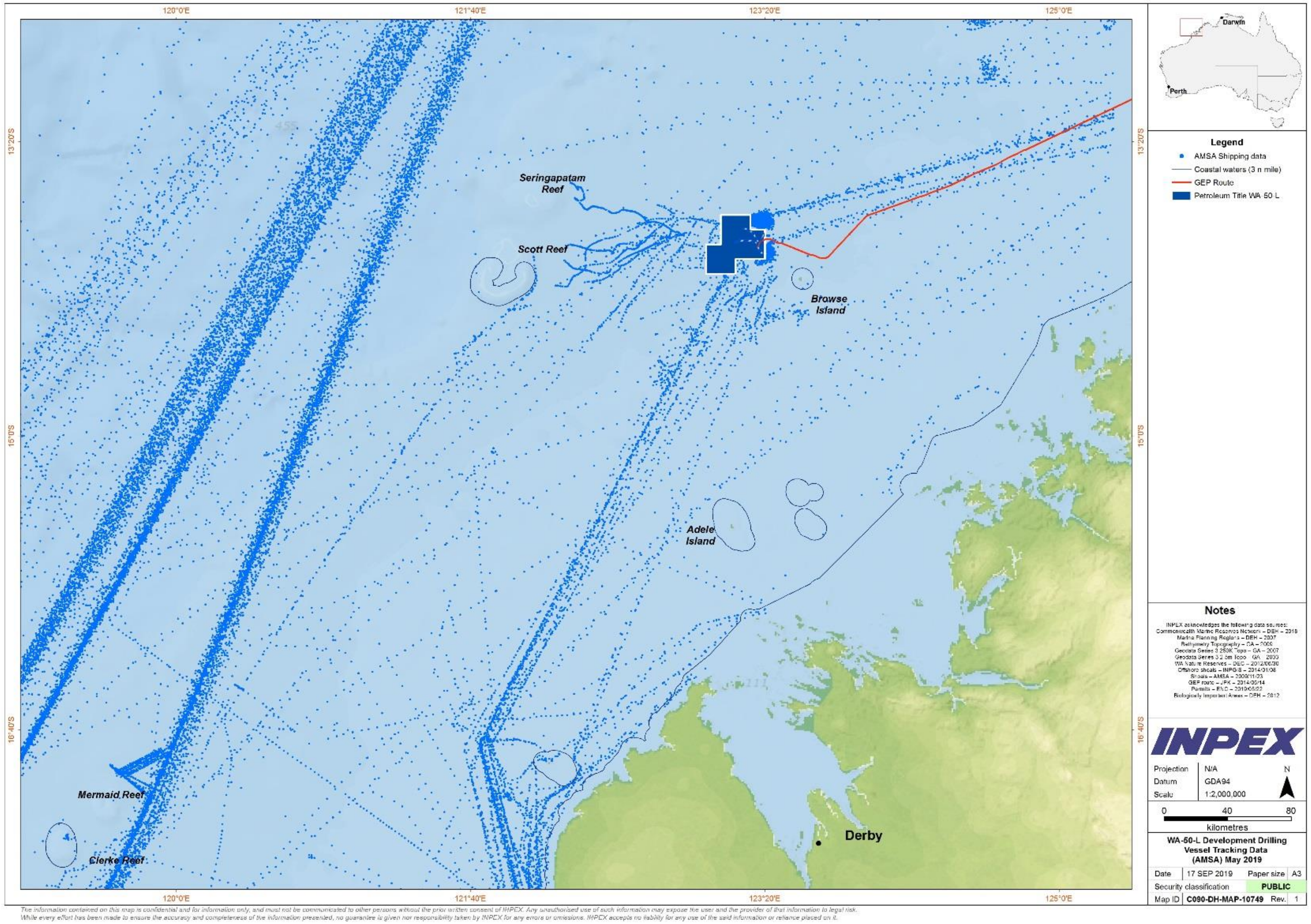



**Figure 4-9: Vessel tracking data in the Browse Basin (May 2019)**

## 4.10 Summary of values and sensitivities

### 4.10.1 WA-50-L

**Table 4-9: Particular values and sensitivities potentially within WA-50-L**

<table>
<tr><th colspan="2">Value and sensitivity</th><th>Description</th></tr>
<tr><td colspan="2">Receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage).</td><td>Fisheries (traditional and commercial).</td></tr>
<tr><td colspan="2">Benthic primary producer habitat, defined by the Western Australian Environmental Protection Authority (WA EPA) Environmental Assessment Guideline No. 3 Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment as functional ecological communities that inhabit the seabed within which algae (e.g. macroalgae, turf and benthic microalgae), seagrass, mangroves, corals, or mixtures of these groups, are prominent components.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Regionally important areas of high diversity (such as shoals and banks).</td><td>WA-50-L overlaps the continental slope demersal fish communities KEF</td></tr>
<tr><td colspan="2">World heritage values of a declared World Heritage property within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">National heritage values of a National Heritage place within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Ecological character of a declared Ramsar wetland within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">Presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act.</td><td rowspan="2">A number of threatened species or migratory species have been identified as having the potential to transit through WA-50-L.<br>These have been categorised as marine fauna:<br>• marine mammals<br>• marine reptiles<br>• fishes and sharks<br>• marine avifauna.<br>Also refer to Appendix B (EPBC Act Protected Matters Report).</td></tr>
<tr><td colspan="2">Presence of a listed migratory species within the meaning of the EPBC Act.</td></tr>
<tr><td rowspan="2">Any values and sensitivities that exist in, or in relation to, part or all of:</td><td>a Commonwealth marine area within the meaning of the EPBC Act.</td><td>Productivity and diversity associated with planktonic communities and benthic communities.</td></tr>
<tr><td>Commonwealth land within the meaning of the EPBC Act.</td><td>None identified within WA-50-L.</td></tr>
<tr><td colspan="2">BIAs associated with EPBC-listed species.</td><td>There are no known BIAs associated with listed threatened species or migratory species within WA-50-L.</td></tr>
</table>

### 4.10.2 EMBA

**Table 4-10: Particular values and sensitivities potentially within the EMBA**

| Value and sensitivity | Description |
|---|---|
| Receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage). | Fisheries (commercial, traditional and recreational). |
| Benthic primary producer habitat, defined by the Western Australian Environmental Protection Authority (WA EPA) Environmental Assessment Guideline No. 3 *Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment* as functional ecological communities that inhabit the seabed within which algae (e.g. macroalgae, turf and benthic microalgae), seagrass, mangroves, corals, or mixtures of these groups, are prominent components. | Benthic primary producer habitats are described in Section 4.8.2 and include the Commonwealth and state marine reserves and KEFs listed below. |
| Regionally important areas of high diversity (such as shoals and banks). | KEFs:<br>• Continental slope demersal fish communities<br>• Ancient coastline at 125 m depth contour<br>• Ashmore Reef and Cartier Island and surrounding Commonwealth waters<br>• Canyons linking the Argo Abyssal Plain with Scott Plateau<br>• Pinnacles of the Bonaparte Basin<br>• Carbonate bank and terrace system of the Sahul Shelf<br>• Mermaid Reef and Commonwealth waters surrounding the Rowley Shoals<br>• Seringapatam Reef and Commonwealth waters in the Scott Reef complex.<br>Benthic habitats:<br>• Various banks and shoals, and coral reefs (Section 4.8.2)<br>• Seagrasses (Ashmore Reef) and along Indonesian coastline.<br>Shoreline habitats:<br>• Islands, mangroves and sandy beaches (Section 4.8.3). |
| World heritage values of a declared World Heritage property within the meaning of the EPBC Act. | None identified within this area. |
| National heritage values of a National Heritage place within the meaning of the EPBC Act. | The West Kimberley is identified as natural National Heritage Places (Section 4.9.2). |
| Ecological character of a declared Ramsar wetland within the meaning of the EPBC Act. | One Ramsar site (Section 4.6):<br>• Ashmore reef national nature reserve |

<table>
<tr><th colspan="2">Value and sensitivity</th><th>Description</th></tr>
<tr><td colspan="2">Presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act.</td><td rowspan="2">A number of threatened species or migratory species have been identified as having the potential to transit through the EMBA.<br>These have been categorised as marine fauna (Section 4.8.4):<br>• marine mammals<br>• marine reptiles<br>• fishes and sharks<br>• marine avifauna.<br>Also refer to Appendix B (EPBC Act Protected Matters Report).</td></tr>
<tr><td colspan="2">Presence of a listed migratory species within the meaning of the EPBC Act.</td></tr>
<tr><td rowspan="2">Any values and sensitivities that exist in, or in relation to, part or all of:</td><td>a Commonwealth marine area within the meaning of the EPBC Act.</td><td>Productivity and diversity associated with planktonic communities and benthic communities.</td></tr>
<tr><td>Commonwealth land within the meaning of the EPBC Act.</td><td>None identified within this area.</td></tr>
<tr><td colspan="2">BIAs associated with EPBC-listed species.</td><td>A large number of BIAs are present within the EMBA. These are mainly associated with coastlines and the adjacent shallow waters and include:<br>Marine mammals<br>• humpback whale migration route and aggregation/calving areas<br>• pygmy blue whale migration route<br>• dugong foraging at Ashmore Reef<br>• coastal dolphins breeding, calving and foraging areas.<br>Marine reptiles<br>• Turtle nesting, internesting and adjacent foraging areas including Browse Island, Ashmore Reef, Cartier Island, Lacepde Islands, Cassini Island and Sandy Islet (Scott Reef).<br>Fish and sharks<br>• whale shark foraging area<br>• KEFs associated with increased species diversity and abundance (i.e. continental slope demersal fish communities and the ancient coastline at 125 m depth contour).<br>Marine avifauna<br>• a number of resting and breeding areas associated with shoreline habitats (e.g. Adele Island, Ashmore Reef, Browse Island, Cartier Island, Sandy Islet (Scott Reef) and nearshore waters and islands of the WA coastline)<br>• a large number of offshore foraging areas that are adjacent to these shoreline habitats.</td></tr>
</table>

# 5 STAKEHOLDER CONSULTATION

INPEX has been a member of the Australian business community since 1986 and during this time has engaged on a regular basis with stakeholders in WA and in federal jurisdictions on a broad range of activities. INPEX maintains a corporate webpage (http://www.inpex.com.au) to provide company and project-related information to the public. INPEX also participates in industry forums, conferences and community meetings in order to facilitate opportunities for meaningful engagement about current and future activities.

INPEX acknowledges the importance of consultation to ensure that persons who may be affected by a proposed petroleum activity ('relevant persons') are informed about the proposed activity and have the opportunity to advise INPEX of any functions, interests or activities that could be impacted by the proposed activity.

INPEX's awareness of the functions, interests or activities of relevant persons supports the development of management plans that consider and address any environmental, social or economic objections or claims about the proposed activity.

INPEX's process for stakeholder engagement (consultation) in the development and implementation of an EP and relevant management plans is shown in Figure 5-1 and further described in this section.

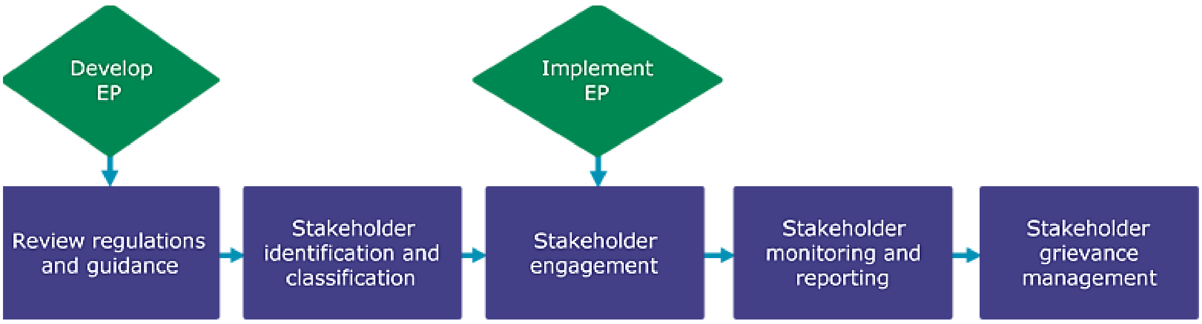



**Figure 5-1: Process for stakeholder engagement (consultation) for development and implementation of an EP**

## 5.1 Regulatory requirements and guidelines

As a first step in EP development, INPEX reviewed the following documents to prepare for stakeholder consultation on the proposed offshore petroleum activity:

- Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations
- NOPSEMA policies, guidance and information papers related to environment plan development, including:
  - GL1721 - Environment plan decision making - Rev 5 - June 2018
  - GN1344 - Environment plan content requirements - Rev 4 - April 2019
  - GN1488 - Oil pollution risk management - Rev 2 - February 2018
  - IP1411 - Consultation requirements under the OPGGS Environment Regulations 2009 - Rev 2
  - GN1785 – Petroleum activities and Australian marine parks – Rev 0 – July 2018
- Guidance issued by relevant stakeholders (as known or provided to INPEX), including:

  - Australian Government Guidance: Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area
  - Australian Fisheries Management Authority (AFMA): Petroleum industry consultation with the commercial fishing industry
  - WA Department of Primary Industry and Regional Development (WA DPIRD): Guidance statement for oil and gas industry consultation with the Department of Fisheries
  - WA Department of Transport (WA DoT): Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements
- INPEX stakeholder engagement procedures and guidelines.

INPEX acknowledges its responsibility under the various legislative instruments and other guidance to ensure that relevant persons are appropriately identified and consulted in the development of its EPs and in the conduct of its offshore activities.

## 5.2 Stakeholder identification and classification

With an understanding of the general requirements and expectations for consultation, INPEX conducted stakeholder identification and classification activities.

As an initial exercise, 'relevant persons' were identified, then classified, to determine a suitable engagement priority and method. Key INPEX personnel met in a workshop to outline the requirement for engagement, established the context of the proposed activities, and identified relevant persons in accordance with Regulation 11A(1) of the OPPGS (E) Regulations and NOPSEMA's additional clarifications of Regulation 11A(1) as provided in Issues Paper IP1411 (NOPSEMA 2014).

INPEX treats stakeholder identification (and subsequent activities) as an iterative process whereby the company may become aware of relevant persons both during the process of consultation on, and also after the development and submission of, an EP. INPEX acknowledges that relevant persons may be identified during an EP assessment period and also in the lead up to and conduct of an accepted petroleum activity.

### 5.2.1 Definition of 'relevant persons'/relevant stakeholders

In identifying relevant persons to be consulted on the proposed petroleum activity, INPEX prescribes to the definition provided under Subregulation 11A(1) of the OPGGS (E) Regulations, being:

a. *each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant*

b. *each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant*

c. *the Department of the responsible State Minister, or the responsible Northern Territory Minister*

d. *a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan*

e. *any other person or organisation that the titleholder considers relevant.*

### 5.2.2 Relevant activity

In determining who is a relevant stakeholder, it was necessary for INPEX to determine what constitutes a relevant activity, and for which activities a stakeholder should be engaged.

**Petroleum activity (planned activity)**

The OPGGS (E) Regulations require that consultation be undertaken to ensure that persons who may be affected by a petroleum activity are given the opportunity to inform the titleholder how they may be affected and to allow the titleholder to assess and address any objections or claims about that activity in the preparation of environment submissions.

Regulation 4 of the OPGGS (E) Regulations defines a petroleum activity as *"any operations or works in an offshore area carried out for the purpose of:*

*a. exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or*

*b. discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act."*

When identifying relevant persons, INPEX considers which stakeholders perform a function in the relation to – or have a function, activity or interest that may be impacted by – the planned, physical petroleum activity.

The planned activity for this EP is the development drilling activity to be undertaken in Commonwealth waters. Therefore, in determining who is a relevant person for engagement on the petroleum activity, INPEX sought to identify and engage with stakeholders whose functions, interests or activities could be affected by the drilling activity.

**Unplanned event/activity (emergency conditions)**

INPEX undertakes a more targeted approach to consultation with stakeholders in relation to unplanned – and highly improbable – emergency conditions, e.g. a loss of containment of hydrocarbons during the development drilling activity.

Stakeholders who may perform a function in INPEX's planning for, or management of an unplanned activity, and whose information is integral to the development of those management plans, are engaged during the development of the EP and OPEP.

Stakeholders whose functions, interests or activities otherwise overlap the EMBA for the unplanned activity are not engaged during the development of those plans but may be engaged in the event of an unplanned emergency condition.

This approach has been adopted to reduce consultation fatigue for stakeholders who will not be impacted by the (physical) petroleum activity.

INPEX will engage contrary to this approach where a stakeholder has expressed a significant (high to very high) level of concern about loss of containment events and wishes to understand more about the potential impact and planned response activities.

INPEX maintains an extended stakeholder list which includes stakeholders who may have a function, activity or interest that falls within for the EMBA, but for the purpose of the development of these plans, engages with stakeholders as outlined in Table 5-1.

**Table 5-1: Classification and method of engagement with stakeholders in relation to an unplanned oil spill event and oil spill response**

| Stakeholder category | Method of engagement | Stakeholders |
|---|---|---|
| Government departments, agencies or organisations with functions or roles directly relevant to emergency and oil spill preparedness and response | Involve / consult regarding the proposed activity and potential unplanned emergency conditions during the preparation of the EP and OPEP. | • Australian Maritime Safety Authority (AMSA)<br>• WA Department of Transport (DoT)<br>• WA Department of Primary Industries and Regional Development (WA DPIRD)<br>• WA Department of Biodiversity, Conservation and Attractions (DBCA)<br>• Australian Marine Oil Spill Centre (AMOSC) |
| Stakeholders where land access is required to be agreed prior to the activity commencing | Involve / consult regarding the proposed activity and potential unplanned emergency conditions during the preparation of the EP and OPEP. | • Landowners<br>• Native title holders<br>• Aboriginal and Torres Strait Islander communities |
| Stakeholders whose level of interest (or expectation) in relation to a potential oil spills and oil spill response for the planned activity is high or very high. | Inform regarding the proposed activity and potential unplanned emergency conditions during the preparation of the EP and OPEP. | As determined during stakeholder identification workshop. |
| Stakeholders whose level of interest (or expectation) in relation to a potential oil spills and oil spill response for the planned activity is low or medium. | To be informed only in the event of an unplanned emergency condition (i.e. oil spill) that has the potential to affect their functions, activities or interests. | As determined during stakeholder identification workshop. |

### 5.2.3 Commercial fishery stakeholder identification and classification

In addition to the process outlined above for planned activities and unplanned events, identification of relevant commercial fishing stakeholders distinguishes between:

- fisheries that overlap the planned petroleum activity; and
- fisheries that overlap the EMBA but not the location of the planned petroleum activity.

INPEX used a variety of resources (e.g. data files and fishery reports) to identify and classify stakeholders according to these criteria.

With the view to minimise stakeholder fatigue, INPEX restricted engagement activities to licence holders in fisheries that overlap the area (location) of the planned petroleum activity. INPEX also considered if and where licence holders are active (or potentially active) within a fishery to assess whether that licence holder should be engaged.

In summary, identification of and engagement with commercial fishing stakeholders was conducted as follows:

- Government authorities (AFMA, Department of Agriculture and WA DPIRD) were engaged regarding the proposed activity and engagement with commercial fishing stakeholders. Materials made available by government authorities, e.g. WA FishCube (fishing effort) data files and fishing reports, were used in fisheries determinations.

- Fishing industry associations that represent fisheries with licence areas that overlap the proposed activity (e.g. WAFIC, Commonwealth Fisheries Association) were consulted regarding the proposed activity and engagement with their members.
- Licence holders in commercial fisheries were engaged/not engaged according to the following criteria:
  - Active or potentially active licence holders in commercial fisheries whose activities overlap or are very close to the proposed petroleum activity were considered to be relevant stakeholders, and were accordingly engaged during the development of the EP.
  - Licence holders in commercial fisheries that overlap or are close to the planned petroleum activity, but whose activities or interests are not expected to be affected by the planned petroleum activity are not considered to be relevant stakeholders. Such licence holders were not engaged during the development of the EP, but the industry associations representing these fisheries were informed. An example would be where the licence holder fishes in a distant part of that fishery, e.g. off the southern coast of Australia.
  - Licence holders in commercial fisheries that overlap the broader EMBA but not the area of the proposed petroleum activity are not considered affected parties/relevant stakeholders and were therefore not informed during the development of the EP.

Licence holders that are not considered to be relevant to the planned petroleum activity are included in the expanded list of stakeholders who would be informed in the event of an unplanned emergency condition.

Table 5-2 presents the commercial fisheries classified according to their relevance to the planned petroleum activity or an unplanned emergency condition. No commercial fishery has been active within WA-50-L within the last 4 years, though it is noted that the Northern Demersal Scalefish Fishery (WA) and the North West Slope Trawl Fishery (Cwth) fish in adjacent waters and so licence holders of these two fisheries were determined to be relevant stakeholders. No other commercial fisheries fish in or close to the proposed petroleum activity.

**Table 5-2: Classification of commercial fishery licence holders**

| Fishery | Relevance and process of engagement |
|---|---|
| Commercial fisheries overlapping or close to the planned petroleum activity area and with licence holder activities or interests that may be affected by the planned petroleum activity. | |
| Northern Demersal Scalefish Fishery – Area 2 (WA) | Relevant.<br>Licence holders directly consulted. |
| North West Slope Trawl Fishery (Cwth) | |
| Commercial fisheries overlapping the planned petroleum activity area, but licence holder activities or interests are not expected to be affected by the planned petroleum activity. | |
| Mackerel Managed Fishery – Area 1 (WA) | Not affected.<br>Licence holders not consulted during the development of the EP; however, representative industry associations were informed, and each fishery’s |
| Pearl Oyster Managed Fishery - Zone 3 (WA) | |
| North Coast Shark Fishery (Northern Zone) (WA) | |

| | |
|---|---|
| Western Tuna and Billfish Fisheries (Cwth) | interests considered in the development of the EP.<br>Licence holders to be informed in the event of an unplanned emergency condition. |
| Southern Bluefin Tuna Fishery (Cwth) | |
| Western Skipjack Fishery (Cwth) | |
| West Coast Deep Sea Crustacean Managed Fishery (WA) | |
| Commercial fisheries overlapping the EMBA but not the proposed petroleum activity area. | |
| Northern Prawn Fishery (Cwlth) | Not affected.<br>Licence holders not consulted during the development of the EP, but each fishery's interests considered in the development of the EP.<br>Licence holders to be informed in the event of an unplanned emergency condition. |
| Broome Prawn Managed Fishery (WA) | |
| Kimberley Prawn Managed Fishery (WA) | |
| Nickol Bay Prawn Managed Fishery (WA) | |
| Pilbara Trap Managed Fishery (WA) | |
| Pilbara Trawl Interim Managed Fishery (WA) | |
| Pilbara Line Fishery (WA) | |
| Pilbara Developing Crab Fishery (WA) | |
| Specimen Shell Managed Fishery (WA) | |
| Abalone Managed Fishery – Area 8 (WA) | |
| Hermit Crab Fishery (WA) | |
| Kimberley Mud Crab Managed Fishery (WA) | |
| Kimberley Gillnet and Barramundi Fishery (WA) | |
| Mackerel Managed Fishery – Area 2 (WA) | |
| Marine Aquarium Fish Managed Fishery (WA) | |
| Northern Demersal Scalefish Managed Fishery – Area 1 (WA) | |
| Pearl Oyster Managed Fishery – Zones 1 and 2 (WA) | |
| Trochus Fishery (WA) | |
| North Coast Shark Fishery (WA) – Southern Zone | |
| Joint Authority Northern Shark Fishery (Cwlth/WA) | |
| South West Coast Salmon Managed Fishery (WA) | |

### 5.2.4 Stakeholder classification

Stakeholders were then classified based on their level of interest in/potential impact by, and influence over, the proposed petroleum activity. The purpose of this activity was to determine a 'priority' for consultation that was appropriate to the classification. Priority levels are shown in Table 5-3.

**Table 5-3: Engagement classification**

| Priority | Interest/potential impact level and/or Influence level | Stakeholder classification (engagement priority) |
|---|---|---|
| Level 1 | (Both) High to very high | **Collaborate/empower**: partner with stakeholder on each aspect of the decision; allow stakeholder (regulatory or approvals bodies) to make the final decision |
| Level 2 | (Either) High to very high | **Consult/involve**: ensure stakeholder concerns and expectations are consistently understood and considered, and obtain feedback from stakeholders on analysis, alternatives and/or decisions |
| Level 3 | (Both) Low to medium | **Inform**: provide balanced, objective, timely and consistent information to stakeholder |

Stakeholders who are relevant only in the event of unplanned emergency conditions were classified separately based on their role or function in relation to unplanned emergency conditions or based on their level of interest and influence in unplanned emergency conditions.

## 5.3 Stakeholder engagement

Following the stakeholder identification and classification exercise, an engagement plan was developed to register identified stakeholders and the following information:

- the activity/ies (planned and unplanned) for which they have been identified as relevant
- the activities on which they should be engaged
- the function, activity or interest that may be affected by the relevant activity
- their assigned classification (priority for engagement)
- the proposed manner of engagement (i.e. modes, timing, and by whom).

Those INPEX personnel responsible for engagement were provided with a copy of the plan and instructions on how to carry out the necessary engagement.

INPEX prepared a consultation information sheet to provide relevant stakeholders with important details of the proposed petroleum activity. The document (Appendix C) includes the following information:

- description of the activity, including location and map
- schedule
- methodology (i.e. how the activity will be undertaken, as well as general logistics and safety information)
- environmental management approach

- enquiries and feedback information.

The accompanying email (or cover letter) may provide more information relevant to the functions, activities or interests of the stakeholder receiving the information sheet. Additional information was also sent to stakeholders in subsequent communications, as requested by the stakeholder and/or as the information became available.

## 5.4 Stakeholder monitoring and reporting

Using the stakeholder engagement plan as a guide, INPEX retains a record of all communications sent and received as part of the stakeholder engagement activity. This includes email correspondence, telephone call logs, letters and minutes of meetings.

All queries and feedback from stakeholders were logged, and where applicable, forwarded for follow up, where applicable. All responses provided to stakeholders were appropriate to the nature of their communication, e.g. technical queries were investigated by area experts and responses provided.

### 5.4.1 Relevant matters, objections and claims

During stakeholder consultation, each meeting, phone call or piece of correspondence received from a stakeholder was assessed by INPEX for relevant information or for objections, claims or concerns raised regarding the activity. The INPEX assessment of relevance and assessment of merit considered four broad categories:

- objection, claim or concern has merit – The objection, claim or concern raised is relevant to both the planned petroleum activity and the stakeholder's functions, activities or interests. The matter has merit if there is a reasonable / scientific basis for related effects or impacts to occur and/or there is reasonable basis for the matter to be addressed in the EP.
- objection, claim, or concern does not have merit – The objection, claim or concern raised may be relevant to the planned petroleum activity or the stakeholder's functions, activities or interests, however, the matter raised has no credible or scientific basis.
- relevant matter – The matter raised does not fit the criteria descriptions for objections, claims or concerns with/without merit. However, the matter raised is relevant to the planned petroleum activity, comprises a request to INPEX for further relevant information, or provides information to INPEX that is relevant to the petroleum activity or the EP.
- not a relevant matter – Correspondence does not relate to the planned petroleum activity or the stakeholder's functions; interests or activities being affected by the petroleum activity. Non-relevant matters may also be generic in nature with no specific issues raised (e.g. salutations, acknowledgements, meeting arrangements, etc.).

A summary of all stakeholder consultation undertaken, and the full assessment relevance and merit are provided in Appendix C. The actual records of correspondence are provided in a 'Sensitive Matters Report' that is submitted to the Regulator separately to this EP.

An overview of feedback received from stakeholders that resulted in material inputs to the EP is provided in Table 5-4.

**Table 5-4: Summary of relevant matters, objections, claims or concerns from stakeholder consultation**

| Stakeholder | Summary of material stakeholder feedback | Summary of INPEX action |
|---|---|---|
| Australian Maritime Safety Authority (AMSA) | AMSA requested:<br>• The Master notify AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings at least 24-48 hours before operations commence.<br>• The JRCC be advised when operations start and end.<br>• The Australian Hydrographic Office (AHO) be contacted no less than four working weeks before operations to promulgate the appropriate Notice to Mariners (NTM). | The relevant notifications requested by AMSA have been adopted as controls in Section 7.7.1 of the EP. |
| Department of Agriculture (DA; previously the Department of Agriculture and Water Resources) | DA advised that where domestic conveyances become exposed through interactions with persons, goods or conveyances outside of Australian Territorial Sea, they automatically become subject to biosecurity control upon their return. Advised that if the DA concludes that the level of biosecurity risk associated with the offshore installation is low, an exposed conveyance (the support vessels to the offshore installation) may be eligible for exemption from biosecurity control. | INPEX provided DA with a copy of INPEX's Domestic Biofouling risk assessment process and an example of a Biosecurity risk assessment.<br>The biosecurity matters raised by DA have been considered in Section 7.5.1 of the EP. |
| Department of Mines, Industry Regulation and Safety WA (DMIRS) | Requested INPEX send through activity commencement and cessation notifications. | DMIRS's request to be notified of the activity commencement has been incorporated into Section 9.8.3 of the EP (ongoing stakeholder consultation). |
| Office of the Director of National Parks (DNP) | DNP confirmed that the planned activities associated with the EP do not overlap any AMPs and therefore there no authorisation requirements from DNP.<br>DNP do not require further notification of progress made in relation to this activity unless details regarding the activity changes and result in an overlap with a marine park or for emergency responses. | Information provided from the DNP with respect to the values associated with the closest AMPs have been described in Section 4 of the EP and considered in Sections 7 and 8 with respect to control measures that will ensure the activity is managed in accordance with AMP management plans.<br>In the event of a spill, INPEX oil spill notifications are aligned with the DNP requirements as described in Section 4.3, Section 9.11.3 and Appendix D (OPEP – Section 2.4.3/Table 2-3). |

| Stakeholder | Summary of material stakeholder feedback | Summary of INPEX action |
|---|---|---|
| | In emergency situations, DNP requested to be made aware as soon as possible of oil/gas pollution incidences which occur within or are likely to impact on a marine park. | |

## 5.5 Stakeholder grievance management

For the development of an EP or OPEP and subsequent performance of the activities described therein, a grievance is a complex stakeholder objection or claim ('relevant matter') which has progressed beyond management through the Stakeholder Monitoring and Reporting process.

In line with grievance management as described in the INPEX Community Grievance Management Procedure, a relevant matter that cannot be resolved with the concerned stakeholder (grievant) by the applicable contact person (supported by area experts where required) will be referred to the INPEX Community Relations Working Group (CRWG) for advice and resolution before a response is made to the grievant.

If the resolution proposed by the INPEX CRWG is unacceptable to the grievant, a third-party mediator may become involved to facilitate a resolution between the parties.

In relation to engagement activities for this EP, all stakeholder enquiries were either dealt with as outlined above or are ongoing due to the iterative process of engagement being applied.

## 5.6 Ongoing consultation

Ongoing consultation activities ensure that INPEX develops and maintains a current and comprehensive view of stakeholder functions, interests and activities, and provide a forum for enquiries, objections or claims by relevant persons in the lead up to and during the conduct of a petroleum activity.

Ongoing consultation for the proposed activity is outlined in the implementation strategy (Section 9.8.3).

# 6 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT METHODOLOGY

In accordance with Division 2.3, Regulation 13(5) of the OPGGS (E) Regulations 2009, an environmental risk assessment was undertaken to evaluate impacts and risks arising from the activities described in Section 3. This section describes the process in which impacts and risks were identified. A summary of the outcomes from this process are included in Section 7 and Section 8.

An environmental hazard identification (HAZID) workshop was undertaken for the petroleum activity. The workshop involved environmental, compliance, health, safety, emergency response, drilling, completions, fluids and well test personnel.

The workshop was undertaken in accordance with INPEX health, safety and environment (HSE) Risk Management processes. The approach generally aligned to the processes outlined in ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia/ Standards New Zealand, 2009) and Handbook 203:2012 *Managing environment-related risk* (Standards Australia/Standards New Zealand 2012).

The environmental impact and risk evaluation process has been undertaken in nine distinct stages:

1. the establishment of context
2. the identification of aspects, hazards and threats
3. the identification of potential consequences (severity)
4. the identification of existing design safeguards and control measures
5. proposal of additional safeguards (ALARP evaluation)
6. an assessment of the likelihood
7. an assessment of the residual risk
8. an assessment of the acceptability of the residual risk
9. the definition of environmental performance outcomes, standards and measurement criteria.

## 6.1 Establishment of context

The first stage in the process involved defining the activity, characterising the environment and identifying the particular values and sensitivities of that environment. The outcomes of these exercises are presented in Section 3 *Description of Activity* and Section 4 *Existing Environment*, of this EP.

## 6.2 Identification of aspects, hazards and threats

An assessment was undertaken to identify the aspects associated with the petroleum activity. An aspect is defined by ISO 14001: 2015 *Environmental Management Systems (EMS)* as:

"An element or characteristic of an activity, product, or service that interacts or can interact with the environment".

The aspects were grouped to align with the INPEX HSEQ-MS environment standards. A summary of the aspects identified for the petroleum activity were as follows:

- emissions and discharges
- waste management
- noise and vibration

- loss of containment
- biodiversity and conservation protection
- land disturbance (or seabed disturbance)
- social and cultural heritage protection.

Hazards are defined by the *INPEX HSE Hazard and Risk Management Standard* as:

"A physical situation with the potential to cause harm to people, damage to property, damage to the environment".

As the definition suggests, for an environmental risk or impact to be realised, there needs to be a chance of exposing an environmental value or sensitivity to a hazard.

Given the various receptors present in the environment, they have been refined to environmentally sensitive or biologically important receptors (values and sensitivities). They have been selected using regulations, government guidance and stakeholder feedback.

For the purposes of the evaluation, environmental values and sensitivities to be considered include the following:

- receptors that are considered socially important as identified during stakeholder engagement (including social and cultural heritage)
- benthic primary producer habitat, defined by the Western Australian Environmental Protection Authority (WA EPA) Environmental Assessment Guideline No. 3 *Environmental Assessment Guidelines for Protection of Benthic Primary Producer Habitat in Western Australia's Marine Environment* as functional ecological communities that inhabit the seabed within which algae (e.g. macroalgae, turf and benthic microalgae), seagrass, mangroves, corals, or mixtures of these groups, are prominent components
- regionally important areas of high diversity (such as shoals and banks)
- particular values and sensitivities as defined by Regulation 13(3) of the OPGGS(E) Regulations 2009:
  - the world heritage values of a declared World Heritage property within the meaning of the EPBC Act
  - the national heritage values of a National Heritage place within the meaning of the EPBC Act
  - the ecological character of a declared Ramsar wetland within the meaning of the EPBC Act
  - the presence of a listed threatened species or listed threatened ecological community within the meaning of the EPBC Act
  - the presence of a listed migratory species within the meaning of the EPBC Act
  - any values and sensitivities that exist in, or in relation to, part or all of:
    - a Commonwealth marine area within the meaning of the EPBC Act – Note that this value and sensitivity includes receptors (e.g. planktonic and benthic communities) that, when exposed, have the potential to affect regionally significant ecological diversity and productivity from benthic and planktonic communities
    - Commonwealth land within the meaning of the EPBC Act.
- biologically important areas associated with EPBC-listed species.

## 6.3 Identify potential consequence

In sections 7 and 8, for each aspect, the greatest consequence (or potential impact) of an activity, is evaluated with no additional safeguards or control measures in place. This allows the assessment to be made on the maximum foreseeable exposure of identified values and sensitivities to the hazard taking into account the extent and duration of potential exposure. The consequence is defined using the INPEX Risk Matrix (Figure 6-1).

Given that the receptors, identified as particular values and sensitivities are the most regionally significant or sensitive to exposure, these are considered to present a credible worst-case level of consequence to assess against.

## 6.4 Identify existing design safeguards/controls

Control measures associated with existing design are then identified to prevent or mitigate the threat and/or its consequence(s).

## 6.5 Propose additional safeguards (ALARP evaluation)

Where existing safeguards or controls have been judged as inadequate to manage the identified hazards (on the basis that the criteria for acceptability is not met as defined in Section 6.8), additional safeguards or controls are proposed.

The INPEX *HSE Hazard and Risk Management Standard* describes the process in which additional engineering and management control measures are identified, taking account of the principle of preferences illustrated in Figure 6-2. The options were then systematically evaluated in terms of risk reduction. Where the level of risk reduction achieved by their selection was determined to be grossly disproportionate to the "cost" of implementing the identified control measures, the control measure will not be implemented, and the risk is considered ALARP. Cost includes financial cost, time or duration, effort, occupational health and safety risks, or environmental impacts associated with implementing the control.

## 6.6 Assess the likelihood

The likelihood (or probability) of a consequence occurring was determined, taking into account the control measures in place. The likelihood of a particular consequence occurring was identified using one of the six likelihood categories shown in Figure 6-1.

## 6.7 Assess residual risk

Where additional controls/safeguards are identified, the residual risk is then evaluated and ranked.

INPEX

# Risk Matrix

Refer to the Risk Management Guideline [0000-A0-GLN-60010] for guidance on how to apply the risk matrix.

## LIKELIHOOD TABLE

| | | | | | | |
|---|---|---|---|---|---|---|
| **Time Frame** Could be experienced | 100 year timeframe or less | 50 year timeframe | 10 - 20 year timeframe | 5 year strategic planning time frame | 1 -2 year budget timeframe | Once or more during the next year |
| **Experience** History of occurrence in Company or Industry | Unheard of in the industry or in Projects | Has occurred once or twice in the industry or rarely occurs in Projects | Has occurred many times in the industry but not in the company or in <1 out of 100 Projects | Has occurred once or twice in the company or in <1 out of 10 Projects | Has occurred frequently in the company or in many Projects | Has occurred frequently at the location or in every Project |
| **Frequency** Continuous Operation | Once every 10 000 – 100 000 years at location | Once every 1,000 – 10 000 years at location | Once every 100 - 1000 years at location | Once every 10 - 100 years at location | Once every 1 - 10 years at location | More than once a year at location or continuously |
| **Probability** Single activity | 1 in 100 000 – 1 000 000 | 1 in 10 000 – 100 000 | 1 in 1000 – 10 000 | 1 in 100 - 1000 | 1 in 10 - 100 | >1 in 10 |

## CONSEQUENCE TABLE

**CONSEQUENCES**

| Severity Level | Financial NPV | Financial A$ | Health & Safety | Environment | Reputation | Cultural & Social Heritage | Legal |
|---|---|---|---|---|---|---|---|
| A | >$1B | > $5B<br>**Project Schedule**<br>>24 months | >20 fatalities or permanent total disabilities | Regional scale event, permanent impact on environment. Eradication of local populations of protected species | Prolonged international multi-NGO and media and by public protests. Loss of host government support and/ or social licence to operate. Company reputation severely tarnished | Permanent, long-term impact on social structure, and destruction of highly-valued heritage, aesthetic, economic or recreational items | Criminal prosecution, potential jail sentences for directors and senior officers. Civil prosecution, class actions. Heavy fines, threat to licence to operate or future approvals |
| B | $100M – $1B | $1B – $5B<br>**Project Schedule**<br>12 – 24 months | 2 – 20 fatalities or permanent total disabilities | Large scale event, long term impact on environment. Extensive impact on populations of protected species | International multi-NGO and media condemnation. Host government registers concerns. Prolonged large protests. Company reputation seriously impacted | Widespread disruption to a number of communities with damage to highly-valued heritage, aesthetic, economic or recreational items | Criminal prosecution for directors and senior officers. Civil prosecution and class actions. Heavy fines, threat to licence to operate |
| C | $10M – $100M | $100M – $1B<br>**Project Schedule**<br>6 – 12 months | Single fatality or Permanent Total Disability | Medium to large scale event, medium term impact on environment. No threat to overall population viability of protected species | Serious public or national media outcry. Damaging NGO campaign. Large protests. Company reputation impacted | Significant impact to regional communities, and to heritage, aesthetic, economic or recreational items of significant value | Significant, multiple breaches of regulation or licence conditions. Significant litigation and fines |
| D | $1M – $10M | $10M – $100M<br>**Project Schedule**<br>1 - 6 months | Major injury or illness, permanent partial disability, lost time injury | Local to medium scale event with short to medium term impact on environment. No threat to overall population viability of protected species | Major adverse national media, public or NGO attention. Significant protests. Asset reputation impacted | Regional community disruption with moderate impact on heritage, aesthetic, economic or recreational values | Serious breach of regulation. Investigation by regulatory authorities. Potential litigation and moderate fines |
| E | $100K– $1M | $1M – $10M<br>**Project Schedule**<br>2 - 4 weeks | Minor injury or illness, alternative duties injury, medical treatment injury | Local scale event with short term impact on the environment. Minor and temporary impact on a small portion of the population of protected species | Attention from regional media with heightened concern with local community. Criticism by community or NGOs | Isolated community disruption with limited adverse impact on heritage, aesthetic, economic or recreational values | Minor legal issues. Report provided to regulatory authorities. Potential for minor fines |
| F | <$100K | <$1M<br>**Project Schedule**<br><2 weeks | Slight injury or illness, first aid injury | Local scale event with temporary impact on environment. Behavioural responses inconsequential ecological significance to protected species | Short term local concern or complaints. Low level media or regulatory issue | Minor impact on heritage, aesthetic, economic or recreational values | Breach of internal standards. Potential scrutiny by regulatory authorities |

**Likelihood Level**

| Severity | 6 Remote | 5 Highly Unlikely | 4 Unlikely | 3 Possible | 2 Likely | 1 Highly Likely |
|---|---|---|---|---|---|---|
| A Catastrophic | 6 | 5 | 4 Critical Risk | 3 | 2 | 1 |
| B Major | 7 | 6 | 5 | 4 | 3 | 2 |
| C Significant | 8 | 7 | 6 High Risk | 5 | 4 | 3 |
| D Moderate | 9 | 8 | 7 | 6 | 5 | 4 |
| E Minor | 10 | 9 | 8 Moderate Risk | 7 | 6 | 5 |
| F Insignificant | 10 | 10 | 9 Low Risk | 8 | 7 | 6 |



Document no.: 0000-A0-TPL-60003
Security Classification: Unrestricted
Revision: 1

Page 1 of 2
Date: 19 September 2017

**Figure 6-1: INPEX risk matrix**

| | | | |
|---|---|---|---|
| ***Most Preferred*** | **Elimination** | | Removal of the hazard or sensitive receptor |
| | **Substitution** | | Replacement of highly hazardous materials / approaches with less hazardous materials / approaches |
| | **Engineering** | **Prevention** | Design measures that reduce the likelihood of a hazardous event occuring |
| | | **Detection** | Design measures that facilitate early detection of a hazardous event |
| | | **Control** | Design measures that limit the extent/escalation potential of a hazardous event |
| | | **Mitigation** | Design measures that protect the environment should a hazardous event occur |
| | | **Response Equipment** | Design measures or safeguards that enable clean-up / response following the realisation of a hazardous event |
| | **Procedures & Administration** | | Management systems and work instructions used to prevent or mitigate environmental exposure to hazards |
| ***Least Preferred*** | **Sensitive Receptor Protection** | | The lowest level in the hazard management hierarchy which should only be considered when all higher controls in the hierarchy have been exhausted e.g. physical barriers located at the sensitive receptor |

**Figure 6-2: ALARP options preferences**

## 6.8 Assess residual risk acceptability

Potential environmental impacts and risks are only deemed acceptable once all reasonably practicable alternatives and additional measures have been taken to reduce the potential impacts and risks to ALARP.

INPEX has determined that risks rated as "Critical" are considered too significant to proceed and are therefore, in general, unacceptable. In alignment with NOPSEMA's *Environment Plan Decision Making Guideline* (GL1721 Rev5 June 2018), INPEX considers that when a risk rating of "Low" or "Moderate" applies, where the consequence does not exceed "C" (Significant) and where it can be demonstrated that the risk has been reduced to ALARP, that this defines an acceptable level of impact.

Through implementation of this EP, impacts to the environment will be managed to ALARP and acceptable levels and will meet the requirements of Section 3A of the EPBC Act (principles of ecologically sustainable development) as shown in Table 6-1.

**Table 6-1: Principles of ecological sustainable development (ESD)**

| Principles of ESD | Demonstration |
|---|---|
| a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations; | The INPEX environmental policy (Figure 9-2), INPEX *HSE Hazard and Risk Management Standard* and the INPEX HSEQ-MS (Section 9.1) consider both long-term and short-term economic, environmental, social and equitable considerations. |

| Principles of ESD | Demonstration |
|---|---|
| b) if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation; | No threat of serious or irreversible environmental damage is expected from the activity. Scientific knowledge is available to support this and processes are in place to ensure that INPEX remains up-to-date with scientific publications (Section 9.13). |
| c) the principle of inter-generational equity - that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations; | The health, diversity and productivity of the environment shall be maintained and not impacted by the activity. |
| d) the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making; | Biological diversity and ecological integrity will not be compromised by the proposed activity. |
| e) improved valuation, pricing and incentive mechanisms should be promoted. | N/A |

Consequently, the potential environmental impacts and risks associated with implementing the activity were determined to be acceptable if the activity:

- complies with relevant environmental legislation and corporate policies, standards, and procedures specific to the operational environment
- takes into consideration stakeholder feedback
- takes into consideration conservation management documents
- does not compromise the relevant principles of ESD; and
- the predicted level of impact does not exceed the defined acceptable level, in that the environmental risk has been assessed as "Low" or "Moderate", the consequence does not exceed "C – Significant" and the risk has been reduced to ALARP.

## 6.9 Definition of performance outcomes, standards and measurement criteria

As defined in Regulation 4 of the OPGGS (E) Regulations 2009, INPEX has used environmental performance outcomes and performance standards to address potential environmental impacts and risks identified during the risk assessment.

Environmental performance outcomes, standards, and measurement criteria that relate to the management of the identified environmental impacts and risks are defined as follows:

- Environmental performance outcome means a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level.
- Environmental performance standard means a statement of the performance required of a control measure.
- Measurement criteria are used to determine whether each environmental performance outcome and environmental performance standard has been met.

# 7 IMPACT AND RISK ASSESSMENT

Following the environmental impact and risk assessment methodology described in Section 6, the aspects, hazards and threats have been systematically identified. The aspects (and associated hazards) with the potential for impact or risk in relation to the relevant identified values and sensitivities are discussed in this section and in Section 8.

## 7.1 Emissions and discharges

### 7.1.1 Light emissions

**Table 7-1: Impact and risk evaluation – change in ambient light levels from flaring and navigational lighting on MODU and vessels**

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">Light emissions have the potential to disturb light-sensitive marine fauna, specifically marine turtles, seabirds and migratory bird species, through localised attraction to light that may result in behavioural changes.<br><br>Flaring undertaken during well flow back operations (Section 3.2.1 Well flow back) will occur for approximately 24 hours per well. Gas flow rates will vary during the 24-hour period; however, flaring may occur continuously at a range of flow rates throughout this time. In addition to flaring, light emissions will also be generated from MODU and vessel lighting (necessary for navigational and safe working condition requirements).<br><br>It should be noted that the INPEX Ichthys interlinked facility (CPF and FPSO) is present within WA-50-L. The facility is equipped with flares that are permanently lit with a limited amount of pilot gas. During normal production, continuous operational flaring does not occur. However, there are some circumstances under which flaring is required in order to protect the integrity of the facility and to prevent harm to personnel, the environment and equipment. The levels of flaring (gas flow rates and duration) associated with well flow back on the MODU is considerably lower than flaring events associated with process upset/manual or emergency blowdown at the interlinked facility.</td></tr>
<tr><td>Potential consequence</td><td>Severity</td></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by light emissions from flaring and navigational lighting are:<br><br>• marine turtles (including the green turtle BIA at Browse Island)<br>• marine avifauna.<br><br>Behavioural changes reported in marine turtles exposed to increases in artificial lighting can include disorientation and interference during nesting (Pendoley 2005). Disorientation of adult marine turtles or hatchlings has been known to result in risks to the survival of some individuals through excess energy expenditure or increased likelihood of predation (Witherington & Martin 2000; Limpus et al. 2003). Browse Island (listed as a C-class reserve) is the closest turtle-nesting area (located approximately 33 km south-east of WA-50-L) and is surrounded by a 20 km internesting buffer for green turtles between November and March (DEE 2017a) as described in Section 4.8.4.</td><td>Insignificant (F)</td></tr>
</table>

| | |
|---|---|
| Shell (2009) estimated that light from production flaring activities can be detected as far as 51 km from the source. Similarly, an assessment by Woodside (2014) for the Browse FLNG development reported that the maximum distance at which production flaring under routine operational conditions was detectable was 47.7 km. Gas flares emit measurable light energy over the whole range of visible and near-infrared wavelengths, with peak intensities in the spectral range from 750 to 900 nanometers (Hick 1995), while the most disruptive wavelengths to turtles are reported to be in the range of 300 to 500 nm (Tuxbury & Salmon 2005; Witherington 1992). Therefore, the glow that may be visible at Browse Island from flaring light emissions is considered to be primarily of the wrong spectral range to cause any disturbance to turtles. It should also be noted that while turtle hatchlings primarily use light cues to orient to water, once in the water they normally maintain seaward headings by using wave propagation direction as an orientation cue (Lohmann & Fittinghoff-Lohmann 1992) therefore further limiting any potential impacts of light from flaring once turtles have reached the ocean.<br><br>Although light emissions from INPEX production flaring (CPF/FPSO) may be visible at Browse Island and from within the internesting buffer, significant exposure or changes in ambient light levels are not expected to affect the behaviour of the marine turtle population in this area. This assessment was confirmed by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2008) through the formal environmental assessment process, indicating that the risk of light spill adversely impacting any listed threatened species is low. The offshore light emissions generated from flaring and/or from MODU/vessel lighting is not expected to result in an increase in light emissions and therefore cause any discernible effect on adult turtles' or hatchlings' abilities to orientate to water at Browse Island. The potential for light from flaring on the MODU to attract marine turtles once they are at sea is expected to be temporary with an inconsequential ecological significance (Insignificant F).<br><br>The light emissions associated with flaring during well flowback (infrequent and short duration < 24 hours) is considered to be several orders of magnitude lower than those that may result from the operation of the Ichthys interlinked facility. The closest distance between the MODU and the facility in WA-50-L is expected to be approximately 5 km. It is stated in the Recovery Plan for Marine Turtles in Australia (DEE 2017a) that based on the long-life span and highly dispersed life history requirements of marine turtles that they may be subject to multiple threats acting simultaneously across their entire life cycle, such as increases in background noise levels and vessel strike. In considering cumulative impacts of threats on small or vulnerable stocks of marine turtles, it is possible that light emissions may act as contributor to a stock level decline. | |

| | |
|---|---|
| As described in Section 4.8.4, WA-50-L is located within the East Asian–Australasian Flyway (EEA Flyway), an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. The migration of marine avifauna through the EAA Flyway generally occurs at two times of year, northward between March and May and southward between August and November (Bamford et al. 2008; DEE 2017b). There are no BIAs for marine avifauna that overlap WA-50-L. However, the EMBA overlaps a Ramsar site at Ashmore Reef and a nationally important wetland, Mermaid Reef (Section 4.6), and a large number of BIAs for many marine avifauna species are present within the region, the closest of which relates to foraging around Adele Island, Ashmore Reef and Cartier Island (Figure 4-8). While not an identified BIA, the closest habitat for seabirds from WA-50-L is Browse Island. Browse Island is not a regionally significant habitat for seabirds, with previous surveys finding a lack of diversity of seabirds breeding there (Clarke 2010). Colonies of nesting crested terns (>1,000 birds) have been observed on Browse Island (Olsen et al. 2018). Browse Island has also been recognised, through previous INPEX stakeholder consultation with WA DBCA, as an important location for marine avifauna.<br><br>Light emitted from offshore platforms and vessels has been found to attract seabirds, particularly those that are nocturnally active (BirdLife International 2012). Nocturnal birds are at much higher risk of impact (Wiese et al. 2001); however, there are no threatened nocturnal migratory seabirds that use the EEA Flyway (DEWHA 2010). A study by Poot et al. (2008) of offshore oil platforms in the North Sea, found that large flocks of migrating seabirds can be attracted to the lights of offshore oil platforms, particularly on cloudy nights and between the hours of midnight and dawn. Poot et al. (2008) hypothesised that when such offshore platforms are located on long-distance bird migration routes, the impact of this attraction could be considered highly significant, as many birds cross the ocean with only small additional fat reserves than required for the transit (e.g. twelve hours of fat reserves for a ten-hour flight). Any delay (e.g. resting on a platform or circling around them) may decrease the bird's resilience and potential survival. Studies conducted in the North Sea indicate that migratory birds may be attracted to offshore lights when travelling within a radius of 3 to 5 km from the light source. Outside this area their migratory paths are likely to be unaffected (Marquenie et al. 2008). There is no published literature of these impacts occurring on the NWS of WA, however during the first 18 months of production operations at the INPEX Ichthys interlinked facility there have been no observations of birds being attracted to the CPF or FPSO. Isolated incidents of individual birds arriving at the facility have been reported however there has been no link to flaring activities, therefore the presence of offshore facilities in WA-50-L does not appear to have any impact on marine avifauna transiting over the licence area.<br><br>Migratory shorebirds travelling the EAA Flyway may fly over the licence area, before moving on to the mainland (south) in the spring or Indonesia/Australian External Territories (north) in the autumn. It is possible that migratory birds may use ships and other offshore facilities in order to rest. However, the possibility of this occurring on the MODU or vessels associated with the activity in WA-50-L is considered to be low due to the short duration of flaring and the presence of alternative habitat for resting and foraging at Browse Island and Ashmore Reef/Cartier Island, resulting in minimal deviation from migratory pathways and limited potential for behavioural disruption. Therefore, any impact to seabirds or migratory birds from light emissions associated with the MODU (including flaring) and vessels is considered to be of inconsequential ecological significance (Insignificant F). | |
| Identify existing design and safeguards/controls measures | |
| None identified | |

| Propose additional safeguards/control measures (ALARP Evaluation) | | | |
|---|---|---|---|
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | Do not use lighting at night time. | No | Lighting is required by law for navigational and safety purposes. |
| | No flaring during well flow back | No | Given the expected gas flow rates resulting during the well flow back, there is no other mechanism for the safe disposal of gas on the MODU other than flaring. The gas could be disposed by venting; however, this is considered to have a higher environmental impact than flaring with respect to greenhouse gas emissions. |
| Substitution | Exclude offshore lighting during key periods for bird migration. | No | In general, bird migrations occur over several months of the year: between March and May (northward) and between August and November (southward) (Bamford et al., 2008). Lighting of MODU/vessels is required year-round to ensure the safety of workers and the environment and cannot be eliminated for certain periods during the year. |
| | Exclude flaring during key periods for bird migration. | No | Flaring during the well flow back is required to safely dispose of the gas. The duration of each well's flaring event is limited (approximately 24-hours per well) and is relatively short-term over the life of the EP. Well flow back timing will be dictated by the MODU drilling schedule and it is not considered practicable to exclude flaring during bird migrations based on the short duration of flaring and inconsequential ecological significance. |
| | Exclude flaring during key periods for marine turtles | No | Light emissions from flaring is not expected to have a discernible effect on adult turtles' or hatchlings' abilities to orientate to water at Browse Island. Therefore, excluding flaring during key periods (November to March) is not considered practicable given the requirement to flare as a mechanism for the safe disposal of gas. Well flow back timing will be dictated by the MODU drilling schedule and flaring is a short duration event and has been assessed as having an inconsequential ecological significance to turtles at Browse Island. |
| Engineering | Reduce light intensity and/or frequencies which may attract turtles. | No | Lighting will be designed in accordance with the relevant Australian and international standards to ensure that worker and MODU/vessel safety is not compromised.<br>The deployment of low-pressure sodium vapour lamps or other technologies which reduce / eliminate frequencies which have been shown to attract turtles (Witherington 1992) would not result in any significant benefit regarding turtle hatchling attraction from |

| | | | |
|---|---|---|---|
| | | | the closest nesting rookery on Browse Island, given the distance (approximately 33 km to Browse Island) and wave-front orientation cues (rather than light cues) of hatchlings once they are in the ocean. |
| Procedures & administration | None identified | N/A | N/A |

| Identify the likelihood |
|---|
| Although light may potentially be visible, given the distance from WA-50-L to the closest turtle nesting beaches (approximately 33 km to Browse Island) and short duration of flaring, impacts to turtles from light emissions is Highly Unlikely (5). While impacts to seabirds from lighting of offshore platforms and vessels have been reported in the industry, they have only been recorded for facilities in the northern hemisphere. Given the presence of alternative resting/foraging habitat (Browse Island) and that there are several other permanently moored offshore installations in the vicinity of WA-50-L, with no records published on the attraction of seabirds or negative impacts to migratory seabirds from lighting, the likelihood of impact to these receptors from the lighting of the MODU and vessels is considered Unlikely (4). |
| Residual risk summary |
| Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9). |

| Consequence | Likelihood | Residual risk |
|---|---|---|
| Insignificant (F) | Unlikely (4) | Low (9) |

Assess residual risk acceptability

Legislative requirements

Navigational lighting is required by law for the safe operation of MODUs and vessels (*Navigation Act 2012* as appropriate to vessel class and AMSA's Marine Orders Part 30: Prevention of Collisions). Although there is no environmental legislation or guideline regarding the environmental management of light emissions from offshore facilities, the activity aligns with INPEX corporate policies through the reduction of environmental impacts and risks to ALARP levels.

Stakeholder consultation

During previous stakeholder consultation by INPEX for the Ichthys project, the DBCA confirmed to INPEX they have an interest in emissions of light that may affect DBCA managed lands or waters, or areas documented as likely to be important for wildlife conservation. INPEX have maintained ongoing consultation with DBCA as part of Ichthys operations and further information was provided to DBCA in relation to light emissions and seabirds in the Browse area. No other stakeholder concerns have been raised regarding potential impacts and risks from light emissions in WA-50-L.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Light emissions have been identified as a threat for marine turtles and in accordance with the DEE's Recovery Plan for Marine Turtles in Australia (2017a) consideration has been given in the above assessment to the actions described in the plan to minimise light pollution.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the risk of impacts is managed to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| N/A no controls identified | | | |

### 7.1.2 Atmospheric emissions

**Table 7-2: Impact and risk evaluation – atmospheric emissions from flaring, MODU and vessels**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Atmospheric emissions will be generated through flaring during well flow back operations, the use of combustion engines, compressors, steam generators, waste incinerators and ODS containing equipment on board the MODU and vessels. In addition to these sources, emissions associated with venting of gas from the reservoir may occur during drilling operations (Section 3.2.2), venting may also occur to avoid emergency conditions e.g. in the event of a well-kick. Atmospheric emissions from the MODU and vessels during the activity have the potential to result in localised changes in air quality and subsequent exposure of marine avifauna to air pollutants.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities identified as having the potential to be impacted by atmospheric emissions are:<br>• marine avifauna.<br><br>As described in Section 4.8.4, WA-50-L is located within the EAA Flyway, an internationally recognised migratory bird pathway that covers the whole of Australia and its surrounding waters. The migration of marine avifauna through the EAA Flyway generally occurs at two times of year, northward between March and May and southward between August and November (Bamford et al. 2008; DEE 2017b). There are no BIAs for marine avifauna that overlap WA-50-L. However, the EMBA overlaps a Ramsar site at Ashmore Reef and a nationally important wetland at Mermaid Reef (Section 4.6). Additionally, a large number of BIAs for many marine avifauna species are present within the region (Figure 4-8), the closest of which relate to foraging around Adele Island, Ashmore Reef and Cartier Island. While not an identified BIA, the closest habitat for seabirds from WA-50-L is Browse Island. Browse Island is not a regionally significant habitat for seabirds, with previous surveys finding a lack of diversity of seabirds breeding there (Clarke 2010). Colonies of nesting crested terns (>1,000 birds) have been observed on Browse Island (Olsen et al. 2018). Browse Island has also been recognised, through previous INPEX stakeholder consultation with WA DBCA, as an important location for marine avifauna.<br><br>In the absence of air quality standards or guidelines specifically for marine avifauna, human health air quality standards and guidelines have previously been used as a proxy for the assessment of atmospheric emissions from offshore production facilities and potential impacts to marine avifauna. The outcome of such assessments concluded that $NO_2$ concentrations may typically exceed long term (annual average) concentrations within a few kilometres of the emissions source and that short-term (1-hour average) exposure levels may be exceeded within a few hundred metres (i.e. 200-400 m) of the emission source (RPS APASA 2014). This assessment was undertaken for a production facility and therefore any changes in air quality resulting from the MODU/vessel and equipment emissions in WA-50-L are also predicted to be highly localised given the nature of the emissions are less than those from a production facility.</td><td>Insignificant (F)</td></tr>
</table>

| | |
|---|---|
| There may be temporary increases in emissions (e.g. hydrocarbon gases and $H_2S$) as a result of venting during drilling operations, well flow back operations or a well-control event. This is not expected to result in a significant increase in exposure to marine avifauna as emissions will rapidly disperse following release in the open marine environment and the potential for exposure remains limited to the immediate vicinity of the vents.<br><br>If marine avifauna are exposed at all, they are only expected to be exposed to changes in air quality for short periods as they pass close to emissions sources. Chronic exposures are not considered plausible given that marine avifauna would move away (i.e. continue migration or undertake foraging activities elsewhere).<br><br>Overall, the consequence of temporary, localised changes in air quality may result in short-term, sublethal effects to a small number of transient marine avifauna individuals and is therefore considered Insignificant (F). | |

**Identify existing design and safeguards/controls measures**

The MODU and vessels that will be involved in the activity comply with the requirements of Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution, the POTS Act, the *Navigation Act 2012* and Annex VI of MARPOL 73/78 (as applicable to vessel and engine size, type and class), specifically:

- marine diesel engines meet $NO_X$ emission requirements and limits as set out by MARPOL 73/78, Annex VI, Regulation 13, and have an International Air Pollution Prevention (IAPP) certificate.
- onboard incinerators (if present) will meet International Maritime Organization (IMO) standards and are identified in the vessels' IAPP certificate. Personnel operating incinerators will be trained in accordance with MARPOL 73/78, Annex VI, Regulation 16.
- equipment and systems that contain ozone depleting substances (ODS) comply with MARPOL 73/78, Annex VI, Regulation 12, are identified in the vessels' IAPP certificate and an ODS record book is maintained (where applicable).
- vessels >400 GT have a Ship Energy Efficiency Management Plan (SEEMP).
- MODU/vessel contractors use marine diesel with 0.5% m/m sulfur content (on and after 1 January 2020) as required by the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.

Reporting of greenhouse gas (GHG) emissions.

**Propose additional safeguards/control measures (ALARP Evaluation)**

| Hierarchy of control | Control measure | Used? | Justification |
|---|---|---|---|
| Elimination | Eliminate the use of MODU/vessels | No | The use of MODU/vessels to undertake the activity cannot be eliminated. |
| | No flaring during well flow back | No | Given the expected gas flow rates resulting during well flow back operations, there is no other mechanism for the safe disposal of gas on the MODU other than flaring. The gas could be disposed by venting; however, this is considered to have a higher environmental impact than flaring with respect to greenhouse gas emissions. |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |

| | | | |
|---|---|---|---|
| Procedures & administration | Preventative maintenance system | Yes | MODU/vessel contractors have a preventative maintenance system in place to ensure diesel powered, power generation equipment is maintained and operated within original equipment manufacturers' (OEM) specification. |
| | Implement IFC Environment, Health and Safety (EHS) Guidelines – Offshore Oil and Gas Development (2015) applicable for flaring activities. | Yes | INPEX will verify that the contractor will comply with IFC EHS guidelines with respect to maximising flaring efficiency and thereby reducing potential atmospheric emissions associated with flaring during well flow back. |
| | Well test procedure implemented for flaring operations. | Yes | INPEX well test procedure includes a continuous 24/7 flare watch to observe and monitor flaring operations and function testing of ignition and pilot systems to ensure burning efficiency thereby reducing potential atmospheric emissions. |
| | NOPSEMA approved WOMP and accepted MODU safety case and safety case revision includes aspects relevant to controls in place to minimise gas venting in the event of a well-kick. | Yes | INPEX and MODU contractor will comply with the regulatory requirements of the OPGGS (Resource Management and Administration) Regulations 2011 (Cwlth) and the OPGGS (Safety) Regulations 2009 by ensuring the drilling activity is carried out in accordance with the accepted WOMP and safety case. |
| | MODU contractor Well Control Manual will cover all aspects of primary and secondary well control for drilling operations that includes aspects relevant to controls in place to minimise gas venting in the event of a well-kick. | Yes | INPEX will ensure the Well Control Bridging Document aligns requirements of the contractor's Well Control Manual with the requirements of the INPEX Well Integrity Standard and INPEX Well Operations Standard. This will ensure that in the event of a requirement to vent gas (e.g. from a well-kick), the influx volume can be minimised and therefore reduce the overall volume of gas vented to atmosphere. |
| Identify the likelihood | | | |
| The likelihood of marine avifauna approaching and/or resting on exhaust vents on MODU/vessels during the activity and remaining in close enough proximity to be exposed to concentrations of air pollutants that result in symptoms such as irritation of eyes and respiratory tissues and breathing difficulties is considered unlikely. Marine avifauna that may pass by near the MODU and vessels during the activity are unlikely to be in close enough proximity to be exposed to the emissions sources and are therefore unlikely to have any discernible symptoms. It is considered likely that they would move away from any emissions source if they began to experience discomfort or symptoms. No marine avifauna BIAs or critical habitats are located in proximity or within WA-50-L.<br><br>Given the presence of alternative resting/foraging habitat (Browse Island) and with the control measures described above in place, the potential for changes to air quality and associated impacts to marine avifauna are reduced. Therefore, the likelihood of the described consequences to marine avifauna occurring is considered Unlikely (4). | | | |
| Residual risk summary | | | |

| Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9). | | |
|---|---|---|
| Consequence | Likelihood | Residual risk |
| Insignificant (F) | Unlikely (4) | Low (9) |

Assess residual risk acceptability

Legislative requirements

The activities and proposed management measures are compliant with industry standards, relevant international conventions and Australian legislation, specifically AMSA Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution, the POTS Act, the *Navigation Act 2012*, and MARPOL 73/78, Annex VI. The above controls are aligned to the IFC EHS Guidelines – Offshore Oil and Gas Development (2015) with respect to flaring.

Stakeholder consultation

No specific stakeholder concerns have been raised regarding potential impacts and risks associated with atmospheric emissions in WA-50-L.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). None of the recovery plans or conservation advice documents have specific threats relating to atmospheric emissions from MODUs and vessels operating offshore.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| Risks of impacts to marine avifauna from atmospheric emissions are reduced and | Pre-mobilisation HSE inspections confirm MODU/vessel contractors will comply with the MARPOL 73/78 (Annex VI), *Navigation* | Pre-mobilisation HSE inspection documentation demonstrates that that MODU/vessels hold a valid | INPEX Drilling Supervisor |

| | | | |
|---|---|---|---|
| maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | *Act 2012* – Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution, Annex VI (as appropriate to class of vessel), specifically:<br>• International Air Pollution Prevention (IAPP) certificate and emission of NOx (for MODU and vessels 400 GT or above).<br>• IMO type approval certificate has been issued for any onboard incinerators. | IAPP Certificate and emission of NOx from engines is within specified limits, as appropriate to vessel class.<br><br>Pre-mobilisation HSE inspection documentation demonstrates that vessels have an IMO type approval certificate for the onboard incinerator. | |
| | Personnel responsible for operating incinerators will be trained in incinerator operation and appropriate waste for incineration in accordance with Marine Orders Part 97, the POTS Act and Annex VI of MARPOL 73/78. | Training records for personnel responsible for operating incinerators demonstrate that they are trained in incinerator operation and appropriate waste for incineration. | OIM/vessel master |
| | Pre-mobilisation HSE inspections confirm the MODU contractor complies with MARPOL 73/78, Annex VI, Regulation 12 - Ozone-Depleting Substances from refrigerating plants and firefighting equipment, which includes:<br>• maintenance of an ODS Record Book (where applicable). | Pre-mobilisation HSE inspection documentation demonstrates that ODS Record Book (where applicable) is current and maintained, as per MARPOL 73/78, Annex VI, regulation 12. | INPEX Drilling Supervisor |
| | Pre-mobilisation HSE inspections confirm vessels >400 GT hold a valid International Energy Efficiency (IEE) certificate and a Ship Energy Efficiency Management Plan (SEEMP) compliant with the requirements of Marine Orders – Part 97, the POTS Act and MARPOL 73/78, Annex VI (as applicable to the vessel and engine size, type and class). | Premobilisation HSE inspection records confirm vessels >400 GT have an IEE certificate and a SEEMP that meet the requirements of Marine Orders – Part 97, the POTS Act and MARPOL 73/78, Annex VI (as applicable to the vessel, engine/propulsion size, type and class). | INPEX Drilling Supervisor |
| | Marine diesel with 0.5% m/m sulfur content or less will be used in MODU/vessel engines. | Fuel delivery receipt indicates only low sulfur marine diesel is used. | Offshore Installation Manager (OIM)/Vessel master (INPEX Drilling Supervisor) |

| | | | |
|---|---|---|---|
| | Contractor has a preventative maintenance system to ensure diesel powered, power generation equipment is maintained and operated within OEM specification. | Records show diesel and power generation equipment is maintained in accordance with manufacturers' specifications. | INPEX Drilling Supervisor |
| | INPEX and the MODU contractor will comply with IFC EHS guidelines relating to flaring, specifically:<br>• maintenance program to ensure maximum flare efficiency<br>• use of a reliable pilot ignition system<br>• minimum volume of hydrocarbons required for well testing to the flared and durations reduced to the extent practical. | Well clean-up/well testing records and Well test procedure safety checklist. | INPEX Environmental advisor |
| | Well test procedure implemented including:<br>• continuous (24/7) flare watch during flaring operations<br>• function testing of continuous ignition system and pilot system. | Well test procedure safety checklist. | INPEX Environmental advisor |
| | Reporting of emissions including:<br>• greenhouse gas (GHG) reporting. | Records show reporting of air emissions to relevant agencies. | INPEX Environmental advisor |
| | INPEX and the MODU contractor will comply with the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 (Cwlth) and the Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009, including:<br>• NOPSEMA-approved WOMP<br>• preparation and acceptance of the MODU Safety Case and Safety Case Revision. | • WOMP approval received from NOPSEMA.<br>• MODU Safety Case acceptance received from NOPSEMA. | • INPEX Drilling Supervisor<br>• Offshore Installation Manager (OIM) |
| | INPEX will verify that the MODU contractor complies with the requirements of the approved Well Control Bridging Document | Summary of compliance with primary and secondary well control in the Well Integrity Standard | Offshore Installation Manager (OIM) |

| | | | |
|---|---|---|---|
| | which aligns requirements (and clarifies if conflicts exist, which standard takes precedence) between the Contractor Well Control Manual, and INPEX policies and standards including INPEX Well Integrity Standard (0000-AD-STD-60003), Well Operations Standard (0000-AD-STD-60004) and Well Operations Manual (0000-AD-MAN-60002), which covers primary and secondary well control for drilling operations, including:<br>• planned mud weight overbalance to stop ingress potential (i.e. inflow of formation fluids) into the well.<br>• leak off or limit testing to confirm that the formation has sufficient strength for planned mud weight with adequate kick tolerance.<br>• two independent well barriers in place at all times and tested in situ to ensure the system is capable of holding pressure in the well-bore or annulus. | (0000-AD-STD-60003); Well Operations Standard (0000-AD-STD-60004) and Well Operations Manual (0000-AD-MAN-60002) reported in the daily drilling report. | (INPEX Drilling Supervisor) |

### 7.1.3 Routine discharges to sea

#### Sewage, grey water and food waste

**Table 7-3: Impact and evaluation – MODU and vessels sewage, grey water and food waste discharges**

| Identify hazards and threats | |
|---|---|
| Discharging treated sewage effluent, grey water and food waste has the potential to expose planktonic communities to changes in water quality from the introduction of nutrients. Such a decline in water quality has the potential to result in reduced ecosystem productivity or diversity. These intermittent discharges will occur in WA-50-L, which is located in the open ocean and more than 12 nm from the nearest land. The average volume of sewage and greywater expected from the MODU and vessels (including domestic waste water) generated by a person per day is approximately 230 L (based on calculations in Huhta et al. 2009), therefore based on the maximum personnel on board (POB) of 180 on the MODU would equate to approximately 41 $m^3$ per day. | |
| **Potential consequence** | **Severity** |
| The particular values and sensitivities identified as having the potential to be impacted by sewage, grey water and food waste discharges are:<br>• planktonic communities.<br>A study undertaken to assess the effects of nutrient enrichment from the discharge of sewage in the ocean found that the influence of nutrients in open marine areas is much less significant than that experienced in enclosed, poorly mixed water bodies. The study also found that zooplankton composition and distribution in areas associated with sewage dumping grounds were not affected (McIntyre & Johnston 1975).<br>When sewage effluent, grey water and food waste is discharged there is the potential for localised and temporary, changes in water quality within WA-50-L. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge. Given the deep water (approximately 250 m) location, oceanic currents will result in the rapid dilution and dispersion of these discharges. Therefore, the consequence is considered to be of inconsequential ecological significance (Insignificant F). | Insignificant (F) |
| **Identify existing design and safeguards/controls measures** | |
| MODU and vessels will manage the discharge of sewage effluent and grey water in accordance with MARPOL 73/78 Annex IV, Marine Orders 96: Marine Pollution Prevention – Sewage (as appropriate to class), which is implemented through the POTS Act.<br>MODU and vessels will manage the discharge of garbage in accordance with MARPOL 73/78 Annex V, Marine Orders 95: Marine Pollution Prevention – Garbage (as appropriate to class), which is implemented through the POTS Act.<br>Sewage and grey water discharge records will be monitored and maintained. | |
| **Propose additional safeguards/control measures (ALARP Evaluation)** | |

| Hierarchy of control | Control measure | Used? | Justification |
|---|---|---|---|
| Elimination | Eliminate discharges from MODU and vessels by storage of sewage, grey water and food waste on board and ship to the mainland. | No | The significant financial cost and health risks associated with storing sewage, grey water and food waste on board MODU/vessels and transporting it to the mainland for the duration of operations is grossly disproportionate to the low level of risk associated with this discharge, permitted under legislation. Additional environmental impacts would also be generated in terms of air emissions and onshore disposal. |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |
| Procedures & administration | Preventative maintenance system | Yes | MODU/vessel contractors have a preventative maintenance system in place to ensure sewage treatment plant (STP) and macerator equipment is maintained and operated within OEM specification. |

**Identify the likelihood**

Sewage and garbage discharges for the MODU and vessels will be in accordance with legislative requirements (MARPOL 73/78 Annex IV & V, Marine Orders 95 and 96). Maceration of sewage and food waste to a particle size <25 mm prior to disposal will increase the ability of the discharges to disperse rapidly.

The effects of sewage discharged to the ocean have been relatively well studied (Gray et al. 1992; Weis et al. 1989) and toxic effects generally only occur where high volumes are discharged into a small and poorly mixed waterbody. The volumes discharged within the licence area are unlikely to cause toxic effects, especially considering the rapid dilution provided by the deep water and ocean currents.

Based on the expected high dispersion due to the open-ocean environment of WA-50-L, localised impacts to plankton at the point of the planned discharge are considered to be Unlikely (4).

**Residual risk summary**

Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9).

| Consequence | Likelihood | Residual risk |
|---|---|---|
| Insignificant (F) | Unlikely (4) | Low (9) |

**Assess residual risk acceptability**

Legislative requirements

Sewage, grey water and food waste discharges are standard practice in the offshore environment and the disposal at sea is permitted under AMSA (2013) Marine Orders – Part 96: Marine Pollution Prevention – Sewage, which gives effect to MARPOL 73/78, Annex IV and Marine Orders – Part 95: Marine Pollution Prevention – Garbage, which gives effect to MARPOL 73/78, Annex V.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from planned discharges (sewage, grey water and food waste).

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advice documents has specific actions relating to discharges of sewage, grey water and food waste. The maceraters will assist in reducing impacts from the discharge stream, consistent with the intent of the conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| Zero discharges of untreated sewage and grey water or unmacerated putrescible waste to the marine environment for the duration of the activity. | Manage and dispose of sewage in accordance with: MARPOL 73/78 Annex IV, Marine Orders – Part 96: Marine Pollution Prevention – Sewage as enacted in the POTS Act – Part IIIB (as appropriate to vessel class), including:<br>• current International Sewage Pollution Prevention Certificate (ISPPC). | Pre-mobilisation HSE inspection confirms that the vessel holds a current ISPPC. | OIM/vessel master |
| | Manage and dispose of garbage in accordance with: MARPOL 73/78 Annex III, Marine Orders – Part 95: Marine Pollution Prevention – Garbage, as enacted in the POTS Act – Parts IIIA and IIIC (as appropriate to vessel class), including: | Garbage disposal record book | OIM/vessel master |

| | | | |
|---|---|---|---|
| | • garbage that has been ground or comminuted to particles <25 mm: >3 nm from the nearest land.<br>• garbage disposal record book maintained in accordance with the POTS Act – Part IIIC. | | |
| | Records of sewage and grey water discharged will be monitored and maintained. | Operational discharges (planned and unplanned) of sewage and grey water are recorded on the MODU/vessels and demonstrate compliance with all requirements for operational discharge. | OIM/vessel master |
| | MODU contractor has a preventative maintenance system to ensure STP and macerator is maintained. | Pre-mobilisation and ongoing HSE inspection documentation demonstrate STP and macerator equipment is maintained. | INPEX Drilling Supervisor |

## Deck drainage, bilge and firefighting foam

**Table 7-4: Impact and evaluation – MODU and vessels deck drainage, bilge and firefighting foam discharges**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Contaminated deck drainage and bilge discharges or failure to treat oily water to suitable OIW concentrations before discharge, have the potential to expose marine fauna to changes in water quality and/or result in impacts through direct toxicity. Deck drainage discharge volumes on the MODU and vessels will be intermittent and are dependent on weather conditions and frequency of deck washing. Volumes of bilge water from engines and other mechanical sources found throughout the machinery spaces will also vary between vessels.<br><br>The MODU and vessels are equipped with firefighting foam that is a safety critical requirement. The foam systems supply 3% AR-AFFF and 3% FFFP foams which will be used in the event of an incident or (infrequent) maintenance testing. Foam discharges will not be routine, but foam released on to the helideck will be routed to the open-drains system for discharge to sea.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by deck drainage, bilge and fire foam discharges are:<br>• transient, EPBC-listed species<br>• planktonic communities<br>• fish (demersal fish community KEF and commercial species).<br><br>Discharges of oily water will be treated to <15 ppm (v) in accordance with MARPOL requirements. This could introduce hazardous substances (mixture of water, oily fluids, lubricants, cleaning fluids (rig wash), etc.) into the water column, albeit in low concentrations. In turn, this could result in a reduction in water quality, and impacts to transient, EPBC-listed species, plankton and other pelagic organisms such as fish species (demersal fish community KEF or those species targeted by commercial fisheries).<br><br>Given the highly mobile and transient nature of marine fauna and the absence of known BIAs in WA-50-L, the potential exposure is likely to be limited to individuals close to the discharge point at the time of the discharge. The closest BIA to WA-50-L relates to the 20 km green turtle internesting buffer at Browse Island (33 km away). Additionally, a whale shark foraging BIA is located approximately 15 km south-east from the licence area at its closest point (Figure 4-7) however, based on the levels of whale shark abundance observed in numerous studies (as described in Section 4.8.4), the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration.</td><td>Insignificant (F)</td></tr>
</table>

| | |
|---|---|
| Worst case impacts to exposed marine fauna may include direct toxic effects, such as damage to lungs and airways, and eye and skin lesions from exposure to oil at the sea surface (Gubbay & Earll 2000). Considering the low concentrations of oil and the location of the discharges in the dispersive open ocean environment, a surface expression is not anticipated; therefore, impacts are considered to be of inconsequential ecological significance to transient, EPBC-listed species and are therefore considered Insignificant (F).<br><br>Planktonic communities in close proximity to the discharge point may be affected if exposed to oily water. Such exposure may result in lethal effects to plankton. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge with inconsequential ecological significance (Insignificant F).<br><br>There is the potential for individual fishes to be exposed to the discharge; however, this would be limited to those fish present at the sea surface rather than those associated with the demersal fish community KEF. Such exposure is not expected to result in any significant impacts to fishes based on the low toxicity, low volume and high dilution levels; in addition, the highly mobile nature and ability of fishes to move away. The potential consequence on the demersal fish community KEF or commercially targeted fish species will be short-term and highly localised with inconsequential ecological significance (Insignificant F).<br><br>Firefighting foams generally contain organic and fluorinated surfactants, which can deplete dissolved oxygen in water (Schaefer 2013; IFSEC Global 2014). However, in their diluted form (as applied in the event of a fire), these foams are generally considered to have a relatively low toxicity to aquatic species (Schaefer 2013; IFSEC Global 2014) and further dilution of the foam mixtures in dispersive aquatic environments may then occur before there is any substantial demand for dissolved oxygen (Schaefer 2013; IFSEC Global 2014). To date, limited research regarding the potential impacts of firefighting foam to the marine environment has been undertaken with respect to bioaccumulation and persistence (Suhring et al 2017). Toxicological effects from these types of foams is typically only associated with prolonged or frequent exposures, such as on land and in watercourses near firefighting training areas (McDonald et al. 1996; Moody and Field 2000). As toxicological effects from foams are associated with frequent or prolonged exposures, and any discharges during the activity are expected to be very infrequent and rapidly disperse, it is not expected that any impacts will occur to transient, EPBC-listed species. It is also expected that effects on planktonic communities, if any, would be localised and of a short-term nature (Insignificant F). Additionally, the potential consequences are also considered to be countered by the net environmental benefit that would be achieved through mitigating the potential for a fire resulting in harm to people and the environment. | |
| Identify existing design and safeguards/controls measures | |
| The MODU and vessels are equipped with oil–water separators (OWS) which remove traces of oil from the bilge and drainage water prior to discharge to sea. Oily water is treated to a maximum concentration of 15 ppm (v) prior to discharge as specified in MARPOL 73/78, Annex I. Bilge and deck drainage water that does not meet MARPOL 73/78 discharge requirements will be recycled for retreatment or retained on board for controlled disposal at a port reception facility.<br><br>MODU and vessels may discharge oily water in accordance with MARPOL 73/78 Annex I, Marine Orders 91: Marine Pollution Prevention – Oil (as appropriate to class). | |

| Propose additional safeguards/control measures (ALARP Evaluation) | | | |
|---|---|---|---|
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | No discharges of contaminated deck drainage or bilge to sea. | No | Discharge of deck drainage, stormwater runoff, or bilge discharges cannot be eliminated from the MODU or vessels. There is not sufficient space on board for storage, and onshore disposal is not practicable given the distance to the mainland (18-hour transit time to the closest port facility). Further, the associated emissions and discharges associated with such frequent transfers would have a negative impact. |
| | No discharge of firefighting foams to sea. | No | Firefighting foams are safety critical and are required in the event of a fire to prevent potential loss of human life or the occurrence of a significant environmental incident. It is not possible to retain and dispose of foam (from testing or during an incident) by any other practicable means. |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |
| Procedures & administration | MODU and vessel inspections confirming MARPOL 73/78 compliant oil–water separators (OWS) are operational and maintained. | Yes | MARPOL 73/78 requirements are standard industry practice and MODU and vessel inspections will ensure that the requirements with respect to deck drainage and bilge discharges can be demonstrated before mobilisation and during the activity. |
| | Spill kits will be available on board MODU and vessels. | Yes | The availability of spill kits on board vessels and the MODU (and trained personnel in the use of spill kits) will enable minor spills to be responded to in a timely manner to reduce the likelihood of spillages reaching the marine environment. Training of personnel to understand the importance of cleaning up spills, and correct techniques for spill clean-up and hydrocarbon contaminated waste disposal will be communicated through vessel-based awareness materials. |

| | | | |
|---|---|---|---|
| | MODU/vessel contractors will implement specific procedures to reduce the potential for deck spills reaching the sea. | Yes | To reduce potential for deck spills entering the marine environment contractors will ensure deck drainage systems are in place and maintained. This includes implementation of maintenance procedures and the use of plugs/scuppers etc. |
| | Use of rig wash and firefighting foam assessed and approved in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline. | Yes | The INPEX Drilling Chemical Assessment and Approval Guideline will be used to assess the rig wash and firefighting foam and ensure that it is assessed as having a low environmental hazard rating and, therefore, the environmental impact will be minimised. |

Identify the likelihood

Deck drainage and bilge discharges are treated to a maximum concentration of 15 ppm (v) OIW prior to discharge as specified in MARPOL 73/78, Annex 1. Impacts to the abundance of plankton in the vicinity of the discharge (oily water and firefighting foam) are not expected and are considered Unlikely (4) and will be ecologically insignificant based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters.

Due to the absence of any known BIAs for mobile, transient EPBC-listed species in the licence area, the likelihood of impacts from the discharge after treatment by the OWS and subsequent dilution and dispersion is considered Unlikely (4) and is not expected to result in a threat to population viability of protected species.

Residual risk summary

Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9).

| Consequence | Likelihood | Residual risk |
|---|---|---|
| Insignificant (F) | Unlikely (4) | Low (9) |

Assess residual risk acceptability

Legislative requirements

MODU and vessel oil–water separators (OWS) meet relevant international regulatory requirements, including MARPOL 73/78, enacted by the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 in Commonwealth waters. The discharge of oil in water of <15 ppm (v) is permitted under MARPOL 73/78.

Stakeholder consultation

| | | | |
|---|---|---|---|
| No stakeholder concerns have been raised regarding potential impacts and risks from deck drainage, bilge or firefighting foam discharges.<br>Conservation management plans / threat abatement plans<br>Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advice documents has specific actions relating to deck drainage/bilge/firefighting foam discharges. Managing oily water discharges in accordance with legislative requirements is consistent with the intent of the conservation management documents.<br>ALARP summary<br>Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.<br>Acceptability summary<br>Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:<br>• the activity demonstrates compliance with legislative requirements/industry standards<br>• the activity takes into account stakeholder feedback<br>• the activity is managed in a manner that is consistent with the intent of conservation management documents<br>• the activity does not compromise the relevant principles of ESD<br>• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP. | | | |
| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
| Zero discharges of deck drainage and bilge to the marine environment if oil in water content exceeds 15 ppm. | MODU/vessel contractors will comply with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Part II (Section 9), as appropriate to the vessel class, including: | Documented use of oil record book to record all oil disposal. | OIM/vessel master |

| | | | |
|---|---|---|---|
| | • Liquids from drains will only be discharged if the oil in water content does not exceed 15 ppm. Any treated water that does not meet the <15 ppm specification will be recycled back to the source tank for retreatment. | | |
| | INPEX will verify that the contractor complies with the *Navigation Act 2012* – Marine Orders - Part 91: Marine Pollution Prevention – Oil, including:<br>• Vessels to have International Oil Pollution Prevention (IOPP) certificate to show that vessels have passed structural, equipment, systems, fittings, and arrangement and material conditions.<br>• Oil water separators (OWS) tested and approved as per IMO resolutions MARPOL 73/78 (Annex I). | Record of current International Oil Pollution Prevention (IOPP) certificate.<br>Calibration and maintenance records of the OWS. | INPEX Drilling Supervisor |
| | MODU/vessel contractors will manage deck drainage systems including:<br>• Facility for plugging or closing of outboard drains.<br>• Inboard drains routed to oil water separator units, as required.<br>• Maintain MODU drainage systems to restrict leakages and small spills overboard. | Deck drainage plans confirm inboard/outboard drainage<br>Documentation of operational status of MODU deck drainage systems | INPEX Drilling Supervisor |
| Risks of impacts to marine fauna and planktonic communities from deck drainage, bilge, and | Spill kits will be located around the MODU and vessels to allow clean-up of any spill to the deck. | Inspection records confirm spill kits are available and stocked. | INPEX Drilling Supervisor |

| | | | |
|---|---|---|---|
| firefighting foam are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | Personnel are made aware of deck spill response requirements. | Training and awareness materials include deck spill response requirements. | INPEX Environmental Adviser |
| | Rig wash and firefighting foam used will be assessed and approved in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline to minimise potential environmental risks. | Records demonstrate that rig wash and firefighting foam have been assessed and approved in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline. | INPEX Environmental Adviser |

## Cooling water

**Table 7-5: Impact and evaluation – MODU and vessels cooling water discharges**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Sea water is used as a heat exchange medium for the cooling of machinery engines on the MODU and support vessels. It is pumped aboard and may be treated with biocide (e.g. hypochlorite) before circulation through heat exchangers. It is subsequently discharged from the MODU to the sea surface. Cooling water (CW) discharges to the marine environment will result in a localised and temporary increase in the ambient water temperature surrounding the discharge point. Elevated discharge temperatures may cause a variety of effects, including marine fauna behavioural changes and reduced ecosystem productivity or diversity through impacts to planktonic communities. CW discharge rates vary largely depending on the vessel type. However, as a worst-case, the rate of CW discharge from the MODU during drilling is estimated to be approximately 10,000 – 20,000 m$^3$ per day on a continuous basis. The temperature of the CW discharge will be approximately 40 °C, in contrast to ambient surface-water temperatures of 26 °C to 30 °C as recorded in the Ichthys Field (Section 4.7.4).</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by cooling water discharges are:<br>• transient, EPBC-listed species<br>• planktonic communities.<br><br>Effects of elevation in seawater temperature may include a range of behavioural responses in transient, EPBC-listed species including attraction and avoidance behaviour. There are no known BIAs or aggregation areas that would result in sedentary behaviour in WA-50-L, and EPBC-listed species with the potential to be present in the licence area (within close enough proximity to the discharge to be affected) are considered to be transient in nature (Section 4.8.4). The closest BIA to WA-50-L relates to the 20 km green turtle internesting buffer at Browse Island (33 km away) between November and March. Additionally a whale shark foraging BIA is located approximately 15 km south-east from the licence area at its closest point (Figure 4-7); however, based on the levels of whale shark abundance observed in numerous studies (as described in Section 4.8.4), the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration. The activity will occur in a water depth of approximately 250 m in a dispersive, high current environment. Therefore, potential consequences to transient, EPBC-listed species are potentially localised avoidance of thermally elevated water temperatures, with an inconsequential ecological significance to protected species (Insignificant F).<br><br>Elevated seawater temperatures are known to cause alterations to the physiological (especially enzyme-mediated) processes of exposed biota (Wolanski 1994). These alterations may cause a variety of effects and potentially even mortality of plankton in cases of prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species, UNEP (1985) indicates that there is no evidence to suggest that lethal effects to plankton from thermal discharges are ecologically significant. The potential consequence on planktonic communities is a localised impact on plankton abundance in the vicinity of the point of discharge with inconsequential ecological significance (Insignificant F).</td><td>Insignificant (F)</td></tr>
</table>

| | |
|---|---|
| The use of biocide (hypochlorite) for the control of biofouling is considered an established and efficient technology for use in offshore environments and is used throughout the world (Khalanski 2002). The effects of chlorination on the marine environment have been summarised by Taylor (2006) who, based on a review of applications using hypochlorite as an antifoulant for the seawater cooling circuits, concluded that:<br>• the chlorination procedure itself does cause the mortality of a proportion of planktonic organisms and the smaller organisms entrained through a cooling water system; however, only in very rare instances, where dilution and dispersion were constrained, were there any impacts beyond the point of discharge<br>• long term exposure to chlorination residues on fish species did not impose any apparent ecotoxicological stress<br>• studies of the impact of chlorination by-products on marine communities, population, physiological, metabolic and genetic levels, indicate that the practice of low-level chlorination on coastal receiving water is minor in ecotoxicological terms.<br>These findings indicate that the toxicity of the CW discharge is negligible at the point of discharge, therefore impacts are limited to thermal effects. | |

**Identify existing design and safeguards/controls measures**

None identified

**Propose additional safeguards/control measures (ALARP Evaluation)**

| Hierarchy of control | Control measure | Used? | Justification |
|---|---|---|---|
| Elimination | No discharges of CW to sea | No | Engines and machinery require cooling to operate safely and efficiently, therefore CW cannot be eliminated. Storage and containment of CW to allow cooling on board the MODU and vessels prior to discharge is not considered practicable given the size/space requirements (i.e. large surface areas are required to sufficiently cool the water). Onshore disposal was also not considered practicable given the distance to the mainland, frequency of trips required, and the associated emissions and discharges generated by such transfers. |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |
| Procedures & administration | None identified | N/A | N/A |

**Identify the likelihood**

CW discharges are expected to rapidly disperse in the open-ocean environment of WA-50-L. These discharges may result in temporary, localised and ecologically insignificant avoidance behaviour in transient, EPBC-listed species in response to elevated water temperatures. However, in the

| | | |
|---|---|---|
| absence of any known BIAs within the licence area the likelihood of CW discharges resulting in a threat to the population viability of protected species is considered to be Unlikely (4).<br>Localised impacts to the abundance of plankton within the vicinity of the CW discharges are considered to be Unlikely (4) based on the naturally high spatial and temporal variability of plankton distribution in Australian tropical waters. | | |
| Residual risk summary | | |
| Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9). | | |
| Consequence | Likelihood | Residual risk |
| Insignificant (F) | Unlikely (4) | Low (9) |
| Assess residual risk acceptability | | |
| Legislative requirements<br>The discharge of return seawater from cooling water systems to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of cooling water. IFC EHS Guidelines – Offshore Oil and Gas Development (2015) state that cooling water discharges should be no more than 3 °C above the ambient seawater temperature at 100 m from the discharge point. CW discharge modelling for the Ichthys offshore facility located in WA-50-L, predicted a maximum 1.6 °C at 100 m from discharge point (this is based on higher discharge temperatures and greater discharge rates than would apply to a MODU).<br>Stakeholder consultation<br>No stakeholder concerns have been raised regarding potential impacts and risks from CW discharges.<br>Conservation management plans / threat abatement plans<br>Several conservation management plans have been consulted in the development of this EP (refer Appendix B), none of the recovery plans or conservation advice documents have specific threats or actions relating to discharges of cooling water in remote offshore waters.<br>ALARP summary<br>Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.<br>Acceptability summary<br>Based on the above assessment, the risk of impacts is managed to acceptable levels because:<br>• the activity demonstrates compliance with legislative requirements/industry standards<br>• the activity takes into account stakeholder feedback<br>• the activity is managed in a manner that is consistent with the intent of conservation management documents<br>• the activity does not compromise the relevant principles of ESD | | |

| | | | |
|---|---|---|---|
| • the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP. | | | |
| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
| N/A no controls identified | | | |

### Desalination brine

**Table 7-6: Impact and evaluation – MODU and vessels desalination brine discharges**

<table>
<tr><th colspan="4">Identify hazards and threats</th></tr>
<tr><td colspan="4">Potable water will be generated on the MODU and vessels using a RO plant which is supplied with sea water. Potable water is primarily supplied to the accommodation and domestic services areas. It is also supplied for other purposes such as the eyewash and safety shower systems and utilities water systems. Desalination brine produced from the RO process will be discharged to sea on a continuous basis. Discharging desalination brine has the potential to cause changes in water salinity. The estimated volume of brine discharge for the vessels and MODU is estimated to be in the order of 60 - 140 $m^3$ per day with salinity in the order 50 parts per thousand (ppt) in comparison to ambient seawater with a salinity of 34-35 ppt (Section 4.7.4).</td></tr>
<tr><th colspan="3">Potential consequence</th><th>Severity</th></tr>
<tr><td colspan="3">The particular values and sensitivities with the potential to be impacted by desalination brine discharges are:<br>• planktonic communities.<br><br>The discharge of desalination brine has the potential to result in increased salinity within the receiving environment. Exposure to increased levels of salinity has the potential to result in impacts to planktonic communities. Azis et al. (2003) reported that effects on planktonic communities in areas of high mixing and dispersion, such as those found in the licence area, are generally limited to the point of discharge only.<br><br>Given the water depths in WA-50-L (approximately 250 m) and the dynamic marine environment (i.e. tides and currents) it is expected that the brine discharge would rapidly disperse relatively close to the point of discharge. Therefore, the effects of a temporary and highly localised increase in salinity are not expected to result in any significant ecological impacts to planktonic communities (Insignificant F).</td><td>Insignificant (F)</td></tr>
<tr><th colspan="4">Identify existing design and safeguards/controls measures</th></tr>
<tr><td colspan="4">None identified</td></tr>
<tr><th colspan="4">Propose additional safeguards/control measures (ALARP Evaluation)</th></tr>
<tr><th>Hierarchy of control</th><th>Control measure</th><th>Used?</th><th>Justification</th></tr>
<tr><td>Elimination</td><td>Eliminate brine discharges from MODU and vessels</td><td>No</td><td>The significant financial cost and health risks associated with providing fresh water to support vessels from the mainland via vessel transfer or transiting directly to port for resupply is grossly disproportionate to the low level of risk associated with this discharge. Steaming time to the closest port facilities for resupply is approximately 18 hours. This would also generate additional environmental impacts in terms of air emissions and increased demands to the onshore supply.</td></tr>
</table>

| | | | |
|---|---|---|---|
| Substitution | None identified | N/A | N/A |
| Engineering | Use of a diffuser on vessels/MODU to increase mixing in the receiving environment. | No | Given the water depth and oceanic currents in WA-50-L and the small volumes of discharges, retrospective installation of a diffuser on the MODU and all vessels is not considered practicable, given the insignificant consequence from brine discharges. |
| Procedures & administration | None identified | N/A | N/A |

**Identify the likelihood**

Direct effects on plankton from desalination brine discharges may occur in WA-50-L near the point of discharge but are not expected to result in an ecological impact to planktonic communities in the wider region. Therefore, the likelihood of impact to planktonic communities from these planned discharges is considered Highly Unlikely (5).

**Residual risk summary**

Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (10).

| Consequence | Likelihood | Residual risk |
|---|---|---|
| Insignificant (F) | Highly Unlikely (5) | Low (10) |

**Assess residual risk acceptability**

Legislative requirements

The discharge of desalination brine to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge of desalination brine.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from desalination brine discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B), none of the recovery plans or conservation advice documents have specific threats or actions relating to discharges of desalination brine in remote offshore waters.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls have been identified that can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the risk of impacts is managed to acceptable levels because:

| | | | |
|---|---|---|---|
| • the activity demonstrates compliance with legislative requirements/industry standards<br>• the activity takes into account stakeholder feedback<br>• the activity is managed in a manner that is consistent with the intent of conservation management documents<br>• the activity does not compromise the relevant principles of ESD<br>• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP. | | | |
| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
| N/A no controls identified | | | |

### Drill fluids, well completion fluids and drill cuttings

**Table 7-7: Impact and evaluation – discharges of drill fluids, well completion fluids and drill cuttings**

| Identify hazards and threats | |
|---|---|
| During drilling operations, drill cuttings consisting of crushed rock fragments are generated. Along with the cuttings, drill fluids (used to lubricate/ cool the drill bit, stabilise the borehole and control pressure) are brought to the surface. The main constituents of drill fluids are either WBM or SBM, and a weighting material (typically barite) (Section 3.2.1). Barium sulphate (barite) is considered to be relatively inert in the marine environment, and unlikely to be toxic (Neff 2002). The acute toxicity of WBM is also considered to be low (Neff 1987). Various additives may also be added to improve the technical performance of the drill fluids such as viscosifiers, emulsifiers and pH control agents. The chemicals used as additives in the drill fluids are mostly classified as PLONOR (Pose Little or No Risk to the Environment) by OSPAR Commission (2012).<br><br>During well completions, SBM or WBM drilling fluids will be displaced from the well with a filtered and inhibited sodium chloride brine or base oil. The brine may contain several inhibitors such as a biocide, oxygen scavenger and lubricant. Well completion fluids (non-oily surfactant) will be water-based and will be used to remove oil film from the pipe. All oil-contaminated fluids (approximately <15 $m^3$ per well) will be contained and returned to shore for suitable disposal. Any of the surfactant that is not contaminated with oil will be discharged to the marine environment (approximately <80 $m^3$ per development well).<br><br>Routine discharges of well completion fluids, drill fluids and drill cuttings will occur during the drilling activity. Sources of discharge are listed below, and quantities discharged are shown in Table 3-1:<br>• WBM drill cuttings and drilling fluid discharge at the seabed<br>• WBM drill cuttings discharge at the sea surface (overboard from the MODU) including bulk discharges of WBM fluid and cuttings at the end of drilling/pit washing and cleaning<br>• SBM drilling cuttings with ≤7% oil-on-cuttings (OoC).<br>• Well completion fluids discharged at the sea surface (overboard from the MODU).<br>Discharged well completion fluids and drill cuttings/fluids may impact benthic communities, water quality and associated pelagic receptors within the discharge plume (Bakke et al. 2013). | |
| **Potential consequence** | **Severity** |
| The particular values and sensitivities with the potential to be impacted by drilling discharges (fluids/cuttings) are:<br>• benthic communities<br>• fish (demersal fish communiy KEF and commercial species).<br><br>The main impact pathways from the discharge of drill fluids and drill cuttings are associated with smothering of benthic communities and an increase in turbidity within the water column potentially impacting on water quality. Cuttings in suspension may also affect pelagic organisms, sponges, corals and other sessile fauna within the discharge plume (Bakke et al. 2013). | Minor (E) |

| | |
|---|---|
| Smothering<br><br>Smothering of benthic fauna may occur in locations where the rate of cuttings deposition exceeds the rate at which in situ fauna are able to move up through the sediments. There is generally no agreed threshold point for tolerance to sedimentation as it depends on the species and the structure of the accumulating material. Smit et al. (2008) conducted an extensive literature review of species sensitivity distributions for sediment burial in the marine environment. They reported that the 50% hazardous level for burial of deep-water epibenthic fauna, such as found in WA-50-L, was 54 mm.<br><br>The discharge of drill fluids and cuttings may result in the smothering of benthic communities in the immediate vicinity of the wells in WA-50-L. This may result in burial and low sediment oxygen concentrations caused by increased oxygen consumption and organic enrichment (Neff 2008). Monitoring in the North Sea has not revealed any in situ effects of WBM cuttings on sediment macrofauna community structure, implying that any such effects, if present, will be confined to within 25–250 m from the discharge point (Bakke et al. 2013 and references within). Effects on filter feeding bivalves were reported to be limited to within a distance of 0.5 to 1 km from the discharge (Bakke et al. 2013). Further studies also indicate impacts from drilling (fluids/cuttings) discharges are localised to within 1 km of the wells (Ellis et al. 2012; Purser 2015).<br><br>While complete smothering of corals in sediment or drill cuttings will cause suffocation, conditions typically generated during the discharge of drill cuttings are unlikely to cause coral death, although this will be dependent on coral morphology (branching) and the capacity to shed sediment through the release of mucus (Allers et al. 2013). The nearest submerged coral communities to WA-50-L are located at Echuca and Heywood Shoals, located approximately 79 and 96 km respectively, and as such these are not expected to be impacted by smothering effects due to the drilling discharges. The closest coral reef to WA-50-L is located at Browse Island (33 km); however, this includes an intertidal reef platform and fringing reef and is therefore not expected to be contacted by drilling fluids/cuttings discharges given the distance from the licence area.<br><br>As described in Section 4.7.3, seabed conditions in WA-50-L are suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities. The presence of sand waves are also expected to limit the development of infaunal communities in this habitat due to substrate instability associated with changes in the currents. Any potential impacts to benthic communities from drilling discharges are expected to be at a local scale and short-term, therefore the consequence is considered to be Minor (E); particularly given the expected re-colonisation through the recruitment of new colonists from planktonic larvae and adjacent sediments.<br><br>As part of the Ichthys Project Environmental Impact Statement (2010), INPEX made a commitment to investigate potential impacts of development drill cuttings discharges on benthic communities in the offshore project area through environmental monitoring. This commitment was recorded in the Ichthys Development Drilling Campaign WA-50-L Environment Plan (EP) (D020-AD-PLN-10116) for the first phase of drilling. | |

| | |
|---|---|
| A baseline ‘before’ study, conducted in June 2018 indicated the seabed in the Project area, within WA-50-L, comprised of flat and unconsolidated sand/mud substrate with sparse biota (BMT 2019a). These results are similar to other studies in the Northwest Shelf and Timor Sea (BMT 2019b). An ROV video survey was then undertaken in October 2018 (following drilling of the BDC 1A-03 well, comprising of video footage collected along 8 transects radiating from the well centre. The benthic substrate surrounding the 1A-03 well was classified as unconsolidated sand/mud (<2 mm) in both the before and after drilling surveys. However, small areas of flat, consolidated substrate were observed within 30 m of the well centre in 3 of the 8 transects during the ‘after’ survey. Drill cuttings from previously completed wells (BDC 1A-01 and/or BDC 1A-04) were also observed in both the before and after surveys, with drill cuttings being similar in appearance (shape and size).<br><br>Distribution of drill cuttings was wider during the after survey which was to be expected post-drilling, with cuttings observed up to 100 m from the well centre along most transects. Drill cuttings observed within ~40 m of the well centre along transects 1 and 5 appeared to be more recent, possibly due to the lack of an overlaying thin sediment layer. This suggests that these drill cuttings may be a result of recent drilling activity, whereas those overlaid with a thin sediment layer may be related to historical drilling activity in the area (BMT 2019b).<br><br>Biota were sparsely distributed during both surveys, belonging to two categories during the before survey (sea stars and sea urchins) and three categories during the after survey (sea stars, sea urchins and prawns/shrimps/mysids). Sea urchins were observed closer to the well centre and in a much higher abundance during the before survey, whilst sea stars and prawn/shrimps/mysids were observed in a higher abundance during the after survey. These differences in biota abundance could be the result of the slight change in ROV track between the two surveys, in which the video may have captured different habitat areas (e.g. habitat association of urchins and manmade structure). Changes in abundance between the two surveys may also be due to the natural movement pattern of biota in the area (BMT 2019b). Further visual surveys are scheduled for 2019 and will be complimented with sediment sampling and analysis in order to further characterise the distribution of drill cuttings discharges and inform potential impacts to benthic communities in WA-50-L. Through implementation of this environmental monitoring program the potential for cumulative impacts on the abundance and distribution of biota from drilling discharges will be identified.<br><br>Turbidity and water quality<br><br>Disposal of well completion fluids, drill fluids and cuttings discharges overboard at the sea surface may affect other parts of the marine ecosystem such as pelagic organisms and other submerged receptors that may be present within the discharge plume. Discharged drill cuttings and fluids will create a temporary and localised turbid plume, which will gradually dilute as it disperses through the water column as a result of the action of currents. Field observations from drilling campaigns on the NWS have found that plumes associated with drilling discharges at the seabed and sea surface were visible in the upper water column for up to approximately 1 km from the discharge location and for a short time (approximately 24 hours) after discharge (INPEX 2010). Exposure to increased turbidity and potential toxicity is expected to be short term, and intermittent depending on plume behaviour (Bakke et al. 2013). | |

| | | | | |
|---|---|---|---|---|
| The seabed in WA-50-L is below the photic zone (water depths approximately 250 m) and benthic communities are expected to be largely unaffected from the presence of a discharge plume (reducing light exposure levels), due to the high dispersion and mixing of the drilling cuttings and fluids within the water column.<br><br>Pelagic species including the demersal fish community KEF which overlaps WA-50-L, fish species targeted by commercial fisheries, and EPBC-listed species transiting the area, are unlikely to be significantly impacted as they are likely to exhibit avoidance behaviour. These receptors may be impacted by increased suspended solids in the water column as an increase in particle load could adversely affect the respiratory efficiency of fish. However, most visual orientated fish/fauna species would likely relocate to an unaffected area to avoid the plume or simply pass unaffected through turbid waters. There is limited evidence that drilling discharges affect fishes in the natural environment, other than references to laboratory experiments, such as those undertaken by Gagnon and Bakhtyar (2013) that reported that acute toxicity of SBMs was generally low for pink snapper (*Pagrus auratus*). The barite to be used for the wells in WA-50-L has very low concentrations of mercury and cadmium (less than 1 mg/kg and 3 mg/kg respectively). A study investigating barite solubility and the release of trace metal compounds to the marine environment recorded that <1% of the mercury and 15% of the cadmium dissolved from the barite after one-week exposure in sea water (Crecelius et al. 2007). Considering the low levels of these metals released to sea, and the small initial amounts of these metals present in the barite, it is considered that the discharge of drilling fluids will not have a significant environmental impact on water quality and the marine fauna present within the water column.<br><br>While turbidity and potential associated toxicity in WA-50-L is likely to increase, up to approximately 1 km from the point of discharge, the plume is expected to rapidly disperse, and any impacts will be localised and of short-term duration (Minor E). | | | | |
| Identify existing design and safeguards/controls measures | | | | |
| None identified | | | | |
| Propose additional safeguards/control measures (ALARP Evaluation) | | | | |
| Hierarchy of control | Control measure | Used? | Justification | |
| Elimination | Do not use drilling/well completion fluids. | No | Drilling and well completion fluids are critical to drilling development wells and therefore cannot be eliminated. | |
| | Do not discharge drill cuttings. | No | Containment of cuttings and centrifuge solids and shipping for onshore disposal was discounted due to excessive logistical costs, significant safety implications and transfer of potential environmental impact to an onshore location rather than reducing it. | |
| | Reinject cuttings to avoid discharge to sea. | No | In cuttings reinjection, the cuttings are crushed and blended with water to create slurry. Typically, the slurry is then pumped to a suitable geological structure with an appropriate seal below the seabed through an annulus or tubing. This method of disposal is only an option if a suitable disposal well or disposal annuli are available. | |

| | | | |
|---|---|---|---|
| Substitution | Only use WBM in preference to SBM | No | Due to the expected high temperature and high-pressure conditions in the well, it is not technically feasible to only use WBM. In well sections with highly reactive claystones, the use of WBM is known to result in borehole breakout and collapse of the well-bore. The use of SBM results in a less reactive down-hole environment and lowers the potential for destabilisation of the well-bore. |
| Engineering | Use of solids control equipment (SCE) that is appropriately maintained for effective operation | Yes | Quantities of drilling fluids and cuttings discharged will be minimised through the use of SCE, which includes recirculation of the mud where possible. |
| | Treatment of SBM cuttings to <1% OoC | No | Drilling operations use a combination of cuttings dryers and dryer centrifuges to further reduce the amount of oil on cuttings leaving the shale shakers. Additional cuttings dryers and dryer centrifuges could further reduce the average concentration of oil on cuttings to 6–8% wt/wt. However, drying down to <1% would use significant amounts of energy and requires significant MODU deck space. Treating from <6-8% down to <1% to reduce cuttings pile biodegradation time is therefore not considered ALARP due to the energy consumption and resulting air emissions.<br>Another option considered is the use of thermal desorption using a rotomill to pulverise and process the cuttings further. While this option reduces the discharge of residual SBM cuttings to the seabed, it is energy-intensive (i.e. consumes significant amounts of diesel fuel) and entails significant costs. Therefore, thermal desorption creates additional environmental impacts and has considerable practicability constraints associated with its use and has been discounted for this activity. |
| | Treatment of SBM cuttings to ≤7% OoC | Yes | The proposed discharge of WBM and treatment for SBM is considered to exceed current industry benchmarks. The additional control measure of installing a cuttings dryer to further reduce the concentration of oil on cuttings provides assurance that a suitable buffer can be maintained to ensure that the average concentration of SBM OoC is no greater than 7% wt/wt (averaged over the SBM sections of the well). |
| Procedures & administration | Drilling and completion chemicals selected in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline. | Yes | The INPEX Drilling Chemical Assessment and Approval Guideline will be used to assess drilling and completions chemicals and ensure that they are assessed as having a low environmental hazard rating and, therefore, the environmental impact will be minimised.<br>All completion fluids, SBM and WBM used will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold (where technically feasible). If not OCNS registered, all chemicals will be assessed as 'green' |

| | | | |
|---|---|---|---|
| | | | via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria. All chemicals used will be listed in the chemical management system (ChemAlert). |
| | Concentrations of mercury and cadmium in stock barite will meet IFC EHS guidelines (2015) effluent levels. | Yes | The barite used for drilling operations in WA-50-L will have low concentrations of mercury and cadmium (less than 1 mg/kg and 3 mg/kg respectively) in accordance with IFC EHS guidelines. |

Identify the likelihood

Smothering of benthic communities may occur adjacent to the well site albeit limited to an extent ranging to within a couple of hundred metres. With the reported limited benthic community diversity in WA-50-L (Section 4.7.3) and distances to sensitive benthic communities (Echuca Shoal 79 km; Heywood Shoal 96 km) any localised loss of benthic communities in the vicinity of the wells from smothering are predicted to be relatively temporary based on the expected recovery of benthic communities through re-colonisation aided by seabed currents. Therefore, with the controls in place to minimise toxicity by selecting the least hazardous chemicals coupled with the likely recolonisation within WA-50-L, impacts to benthic communities from smothering are considered to be Highly Unlikely (5).

Based on the highly dispersive environment in WA-50-L, short-term and intermittent nature of the discharges, the low levels of associated toxicity and the localised scale of potential impact (<1 km) it is Highly Unlikely (5) that drill fluids and cuttings will have a significant environmental impact on water quality, submerged receptors and marine fauna present within the water column.

Residual risk summary

Based on a consequence of Minor (E) and a likelihood of Highly Unlikely (5) the residual risk is Low (9).

| Consequence | Likelihood | Residual risk |
|---|---|---|
| Minor (E) | Highly Unlikely (5) | Low (9) |

Assess residual risk acceptability

Legislative requirements

The discharge of drill fluids and cuttings to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge. Barite contamination is to be managed in accordance with IFC Environment, Health and Safety (EHS) Guidelines – Offshore Oil and Gas Development (2015).

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from planned discharges of drill fluids and cuttings.

Conservation management plans / threat abatement plans

| |
|---|
| Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advice documents has specific actions relating to discharges of drill fluids or cuttings in remote offshore waters.<br><br>ALARP summary<br><br>Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.<br><br>Acceptability summary<br><br>Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:<br>• the activity demonstrates compliance with legislative requirements/industry standards<br>• the activity takes into account stakeholder feedback<br>• the activity is managed in a manner that is consistent with the intent of conservation management documents<br>• the activity does not compromise the relevant principles of ESD<br>• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP. |

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| All discharges to the marine environment of SBM drill cuttings will be ≤7% wt/wt oil on cuttings (averaged over the SBM sections). | Oil-on-cuttings for SBM cuttings will be ≤ 7%. | Daily OoC results recorded in the daily drilling report. | INPEX Drilling Supervisor |
| Zero unplanned releases of oil contaminated well completion fluids discharged to the marine environment. | All oil-contaminated well completion fluids will be contained and returned to shore for suitable disposal.<br>Any of the surfactant pill that is not contaminated with oil will be discharged to the marine environment. | Records of oil contaminated fluids return to shore as recorded in the daily drilling report.<br>Records of measurement of oil in surfactant pill as recorded in the daily drilling report. | INPEX Drilling Supervisor |
| Risks of impacts to marine fauna and benthic communities from drill cuttings and drill fluids discharges are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of | All SBM on cuttings and WBM that may be discharged to the marine environment will be selected to be least hazardous (while maintaining technical feasibility) and will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold. If not OCNS registered, all chemicals will be assessed as 'green' via the INPEX pseudo | Documentation of chemical assessment confirms that CHARM, OCNS or INPEX pseudo rankings have been used as selection criteria for SBM and WBM fluids operationally discharged to environment. | INPEX Environmental Adviser |

| | | | |
|---|---|---|---|
| the environmental management implementation strategy. | ranking system in line with the OCNS CHARM/ non-CHARM criteria. | | |
| | Volumes of drill fluids discharged will be minimised through the use of SCE, which includes recirculation of the mud where possible. | Records of all operational discharges (planned and unplanned) of drilling fluids and cuttings are recorded on the MODU and demonstrate compliance with all requirements for operational discharge. | INPEX Environmental Adviser |
| | Maintenance of SCE in accordance with the MODU preventive maintenance system. | Documentation of planned and completed maintenance and testing of SCE in accordance with the MODU preventive maintenance system. | INPEX Drilling Supervisor |
| | INPEX will verify that the MODU contractor adheres to the following with respect to limits on mercury and cadmium concentration in drilling fluids including:<br>• Mercury (Hg) – 1 mg/kg dry weight in stock barite (WBM and SBM)<br>• Cadmium (Cd) – 3 mg/kg dry weight in stock barite (WBM and SBM). | • Drilling fluids will have concentrations of mercury and cadmium less than 1 mg/kg and 3 mg/kg respectively in stock barite.<br>• Documentation of QA/QC acceptance process undertaken for all individual batches of barite used. | INPEX Environmental Adviser |

### Cement, cementing fluids and additives

**Table 7-8: Impact and evaluation – discharges of cement, cementing fluids and additives**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Planned cement discharges at the seabed during the cementing of conductors and surface casing, and in the event of a well abandonment, will occur as part of the drilling activity in WA-50-L. Small volumes (1–2 m³ of cement per section) may also be discharged as a slurry at the sea surface from circulating cement with the riser installed, or from cleaning of cementing tanks and equipment on the MODU. Contingency discharges of cement may also be required if a cementing job does not meet technical and safety standards. It is intended that any bulk cement remaining at the end of each well will be used for subsequent wells being drilled in the licence area. At the end of the activity any bulk cement will be transferred onshore for disposal/reuse. Should this option not be available, the remaining cement will be mixed and operationally discharged to the marine environment. As described in Section 3.2.1, it is standard practice to allow some excess cement slurry to overflow when cementing the top-hole section of a well to visually confirm that the annular space between the hole and the casing has been filled. This may typically cover an area of up to 10 m² per well.<br>The discharge of cement, cementing fluids and additives has the potential to reduce water quality through increasing turbidity or toxicity which may affect organisms within the water column. Seabed cement discharges may result in smothering of benthic communities in the vicinity of the well.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by cementing discharges (fluids/additives) are:<ul><li>benthic communities</li><li>fish (demersal fish community KEF and commercial species).</li></ul>Impact pathways associated with the discharge of cement during drilling operations are associated with smothering of benthic communities in close proximity to the wells, and an increase in turbidity or toxicity within the water column potentially impacting on water quality.<br><br>Smothering<br><br>As described in Table 7-7, discharges at the seabed may result in the smothering of benthic communities in the immediate vicinity of the wells in WA-50-L. Discharges of cement (potentially covering up to approximately 10 m from each well) will result in burial and loss of benthic communities immediately adjacent to the well, particularly for sessile epifauna.</td><td>Insignificant (F)</td></tr>
</table>

| | |
|---|---|
| As described in Section 4.7.3, seabed conditions within the licence area are suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities. The presence of sand waves are also expected to limit the development of infaunal communities in this habitat due to substrate instability associated with changes in the currents. Any potential impacts to benthic communities and loss of benthic habitat due to cement discharges are expected to be at a local scale, therefore the consequence is considered to be Insignificant (F); particularly given the context of the potential area impacted < 10 $m^2$ per well, in comparison to the total area of WA-50-L. There are no sensitive or unique benthic habitats that would be impacted by seabed cement discharges.<br><br>Turbidity<br><br>Disposal of cement discharges overboard at the sea surface may affect other parts of the marine ecosystem such as pelagic organisms and other submerged receptors that may be present within the discharge plume. Intermittent discharges of cement, albeit at small volumes (1–2 $m^3$) may create a temporary and localised turbid plume, which will gradually dilute as it disperses through the water column as a result of the action of currents. Data on the longevity of cement discharge plumes is not available; however, plumes associated with drilling muds have been reported to be visible in the upper water column for up to approximately 1 km from the discharge location and for a short time (approximately 24 hours) after discharge (INPEX 2010). Therefore, low volume cement discharges would also be expected to dissipate within this timeframe and exposure to increased turbidity and potential toxicity associated with the discharge is expected to be short term, and intermittent.<br><br>The seabed in WA-50-L is below the photic zone (water depths approximately 250 m) and benthic communities are expected to be largely unaffected by the presence of a discharge plume (reducing light exposure levels), due to the high dispersion and mixing of the cement discharge within the water column.<br><br>Pelagic species including the demersal fish community KEF which overlaps the licence area; fish species targeted by commercial fisheries; and EPBC-listed species transiting the area, are unlikely to be significantly impacted as they are likely to exhibit avoidance behaviour. These receptors may be impacted by increased suspended solids in the water column as an increase in particle load could adversely affect the respiratory efficiency of fish. However, most visual orientated fish/fauna species would likely relocate to an unaffected area to avoid the plume or simply pass unaffected through turbid waters. The potential for toxicity effects to fish and pelagic organisms is expected to be limited given toxicity is mainly associated with cement additives that are used in minor quantities. Given the dispersive environment in WA-50-L and expected high level of dilution, any exposure is expected to be limited a few individuals within the immediate vicinity of the discharge. Therefore, the discharge of cement/cement slurry will not have a significant environmental impact on water quality and the marine fauna present within the water column (Insignificant F). | |
| Identify existing design and safeguards/controls measures | |
| Records of all operational cement discharges will be monitored and maintained. | |
| Propose additional safeguards/control measures (ALARP Evaluation) | |

| Hierarchy of control | Control measure | Used? | Justification |
|---|---|---|---|
| Elimination | Do not cement well casing | No | Cementing of the well casing is required and cannot be eliminated. The wells in WA-50-L are to be long-term production wells with an estimated life span of 40 years, therefore sufficient cementing is required during well construction to maintain integrity. Only the 36" conductor section will result in the discharge of cement to the seabed. Through casing design of the lower well sections, no cement will be discharged to the seabed from the lower casings. |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |
| Procedures & administration | Cementing chemicals selected in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline. | Yes | The INPEX Drilling Chemical Assessment and Approval Guideline will be used to assess drilling chemicals (including cement and cement additives) and ensure that they are assessed as having a low environmental hazard rating and, therefore, the environmental impact will be minimised.<br>All cementing chemicals used will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold (where technically feasible). If not OCNS registered, all chemicals will be assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria. All chemicals used will be listed in the chemical management system (ChemAlert). |
| | Dye used to provide a pre-indicator of cement overflow to seabed | Yes | A dye is used during cementing operations to indicate cement overflow, therefore minimising the volume discharged at the seabed. The dye is selected in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline. |

| Identify the likelihood |
|---|
| Localised smothering of benthic communities and habitats may occur immediately adjacent to the well site from seabed cement returns for an area of up to 10 m from each well. With the reported limited benthic community diversity in WA-50-L (Section 4.7.3) and the controls in place to minimise toxicity, the loss of sensitive benthic communities from smothering due to cement discharge is considered Highly Unlikely (5).<br>Based on the highly dispersive environment in WA-50-L, the short-term and intermittent nature of the discharges, the low levels of associated toxicity and the localised scale of potential impact (<1 km), it is Highly Unlikely (5) that cement discharges will have a significant environmental impact on water quality and the marine fauna present within the water column. |

| Residual risk summary | | |
|---|---|---|
| Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (10). | | |
| Consequence | Likelihood | Residual risk |

| | | |
|---|---|---|
| Insignificant (F) | Highly Unlikely (5) | Low (10) |

**Assess residual risk acceptability**

Legislative requirements

The discharge of cement to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to the discharge.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from planned discharges of cement.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advice documents has specific actions relating to discharges of cement in remote offshore waters.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| Risks of impacts to marine fauna and benthic communities from cement discharges are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of | All cementing chemicals that may be discharged to the marine environment will be selected to be least hazardous (while maintaining technical feasibility) and will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold. If not OCNS registered, all chemicals will be | Documentation of chemical assessment confirms that CHARM, OCNS or INPEX pseudo rankings have been used as selection criteria for cementing chemicals operationally discharged to environment. | INPEX Environmental Adviser |

| | | | |
|---|---|---|---|
| the environmental management implementation strategy. | assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria. | | |
| | Use dye to provide a pre-indicator of cement overflow to seabed surface which is selected in accordance with the chemical assessment and selection process. | Documentation of chemical assessment confirms that CHARM and OCNS ratings have been used as selection criteria for dye operationally discharged to environment | INPEX Environmental Adviser |
| | Volumes of cement discharged will be minimised through the implementation of the campaign cement program. | Records of all operational discharges (planned and unplanned) of cement are recorded on the MODU and demonstrate compliance with all requirements for operational discharge. | INPEX Environmental Adviser |
| | Discharge of excess cement will be minimised through optimising operational cement discharge or return of excess bulk to vendor, where feasible. | Records of all operational discharges (planned and unplanned) of cement are recorded on the MODU and demonstrate compliance with all requirements for operational discharge. | INPEX Environmental Adviser |

## Subsea discharges

**Table 7-9: Impact and evaluation – subsea discharges**

| Identify hazards and threats |
|---|
| Subsea discharges to the marine environment during drilling operations and IMR activities within WA-50-L may result in a change in ambient water quality potentially impacting transient, EPBC-listed species, fish and benthic communities. The range of subsea discharges may include:<br>• BOP control fluids from function and pressure testing of BOP<br>• Subsea control fluids from function and pressure testing of EDP/LRP, well intervention package and use of ROV and THS/XT valve actuations<br>• Hydraulic control fluids from use of ROV, and THS/XT valve actuations<br>• Leak detection/fluid displacement fluorescein dye (non-toxic fluorescein with a CHARM rating of Gold) from subsea installation of THS and XT<br>• IMR discharges including MEG and marine growth removal chemicals. Contingent MEG discharges during manifold flushing may contain residual hydrocarbons<br>• Well intervention discharges including MEG and methanol<br>• Well suspension fluids including corrosion inhibitors, biocide and MEG (any WBM, SBM and completion fluids present during a well suspension will be discharged in accordance with the controls detailed in Table 7-7).<br><br>BOP function testing is undertaken approximately weekly or fortnightly during the drilling activity. BOP control fluid generally consists of water mixed with a glycol based detergent, or equivalent water based, anti-corrosive additive suitable for open hydraulic systems. BOP control fluid is ranked as a Group E product by the OCNS and, therefore, considered PLONOR.<br><br>The EDP/LRP is installed on top of the XT and consists of a number of actuated and ROV operated valves. Subsea control fluids, typically glycol based are ranked as Group E product by the OCNS and, therefore, considered PLONOR.<br><br>Subsea control fluid will be discharged from the well intervention package, ROV and XT valves to the marine environment. Typically, per function and pressure test, volumes of approximately 30 L of control fluid will be discharged from the ROV and approximately 20 L of control fluid will be discharged from the XT valves. In addition to discharges from XT valve functioning, the XT internal body will also be flushed with hydraulic control fluid where approximately 20 L of control fluid will be discharged from each XT body during this activity.<br><br>Other control fluids such as water-based hydraulic fluids will also be discharged subsea during the drilling activity which may result in a temporary and localised reduction in water quality.<br><br>Small quantities (<1 $m^3$ per activity) of weak acid (acetic acid/vinegar) may be used in marine growth / lime-scale removal as an IMR activity. These discharges have the potential to expose marine fauna to changes in water quality through changing ambient pH levels. MEG (< 5 - 20 $m^3$) may also be routed from the SPS to the MODU for disposal, this is typically discharged subsea; however, it may require to be discharged at the sea surface if no subsea flow path can be identified. |

| During well intervention activities, MEG (< 5 $m^3$ per activity) will be discharged to the marine environment and potentially also methanol (if required for hydrate removal). Other MEG discharges include well suspension fluids, where residual biocide and corrosion inhibitors may also be present. MEG is considered to pose little or no risk to the environment (PLONOR) by OSPAR (2012). Subsea discharges of methanol, biocide and corrosion inhibitor may result in a change in ambient water quality. | |
|---|---|
| Potential consequence | Severity |
| The particular values and sensitivities with the potential to be impacted by subsea discharges are:<br>• transient, EPBC-listed species<br>• fish (demersal fish community KEF and commercial species)<br>• benthic communities.<br>Subsea discharges could introduce hazardous substances into the water column, albeit in low concentrations and in the majority of cases the chemicals are classified as PLONOR. However, this could result in a reduction in water quality, and impacts to transient, EPBC-listed species; other pelagic organisms such as fish species (demersal fish community KEF or those species targeted by commercial fisheries) and benthic communities given some discharges may occur at or near the seabed.<br>Given the highly mobile and transient nature of marine fauna and the absence of known BIAs in the licence area, the potential exposure is likely to be limited to individuals close to the discharge point at the time of the discharge. Given the water depths in WA-50-L (approximately 250 m) any individual turtles associated with the 20 km green turtle internesting buffer at Browse Island (33 km away) are not expected to be present in the vicinity of the discharge. Similarly, whale sharks present in the foraging BIA approximately 15 km south-east of WA-50-L are not expected to be exposed to any subsea discharges. Considering the low volumes and low levels of associated toxicity of the subsea discharges in the dispersive open environment of the licence area, impacts are considered to be of inconsequential ecological significance to transient, EPBC-listed species and are therefore considered Insignificant (F).<br>There is the potential for individual fishes, directly adjacent to the discharge point to be exposed to the subsea discharges. Such exposure is not expected to result in any significant impacts to fishes based on the high dilution levels, low toxicity, low volumes and in consideration of the highly mobile nature and ability of fishes to move away. The potential consequence on the demersal fish community KEF and any species targeted by commercial fisheries will be short-term and highly localised with inconsequential ecological significance (Insignificant F). | Insignificant (F) |

| | | | |
|---|---|---|---|
| As described in Section 4.7.3, seabed conditions in WA-50-L are suggestive of strong near-seabed currents and mobile sediments that do not favour the development of diverse epibenthic communities. The presence of sand waves is also expected to limit the development of infaunal communities in this habitat due to substrate instability associated with changes in the currents. Subsea discharges are expected to be highly influenced by natural dispersion and dilution processes associated with the currents experienced in the offshore environment. Potential impacts on benthic communities may include lethal and sub-lethal effects; however, impacts are expected to be limited both spatial and temporally due to small volumes and low toxicity. Therefore, the consequence of the exposure of benthic communities would be at a local scale with a temporary impact and is ranked as Insignificant (F). | | | |
| Identify existing design and safeguards/controls measures | | | |
| Records of subsea discharges will be monitored and maintained. | | | |
| Propose additional safeguards/control measures (ALARP Evaluation) | | | |
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | No subsea discharges | No | Function and pressure testing of key equipment (BOP, EDP/LRP) is required to ensure safe and effective operation. Therefore, these subsea discharges cannot be eliminated. Hydraulic fluid (water-based) discharges are inherent for the use of subsea equipment e.g. ROVs. There are no practicable ways to eliminate these small volume discharges (< 1 $m^3$).<br>During well intervention and IMR activities there are no practicable ways to capture the small volumes of potential subsea discharges and based on the chemical composition (water/glycol based) these discharges are considered to PLONOR when discharged to the marine environment. |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |
| Procedures & administration | All chemicals to be discharged subsea will be selected in accordance with the INPEX Drilling Chemical Assessment and Approval Guideline. | Yes | The INPEX Drilling Chemical Assessment and Approval Guideline will be used to assess all chemicals to be discharged and ensure that they are assessed as having a low environmental hazard rating and, therefore, the environmental impact will be minimised. All subsea control fluids/hydraulic fluids used will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold (where technically feasible). If not OCNS registered, all chemicals will be assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria. All chemicals used will be listed in the chemical management system (ChemAlert). |

| Identify the likelihood | | |
|---|---|---|
| Impacts to the EPBC-listed marine fauna, fish and benthic communities in the vicinity of the subsea discharges are not expected to occur and are considered Unlikely (4). This is largely due to the water depth, absence of any known BIAs for mobile, transient EPBC-listed species in the licence area and the low toxicity and low volumes of the discharged fluids. The open-ocean, highly dispersive environment in the licence area will also result in high levels of dilution further reducing the likelihood of exposure to the identified receptors. | | |
| Residual risk summary | | |
| Based on a consequence of Insignificant (F) and a worst-case likelihood of Unlikely (4) the residual risk is Low (9). | | |
| Consequence | Likelihood | Residual risk |
| Insignificant (F) | Unlikely (4) | Low (9) |
| Assess residual risk acceptability | | |

Legislative requirements

Open-loop subsea control systems are an industry standard. The majority of subsea control fluids are based on fresh water with additives, such as MEG as well as lubricants, corrosion inhibitors, biocides and surfactants. Subsea discharges to the marine environment is considered to be standard practice in industry and there are no relevant Australian environmental legislative requirements that relate specifically to these discharges.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from planned subsea discharges.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Emissions and discharges are listed as threatening processes; however, none of the recovery plans or conservation advices has specific actions relating to discharges of BOP control/hydraulic fluid discharges in remote offshore waters.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents

| | | | |
|---|---|---|---|
| • the activity does not compromise the relevant principles of ESD<br>• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP. | | | |
| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
| Risks of impacts to marine fauna from subsea discharges are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | All chemicals that may be discharged to the marine environment will be to be least hazardous (while maintaining technical feasibility) and will have an OCNS rating of D or E or a hazard quotient (HQ) rating of silver or gold. If not OCNS registered, all chemicals will be assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria. | Documentation of chemical assessment confirms that CHARM, OCNS or INPEX pseudo rankings have been used as selection criteria for chemicals operationally discharged to the marine environment. | INPEX Environmental Adviser |
| | Records of subsea discharges will be monitored and maintained. | Operational daily drilling report | INPEX Drilling Supervisor |

## 7.2 Waste management

**Table 7-10: Impact and evaluation – waste management**

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">Unsecured or incorrectly stored waste may be windblown or displaced into the ocean where it has the potential to negatively affect marine ecosystems. Wastes can cause contamination of the ocean resulting in changes to water quality (e.g. through the leaching of chemicals from wastes that are displaced) which can cause changes to ecosystem productivity and diversity. Additionally, certain types of waste can cause injury to marine fauna through entanglement or may affect the health of marine fauna if waste materials are ingested.</td></tr>
<tr><td>Potential consequence</td><td>Severity</td></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by improper waste management are:<br>• transient, EPBC-listed species<br>• planktonic communities.<br><br>Improper management of wastes may result in pollution and contamination of the environment. There is also the potential for secondary impacts on marine fauna that may interact with wastes, such as packaging and binding, should these enter the ocean. These include physical injury or death of marine biota (as a result of ingestion, or entanglement of wastes).<br><br>In the event of an accidental release of waste overboard, the particular values and sensitivities identified as having the potential to be impacted include transient, EPBC-listed species (marine fauna) and planktonic communities.<br><br>A change to water quality has the potential to impact planktonic communities found at the sea surface. Impacts associated with the accidental loss of hazardous waste materials to the ocean as a result of leaching from waste would be localised and limited to the immediate area. These are further likely to be reduced due to the dispersive open ocean offshore environment. While plankton abundance in close proximity to the accidental loss location, or leaching waste items may be reduced, this is expected to be of insignificant ecological consequence (Insignificant F).<br><br>Marine fauna can become entangled in waste plastics, which can also be ingested when mistaken as prey (Ryan et al. 1988), potentially leading to injury or death. For example, due to indiscriminate foraging behaviour, marine turtles have been known to mistake plastic for jellyfish (Mrosovsky et al. 2009). Seabirds foraging on planktonic organisms, generally at, or near, the surface of the water column may eat floating plastic (DEE 2018). Other items (e.g. discarded rope) have also been found to entangle fauna, such as birds and marine mammals. The accidental loss of waste to the ocean may result in injury or even death to individual transient EPBC-listed species, but this is not expected to result in a threat to population viability of a protected species (Insignificant F).</td><td>Insignificant (F)</td></tr>
<tr><td colspan="2">Identify existing design and safeguards/controls measures</td></tr>
<tr><td colspan="2">MODU and vessels manage waste in accordance with MARPOL 73/78 Annex V, which is implemented through the POTS Act (Cwlth) specifically the requirement to have a garbage management plan.</td></tr>
</table>

| Propose additional safeguards/control measures (ALARP Evaluation) | | | |
|---|---|---|---|
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | None identified | N/A | N/A |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |
| Procedures & administration | HSE inspection of MODU/vessel and waste contractors | Yes | HSE inspection conducted pre-mobilisation and ongoing during the activity will confirm correct storage, labelling and handling of wastes including presence of netting to prevent windblown waste |
| | Waste management processes communicated to personnel. | Yes | Waste management processes can be communicated to personnel through awareness materials such as inductions, posters, toolboxes and labelling. |

| Identify the likelihood |
|---|
| Given the proposed safeguards in place, the absence of any known BIAs and the dispersive open ocean environment in the licence area, impacts to transient EPBC-listed species and planktonic communities, while not expected, are considered Possible (3) in the event of an accidental loss of waste to the ocean. |

| Residual risk summary | | |
|---|---|---|
| Based on a consequence of Insignificant (F) and a worst-case likelihood of Possible (3) the residual risk is Low (8). | | |
| Consequence | Likelihood | Residual risk |
| Insignificant (F) | Possible (3) | Low (8) |

| Assess residual risk acceptability |
|---|
| Legislative requirements<br><br>The existing preventative and mitigation measures outlined to prevent accidental release of hazardous and non-hazardous wastes are consistent with, and typical of, good industry practice. Procedures for managing waste (i.e. handling, storage, transfer and disposal) will be outlined in the vessel/MODU garbage management plan, in accordance with MARPOL Annex V requirements.<br><br>Stakeholder consultation<br><br>No stakeholder concerns have been raised regarding potential impacts and risks from improper waste management.<br><br>Conservation management plans / threat abatement plans |

Several conservation management plans have been consulted in the development of this EP (refer Appendix B). Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris was listed in August 2003 as a key threatening process under the EPBC Act as detailed in the 'Threat abatement plan for impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans' (DEE 2018). The entanglement and ingestion of marine debris is also identified as a threat in the 'Recovery Plan for Marine Turtles in Australia" (DEE 2017a). Specific actions which contribute to the long-term prevention of marine debris (Objective 1 of the 'Threat abatement plan for marine debris on vertebrate marine life' (DEE 2018)) have been adopted including compliance with applicable legislation in relation to the improvement of waste management practices, such as MARPOL 73/78, Annex V.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| Zero unplanned discharge of wastes into the marine environment. | Implementation of garbage management plan. | Incident report of waste lost overboard. | MODU OIM/Vessel master |
| Risks of impacts to marine fauna and planktonic communities from unsecured, or incorrectly stored waste are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | MODU/vessel waste management plans are in place and comply with MARPOL 73/78 (Annex V) requirements (as appropriate to vessel class) for waste management (including recording of amounts). | Garbage record book. | MODU OIM/Vessel master<br><br>INPEX Environmental Adviser |
| | Pre-mobilisation HSE inspection of MODU/vessel includes assessment of waste management practices. | Pre-mobilisation and ongoing HSE inspection documentation. | INPEX Environmental Adviser |
| | Waste management awareness materials communicated to site personnel. | Awareness materials on waste management procedures. | INPEX Environmental Adviser |

## 7.3 Noise and vibration

**Table 7-11: Impact and risk evaluation – underwater noise**

| Identify hazards and threats | |
|---|---|
| Marine fauna may be exposed to several sources of noise emissions during the activity, as summarised below:<br>• Operation of the MODU (including power generation and drilling) has the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels. Machinery positioned on the deck is above the waterline and therefore the overall noise levels will be low. The level of underwater noise associated with MODUs while not drilling are reported to decrease rapidly with distance from the MODU. In a study by McCauley (1998), it is reported that during non-drilling operations sound levels of 117 dB re 1µPa were recorded at a distance of 125 m from the wellhead and were audible over a distance of 1-2 km. This noise was reported to be associated with the discharging of fluids and the operation of pumping systems and mechanical plant, etc. While actively drilling, sound levels of 115 dB re 1µPa were recorded at a distance of 405 m from the wellhead (McCauley 1998). Other studies have reported measured sound levels of 136 dB re 1 µPa at 100 m distance from drilling activities (Nedwell & Edwards 2004) and Greene (1986) reported 117 dB re 1 µPa at 185 m and 110 dB re 1µPa at 926 m. The noise generated during drilling activities was primarily associated with the use of the drill string.<br>• Operating vessels (support vessels and LWI) have the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels. Vessel engines and dynamic positioning thrusters are capable of generating sound at levels between 108 and 182 dB re 1 µPa at 1 m at dominant frequencies between 50 Hz and 7 kHz (Simmonds et al. 2004; McCauley 1998).<br>• As part of reservoir evaluation, a VSP will be undertaken at up to two wells during the campaign (Section 3.2.3), which will generate high-intensity, impulsive sound that will propagate into the water column with the potential to expose sound sensitive marine fauna to localised changes in underwater noise levels. Sound levels generated during the VSP will be 238 dB re 1 µPa@1 m with a frequency range of 5 – 125 Hz. The VSP will be of short-duration (approximately 7- 10 hours). | |
| **Potential consequence** | **Severity** |
| The particular values and sensitivities with the potential to be impacted by underwater noise emissions are:<br>• transient, EPBC-listed species<br>• fish (demersal fish community KEF and commercial species).<br><br>The generation of underwater sound from the proposed activities in WA-50-L has the potential to impact EPBC-listed marine fauna, specifically marine mammals and turtles. Sudden exposure to very high sound levels or exposure for prolonged periods can result in a permanent threshold shift (PTS) or temporary threshold shift (TTS) in hearing. Noise impact thresholds proposed by the U.S. National Oceanic and Atmospheric Administration and National Marine Fisheries Service (NMFS 2018) for cetaceans, suggest that, for the types of cetacean with the potential to occur in WA-50-L, PTS could occur as a result of peak sound pressure levels of 219 – 230 dB re 1 µPa or prolonged exposure to sound exposure levels of 198 – 199 dB re 1 µPa2·s. TTS could occur at peak sound pressure levels of 213 - 224 dB re 1 µPa or prolonged exposure to sound exposure levels of 168 - 170 dB re 1 µPa2·s (NMFS 2018). Popper et al. (2014) propose conservatively protective sound pressure thresholds of 207 - 213 dB re 1 µPa for potential injury to various types of fish and for marine turtles. With the exception of the VSP, no sources of noise associated with the activity are expected to have the potential to result in PTS or TTS. | Insignificant (F) |

| | |
|---|---|
| However, a range of behavioural changes can occur in cetaceans in response to sound pressure levels as low as 120 dB re 1 µPa (Southall et al. 2007). This may include minor responses, such as a momentary pause in vocalisation or reorientation of an animal to the source of the sound, or avoidance responses (Southall et al. 2007). For cetaceans, NMFS (2013) propose a behavioural response threshold of 160 dB re 1 µPa for impulsive sound sources and 120 dB re 1 µPa for continuous sound sources (NMFS 2013). Marine turtles are not reported to use sound for communication; however, it is proposed that they may use sound for navigation, avoiding predators and finding prey (Dow Piniak 2012). For received sound pressure levels above 166 dB re 1 µPa, turtles have shown some increased swimming activity and above 175 dB re 1 µPa can become more agitated (McCauley et al. 2000). The 166 dB re 1 µPa level is used as the threshold level for a behavioural disturbance response by turtles (NSF 2011).<br><br>A limited number of commercially significant fish stocks may be present in WA-50-L that may be exposed to underwater noise emissions (Section 4.9.3). Given the deep waters, commercially significant fish stocks in WA-50-L are primarily limited to highly mobile pelagic species such as tuna and billfish. The water depths and absence of suitable habitats mean the licence area is not considered to offer spawning or aggregation habitat for commercially targeted demersal species which occur in the shallower waters on the continental shelf (typically less than 200 m water depth) (Section 4.9.3). Deep water scampi (*Metanephrops australiensis*), targeted by the North West Slope Trawl Fishery, may occur on the continental slope in the water depths where WA-50-L is located. Scampi may be fished on the slope in water depths deeper than 200 m but are most commonly found at depths of 420 - 500 m (AFMA 2019f; Harte & Curtotti 2018). Timing of scampi spawning is uncertain, but studies of similar species suggest that spawning occurs in September-October (AFMA 2019f).<br><br>MODU and drilling noise<br><br>Based on the expected noise emissions associated with the MODU and drilling activities (including completion, workovers and well intervention), any noise emissions that are typically attributed to behavioral changes are expected to be limited to within a few hundred metres of the MODU, based on recorded drilling sound levels by McCauley (1998), Nedwell & Edwards (2004) and Greene (1986). Underwater noise modelling undertaken for the Ichthys Project (INPEX 2010) to consider noise emissions (albeit for tanker offloading operations rather than drilling activities, reported that low-frequency noise generated would abate to 120 dB re 1 µPa within 8 km of the source location and the area receiving 130–140 dB re 1 µPa was very small, i.e. less than 1 km in radius. Therefore, drilling noise combined with associated vessel and MODU engines and thrusters may result in sound that is detectable above ambient noise levels over several kilometres from the MODU, although behavioural avoidance responses are more likely to occur within 1-2 km.<br><br>There are no known BIAs or aggregation areas within WA-50-L that could be affected by increased noise levels, and EPBC-listed species with the potential to be exposed are considered to be transient in nature (Section 4.8.4) with the ability to avoid the source in the open ocean area. The closest turtle BIA to WA-50-L relates to a 20 km internesting buffer for green turtles (Browse Island 33 km away) and based on the distance, impacts to marine turtles are not likely to occur. In the unlikely event that behavioural changes did occur they are expected to be limited to individuals (Insignificant F). Gradual exposure to continuous noise sources, such as the MODU, are generally regarded as being less harmful and less likely to startle or stress marine fauna than rapid-onset impulsive noise sources (Hamernik et al. 1993; Hamernik et al. 2003; Southall et al. 2007). | |

| | |
|---|---|
| Vessel noise<br><br>Based on the expected noise emissions associated with the operation of vessels during the activity in WA-50-L, any noise emissions (ranging from 108 to 182 dB re 1 μPa at 1 m) are not expected to result in PTS or TTS impacts to marine fauna. Although not directly relevant to vessel engine noise, modelling for the Ichthys Project (INPEX 2010) indicated that low frequency noise generated from tanker offloading operations would abate to 120 dB re 1 μPa within 8 km of the source location with the area receiving 130–140 dB re 1 μPa predicted to be less than 1 km in radius. The sound levels produced by smaller support vessels is expected to be less than the levels modelled for offloading tankers, but the sound may be audible to marine fauna over several kilometres, with the likelihood of behavioural impacts increasing in close proximity to the vessels. Gradual exposure to continuous noise sources, such as vessel engines, are generally regarded as being less harmful and less likely to startle or stress marine fauna than rapid-onset impulsive noise sources (Hamernik et al. 1993; Hamernik et al. 2003; Southall et al. 2007). As such, exposure that would result in significant alteration of behaviour is not expected particularly in the absence of any known BIAs or important habitats in the licence area, and as such any impacts are considered to be Insignificant (F).<br><br>VSP noise<br><br>The VSP will emit high-intensity, impulsive sounds albeit on a temporary basis (7 - 10 hours) on up to two occasions. Based upon the sound levels generated during the VSP (238 dB re 1 μPa@1 m) there is the potential for noise impacts to occur (PTS and TTS) in close proximity to the VSP source, with sound levels likely to be above ambient noise levels over several kilometres. Discharging the VSP source at full power may result in PTS for any cetaceans within a few metres of the source and TTS within a few tens of metres of the source. These ranges are comparable to ranges modelled for VSP by Matthews (2012) and reported in Salgado Kent et al. (2016). Prolonged exposure to multiple pulses of the VSP source could result in TTS within a few hundred metres of the source, but such exposures would occur after many minutes or hours and marine fauna are likely to move to avoid such sound exposures before TTS effects occur. In the unlikely event that TTS did occur to marine fauna, it would be limited to a few individuals and the effects will be temporary and recoverable. Salgado Kent et al. (2016) reported that seismic pulses, in the order of that used for the VSP in WA-50-L, will reduce to levels < 120 dB re 1 μPa over approximately 5 – 10 km, therefore a range of behavioral responses may occur within this distance from the VSP source, although actual behavioural avoidance as a result of sound pressure levels greater than 160 dB re 1 μPa is more likely to occur within 1 – 2 km of the source.<br><br>Given other marine fauna have less sensitive hearing than cetaceans, the range of distances for which noise impacts may occur for other EPBC-listed species is expected to be less. Popper et al. (2014) reported that turtles are highly likely to exhibit a behavioural response when they are near an airgun (tens of metres), a moderate response if they encounter the source at intermediate ranges (hundreds of metres), and a low response if they are far (thousands of metres) from the airgun. Based on the NSF (2011) behavioural response threshold of 166 dB re 1 μPa, turtles may actively swim to avoid the VSP within 1 – 2 km. Potential significant behavioural impacts in fish arising from exposure to seismic pulses is likely to be limited to within tens to hundreds of metres, or within thousands of metres for the most sensitive fish species (Popper et al. 2014). | |

| | |
|---|---|
| On this basis, it is possible that physical and behavioral impacts may occur from the VSP undertaken in the licence area. Potential behavioural responses for various groups of sound sensitive marine fauna are expected, at a worst case, to be limited to several kilometres from the source for the duration of the VSP. The closest BIA to WA-50-L is the green turtle internesting buffer (20 km) at Browse Island 33 km away. The whale shark foraging BIA (approximately 15 km south-east) which largely follows the ancient coastline KEF, has low reported levels of abundance (Section 4.8.4). The licence area is located some distance from reported whale BIAs (humpback whale calving BIA approximately 120 km south-east of WA-50-L at its closest point; blue whale migration BIA approximately 60 km west of WA-50-L at its closest point) (Figure 4-4). Therefore, within the licence area, marine fauna are expected to be transient and able to move away from noise sources and as such any impacts are considered to be Insignificant (F).<br><br>The impact of sound on crustacean species similar to scampi, such as rock lobster, crabs and prawns has been studied with respect to commercial scale seismic surveys, which are significantly louder than VSP sources. Many studies (e.g. Christian et al. 2003; Payne et al. 2008) found no acute or chronic mortality or stress impacts. Research undertaken by Day et al. (2016) on rock lobsters in Australian waters also found no mortality impacts and no impacts to the eggs or hatched larvae of berried females exposed to seismic sound at very close range. Some sub-lethal stress and pathological impacts were observed in these studies although this occurred while lobster were captive in cages and subject to repeat exposures within close proximity to an airgun. Therefore, the effect of VSP on scampi is not expected to result in any mortality or impacts to their eggs or larvae. It is likely that scampi will move to avoid the immediate proximity of the well site during VSP well evaluation, although in all probability are likely to have moved away from the well site prior to this as a result of drilling vibration and settlement of drill cuttings. The impacts will be highly localised (e.g. hundreds of metres) and limited to the duration of VSP activities (approximately 7 -10 hours on up to two occasions). Therefore, the effects of sound to scampi will be negligible and are considered to be Insignificant (F). Pelagic fish species such as tuna and billfish may also be present in WA-50-L but these species are highly mobile and belong to a group of fish with limited sensitivity to sound (Popper et al. 2014; Hawkins & Popper 2016; Carroll et al. 2017). Fish may avoid waters immediately surrounding VSP activities but no impacts to these stocks are expected. Therefore, disturbance to commercially important fish species may occur; however, given the absence of any spawning or aggregation habitat within WA-50-L, any impact would be localised to individuals and would not result in any detrimental impacts in stock levels, and as such any impacts are considered to be Insignificant (F). | |

| Identify existing design and safeguards/controls measures |
|---|
| Implementation of EPBC Regulations 2000 – Part 8 Division 8.1.<br>Implement EPBC Act Policy Statement 2.1 - *Interaction between offshore seismic exploration and whales* during VSP operations. |

**Propose additional safeguards/control measures (ALARP Evaluation)**

| Hierarchy of control | Control measure | Used? | Justification |
|---|---|---|---|
| Elimination | Eliminate the use of MODU and vessels | No | The use of MODU/vessels to undertake the activity cannot be eliminated. |
| | Do not undertake VSP | No | VSP is required to obtain information on the reservoirs. The number of VSPs has been limited to two wells only. |
| Substitution | None identified | N/A | N/A |

| | | | |
|---|---|---|---|
| Engineering | None identified | N/A | N/A |
| Procedures & administration | Implementation of environmental awareness program for site personnel. | Yes | Before work commences, site personnel will be informed through an environmental awareness program of the need to avoid harm to marine fauna. |

| |
|---|
| Identify the likelihood |
| With the above described controls in place and the absence of any BIAs or important habitats in WA-50-L, the likelihood of impacts to marine fauna and fish species from noise emissions generated from the MODU, vessels and drilling operations are considered Unlikely (4).<br>Despite the distances to important marine habitats, transient marine fauna individuals (particularly green turtles at Browse Island) may be present within the licence area and due to the increased sound source levels and expected propagation distances associated with VSP noise emissions, impacts to marine fauna and fish species are considered Possible (3); however, this would be limited to individuals and the timeframes associated with VSP operations is considered to be of short duration. |
| Residual risk summary |
| Based on a consequence of Insignificant (F) and a worst-case likelihood of Possible (3) the residual risk is Low (8). |

| Consequence | Likelihood | Residual risk |
|---|---|---|
| Insignificant (F) | Possible (3) | Low (8) |

Assess residual risk acceptability

Legislative requirements

As required by law the EPBC Regulations 2000 – Part 8, Division 8.1 will be implemented during the activity. During VSP operations the EPBC Act Policy Statement 2.1 will also be implemented including the presence of an MMO on board (Part B: additional management procedures).

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from underwater noise.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (Appendix B). Anthropogenic noise from seismic surveys (e.g. VSP) has been identified as a threat to pygmy blue whales in the Conservation Management Plan for the Blue Whale (DoE 2015). Noise interference has also been identified as a threat to marine turtles (DEE 2017a). The above listed controls to be adopted during the activity are in alignment with the actions identified in the various conservation management documents.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

| Acceptability summary | | | |
|---|---|---|---|
| Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:<br>• the activity demonstrates compliance with legislative requirements/industry standards<br>• the activity takes into account stakeholder feedback<br>• the activity is managed in a manner that is consistent with the intent of conservation management documents<br>• the activity does not compromise the relevant principles of ESD<br>• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP. | | | |
| **Environmental performance outcomes** | **Environmental performance standards** | **Measurement criteria** | **Responsibility** |
| Risk of impacts to marine fauna from planned noise emissions are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | Vessel contractors comply with relevant requirements of the EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans, within the 500m exclusion zone including:<br>• Supply vessels will not travel greater than 6 knots within 300 m of a whale (caution zone)<br>• Supply vessels will not approach closer than 100 m of a whale. | • Records of breaches of vessel - cetacean interaction requirements outlined in the EBPC Regulations 2000 reported. | INPEX Drilling Supervisor |
| | INPEX will verify VSP operations are conducted in accordance with EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales which includes:<br>• Implement 30-minute pre-start observations to the extent of the observation zone (as defined in Policy Statement 2.1), only start if no whales are sighted within 3 km.<br>• Implement soft start procedures, including a gradual ramp up of acoustic source to full power over 20 minutes only if no whales are sighted within the shutdown zone during the pre-start observations. | • Records of pre-start observations prior to time of commencement; and soft-start time of commencement and durations.<br>• Records of sound source on standby or VSP shutdown if whales are observed.<br>• Completed MMO records during VSP operations. | INPEX Drilling Supervisor |

| | | | |
|---|---|---|---|
| | • While the VSP is operating, both during soft start and operations: visual observations of the observation zone are maintained; if whales are sighted – acoustic source placed on standby; if whales are sighted in the shut-down zone (within 1 km of source)– the acoustic source will be shut down.<br>• An MMO will be on board during VSP operations. | | |
| | Awareness materials for site personnel for avoiding harm to marine fauna. | Record of provision of awareness materials to site personnel. | INPEX Environmental Adviser |

## 7.4 Loss of containment

The activity will require the handling, use and storage of chemicals and hydrocarbon materials which may include, but are not limited to:

- diesel
- hydraulic oil
- subsea/hydraulic/BOP control fluids
- grease
- drilling fluids.

Undertaking the activity introduces the potential for loss of containment events. These events may be classified as Level 1, Level 2 or Level 3 incidents, in accordance with Table 2.2 of the OPEP (Appendix D).

INPEX defines an emergency condition as:

"an unplanned or uncontrolled situation that harms or has the potential to harm people, the environment, assets, Company reputation or Company sustainability and which cannot, through the implementation of Company standard operating procedures, be contained or controlled."

An evaluation of the environmental impacts and risks associated with emergency conditions is included in Section 8 of this EP.

A summary of the loss of containment events (and emergency conditions) associated with this EP is presented in Table 7-12. Incident levels are indicative only and classifications have been assigned for the purposes of enabling the risk evaluation to be undertaken. In the event of a spill, the incident level will be classified as described in the OPEP (Appendix D).

**Table 7-12: Representative loss of containment events and emergency conditions identified for the petroleum activity**

| Scenario | | Basis of volume calculation | Type | Indicative incident level | Section addressed |
|---|---|---|---|---|---|
| Source | Threat | | | | |
| Management of chemicals and hydrocarbons products on board | Inappropriate use /handling/ spills<br>Failure of hydraulic hoses on equipment<br>Drop out of hydrocarbons while flaring due to non-combustion | Failure of tote tank estimated to be in the order of 1 $m^3$<br>Failure of hydraulic hoses estimated to be in the order of < 1 $m^3$<br>Drop out volumes estimated to be in the order of < 1 $m^3$ | Various | 1 | Accidental release – Table 7-13 |

| Scenario | | Basis of volume calculation | Type | Indicative incident level | Section addressed |
|---|---|---|---|---|---|
| **Source** | **Threat** | | | | |
| Cargo transfers | Dropped objects | 5.5 $m^3$ – based on the volume of a tote tank which, if lost during cargo transfer, has the potential to result in a full loss of contents | Various | 1 | Accidental release – Table 7-13 |
| SBM transfers | Spill during transfer | 10 $m^3$ – based on hose failure during transfer<br>50 $m^3$ - loss of riser contents | Various | 1 | Accidental release – Table 7-13 |
| Hydrocarbon transfers | Spill during bunkering | 10 $m^3$ – based on hose failure during transfer | Group II – diesel | 1 | Accidental release – Table 7-13 |
| Helicopter refuelling | Spill during refuelling on board the MODU | 4.4 $m^3$ – based on volume stored on board the MODU | Group I (i.e. aviation fuel) | 1 | Accidental release – Table 7-13 |
| Emergency conditions (refer to Section 8) | | | | | |
| Vessels | Collision | 250 $m^3$ – based on capacity of largest single fuel tank (AMSA 2013) | Group II – diesel | 2 | Vessel collision – Section 8.3 |
| Loss of containment – rupture/ damage to Ichthys SPS | Dropped object | 140 $m^3$ - based on a worst-case release of Brewster condensate/gas from a leak in the longest production flowline at the seafloor | Group I – condensate | 2 | Loss of containment – Section 8.2 |
| Loss of well containment | Integrity failure | Brewster:<br>255,475 $m^3$ – based on 3,193 $m^3$ per day for an 80-day blowout | Group I – condensate | 3 | Loss of containment – Section 8.2 |

| Scenario | | Basis of volume calculation | Type | Indicative incident level | Section addressed |
|---|---|---|---|---|---|
| **Source** | **Threat** | | | | |
| | | Plover:<br>116,856 $m^3$ - based on 1,082 $m^3$ per day for a 108-day blowout. | | | |

### 7.4.1 Accidental release

**Table 7-13: Impact and evaluation – loss of containment: accidental release**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">Several loss of containment events were identified (Table 7-12), including minor spills on board (<1 $m^3$); drop out of hydrocarbons during flaring (< 1 $m^3$); loss of tote tank during cargo transfer (5.5 $m^3$); failure of hydraulic hoses (<1 $m^3$); loss of SBM during transfer or from riser (10 - 50 $m^3$) and loss of hydrocarbon fuels during bunkering of vessels and helicopters (4.4 $m^3$ to 10 $m^3$).<br>Specific predictive modelling was not undertaken for the potential loss of containment events. This was based on the low worst-case volumes (< 10 $m^3$) and that any predicted impacts are expected to be localised to the point of release. Given the properties of the chemicals involved (predominantly Group I and Group II hydrocarbons), which tend to be more volatile and less persistent in the environment any spills will rapidly disperse at the sea surface.<br>An accidental release overboard resulting in a spill that reaches the marine environment has the potential to result in localised changes to water quality, resulting in impacts to marine fauna and planktonic communities at the sea surface, but no impact on deeper water communities or benthic habitats would be expected.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by a loss of containment/accidental release are:<br>• transient, EPBC-listed species<br>• planktonic communities.<br><br>Potential accidental releases overboard from loss of containment events may result in the exposure of marine fauna and plankton near the sea surface, to a range of chemicals and Group I and Group II hydrocarbons. Foreseeable loss of chemicals to the marine environment would be of small volumes (<1 – 2 $m^3$), and impacts would generally be of low consequence (Insignificant F). Therefore, the focus of this assessment is based on the larger spill volumes associated with loss of SBM and diesel during transfers/bunkering.<br><br>Given the anticipated volumes (worst case 10 $m^3$ of diesel or 50 $m^3$ SBM), potential exposure is expected to be localised to the point of discharge in WA-50-L and in some instances a portion of the spilled volume is expected to be at least partially captured within the MODU drainage system, therefore further reducing the potential spill volume. Upon release to the marine environment hydrocarbons will disperse through natural physical oceanic processes, such as currents, tides and waves, and photochemical and biological degradation. Therefore, any surface expression is expected to weather and dissipate in a relatively short time with limited potential for exposure to surfacing marine fauna or plankton at the sea surface.</td><td>Insignificant (F)</td></tr>
</table>

| | |
|---|---|
| In the absence of any known BIAs for marine fauna in the licence area, any individuals present are likely to be transiting the area for a short duration. The closest BIA to WA-50-L relates to the 20 km green turtle internesting buffer at Browse Island (33 km away). Additionally, a whale shark foraging BIA is located approximately 15 km south-east from the licence area at its closest point (Figure 4-7); however, based on the levels of whale shark abundance observed in numerous studies (as described in Section 4.8.4), the likelihood of whale shark presence within this BIA is considered very low, with no specific seasonal pattern of migration. Given the low volumes, limited duration of exposure due to expected weathering and dispersion in an open ocean environment, the level of consequence is expected to present a local scale event of inconsequential ecological significance (Insignificant F).<br><br>As a consequence of their presence close to the water surface, plankton may be exposed to any entrained/dissolved components of any hydrocarbons spilled at the sea surface, particularly in high energy seas where the vertical mixing of oil through the water column would be enhanced. The effects of oil on plankton have been well studied in controlled laboratory and field situations. The different life stages of a species often show widely different tolerances and reactions to oil pollution. Usually, eggs, larval and juvenile stages will be more susceptible than adults (Harrison 1999). Post-spill studies on plankton populations are few, but those that have been conducted, typically show either no effects or temporary minor effects (Kunhold 1978). Given the high temporal and spatial variability in plankton communities, and the small size of the area impacted by an accidental release, the potential consequence in regard to planktonic communities is considered to be Insignificant (F). | |

**Identify existing design and safeguards/controls measures**

Marine vessels >400 tonne (t) will carry SOPEPs approved under MARPOL 73/78 Annex 1, Regulation 37.

**Propose additional safeguards/control measures (ALARP Evaluation)**

| Hierarchy of control | Control measure | Used? | Justification |
|---|---|---|---|
| Elimination | Eliminate the use of chemicals and hydrocarbons on board. | No | Chemicals and hydrocarbons are required for safe and efficient operations and cannot be eliminated. In the case of diesel, it is required as fuel and cannot be eliminated. |
| | No bunkering or SBM transfers. | No | Bunkering of fuel and SBM from supply vessels to the MODU is required during the activity as space limitations/tank capacities mean that supplies need to be replenished. |
| | No cargo transfers. | No | Cargo transfers cannot be eliminated, as this is the only practicable option for supplying the MODU in an offshore location. |
| Substitution | None identified | N/A | N/A |
| Engineering | Prevent onboard spills through appropriate storage of hydrocarbons and chemicals including their associated waste constituents. | Yes | Through bunding of storage areas and good housekeeping practices, the storage and management of hydrocarbon and chemical products and associated wastes can reduce the potential risk of a loss of containment event occurring. |
| | Reduce potential volumes of spilled chemicals/hydrocarbons reaching the | Yes | The availability of spill kits on board vessels and the MODU (and trained personnel in the use of spill kits) will enable minor spills to |

| | | | |
|---|---|---|---|
| | marine environment by ensuring spill containment and recovery equipment, such as spill kits, are available for responding to minor spillage of hydrocarbons and chemicals on board. | | be responded to in a timely manner to reduce the likelihood of spillages reaching the marine environment. |
| | Dry break, breakaway couplings or similar technology will be installed and used during SBM transfer and hydrocarbon bunkering operations. | Yes | The use of dry break and breakaway couplings during transfers and bunkering, as specified by the contractors transfer procedures, will reduce the potential volume of any spills. |
| Procedures & administration | Implement hydrocarbon/SBM transfer procedures that specify keeping of hose registers, and operational requirements (e.g. minimum lighting conditions, communications, visual monitoring and a permit-to-work system). | Yes | The transfer of fuel and SBM will occur in accordance with strict conditions for preventing spills to the marine environment. Offshore transfers of fuel and SBM will be conducted in accordance with the MODU contractor's transfer procedures. |
| | Hydraulic equipment on board MODU and vessels will be subject to routine servicing and inspection to ensure it is fit for purpose. | Yes | Routine servicing and inspection of hydraulic equipment will ensure it is fit for purpose and minimise the potential for leaks and spills to deck as a result of corrosion, and wear and tear of hydraulic hoses. |
| | Lifting procedures implemented to reduce the risk of dropped objects. | Yes | Lifting and cargo transfer processes will be followed to ensure that the risk of dropping hazardous materials during transfers is reduced. |
| | Implement IFC Environment, Health and Safety (EHS) Guidelines – Offshore Oil and Gas Development (2015) applicable for flaring activities. | Yes | INPEX will verify that the contractor will comply with IFC EHS guidelines with respect to maximising flaring efficiency and thereby reducing potential hydrocarbon liquid drop out while flaring during well flow back. |
| | Well test procedure implemented for flaring operations. | Yes | INPEX well test procedure includes a continuous 24/7 flare watch to observe and monitor flaring operations and reduce potential for hydrocarbon drop out during flaring. |
| | Implement the INPEX Drilling Chemical Assessment and Approval Guideline | Yes | The INPEX Drilling Chemical Assessment and Approval Guideline will be used to assess all chemicals to be discharged and ensure that they are assessed as having a low environmental hazard rating and, therefore, the environmental impact will be minimised in the event of an accidental release. |
| Identify the likelihood | | | |

| | | |
|---|---|---|
| Based on the low volumes, expected weathering of spilled chemicals, absence of any important habitats within WA-50-L for marine fauna and in conjunction with the controls in place the likelihood of a loss of containment event causing harm to the identified receptors is considered to be Unlikely (4). | | |
| Residual risk summary | | |
| Based on a consequence of Insignificant (F) and a likelihood of Unlikely (4) the residual risk is Low (9). | | |
| Consequence | Likelihood | Residual risk |
| Insignificant (F) | Unlikely (4) | Low (9) |
| Assess residual risk acceptability | | |

Legislative requirements

The activities and proposed management measures are compliant with industry standards and relevant Australian legislation, specifically concerning prevention pollution, including the POTS Act.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from accidental release/loss of containment. Spill response activities and notifications to relevant stakeholders have been identified and included in INPEX spill response processes.

Conservation management plans / threat abatement plans

Several conservation management plans (Appendix B) identify oil or chemical spills as key threatening processes, through both direct/acute impacts, as well as indirect impacts through habitat degradation. The prevention of loss of containment events and reducing impacts to the marine environment through the preventative controls in place and spill response preparedness, demonstrates alignment with the various conservation management plans.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| No incidents of spills reaching the marine environment during transfer, handling or storage of chemicals, hydrocarbons and liquid waste products. | Premobilisation HSE inspection confirm that MODU and vessels >400 GT have SOPEPs compliant with Marine Orders – Part 91, the POTS Act, and Annex I of MARPOL 73/78 (oil) on board. | Premobilisation HSE inspection documentation. | INPEX Environmental Adviser |
| | Bunding around stored bulk wet chemicals or hazardous liquid waste storage areas in accordance with Australian standards. | Bunding and drainage verified by containment specialist. | INPEX Drilling Supervisor |
| | Spill kits will be located around the MODU and vessels to allow clean-up of any spill to the deck. | Inspection records confirm spill kits are available and stocked. | INPEX Drilling Supervisor |
| | Site personnel are made aware of deck spill response requirements. | Records of awareness materials include deck spill response requirements provided. | INPEX Environmental Adviser |
| | Lifting and cargo transfer processes are implemented. | Training records of personnel involved in lifting and cargo transfer activities. | OIM |
| | INPEX and the MODU contractor will comply with IFC EHS guidelines relating to flaring, specifically:<br>• Maintenance program to ensure maximum flare efficiency<br>• Use of a reliable pilot ignition system. | Well test procedure safety checklist | INPEX Environmental advisor |
| | Well test procedure implemented including:<br>• Continuous (24/7) flare watch during flaring operations<br>• Function testing of continuous ignition system and pilot system. | Well test procedure safety checklist | INPEX Environmental advisor |
| | INPEX will verify the contractor implements MODU and vessel bunkering procedures for hydrocarbon and SBM transfers that will include as a minimum:<br>• Completion of PTWs for all diesel and SBM transfers.<br>• Dry break couplings/weak link breakaway couplings and flotation | • Documentation that hydrocarbon and SBM bunkering procedures approved and are implemented, e.g. undertaken during daylight hours and in appropriate sea state etc.<br>• Hose register. | INPEX Drilling Supervisor |

| | | | |
|---|---|---|---|
| | collars are installed on hydrocarbon bulk transfer hoses to prevent entanglement and enable early leak detection.<br>• Hydrocarbon bulk transfer hoses are certified and rated for hydrocarbons and pressure tested and maintained in a hose register.<br>• Bunkering is undertaken during daylight hours, if permit to work in place and weather is good (e.g. suitable sea conditions). Night time bunkering will not be undertaken on a routine basis. This will only be undertaken in fully lit conditions and in favourable sea states.<br>• Preventive maintenance of hydraulic equipment to ensure its integrity. | • Completed and approved PTW records for all diesel and SBM transfers.<br>• Documentation of maintenance recorded in the preventive maintenance system. | |

## 7.5 Biodiversity and conservation protection

### 7.5.1 Introduction of invasive marine species (IMS)

**Table 7-14: Impact and evaluation – Introduction of invasive marine species**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">IMS are non-indigenous marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish founder populations. IMS are widely recognised as one of the most significant threats to marine ecosystems worldwide. Shallow coastal marine environments in particular, are thought to be amongst the most heavily invaded ecosystems, which largely reflects the accidental transport of IMS by international shipping to marinas and ports where the preferred artificial hard structures are commonly found.<br><br>Vessels used for the activity will not be mobilised from overseas; however, mobilisation of the MODU from international waters may occur. This has the potential to act as a pathway for IMS to be translocated into offshore Commonwealth waters, if unmanaged, via the discharge of high-risk ballast water containing IMS (DAWR 2017) and/or via the presence of IMS within biofouling communities on the MODU and/or subsea equipment.<br><br>Vessels on domestic journeys (e.g. support vessels transiting between WA-50-L and WA mainland) may, if unmanaged, act as a pathway through the uptake and subsequent discharge of high-risk ballast water containing IMS and/or IMS recruitment on submerged vessel hulls while in the vicinity of confirmed IMS sources. Such sources could include other offshore infrastructure i.e. other vessels or platforms that may have support vessel sharing arrangements; and artificial substrates such as jetties and wharves already colonised by mature IMS, such as in Broome Port.<br><br>The introduction and establishment of IMS into the marine environment may result in impacts to benthic communities and associated receptors dependent on these including fishing.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by the introduction of IMS are:<br>• benthic communities<br>• commercial, traditional and recreational fishing/aquaculture.<br><br>The introduction and subsequent establishment of IMS could result in changes to the structure of benthic communities leading to a change in ecological function due to predation of native marine organisms and/or competition for resources. Once IMS establish, spread and become abundant in coastal waters some species can have major ecological, economic, human health and social/cultural consequences (Carlton 1996, 2001; Pimental et al. 2000; Hewitt et al. 2011).<br><br>Benthic communities, shallow water coastal environments in WA marine parks and reserves (the closest of which is Browse Island) and fisheries (commercial (including aquaculture)/ traditional/recreational) all have the potential to be impacted by IMS.</td><td>Moderate (D)</td></tr>
</table>

| | |
|---|---|
| Shallow water, coastal marine environments are susceptible to the establishment of invasive populations, with most IMS associated with artificial substrates in disturbed shallow water environments such as ports and harbours (e.g. Glasby et al. 2007; Dafforn et al. 2009a, 2009b). Aside from ports and harbours, other shallow water, pristine environments also at risk include offshore island and shoals such as those found in the EMBA in WA marine parks and reserves as presented in Section 4.4. Many of these marine parks and reserves contain sensitive benthic habitats with a potential to be impacted by invasive populations.<br><br>In order for an IMS to pose a biosecurity risk once present at a recipient location, viable IMS propagules and/or individuals must be able to transfer from the colonised area (e.g. a vessel hull), survive in the surrounding environment, find a suitable habitat, and establish a self-sustaining population.<br><br>Vessel operations are a mechanism for such transfer of IMS propagules either through the uptake and discharge of high-risk ballast water containing IMS and/or via the presence of IMS within biofouling communities on hulls or submerged equipment. IMS propagules may also be transferred via natural dispersion. Natural dispersal mechanisms could involve a mobile life-history stage (such as actively swimming adults or larval stages) with sufficient swimming capacity and/or larval durations to directly reach suitable habitats in coastal waters. Natural dispersal from offshore locations for IMS with shorter pelagic dispersal capabilities to coastal areas is also theoretically possible via intermediate steps (stepping stone dispersal), where intermediate populations establish in suitable habitats closer inshore, and subsequent generations then spread towards coastal regions.<br><br>With consideration of the habitat preferences of IMS (shallow water environments), the closest shallow water habitat to the licence area is Browse Island, located approximately 33 km away. However, it is neither disturbed nor contains artificial structures that IMS are reported to prefer.<br><br>Support vessels transiting between WA-50-L and Broome port have the potential to act as vectors for the transfer of IMS propagules to sensitive benthic habitats in the wider EMBA and this may result in local to medium scale impacts to benthic communities with a consequence rating of Moderate (D).<br><br>The successful introduction of IMS into fishing grounds/areas of aquaculture may result in changes to benthic habitats with the potential to alter faunal assemblages, resulting in decreased ecological diversity or ecosystem health. In turn this may result in an economic loss of revenue. Other fishing activities that may be impacted include traditional fishing known to occur at Dambimangari IPA and Uunguu IPA (Section 4.9.3) and recreational fishing that is known to occur around Broome Port (Section 4.9.6). This may result in regional community disruption with a moderate impact on economic or recreational values with a consequence rating of Moderate (D). | |
| Identify existing design and safeguards/controls measures | |
| Support vessels have an anti-fouling coating applied that is in accordance with the prescriptions of the International Convention on the Control of Harmful Anti-fouling systems on ships, 2001, and the *Protection of the Sea (Harmful Antifouling Systems) Act 2006* (Cwlth) (as appropriate to vessel class). | |
| Propose additional safeguards/control measures (ALARP Evaluation) | |

| Hierarchy of control | Control measure | Used? | Justification |
|---|---|---|---|
| Elimination | Eliminate vessel use to avoid the spread of IMS | No | Vessels are the only form of transport that can supply and support the MODU that is practicable and cost efficient. |
| Substitution | Only use a local MODU already operating in Australian waters. | No | Although using only local vessels is possible for the activity, using only a local MODU would result in delays when sourcing an appropriate available MODU. The potential cost and time needed to source a capable MODU locally is disproportionate to the minor environmental gain potentially achieved.<br><br>Additional to this, there are known locations within Australia which harbour IMS and could potentially act as a source for the further spread of IMS within Australian regions. Therefore, substituting to the use of a locally available MODU will not provide any environmental benefit. |
| Engineering | MODU has an anti-fouling coating to all submerged areas. | No | Some MODUs currently on the market may have anti-fouling coatings applied to all submerged areas and others may only have it applied to intakes and seachests.<br><br>Anti-fouling coatings vary in their efficacy and utilise a range of technologies to limit the ability of biofouling to attach to the surface. Some anti-fouling coatings include biocidal layers, while others rely upon creating surfaces that reduce the likelihood of organisms to freely attach. Despite the differences in types of anti-fouling coatings and the subsequent variations in performance and efficacy, there is always an inherent risk that niche areas below the water line may harbor biofouling communities and IMS, even when antifoul coatings are present.<br><br>MODU availability must align with the schedule and other commercial considerations, therefore to limit MODU selection to only those that have anti-fouling coatings may add some value, but it will not eliminate the risk completely.<br><br>Therefore, INPEX will engage an independent third-party to undertake a biofouling risk assessment for the MODU (described in procedural controls row below) and will implement any controls required as the outcome of the biofouling risk assessment rather than rely on a MODU being available that has an anti-fouling coating that may not necessarily be an effective control. |

| | | | |
|---|---|---|---|
| | MODU/vessels will have an approved ballast water treatment system installed. | No | All vessels and the MODU will comply with the Australian Ballast Water Requirements, Version 7 (DAWR 2017) – see procedural control below for all vessels.<br>The INPEX MODU and vessel contracting process is outcomes focused and is not prescriptive in relation to how MOPDU/vessels meet the Department of Agriculture requirements. This allows for commercial flexibility and still achieves the environmental outcome.<br>A requirement for MODU/vessels to have approved ballast water treatment systems is unnecessary when it is possible to comply with the requirements of the Australian Ballast Water Requirements (Version 7) by alternative means, therefore fitting a treatment system is considered disproportionate to the level of risk. |
| Procedures & administration | Complete a biofouling risk assessment (including immersible equipment) for vessels/MODU mobilised from international waters, and implement mitigation measures commensurate to the risk, as appropriate to ensure the mobilisation of the vessel poses a low risk of introducing IMS. | Yes | The completion of a biofouling risk assessment and the implementation of associated biofouling reduction and management measures reduce the likelihood of IMS translocation and subsequent potential for transfer and establishment. This approach is in accordance with the National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (Marine Pest Sectoral Committee 2018)<br>A biofouling risk assessment is a desktop-based evaluation to determine the likelihood, and hence theoretical risk of a vessel acting as a vector for the transfer of marine pests. It does not attempt to identify whether or not a vessel is actually carrying a pest species, but rather ranks vessels on a relative scale of High, Uncertain or Low/Acceptable risk, to identify which vessels may require further detailed investigation and/or management actions to reduce potential risk.<br>The assessment, undertaken by an independent third-party IMS expert on behalf of INPEX, relies on the provision of accurate information from the vessel operator, which may include, but is not limited to, the following:<br>• vessel specifications: vessel name, type, size and Flag State, etc. |

| | | | |
|---|---|---|---|
| | | | • movements: port of origin, voyage history, destination, transport method, evidence of recent dry-docking and/or inspection, etc.<br>• anti-fouling coating: type (i.e. biocidal/non-biocidal), age, service life, application area, record of Antifouling Systems Certificate, etc.<br>• inspection/cleaning: inspection and cleaning history including any relevant independent biofouling inspection reports, etc.<br>• seawater systems: marine growth prevention systems present and functioning, maintenance records, evidence of chemically or manually cleaned seawater systems including last treatment date and chemicals used etc.<br>• duration of stay: at overseas or interstate locations, and duration in WA coastal waters etc.<br>Outcomes of the biofouling risk assessment may identify the need to implement mitigation measures such as limitations of time spent in coastal waters/or alongside and managing interactions with supply vessels, through to inspection and cleaning of hulls and submerged areas. |
| | Complete a biofouling risk assessment for a MODU/vessels (including immersible equipment) mobilised <u>domestically</u> from other regions in Australia, and implement mitigation measures commensurate to the risk, as appropriate to ensure the mobilisation of the MODU/vessels poses a low risk of introducing IMS. | Yes | If a domestically sourced MODU or vessel is used, a biofouling risk assessment will be completed by INPEX with the process* to be followed described in Section 9.6.1 of this EP. The assessment will include aspects of the vessels history with respect to IMS risk e.g. MODU/vessels origin from within Australian waters and previous locations of operation (including whether these Australian locations have reported IMS occurrences), periods out-of-water and inspections/cleaning undertaken, age of anti-fouling coatings, presence and condition of internal treatment systems etc.<br>While undertaking the INPEX biofouling risk assessment for domestic movements, in any instances where potential risks are identified e.g. no anti-fouling coating or extended stays in Port, the process requires INPEX to engage an independent IMS expert and if required a further risk assessment (as described above for international MODU/vessels) may be undertaken. |

| | | | |
|---|---|---|---|
| | | | This control and implementation of any associated management measures will reduce the likelihood of IMS translocation and subsequent potential for transfer and establishment.<br>* The process shown in Figure 9-4 in Section 9.6.1 was developed in conjunction with WA DPIRD. |
| | MODU/vessels operating within Australian seas will manage ballast water discharge using one of the following approved methods of management including (DAWR 2017):<br>• an approved ballast water management system<br>• ballast water exchange conducted in an acceptable area *<br>• use of low risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place)<br>• retention of high-risk ballast water on board the vessel<br>• discharge to an approved ballast water reception facility<br>**Acceptable area is as defined in the Biosecurity (Ballast Water and Sediment) Determination 2017. For high risk ballast water an acceptable area for ballast water exchange is defined as (DAWR 2017):*<br>• Vessels servicing an offshore installation: at least 500 m from the facility, and no closer than 12 nm from the nearest land | Yes | The discharge of high-risk ballast water has the potential to translocate IMS from a donor region to a recipient region. MODU/support vessels operating within Australian seas will comply with the Australian Ballast Water Requirements, Version 7 (DAWR 2017). Specifically, discharge of high-risk* ballast water into Australian seas is prohibited, unless it has been managed for discharge using one of the approved management methods as specified by DAWR (2017). The MOPDU/vessels will have documentation of Department of Agriculture release from biosecurity control or low risk status.<br>Note ballast water exchange is being phased out, in favour of methods that are required to meet the Regulation D-2 standard.<br>* DAWR (2017) defines high-risk ballast water as any ballast water that has not been managed in accordance with an approved method, and has been taken up:<br>• within 12 nautical miles of any land mass or in water less than 50 metres deep<br>• within 500 metres of an offshore installation, or<br>• in an Australian port and then intended to be discharged in the Australian territorial seas. |

| | | | |
|---|---|---|---|
| | • All other vessel movements: at least 12 nm from the nearest land and in water at least 50 m deep; not within 12 nm of the Great Barrier Reef or Ningaloo Reef ballast water exchange exclusion areas. | | |
| | MODU/vessels will have an approved ballast water management plan and valid ballast water management certificate, unless an exemption applies or is obtained. | Yes | Vessels operating in Australian seas that are designed or constructed to carry ballast water are required to carry and implement an approved vessel specific ballast water management plan. The format of the plan must be in accordance with Ballast Water Management Convention and Resolution MEPC.127 (53). The ballast water management plan outlines the duties of personnel on board for carrying out ballast operation and operational procedures for the vessel. A ballast water management certificate certifies that the vessel has an approved ballast water management plan. |
| | MODU/vessels will have a biofouling management plan and maintain a biofouling record book. | Yes | A biofouling management plan provides operational guidance for the planning and actions required to manage vessel biofouling, in addition to outlining measures for the control and management of vessel biofouling in accordance with the IMO Guidelines for the Control and Management of Ship' Biofouling to Minimize the Transfer of Invasive Aquatic Species (2012 Edition). The biofouling management plan will be written by an independent IMS expert. |
| Identify the likelihood | | | |
| The MODU (that may be mobilised from international waters) and domestic vessels are not considered to provide a likely source for the introduction and establishment of IMS. This is due to a number of factors including the lack of man-made infrastructure e.g. jetties/wharves in the deep waters of WA-50-L where the activity will occur, and the controls and procedures in place to manage ballast water exchange and biofouling risks. As such, there is a low potential for biofouling to occur and act as a potential inoculum for the establishment and subsequent spread of IMS. Adherence to the Australian ballast water management requirements including the use of an approved ballast water management method also reduces the potential for the spread of IMS (Highly Unlikely 5). | | | |

| | | |
|---|---|---|
| During drilling, support vessels will use Broome Port as the main supply base. The presence of jetties and wharves in the port, providing substrate for IMS, mean that the port could act as a source of IMS inoculum. However, resupply is typically undertaken within a relatively short timeframe (approximately 48 hours) therefore the potential for vessels to become colonised by biofouling communities is reduced. Guidance from DPIRD (Vessel Check Biofouling Risk Assessment Tool) acknowledges that the attachment of biofouling may occur in as short a time frame as 24 hours; however, as a 'rule of thumb', 7 days is considered to provide a pragmatic balance between logistical factors versus the risk of a vessel being contaminated with an IMS. With the described controls in place, the potential spread of IMS via support vessels during the activity is considered to be Highly Unlikely (5).<br>Overall, the likelihood of introducing IMS is considered to be Highly Unlikely (5) due to the remote location of the drilling activity (>12 nm from the nearest coastal waters), and the inability of IMS to establish based on water depths within the licence area (approximately 250 m). | | |
| Residual risk summary | | |
| Based on a consequence of Moderate (D) and a worst-case likelihood of Highly Unlikely (5) the residual risk is Moderate (8). | | |
| Consequence | Likelihood | Residual risk |
| Moderate (D) | Highly Unlikely (5) | Moderate (8) |
| Assess residual risk acceptability | | |
| Legislative requirements<br>MODU/vessel ballast water will be managed in accordance with the intent of the *Australian Ballast Water Requirements Version 7* (DAWR 2017) and the *Biosecurity Act 2015.* Biofouling will be managed through MODU/vessel and equipment risk assessments and mitigation measures, in accordance with the *National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry* (Marine Pest Sectoral Committee 2018).<br>Stakeholder consultation<br>The DA advised INPEX during the stakeholder engagement process that where domestic conveyances become exposed through interactions with persons, goods or conveyances outside of Australian Territorial Sea, they automatically become subject to biosecurity control upon their return. INPEX provided DA with a copy of INPEX's Domestic Biofouling risk assessment process and the controls developed above are considered to address the concerns of the DA.<br>Conservation management plans / threat abatement plans<br>Several conservation management plans have been consulted in the development of this EP (refer Appendix B). IMS have been identified as a threat in many conservation management plans, with actions focusing on the prevention of their introduction. The control measures described are consistent with the actions described in the conservation management documentation.<br>ALARP summary | | |

The level of environmental risk is assessed as Moderate, therefore a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "moderate", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| Prevent introduction and establishment of IMS as a result of the petroleum activity (including through ballast water and biofouling from MODU/vessels). | Support vessels (of appropriate class) will have an antifouling coating applied in accordance with the prescriptions of the International Convention on the Control of Harmful Anti-fouling Systems on Ships (2001) and the *Protection of the Sea (Harmful Antifouling Systems) Act 2006* (Cwlth). | Support vessels (of appropriate class) have a current International Anti-fouling Systems certificate or a Declaration on Anti-fouling Systems. | INPEX Environmental Adviser |
| | A biofouling risk assessment will be completed by an independent IMS expert for the MODU and all support vessels, including immersible equipment, prior to mobilisation from international waters. Where required, mitigation measures commensurate to the risk will be implemented to ensure the vessel mobilisation poses a low risk of introducing IMS. | MODU/vessel-specific biofouling risk assessment and any records of mitigation measures implemented confirming the MODU/vessel presents a low risk. | INPEX Environmental Adviser |
| | A biofouling risk assessment will be completed for the MODU and all support vessels, including immersible equipment, prior to mobilisation from any Australian | MODU/vessel-specific biofouling risk assessment and any records of mitigation measures implemented | INPEX Environmental Adviser |

| | | | |
|---|---|---|---|
| | port. Where required, mitigation measures commensurate to the risk will be implemented to ensure the MODU/vessel mobilisation poses a low risk of introducing IMS. | confirming the MODU/vessel presents a low risk. | |
| | MODU/ vessels operating within Australian seas will manage ballast water discharge using one of the following approved methods of management including (DAWR 2017):<br>• an approved ballast water management system or<br>• exchange of ballast water exchange conducted in an acceptable area or<br>• use of low risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place) or<br>• retention of high-risk ballast water on board the vessel or<br>• discharge to an approved ballast water reception facility or<br>• use of low risk ballast water (e.g. fresh potable water, water taken up on the high seas, water taken up and discharged within the same place). | MODU/vessels premobilisation HSE inspection documentation and annual verification reports confirm through ballast water records that an approved ballast water management option has been used.<br><br>Documentation of Department of Agriculture release from biosecurity control or low risk status. | INPEX Environmental Adviser |
| | MODU and all support vessels will have:<br>• an approved ballast water management plan, unless an exemption applies or is obtained<br>• a valid ballast water management certificate, unless an exemption applies or is obtained. | • Ballast water management plan or record of exemption (if not automatic exemption)<br>• Valid ballast water management certificate or record of exemption (if not an automatic exemption). | INPEX Environmental Adviser |
| | MODU and all support vessels will have a biofouling management plan prepared by an independent IMS expert to include elements of performance described in the IMO Guidelines for the Control and Management of Ship Biofouling to Minimize | • Biofouling record book | INPEX Environmental Adviser |

| | | | |
|---|---|---|---|
| | the Transfer of Invasive Aquatic Species (2012 Edition). | | |

### 7.5.2 Interaction with marine fauna

**Table 7-15: Impact and risk evaluation – Physical presence of vessels and interaction with marine fauna (vessel strike)**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">The physical presence and use of vessels in the licence area has the potential to result in collision (vessel strike) with marine fauna.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by vessel strike are:<br>• transient, EPBC-listed species.<br><br>Vessels supporting the drilling campaign (including LWI vessels) in WA-50-L have the potential to interact with transient, EPBC-listed species; specifically, marine mammals, whale sharks and turtles. This may result in injury or death of marine fauna from a vessel strike. Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat overlap (Dolman & Williams Grey 2006). Vessel speed has been demonstrated as a key factor in collisions with marine fauna such as cetaceans and turtles, and it is reported that there is a higher likelihood of injury or mortality from vessel strikes on marine mammals when vessel speeds are greater than 14 knots (Laist et al. 2001; Vanderlaan & Taggart 2007). The potential for vessel strike applies to all marine mammals, whale sharks and turtle species; however, humpback whales are considered to have a higher potential likelihood due to their extended surface time. However, the potential for collision during the drilling campaign is reduced as the licence area is located hundreds of kilometres offshore, away from critical habitats such as humpback BIA areas (migration and calving) as shown in Figure 4-4 (located approximately 120 km south-east from WA-50-L at its closest point). The reaction of whales to approaching ships is reported to be quite variable. Dolman and Williams Grey (2006) indicate that some cetacean species, such as humpback whales, can detect and change course to avoid a vessel. Humpback whales are subject to a DEE Conservation Advice (Appendix B) which requires the assessment of vessel strike on humpback whales and encourages the implementation of mitigation measures and vessel strike incident reporting to the National Ship Strike Database. As such, control measures are included below, to align with the DEE Conservation Advice and address vessel strike on humpback whales. Another marine mammal with a BIA in the region (approximately 60 km to the west of WA-50-L (Figure 4-4)) is the blue whale, which is also subject to a DEE Conservation Management Plan (Appendix B). The Conservation Management Plan identifies that, since 2006, there have been two records of likely ship strikes of blue whales in Australia. In 2009 and 2010, there were blue whale strandings in Victoria, near the Bonney Upwelling with suspected ship strike injuries visible. Where blue whales are feeding at or near the surface, they are more susceptible to vessel strike. However, the open ocean environment allows for whales to invoke avoidance behaviour in threatening situations. The Blue Whale Conservation Management Plan highlights that minimising vessel collision is one of the top four priorities and requires assessment of vessel strike on blue whales, assures that incidents are reported in the National Ship Strike Database, and that control measures proposed will align with these priorities.</td><td>Minor (E)</td></tr>
</table>

| | |
|---|---|
| Whale sharks do not breach the surface as cetaceans do; however, they are known to swim near to the water surface; hence, are susceptible to vessel strike. The foraging area for whale sharks (BIA) is located approximately 15 km south-east of WA-50-L and whale sharks are also subject to a DEE Conservation Advice (Appendix B), which notes that the threat to the recovery of the species includes strikes from vessels.<br><br>Turtles transiting the region are also at risk from vessel strike when they periodically return to the surface to breathe and rest. Only a small portion (3–6%) of their time is spent at the surface, with routine dive times lasting anywhere between 15 and 20 minutes nearly every hour. The presence of vessels has the potential to alter the behaviour of individual turtles. Some turtles have been shown to be visually attracted to vessels, while others show strong avoidance behaviour (Milton et al. 2003). Within the EMBA, marine turtle BIAs are known to occur (Figure 4-6). Following publication of the Recovery Plan for Marine Turtles in Australia, in 2017, habitats critical for the survival of the genetically distinct, 'Scott Reef – Browse Island' green turtle population has been identified. The closest identified habitat to WA-50-L, relates to an internesting area consisting of a 20 km buffer around Browse Island between November and March each year. The BIA does not overlap the licence area which is located approximately 33 km from Browse Island. During the internesting periods studies have shown that green turtles tend to stay relatively close to their nesting beach, approximately 7 km as reported by Pendoley (2005) and generally within 10 km (Waayers et al. 2011). Therefore, any impacts are expected to be localised and of minor consequence at the population level for these mobile and broad-ranging species.<br><br>Given the expansive open ocean environment of the licence area, the potential for the displacement of cetaceans by operational activities is considered to be low. Additionally, there are no recognised feeding or breeding grounds for cetaceans or turtles within WA-50-L. While there is potential for a small number of individual marine fauna to be impacted by vessels associated with the activity, any potential vessel strike to marine fauna is likely to be limited to isolated incidents. As reported by the DEE (2017a), although the outcome can be fatal for individual turtles, vessel strike (as a standalone threat) has not been shown to cause stock level declines. In the event of the death of an individual whale or turtle, it would not be expected to have a significant effect at the population level (Minor E).<br><br>With reference to the Recovery Plan for Marine Turtles in Australia (DEE 2017a) based on the long-life span and highly dispersed life history requirements of marine turtles it is acknowledged that they may be subject to multiple threats acting simultaneously across their entire life cycle, such as increases in background light and noise levels. In considering cumulative impacts of threats on small or vulnerable stocks of marine turtles, it is likely that vessel strike may act as contributor to a stock level decline. | |

| | | | |
|---|---|---|---|
| Identify existing design and safeguards/controls measures | | | |
| Implementation of EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05). | | | |
| Propose additional safeguards/control measures (ALARP Evaluation) | | | |
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | Eliminate the use of vessels | No | Vessels are the only form of transport that can undertake the required level of supply and support to the MODU, that is practicable and cost efficient. |

| | | | |
|---|---|---|---|
| | | | In the absence of any critical habitats in WA-50-L, altering the timing of the activity is not deemed warranted. |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |
| Procedures & administration | Vessel speed restrictions or separation distances maintained for turtles | No | It is reported that turtles generally stay close to their nesting beaches during the internesting period, so only individuals would be likely to be present in the licence area given the distance from Browse Island (33 km). Additionally, turtles reportedly spend a small portion (3–6%) of their time at the surface, this makes turtle observations by crew from the bridge of a vessel very difficult given that turtles are considerable smaller whales or whale sharks. On this basis, reducing vessel speeds and maintaining separation distances is not considered to be an effective control and will not be implemented. |
| | Vessel speed restrictions or separation distances maintained for whale sharks | Yes | As whale sharks swim near the sea surface, vessel strike is a possibility, given the closest BIA is located 30 km east of the licence area. In the absence of any current guidance for petroleum/commercial vessels, controls for vessels tour operators in Ningaloo (i.e. Whale Shark Wildlife Management Program No. 57) have been considered. Therefore, to be conservative, INPEX will adopt separation distances and vessel speed restrictions for whale sharks. |
| | Implementation of environmental awareness program for site personnel. | Yes | Before work commences, site personnel will be informed through an environmental awareness program of the need to avoid harm to marine fauna. |

| Identify the likelihood |
|---|
| Records from 2011 (most recently available data) showed that between six and nine vessel strikes with cetaceans, including non-fatal cases, had been reported in Australian waters in the previous three years, with only a minority occurring in WA (IWC 2011). This suggests that, despite the growing presence of oil & gas activities on the NWS/Timor Sea, and the steady increase (approximately 10% per year) in humpback whale numbers, whale populations have not been affected by collisions with oil & gas vessels.<br><br>An internesting BIA for green turtles at Browse island (20 km buffer, DEE 2017a) has identified habitat critical for survival between November and March each year, however internesting turtles are likely to stay within 10 km of their nesting beach. Nevertheless, support vessel routes will not encroach on the 20 km buffer unless in adverse sea conditions, as they shall remain beyond the 12 nm territorial sea limit (12 nm equates to approximately 22 km). During weather events i.e. sheltering during cyclone events, support vessel may seek shelter in lee of Browse Island for safety reasons. The duration of such activities is expected to be limited to 12-48 hours and therefore the likelihood of interactions with marine turtles is further reduced. |

| | | | |
|---|---|---|---|
| The controls described above are commensurate with the level of risk and given the slow vessel speeds, the absence of any known BIAs or critical habitats in WA-50-L the likelihood of a vessel strike causing injury or death to a transient, EPBC-listed species is considered to be Highly Unlikely (5). | | | |
| Residual risk summary | | | |
| Based on a consequence of Minor (E) and a likelihood of Highly Unlikely (5) the residual risk is Low (9). | | | |
| Consequence | Likelihood | Residual risk | |
| Minor (E) | Highly Unlikely (5) | Low (9) | |
| Assess residual risk acceptability | | | |
| Legislative requirements<br>EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.05) will be implemented with regards to vessel speeds and separation distances.<br>Stakeholder consultation<br>No stakeholder concerns have been raised regarding potential impacts and risks from the physical presence of the MODU and support vessels and potential for vessel strike associated with the petroleum activity.<br>Conservation management plans / threat abatement plans<br>Several conservation management plans have been consulted in the development of this EP (Appendix B). Actions identified in the Blue Whale Conservation Management Plan and DEE conservation advice documents for humpback whales and whale sharks regarding vessel strike incident reporting will be implemented.<br>ALARP summary<br>Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.<br>Acceptability summary<br>Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:<br>• the activity demonstrates compliance with legislative requirements/industry standards<br>• the activity takes into account stakeholder feedback<br>• the activity is managed in a manner that is consistent with the intent of conservation management documents<br>• the activity does not compromise the relevant principles of ESD<br>• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as “low”, the consequence does not exceed “C – significant” and the risk has been reduced to ALARP. | | | |
| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |

| | | | |
|---|---|---|---|
| Zero incidents of injury/mortality of cetaceans and turtles from vessel collision for the duration of the drilling activity. | EPBC Regulations 2000 – Part 8 Division 1 Interacting with cetaceans, within the 500m exclusion zone including:<br>• Supply vessels will not travel greater than 6 knots within 300 m of a cetacean (caution zone)<br>• Supply vessels will not approach closer than 50 m to a dolphin and/or 100 m of a whale (with the exception of bow riding). | Records of any breaches of vessel/cetacean interaction requirements outlined in the EBPC Regulations 2000 reported. | INPEX Drilling Supervisor |
| | Support vessels will not travel faster than 8 knots within 250 m of a whale shark and not approach closer than 30 m from ahead of a whale shark's direction of travel. | Records of any breaches. | INPEX Drilling Supervisor |
| | Awareness materials for site personnel for avoiding harm to marine fauna. | Record of provision of awareness materials to site personnel. | INPEX Environmental Adviser |

## 7.6 Seabed disturbance

**Table 7-16: Impact and risk evaluation – Seabed disturbance from anchoring, moorings and IMR equipment**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">As described in sections 3.2 and 3.3, a moored MODU will be secured to the seabed through a series of anchors and anchor chains. No vessels will anchor during the activity. For a typical moored semi-submersible MODU, given the expected anchor and anchor chain dimensions (Section 3.3.1) approximately 1,000 $m^2$ (0.001 $km^2$) of benthic habitat in the licence area may be disturbed for each well.<br><br>During the drilling campaign, vessels may also use temporary moorings which may be installed in the vicinity of the Ichthys Field to reduce marine diesel consumption while vessels are on stand-by. Temporary moorings would likely consist of a single clump weight or drag embedment anchor, a length of chain and cable to a buoy, which would be retrieved at the end of the drilling campaign. The expected area of physical disturbance to the seabed associated with a temporary mooring is approximately 15-30 $m^2$.<br><br>The use of the rig acoustic positioning system/LBL arrays (2 – 3 $m^2$), IMR related equipment e.g. leak detection systems (4 – 5 $m^2$) and cathodic protection systems (2 -3 $m^2$), and ROV tooling baskets (2 -3 $m^2$) may be temporarily positioned on the seabed during the drilling campaign. These items will be retrieved at the end of the campaign/IMR activity.<br><br>The physical footprint of the drilling campaign will be limited to the well locations, MODU mooring system and temporary moorings. Anchoring, the use of temporary moorings and the temporary placement of LBL arrays/IMR and ROV equipment on the seabed has the potential to physically disturb the seabed in WA-50-L. A disturbance to benthic communities has the potential to result in reduced ecosystem productivity or diversity.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by seabed disturbance are:<br>• benthic communities<br>• fish (demersal fish community and commercial species).<br><br>Physical disturbance of the seabed may cause temporary disturbance to benthic habitats and loss of associated infauna and epifauna. As described in Section 4.7.3, seabed habitat surveys have been undertaken in the Ichthys Field, Echuca and Heywood Shoals located approximately 79 km and 96 km from WA-50-L respectively. The results of the surveys observed that seabed topography was relatively flat and featureless (INPEX 2010) with no obstructions or features on the seafloor, such as boulders, reef pinnacles or outcropping hard layers (Fugro Survey Pty Ltd. 2005; RPS 2007). The observed habitat generally supported a diverse infauna dominated by polychaetes and crustaceans typical of the broader region and this was reflected in survey results which indicated that the epibenthic fauna was diverse but sparsely distributed (RPS 2008).</td><td>Insignificant (F)</td></tr>
</table>

| | |
|---|---|
| Benthic habitats within WA-50-L comprise of soft substrate, typical of deep continental shelf seabed habitats which are widely distributed in deeper parts of the Browse Basin (RPS 2007), and commonly found throughout the NWMR (Baker et al. 2008). Survey data also confirmed the seabed in WA-50-L has heavily rippled sediments suggestive of strong near seabed currents and a lack of seabed features. In general, deep-sea infaunal assemblages are poorly studied on the NSW but are likely to be widely distributed in the region including WA-50-L (INPEX 2010).<br><br>The total disturbance footprint from the drilling campaign is expected to be approximately 0.015 $km^2$, which in the context of WA-50-L, covering an area of approximately 570 $km^2$, represents the disturbance of 0.0085% of the production licence area. The activity may result in the mortality of sessile fauna within this footprint and potentially the mortality of benthic infauna associated with the habitat; however, it is considered that potentially impacted benthic habitats and associated biota are well represented in the region. Therefore, any temporary disturbance and losses will represent a very small fraction of the widespread available habitat. Following removal of the MODU anchors, temporary moorings and completion of the drilling campaign, the soft sediments will be left disturbed; however, upon retrieval of the anchors/moorings, benthic habitats would remain viable and are expected to recolonise through the recruitment of new colonists from planktonic larvae and adjacent undisturbed areas.<br><br>Displacement of sediments during anchor and mooring deployment/retrieval may result in temporary, localised plumes of suspended sediment and subsequent deposition of sediment resulting in smothering of marine benthic habitat and benthic communities in the immediate vicinity. Parts of the ancient coastline KEF, particularly where it exists as a rocky escarpment, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments (DSEWPaC 2012a). It is considered that the hard substrate of the escarpment is likely to support a range of sponges, corals, crinoids, molluscs, echinoderms and other benthic invertebrates (DSEWPaC 2012a). The ancient coastline KEF is located, approximately 20 km south of WA-50-L at its closest point. Therefore, benthic communities associated with the KEF are not expected to be impacted as any silt plumes generated would have dissipated over this distance in the presence of near-seabed currents and it is not expected that sedimentation/smothering impacts would occur to benthic communities. This is also expected to be the case for Echuca and Heywood Shoals located 79 km and 96 km away respectively.<br><br>The potential consequence on benthic communities is a localised impact from physical disturbance within the footprint of the anchors/chains which is expected to be limited given the predicted sparse cover of benthic communities and expected recovery through recolonization. Therefore, it is assessed to be of inconsequential ecological significance (Insignificant F).<br><br>The demersal fish community KEF overlaps the licence area and a limited number of commercially significant fish stocks, considered as key indicator species, may be present in the waters of WA-50-L (Table 4-6). Although they may be present, given the deep waters and absence of suitable habitats, WA-50-L is not considered to offer spawning or aggregation habitat (Section 4.9.34.9.3). Disturbance to seabed habitats from the drilling campaign is therefore not expected to affect fish spawning habitats (Insignificant F). | |
| Identify existing design and safeguards/controls measures | |
| None identified | |

| Propose additional safeguards/control measures (ALARP Evaluation) | | | |
|---|---|---|---|
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | No anchoring by MODU | No | Use of a jack-up rig is not possible given the 250 m water depth in the licence area. A DP MODU may be used or alternatively, a moored semi-submersible MODU will be used and therefore this has been assessed in this EP. |
| | No anchoring by vessels | Yes | Support vessels will not anchor in the licence area but will use DP to maintain position. Vessels may also use temporary moorings to save fuel while on standby. LWI vessels will maintain position through the use of DP systems and will not anchor in WA-50-L unless in the case of an emergency. |
| Substitution | None identified | N/A | N/A |
| Engineering | None identified | N/A | N/A |
| Procedures & administration | Rig move and positioning plan | Yes | Anchor installation and retrieval operations will be managed by implementation of the plan, based on the approved mooring design, to ensure that the mooring lines are installed as per design and the MODU remains on station and within the boundaries of WA-50-L. |

| Identify the likelihood |
|---|
| Given the controls in place, the likelihood of impacting benthic communities located at the anchor/chain and temporary mooring locations in WA-50-L, is considered to be Possible (3). Any temporary impacts are considered to be ecologically insignificant to the wider diversity and productivity of benthic communities in the region, including the ancient coastline KEF, based on the relatively small area potentially impacted i.e. total disturbance footprint relative to the widespread available habitat and expected recovery. |
| Residual risk summary |
| Based on a consequence of Insignificant (F) and a likelihood of Possible (3) the residual risk is Low (8). |

| Consequence | Likelihood | Residual risk |
|---|---|---|

| | | |
|---|---|---|
| Insignificant (F) | Possible (3) | Low (8) |
| Assess residual risk acceptability | | |

Legislative requirements

There are no specific environmental guidelines/legislation regarding the environmental management of anchoring/moorings with respect to impacts on benthic communities. The rig moves and positioning plans will be developed in accordance with industry guidelines and standards namely the Mooring Code API RP 2SK and the APPEA MODU Mooring in Australian Tropical Waters Guidelines.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from seabed disturbance caused by anchoring and moorings associated with the drilling campaign.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (Appendix B). The recovery plan for sawfish and river sharks specifies habitat degradation and modification as a principle threat and details actions to reduce impacts on critical sawfish and river shark habitats. There are no critical habitats for sawfish or river sharks within WA-50-L and therefore no specific actions relating to seabed disturbance from anchoring/mooring activities apply.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| No MODU anchoring to take place in areas which support sensitive primary producer benthic habitat. | INPEX will verify that the contractor prepares and implements a Rig Move and Positioning Plan prior to the MODU arriving in WA-50-L. The plan shall include:<br>Details of the configuration of the anchors necessary to keep the MODU securely on location and provides anchor-mooring analyses and procedures for anchor mobilisation and retrieval activities. This includes:<br>• planning and verification of well and MODU anchoring locations (including for relief wells) so that well and anchors are all located within the boundaries of WA-50-L.<br>• definition of procedures for anchor deployment and recovery.<br>• anchors will be carried to the deployment location and deployed or retrieved directly using AHSV to minimise drag. | Documentation confirming implementation of the Rig Move and Positioning Plan and any issues with anchor deployment, use and recovery that could increase seabed footprint of anchors. | INPEX Drilling Supervisor |
| | Vessels will not anchor in WA-50-L, unless in case of an emergency. | Incident reports | INPEX Drilling Supervisor |

## 7.7 Social and cultural heritage protection

### 7.7.1 Physical presence - disruption to other marine users

**Table 7-17: Impact and risk evaluation – Physical presence of MODU and vessels resulting in disruption to marine users**

<table>
<tr><th colspan="2">Identify hazards and threats</th></tr>
<tr><td colspan="2">The physical presence of the MODU with associated support vessels (including LWI vessel) in WA-50-L has the potential to cause disruption to other marine users, including shipping operators and fisheries through the reduction of space available to conduct shipping and fisheries activities in the licence area. Support vessels do not have an associated 500 m exclusion zone, however the MODU and LWI are required to maintain a PSZ under the OPGGS Act. The PSZ will remain in place for the duration of the drilling activity while the MODU (or LWI vessel) is at each well location in WA-50-L with drilling activities estimated to last for 90-120 days per well (Section 3.1). The potential, albeit temporary, interference with and/or exclusion of other users, within the PSZ may result in a loss of revenue for commercial users including fisheries.</td></tr>
<tr><th>Potential consequence</th><th>Severity</th></tr>
<tr><td>The particular values and sensitivities with the potential to be impacted by physical presence of the MODU/vessels are:<br>• shipping<br>• commercial, traditional and recreational fisheries.<br><br>Other marine users in the vicinity of WA-50-L may be impacted by MODU and vessel presence (including the presence of PSZ exclusion) because of the loss of navigable space available to conduct their activities. The implications of such disruptions include changes to sailing routes and journey times, or reduced ability to fish in an area. The worst-case consequence from a loss of access to an area could result in economic losses and/or potential reduction in employment levels.<br><br>A review of AMSA's vessel traffic data for the Browse Basin in May 2019 confirmed the absence of any major shipping lanes within the licence area (Figure 4-9). A large proportion of the high-density vessel traffic in and around WA-50-L is related to supply vessels supporting the offshore developments (INPEX Ichthys facility and Shell Prelude FLNG facility) that routinely transit between the offshore facilities and the ports of Darwin and Broome on the mainland. Therefore, in some areas of WA-50-L heavy vessel traffic will occur. In addition to vessel traffic, INPEX's Ichthys offshore facility (CPF and FPSO) are permanently moored within WA-50-L, with 500 m exclusion zones in place, also contributing to a loss of navigable space in the licence area.<br><br>Individual vessels may have to slightly alter their sailing routes to avoid the MODU in WA-50-L, potentially leading to longer journey times; however, given the presence of the permanently moored facilities in the licence area that other marine users are aware of, any disruption is expected to cause minor impact and not result in any economic losses. Therefore, the consequence is considered to be insignificant (F).</td><td>Insignificant (F)</td></tr>
</table>

| | |
|---|---|
| Several Commonwealth and State managed fisheries overlap the licence area and the EMBA (Section 4.9.3). In many instances, although the area of the fishery overlaps WA-50-L, no fishing effort actually occurs in the licence area based on the water depth, water temperature and lack of suitable habitat. Of the fisheries overlapping WA-50-L, the North West Slope Trawl Fishery is the only active fishery, however it reportedly fishes at low levels, with only negligible trawl fishing occurring in the Ichthys Field (AFMA 2019d). Based on the low level of identified commercial fishing activity and the relatively small spatial area occupied by the PSZ in comparison to the entire extent of the fishing grounds available to commercial operators, the potential loss of navigable space in which a fishing operator could conduct their activities is considered to be insignificant (F).<br><br>WA-50-P is situated within the MoU box for Indonesian traditional fishing (DSEWPaC 2012) as shown on Figure 4-2. Therefore, Indonesian fishing vessels may be present in the area when transiting between fishing grounds at Scott Reef and Browse Island; however, transit routes are not expected to overlap WA-50-L as Scott Reef and Browse Island are located south of the licence area. Therefore, interference and disruption are not expected, and impacts are expected to be insignificant (F).<br><br>Recreational fishing may also operate off the WA coast during certain times of the year. Generally, there is little recreational fishing that occurs within WA-50-L because of its distance from land, lack of features of interest and deep waters. Therefore, the potential for loss of access to the recreational fishing industry as a result of MODU/vessel physical presence is considered to be of Insignificant consequence (F). | |

| | | | |
|---|---|---|---|
| **Identify existing design and safeguards/controls measures** | | | |
| Stakeholder consultation with relevant stakeholders.<br><br>MODU and vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the *Navigation Act 2012*. | | | |
| **Propose additional safeguards/control measures (ALARP Evaluation)** | | | |
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | Eliminate the use of MODU/vessels | No | The use of MODU/vessels to undertake the activity cannot be eliminated. |
| Substitution | Alter timing to avoid peak fishing periods | No | The area that stakeholders are excluded from is of limited size (500 m radius PSZ) when compared to the area available to other marine users. In conjunction with low fishing activity in the area, as confirmed through stakeholder consultation, altering the timing of the activity is not deemed necessary or considered an effective control. |

| | | | |
|---|---|---|---|
| Engineering | None identified | N/A | N/A |
| Procedures & administration | Australian Hydrographic Office (AHO) will be informed of the proposed MODU location prior to the activity commencing. | Yes | By informing AHO of the location of the MODU, it can update navigation charts, to inform third parties of the location of the infrastructure, reducing the risk of accidental third-party interactions with areas of increased vessel activity around the MODU. |
| | Issue notice to mariners | Yes | By informing AHO start date of the activity, information will be included in the promulgation of fortnightly Notice to Mariners.<br>Notice to Mariners provide commercial shipping operators with information regarding activities or hazards in the region and will include details of the relevant vessels. |
| | Notification to AMSA's Joint Rescue Coordination Centre (JRCC) | Yes | The AMSA JRCC will be advised of the activity details for promulgation of radio-navigation warnings 24-48 hours before operations commence and upon completion of the activity. |

| Identify the likelihood | | |
|---|---|---|
| The MODU and vessels associated with the drilling campaign in WA-50-L will have an insignificant impact by reducing the navigable space available to shipping and fishing operators. The likelihood of loss of access/space in the open ocean resulting in an economic loss or reduction in employment levels is considered to be Highly Unlikely (5). During stakeholder engagement for the EP, shipping operators were not considered as relevant stakeholders to be consulted, as the petroleum activity is outside of any shipping routes/channels. Relevant stakeholders, including fisheries, were consulted throughout the development of this EP. Commercial fisheries will continue to be informed and updated on operational activities being undertaken by INPEX. On this basis, with the controls in place, impacts to economic values from loss of revenue for fisheries due to lack of access to fishing grounds with potential reduction in employment levels is considered Highly Unlikely (5). | | |
| Residual risk summary | | |
| Based on a consequence of Insignificant (F) and a likelihood of Highly Unlikely (5) the residual risk is Low (10). | | |
| Consequence | Likelihood | Residual risk |
| Insignificant (F) | Highly Unlikely (5) | Low (10) |
| Assess residual risk acceptability | | |

Legislative requirements

While the MODU is on location, a safety exclusion zone with a 500 m radius will be maintained around it to control activities and reduce the risk of marine collisions, as required under the OPGGS Act. The OPGGS Act requires that activities do not cause interference to other users more than is reasonably necessary for carrying out rights conferred by the Act. Marine Safety Information (MSI) notifications will be issued for the drilling period via AMSA, while the Australian Hydrographic Office (AHO) will issue a Notice to Mariners. The MODU and vessels will be equipped with navigation equipment as required by the *Navigation Act 2012*.

Stakeholder consultation

No stakeholder concerns have been raised regarding potential impacts and risks from the physical presence of the MODU and PSZ in WA-50-L. During stakeholder consultation AMSA requested that all relevant notifications be adopted as controls in this EP and therefore, these requirements have been adopted.

Conservation management plans / threat abatement plans

Several conservation management plans have been consulted in the development of this EP (Appendix B). None of the recovery plans or conservation advice documents are relevant to the physical presence of vessels disrupting shipping or fishing operators.

ALARP summary

Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

Acceptability summary

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
| --- | --- | --- | --- |

| | | | |
|---|---|---|---|
| Relevant persons (i.e. shipping operators and commercial, traditional, and recreational fisheries) will be identified and any concerns raised will be assessed and those of merit resolved. | Disruption to fishing/shipping and other marine users will be managed by identifying and conducting ongoing stakeholder consultation on an as required basis during the activity. | Stakeholder engagement records demonstrating assessment of stakeholder feedback received and INPEX response (or resolution). | INPEX Environmental Adviser |
| | The Australian Hydrographic Service (AHO) will be notified no less than four working weeks before operations commence for the promulgation of related notices to mariners (via datacentre@hydro.gov.au). | Records of document transmittal to AHO. | INPEX Environmental Adviser |
| | Notification will be provided to AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings 24-48 hours before operations commence, including following information (via rccaus@amsa.gov.au, ph: 1800 641 792 or +61 2 6230 6811):<br>• Vessel details, including name, call sign and Maritime Mobile Service Identity (MMSI)<br>• Satellite communications details, including INMARSAT-C and satellite telephone<br>• Area of operation<br>• Requested clearance from other vessels<br>• Notification of operations start and end. | Records of document transmittal to AMSA JRCC. | INPEX Environmental Adviser |

| | | | |
|---|---|---|---|
| | MODU and vessels will be fitted with lights, signals, AIS transponders and navigation and communications equipment, as required by the *Navigation Act 2012.* | Records confirm that required navigation equipment is fitted to MODU and vessels to ensure compliance with the *Navigation Act 2012.* | INPEX Environmental Adviser |

# 8 EMERGENCY CONDITIONS

An evaluation of potential spill sources identified during the environmental hazard identification (HAZID) workshops determined various potential emergency conditions related to the activity (Table 7-12). The emergency conditions are summarised in Table 8-1.

**Table 8-1: Potential emergency conditions**

| **Scenario** | | **Hydrocarbon type** | **Release location** |
|---|---|---|---|
| Source | Threat | | |
| Support vessels | Collision | Group II – diesel | Surface |
| Rupture/damage to live infrastructure (SPS) | Dropped object | Group I – condensate | Subsea |
| Loss of well containment | Integrity failure | Group I – condensate | Subsea |

## 8.1 EMBA based on oil spill modelling

Hydrocarbon exposure has the potential to result in both acute and chronic impacts to marine flora and fauna, depending on the sensitivity of organisms exposed and the concentration of exposure. A summary of the range of concentrations of different hydrocarbon exposure thresholds adopted to conservatively identify an area with potential environmental impacts is described in Table 8-2. These thresholds include surface, entrained, dissolved and shoreline accumulation thresholds to account for the different partitioning and fate of oils released in different scenarios as outlined in Table 8-1. These thresholds have been used in stochastic modelling to define the EMBA as described in Section 4, for oil spill planning purposes.

**Table 8-2: Hydrocarbon exposure threshold for impact and risk evaluation**

| **Threshold** | **Description** |
|---|---|
| Surface hydrocarbon exposure: 1–10 $g/m^2$. | Certain socioeconomic receptors, such as oil & gas industry and fishing activities may be affected by safety concerns associated with a light surface expression. Therefore, a surface exposure threshold of 1 $g/m^2$ is included, for information purposes. However, it is considered too low for ecological impact assessment purposes. |

| Threshold | Description |
|---|---|
| | The surface oil threshold of 10 g/m$^2$ to assess environmental impacts is based on research by French-McCay (2009) who has reviewed the minimum oil thickness (0.01 mm) required to impact on thermoregulation of marine species, predominantly seabirds and furred mammals. Seabirds are particularly vulnerable to oil spills because their feathers easily become coated and they feed in the upper water column. Other tropical marine megafauna species are unlikely to suffer from comparable physical oil coating because they have smooth skin. Applying the threshold for the scenarios outlined for this EP therefore, represents a conservative measure to define the EMBA. This threshold has been applied to various industry oil spill impact assessments by French-McCay (2002; 2003) and is recommended in the AMSA guidelines (AMSA 2015). |
| Dissolved and entrained hydrocarbon exposure: 100–500 ppb. | Unplanned spills scenarios in this EP include release of various oil types, both at the sea surface and at the seabed (Table 8-1). These different oil types and release sites/depths affect the recommended thresholds for dissolved and entrained hydrocarbons (see a review by French-McCay 2009). Therefore, a range of concentrations, from 100–500 ppb is included to cover all scenarios provided in this EP.<br><br>The biological impact of entrained oil cannot be determined directly using available ecotoxicity; however, it can be derived from tests using either water-soluble fraction (WSF) of oil or oil-in-water dispersions (OWD). OWD are prepared by highly turbulent shaking of oil in water, which are allowed to separate before use, so that the test organisms are exposed to the dissolved fractions, as well as any very fine entrained oil droplets that remain in suspension. However, results are conservative because entrained droplets are less biologically available to organisms through tissue absorption than the dissolved fraction (Tsvetnenko 1998).<br><br>To provide an estimate of the magnitude of toxicity effects from oil exposure to marine biota across a wide taxonomic range, a review was undertaken of global ecotoxicology data for numerous species (115 for fish, 129 for crustaceans, and 34 for other invertebrates) by French-McCay (2002). These were based on both WSF and OWD tests. Under low-turbulence conditions, the total polycyclic aromatic hydrocarbon (PAH) $LC_{50}$ for species of average sensitivity ranges from about 300–1,000 ppb. Under higher turbulence, such as a subsea release, the total PAH $LC_{50}$ decreased to about 64 ppb (French-McCay, 2002). This is close to the 99% species protection threshold of 50 ppb for PAH in the Australian and New Zealand *Guidelines for Fresh and Marine Water Quality* (ANZECC/ARMCANZ 2000). Comparatively, the lowest no observed effect concentration (NOEC) level for unweathered Browse condensate from the north-west region was found to be 20 ppm, based on a fish imbalance and tiger-prawn toxicity test (Woodside 2014). |

| Threshold | Description |
|---|---|
| | To be conservative, a 100 ppb entrained/dissolved threshold is proposed for a subsea release of condensate to account for any ecological impacts in the EMBA. Because it is derived from the WSF and OWD results, it is also proposed for the dissolved hydrocarbon threshold. Although the ANZECC/ARMCANZ water quality guidelines (2000) have the lowest trigger levels for total hydrocarbons in water set at 10 ppb, a relatively long exposure time is required for these concentrations to be significant. The threshold of 100 ppb is considered to indicate the zones where acute exposure could potentially occur over shorter durations, following a spill.<br>For marine diesel, the surface release of the hydrocarbon tends to reduce its potential for solubility, so the toxicity decreases and a threshold up to 1,000 ppb is recommended (French-McCay 2009). To be conservative a 500 ppb entrained/dissolved threshold is proposed for a surface release of marine diesel to account for any ecological impacts in the EMBA. |
| Shoreline accumulation: 100 g/m$^2$ (where threshold for surface or entrained/dissolved hydrocarbon exposure at that shoreline is also exceeded). | A shoreline accumulation threshold of 100 g/m$^2$ is also recommended from the review by French-McCay (2009) based on exposure to birds and smothering of invertebrates in intertidal habitats. |

As described in Section 4, the spatial extent of the EMBA, used as the basis for the EPBC Protected Matters Database search (Appendix B), was determined using stochastic spill modelling. Based on the defined hydrocarbon exposure thresholds, the resulting EMBA is the sum of 300 overlaid modelling runs (100 per season) for three worst-case spill scenarios including a loss of well containment from both Brewster and Plover reservoirs, and a vessel collision scenario, during all seasons (summer, winter and transitional) and under different hydrodynamic conditions (e.g. currents, winds, tides, etc.). This technique has been used to provide a highly conservative representation of the EMBA from all potential loss of containment events to ensure that the EPBC Protected Matters Database search includes all potential receptors. As such, the actual area that may be affected from any single spill event would be considerably smaller than that represented by the EMBA. The stochastic and deterministic modelling outputs for each of the worst-case spill scenarios provide sufficient information to inform spill response planning.

The EMBA within this EP is driven by the outer extent of entrained oil, from an 80 day, 255,475 m$^3$ condensate spill, from a Brewster reservoir loss of well containment. This EMBA was originally modelled in 2013 (APASA 2013) and is considered highly conservative.

RPS (2019a) (previously APASA, who produced the APASA (2013) modelling) have advised of upgrades/improvements to the oil spill modelling software used in oil spill risk assessments. The new software is named SPILLMODEL. SPILLMODEL incorporates all the recent developments related to the Macondo (Deepwater Horizon) spill research and validation efforts in the Gulf of Mexico. The latest SPILLMODEL includes several branched model developments which have been merged. The consequences of the updated model include the following:

- higher rates of entrainment with increasing wind speed compared to the previous model

- higher rates of entrainment at higher viscosities compared to the previous model, however the new model calculates similar rates of physical entrainment for low viscosity oils, such as condensates.
- higher degradation rates for shorter chain components and slower degradation rates for very long-chain hydrocarbons. Given the high proportion of relatively short-chain components in the condensates, the new degradation calculations results in increased rates of degradation of condensates.
- ability to represent the released oil mass by an unlimited number of particles, or 'spillets', allowing for a more accurate representation of the spill (less mass per spillet). The unlimited number of 'spillets' mitigates issues around calculations for dispersion (spread of the 'spillets', representing spread of the oil) and calculations for concentration on a nominal grid size (grid cell averaging). In the previous model, the finite number of 'spillets' was known to produce overly conservative calculations for entrained oil concentrations at the outer extents of trajectories where all other weathering processes except degradation had been completed.

To determine the effects of the new SPILLMODEL on a Brewster reservoir worst-case loss of well containment scenario, a comparison between the worst-case model run from APASA (2013) was re-run with SPILLMODEL and results compared (RPS 2019b).

A single deterministic run (worst case maximum lineal extent of coverage single run) from the APASA 2013 was selected. Oil type and reservoir pressure were slightly updated for the SPILLMODEL simulation, using Brewster condensate assays and reservoir pressure data as this information is now available since production operations have commenced from the reservoir. All other parameters such as release location, spill volume, release depth, water column properties, weather, sea-state, etc. remained consistent between the APASA (2013) and new SPILLMODEL (RPS 2019b) deterministic runs.

The results of this comparison (RPS 2019b) are summarised below;

- both weathering plots show high biodegradation with >80% of the released condensate expected to decay after 90 days
- the higher biodegradation predicted using SPILLMODEL reduced the overall amount of entrained oil in the water column therefore reducing the predicted impact and indicating that the original modelling (APASA 2013) was most likely conservative
- significant reduction in the entrained and dissolved oil concentrations were noted at sensitive receptors using SPILLMODEL, compared to the APASA (2013) results
- the overall size of the predicted risk EMBA for the worst-case replicate was significantly reduced using SPILLMODEL compared to the APASA (2013) results, with the greatest reduction occurring in the extent of the entrained oil.

Therefore, for a Brewster reservoir loss of well containment scenario, APASA (2013) modelling results are considered to provide a highly conservative EMBA.

RPS (2019c) completed stochastic oil spill trajectory modelling for a worst-case 116,856 $m^3$, 108 day Plover reservoir loss of well containment scenario. RPS (2019c) utilised SPILLMODEL, and with the lower release rate compared to a Brewster release rate, the EMBA for this scenario is significantly smaller than the EMBA produced from APASA (2013).

RPS (2019c) also included completed stochastic oil spill trajectory modelling for an instantaneous 250 $m^3$ diesel spill in WA-50-L. The EMBA for this scenario is also smaller than the EMBA produced from APASA 2013.

Therefore, through analysis of RPS (2019b) and (2019c) studies, it has been determined that the APASA (2013) EMBA provides a highly conservative EMBA for oil spill risk and impact assessment for the worst credible oil spill scenarios defined in this EP. APASA (2013) oil shoreline accumulation data has also been re-evaluated, to understand worst-case oil on shoreline at any time during the simulation, instead of worst-case oil ashore 2 weeks after the spill has stopped (RPS 2019d). In addition, RPS (2019c) recorded some higher shoreline accumulations than APASA (2013). As such, higher volumes of oil ashore are reported in Table 8-4 than is presented in the original APASA (2013) report.

A summary of the modelling outputs (used to inform the EMBA) for loss of well containment and vessel collision scenarios are provided in Table 8-4 and Table 8-7 respectively, with the impacts and risks associated with the loss of well containment and vessel collision scenarios presented in Table 8-5 and Table 8-8 respectively.

## 8.2 Loss of containment – well or SPS

A worst-case loss of well containment leading to a Group I hydrocarbon loss (gas and condensate) at a rate of 3,193 $m^3$ per day could occur due to integrity failure resulting from any of the following:

- MODU loss of stability
- failure of primary and secondary well controls
- loss of well integrity.

A worst-case loss of containment from a dropped object impacting the SPS is 140 $m^3$ of Group I hydrocarbon (gas and condensate). As such, the loss of well containment is the worst-credible scenario, with modelling presented for the loss of well containment scenario only.

### 8.2.1 Location

The petroleum activity associated with this EP is limited to the WA-50-L licence area. The production well loss of containment event (modelled release depth of 238 m) was modelled using a location within the licence area, approximately 35 km north-west of Browse Island (APASA 2013).

### 8.2.2 Volume and duration

The volume of Brewster condensate used in the modelling was 255,475 $m^3$, based on an uncontrolled blowout of a production well during development drilling. The duration of the hydrocarbon release was 80 days (based on 80 days to complete a relief well / well-kill operation). The overall duration of the modelled simulations was 94 days, to account for the fate of hydrocarbons after the well has been contained.

A well-kill for a Plover reservoir well blow-out may be longer, up to 108 days in duration, due to deeper reservoir depth and associated deeper relief well drilling requirements. However, because of the Plover reservoir properties, the overall Plover release volume would be approximately 50% of the volume of a Brewster reservoir scenario. Therefore, the Brewster loss of well containment scenario is still considered the worst-case.

### 8.2.3 Hydrocarbon properties

Hydrocarbon properties associated with the Group I Brewster and Plover condensate used for the modelling (APASA 2013) are presented in Table 8-3.

**Table 8-3: Group I condensate properties**

| Hydrocarbon type | Density at 15 ˚C (g/cm$^3$) | Viscosity – centipoise (cP) – at 20 ˚C | Characteristic | Volatile (%) | Semi-volatile (%) | Low volatility (%) | Residual (%) |
|---|---|---|---|---|---|---|---|
| | | | Boiling point (˚C) | <180 | 180–265 | 265–380 | >380 |
| Brewster condensate | 0.764 | 1.200 | % of total | 62.0 | 23.0 | 12.0 | 3.0 |
| Plover condensate | 0.780 | 0.878 | | 59.5 | 16.1 | 18.0 | 6.4 |

### 8.2.4 Modelling results

Modelling results are summarised in Table 8-4 and include results taken for three modelled seasons; summer (October to March), winter (May to August) and transitional (April and September). For each season, 100 modelled replicates were run and therefore the results summarised in Table 8-4, represent 300 possible spill scenarios.

The modelled release predicted that the discharge would generate a cone of rising gas bubbles that would entrain the oil droplets and ambient sea water up to the water surface. Condensate would initially build up in the water column in entrained form, but the level of entrainment would steadily decrease over the duration of the simulation due to losses associated with degradation and evaporation. A low volume of oil is expected at the sea surface over the duration of the release, due to slow surfacing rates. This is because high-pressure releases that involve mixed gas and oil generate relatively small oil droplet sizes that have slow rise rates, due to viscous resistance imparted by the surrounding seawater, and may become trapped by density layers in the water column (APASA 2013).

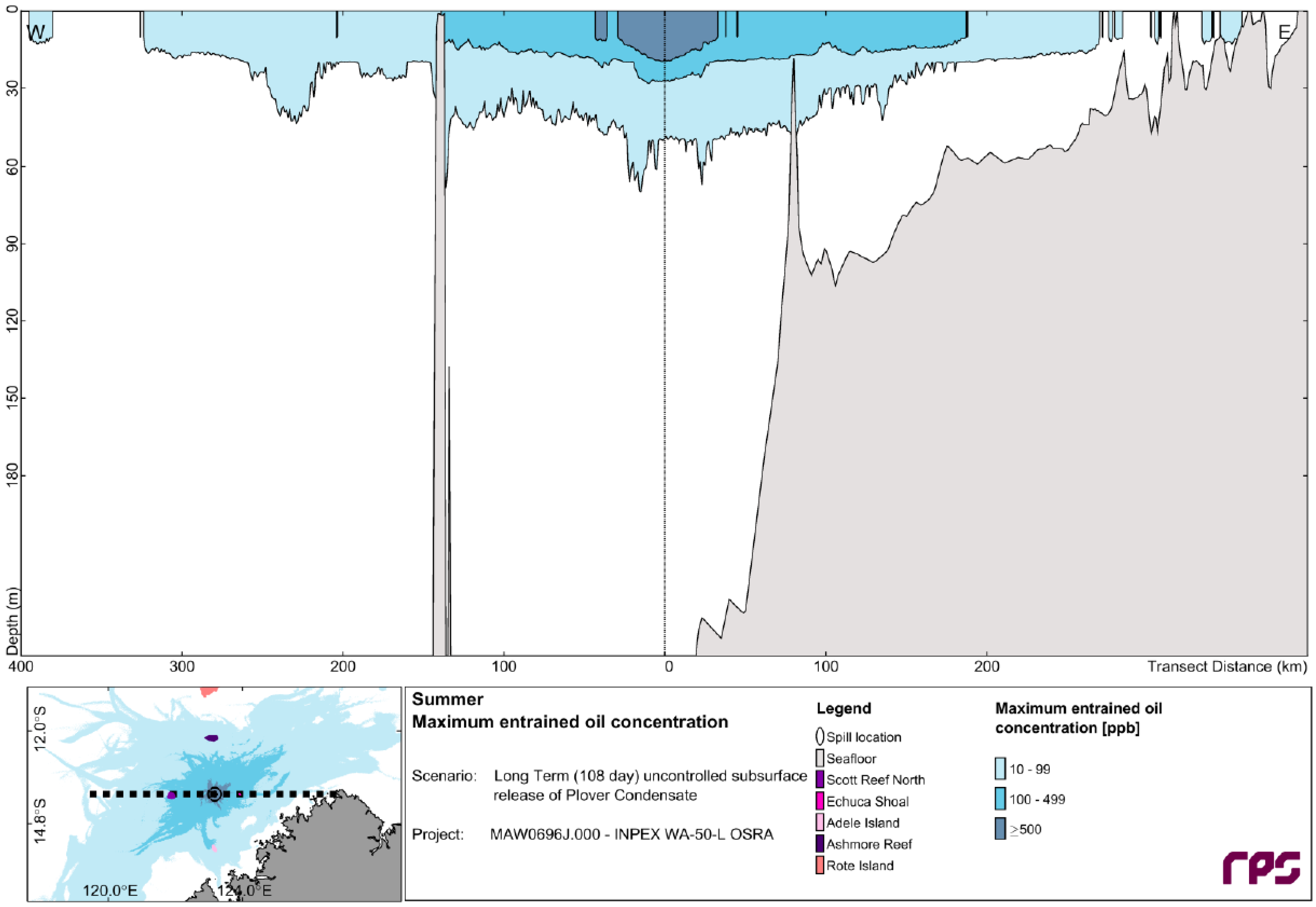
**Table 8-4: Loss of well containment modelling results summary**

| Hydrocarbon exposure | Seabed discharge rate of 3,193 m$^3$ per day (total volume 255,475 m$^3$) of Brewster condensate (APASA 2013) |
|---|---|
| Surface | Floating condensate at concentrations greater than 1 g/m$^2$ is likely to occur over a region of approximately 50 km from the production well site.<br>Surface oil concentrations >10 g/m$^2$ were predicted at <1% probability for all receptors, with no floating oil concentrations >10 g/m$^2$ beyond the immediate spill location. |
| Entrained and dissolved | The maximum received entrained/dissolved concentrations are predicted to be received at Browse Island (summer) 6535 ppb; and Echuca Shoal (winter) 6140 ppb.<br>Browse Island, Echuca Shoal and Heyward Shoal were all predicted to exceed the 100 ppb threshold at probabilities of >66% during summer, >78% during transition months and >90% during winter months.<br><br>Other, more distant locations, such as Ashmore Reef, Cartier Island, Barracouta Shoals, Eugene McDermott Shoal and Vulcan Shoal were predicted to exceed the 100 ppb threshold at probabilities of between 38% and 76% throughout all seasons.<br>All other receptors showed <50% probability of exceeding the 100 ppb threshold for all seasons. |

| **Hydrocarbon exposure** | **Seabed discharge rate of 3,193 $m^3$ per day (total volume 255,475 $m^3$) of Brewster condensate (APASA 2013)** |
|---|---|
| | APASA (2013) did not include any assessment of the depth of entrained/dissolved hydrocarbons in the water column. However, RPS (2019c) modelling has included cross-sections to provide an understanding of the depth of entrained/dissolved concentrations through the water column. Modelling results indicate that entrained oil will not exceed the 100 ppb threshold deeper than 30 m below sea surface and dissolved oil will not exceed the 100 ppb threshold deeper than 100 m below sea surface. Examples of cross-sectional plots are provided in Figure 8-1 and Figure 8-2. It is considered, due to the similarities in hydrocarbon types, that these cross-sections would be applicable for both Brewster and Plover well blow-out scenarios. |
| Shoreline | The only shorelines which were predicted to trigger the shoreline accumulation threshold (100 $g/m^2$) were Browse Island, Cartier Island and Scott Reef (Sandy Islet).<br>The worst-case volume of oil accumulation at any time (RPS 2019c, RPS 2019d), at these locations was:<br>• Adele Island – 18 $m^3$ (summer)<br>• Ashmore Reef – 65 $m^3$ (transition)<br>• Bonaparte Archipelago- 34 $m^3$ (summer)<br>• Browse Island – 109 $m^3$(summer)<br>• Buccaneer Archipelago – 120 $m^3$(summer)<br>• Cartier Island – 15 $m^3$ (winter)<br>• Clerke Reef -7 $m^3$ (summer)<br>• Imperieuse Reef – 21 $m^3$ (summer)<br>• Lalang-garram / Camden Sound MP – 33 $m^3$ (summer)<br>• North Lalang-garram MP – 5 $m^3$ (summer)<br>• Scott Reef – 15 $m^3$ (summer) |

APASA (2013) modelling did not include any deterministic modelling, where a single worst-case spill scenario was presented as a time-series. However, this analysis was included in the Plover modelling (RPS 2019c). The deterministic assessment was made on the worst-case individual run from the stochastic modelling study. The worst-case was based on the run with the greatest number of shoreline receptors with an accumulated volume of oil of >5 $m^3$. This was predicted to occur in the summer season where 7 shoreline receptors were predicted to be contacted.

Figure 8-3 shows a time-series (1-day, 7-days, 5-weeks and 11-weeks following commencement of the spill) of predicted concentrations of surface, entrained/dissolved, and shoreline hydrocarbons during the worst-case run (summer season).



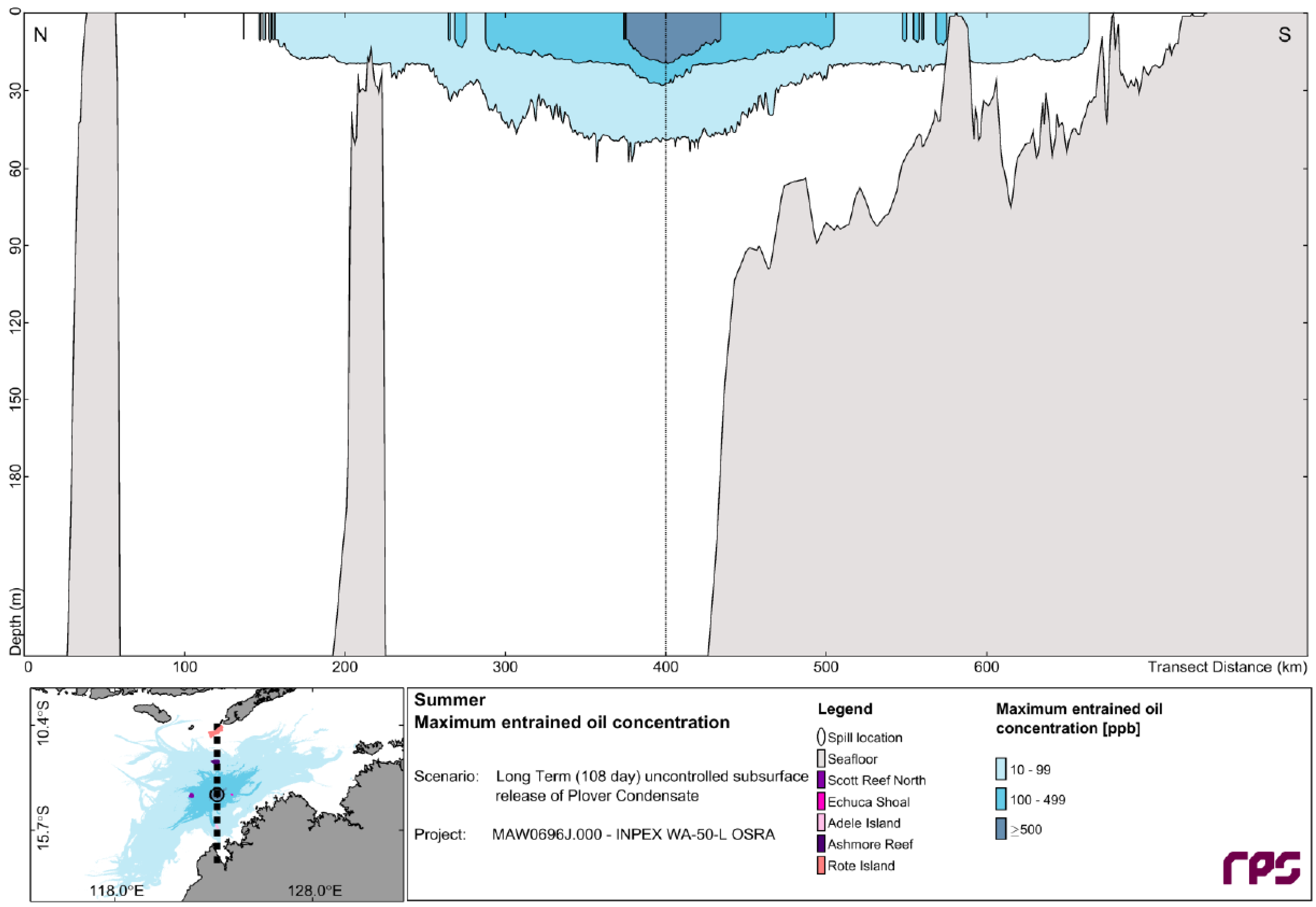




**Figure 8-1: Cross-section transects of predicted maximum entrained oil concentration for 50 replicates (summer) from a subsurface release of Plover condensate. (RPS 2019c)**

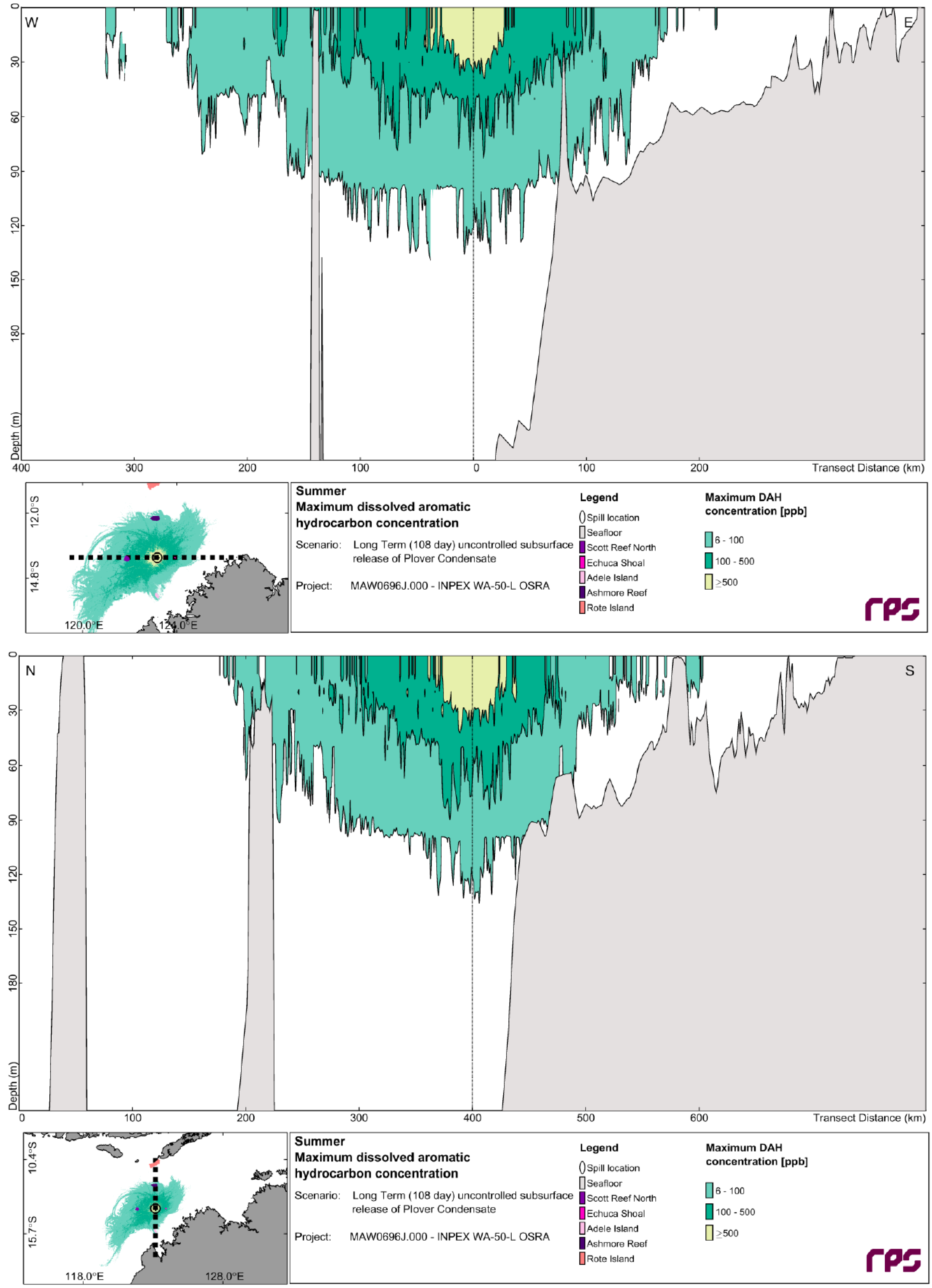



**Figure 8-2: Cross-section transects of predicted maximum dissolved aromatic hydrocarbon concentration for 50 replicates (summer) from a subsurface release of Plover condensate. (RPS 2019c)**

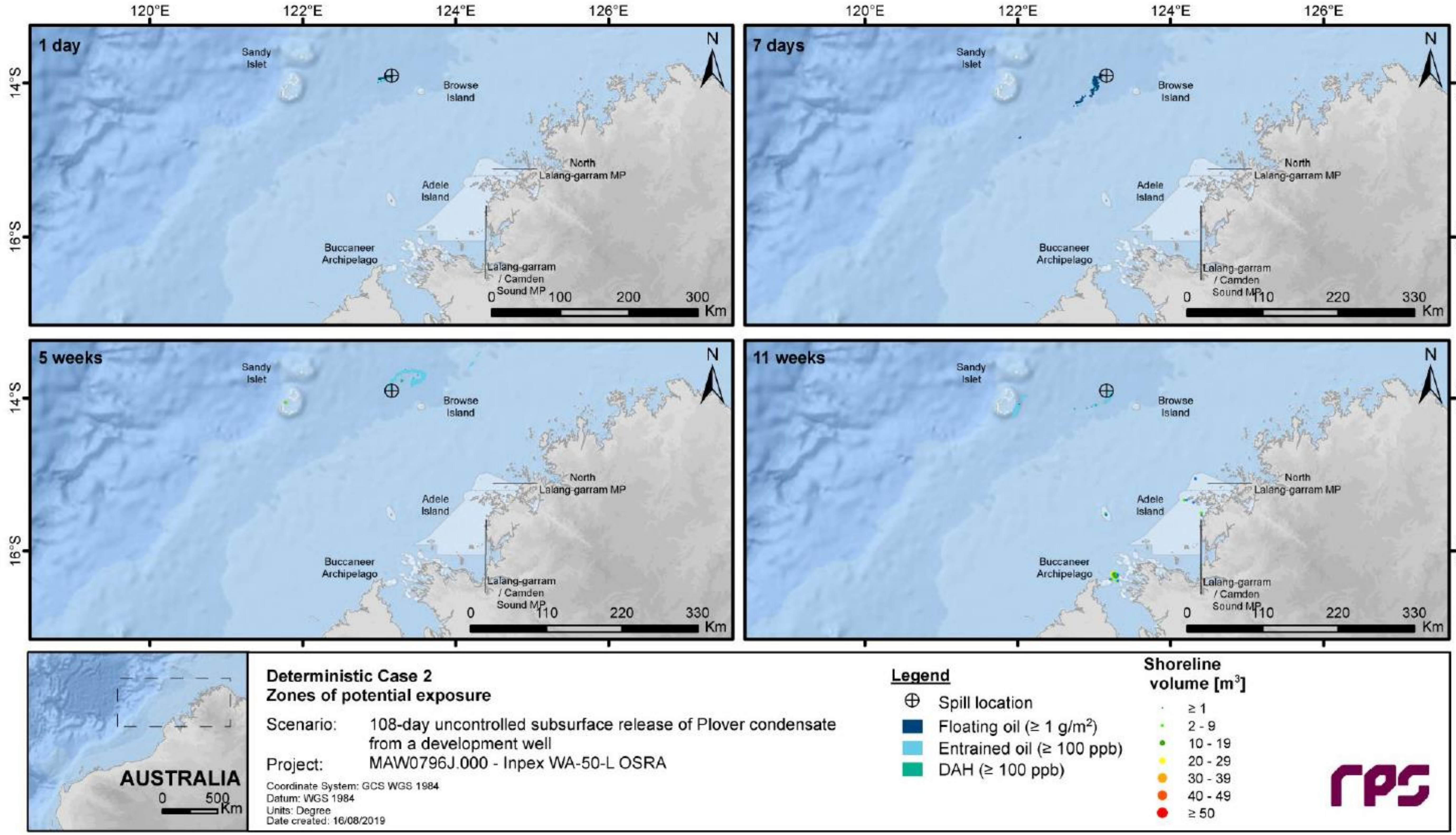



**Figure 8-3: Example of time-series of oil exposure for floating oil (≥ 1 g/m²), entrained oil (≥ 100 ppb), dissolved aromatic hydrocarbons (≥ 100 ppb) and shoreline oil (≥ 100 g/m²) for a Plover well blow-out replicate in summer season (RPS 2019c).**

### 8.2.5 Impact and risk evaluation

**Table 8-5: Impact and evaluation – Loss of containment – well or SPS resulting in a Group I (condensate) spill**

<table>
<tr><td colspan="2">Identify hazards and threats</td></tr>
<tr><td colspan="2">A subsea release of Group I hydrocarbons from the SPS or from a production well, has the potential to result in changes to water quality through surface, entrained/dissolved, and shoreline hydrocarbon exposure. The thresholds for impacts associated with surface, entrained/dissolved, and shoreline hydrocarbon exposures are described in Table 8-2. The outcome of the predictive modelling for the loss of well containment scenario is presented in Table 8-4. The worst credible loss from the SPS is several orders of magnitude smaller than a well blow-out, therefore the well blowout scenario was used for the risk assessment below.</td></tr>
<tr><td>Potential consequence – surface hydrocarbons</td><td>Severity</td></tr>
<tr><td>The particular values and sensitivities with the potential to be exposed to surface hydrocarbons may include:<br>• commercial, recreational and traditional fisheries including aquaculture (within 50 km from the release location based on 1 g/m$^2$ visible sheen threshold)<br>• transient, EPBC-listed species (within immediate vicinity of the release location based on 10 g/m$^2$ impact threshold)<br>• planktonic communities (within immediate vicinity of the release location based on 10 g/m$^2$ impact threshold).<br>The values and sensitivities associated with commercial, traditional and recreational fisheries (seafood quality and employment) could be impacted due to entrained/dissolved/dispersed oil. Exclusion zones may impede access to fishing areas for a short-to-medium term, and nets and lines could become oiled (ITOPF 2011). Generally, there is little recreational fishing that occurs within the licence area because of its distance from land, lack of features of interest and the deep waters. Recreational day-fishing is concentrated around the population centres of Broome, Derby and Wyndham, as well as other readily accessible coastal settlements which are generally at the edge of, or outside of the EMBA, and therefore unlikely to be impacted by this type of spill.<br>Commercial fisheries that transect the EMBA predominantly operate in the shallower waters of the EMBA, with generally low levels of fishing activity reported (refer to Section 4.9.3). Traditional fishing, particularly at Browse Island and along the Kimberley coast at Dambimangari IPA and Uunguu IPA, including on intertidal reef platforms, could be affected by impacts to fish and benthic habitats from entrained oil, discussed below. Based on the expected rapid weathering of condensate at the sea surface by evaporation, photo-oxidation and biodegradation and high potential for entrainment due to wave and wind action, any surface exposure is expected to be limited to a relatively short duration (APASA 2013, RPS 2019c). Therefore, the socioeconomic impacts on commercial, recreational and traditional fishing are expected to be short-to-medium term, and the consequence is considered to be Minor (E).</td><td>Minor (E)</td></tr>
</table>

| | |
|---|---|
| There are no known BIAs or aggregation areas within WA-50-L and no marine fauna BIAs located in areas predicted to be exposed to surface expressions above the 10 g/m$^2$ exposure threshold (within immediate vicinity of the release location). However, a range of marine fauna may still be present within this area albeit on a transient basis. As air-breathers, marine mammals, if they surface, are vulnerable to exposure to hydrocarbon spill impacts through the inhalation of evaporated volatiles. Effects include toxic effects, such as damage to lungs and airways, and eye and skin lesions from exposure to oil (WA DoT 2018a). Vapours from the spill are considered the most significant risk to cetacean health, as their exposure can be significant. Vapours, if inhaled, have the potential to damage the mucous membranes of the airways and the eyes. Inhaled volatile hydrocarbons are transferred rapidly to the bloodstream and may accumulate in tissues, such as in the brain and liver, resulting in neurological disorders and liver damage (Gubbay & Earll 2000). Blue whales and humpback whales (baleen whales), that may filterfeed near the surface, would be more likely to ingest oil than gulp-feeders, or toothed-whales and dolphins. Spilled hydrocarbons may also foul the baleen fibres of baleen whales, thereby impairing food-gathering efficiency, or resulting in the ingestion of hydrocarbons, or prey that has been contaminated with hydrocarbons (Geraci & St. Aubin 1988).<br><br>Browse Island (listed as a C-class reserve) is the closest turtle-nesting area (located approximately 33 km south-east of WA-50-L) and is surrounded by a 20 km internesting buffer for green turtles between November and March (DEE 2017a) as described in Section 4.8.4. Turtles can be exposed to hydrocarbons if they surface within the spill, resulting in direct contact with the skin, eyes, and other membranes, as well as the inhalation of vapours or ingestion (Milton et al. 2003). Floating oil is considered to have more of an effect on reptiles than entrained/dissolved oil because reptiles hold their breath underwater and are unlikely to directly ingest dissolved oil (WA DoT 2018a). Other aspects of turtle behaviour, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large, pre-dive inhalations, make them vulnerable (Milton et al. 2003; WA DoT 2018a). In addition, hatchlings spend more time on the surface than older turtles, thus increasing the potential for contact with oil slicks (Milton et al. 2003).<br><br>As described in Section 4.8.4, WA-50-L is located within the East Asian–Australasian Flyway. The migration of marine avifauna through the EAA Flyway generally occurs at two times of year, northward between March and May and southward between August and November (Bamford et al. 2008; DEE 2017b). There are no BIAs for marine avifauna that overlap WA-50-L. However, the EMBA overlaps a Ramsar site at Ashmore Reef and a nationally important wetland, Mermaid Reef (Section 4.6), and a large number of BIAs for many marine avifauna species are present within the region (Figure 4-8). Marine avifauna have the potential to directly interact with hydrocarbons on the sea surface, in the course of normal foraging activities. Direct contact with surface hydrocarbons may result in dehydration, drowning and starvation and is likely to foul feathers, which may result in hypothermia (Matcott et al. 2019). Birds resting at the sea surface and surface-plunging birds are considered particularly vulnerable to surface hydrocarbons. Impacts may include damage to external tissues, including skin and eyes, and internal tissue irritation in lungs and stomachs (WA DoT 2018a). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (Jenssen 1994; Matcott et al. 2019).<br><br>Based on the predicted limited extent of the surface hydrocarbons (> 10 g/m$^2$ only in the immediate vicinity of the spill), the rapid evaporation of volatile components (during light wind conditions), and rapid entrainment (during increased wind conditions) (RPS 2019e) and expected weathering resulting in reduced levels of toxicity, any impacts to transient EPBC-listed species are expected to be on a local scale, with short-term impacts on a small portion of the population of a protected species (Minor E). | |

| | |
|---|---|
| Plankton may potentially be exposed to hydrocarbons on the sea surface. However, the majority of impacts would be toxicity related, associated with entrained/dissolved hydrocarbons exposure, therefore, the impact evaluation for plankton is provided in the subsection below. | |
| **Potential consequence – entrained/dissolved hydrocarbons** | **Severity** |
| The values and sensitivities with the potential to be affected by entrained and dissolved hydrocarbon exposure from a subsea discharge include:<br>• commercial, traditional and recreational fisheries including aquaculture<br>• KEFs and associated biodiversity (fish communities, BIAs - sawfish & whale shark foraging)<br>• benthic primary producer habitats / benthic habitats (corals, seagrasses and mangroves)<br>• planktonic communities<br>• transient, EPBC-listed species (BIAs - marine mammals, turtles and avifauna).<br>The values and sensitivities associated with commercial, traditional and recreational fisheries (seafood quality and employment) could be impacted due to entrained/dissolved/dispersed oil. The impact to fish communities from exposure to entrained and dissolved hydrocarbons above threshold values, is primarily associated with toxicity. This is linked to seafood quality for commercial, recreational and traditional fishing.<br>Predictive oil spill modelling (RPS 2019c), concluded that entrained/dissolved hydrocarbons will predominantly occur within the top layers of the water column, and no exceedance of entrained/dissolved impact threshold (100 ppb) predicted below 100 m deep (refer Figure 8-1 and Figure 8-2). Therefore, exposure/impacts will predoimantly be limited to only those fish and sharks present in the upper water column within the EMBA (described in Section 4.8.4). Therefore, pelagic fish, and site attached fish on coral reefs, such as Heywood Shoal, Echuca Shoal and Browse Island, have the potential to be exposed to entrained/dissolved hydrocarbons above the 100 ppb threshold. However, there is a far lower likelihood that demersal fish communities (such as the continental slope demersal fish community KEF which intersects WA-50-L) and fish associated with other KEFs or deeper benthic habitats will be exposed above impact thresholds.<br>Chronic impacts to juvenile fish, larvae, and planktonic organisms may occur if exposed to entrained/dissolved hydrocarbon plumes potentially resulting in lethal or sub-lethal effects or impairment of cellular functions (WA DoT 2018a). Juvenile fish and larvae may experience increased toxicity upon such exposure to plumes, because of the sensitivity of these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018a). Adult fish exposed to entrained hydrocarbons are likely to metabolise the hydrocarbons and excrete the derivatives, with studies showing that fish have the ability to metabolise petroleum hydrocarbons. These accumulated hydrocarbons are then released from tissues when fish are returned to hydrocarbon free seawater (Reiersen & Fugelli 1987). | Significant (C) |

| | |
|---|---|
| Given the highly mobile nature of pelagic fish, they are not expected to remain within entrained hydrocarbon plumes for extended periods, and limited acute impacts or risks associated with entrained hydrocarbons are expected. However, within the EMBA there are several sawfish BIAs (along the WA coastline) and a whale shark foraging BIA (approximately 15 km south-east of WA-50-L). Potential effects to whale sharks include damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). As whale sharks are filter-feeders they are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al. 2011).<br><br>Site attached fish, such as reef fish within the EMBA (refer to Section 4.8.2) may be exposed above the hydrocarbon exposure threshold for a more extended duration. Therefore, medium to large scale, medium term impacts could occur to site attached fish and sharks. As such, the consequence of entrained/dissolved hydrocarbons on fisheries, fish and shark populations is considered to be Significant (C).<br><br>Benthic communities, including benthic primary producers, such as coral reefs, seagrass and mangroves, and deeper water filter-feeding communities (down to 100m depth), would be exposed to entrained/dissolved hydrocarbons above impact thresholds. Studies undertaken on benthic communities have found a wide range of variation in their associated toxicity threshold levels (Tsvetnenko 1998; NRC 2005). This is to be expected, as benthic communities are made up of a large variety of different organisms. In some cases, little to no impact is observed on benthic communities. For example, in the case of the Montara oil spill, where impacts were assessed at locations such as Ashmore Reef, Cartier Island, Barracouta Shoal and Vulcan Shoal, there was no observed impact on benthic communities (Heyward et al. 2010a; 2010b; 2011a; 2013). These findings are supported by blow-out modelling (RPS 2019c), which concluded that entrained/dissolved hydrocarbons will predominantly occur within the top layers of the water column, and no exceedance of impact thresholds predicted below 100 m deep (refer Figure 8-1 and Figure 8-2).<br><br>Benthic communities in the EMBA (refer to Section 4.8.2) including coral reefs, would be exposed to entrained/dissolved hydrocarbons above the impact threshold. Shallow-water communities are generally at greater risk of exposure than deep-water communities (NRC 1985; WA DoT 2018a, RPS 2019c). Exposure of entrained and dissolved hydrocarbons to shallow subtidal corals has the potential to result in lethal or sublethal toxic effects, resulting in acute impacts or death at moderate-to-high exposure thresholds (Loya & Rinkevich 1980; Shigenaka 2001; WA DoT 2018a), including increased mucus production, decreased growth rates, changes in feeding behaviours and expulsion of zooxanthellae (Peters et al. 1981; Knap et al. 1985). Adult coral colonies, injured by oil, may also be more susceptible to colonisation and overgrowth by algae or to epidemic diseases (Jackson et al. 1989). Lethal and sublethal effects of entrained and dissolved oils have been reported for coral gametes at much lesser concentrations than predicted for adult colonies (Heyward et al. 1994; Harrison 1999; Epstein, Bak & Rinkevich 2000). Goodbody-Gringley et al. (2013) found that exposure of coral larvae to oil and dispersants negatively impacted coral settlement and survival, thereby affecting reef resilience. A loss of well containment that occurred outside of a coral-spawning period may not affect coral planktonic stages, however, as described in Table 8-4, a range of locations may be exposed to entrained and dissolved oil concentrations greater than the threshold concentrations. Therefore, due to the potentially large physical extent and high concentrations received, potential impacts to coral reefs are considered to be Significant (C). | |

| | |
|---|---|
| Entrained and dissolved hydrocarbons have the potential to affect seagrasses and macroalgae through toxicity impacts. The hydrophobic nature of hydrocarbon molecules allows them to concentrate in membranes of aquatic plants. Hence the thylakoid membrane (an integral component of the photosynthetic apparatus) is susceptible to oil accumulation, potentially resulting in reduced photosynthetic activity (Runcie & Riddle 2006). However, a layer of mucilage present on most species of seagrass prevents the penetration of toxic aromatic fractions (Burns et al. 1993). Although seagrass and macroalgae may be subject to lethal or sublethal toxic effects, including mortality, reduced growth rates, and impacts to seagrass flowering, several studies have indicated rapid recovery rates may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006). For algae, this could be attributed to new growth being produced from near the base of the plant while the distal parts (which would be exposed to the oil contamination) are lost. For seagrasses this may be because 50–80% of their biomass is in their rhizomes, which are buried in sediments, thus less likely to be adversely impacted by hydrocarbons (Zieman et al. 1984). It has been reported by Taylor & Rasheed (2011) that seagrass meadows were not significantly affected by an oil spill when compared to a non-impacted reference seagrass meadow. The majority of seagrass locations within the EMBA (refer to Section 4.8.2) are distant from WA-50-L, therefore the associated received concentrations will be lower; however, still above the threshold that could cause impacts. Based on the above impact assessment and expected recovery, the consequence is considered to be Minor (E).<br><br>Mangrove communities within the EMBA (refer to Section 4.8.3), present along WA and international coastlines are also susceptible to entrained oil exposure, with potential impacts, including defoliation and mortality. A study by Duke (2000), on the use of dispersant on surface spills, resulting in an increase in the entrainment of oil showed a positive benefit to mangroves. Therefore, the impacts of entrained/dissolved oil on mangroves is expected to be less than the impacts predicted from surface oiling (Burns et al. 1993; Duke et al. 2000). Mangrove communities are distant from WA-50-L therefore, the associated received concentrations will be lower; however, still above the threshold that could cause impacts. Based on the above impact assessment, the consequence is considered to be Moderate (D). | |

| | |
|---|---|
| As a consequence of their presence close to the water surface, plankton may be exposed to entrained/dissolved hydrocarbon plumes, especially in high-energy seas where the vertical mixing of oil through the water column would be enhanced. The effects of oil on plankton have been well studied in controlled laboratory and field situations. The different life stages of a species often show widely different tolerances and reactions to oil pollution. Usually, eggs, larval and juvenile stages will be more susceptible than adults (Harrison 1999). Post-spill studies on plankton populations are few, but those that have been conducted typically show either no effects, or temporary minor effects (Kunhold 1978). The lack of observed effects may be accounted for by the fact that many marine species produce very large numbers of eggs, and therefore larvae, to overcome natural losses (such as through predation by other animals; adverse hydrographical and climatic conditions; or failure to find a suitable habitat and adequate food). A possible exception to this would be if a shallow entrained/dissolved hydrocarbon plume were to intercept a mass, synchronous spawning event. Recently spawned gametes and larvae would be particularly vulnerable to oil spill effects, since they are generally positively buoyant and would be exposed to surface spills. Hook & Osborn (2012) reported that typically, phytoplankton are not sensitive to the impacts of oil. Although phytoplankton are not sensitive to oil, they do accumulate it rapidly because of their small size and high surface area to volume ratio and can pass oil onto the animals that consume them (Wolfe et al. 1998a & b). This is also applicable to zooplankton, that are reported to accumulate oil via the ingestion of phytoplankton. However, consumption of zooplankton by fish does not appear to be an efficient means of trophic transfer, perhaps because of the metabolism of oil constituents (Wolfe et al. 2001). Under most circumstances, impacts on plankton from surface spills is expected to be localised, with short-term impacts; however, if a shallow entrained/dissolved plume reached a coral-spawning location, such as Browse Island or Scott Reef, during a spawning event, localised short-to-medium term impacts could occur. Therefore, the consequence is considered to be Moderate (D).<br><br>Marine mammals, marine reptiles and marine avifauna could also be impacted through entrained and dissolved hydrocarbon exposure, primarily through ingestion during foraging activities (WA DoT 2018a). There are no known BIAs or aggregation areas within WA-50-L. However, the EMBA overlaps a large number of BIAs for a number of different marine fauna species (refer to Section 4.8.4). A Ramsar site (Ashmore Reef) and a wetland of conservational significance (Mermaid Reef) are also present within the EMBA (refer to Section 4.6), these sites provide important habitat for marine avifauna. Small proportions of populations of protected species could be imapacted, therefore the consequence is considered to be Moderate (D).<br><br>In summary, the potential extent of entrained/dissolved hydrocarbon with a concentration >100 ppb may result in widespread exposure to the identified values and sensitivities. There would likely also be cumulative impacts as a result of interactions between surface, entrained/dissolved and shoreline hydrocarbon impacts on the food web and through bioaccumulation up the food chain. On this basis, the potential consequence associated with entrained/dissolved plumes from a loss of well containment is considered to be Significant (C). | |
| **Potential consequence – shoreline hydrocarbons** | **Severity** |
| As summarised in Table 8-4, shorelines within the EMBA were predicted to receive shoreline accumulations of hydrocarbons. For those shorelines with concentrations in excess of the 100 g/m$^2$ threshold, the maximum concentration received on the worst-case replicate across all seasons are listed as follows:<br><br>• Adele Island – 796 g/m$^2$ | Moderate (D) |

- Ashmore Reef –2872 g/m$^2$
- Bonaparte Archipelago- 966 g/m$^2$
- Browse Island – 3712 g/m$^2$
- Buccaneer Archipelago –2480 g/m$^2$
- Cartier Island –1221 g/m$^2$
- Clerke Reef -191 g/m$^2$
- Imperieuse Reef –337 g/m$^2$
- Lalang-garram / Camden Sound MP –966 g/m$^2$
- North Lalang-garram MP –151 g/m$^2$
- Scott Reef – 1251 g/m$^2$

The worst-case volumes received ashore and minimum time to contact (>100 g/m$^2$) across all seasons are listed as follows:

- Adele Island – 18 m$^3$ (summer) (302 hrs)
- Ashmore Reef – 65 m$^3$ (transition) (228 hrs)
- Bonaparte Archipelago- 34 m$^3$ (summer) (651 hrs)
- Browse Island – 109 m$^3$ (summer) (137 hrs)
- Buccaneer Archipelago – 120 m$^3$ (summer) (318 hrs)
- Cartier Island – 15 m$^3$ (winter) (263 hrs)
- Clerke Reef -7 m$^3$ (summer) (793 hrs)
- Imperieuse Reef – 21 m$^3$ (summer) (664 hrs)
- Lalang-garram / Camden Sound MP – 33 m$^3$ (summer) (661 hrs)
- North Lalang-garram MP – 5 m$^3$ (summer) (1157 hrs)
- Scott Reef – 15 m$^3$ (summer) (234 hrs)

Modelling results indicated that at all other shoreline locations, shoreline oil accumulation would be <1 m$^3$.

The minimum reported time to contact for all seasons was 137 hours at Browse Island and several weeks for receptors further away. Given these long predicted minimum times to reach shorelines, the spill is expected to have undergone several physical and biological weathering processes, such as evaporation of volatile/toxic components, photo-oxidation and biodegradation (Stout et al. 2016). Impacts to ecological receptors from exposure to weathered oil (waxy flakes and residues) are far less than those associated with exposure to fresh oils, which have higher levels of toxicity (Milton et al. 2003; Hoff & Michel 2014; Woodside 2014; Stout et al. 2016). Therefore, impacts from weathered oil are generally limited to smothering and coating associated with the waxy flakes and residues which generally have low levels of adhesion. Intertidal habitats and marine fauna known to use shorelines are most at risk from shoreline accumulations, due to smothering of intertidal habitats (such as emergent coral reefs) and coating of marine fauna (WA DoT 2018a). Consequently, the particular values and sensitivities with the potential to be exposed to shoreline accumulated hydrocarbons are:

- benthic primary producer habitats/shoreline habitats (intertidal only)
- transient, EPBC-listed species (BIAs - turtles and avifauna).

Benthic primary producer habitats exposed at spring low tides are the most vulnerable to smothering. However, as spills disperse, intertidal communities are expected to recover (Dean et al. 1998). Direct contact of hydrocarbons to emergent corals can cause smothering, resulting in a decline in metabolic rate and may cause varying degrees of tissue decomposition and death. A range of impacts may also result from toxicity, including partial mortality of colonies, reduced growth rates, bleaching, and reduced photosynthesis (Negri & Heyward 2000; Shigenaka 2001). The rate of recovery of coral reefs depends on the level or intensity of the disturbance, with recovery rates ranging from 1 or 2 years, to decades (Fucik et al. 1984, French-McCay 2009).

A Ramsar site (Ashmore Reef) and a wetland of conservational significance (Mermaid Reef) are present within the EMBA (refer to Section 4.6). These coastal sites generally include intertidal mudflats and mangroves that provide important foraging, resting and breeding habitats for migratory and shoreline bird species. As described for entrained and dissolved hydrocarbon exposure, mangrove communities within EMBA could potentially be exposed to shoreline oil accumulation above impact threshold concentrations, with potential impacts including defoliation and mortality (Burns et al. 1993; Duke et al. 2000). The recovery of mangroves from shoreline oil accumulation can be a slow process, due to the long-term persistence of oil trapped in anoxic sediments and subsequent release into the water column (Burns et al. 1993). Given the predicted time to contact locations in the EMBA with mangrove communities is many days, the shoreline accumulations are expected to be highly weathered and comprise of waxy flakes/residues. Lighter oils are reported to penetrate more deeply into mangrove forests than heavier and more weathered oils (Hoff & Michel 2014); therefore, it is considered that the weathered hydrocarbons will generally be less toxic in nature (Stout et al. 2016). Given the predicted times to contact and significant expected weathering of any hydrocarbons accumulating on shorelines, any impacts to benthic habitats are expected to be localised and of short to medium term with a consequence of Moderate (D).

| | |
|---|---|
| Marine reptiles, including turtles and crocodiles that utilise shoreline habitats can be exposed to hydrocarbons externally, through direct contact; or internally, by ingesting oil, consuming prey containing oil, or inhaling volatile compounds (Milton et al. 2003). Shoreline hydrocarbons can impact turtles at nesting beaches when they come ashore, with exposure to skin and cavities, such as eyes, nostrils, and mouths. Eggs may also be exposed during incubation, potentially resulting in increased egg mortality and detrimental effects on hatchlings. Hatchlings may be particularly vulnerable to toxicity and smothering, as they emerge from the nests and make their way over the intertidal area to the water (Milton et al. 2003). There are a number of foraging, nesting and internesting BIAs for turtles within the EMBA that have the potential to be exposed to shoreline accumulations above the impact threshold concentration (100 g/m$^2$). Potential impacts may occur on nesting populations, which may affect species recruitment at a local population level particularly in relation to the green turtles at Browse Island with a small, localised range of habitat (DEE 2017a). Given the shortest predicted time for shoreline contact to occur (14 hours for Browse Island) and worst-case predicted concentration (457 g/m$^2$), there is the potential for local-to-medium-scale impacts with medium-term effects on nesting populations of turtles at individual nesting beaches/locations. At locations with longer times for shoreline contact, there is a high potential for hydrocarbons to become more weathered. Weathered oil has been shown to have little impact on turtle egg survival, while fresh oil may have a significant impact (Milton et al. 2003). Therefore, given the time to reach shoreline contact and potential for weathering, the potential consequence is considered to be Moderate (D).<br><br>Birds coated in hydrocarbons can suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs (Jenssen 1994; Matcott et al. 2019). Toxic effects may also result where the product is ingested, either through birds' attempts to preen their feathers (Jenssen 1994; Matcott et al. 2019) or ingested as weathered waxy flakes/residues present on shorelines. However, waxy residues are generally considered to be of lower toxicity (Stout et al. 2016; Woodside 2014). Shorebirds foraging and feeding in intertidal zones are at potential risk of exposure to shoreline hydrocarbons, potentially causing acute effects to numerous marine avifauna BIAs, and species present at Ramsar/wetland sites as described above. It is also possible that birds exposed to surface hydrocarbons may be displaced (i.e. fly away) and use nearby shorelines to recover, thereby, potentially increasing their exposure to shoreline hydrocarbons. In the event of a shoreline contact following a loss of well containment, there is the potential for short–to-medium-term impacts on the environment while local populations recover; however, it is not expected that the overall population viability for any protected species would be threatened. Therefore, the potential consequence associated with shoreline hydrocarbon exposure is considered to be Moderate (D).<br><br>In summary, the potential extent of shoreline accumulation (> 100 g/m$^2$) may result in exposure to the identified values and sensitivities. There would likely also be cumulative impacts as a result of interactions between surface, entrained/dissolved and shoreline hydrocarbon impacts on the food web and through bioaccumulation up the food chain potentially impacting a small portion of a population of protected species. On this basis, the potential consequence associated with shoreline accumulation from the identified spill events is considered to be Moderate (D). | |
| Identify existing design safeguards/controls | |

| | | | |
|---|---|---|---|
| Conduct drilling in accordance with the OPGGS (Resource Management and Administration) Regulations 2011 and OPGGS (Safety) Regulations 2009.<br>The inspection, maintenance and repair, and response to loss of containment from the SPS is addressed in the NOPSEMA accepted INPEX Ichthys Offshore Facility EP (X060-AH-PLN-00015). | | | |
| Propose additional safeguards/control measures (ALARP evaluation) | | | |
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | None identified. | N/A | N/A |
| Substitution | None identified. | N/A | N/A |
| Engineering | Maintain well integrity throughout the well's lifecycle to avoid the requirement to implement source control. | Yes | Controls to maintain well integrity throughout the well's lifecycle will be in place as documented in the NOPSEMA accepted WOMP. These will include but are not limited to:<br>• adherence to the drilling management system including in particular the well integrity standard, well design standard and well operations standard<br>• well design inputs such as hazardous gases, temperature and pore pressure and how these are used in well design<br>• barrier design, installation and verification<br>• drilling Technical Authorities<br>• well integrity assurance activities<br>• well design assurance activities<br>• drilling fluid type and density selection and calculation of kick tolerance<br>• cementing design, placement and verification<br>• well abandonment design, execution and verification<br>• risk management process including identification, analysis, evaluation, control, monitoring and review<br>• management of change |

| | | | |
|---|---|---|---|
| | | | • use of performance standards in well construction including but not limited to well acceptance criteria<br>• process safety management<br>• the competency assurance process.<br>Through implementation of such preventative controls, the potential for a release of hydrocarbon to the marine environment is reduced. |
| | Implement source control. | Yes | In the event of a loss of well containment a number of source control activities may be implemented. As this would be an unplanned event, the specific circumstances are unknown. Therefore, multiple source control options have been included in this EP in order to reduce potential hydrocarbon spill volumes released in the event of a loss of well containment.<br>The recommended course of action in the case of a loss of well containment will depend upon the level of damage to the wellhead infrastructure, flow potential of the well and required response actions. Blowout rates and pressures will be modelled using actual well geometry and reservoir pressure/temperature/permeability/fluid properties. These modelled blowout rates and pressures determine recommended relief well configurations and well kill hardware requirements. There may be more than one option for regaining control of the blowing well.<br>Source controls activities may include:<br>• site survey<br>• debris clearance<br>• BOP intervention<br>• capping stack<br>• relief well<br>• subsea dispersant injection (SSDI).<br>Source control arrangements and capability are evaluated in Section 8.7. |
| Procedures and administration | Well Control Bridging Document, well integrity standard and well operations standard. | Yes | The drilling Contractor’s Well Control Bridging Document, INPEX Well Integrity Standard and INPEX Well Operations Standard covers all aspects of primary and secondary well control for drilling operations implemented to minimise the potential for a loss of well containment and reduce any impacts to the environment by preventing a spill. |

| | | | |
|---|---|---|---|
| | INPEX Lifting Standard. | Yes | All activities that require critical lifts near the SPS will be undertaken in accordance with the INPEX Lifting Standard to reduce the risk of a dropped object impacting the SPS. Lifts which are determined as 'critical lifts' will be conducted under a 'Permit to Work'. |
| | INPEX SIMOPs Interface Plan | Yes | INPEX SIMOPs interface plan (SIP) is used to risk assess all activities on a case-by-case basis, and determine the appropriate controls and isolations required to reduce the risk of a dropped object impacting the SPS. |
| | Trained and competent personnel. | Yes | Adherence to the INPEX Competency Assurance and Management Standard (0000-AN-STD-60011) to ensure all personnel on the MODU and vessels will be competent to undertake their assigned positions, including, all critical drilling personnel comply with minimum well control training and oil spill response competency requirements. |
| | Incident management, and emergency response plans in place. | Yes | To ensure the INPEX IMT are prepared and informed, an INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and Drilling contractor Emergency Response Plan (ERP) will be in place and implemented, and personnel trained in their relevant plans. |
| | Oil spill and source control response preparedness will be maintained. | Yes | To ensure that INPEX is prepared to respond to loss of containment event, oil spill and source control response preparedness will be maintained in accordance with Sections 8.6, 8.7 and 9.10 of this EP. |
| | INPEX will provide all available support to WA DoT in their performance as control agency for a spill which reaches WA waters resulting from a loss of well containment. | Yes | WA DoT is the control agency for all spills entering WA waters, regardless of the source of the spill. WA DoT has issued the State Hazard Plan-Marine Environmental Emergencies (WA DoT 2018b), which specifies the WA DoT expectations (detailed in Section 2.2.1 of the OPEP). In summary, the WA DoT will require INPEX to work in partnership to ensure an adequate response is provided across the entire incident as reflected in the INPEX IMT organisation chart (refer Figure 9-5). This may include:<br>• WA DoT nominating officers to facilitate aligned communications, shared situational awareness and coordinated response actions with the INPEX IMT<br>• WA DoT establishing an Incident Control Centre in Fremantle and INPEX providing a number of emergency management support personnel to work within the WA DoT IMT (The INPEX IMT would still function and lead the response in Commonwealth waters and liaise with WA DoT IMT). |
| Identify the likelihood | | | |

| | | | |
|---|---|---|---|
| Likelihood | Given the design and mitigation controls that have been identified to minimise the potential for a loss of well containment or loss of containment from the SPS, the likelihood of the consequence occurring is considered Highly Unlikely (5) in that it has happened in industry once or twice. | | |
| Residual risk | Based on the worst-case consequence for all hydrocarbon exposure mechanisms (surface/entrained/dissolved/shoreline) Significant (C) and a likelihood of Highly Unlikely (5) the residual risk is ranked as Moderate (7). | | |
| Residual risk summary | | | |
| Consequence | Likelihood | Residual risk | |
| Significant (C) | Highly Unlikely (5) | Moderate (7) | |
| Assess residual risk acceptability | | | |

**Legislative requirements**

All reasonable means to minimise the likelihood of a loss of well containment/loss of containment from the SPS occurring have been taken during the design and planning process for the wells in WA-50-L. Relevant Australian standards, codes of practice and industry best practice has been adopted to ensure well integrity is maintained. All activities will be undertaken in accordance with the OPGGS (Resource Management and Administration) Regulations 2011 and OPGGS (Safety) Regulations 2009. The preventative and mitigation measures are typical for the proposed activities and are appropriate for the North West Shelf region.

**Stakeholder consultation**

Stakeholders have been engaged throughout the development of the EP. Where relevant, the controls in place have been developed in consultation with relevant stakeholders (e.g. WA DoT, AMSA and AMOSC).

**Conservation management plans / threat abatement plans**

Several conservation management plans (refer Appendix B) identify oil spills as a key threatening process, through both direct and acute impacts of oil, as well as indirect impacts through habitat degradation (which is a potential consequence of an oil spill). The prevention of a loss of well containment and reducing impacts to the marine environment through oil spill response preparedness and response (refer OPEP and Table 8-11) demonstrates alignment with the various conservation management plans.

**ALARP summary**

Given the level of environmental risk is assessed as Moderate, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

**Acceptability summary**

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "moderate", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| No loss of containment from the SPS due to dropped objects | Any lifting of large infrastructure ('critical lifts') in WA-50-L will be managed under a permit to work issued in accordance with the INPEX *Lifting Standard*. | Records of permit to work for all critical lifts conducted in WA-50-L. | Field manager |
| | INPEX SIP risk assessment undertaken and appropriate controls implemented. | Risk assessment records confirm appropriate controls implemented. | INPEX Drilling Superintendent |
| No incidents of loss of hydrocarbons to the marine environment as a result of a loss of well containment | INPEX and MODU contractor will conduct drilling activities in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 and OPGGS (Safety) Regulations 2009 requirements, including:<br>• a NOPSEMA accepted WOMP<br>• a NOPSEMA accepted MODU safety case. | • WOMP approval letter received from NOPSEMA.<br>• NOPSEMA acceptance of MODU safety case. | INPEX Drilling Superintendent |

| | | | |
|---|---|---|---|
| | INPEX will verify that the MODU contractor complies with the requirements of the approved Well Control Bridging Document which aligns requirements (and clarifies if conflicts exist, which standard takes precedence) between the INPEX Well Operations Standard (0000-AD-STD-60004) and Well Operations Manual (0000-AD-MAN-60002) which covers all aspects of primary and secondary well control for floating drilling operations, including:<br><br>Well design/planning<br>• Assessment of formation pressure and fracture gradient along the length of the well.<br>• Shallow gas analysis and assessment has shown no potential for any shallow hazards.<br>• Planned mud weight overbalance to stop ingress potential (i.e. inflow of formation fluids) into the well.<br>• Kick tolerance – adequate design window to tolerate a kick of a certain volume and safe circulation out of the well.<br>• Assessment of well control equipment requirements to ensure they are suitable and specific for well design, including subsea BOP stacks, well choke and kill systems.<br>• Well-bore monitoring equipment – two independent systems for monitoring flow and volume from the well-bore shall be provided (by the drilling contractor and the mud logging contractor).<br><br>BOP system<br>• BOP installed in sections where there is potential for flow from the well. | Well design/planning<br>• Proposed well design, and comparison with drilling contractor's equipment to ensure minimum requirements are met and align with the INPEX Well Operations Manual (0000-AD-MAN-60002).<br><br>BOP system<br>• BOP pressure and function testing prior to installation and at regular intervals for the duration of drilling campaign while installed. The INPEX drilling supervisor or drilling engineer must approve BOP pressure tests and report appropriately.<br>• Inspection and maintenance records show BOP meets INPEX requirements (e.g. shear ram capability, industry standard etc.) and maintained in accordance with MODU preventive maintenance system.<br><br>Mud logging<br>• Documentation that mud logging unit provides kick detection.<br>• Documentation demonstrates all issues identified, addressed or closed out. Summary of compliance with INPEX Well Integrity Standard (0000-AD-STD-60003) summarised in pre-start environmental audit and annual environmental audit report.<br><br>Well abandonment<br>• Compliance with INPEX Well Integrity Standard (0000-AD-STD-60003) and WOMP reported. | OIM<br><br><br><br><br><br><br>INPEX Drilling Superintendent |

| | | | |
|---|---|---|---|
| | • BOP function and pressure tested prior to use and meets the requirements of the industry standard American Petroleum Institute (API) STD 53 Blowout Prevention Equipment Systems for Drilling Wells (4th edition, November 2012). The INPEX drilling supervisor or drilling engineer must approve BOP pressure tests in accordance with predetermined acceptance criteria.<br>• The drilling contractor shall have a maintenance/inspection program for BOP control equipment which will align with the drilling contractor's well control standard. The BOP will undergo weekly/fortnightly function and pressure testing.<br>• BOP shall have a shear ram capable of shearing the drill pipe in use and sealing the well-bore.<br>• Compliance with INPEX Well Integrity Standard (0000-AD-STD-60003) which requires two tested barriers to allow removal of the BOP.<br>Mud logging<br>The mud logging unit shall provide kick detection through the following:<br>• continually manned (24 hrs) during all live, open hole well operation, with appropriate checks and calibration checks on key components<br>• continuous recording of drilling operations, including mud flow out and pressure evaluation, with alarms in place to detect any significant changes.<br>Well abandonment | | |

| | | | |
|---|---|---|---|
| | • INPEX will verify compliance with the WOMP which outlines the means by which the well will be plugged and abandoned using a combination of verified barriers. | | |
| Contain the well within 80 days (Brewster)/108 days (Plover) of occurrence of loss of well containment. | Source control activities will be undertaken in accordance with Section 8.7 of this EP. | Records confirm source control activities were implemented, as detailed in Section 8.7 of this EP. | INPEX Drilling Supervisor |
| | MODU and vessel personnel will demonstrate competence in accordance with the INPEX Competency Assurance and Management Standard (0000-AN-STD-60011). | Training records. | INPEX Drilling Supervisor |
| | INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and Drilling contractor ERP will be implemented in the event of a loss of well containment. | Records demonstrate Incident and Crisis Management Plans and were implemented following a loss of well containment. | INPEX Drilling Supervisor |
| | Oil spill and source control response preparedness will be maintained through implementing Sections 8.6, 8.7 and 9.10 of this EP.<br><br>INPEX and Contractor personnel will be trained in the above plans, as defined in Section 9.10 of this EP. | Records confirm oil spill and source control response preparedness, as detailed in Sections 8.6, 8.7 and 9.10 of this EP, is maintained.<br><br>Records demonstrate personnel are trained in the INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and Drilling contractor ERP. | INPEX Environmental Adviser |

| | | | |
|---|---|---|---|
| | In the event of a loss of well containment, resulting in a spill reaching WA state waters, INPEX will provide support to WA DoT in their performance as control agency, including provision of INPEX resources to support the WA IMTs, under the relevant 'cross jurisdictional arrangements', described in the OPEP, and in accordance with Figure 9-5. | In the event of a loss of well containment, resulting in a spill reaching WA state waters, records confirm INPEX provided support, as requested by WA government. | IMT leader |

## 8.3 Vessel collision

### 8.3.1 Location

Spill modelling (RPS 2019c) was undertaken for a Group II hydrocarbon surface release of marine diesel in the licence area, WA-50-L, at a location approximately 46 km WNW of Browse Island. The release point provides indicative information only as an exact location for a vessel collision cannot be predicted.

### 8.3.2 Volume and duration

AMSA guidance (AMSA 2015) recommends that the maximum credible volume spill for a vessel collision scenario be based on the volume of the largest single fuel tank. A review of the expected tank sizes associated with the activity indicated the MODU support vessels to be approximately 225 $m^3$. Conservatively, a 250 $m^3$ spill volume was used (RPS 2019c). The spill was modelled as an instantaneous spill, with spill trajectory and fate tracked for 21 days.

### 8.3.3 Hydrocarbon properties

Hydrocarbon properties associated with the Group II diesel used for the modelling study are presented in Table 8-6.

**Table 8-6: Group II diesel properties**

| Hydrocarbon type | Density at 15 ˚C ($g/cm^3$) | Viscosity – centipoise (cP) – at 40 ˚C | Characteristic | Volatile (%) | Semi-volatile (%) | Low volatility (%) | Residual (%) |
|---|---|---|---|---|---|---|---|
| | | | Boiling point (˚C) | <180 | 180–265 | 265–380 | >380 |
| Diesel fuel oil | 0.8291 | 4.0 | % of total | 6 | 34.6 | 54.4 | 5 |

### 8.3.4 Modelling results

Modelling results are summarised in Table 8-7 and include results taken for three modelled seasons throughout the year; October to March (summer), May to August, (winter) and combined April and September (transition). For each season, 100 modelled replicates were run and therefore the results summarised represent 300 possible spill scenarios.

Diesel is a mixture of volatile and persistent hydrocarbons with low percentages of highly volatile and residual components. When exposed to the atmosphere, around 41% of the mass would be expected to evaporate in around 24 hours, another 54% within a few days, and the remaining 5% would be expected to persist in the marine environment until decayed. The influence of entrainment will regulate the degree of mass retention in the environment, with increasing wind speed resulting in increased entrainment (RPS 2019c). Considering the spill volume, there is a low potential for dissolution of soluble aromatic compounds.

**Table 8-7: Vessel collision stochastic modelling results summary**

| Hydrocarbon exposure | Surface instantaneous release of 250 $m^3$ (RPS 2019c) |
|---|---|
| Surface | The maximum distance of floating hydrocarbon, at concentrations greater than 1 $g/m^2$ (visible sheen), travelled by a single spill trajectory (out of 300 simulations) was approximately 277 km.<br><br>At a concentration of >10 $g/m^2$ (environmental impact threshold), the maximum distance travelled by a single spill trajectory (out of 300 simulations) was approximately 159 km. |
| Entrained and dissolved | The maximum distance of entrained hydrocarbon, at concentrations greater than 500 ppb, travelled by a single spill trajectory (out of 300 simulations) was approximately 188 km.<br><br>The worst-case instantaneous entrained oil concentration at any receptor is predicted at the North-West Slope Trawl Fishery, Southern Bluefin Tuna Fishery, Western Skipjack Fishery and Western Tuna and Billfish Fishery as 43,207 ppb.<br><br>Browse Island is predicted to have a worst-case entrained oil concentration of 679 ppb in summer. No other receptors were predicted to be exposed >500 ppb in any season.<br><br>The worst-case dissolved oil concentration was 490 ppb, which is below the impact threshold, and therefore contact above the 500 ppb impact threshold was never exceeded for any receptor. The majority of concentrations predicted were below 200 ppb (Figure 8-5).<br><br>RPS (2019c) produced cross-sections to provide an understanding of the depth of entrained/dissolved concentrations through the water column. Modelling results indicate that entrained oil will not exceed the 500 ppb threshold deeper than 25 m below sea surface. Examples of cross-sectional plots are provided in Figure 8-4 and Figure 8-5. |
| Shoreline | Shoreline accumulation was predicted as <1 $m^3$ at all shoreline receptors. The worst-case replicate was 0.07 $m^3$ predicted to accumulate along 1.6 km of shoreline at Cartier Island MP.<br><br>The worst-case local accumulated concentration was calculated at 11 $g/m^2$ at Scott Reef - Sandy Islet and Ashmore Reef (summer). |

In addition to the stochastic modelling, a further deterministic assessment was made on the worst-case individual run from the stochastic modelling study. The worst-case was based on the maximum volume on shoreline and the maximum length of shoreline oiled. This was predicted to occur in the transitional season where 0.07 $m^3$ of oil was forecast to accumulate along 1.6 km of shoreline at Cartier Island MP.

Figure 8-6 shows a time-series (1-day, 3-days, 5-days and 1-week following commencement of the spill) of predicted concentrations of surface, entrained/dissolved, and shoreline hydrocarbons during the worst-case run (transitional season).

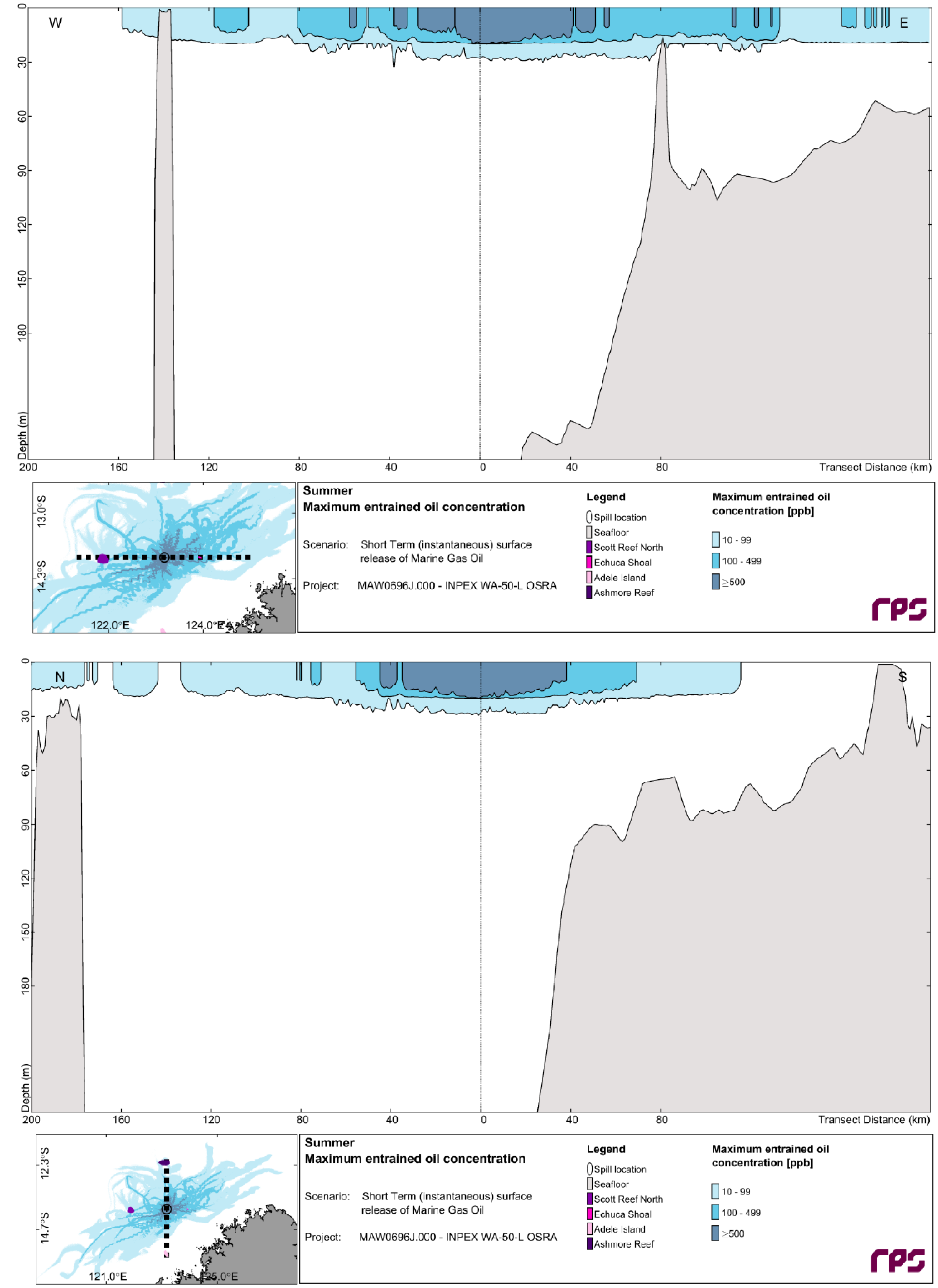



**Figure 8-4: Cross-section transects of predicted maximum entrained hydrocarbon concentration for 100 replicates (summer) from a surface release of diesel. (RPS 2019c).**

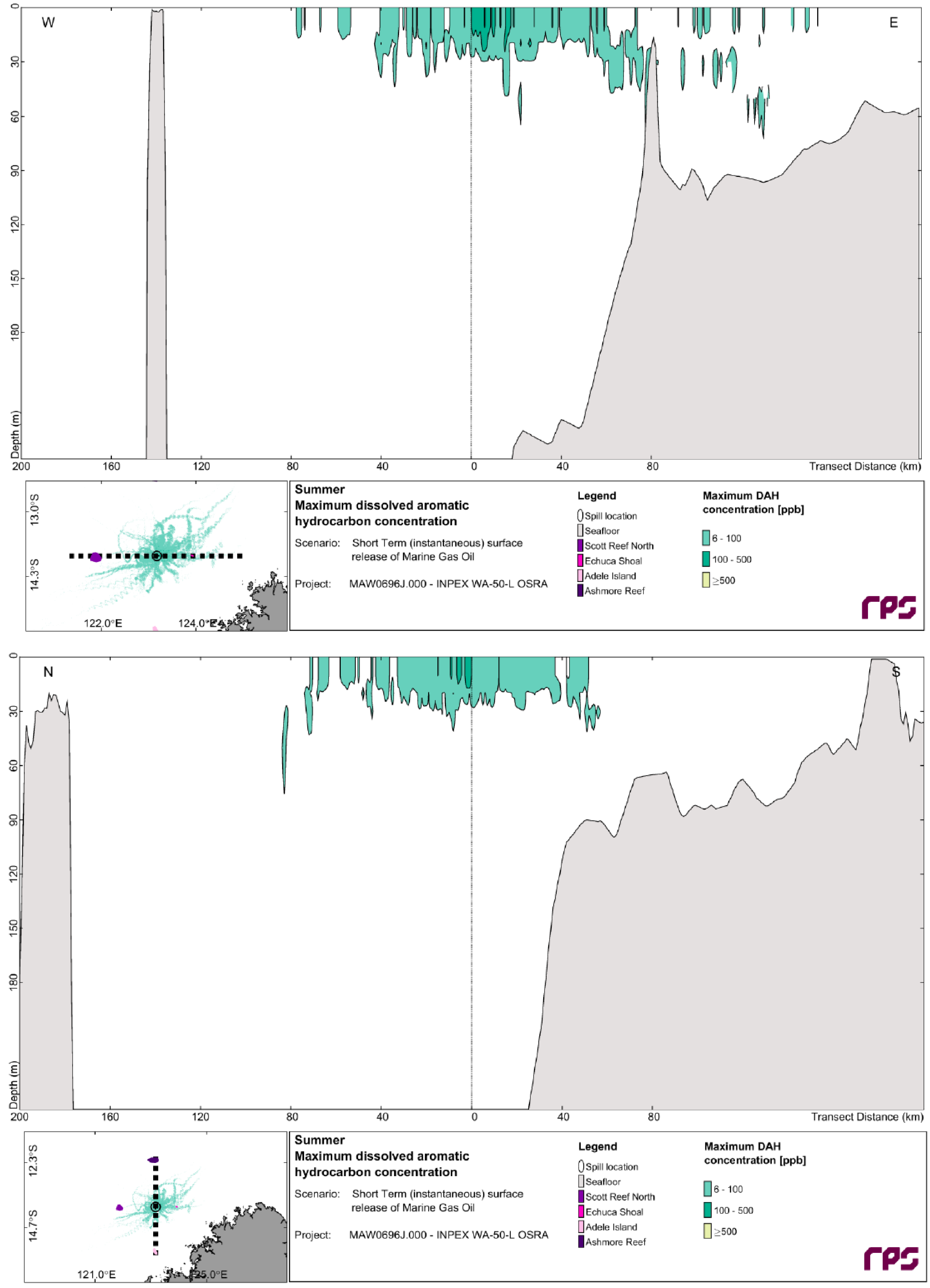



**Figure 8-5: Cross-section transects of predicted maximum dissolved aromatic hydrocarbon concentration for 100 replicates (summer) from a surface release of diesel. (RPS 2019c).**

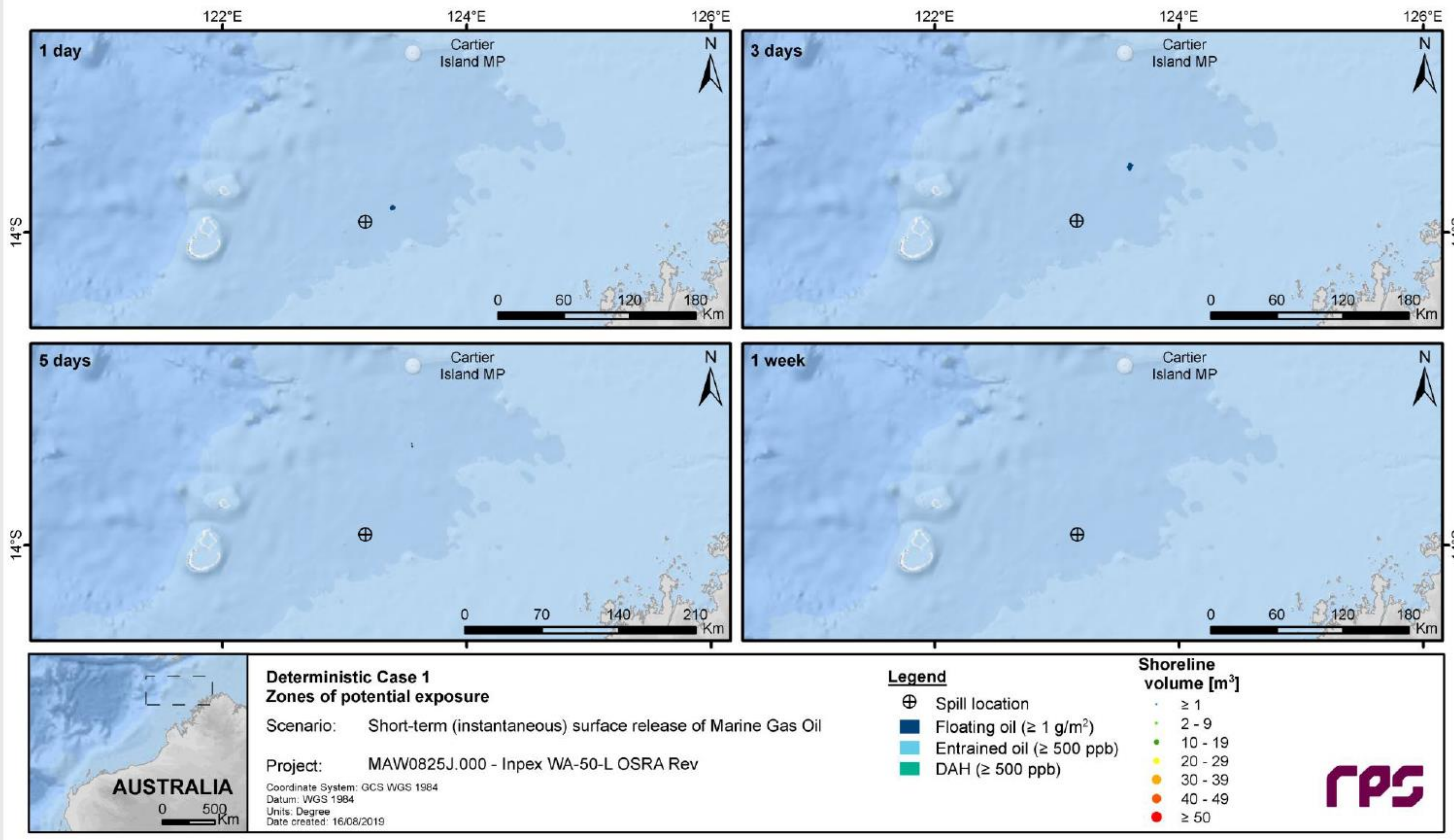



**Figure 8-6: Example of time-series of oil exposure for floating oil (≥ 1 g/m²), entrained/dissolved oil (≥ 500 ppb) and shoreline oil (≥ 100 g/m²) for a replicate in transitional season (RPS 2019c).**

### 8.3.5 Impact and risk evaluation

**Table 8-8: Impact and evaluation – Vessel collision resulting in a Group II (diesel) spill**

| **Identify hazards and threats** | |
|---|---|
| A surface release of Group II hydrocarbons has the potential to result in changes to water quality through surface and shoreline hydrocarbon exposure. The thresholds for impacts associated with surface, entrained/dissolved, and shoreline, hydrocarbon exposures are described in Table 8-2. The outcome of the predictive modelling for the vessel collision scenario is presented in Table 8-7. | |
| **Potential consequence – surface hydrocarbons** | **Severity** |
| The values and sensitivities with the potential to be affected by surface hydrocarbon exposure from a surface release due to a vessel collision include:<br>• commercial, recreational and traditional fisheries including aquaculture (within 277 km from the release location based on 1 $g/m^2$ visible sheen threshold)<br>• transient, EPBC-listed species (within 159 km from the release location based on 10 $g/m^2$ impact threshold)<br>• planktonic communities (within 159 km from the release location based on 10 $g/m^2$ impact threshold).<br>As described in Table 8-5, commercial, recreational and traditional fisheries including aquaculture may be impacted by the presence of exclusion zones and the oiling of nets and lines. The potential extent of the visible sheen associated with the vessel collision scenario is significantly less than for a loss of well containment. There are low levels of recreational and traditional fishing activities in WA-50-L, and no aquaculture (refer to Section 4.9.3 and 4.9.4). Based on the low level of reported commercial fishing in the licence area, any socioeconomic impacts are expected to be localised to within 227 km of the release location and temporary in nature given the expected evaporation and rapid dispersion of Group II hydrocarbons at the sea surface. Therefore, the consequence is considered to be Insignificant (F)<br><br>There are no known BIAs or aggregation areas within WA-50-L. However, there are several marine fauna BIAs located in areas predicted to be exposed to surface expressions above the 10 $g/m^2$ exposure threshold (within 159 km of the release location in WA-50-L). These include a 20 km internesting buffer at Browse Island for green turtles, blue whale foraging/migration located approximately 60 km west of WA-50-L and the humpback whale migration corridor located 120 km south-east from WA-50-L. A range of other marine fauna may also be present within this area albeit on a transient basis. Impacts to transient, EPBC-listed species are described in Table 8-5. Based on the predicted limited extent of the surface hydrocarbons (within 159 km where concentrations are > 10 $g/m^2$), limited surface area affected at any time (Figure 8-6) the rapid evaporation of volatile components and expected weathering resulting in reduced levels of toxicity, any impacts to transient EPBC-listed species are expected to be on a local scale, with short-term impacts on a small portion of the population of a protected species (Minor E).<br><br>Plankton may potentially be exposed to hydrocarbons on the sea surface. However, the majority of impacts would be toxicity related, associated with entrained/dissolved hydrocarbons exposure. As such, these impacts are discussed below. | Minor (E) |

| **Potential consequence – entrained/dissolved hydrocarbons** | **Severity** |
|---|---|
| RPS (2019c) summarised in Table 8-7, predicted that the dissolved threshold (>500 ppb) would not be exceeded at any time, and that only fauna present in the top 20 m of the water column would be exposed above the 500 ppb entrained oil threshold (Figure 8-4 and Figure 8-5). No benthic habitats were contacted above impact thresholds, except Browse Island, at 679 ppb (entrained oil), in summer only.<br><br>Therefore, the values and sensitivities with the potential to be exposed above the entrained hydrocarbon impact threshold (>500 ppb) from a surface release due to a vessel collision include;<br><br>• commercial, traditional and recreational fisheries including aquaculture<br>• KEFs and associated biodiversity (fish communities, BIAs whale shark foraging)<br>• benthic primary producer habitats / benthic habitats (coral reef/macro algae at Browse Island only)<br>• planktonic communities<br>• transient, EPBC-listed species (BIAs - marine mammals, turtles and avifauna).<br><br>The values and sensitivities associated with commercial, traditional and recreational fisheries (seafood quality and employment) could be impacted due to entrained/dissolved oil. The impact to fish communities from exposure to entrained and dissolved hydrocarbons above threshold values is primarily associated with toxicity, which is typically associated with dissolved hydrocarbons. Note, the dissolved oil impact threshold (500 ppb) was not exceeded at any location during the modelling (RPS 2019c) with the majority of predicted concentrations of dissolved hydrocarbons below 200 ppb (Figure 8-5).<br><br>Adult fish exposed to entrained hydrocarbons are likely to metabolise the hydrocarbons and excrete the derivatives, with studies showing that fish have the ability to metabolise petroleum hydrocarbons. These accumulated hydrocarbons are then released from tissues when fish are returned to hydrocarbon free seawater (Reiersen & Fugelli 1987). Chronic impacts to juvenile fish, larvae, and planktonic organisms may occur if exposed to entrained/dissolved hydrocarbon plumes potentially resulting in lethal or sub-lethal effects or impairment of cellular functions (WA DoT 2018a). Juvenile fish and larvae may experience increased toxicity upon such exposure to plumes, because of the sensitivity of these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018a). | Minor (E) |

| | |
|---|---|
| Pelagic fish and sharks are highly mobile in nature, and therefore they are not expected to remain within entrained hydrocarbon plumes for extended periods, limiting acute impacts or risks associated with entrained hydrocarbons. However, within the EMBA there are several sawfish BIAs (along the WA coastline) and a whale shark foraging BIA (approximately 15 km south-east of WA-50-L). Potential effects to whale sharks include damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). As whale sharks are filter-feeders they are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al. 2011). Site attached fish on shallow coral reefs, such as Heywood Shoal, Echuca Shoal and Browse Island, have the potential to be exposed to entrained/dissolved hydrocarbons above the 500 ppb threshold. Due to the limited depth of entrained/dissolved hydrocarbon exposure (limited to the top 20 m for a vessel collision diesel spill), demersal fish communities (such as the continental slope demersal fish community KEF described in Section 4.2.1) and fish associated with other deeper benthic habitats and KEFs will not be exposed above impact thresholds.<br><br>In summary. no receptors are predicated to be exposed above the 500 ppb dissolved impact threshold. The entrained plume is expected to be spatially and temporally limited (Figure 8-6), and limited to the top 20 m of the water column (Figure 8-4 and Figure 8-5). Therefore, the values and sensitivities associated with the fisheries, fish and shark BIAs and KEFs are highly unlikely to be exposed to any significant impacts. As such, the consequence of entrained/dissolved hydrocarbons is considered to be Minor (E).<br><br>The potential range of impacts of entrained/dissolved oil exposure on plankton is described in Table 8-5. In the event of a vessel collision resulting in a diesel spill, impacts on plankton are expected to be highly localised, with short-term impacts, due to no exceedance of the 500 ppb dissolved threshold, exposure limited to the top 20 m of the water column, and the limited temporal and spatial extent of any entrained plume (Figure 8-6). However, if a shallow entrained/dissolved plume reached a coral-spawning location, such as Browse Island or Scott Reef, during a spawning event, localised short-to-medium term impacts could occur. Therefore, the consequence is considered to be Minor (E).<br><br>Marine mammals, marine reptiles and marine avifauna could also be impacted through entrained and dissolved hydrocarbon exposure, primarily through ingestion during foraging activities (WA DoT 2018a). There are no known BIAs or aggregation areas within WA-50-L. However, the EMBA overlaps a large number of BIAs for a number of different marine fauna species (Section 4.8.4). A Ramsar site (Ashmore Reef) and a wetland of conservational significance (Mermaid Reef) are also present within the EMBA (refer to Section 4.6), these sites provide important habitat for marine avifauna. Modelling predicted no exceedance of the 500 ppb dissolved threshold, exposure limited to the top 20 m of the water column, and the limited temporal and spatial extent of any entrained plume (Figure 8-6). As such, impacts to EPBC-listed species are expected to be on a local scale, with short-term impacts on a small portion of the population of a protected species, with the consequence considered to be Minor (E).<br><br>In summary, the potential extent of entrained/dissolved hydrocarbon with a concentration >500 ppb may result in localized, short-term exposure to the identified values and sensitivities. There would be limited potential for cumulative impacts as a result of interactions between surface, entrained/dissolved hydrocarbon impacts on the food web and through bioaccumulation up the food chain, as key aggregation areas such as benthic primary producer habitats which supports EPBC-listed species will not be exposed above impact thresholds. On this basis, the potential consequence from cumulative impacts associated with entrained/dissolved plumes from a vessel collision is considered to be Minor (E). | |
| **Potential consequence – shoreline hydrocarbons** | **Severity** |

| | |
|---|---|
| As summarized in Table 8-7, no shorelines were predicted to exceed the 100 g/m$^2$ threshold (highest predicted concentration of 11 g/m$^2$), and shoreline accumulation was predicted at <1 m$^3$ at all shorelines.<br><br>As the modelling predicts that worst-case hydrocarbon shoreline concentrations would be an order of magnitude less than the shoreline impact threshold, and the model predicts extremely low volumetric accumulations at all shoreline receptors (worst-case 0.07 m$^3$ accumulating along 1.6 km of shoreline at Cartier Island MP), the consequence from shoreline hydrocarbons is considered to be Insignificant (F). | Insignificant (F) |

| **Identify existing design safeguards/controls** |
|---|
| Marine vessels >400 tonne (t) will carry SOPEPs approved under MARPOL 73/78 Annex 1, Regulation 37.<br>Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the *Navigation Act 2012*.<br>PSZ maintained around the MODU in accordance with the OPGGS Act. |

| **Propose additional safeguards/control measures (ALARP evaluation)** | | | |
|---|---|---|---|
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | Eliminate vessels. | No | Vessels are the only form of transport that can maintain ongoing logistical support to the MODU. |
| Substitution | None identified. | N/A | N/A |
| Engineering | Vessels used will have dynamic positioning equipment. | Yes | The use of DP vessels will reduce the potential for vessel collisions. Supply vessels will also be equipped with a backup DP system as a failsafe (DP2 or greater). |
| Procedures and administration | Australian Hydrographic Office (AHO) will be informed of the proposed MODU location prior to the activity commencing. | Yes | By informing AHO of the location of the MODU, it can update navigation charts, to inform third parties of the location of the infrastructure, reducing the risk of accidental third-party interactions with areas of increased vessel activity around the MODU. |
| | Incident management, and emergency response plans in place. | Yes | To ensure the INPEX IMT are prepared and informed, an INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and Drilling contractor Emergency Response Plan (ERP) will be in place and implemented, and personnel trained in their relevant plans. |

| | | | |
|---|---|---|---|
| | Emergency response preparedness will be maintained. | Yes | To ensure that INPEX is prepared to respond to a marine diesel spill originating from a vessel collision event, oil spill and source control response preparedness will be maintained in accordance with Section 8.6 and 9.10 of this EP. |
| | INPEX will provide all available support to AMSA in AMSA's performance of its combat (control) agency responsibilities for vessel-based spill events. | Yes | INPEX has signed a MOU with AMSA for oil spill preparedness and response (AMSA/INPEX 2013).<br>This MoU acknowledged AMSA's responsibility under the NatPlan as the control agency for vessel-based spill scenarios, and INPEX has acknowledged that it will support AMSA to implement the NatPlan. |
| | INPEX will provide all available support to WA DoT in their performance as control agency for a spill which reaches WA waters, resulting from a vessel collision. | Yes | WA DoT is the control agency for all spills entering WA waters, regardless of the source of the spill. WA DoT has issued the State Hazard Plan – Marine Environmental Emergencies (WA DoT 2018b) which specifies the WA DoT expectations (refer to Section 2.2.1 of the OPEP). In summary, the WA DoT will require INPEX to work in partnership to ensure an adequate response is provided across the entire incident as reflected in the INPEX IMT organisation chart (Figure 9-5).<br>This may include:<br>• WA DoT nominating officers to facilitate aligned communications, shared situational awareness and coordinated response actions with the INPEX IMT.<br>• WA DoT establishing an Incident Control Centre in Fremantle and INPEX providing a number of Emergency management support personnel to work within the WA DoT IMT (The INPEX IMT would still function and lead the response in Commonwealth waters and liaise with WA DoT IMT). |
| | Stakeholder engagement plan. | Yes | As required by the OPGGS (E) Regulations 2009, INPEX has implemented a stakeholder engagement plan to inform stakeholders of the description of the activities, schedule, regulatory requirements, and details for directing enquiries and feedback (refer Section 5.2). Through implementation of the engagement plan other marine users are kept informed of potential interactions with vessels and the location of the gazetted PSZ. |

<table>
<tr><td rowspan="2"></td><td>Issue notice to mariners</td><td>Yes</td><td>By informing AHO start date of the activity, information will be included in the promulgation of fortnightly Notice to Mariners.<br>Notice to Mariners provide commercial shipping operators with information regarding activities or hazards in the region and will include details of the relevant vessels.</td></tr>
<tr><td>Notification to AMSA's Joint Rescue Coordination Centre (JRCC)</td><td>Yes</td><td>The AMSA JRCC will be advised of the activity details for promulgation of radio-navigation warnings 24-48 hours before operations commence and upon completion of the activity.</td></tr>
<tr><td colspan="4">Identify the likelihood</td></tr>
<tr><td>Likelihood</td><td colspan="3">Reported industry statistics indicate vessel failures are considered rare with 37 collisions reported out of a total of 1200 marine incidents in Australian waters between 2005 and 2012 (most recent data) (ATSB 2013).<br>A ship collision risk assessment was undertaken to support the INPEX Ichthys Project. The study determined collision frequencies and impact energies for passing (third-party) vessels, infield vessels and offloading tankers. The annual frequency of a collision with a passing vessel – i.e. one not within the control of INPEX – imparting at least 150 megajoules (sufficient impact energy) is $3.5 \times 10^{-7}$, or once every 2.9 million years.<br>On this basis and given the controls that have been identified to minimise the potential for vessel collision and subsequent loss of containment, the likelihood of the consequence occurring is considered Highly Unlikely (5).</td></tr>
<tr><td>Residual risk</td><td colspan="3">Based on the worst-case consequence for all applicable hydrocarbon exposure mechanisms (surface, entrained and dissolved) Minor (E) and a likelihood of Highly Unlikely (5) the residual risk is ranked as Low (9).</td></tr>
</table>

| **Residual risk summary** | | |
|---|---|---|
| Consequence | Likelihood | Residual risk |
| Minor (E) | Highly Unlikely (5) | Low (9) |

**Assess residual risk acceptability**

**Legislative requirements**

The activities and proposed management measures are compliant with industry standards and with relevant Australian legislation, specifically concerning navigational safety requirements, including AMSA *Marine Orders – Part 30: Prevention of Collisions, Issue 8* (Order No. 5 of 2009).

**Stakeholder consultation**

Stakeholders have been engaged throughout the development of the EP and OPEP. Where relevant, the controls in place have been developed in consultation with relevant stakeholders (e.g. WA DoT and AMSA). The controls in place are considered to manage risks associated with a vessel collision to ALARP.

| **Conservation management plans / threat abatement plans**<br>Several conservation management plans (refer Appendix B) identify oil spills as a key threatening process, through both direct/acute impacts of oil, as well as indirect impacts through habitat degradation (which is a potential consequence of an oil spill). The prevention of vessel collisions and reducing impacts to the marine environment through oil spill response preparedness and response (refer OPEP, Appendix D), demonstrates alignment with the various conservation management plans.<br>**ALARP summary**<br>Although the level of environmental risk is assessed as Low, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.<br>**Acceptability summary**<br>Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:<br>• the activity demonstrates compliance with legislative requirements/industry standards<br>• the activity takes into account stakeholder feedback<br>• the activity is managed in a manner that is consistent with the intent of conservation management documents<br>• the activity does not compromise the relevant principles of ESD<br>• the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low", the consequence does not exceed "C – Significant" and the risk has been reduced to ALARP. | | | |
|---|---|---|---|
| **Environmental performance outcomes** | **Environmental performance standards** | **Measurement criteria** | **Responsibility** |
| No incidents of loss of hydrocarbons to the marine environment as a result of a vessel collision. | Vessels will be fitted with lights, signals, AIS transponders and navigation and communications equipment, as required by the *Navigation Act 2012.* | Records confirm that required navigation equipment is fitted to MODU/vessels to ensure compliance with the *Navigation Act 2012.* | INPEX Environmental Adviser |
| | Vessels used will have dynamic positioning equipment. Vessels will also be equipped with a backup DP system as a failsafe. | Records confirm that vessel have DP equipment and fail-safe system in place. | INPEX Environmental Adviser |
| | A 500 m PSZ, issued by NOPSEMA, will be maintained around the MODU. | Gazette notice of PSZ.<br>Records of reporting of unauthorised entry into the PSZ. | INPEX Drilling Supervisor |
| | Australian Hydrographic Office (AHO) will be informed of the proposed MODU location prior to the activity commencing. | Records of document transmittal to AHO. | INPEX Environmental Adviser |

| | | | |
|---|---|---|---|
| | In accordance with the stakeholder engagement plan, other marine users will be notified of MODU/vessel presence through ongoing stakeholder consultation on an as required basis during the activity. | Stakeholder engagement records. | INPEX Drilling Supervisor |
| | The Australian Hydrographic Service (AHO) will be notified no less than four working weeks before operations commence for the promulgation of related notices to mariners (via datacentre@hydro.gov.au). | Records of document transmittal to AHO. | INPEX Environmental Adviser |
| | Notification will be provided to AMSA's Joint Rescue Coordination Centre (JRCC) for promulgation of radio-navigation warnings 24-48 hours before operations commence, including following information (via rccaus@amsa.gov.au, ph: 1800 641 792 or +61 2 6230 6811):<br>• Vessel details, including name, call sign and Maritime Mobile Service Identity (MMSI)<br>• Satellite communications details, including INMARSAT-C and satellite telephone<br>• Area of operation<br>• Requested clearance from other vessels<br>• Notification of operations start and end. | Records of document transmittal to AMSA JRCC. | INPEX Environmental Adviser |
| Risks of impacts to commercial, traditional and recreational fisheries, emergent benthic primary producer habitats (intertidal corals, mangroves, macroalgae and seagrasses), turtle BIAs, marine avifauna BIAs, transient, EPBC-listed species and | Premobilisation HSE inspection confirm that MODU and vessels >400 GT have SOPEPs compliant with Marine Orders – Part 91, the POTS Act, and Annex I of MARPOL 73/78 (oil) on board. | Premobilisation HSE inspection documentation. | INPEX Environmental Adviser |
| | INPEX Australia Incident Management Plan (0000-AH-PLN-60005) and INPEX Australia Crisis Management Plan (0000-AH- PLN-60004) and will be implemented in the event of a vessel collision.<br>INPEX personnel will be trained in the above plans, as defined in Section 9.10 of this EP. | Records demonstrate Incident and Crisis Management Plans and were implemented following a vessel collision.<br>Records demonstrate personnel are trained in the INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH- PLN-60004). | INPEX Drilling Supervisor |

| | | | |
|---|---|---|---|
| planktonic communities from Group I or II hydrocarbon spills are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | Emergency response preparedness will be maintained through implementing Sections 8.6 and 9.10 of this EP. | Records confirm response preparedness, as detailed in Sections 8.6 and 9.10 of this EP, is maintained. | INPEX Environmental Adviser |
| | In the event of a vessel collision, resulting in a spill reaching WA state waters, INPEX will provide all available support to WA DoT in their performance as control agency, including provision of INPEX resources to support the WA DoT IMTs, under the relevant 'cross jurisdictional arrangements' described in the OPEP and in accordance with Figure 9-5. | In the event of a vessel collision, resulting in a spill reaching WA state waters, records confirm INPEX provided support, as requested by WA government. | IMT leader |
| | In the event of a vessel collision, INPEX will provide all available support to AMSA in its performance as combat (control) agency responsibilities in accordance with the AMSA/INPEX MoU. | In the event of a vessel collision, records confirm INPEX provided support, as requested by AMSA, in accordance with the MoU. | IMT leader |

## 8.4 Spill Impact Mitigation Assessment

INPEX has developed a series of strategic Spill Impact Mitigation Assessments (SIMA) for each maximum credible spill scenario relevant to INPEX Australia's exploration and production activities in the Browse Basin.

The strategic SIMAs are:

- condensate/gas well blowout – long duration subsea release
- condensate spill – instantaneous surface release
- MGO/diesel spill – instantaneous surface release
- intermediate/heavy fuel oil spill – instantaneous surface release.

The SIMA process has been developed as a pre-spill planning tool for all INPEX EPs, to facilitate response option selection and support the development of the overall response strategies by identifying and comparing the potential effectiveness and impacts of oil spill response options (IPIECA 2017a). The strategic SIMA assists in the assessment of the impact mitigation potential and in making a transparent determination of response strategies that are considered most effective at minimising oil spill impacts (IPIECA 2017a). The framework includes environmental considerations as well as a range of shared values such as ecological, socio-economic and cultural aspects (IPIECA 2017a).

### 8.4.1 SIMA process

The SIMA process as outlined in the "Guidelines on implementing spill impact mitigation assessment (SIMA)" (IPIECA 2017a) has four stages:

1. Compile and evaluate data relevant for relevant oil spill scenarios including fate and trajectory modelling, identification of resources at risk and determination of safe and feasible response options.
2. Predict outcomes/impacts for the "No Intervention" (or "natural attenuation") option as well as the effectiveness (i.e. relative mitigation potential) of the feasible response strategy for each scenario.
3. Balance trade-offs by weighing and comparing the range of benefits and drawbacks associated with each response strategy, compared to 'No Intervention', for the spill scenario.
4. Select the best response strategies to form the response plan for the scenario, based on which best combination of response strategies will minimise the overall spill impacts and promote rapid recovery.

INPEX have generated strategic SIMAs, which includes a subsea condensate release in the Browse Basin [X060-AH-LIS-60034] and a Group II (marine diesel) surface release from a vessel collision in the Browse Basin/NW WA region [X060-AH-LIS-60032] presented in Appendix E.

Predictive oil spill modelling (e.g. outputs from various INPEX Browse Basin oil spill modelling reports) have been used to support the strategic SIMAs through defining generic oil weathering characteristics for each broad type of spill scenario.

The resource compartments presented in each SIMA reflect the values and sensitivities described in Section 4 of EPs. The resource compartments have been defined as broad habitat types which support protected species, rather than focusing on individual protected species. This approach is recommended by IPIECA (2017a).

For each generic spill scenario, a relative impact score has been assigned to each resource compartment, for the 'no intervention' option. A supporting justification for each relative impact score for each resource compartment is also presented in the SIMA.

For each SIMA, eight oil spill response strategies were considered, including operational monitor and evaluation, containment and recovery, protect and deflect, shoreline clean-up, chemical dispersant, pre-contact wildlife response, post-contact oiled wildlife response (OWR) and in-situ burn.

For each response strategy, the impact mitigation potential was assessed against each resource compartment and given a score on a scale of '-3' to '+3', where a negative score reflects additional impact and a positive score reflects mitigation of impact (balance trade-offs). A supporting justification for each impact modification score for each response strategy against each resource compartment is also presented in the SIMA.

Each impact mitigation score was evaluated with no timing or resource limitations or weather constraints on the response strategy effectiveness (these factors are further considered in the oil spill response arrangements and capability evaluation, provided in the relevant EP, as related to the EP specific spill scenario).

Those response strategies with an overall positive score, and therefore represent a mitigation of impact from the spill, are then selected for further assessment in the relevant EP. Those response options with an overall negative score have been discounted and are not further evaluated in the relevant EP.

It should be noted that it is unlikely that a single response strategy will be completely effective in a large spill scenario, hence it is expected that multiple response strategies may be utilised in the event of a Level 2/3 spill.

In order to select appropriate oil spill response strategies applicable to the oil spill scenario described in this EP (Section 8.2 and 8.3) INPEX's strategic SIMAs for a subsea condensate spill and MGO/diesel surface spill have been reviewed and assessed in Section 8.5.

The subsea condensate spill and MGO/diesel surface spill strategic SIMAs are provided in Appendix E.

## 8.5 Oil spill response arrangements and capability evaluation

The response techniques that demonstrated a positive impact mitigation potential in the SIMA subsea condensate and/or surface MGO/diesel have been assessed for their applicability and suitability as response options, taking into account the expected timing and resource limitations specific to WA-50-L and this EP. The response options further evaluated in Table 8-9 are as follows:

- operational monitoring and evaluation
- contain and recover
- protect and deflect
- shoreline clean-up
- subsea dispersant injection
- pre-contact wildlife response (hazing and translocation)
- post-contact wildlife response.

The following response techniques have been excluded from this EP based on the outcome of the SIMAs for each scenario (Appendix E):

- in-situ burn
- chemical dispersion (surface application).

Table 8-9 presents the response strategy applicability evaluation. In this evaluation, the response strategies which were selected via the strategic SIMA have been further evaluated for their applicability and suitability, by taking into account the expected resource and logistical limitations specific to the activity described in this EP. Spill scenario specific oil spill modelling data, including stochastic and deterministic modelling (as relevant), was also evaluated. Depending on the outcome of this evaluation, some response strategies have been excluded from further evaluation, as they have been assessed as not appropriate for the EP specific spill scenario.

Following the response strategy applicability evaluation, a response strategy element identification evaluation is undertaken, to define the resources required to successfully implement the selected response strategies, under a worst-case spill scenario. This evaluation is presented in Table 8-10.

Following the response strategy applicability evaluation, the response strategy arrangements and capability evaluation is undertaken. This process examines the merits of improving the capability or timeliness of response strategy elements. The response strategy arrangements and capability evaluation are presented in Table 8-11.

The response strategy arrangements and capability evaluation provides the justification that the spill response arrangements in place are effective in reducing environmental risks to ALARP and provides the reasoning and justification of the selected controls presented in Table 8-12.

The strategic SIMA identified subsea dispersant injection (SSDI) as a relevant control, from a source control/safety perspective. As such, the SSDI evaluation is included in Section 8.7.

**Table 8-9: Evaluation of the applicability of spill response strategies identified in the SIMA**

| **Oil spill response technique** | **Likelihood of success** | **Considered for implementation** |
|---|---|---|
| Operational monitoring and evaluation | The SIMA evaluation found that operational monitoring and evaluation should always be implemented in the event of a level 2/3 spill.<br>To implement this response strategy, the following capabilities are available:<br>• oil spill trajectory modelling<br>• aerial and vessel surveillance<br>• Electronic surface tracker buoys (ESTBs)<br>• satellite surveillance capability.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-11. | Yes |
| Contain and recover | The SIMA evaluation found that contain and recover was not appropriate against Group I/condensate spills; however, was potentially appropriate for Group II/diesel spills.<br>Generally, oil needs to be >100 g/m$^2$ (O'Brien 2002) to feasibly corral oil with a boom and achieve any significant level of oil recovery with the skimmers.<br>The initial, gravity-dominated release and spreading is generally complete within minutes to hours after a release (O'Brien 2002). In the context of the Browse Basin, with high sea surface and air temperatures in all seasons, the spreading of any diesel spill would be very rapid.<br>INPEX currently do not maintain any offshore containment and recovery equipment (booms and skimmers) offshore in the Browse Basin area. However, INPEX do have access (via AMOSC) to a Level 2 stockpile of equipment in Broome, including offshore boom and skimmers.<br>The practical deployment of offshore booms and skimmers from Broome to the licence area is expected to take approximately 24 hours using a PSV or small vessel (based on 6 hours loading in port and 18-24 hours steaming time to WA-50-L). | No |

| | | |
|---|---|---|
| | Even if boom was stored on offshore facilities/vessels within the licence area, it would take crews several hours to physically deploy lengths of offshore boom. A minimum of two vessels would be required at the time of the slick to create a boom configuration that would attempt to recover oil. To achieve the logistical supply requirements of the drilling activity, it is not feasible to maintain two of the three supply vessels within WA-50-L at all times.<br><br>In addition, in the early stages of a diesel spill, in locations where concentrations are expected to be >100 g/m$^2$, vessel access to the immediate spill area is likely to be restricted due to the presence of volatile organic compounds (VOCs) in excess of safe exposure thresholds, and potential for a flammable atmosphere.<br><br>Given the very short time following a diesel spill in which the slick would have spread to <100 g/m$^2$, and the associated atmospheric safety risks, it would not be considered ALARP to store booms offshore, or commence the mobilisation of booms from Broome, to attempt offshore containment and recovery. Therefore, this response strategy is not considered an appropriate strategy for implementation. | |
| Protect and deflect | The SIMA evaluation found that protection and deflection was not appropriate against Group I/condensate spills; however, was potentially appropriate for Group II/diesel spills.<br><br>Generally, oil needs to be >100 g/m$^2$ (O'Brien 2002) to feasibly deflect oil with a boom to achieve any significant level of oil deflection away from a sensitive location, or to achieve oil deflection into a collection area on a shoreline.<br><br>As discussed in Table 8-7, surface oil concentrations of >10 g/m$^2$ (environmental impact threshold) were predicted out to 159 km from the release location. However, oil films are not predicted to arrive at shorelines with concentrations >100 g/m$^2$, and therefore this response strategy is not considered an appropriate strategy for implementation. | No |
| Shoreline clean-up | The SIMA evaluation found that shoreline clean-up was potentially appropriate for both Group I/condensate, and Group II/diesel spills.<br><br>The outcome of the spill modelling (Table 8-4) indicates that for a loss of well containment, 120 m$^3$ of weathered condensate could accumulate on the shorelines of the islands of Buccaneer Archipelago for the worst-case replicate. Up to 109 m$^3$ was predicted as a worst-case for Browse Island. No diesel shoreline accumulation (<1 m$^3$) was predicted (RPS 2019c).<br><br>Given only weathered condensate is predicted to arrive ashore, over large intertidal areas, shoreline clean-up is unlikely to provide any significant environmental benefit compared to natural weathering. Therefore, this response strategy is considered unlikely to be successful.<br><br>However, in the event of a spill, the IMT would consider shoreline clean-up as a response strategy based on the outcome of real-time operational monitoring and evaluation data. | Yes |

| | | |
|---|---|---|
| | To implement this response strategy, the following capabilities are available to INPEX:<br>• aircraft<br>• vessels<br>• shoreline clean-up equipment<br>• shoreline clean-up personnel (trained and general labour)<br>• waste management resources.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-11.<br>It should also be noted that for WA shorelines, the WA Department of Transport would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore Reef and Cartier Island, INPEX maybe be the control agency. | |
| Pre-contact wildlife response (hazing and translocation) | The SIMA evaluation found that shoreline clean-up was potentially appropriate for both Group I/condensate, and Group II/diesel spills.<br>Wildlife hazing is most suitable when used near sensitive shoreline habitats against persistent oily slicks, such as heavy fuel oil or crude oil spills. It is generally not appropriate in an open water environment. In the case of a subsea condensate release or diesel spill, surface oil slicks are thin and not considered particularly adhesive, therefore reducing the likelihood and severity of impacts on wildlife. Additionally, hazing isn't considered an effective measure against volatile spills which rapidly evaporate.<br>IPIECA (2014) advise that the difficulty of capturing wildlife safely and maintaining their health during relocation should not be underestimated, and that working with live or dead animals has health and safety issues including potential injuries (e.g. bites or scratches) or zoonotic diseases. Risks to wildlife are high during pre-emptive capture and the risks of oiling need to be weighed against the risk of injury, death etc. The translocation of turtles from beaches and islands would likely require the capture of large numbers of hatchlings at night, followed by translocation to a location far from the slick (to prevent surface oil impacts on released hatchlings). Attempting to capture large numbers of healthy seabirds would be very challenging and there is no practicable method to capture healthy seabirds at sea (DPaW 2014). Any seabirds captured and then released would likely fly back to the shoreline from which they originally were captured. Long term veterinary care (e.g. feeding etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the animals. Overall, there is a potential for harm of animals captured to occur; however, as a spill response strategy it may result in a positive impact (Appendix E). | Yes |

| | | |
|---|---|---|
| | In the event of a Group I or II spill, the IMT would consider pre-contact wildlife response as a response strategy based on the outcome of real-time operational monitoring and evaluation data received, and whether indications were that a significant number of individuals of a protected species would be likely to benefit from the response strategy.<br>To implement this response strategy, the following capabilities are available to INPEX:<br>• aircraft<br>• vessels<br>• wildlife response equipment<br>• wildlife response personnel (trained and general labour)<br>• waste management resources.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-11.<br>It should also be noted that for WA shorelines and wildlife response, the relevant Department of Transport would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore and Cartier, INPEX may be the control agency. | |
| Post-contact wildlife response | The SIMA evaluation found that shoreline clean-up was potentially appropriate for both Group I/condensate, and Group II/diesel spills.<br>Capture, relocation, assessment, cleaning, rehabilitation of oiled wildlife does have the ability to increase the survival of individuals. The scale of oil impacts on wildlife is dependent on factors such as timing, location, oceanographic and weather patterns, and the movements of species that forage, feed, nest and inhabit that area (IPIECA 2014). Given the predicted weathering of any Group I or II spill, most wildlife exposure is expected to be to weathered hydrocarbons, with lower associated levels of toxicity (Stout et al. 2016). Group I and II hydrocarbons are relatively non-adhesive compared to crude oils, and generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline. They are also not likely to generate a thick surface barrier on a shoreline which would coat adult nesting turtles or turtle hatchlings as they transit to the ocean. | Yes |

| | | |
|---|---|---|
| | Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they originally were captured and may be repeatedly affected. Therefore, long term veterinary care (rehabilitation, feeding, etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the seabirds. Once oiled, it is generally agreed that birds have a very low survival rate with many studies reporting the probability of dying near to 100%. The reported high success rates of seabird cleaning are typically associated with cleaning pelicans and penguins which are not present within the Browse Basin. IPIECA (2014) advise working with live or dead animals has health and safety issues including potential injuries (e.g. bites or scratches) or zoonotic diseases.<br><br>In the event of a Group I or II spill, the IMT would consider post-contact wildlife response as a response strategy based on the outcome of the real-time operational monitoring and evaluation data received, and whether indications were that a significant number of individuals of a protected species would be likely to benefit from the response strategy.<br><br>To implement this response strategy, the following capabilities are available to INPEX:<br>• aircraft<br>• vessels<br>• wildlife response equipment<br>• wildlife response personnel (trained and general labour)<br>• waste management resources.<br><br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-11.<br><br>It should also be noted that for WA shorelines and wildlife response, the WA Department of Transport would make the ultimate decision on the response strategies to be implemented, with support provided by INPEX. For Ashmore and Cartier, INPEX may be the control agency.<br><br>As described in Section 8.2.4, worst credible potential accumulated volumes of oil along shorelines were predicted as follows:<br>• Adele Island – 18 $m^3$ (summer)<br>• Ashmore Reef – 65 $m^3$ (transition)<br>• Bonaparte Archipelago- 34 $m^3$ (summer)<br>• Browse Island – 109 $m^3$(summer)<br>• Buccaneer Archipelago – 120 $m^3$(summer)<br>• Cartier Island – 15 $m^3$ (winter)<br>• Clerke Reef -7 $m^3$ (summer) | |

| | | |
|---|---|---|
| | • Imperieuse Reef – 21 $m^3$ (summer)<br>• Lalang-garram / Camden Sound MP – 33 $m^3$ (summer)<br>• North Lalang-garram MP – 5 $m^3$ (summer)<br>• Scott Reef – 15 $m^3$ (summer).<br>A shoreline response for a single remote shoreline would typically involve a large accommodation support vessel, supported by tenders/landing barge, a crew change helicopter and potentially a light utility helicopter. If a second shoreline nearby was also contacted at the same time, such as Ashmore Reef and Cartier Island (60 km apart), an additional vessel may be required, however the helicopter assets would remain unchanged and could be shared between the response locations.<br>Operational monitoring and evaluation assets (oil spill trajectory modelling, aerial surveillance, ESTBs etc.) requirements would remain unchanged, regardless of the locations contacted. Table 8-11 presents the arrangements and capability which would support the field response activity. | |

As described in Table 8-5 and Table 8-8, the worst credible spill scenarios could involve:

- floating oil above impact thresholds on the open ocean
- maximum accumulated oil ashore of 120 $m^3$
- potential for multiple shorelines to be contacted.

The individual elements required to successfully undertake the identified response strategies are presented in Table 8-10.

**Table 8-10: Response strategy element identification**

| Response Strategy | Response Strategy Purpose | Response Strategy Element |
|---|---|---|
| Operational monitoring and evaluation | Provide up to date information to the IMT, to enable the IMT to make timely and informed decisions | Oil spill trajectory modelling (OSTM)<br>• OSTM will provide predictions of the trajectory and fate of the oil spill<br>For the worst credible spill response, only a single OSTM provider is anticipated to be required. |
| | | Aerial surveillance aircraft and trained spotters |

| Response Strategy | Response Strategy Purpose | Response Strategy Element |
|---|---|---|
| | | • aerial surveillance will assist with validating the OSTM predictions, through visual confirmation of the location and type of slick.<br>• personnel trained in aerial observation<br>For a worst credible spill response, up to two flights per day over the spill area is anticipated to be required. |
| | | Vessel surveillance<br>• vessel surveillance will assist with validating the OSTM predictions, through visual confirmation of the location and type of slick.<br>For a worst credible spill response, only a single vessel conducting surveillance may be required, if at all (aerial surveillance only may be appropriate). |
| | | Electronic surface tracker buoys (ESTBs)<br>• ESTBs will assist with validating the OSTM predictions<br>• ESTBs will assist with aerial surveillance flight planning<br>For the worst credible spill response, deployment of multiple ESTBs is anticipated to be required, to accurately validate the OSTM and assist with aerial surveillance flight planning. |
| | | Satellite imagery<br>• satellite imagery will assist with validating the OSTM predictions<br>For a worst credible spill response, only a single satellite imagery provider is anticipated to be required. |
| Shoreline Clean-up | Remove oil from the shoreline to minimise impacts to biota and accelerate natural recovery of the shoreline | Shoreline clean-up personnel<br>• experienced personnel, such as AMOSC core-group operations team personnel, who can lead a shoreline clean-up team<br>• labour hire personnel, who would receive on the job training from the team lead, and carry out the shoreline clean-up activities<br>For a worst credible spill response, up to a maximum of 20 shoreline response personnel is anticipated. Refer Table 8-11 for further details. |

| Response Strategy | Response Strategy Purpose | Response Strategy Element |
|---|---|---|
| | | Shoreline clean-up equipment<br>• manual tools such as rakes and shovels, used to manually recover oil and oily debris from the shoreline<br>For a worst credible spill response, a single shoreline clean-up kit is anticipated to be required. |
| Pre and post contact wildlife response | Prevent or minimise harm associated with the oiling of marine fauna | Wildlife response personnel<br>• experienced personnel, such as AMOSC oiled wildlife response team personnel, who can lead a wildlife response team<br>• wildlife handlers, trained in oiled wildlife response, such as the WA Oiled Wildlife Rehabilitators Network, and Phillip Island Nature Park personnel<br>• labour hire personnel, who would receive on the job training from the team leads, to assist with oiled wildlife response activities<br>For a worst credible spill response, up to a maximum of 20 wildlife response personnel is anticipated. Refer Table 8-11 for further details. |
| | | Wildlife response equipment<br>• wildlife response kits – used for the safe capture and transport of oiled wildlife<br>• wildlife response containers – used for triage, washing and rehabilitating wildlife (wildlife response containers can be mounted on the deck of a suitable accommodation support vessel)<br>For a worst credible spill response at a remote shoreline, only a single wildlife response kit and wildlife response container (mounted on an accommodation support vessel (ASV)) is anticipated to be required. |
| | | Wildlife hazing equipment<br>• wildlife hazing equipment typically only includes vessel air-horns, vessel water cannons etc.<br>• acoustic bird scaring devices/buoy can also be deployed onshore or from a vessel.<br>For a worst credible spill response at a remote shoreline, up to two small vessels and/or a bird-scaring device/buoy could be deployed for wildlife hazing at a remote shoreline. |
| | | Accommodation support vessel |

| **Response Strategy** | **Response Strategy Purpose** | **Response Strategy Element** |
|---|---|---|
| Logistical Support<br>(common to all response strategies) | Provide logistical support to enable response strategies to be undertaken | • to act as the Forward Operating Base, coordinating the shoreline response activity, including daily activity planning and communications back to the IMT<br>• provide accommodation and logistical support to the field response personnel<br>• provide a platform to support waste management and oiled wildlife response, if required.<br>For a worst credible spill response at a remote shoreline, only a single ASV is anticipated to be required. |
| | | Small support vessels (resupply vessels, tenders and landing barges)<br>• tenders used to transport personnel and light-weight equipment to and from shorelines<br>• landing barges used to transport heavier equipment and backload waste from shorelines<br>• small support vessels (20-40m) used to resupply the ASV<br>For a worst credible spill response at a remote shoreline, two tenders, a landing barge and logistic supply vessel is anticipated to be required (total of 4 small support vessels) |
| | | Crew change helicopter<br>• provide for routine crew change of response personnel between the mainland and the accommodation support vessel<br>For a worst credible spill response at a remote shoreline, only a single crew change helicopter is anticipated to be required. |
| | | Light utility helicopter<br>• provide an alternative mechanism to land personnel and light equipment onto a shoreline, in the event that sea conditions are prohibitive to marine vessel access<br>• using a sling, provide an alternative mechanism to move heavier equipment and backload waste between a shoreline and a support vessel, in the event that sea conditions are prohibitive to marine vessel access<br>For a worst credible spill response at a remote shoreline, only a single light utility helicopter is anticipated to be required. |

**Table 8-11: Oil spill response arrangements and capability evaluation**

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| Oil spill trajectory modelling (OSTM) - access to OSTM services<br>[within 2 hours of IMT formation] | OSTM will be used to forecast the trajectory and fate of oil plumes resulting from surface or subsurface releases. OSTM is an iterative process using real-time observations to refine modelling predictions. No alternatives have been identified that could improve this oil spill response control. | OSTM requires access to information provided by the field and time for computers to process the data. Consequently, no alternatives have been identified to implement this service in less than 2 hours after the IMT activates and provides the data to the OSTM service provider. | The purpose of OSTM is to provide spill trajectory forecasts, to enable the IMT to develop IAPs, and commence implementing secondary spill response activities which would be implemented in the days after the initial response.<br>Reducing the activation timeframe of OSTM would not provide any benefit in relation to 'first strike' activities. Therefore, there is no benefit in reducing the activation timeframes. |
| Aerial surveillance with aircraft of opportunity using untrained observers will be available and may involve using any of the following:<br>• crew change helicopters that can be mobilised or diverted with two pilots (second pilot can act as a spotter and record observations)<br>• fixed-wing aircraft available on a best endeavours basis, via call-off contract.<br>[within 5 hours of IMT activation *] | Aerial surveillance is used to provide situational awareness of the slick size, type and location to the IMT.<br>Aerial surveillance can only be undertaken during daylight hours and is guided using the OSTM modelling results and tracker buoy locations.<br>There is a dedicated full-time Search and Rescue helicopter, plus a minimum of four crew change helicopters available in Broome at all times. | As the nearest emergent receptors are tens of km from the drilling location, immediate aerial surveillance is not critical to the IMT's first strike or ongoing IAP development requirements. The shortest time to contact (>100 g/m$^2$) was predicted at Browse Island (137 hours) (RPS 2019c).<br>It may be possible to mobilise in a shorter period as a crew change helicopter could be cancelled and diverted to the spill location immediately if safe to do so, and not required for higher priority safety/evacuation related tasks. | The quality of information provided by a faster or greater response is not expected to be improved to a level that would result in substantial environmental benefits.<br>Other techniques, such as OSTM will be implemented in parallel with aerial and/or vessel observations. This combination of data is considered sufficient to inform the IMTs situational awareness during the early stages of a spill response. |

| **Oil spill response control [minimum implementation time]** | **Can a greater response effort be implemented?** | **Can the time to respond be improved?** | **Environmental benefit of increased response effort/reduced response time** |
|---|---|---|---|
| | The crew change helicopters have the INPEX oil spill observation aid available, ready for use during a spill event.<br>This resource can be mobilised to WA-50-L within 5 hours.<br>Fixed wing aircraft on call-off contracts for rapid mobilisation are only available during the cyclone-season. During the dry-season, fixed wing aircraft are utilised by the tourism industry, and therefore these fixed wing aircraft service providers will not guarantee mobilisation within specified timeframes during the dry season, however will provide services on a best-endeavours basis.<br>The fixed wing aircraft response could be improved by having an additional dedicated fixed wing aircraft available for 12 months of the year at $100,000 per month. The cost for this is not considered reasonable based on the availability of alternative means of aerial surveillance (helicopter surveillance available all year). The addition of an extra aircraft will not significantly reduce the time of response. | To guarantee a faster response time, additional dedicated fixed wing aircraft at cost $100,000 per month could be positioned at Broome, Truscott or Darwin. The cost for this is not considered reasonable, as the current arrangements enable aerial surveillance of the licence area within 5 hours (daylight only). | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | The accuracy of aerial surveillance data reported to the IMT could be improved though the use of trained aerial observers experienced and able to reliably detect, recognise and record oil pollution at sea.<br>There would be additional training costs associated with training helicopter and fixed wing pilots in aerial oil spill observers. The INPEX oil spill observation aid is considered a suitable substitute to formal training and is appropriate for use during the first 24-48 hours of the spill, when the spill is likely to be located in a small geographical area.<br>Trained aerial observers, for use during a protracted spill response are available via AMOSC. These personnel can be mobilised to Broome within 48 hours. | | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| Aerial surveillance using 1 x trained aerial observer<br>[within 48 hours] | Personnel formally trained through the AMOSC aerial observer course could be used, to increase the quality of aerial observer data received by the IMT during the spill response.<br>However, the quality of data that would be received by the IMT, from personnel such as a helicopter co-pilot using the INPEX oil spill observation aid, and data from other operational and monitoring evaluation techniques, should still provide adequate information for the INPEX IMT to conduct its role, especially during the first 24 hours of a spill, where the slick is expected to remain close to the release location (RPS 2019c).<br>It should be noted that the crew-change helicopter pilots are familiar with observing the natural colours and shades of the ocean in the Browse Basin/Timor Sea area, and therefore less likely to mis-interpret natural phenomenon such as cloud-shadow or algal bloom for oil slicks.<br>Also, without additional oil spill observation aircraft, additional trained personnel do not provide further value. | To implement aerial surveillance sooner using trained aerial observers, the only identified method would be to have observers on a stand-by contract, located in Broome. However, this additional standby cost is not considered reasonable, given INPEX has crew-change helicopter pilots available in Broome, equipped with the INPEX oil spill observation aid, which should provide adequate initial visual observation information to the IMT for planning purposes during the initial stage of the spill response. | The increased quality of data that could be received by the IMT during the initial stages of a spill response using pre-positioned trained aerial observers, compared to the quality of data received using pilots as observers (using the INPEX oil spill observation aid and data from other operational and monitoring evaluation techniques) will not significantly increase the IMTs situational awareness and ability to develop and implement effective IAPs. Therefore, a greater and/or faster response time is not considered ALARP. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| Vessel surveillance<br>[within 48 hours for large PSV; within 24 hours for small support vessel] | A typical platform support vessel bridge is 10 m to 20 m above sea level. A small support vessel bridge may only be 3 m to 5 m above sea level. Due to this low visual elevation (compared to aerial surveillance platforms) and vessel speed (~14 knots), the observational data a vessel of any size can provide is significantly limited, compared to the observation data able to be obtained by aerial observers.<br>Therefore, additional vessels could be mobilised, however a greater level and quality of information will be obtained by focusing resources on mobilising aerial observation platforms instead.<br>Vessel surveillance during the initial stages of a loss of well containment is not considered safe due to the potential for a flammable atmosphere and a limited surface slick is expected in the longer term. | Vessel surveillance could be undertaken faster if a MODU PSV was available however this cannot be guaranteed as the available vessels, including those supporting offshore facilities in the licence area (such as the INPEX Ichthys CPF/FPSO, and nearby Shell Prelude FLNG) may be being used for other emergency response operations.<br>A PSV on route between the WA mainland and WA-50-L would potentially be available to undertake vessel surveillance in <48 hours, however again this cannot be guaranteed.<br>There may also be safety considerations that prevent vessel access in the vicinity of the spill due to a flammable atmosphere. | The environmental impacts and risks from a spill are not directly affected by this response technique, as the objective is to provide situational awareness to the IMT and to inform on other response techniques. The information provided by a quicker or greater response is not expected to be significant enough to result in substantial environmental benefits.<br>Aerial surveillance and OSTM will provide the greatest level of situational awareness to the IMT.<br>It should be noted that in the event of a vessel collision, the damaged vessel would not be able to conduct vessel surveillance activities, and other vessels may be prioritised to complete tasks that are not directly related to the oil spill response, such as transfer of injured personnel to nearby facilities or to shore, supporting the damages vessels involved in the collision, or search and rescue operations. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | The time to mobilise a separate PSV, purely dedicated to conduct vessel surveillance, from Darwin or Broome wharf, loaded with crew and provisions and sail to location cannot be improved to less than 48 hours. There are less berth spaces available on wharfs in Broome and Darwin for these larger vessels. Therefore, immediate access to wharf space cannot be guaranteed. Additional time alongside the wharf is also required for bunkering and provisioning a large vessel. Therefore, at least 24 hours is required for mobilisation activities in Broome or Darwin. The vessel also requires at least 18-24 hours to transit to the spill location.<br><br>Smaller support vessels are available in Broome and Darwin. These smaller vessels, in an emergency, could be along-side a smaller wharf to load marine crew, spill and supplies within 6 hours, and then transit to the spill location within approximately 24 hours from the time they were activated (assuming vessel speed of 14 knots). | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | Whilst small support vessels can be mobilised to the location of the spill faster than larger support vessels, small vessel bridges are much closer to the sea surface, and therefore are of limited value as an oil spill observation platform. Aerial surveillance is considerably faster than any vessel surveillance platform. Therefore, resources will be focused on aerial surveillance, rather than vessel surveillance. | |
| Electronic surface tracking buoy will be available for deployment immediately from the drilling support vessels.<br>[immediate – upon drilling support vessel arrival at the slick location] | The primary purpose of the tracking buoys is to assist with situational awareness of the IMT during periods when aerial surveillance isn't available (e.g. night-time), and for the longer-term validation of the OSTM.<br>INPEX maintain a total of ten tracker buoys, which are positioned at different locations, depending on the activities underway.<br>During drilling, one tracker buoy will remain on each drilling support vessel.<br>One support vessel will always be in the vicinity of the MODU, and therefore one tracker buoy will always be able to be deployed almost immediately, within the general vicinity of the MODU. | No additional measures have been identified which could improve the timeliness of deployment of tracker buoys. | Sufficient provision has been made for deployment of multiple tracker buoys as quickly as possible, and data will be received by the IMT via web-link. No additional environmental benefits can be achieved through improving the number or location of additional tracker buoys. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | Additional tracker buoys will be available on the other support vessels.<br>The Ichthys CPF and FPSO (within the licence area) also maintain one oil spill tracker buoy each, which could be mobilised to the location and deployed during the early stages of a spill occurring.<br>Additional tracker buoys could be mobilised from Broome or Darwin, if required.<br>More tracker buoys are available via AMOSC, if required. | | |
| Satellite imagery analysis - obtain satellite imagery providers.<br>[within 48 hours] | Information gained from satellite imagery would be used in combination with other controls such as aerial/vessel surveillance and OSTM, to improve the IMT's situational awareness.<br>No greater response effort has been identified. | This service cannot be provided faster as access to satellite imagery is limited due to the continuous movement and orbit of satellites around the globe. This results in up to 48-hour delays to obtain satellite imagery from service providers. | No environmental benefits identified.<br>Satellite imagery is a tool which assists with overall validation of spill modelling and aerial surveillance, however the IMT will still maintain a high level of situation awareness, if satellite imagery isn't immediately available. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| Vessel response - spill response vessel equipped with wildlife hazing, oiled wildlife response, shoreline clean–up.<br>[available to mobilise and depart from Broome within 48 hours for large PSV; within 24 hours for small support vessel] | Additional vessels can be provided if required under the existing call-off contracts described within the OPEP.<br>These contracts include larger vessels such as PSVs, and many medium to small support vessels (< 30m length).<br>Larger vessels could be used for activities such as wildlife hazing using their water cannons and airhorns, and as accommodation vessels to support shoreline response activities.<br>Small support vessels can be used for supporting shallow water response activities. The very small support vessels (<6m in length) can be used for shoreline landings and intertidal access for activities such as shallow water wildlife hazing.<br>Each vessel can be loaded with different spill response equipment as relevant to the response activity and location.<br>Therefore, a suitable response capacity is deemed to have been provided in this regard. | Due to space limitations, spill response equipment cannot be stored on the MODU or support vessels in WA-50-L.<br>INPEX can mobilise any available large support vessel (e.g. a PSV) from the licence area (or other vessels in Ichthys Field) to Broome, load with supplies and personnel, and return to the licence area within 48 hours. Transit each way takes 18-24 hours, and up to 12 hours is required for loading in Broome.<br>Similar timeframes are also required to mobilise, load the vessel and transit to the spill location for large support vessels/equipment departing from Darwin.<br>The timeframe, for mobilising vessels already on hire, cannot be guaranteed to be less than 48 hours.<br>Other large PSVs are also potentially available in Dampier and would require approximately 48 hours to transit to Broome and commence mobilisation. | Implementing a faster vessel-based response may provide an environmental benefit, by preventing the oiling of some animals at offshore islands. However due to the limited shorelines expected to be exposed, and small volumes ashore (worst case 11.8 $m^3$ at Browse Island), benefits would only be expected to be limited.<br>If poor weather conditions are limiting vessel-based responses, these same weather conditions would also be significantly increasing surface oil entrainment, reducing volumes of oil ashore and increasing natural weathering of any oil on shorelines. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | It should be noted that strong winds and elevated sea-states will limit the effectiveness of most vessel-based response activities and there is no additional capability that can overcome this limitation. | 12 hours is required at the wharf to load provisions, equipment and conduct bunkering activities. Additionally, there is no guarantee that wharf space will be available for large vessels at short notice.<br>To improve the response time, it would be necessary to maintain a large vessel on stand-by in Broome or Darwin. This would incur stand by costs of approximately $20,000 per vessel per day. Any vessel would still need to wait for wharf space to become available, to load the relevant response equipment, then depart for the spill location. The additional cost is not considered reasonable, given that the response time would only be reduced by perhaps 12 to 24 hours.<br>It should be noted that the relocation of equipment stockpiles from their storage facilities in Broome/Darwin to the wharf will not result in any additional time, as the positioning of this equipment on the wharf would occur whilst the support vessel is in transit to Broome/ Darwin. | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | Smaller support vessels (< 30 m) are available in Broome and Darwin. These smaller vessels, in an emergency, could be along-side a smaller wharf to load marine crew, spill response equipment and supplies within 6 hours, and then transit to the required offshore location within approximately 24 hours from the time they were activated (assuming a vessel speed of 14 knots).<br>It should be noted that the duration of the small support vessel to reach the spill location, will be dependent on weather and vessel speed. In addition, if a small support vessel is towing a tender, (for shoreline access), vessel speeds will be limited to 10 knots, resulting approximately 30% additional transit time to the spill location.<br>These smaller vessels can support most other spill response activities, including wildlife hazing and shoreline response activities.<br>The only identified method to further improve the speed of a vessel-based response would be to have additional vessels on stand-by pre-loaded with spill response equipment. | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | The various spill response equipment stockpiles in Darwin and Broome require regular maintenance, testing and checking and therefore can't be permanently stored and maintained on board a vessel.<br>In addition, there may be an operational requirement to have specific equipment from the stockpiles mobilised to different locations on different types of vessels, depending on the nature of the spill, receptors at risk and weather conditions at the time.<br>It is not possible (space and weight limitations) to store and maintain all potentially required types of equipment offshore at all times. | |
| Vessel-based wildlife hazing equipment including vessels and vessel fog horns / water cannons.<br>[Within 48 hours] | Other equipment could be purchased such as bird scarers however vessel fog horns/water cannons will achieve the same result, of locally dispersing fauna from an immediate location (however this may just result in moving the wildlife to another location of the slick). | Response times are dependent on the spill location, vessel mobilisation times and vessel transit times, as described above in vessel response. | Implementing a faster or greater wildlife hazing response may assist in preventing oiling of wildlife. However, given there are many limitations to the success of wildlife hazing, detailed in Strategic SIMA, more rapid or greater provision of vessel numbers or mobilisation timeframes compared to that provided is not considered reasonable. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | Increasing the number of vessels may result in greater effectiveness of wildlife hazing, if a geographically appropriate location for hazing was identified. INPEX has a range of vessels it can mobilise for the purpose via vessel call-off contracts. These also include access to other vessels supporting other operations in the area. | | |
| Light utility helicopter – use of a light utility helicopter suitable for landing on remote shorelines for OWR and shoreline clean-up.<br>Available under INPEX aviation call-off arrangements.<br>[within 7 days] | Using a BK-117, H-135 or H-145 light utility helicopter, the helicopter's maximum capacity is two pilots transporting six passengers.<br>The use of additional utility helicopters would enable more responders to access the affected location. However, this will require additional helicopter landing pads/locations to accommodate the helicopter overnight. To mobilise and maintain a second light utility helicopter offshore, a very large support vessel equipped with a helicopter pad would be required. The costs associated with this large support vessel and second helicopter would be in excess of $100,000 per day.<br>Under a worst credible scenario, only a single remote shoreline operation requiring the use of a light utility helicopter is anticipated. | The minimum requirements for a helicopter to support oil spill response activities at remote shoreline locations are:<br>• capacity to carry at least 6 personnel and their equipment,<br>• ability to be fitted with cargo hooks for the ability to sling loads (i.e. equipment/waste) between the shoreline and nearby support vessels.<br>• long range fuel tanks due to the distance offshore<br>• twin engines<br>• life raft, satellite tracking and other safety systems. | The ability to transport additional people and equipment using additional helicopters can enable quicker ramp up of the workforce and faster rate / capacity of the response, if sea-state is limiting vessel response capabilities.<br>A faster mobilisation of a utility helicopter may result in a quicker commencement of shoreline response activities.<br>However, under circumstances where helicopter mobilisation times may be restrictive, vessel-based shoreline responses can be mounted within a few days. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | Under the International Civil Aviation Organization (ICAO) Annex 6 Civil Aviation Safety Regulation (CASR) 133, transport category helicopters with a seating capacity of >19 must be operated under Performance Class 1 or Category A. Therefore, crew transfer helicopters, including the search and rescue (SAR) helicopter, are not available for shoreline oil spill response support activities.<br>In addition, whilst the Sikorsky S-92s used for INPEX crew changes meet some of the criteria e.g. personnel capacity, twin engines and long-range fuel tanks required to access remote areas.<br>However, they do not have the capability to sling equipment as they cannot be configured with cargo hooks. In addition, because of the size of the helicopter the downwash generated is in excess of 125 km/h and landing on unprepared sites can cause “brownout” conditions which can restrict visibility due to the recirculation effect of the rotor downwash. Therefore, these helicopters are not deemed suitable for remote shoreline operations. | If poor weather conditions are limiting vessel-based responses, these same weather conditions would also be significantly increasing the entrainment of any surface oil, reducing volumes of oil ashore and increasing natural weathering of any oil on shorelines.<br>Therefore, the additional cost of maintaining a helicopter on stand-by for faster mobilisation is not considered to be ALARP, even if the costs were shared with another near-by operator. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | Smaller helicopters can be operated under Performance Class 2 or 3 (Category B) and under ICAO Annex 6 CASR 133 and the Civil Aviation Safety Authority (CASA) regulations may be able to land at remote shoreline locations with extreme caution.<br>Under the International Association of Oil and Gas Producers (IOGP) Aircraft Management Guidelines<br>Document 390, INPEX risk assessments, the INPEX Refuelling Handbook and CASA Civil Aviation Advisory Publication (CAAP) 234-1 (2) Para 5.4.2 recommends all aircraft operating under charter should have sufficient fuel to fly to an alternate aerodrome which is not a remote island. For example, for a response at Cartier Island, the closest usable airport would be Truscott/Mungalalu Airbase. The remoteness of other potential shoreline response locations along the WA coastline presents similar challenges.<br>A PSV with a helicopter deck could however be considered an alternative landing location to the remote island, assisting in redundancy landing locations for remote helicopter activities. | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | Based on the distance of Cartier Island to Truscott/Mungalalu and the requirement for smaller helicopter types that can land at remote islands, the most suitable twin-engine helicopter types identified were the MBB Kawasaki BK-117 and the Airbus H-135 or H-145 (if fitted with a long-range fuel tank).<br>Small helicopters such as BELL 206, AS350B and EC120 are capable of landing on remote islands with difficult access. However, they have single engines and were ruled out as they do not meet INPEX's aviation standards for safety, fuel range or have the ability to transport enough people/equipment to implement an effective response.<br>Small helicopters, such as the BK-117 and Airbus H-135 or H-145, are generally working under contract with many configured in an air ambulance role or surf rescue role. The market for surplus available aircraft around Australia is therefore limited and the response time cannot be guaranteed. | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | The response implementation time could be improved to <7 days if a BK-117, H-135 or a long-range H-145 helicopter was positioned, on standby in Broome or Darwin on a permanent basis. The high cost (estimated at AUD $1.5–2.0 million per year) of maintaining this capability, including the hire of the aircraft, pilots on standby, reoccurring training and maintenance of the aircraft, is considered to be grossly disproportionate to the environmental benefit gained.<br>This is because the spill (and resulting offshore impacts) has already occurred and pre-contact wildlife hazing or translocation at a shoreline has a low likelihood of significant impact reduction. It is not expected that a significant improvement for the environment would be achieved if post-contact wildlife response or shoreline clean-up commenced within the first 7 days or whether it occurs from day 7 onwards, noting minimum time to contact >100 g/m$^2$ is 137 hours (6 days). | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | | Other arrangements to get people and equipment on to remote shorelines to undertake oil spill response activities, without the use of a helicopter, have been considered. Vessel access to remote shorelines such as at Browse Island or Cartier Island can be achieved (noting some weather/met-ocean potential limitations). Vessel based response timings are discussed above.<br>It should be noted that if heavy sea conditions were restricting vessel access, this same wave action would be increasing the natural break-up and weathering of oil at sea and on shorelines. | |
| Oiled wildlife response personnel –<br>The Oiled Wildlife Division Coordinator and Oiled Wildlife Advisor role, within an IMT, would be provided by the WA DBCA for WA shoreline responses. If however the response was at an Australian commonwealth island such as Ashmore or Cartier, the AMOSC core-group OWR trained personnel could undertake this role within the IMT. | There is an appropriate limit to the number of personnel that should be put ashore during shoreline response in a sensitive location, to avoid additional impacts, e.g. trampling of turtle nests and disturbance to bird feeding/roosting/nesting behaviours. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers is desired. | As oiled wildlife response will most likely be undertaken on a shoreline, the Control Agency will most likely be the WA DoT. The key oiled wildlife specialists (i.e. WA DBCA oiled wildlife advisers and associated field responders, acting on behalf of the relevant Control Agency) are likely to mobilise with an oiled wildlife response activity. Personnel from these government agencies are living/working in Darwin and Broome, and therefore their mobilisation should not limit mobilisation timeframes. | Given the limited likelihood and predicted time to shoreline contact, expected weathering of oil, limited volumes ashore, the rapid mobilisation of a larger OWR team would be unlikely to results in a significant tangible environmental benefit.<br>Also, there are additional risks of wildlife disturbance associated with mobilising large wildlife response teams to small, remote offshore locations. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| In the field, the OWR team would be led by the relevant personnel from WA DBCA supported by the AMOSC OWR Team.<br>Trained OWR personnel are available through the Oiled Wildlife Rehabilitators Network (approximately 100 personnel), and Philip Island Nature Park (approximately 100 personnel).<br>INPEX could provide additional personnel via INPEX Master Service Agreement with Environmental Service Providers, or other labour hire companies.<br>A minimum of 20 personnel could be ready to mobilise from Broome/Darwin.<br>[Within 24 hours] | The areas of potential shoreline impacted are remote and therefore, numbers of responders are also limited by accommodation and logistics support. For offshore islands with the ability for helicopters to safely land, it is estimated that up to 24 personnel could work onshore on a single day, based on one utility helicopter conducting the daily transits to and from shore. Similar numbers would be expected using small boats for shoreline access. However, it should be noted that personnel numbers are not constrained, as INPEX's arrangements with contracted labour hire and other industry capability (e.g. AMOSC) provides access to additional personnel if required.<br>While multiple shorelines may be assessed (to confirm presence/ absence of shoreline oiling/oiled wildlife), only a single offshore remote island/shoreline is envisaged requiring a large oiled wildlife response, even for a worst credible spill scenario. | Additional trained OWR trained personnel could be positioned on stand-by in Broome/Darwin. However, as personnel can be mobilised from around Australia to Broome/Darwin in a similar timeframe as which vessels can be mobilised to these ports, this is not considered to be reasonable given the high cost and low likelihood of needing to implement an oiled wildlife response. | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| Oiled wildlife response kits, including the kit in Broome can be mobilised from the AMOSC Broome stockpile to a support vessel alongside in Broome.<br>[24 hours] | INPEX could purchase additional OWR kits/containers however as response planning indicates that OWR centres are most likely to be set up 'on-water', the number of centres is limited to the number of shorelines requiring the OWR centre.<br>Only a single 'on water' OWR centre is envisaged, even for a worst credible spill scenario.<br>Additional OWR kits are available around Australia, accessed via the Nat Plan.<br>In addition, the types of equipment contained in the OWR kits onshore is equipment that is typically maintained and available as part of routine supplies on support vessels and the MODU, and therefore resupply or bulking of stocks of OWR kits at an 'on-water' centre should not present a limitation to the response capability. | AMOSC OWR kits are present in Broome and are available to be deployed.<br>This response cannot be implemented faster, without maintaining an OWR kit and associated trained personnel onboard a support vessel, offshore at all times.<br>This is not considered reasonable given the high cost and impracticality compared to the low likelihood of needing an oiled wildlife response.<br>Also, the trained personnel, such as veterinarians, would not be able to maintain their training/skills, if based offshore at all times. | Response planning indicates that a single 'on water' OWR centre would be appropriate, with additional 'on water' centres and the associated people and transport logistics not required, even under worst case scenarios.<br>Maintaining an OWR kit and associated trained personnel offshore, to increase the speed of the response is not considered practicable nor ALARP. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| Shoreline clean-up trained personnel -<br>Response experts would be provided by AMOSC core-group.<br>Additional labour would be provided by INPEX.<br>A minimum of 20 personnel would be ready to mobilise from Broome/Darwin.<br>[Within 24 hours] | Increasing the number of shoreline clean-up personnel can increase the rate at which oil is removed from a shoreline.<br>Personnel numbers can be increased as required to respond to the specific spill scenario and therefore numbers are not constrained.<br>However, personnel numbers onshore will be limited by a range of external factors.<br>There is an appropriate limit to the number of personnel that should be put ashore during shoreline response in a sensitive location, to avoid additional impacts, e.g. trampling of turtle nests and disturbance to bird feeding/roosting/nesting behaviours. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers is desired.<br>If vessels are used for access, sea-state and tides can prevent shore-landings. However, if sea-state and tides are forecast to be good for shore-landings, larger groups can mobilise. | Additional trained shoreline clean-up personnel could be positioned on stand-by in Broome/Darwin. However, as personnel can be mobilised from around Australia to Broome/Darwin in a similar timeframe as vessels can be mobilised to these ports, this is not considered to be reasonable given the high cost and low likelihood of needing to implement a shoreline clean-up response. | Due to the labour hire arrangements INPEX has in place, personnel numbers are not limited. It is therefore, vessels and helicopters, and environmental considerations that will limit this response capacity.<br>Given the arrangements in place, to mobilise within 24 hours, the key trained personnel (AMOSC core-group members) required to lead a shoreline clean-up, the benefits of a slightly faster response by maintaining these trained personnel in Broome/Darwin are not considered reasonable given the high associated financial costs.<br>Also, there are additional risks of wildlife disturbance associated with mobilising large shoreline clean-up teams to small, remote offshore locations. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | If a light utility helicopter is used for shoreline clean-up, sea-state and tidal access issues are eliminated and up to 24 personnel could work ashore in any single day (based on helicopter pilot duty hour limitations).<br>Additional personnel could be transferred using small vessels (sea-state permitting).<br>While multiple shorelines may be assessed (to confirm presence/absence of shoreline oiling), only a single remote island/shoreline is envisaged requiring a large shoreline response, even for a worst credible spill scenario. | | |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| Shoreline clean-up manual cleaning equipment can be mobilised from the Broome/ Darwin stockpiles to a support vessel alongside in Broome/Darwin Port or to other remote mainland locations.<br>[24 hours] | Machinery such as graders could be used to potentially assist with shoreline clean-up, however this often creates a larger volume of oily contaminated sands to be removed. In addition, heavy machinery could damage sensitive turtle nesting habitat, disturb other wildlife and may not be accessible for remote offshore islands. Therefore, response equipment will almost certainly be limited to hand-held equipment, which results in less disturbance when conducting a clean-up operation. Consequently, increasing response effort is limited to increasing numbers of personnel and manual cleaning equipment (shovels etc.). Sufficient equipment is considered available within existing stockpiles. Additional manual clean-up equipment can be purchased at retail outlets, as required in Broome or Darwin. | Manual cleaning equipment can be mobilised to the wharf from the Broome/Darwin stockpiles in 6 hours. Any improvement on this is not warranted as the vessels will not be ready in a shorter duration of time. | There is no environmental benefit to utilising heavy machinery for shoreline clean-up. Manual clean-up equipment is readily available and will not limit response time. |
| Waste management contract enables access to sufficient waste receptacles to be provided to meet the first response vessel.<br>[Immediate] | No greater response effort can be obtained as the waste contract allows for immediate delivery of waste receptacles to be mobilised offshore, when requested by INPEX. | n/a | No additional environmental benefits have been identified. |

| Oil spill response control [minimum implementation time] | Can a greater response effort be implemented? | Can the time to respond be improved? | Environmental benefit of increased response effort/reduced response time |
|---|---|---|---|
| | Based on the estimated worst-case volume of oil accumulated on shorelines (120 $m^3$) and a bulking factor for waste created of 10:1 it is estimated that approximately 1200 $m^3$ of waste could be generated.<br>Shoreline clean-up waste would likely be captured in bulka-bags and 1 $m^3$ Intermediate Bulk Containers (IBCs). Therefore approximately 1200 $m^3$ of bulka-bag/IBC waste capacity would be required, over the full duration (weeks) of any shoreline clean-up. There are no limitations to obtaining this waste storage capacity and no benefit obtained by accessing additional waste storage capacity. | | |

* All timings are based on the assumption that the spill occurs, and response is implemented in daylight hours where visibility is critical for successful implementation.

## 8.6 Oil spill response strategies

As identified in the SIMA (Appendix E) not all response strategies are appropriate for every hydrocarbon spill, and as discussed in Table 8-9, not all response strategies are appropriate for the specific spill scenarios associated with the activity. Different types of hydrocarbon, spill locations and spill volumes require different response strategies, or combinations of techniques, to implement an effective response.

Based on the SIMA and subsequent evaluations (Table 8-9), INPEX has identified a set of primary and secondary response strategies to reduce the impacts and risks of hydrocarbon spills from the petroleum activity to ALARP. However, the deployment of response strategies has the potential to introduce further impacts and risks.

### 8.6.1 Primary response strategy

Operational monitoring and evaluation has been determined as the only appropriate primary (first strike) response measure for all hydrocarbon spills. This involves surveillance and reconnaissance, using vessels, aircraft, satellite imagery and satellite tracking buoys to monitor the size, trajectory, weathering and fate of the hydrocarbon spill.

The information obtained through the surveillance and reconnaissance program will inform spill modelling and the development of IAPs, which will include consideration of the use of secondary response strategies, as identified in the SIMA.

As stated in Table 8-5, source control will always be implemented in the event of a loss of well containment and is discussed further in Section 8.7.

### 8.6.2 Secondary response strategy

The following secondary response strategies have been determined as potentially applicable (depending on hydrocarbon type). An impact and risk evaluation for the implementation of these response strategies is presented in Table 8-12.

**Table 8-12: Impact and risk evaluation – implementation of response strategies**

| Identify hazards and threats |
|---|
| **Primary response strategy – monitoring and evaluation.** |
| Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. |
| Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. |
| The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. |
| **Secondary response strategy – pre-contact wildlife response.** |
| Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. |
| Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. |
| The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. |
| Poorly implemented wildlife response has the potential to cause stress or suffering to wildlife impacted by a spill. |
| **Secondary response strategies –post-contact wildlife response.** |
| Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. |
| Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity. |
| The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions. |
| Capture, cleaning and rehabilitation of oiled wildlife has the potential to create additional stress to animals. |
| The movement of equipment and personnel onto offshore islands has the potential to introduce terrestrial exotic pests, including rats. |
| The movement of personnel and equipment onto offshore islands has the potential to disturb turtle nests and turtle-nesting activities. |
| **Secondary response strategy – shoreline clean-up.** |
| Routine sewage effluent, grey water and food waste discharges from vessels used in oil spill response, when located close to shorelines (such as turtle and marine avifauna breeding rookeries), could result in the exposure of EPBC-listed species to untreated/non-macerated discharges. |

| | |
|---|---|
| Accidental release of waste overboard as a result of inappropriate management may result in impacts to marine fauna through entanglement or ingestion of waste material, with the potential to result in injury. Inappropriate waste management also has the potential to expose marine flora and fauna to changes in water quality and may result in reduced ecosystem productivity or diversity.<br>The physical presence of vessels used in the response strategy has the potential for vessel-to-vessel collisions.<br>The movement of equipment and personnel onto offshore islands has the potential to introduce terrestrial exotic pests, including rats.<br>The movement of personnel and equipment onto offshore islands has the potential to disturb turtle nests and turtle-nesting activities.<br>Incorrect management of hydrocarbon-contaminated wastes generated during shoreline clean-up has the potential to create additional contamination of the shoreline. | |
| **Potential consequence: Primary response strategy – monitoring and evaluation** | **Severity** |
| The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna including foraging BIAs). Monitoring and evaluation does not provide any material changes to the trajectory of the spill. Instead, it provides critical information on the fate, nature and weathering of the spill, as a result of exposure to natural biological and physical degradation processes. The strategy can be used to inform other response strategies and emergency response priorities. Since this strategy does not provide any material changes to the trajectory of the spill, the inherent impacts of the hydrocarbon on marine fauna in the trajectory of the spill will remain until natural degradation/weathering reduces the impacts of the spill.<br>Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of WA coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F).<br>Various conservation management plans (refer to Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F).<br>The physical presence of vessels during the implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-8. | Insignificant (F) |
| **Potential consequence: Secondary response strategy – pre-contact wildlife response (wildlife hazing)** | **Severity** |
| The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna including BIAs associated with turtle and marine avifauna nesting). | Insignificant (F) |

| | |
|---|---|
| Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna, may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of WA coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F).<br>Various conservation management plans (refer to Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F).<br>The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-8.<br>A wildlife response strategy can increase the survival of wildlife potentially affected by a spill (particularly seabirds, marine mammals and reptiles in transit) by encouraging wildlife to move away from the location of the spill (IPIECA 2017b). There may be potential for increased stress to wildlife individuals subjected to hazing activities, or the potential to cause wildlife to move into the area affected by the spill from poorly implemented hazing activities (IPIECA 2017b). Therefore, any potential impacts would be only to individuals of a population, and as the activity is being undertaken to reduce impacts, the impact is considered Insignificant (F). | |
| **Potential consequence: Secondary response strategy – pre-contact (translocation) and post-contact wildlife response** | **Severity** |
| The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (turtles and marine avifauna).<br>Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of WA coastlines, any temporary changes to water quality that may occur are expected to be short term and localised, and are therefore considered to be Insignificant (F). | Moderate (D) |

| | |
|---|---|
| Various conservation management plans (refer to Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F).<br>The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-8.<br>Pre-contact and post-contact wildlife response (capture, cleaning, relocation and rehabilitation of wildlife) can increase the survival rates of wildlife which may be, or has become, oiled at sea or onshore. There may be a potential for increased stress to some animals during capture, cleaning, relocation and/or rehabilitation (IPIECA 2017b). However, any potential impacts are considered to be of inconsequential ecological significance to protected species, as the capture, relocation cleaning, relocation and/or rehabilitation is conducted to increase survival rates of individuals (Insignificant F).<br>The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares* (DEWHA 2009) identifies that exotic rodents (such as rats) have been a major cause of extinction and decline of island biodiversity. Introduction of rodents to any of the offshore islands in the EMBA could result in a medium-term impact on a population of protected species (Moderate D).<br>Physical presence and movement of personnel across turtle-nesting beaches could potentially cause damage to buried turtle eggs, reducing turtle-nesting success. Artificial light is known to disorientate marine turtles, particularly hatchlings and female adults returning to the sea from nesting areas on the shore (Pendoley 2005). Incorrect management of personnel and equipment on turtle-nesting beaches could result in a minor impact on a small proportion of a turtle-nesting population (Minor E). | |
| **Potential consequence: Secondary response strategy – shoreline clean-up** | **Severity** |
| The values and sensitivities with the potential to be impacted are transient, EPBC-listed species (marine fauna) and marine fauna BIAs in the EMBA (turtles and marine avifauna nesting).<br>Due to the types of small vessels which may support an oil spill response, all vessels may not be fitted with sewage disinfection systems, sewage macerators or food macerators. Therefore, EPBC-listed species, such as marine turtles and marine avifauna may be exposed to untreated sewage, grey water and food scraps, particularly when response vessels are conducting activities near breeding rookeries, such as Browse Island, Cartier Island and Scott Reef. The duration of any exposure is likely to be limited to between a few days and a number of weeks, depending on the duration of the oil spill response activity. Due to the local currents and deep offshore waters surrounding these offshore islands, and higher currents around nearshore waters of WA coastlines, any temporary changes to water quality that may occur are expected to be short term and localised and are therefore considered to be Insignificant (F). | Moderate (D) |

| | |
|---|---|
| Various conservation management plans (refer to Appendix B) identify inappropriate waste management as a key threatening process to the recovery of EPBC-listed species. Inappropriate storage and handling of solid and liquid wastes generated through routine operations during an oil spill response could result in impacts to individuals of transient, EPBC-listed species, resulting in isolated and localised impacts only. Therefore, the consequence is considered to be Insignificant (F).<br>The physical presence of vessels during implementation of this response strategy has the potential to increase the risk of a vessel-to-vessel collision. The consequences of a vessel collision are discussed in Table 8-8.<br>The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares* (DEWHA 2009) identifies that exotic rodents (such as rats) have been a major cause of extinction and decline of island biodiversity. Introduction of rodents to any of the offshore islands in the EMBA could result in a medium-term impact on a population of protected species (Moderate D).<br>Physical presence and movement of personnel across turtle-nesting beaches could potentially cause damage to buried turtle eggs, reducing turtle-nesting success. Artificial light is known to disorientate marine turtles, particularly hatchlings and female adults returning to the sea from nesting areas on the shore (Pendoley 2005). Incorrect management of personnel and equipment on turtle-nesting beaches could result in a minor impact on a small proportion of a turtle-nesting population (Minor E).<br>A shoreline clean-up response will generate a significant quantity of hydrocarbon-contaminated solid waste. Contaminated solids will include personal protective equipment (PPE), spill clean-up equipment (shovels, rakes, etc.) and the oil-contaminated sediments collected from shorelines (IPIECA 2015). Inappropriate management of oil-contaminated waste could result in localised contamination of shoreline sediments and harm to individuals of protected species (Minor E). | |
| **Identify existing design safeguards/controls** | |
| Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the *Navigation Act 2012*.<br>Due to the nature of call-off vessels that may be used during an oil spill response, not all vessels can be confirmed to be equipped with onboard sewage treatment plants compliant with MARPOL 73/78 (depending on the sewage treatment plant installation date) or an approved sewage comminuting and disinfecting system. However, all vessels will comply with the requirements of MARPOL 73/78, Annex IV for sewage discharges and Annex V for food scrap discharges during oil spill response activities. | |

| Propose additional safeguards/control measures (ALARP evaluation) | | | |
|---|---|---|---|
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | No response strategies implemented. | No | Not responding to a spill which could result in harm to wildlife populations and leaving the spill without understanding its fate and trajectory is not considered to be ALARP. The spill could harm wildlife populations, contact shorelines above impact thresholds, or pose an operational risk to response personnel; therefore, INPEX will deliver monitoring and evaluation and other appropriate secondary response strategies to reduce impacts to ALARP. |
| | Eliminate use of vessels (collision risk and associated discharges) during a spill response. | No | Vessels are critical assets for monitoring and implementing oil spill response activities. |
| Substitution | None identified. | N/A | N/A |
| Engineering | None identified. | N/A | N/A |
| Procedures and administration | Maintain and implement an appropriate Operational Monitoring and Evaluation capability, as described, and within the timeframes specified in Table 8-11, for any Level 2/3 spill event. | Yes | Operational Monitoring and Evaluation will be implemented for any Level 2/3 oil spill response activity, to provide real-time situational awareness to the IMT.<br>This capability involves the mobilisation/activation of<br>• oil spill trajectory modelling<br>• aerial surveillance<br>• trained aerial observers<br>• vessel surveillance<br>• electronic surface tracking buoys<br>• satellite imagery<br>Justification for the level of capability and mobilisation timeframes are provided in Table 8-11. |
| | Maintain and implement equipment, personnel and logistics capability, as described and within the timeframes specified in Table 8-11, for any shoreline clean-up and/or oiled wildlife response, if selected for activation under the IAP. | Yes | If specified in the Operational SIMA/IAP, shoreline clean-up and/or oiled wildlife response strategies would involve the mobilisation of:<br>• small vessel and large larger support vessels<br>• light utility helicopter<br>• shoreline clean-up and oiled wildlife response equipment<br>• trained shoreline clean-up and oiled wildlife response personnel |

| | | | |
|---|---|---|---|
| | | | Justification for the level of capability and mobilisation timeframes are provided in Table 8-11. |
| | Maintain a waste management contract, to receive and treat/dispose of oily contaminated wastes. | Yes | In the event that an oiled wildlife or shoreline clean-up response is activated, oily wastes will be generated and will therefore require appropriate onshore disposal. |
| | Develop an Operational SIMA in accordance with Section 3 of the OPEP to confirm effectiveness of response strategies before including the selected strategies into the IAP. | Yes | To ensure that response strategies will be effective, the INPEX IMT will use the Operational SIMA template (Appendix D – OPEP Section 3) and operational and monitoring data generated, to develop an Operational SIMA, before selecting the response strategies for inclusion in the IAP.<br>The OPEP details all the response strategies, capabilities, and considerations that need to be undertaken to implement an effective response to a hydrocarbon spill. The IMT will consider all relevant information at the time of the spill, and using the OPEP for guidance, develop the IAPs. The IAPs demonstrate how the OPEP was effectively implemented during a spill event. |
| | Emergency response preparedness will be maintained by implementing Section 9.10 this EP. | Yes | To ensure that INPEX is prepared to respond to a spill, response preparedness will be tested in accordance with Section 9.10 of this EP. |
| | Spill response strategy effectiveness will be monitored and terminated appropriately. | Yes | During response implementation, it is appropriate to monitor the ongoing effectiveness of the response strategy, to ensure the response continues to effectively reduce or mitigate the impacts of the spill and prevent/minimise additional harm. Ongoing monitoring of the effectiveness of the response strategy also ensures an appropriate termination point is reached. |
| | Visual inspections to prevent introduction of terrestrial exotic pests to offshore islands. | Yes | Visual inspections of helicopters and equipment mobilising to remote shorelines as part of any shoreline response activity will significantly reduce the risk of any introductions of terrestrial exotic pests. While the DEWHA threat abatement plan (DEWHA 2009) is focused on vessel-based vectors for introductions, this control is consistent with the intent of the actions described within that plan. |
| | Vessel sewage and food scrap discharges, and waste management will be conducted in accordance with MARPOL 73/78 requirements. | Yes | All vessels involved in oil spill response will have the capability to ensure sewage and food scraps discharges and waste management are compliant with MARPOL 73/78 requirements. |

<table>
<tr><td rowspan="3"></td><td>Shoreline response activity HSE plan prepared and implemented which incorporates consideration of impacts to turtle nesting.</td><td>Yes</td><td>A site-specific HSE plan for any shoreline response activity will be developed to address any risks to turtle nesting associated with personnel and equipment movement on offshore islands / mainland turtle-nesting beaches.<br>The plan will address specific issues including:<br>• personnel and equipment movement on turtle-nesting beaches<br>• light-spill (if night-time activities are required).<br>The section of the relevant HSE plan will be prepared in consultation with AMOSC wildlife experts, DEE (Cwlth), and WA DoT/WA DBCA for responses on WA state lands.</td></tr>
<tr><td>Obtain permits, in consultation with the relevant government agencies, before commencing wildlife hazing activities.</td><td>Yes</td><td>Consultation and obtaining the required permits from relevant government agencies before conducting any wildlife response activities will limit the likelihood of undue stress or harm to wildlife during the response activity.</td></tr>
<tr><td>A waste management plan will be prepared and implemented for any shoreline clean-up operations, in consultation with AMOSC and WA DoT.</td><td>Yes</td><td>A waste management plan to manage all hydrocarbon-contaminated solid/liquid waste is necessary to prevent accidental additional contamination of sediments and reduce the risks to wildlife.</td></tr>
<tr><td colspan="4">Identify the likelihood</td></tr>
<tr><td>Likelihood</td><td colspan="3">Hydrocarbon spills of a Level 2 or Level 3 nature that are likely to trigger response strategies, thereby introducing the impacts and risks from implementing response strategies, are evaluated in Table 8-5 and Table 8-8. The use of secondary response strategies may increase the likelihood of impact occurring in comparison to just employing source control and monitoring and evaluation techniques alone. However, based on the controls described, the likelihood of response activities resulting in the consequences described is considered Unlikely (4).</td></tr>
<tr><td>Residual risk</td><td colspan="3">Based on a worst-case consequence of Moderate (D) and likelihood of Unlikely (4) the residual risk is Moderate (7).</td></tr>
<tr><td colspan="4">Residual risk summary</td></tr>
<tr><td colspan="2">Consequence</td><td>Likelihood</td><td>Residual risk</td></tr>
<tr><td colspan="2">Moderate (D)</td><td>Unlikely (4)</td><td>Moderate (7)</td></tr>
<tr><td colspan="4">Assess residual risk acceptability</td></tr>
<tr><td colspan="4">Legislative requirements<br>The activities and proposed management measures are compliant with industry standards and relevant Australian legislation/guidance, e.g. the NatPlan (AMSA 2019); the Western Australian State Hazard Plan – Maritime Environmental Emergencies (WA DoT 2018b), specifically concerning implementation of oil pollution emergency plans; and MARPOL 73/78 for vessel discharges and garbage management.</td></tr>
</table>

**Stakeholder consultation**

Stakeholders have been engaged and issues/feedback have been incorporated in to the OPEP regarding potential impacts and risks associated with implementation of response strategies for Group I and Group II hydrocarbons. Stakeholder engagement is an ongoing process.

**Conservation management plans / threat abatement plans**

Several conservation management plans (refer to Appendix B) identify marine debris as a key threatening process to recovery. Also, the relevant action from the *Threat abatement plan for the impacts of marine debris on vertebrate marine life* (DEWHA 2009) is to "contribute to the long-term prevention of the incidence of harmful marine debris". The prevention of garbage entering the marine environment and the appropriate management of sewage and food wastes reduces the risk of impacts to the marine environment and demonstrates alignment with the various conservation management plans and threat abatement plans.

The *Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares* (DEWHA 2009), describes the threat of invasion or reinvasion of rodents on bird populations. The relevant action from DEWHA (2009) is to prevent invasion or reinvasion via prevention / risk reduction for rodents gaining access to key vessels at key ports. As INPEX proposes to access islands via helicopter, controls which align with the intent of DEWHA (2009) have been developed.

The recovery plan for marine turtles in Australia (DEE 2017a) identifies that light pollution and vehicle damage (and therefore possibly excessive foot traffic) are possible threats to turtle nesting, which could result from shoreline response activities during an oil spill response. Controls which align with the intent of DEE recovery plan have been developed.

**ALARP summary**

Given the level of environmental risk is assessed as Moderate, a detailed ALARP evaluation was undertaken to determine what additional control measures could be implemented to reduce the level of impacts and risks. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

**Acceptability summary**

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "moderate", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Oil spill response logistics, personnel and equipment<br>capability will be maintained at acceptable levels through implementation of the environmental performance standards. | Operational monitoring and evaluation capability which can meet the mobilisation timeframes specified in Table 8-11, will be maintained including:<br>• oil spill trajectory modelling<br>• aerial surveillance<br>• trained aerial observers<br>• vessel surveillance<br>• electronic surface tracking buoys<br>• satellite imagery. | Records confirm operational monitoring and evaluation capability maintained including:<br>• oil spill trajectory modelling contract in place<br>• aircraft contacts / call-off agreements<br>• AMOSC contract<br>• vessel contracts / call-off agreements<br>• electronic surface tracking buoy locations (tracked via INPEX Oil Spill Preparedness and Response Register)<br>• satellite imagery provider contract. | IMT Leader/ INPEX Environmental Advisor |
| | Oil spill response capability for shoreline and oiled wildlife response, which can meet the mobilisation timeframes specified in Table 8-11, will be maintained including:<br>• access to AMOSC and OSRL equipment and personnel, including shoreline clean-up and oiled wildlife response personnel and equipment<br>• access to small and large support vessel capability<br>• access to light utility helicopter<br>• access to additional support personnel through Environmental Service Providers general labour hire. | Records confirm oil spill response capability is maintained including:<br>• AMOSC contract<br>• OSRL contract<br>• framework agreements. | IMT Leader/ INPEX Environmental Advisor |
| IMT will evaluate operational monitoring and evaluation data for the full duration of the spill event, to determine if additional response strategies are required. | The IMT will activate and evaluate real-time operational monitoring and evaluation data for any Level 2/3 spill event.<br>The operational monitoring and evaluation data and the OPEP's Operational SIMA template will be used for the development of the Operational SIMA and IAP. | Records confirm real-time operational monitoring and evaluation data was received and evaluated by the IMT.<br>Records confirm operational monitoring and evaluation data and the OPEP's Operational SIMA template were used for the development of the Operational SIMA and IAP. | IMT Leader |
| Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals | To monitor response strategy effectiveness, daily reports from field response activities will be provided to the IMT, in accordance with Section 4 of the OPEP. | Daily field activity reports, in accordance with Section 4 of the OPEP.<br>Daily reports or other data confirms oil spill response termination criteria have been met. | IMT Leader/ INPEX Environmental Advisor |

| | | | |
|---|---|---|---|
| and marine avifauna (receptors) from a Level 2 or Level 3 spill (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | Effectiveness of the oil spill response will be monitored until:<br>• the source of the spill has been stopped<br>• the objectives of the IAPs have been met or<br>• there are no further practicable steps that can be taken to respond to a spill. | | |
| | Emergency response preparedness will be maintained by implementing Section 9.10 of this EP. | Records confirm emergency response preparedness, as detailed in Section 9.10 of this EP, is maintained. | INPEX Environmental Advisor |
| Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals and marine avifauna, and benthic communities which support them (receptors) from vessel discharges during oil spill response activities (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards. | All vessels involved in oil spill response activities will conduct sewage disposal activities in accordance with MARPOL 73/78, Annex IV.<br>All vessels involved in oil spill response activities will conduct food scrap disposal activities in accordance with MARPOL 73/78, Annex V.<br>No de-ballasting within marine parks during oil spill response activities. | Records of sewage discharge locations are maintained in a sewage disposal record book that complies with MARPOL 73/78, Annex IV.<br>Records of food scrap discharges are maintained in a garbage record book that complies with MARPOL 73/78, Annex V.<br>Records of de-ballasting. | Vessel Master |
| No inappropriate disposal of garbage. | All vessels involved in oil spill response activities will conduct garbage management in accordance with MARPOL 73/78, Annex V. | Records of garbage disposals are maintained in a garbage record book that complies with MARPOL 73/78, Annex V. | Vessel Master |

| | | | |
|---|---|---|---|
| No incidents of loss of hydrocarbons to the marine environment as a result of a vessel collision during oil spill response. | Vessels will be fitted with lights, signals, AIS transponders and navigation equipment as required by the *Navigation Act 2012*. | A premobilisation report confirms that required navigation equipment is fitted to all vessels to ensure compliance with the *Navigation Act 2012.* | INPEX Environmental Advisor |
| No secondary ocean or shoreline contamination due to inappropriate waste management during a shoreline clean-up response activity. | A contract will be maintained with a licenced waste management contractor, capability of receiving, treating and disposing of solid and liquid oily contaminated wastes. | Records confirm contract in place with a licenced waste management contractor. | INPEX Environmental Advisor |
| | In consultation with WA DoT and AMOSC, a response waste management plan, including decontamination stations and waste storage, transport and disposal arrangements, will be prepared and implemented for any shoreline clean-up response activity. The plan will consider methods to eliminate, reduce and re-use materials to reduce the overall volume of waste generated. | Records demonstrate that a waste management plan was prepared and implemented, in consultation with WA DoT and AMOSC, for any shoreline clean-up response activity. | IMT Leader |
| Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, marine mammals and marine avifauna (receptors) from wildlife response activities (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards. | Permits will be obtained in consultation with DEE (Cwlth) before any wildlife hazing, post-contact wildlife response or shoreline clean-up activities take place in Commonwealth waters or on Commonwealth lands.<br>Permits, including launching and landing aviation assets, will be obtained in consultation with DBCA (via WA DoT) before any wildlife hazing, post-contact wildlife response or shoreline clean-up activities take place in WA waters or lands. | Records demonstrate response activities with the potential to affect wildlife were conducted in consultation with, and under permits issued by DEE (Cwlth) and WA DBCA.<br>Records are kept of response activities demonstrating compliance with any controls defined in the permits. | INPEX Environmental Advisor |
| No introduction of terrestrial exotic pests to offshore islands. | Pre-flight visual inspections of helicopters conducted.<br>Premobilisation visual inspections of vessels and equipment before mobilisation onto an offshore island and recorded on quarantine inspection checklists. | All aircraft technical logs confirm that pre-flight visual inspections have been conducted.<br>Quarantine inspection checklists confirm vessel and equipment premobilisation inspections have been conducted. | INPEX Environmental Advisor |

| | | | |
|---|---|---|---|
| Risks of impacts to transient, EPBC-listed species, i.e. marine turtles, (receptors) from a shoreline response (impactors) are reduced and maintained at acceptable levels through implementation of the environmental performance standards. | In the event of a shoreline response, an HSE plan will be prepared, in consultation with AMOSC and WA DBCA (via WA DoT) which addresses potential impacts to turtle nesting, including:<br>• personnel and equipment movement on turtle-nesting beaches<br>• light-spill (if night-time activities are required). | Records of correspondence with AMOSC and WA DoT regarding turtle-nesting considerations.<br>HSE plan documentation demonstrates controls regarding turtle nesting.<br>Records demonstrate compliance with controls described in the HSE Plan. | INPEX Environmental Advisor |

## 8.7 Source control arrangements and capability

As described in Section 8.2, should a loss of well containment event occur during the drilling activity, a number of source control activities may be implemented depending on the specific circumstances of the loss of well containment.

In advance of commencing the drilling activities described in this EP, a relief well plan will be finalised, utilising specific well kill modelling results to complete the well design. The modelling considers a number of factors including well geometry, reservoir pressure, temperature, permeability and reservoir fluid properties. Depending on the loss of well containment scenario other source control activities may be required to assist in regaining control such as ROV based systems for seabed debris clearance, BOP intervention and/or well capping.

Table 8-14 presents an evaluation of the applicability of various source control options.

Table 8-15 presents further information regarding the environmental benefits and merit in improving the implementation of source control activities i.e. implementing controls to a greater extent or within a faster timeframe and associated cost benefit considerations. This evaluation supports the impact and risk assessment presented in Table 8-16 and demonstrates the arrangements in place are effective in reducing environmental risks to ALARP.

### 8.7.1 Summary of relief well analysis

INPEX engaged a third-party specialist to undertake a relief well and dynamic well kill study for the production wells in WA-50-L (Add Energy 2019). The dynamic well kill portion of this study models a blowout rate for given subsurface and well architecture parameters and then models the kill rate for a given kill fluid density required to kill the well.

NORSOK D-010 Rev 4 (Standards Norway, 2013) Section 4.8.1 gives clear guidance on the assumptions to be used during dynamic well kill modelling and these are outlined as follows:

- expected values for reservoir parameters (pore pressure, permeability, porosity, net-gross pay, etc.)
- expected top of reservoir depth
- expected productivity index / transient productivity index
- expected fluid type parameters, if oil is expected, but gas cannot be disregarded both cases shall be simulated
- mechanical skin is zero
- no restrictions in the flow path
- planned well design (hole size, casing setting depth, etc.).

The modelling and subsequent analysis of logistical requirements has determined the duration of relief well drilling as 80 days for a Brewster well and 108 days for a Plover well, with a single well kill achievable in both reservoirs.

### 8.7.2 Relief well supply base capabilities and mud requirements

If required, drilling a relief well will necessitate supporting a MODU and other source control operations. INPEX operates an existing supply base in Broome which has previously supported a two MODU operation during the Phase 1 Ichthys development drilling campaign and will have sufficient arrangements in place for the Phase 2 Ichthys development drilling. INPEX may possibly also be supporting other exploration drilling operations in the region at the time. Broome is now established as a mature oilfield supply centre with at least one liquid mud plant and cement plant in place. If additional resources or lay down area was required, INPEX operates a supply base in Darwin for its production operations which could also be utilised in the event of a source control operation.

Modelling shows that the well is killed relatively quickly (within 45 minutes) and liquid requirements are easily accommodated by typical relief well candidate MODUs operating in the country. Mud/kill fluid will be supplied through the above-mentioned supply bases.

### 8.7.3 Summary of capping stack feasibility analysis

High energy gas wells located in relatively shallow water (as seen in the Browse Basin) can present challenges with safe vertical access due to the resulting surface boil and Lower Explosion Limit (LEL) hydrocarbons associated with a well blowout. This in turn can preclude the deployment of a capping stack. This being said, INPEX are a member of a capping stack consortium and have access to a primary 15,000 psi, 18 ¾" capping stack in Singapore and the equivalent as secondary in Aberdeen. Because of this, INPEX undertook a capping study with the provider of this stack (Wild Well Control 2019).

This study involved computational fluid dynamics modelling to show the behaviour of the stack as it is landed on a blowing well with expected Plover reservoir properties (Plover reservoir has higher gas pressure than Brewster reservoir and is therefore a worst-case scenario). The study found that "the capping stack is able to move through the discharge plume in a controlled manner and can potentially be landed on the wellhead" (Wild Well Control 2019).

The study (Wild Well Control 2019) then looked at the behaviour of the subsea plume as it rises in the water column and then the dispersion of any gas at the sea surface, in order to infer if vertical access is possible. It was determined that with assumed current and wind conditions, the plume would be displaced 50 m downstream of the well centre but the 10% LEL radius extends up to 60 m upwind. This means that, if limited to 10% LEL, the closest a construction vessel could get to the well centre is 10 m. Therefore, deployment of the capping stack could be possible subject to crane capacity on the selected construction vessel.

While direct vertical access has been determined as not possible for the modelled Plover discharge rate, there are influences that would likely reduce the discharge rate and thus enable vertical access. These are outlined as follows:

- The situation may be a drilled kick escalating to blowout meaning less net pay and possibly non-Plover reservoir (being of lower quality)
- There may be wellbore flow restrictions which are likely to occur from:
    - drill-string remaining in the hole (drilled kick/dropped drill-string)
    - partial closure of BOP due to activation during/after the event from MODU or vessel
    - flowing zone collapse/bridging.

### 8.7.4 Assessment of capping stack deployment duration

Opting for capping as the primary means of containment yields a reduction in the time to contain the well and is outlined in Table 8-13 below.

**Table 8-13: Time to contain well – deployment of capping stack**

| Item | Duration (days) | Comments |
|---|---|---|
| Stack up and test capping stack in Singapore and ready for load out | 4 | Based on guidance from provider. Concurrently source construction vessel in region which has Australian Vessel Safety Case. |
| Continue to source and mobilise construction vessel to Singapore | 10 | Typical response time based on market knowledge of suitably rated vessels with Australian Vessel Safety Cases. |
| Load out capping stack on to construction vessel from Singapore | 1 | Based on guidance from provider. |
| Transit capping stack directly to licence area | 7 | Typical sailing time from Singapore to WA-50-L with some minor allowance for weather on route. |
| Deployment of capping stack onto well and shut-in of well | 7 | Based on guidance from provider. Assumes vertical assess is possible. |
| **Total** | **29** | |

**Table 8-14: Evaluation of applicability of source control response options**

| Source control response technique | Likelihood of success | Considered for implementation |
|---|---|---|
| Site survey | Site survey involves the use a response vessel and ROV to conduct visual/sonar observations, to determine the condition of well and BOP and search for any debris, following the source control event. This information is required, to enable the source control team to conduct detailed planning for all source control activities.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-15. | Yes |
| Debris clearance | Debris clearance involves the use of response vessel(s) with cranes/lifting equipment and work-class ROVs, equipped with cutting tools, to cut and relocate/recover debris on the seabed, to enable other response strategies such as BOP intervention, capping stack deployment and mooring a relief well MODU to occur safety.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-15. | Yes |
| BOP intervention | BOP intervention involves the use of response vessels and work-class ROVs with BOP intervention tooling. The BOP intervention tooling will be used to attempt to close the shear-rams of the BOP to stop the flow from the well. BOP intervention can involve unlatching the BOP/Lower Marine Riser Package to allow its removal for the installation of the capping stack.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-15. | Yes |
| Capping stack | A capping stack response involves the use of a heavy lift vessel (HLV) to lower and latch the capping stack on the blowing well, to stop the flow from the well.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-15. | Yes |
| Capping stack – offset installation equipment | INPEX is aware of new technology developed by Saipem and marketed by Oil Spill Response Limited (OSRL) in the form of Offset Installation Equipment (OIE). The OIE is designed to deploy a capping stack on a blowing well where vertical access is not possible. It is essentially a mobile subsea crane which is used to perform debris clearance and then pick up a capping stack from a subsea parking stand and deploy it, though the discharge plume and on to a blowing well.<br>INPEX do not believe that the proactive gaining of access to this equipment for the planned operations in WA-50-L is in line with ALARP principles for the following reasons: | No |

| | | |
|---|---|---|
| | • Mobilisation: the equipment is stored in Trieste Italy and is believed to include nearly 170 packages with a shipping weight of 300 t. The carrier itself is 14 m x 13 m x 10 m in dimension and as such, mobilisation can only be undertaken by sea, not by air. This long mobilisation duration erodes the time saving realised by capping relative to a conventional relief well kill.<br>• Deployment mass: the deployment mass is understood to be up to 300 t. This is roughly three times the mass of a 15,000 psi 18 ¾” BOP style capping stack and thus would require an installation vessel with up to 900 t crane capacity. This greatly reduces the number of candidate vessels in the region, let alone those with current Australian Vessel Safety Cases.<br>• Debris clearance capabilities: it is understood that that OIE can perform some debris clearance tasks, including lifting debris up to 160 t. While this may be sufficient to remove a LMRP from a BOP, it is unclear what capabilities exist for the clearance work prior to this operation including but not limited to the deployment of super shears to sever riser and the like, if required.<br>• Local fabrication: the OIE scope of supply excludes some significant equipment including but not limited to three gravity anchors and a subsea parking stand for the capping stack. It is understood that this fabrication would require up to 500t of steel and it is estimated that even a significant supply hub such as Darwin would struggle with the scale of this fabrication. This may drive the sourcing of this fabrication to a regional hub such as Singapore which could place this fabrication on the critical path and further erode the time saving realised by capping relative to a conventional relief well kill.<br>• Exclusion zone: while theoretically vertical access is not required with OIE, access into 500 m is required for the initial deployment of the carrier and support operations with ROVs during capping operations. With unfavourable metocean conditions and a high energy blowout, even this may be difficult, particularly with at least 5 vessels being required (2 x anchor handers on either side of boil for initial deployment, 1 x survey, 1 x construction, 1 x air supply). Relief well planning performed for WA-50-L has spud locations 2,000 m away from the blowing well centre which is well beyond the downwind/down current extent of 10% LEL radius of 1,100 m.<br>• Localised soil conditions: The unique carbonate shallow soils present in the Browse Basin have posed significant challenges to well structural design to date and it is understood they are out with the acceptable range verified by Saipem as part of the design validation for the OIE anchors. While this does not preclude the use of the OIE, a revised anchor design needs to be generated in order to achieve the required 50 t capacity of each of the three anchors if they are to be deployed in the Browse Basin. | |

| | | |
|---|---|---|
| | • Drag chain contact with seabed: For stability, the carrier requires a drag chain to be in contact with the seabed at all times. Ichthys drill centres are surrounded by a complex array of SPS infrastructure. The transit of the carrier, and its drag chain would need to be carefully evaluated, at the time of the blow-out, to determine if it was safe to attempt to run the drag chain through possible approach corridors without causing additional damage and possible gas/oil releases to the environment, through additional damage to existing subsea infrastructure. These corridors may be incompatible with the prevailing metocean conditions and the resulting surface boil location and geometry, thereby preventing the safe conduct of the activity.<br>• Contractual arrangements: It is understood that OSRL have been unable to negotiate post event contractual terms with Saipem as the Original Equipment Manufacturer of the OIE. Existing contractual agreements only cover training and maintenance of the system however ultimately Saipem would need to operate the system. This is seen to be a significant issue as such contracts would need to be brokered during mobilisation.<br>The OIE is an extremely complex spread of equipment and as outlined above, comes with attendant risks, any of which if realised, may preclude its deployment. Fortunately, the system has not been used to respond to an actual source control event but that makes it, as yet, unproven. Comparing this with a well-established source control method of intersection with a relief well and dynamic well kill, it is seen that the proactive gaining of access to OIE is not ALARP for operations in WA-50-L. | |
| Relief well | A relief well can be drilled to intercept the original wellbore close to the reservoir. Kill fluid is then pumped through the relief well into the original well-bore, to provide an overbalance pressure to the reservoir, and stop the flow of hydrocarbons from the well. To conduct the relief well, a MODU with support vessels is required. In addition, extra vessels with additional drilling fluid and pumping equipment may be required, for the well kill activity.<br>Following the well kill, the MODU will use the relief well to isolate and abandon both wells.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-15. | Yes |
| Use of relief well injection spool | INPEX is aware of new technology developed by Trendsetter Engineering in the form of the Relief Well Injection Spool (RWIS). The RWIS is a spool piece with side outlets installed below the BOP of the relief well which facilitates the connection of more surface pumping resources. These additional resources can deliver greater kill fluid rates to the relief well.<br>As all WA-50-L development wells can be killed with a single relief well using mud pumping resources available on standard MODUs, the use of the relief well injection spool would not be required. | N/A |

| | | |
|---|---|---|
| Subsea dispersant injection | SSDI involves the use of an ROV, to inject dispersant directly into the hydrocarbon stream flowing from the damaged well. The outcome of SSDI is a significant increase of entrainment of oil in the water column. By increasing the proportion of hydrocarbons becoming entrained, there will be a reduction in hydrocarbons arriving on the ocean surface, and an associated reduction in hydrocarbons evaporating into the atmosphere.<br>Modelling results (RPS 2019e) indicates that under a worst-case blowout scenario, VOC concentrations (from oil evaporating into the atmosphere) are likely to exceed safe exposure thresholds within 1 km of the release location. The workforce onboard vessels conducting source control activities such as BOP intervention, debris clearance and capping stack installation could therefore be exposed to VOCs, and if gas monitoring indicated exposure had exceeded the VOC thresholds, the vessel would be required to cease the activity move out of the area. In effect, VOC exposure may impact the feasibility of debris clearance/capping stack installation and ultimately limit available source control options to drilling a relief well.<br>Modelling results (RPS 2019e) also concluded that SSDI would eliminate the risk of VOCs exceeding exposure thresholds. Therefore, the use of SSDI to significantly reduce the VOC risk to source control vessels/workers may contribute to the feasibility of capping stack, instead of a well kill via relief well, which would take several more months to achieve.<br>A detailed assessment of the logistical resources required to implement this response strategy are described in Table 8-15. | Yes |

**Table 8-15: Source control arrangements and capability evaluation**

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| A vessel with an observation or work-class ROV is required to undertake the site survey and record / report visual observations of the well location and surrounding area.<br>The location and availability of support vessels with ROVs will be tracked on a register which is updated on a monthly basis. | Only a single vessel with a single ROV is required for site survey activities.<br>Additional vessels and/or ROV's will not result in any better information being provided to the source control team, to facilitate ongoing source control planning.<br>Therefore, a single vessel and ROV is appropriate. | It is expected that a support vessel with ROV would be identified from within Australia and would be expected to arrive and commence mobilisation activities in Broome, within 7 days.<br>INPEX's drilling support vessels and Ichthys Field support vessels are not required to be equipped with ROVs.<br>The cost of maintaining a vessel with full ROV spread and ROV crew at all times on a support vessel is estimated to be ~$65,000 a day and not considered ALARP given the cost and many vessels with ROVs can be made available on short notice within the region.<br>Typically, several support vessels with ROVs are located in the NW region, with additional vessels around Australia / SE Asian region capable of completing the site survey.<br>To track and identify capable support vessels and ROVs, the most practicable option is to maintain an up to date register of suitable available support vessels. | No additional site survey response capability required. |
| A Construction Support Vessel (CSV) with lifting equipment of 150t lifting capacity and work-class ROVs will be utilised, if required, for debris clearance. | Only a single CSV equipped with work class ROVs and lifting equipment rated for 150t is required for debris clearance.<br>Additional CSVs and ROVs will provide no additional benefit to the debris clearance activity. | It is expected that a CSV with lifting equipment rated for approximately 150t with a work-class ROV would be identified and contracted from within Australia or the SE Asian region within 10 days and would arrive in the licence area within 17 days. | No additional debris clearance vessel response capability required. |

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| The location and availability of a CSV with suitable lifting equipment and work-class ROVs will be tracked on a register which is updated on a monthly basis. The status of vessel Safety Cases will also be maintained on the register. | Therefore, a single vessel is sufficient. | A vessel with a reduced lifting capacity may be used for debris clearance if available and post debris clearance planning using the information presented by the site survey team.<br>Identification and contracting/mobilisation will typically commence when initial source control planning begins.<br>Response time could be improved by maintaining a CSV on stand-by. However, until site survey activities have been conducted and results evaluated by the source control team, it is unknown if debris clearance is even required. Therefore, the large costs of maintaining a CSV on stand-by (~$225,000 per day) are not considered ALARP, especially given CSVs with ROVs can be made available within the region.<br>To ensure the availability, the most practicable option is to maintain an up to date register of suitable, available vessels and their safety case status. | |
| Debris clearance ROV tooling is required for debris clearance activities.<br>The AMOSC subsea first response tool-kit (SFRT), is located in Perth.<br>Wild Well Control Inc (WWCI) debris clearance equipment is available in | Debris clearance equipment such as drill pipe and riser cutting shears are specifically designed tools for specific tasks, which typically only need to be utilised once during the debris clearance activity.<br>Primary and redundancy equipment is available through the AMOSC and WWCI contracts. | Debris clearance equipment will be mobilised when the initial source control planning begins.<br>The AMOSC SFRT can be mobilised, by road to Broome, within 3 days.<br>The WWCI debris clearance equipment can be mobilised by air to Broome within 5 days. | No additional debris clearance tooling capability required. |

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| Singapore, with back-up equipment based in the United Kingdom. | There is no benefit to increasing the quantities or capabilities of debris clearance equipment. | The debris clearance tooling will likely arrive in Broome before the debris clearance vessel, and whilst site survey and initial source control planning is still occurring.<br>If the debris clearance vessel is mobilising directly to the licence area, a small charter vessel can rapidly mobilise the debris clearance tooling from Broome to WA-50-L.<br>Therefore, maintaining additional debris clearance equipment in Broome is not considered ALARP. | |
| Support vessel with work-class ROVs and BOP intervention tooling (hot stabs) are required for the BOP intervention activity.<br>The location and availability of support vessels with work-class ROVs will be tracked on a register which is updated on a monthly basis. | Only a single vessel equipped with a work-class ROV is required for BOP intervention.<br>BOP intervention uses standard hot-stabs, routinely used on offshore facilities. This type of tooling is readily available and will be mobilised with the BOP intervention vessel and ROV spread.<br>There is only a single BOP, therefore additional vessels and ROVs will provide no benefit to the BOP intervention activity. | Typically, a support vessel with work-class ROV is expected to mobilise from within Australia and commence mobilisation activities in Broome (including gas detection system), within 10 days.<br>Depending on the outcome of site survey activities, debris clearance may be required prior to attempting BOP intervention. However, under some circumstances, BOP intervention could occur without debris clearance. Therefore, mobilisation within 10 days is appropriate.<br>If the site survey vessel is using a work-class ROV instead of an observation class ROV, the site survey vessel with work-class ROV would be capable of attempting BOP intervention, eliminating the requirement to mobilise a second vessel.<br>INPEX's drilling support vessels and Ichthys Field support vessels are not required to be equipped with ROVs. | No additional BOP intervention tooling response capability required. |

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| | | The cost of maintaining a vessel with a work class ROV and ROV crew at all times is estimated to be ~$65,000 a day and is not considered ALARP (given the cost and the availability of vessels with ROVs can be made available on short notice within the region).<br>Typically, several support vessels with work-class ROVs are located in the NW region, with additional vessels around Australia / SE Asian region with the capability of completing a BOP intervention.<br>To ensure the availability, the most practicable option is to maintain an up to date register of suitable, available support vessels. | |
| Capping stack – primary located in Singapore and secondary in the United Kingdom. | INPEX are a member of a capping stack consortium and have access to a primary 15,000 psi, 18 ¾" capping stack in Singapore and the equivalent as secondary in Aberdeen.<br>INPEX and WWCI have reviewed the capping stack interface with the selected BOP, and have identified the required connections and its availability, and that anticipated pressures are within the operating parameters of the capping stack.<br>INPEX are also conducting a landing study, to plan how to safely lower and latch the capping stack onto the BOP. | The estimated durations for capping stack mobilisation are provided in Table 8-13.<br>An operational assessment and deployment planning study conducted by WWCI, determined a one (1) day difference between air (15 days) and sea (16 days) freight logistics options. However, various uncertainties and risks to schedule were identified with the air freight option including handling restrictions at airports and wharfs. Another significant concern for stack up and testing of the capping stack in Australia is the reduced presence of OEM and access to parts. | No additional capping stack response capability required. |

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| | As there is only a single BOP, only a single capping stack is required.<br>As INPEX have access to primary and back-up capping stacks, sufficient redundancy is available, should any issues arise during stack up, testing, mobilisation, deployment and activation of the primary capping stack. | As a result, the capping stack will be stacked up and tested in Singapore due to the established infrastructure and Subject Matter Experts (SMEs) based in Singapore. WWCI conduct an annual stack up of the capping stack capturing lessons learned to improve the preparation time for mobilisation to field. | |
| A HLV with a work class ROV and minimum lifting capacity of 120t would be mobilised to Singapore, to receive the capping stack and ancillary equipment, then deploy to the licence area. The HLV will be used to land the capping stack on the blowing well.<br><br>INPEX will maintain a register, updated on a monthly basis, of the location and availability of all HLVs in the SE Asian region. The register will maintain status of safety cases. | As there is only a single BOP and single capping stack, only a single HLV is required. | The estimated durations for capping stack mobilisation are provided in Table 8-13.<br>Identification and contracting/mobilisation will typically commence when initial source control planning begins.<br>Response time could be improved by maintaining a HLV on stand-by. However, until site survey and other activities have been conducted and results evaluated by the source control team, it is unknown if capping stack deployment will be possible. Therefore, the large costs of maintaining a HLV on stand-by (~$225,000 per day) are not considered ALARP, especially given HLVs with ROVs can be made available within the region.<br>To ensure the availability, the most practicable option is to maintain an up to date register of suitable, available HLVs and their safety case status. | No additional HLV response capability required. |

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| A single MODU would be required to drill a relief well in an absolute worst-case scenario.<br>INPEX will maintain a register, updated on a monthly basis, of the location and availability of all MODUs internationally. The register will maintain status of safety cases.<br>The register will include:<br>• name, contractor, stacking status (cold/warm/on contract/yard)<br>• operator (if on contract)<br>• type<br>• water depth capability<br>• BOP pressure rating and # ram cavities<br>• maximum personnel on board<br>• mud pump, crane, helideck, variable deck load and top drive specifications | Approximate relief well locations have been identified around each drill centre in the licence area. Metocean and seasonal environmental conditions will be considered in final relief well location selection.<br>Preliminary designs have been completed for optimal interception of a blowing well and completing a dynamic kill for the worst-case scenario. | The time to contain the well has been conservatively assessed as 80 days (Brewster) and 108 days (Plover) based on an absolute worst-case discharge.<br>The relief well design and plan will be optimized to intersect the blowing well and to complete a dynamic kill. The relief well cannot be drilled to a shallower depth (less drilling time), and intercept the original well at a shallower depth, as there would not be sufficient hydrostatic head pressure and drilling fluid weight in a shallower relief well to successfully kill the original well.<br>Should the original MODU still be functional (however without BOP), a study would be conducted, and if practicable to implement, to have the MODU pre-drill the top-hole section of the relief well, prior to the arrival of the relief well drilling rig.<br>INPEX has signed the APPEA MoU for mutual assistance between Titleholders. This MoU requires Titleholders to make 'best endeavours' to release and transfer drilling units and well-site services between operators in a source control event. | No additional relief well response capability required. |

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| • base oil, bulk and liquid mud storage capacities<br>• vessel safety case status and jurisdiction.<br>INPEX will also maintain its subscription to the APPEA MoU. | | | |
| Relief well long-lead items (LLIs) and equipment has been identified, e.g. casing and well-head.<br>INPEX drilling logistics team maintain a register of all drilling equipment to ensure relief well stocks are available. | There is no requirement for additional relief well spares, as the required consumables are available and tracked, as part of routine Ichthys development drilling.<br>Specifically, spares to be maintained will include:<br>• wellhead system<br>• conductor<br>• surface casing<br>• intermediate casing<br>• relief well conduit<br>Miscellaneous equipment such as crossovers can be manufactured locally within Australia in relatively short timeframes. This would be undertaken using pre-existing arrangements that INPEX has in place for the manufacture of such consumables. | The response time to access the relief well equipment (including miscellaneous equipment items such as crossovers etc that may be required and can be fabricated locally), will not be a critical path activity during the relief well drilling, as a standard logistics supply chain for INPEX development drilling activities, involving the Drilling Supply Base in Broome (and back-up base in Darwin) and standard supply vessels, will continue to be utilised. | No additional relief well long lead equipment capability required. |

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| A single SSDI spread would be required to implement SSDI. This equipment includes the dispersant stockpile and injection wands.<br>(Note – support vessels with work-class ROVs for SSDI are the same vessels as those required for BOP intervention). | There is no requirement for additional/duplicate SSDI spreads. A single SSDI spread will be able to successfully inject dispersant into the well stream at the optimal ratio of approximately 100:1, which has been demonstrated to reduce VOC concentrations below safe levels (RPS 2019e).<br>Injecting additional dispersant into the well-stream will not result in any greater/beneficial reduction in VOC concentrations in the atmosphere.<br>Based on a worst-case oil release rate of 20,000 bbl/day (3193 $m^3$/day), at 100:1 treatment ratio, the dispersant requirement is 32 $m^3$/day.<br>For a worst case (complex) activity, 30 days of SSDI could be required. Therefore, a worst-case total of ~1000 $m^3$ dispersant could be required.<br>SSDI would generally not be required to commence mobilisation onto a vessel in Broome until approximately day 10 of a response (aligning with BOP intervention/debris clearance mobilisation activities). | SSDI will only be activated when modelled and/or field measurements predict that VOC concentrations are likely to be exceeded during other source control activities such as BOP intervention, debris clearance or capping stack deployment and installation.<br>The SFRT/SSDI spread is located in Western Australia and maintained by AMOSC. This equipment is rapidly able to be mobilised to Broome, the SFRT / SSDI spread is not anticipated to be on the critical path.<br>As such, response time for SSDI spread readiness/mobilisation is determined to be appropriate/ALARP. | No additional SSDI capability required. |

| Source control element | Can a greater response effort be implemented? | Can the time to respond be improved? | Justification for increased response effort/reduced response time |
|---|---|---|---|
| | The SSDI spread maintained by AMOSC in WA includes 500 $m^3$ of Slick-Gone-NS dispersant and can be mobilised to Broome within 10 days. Therefore, 50% of the total worst-case dispersant requirement for a worst credible SSDI response can be mobilised outside of critical path timeframes.<br>Additional Australian and global dispersant stockpiles can be mobilised, should it be estimated that the AMOSC 500 $m^3$ will be used up. Additional dispersant would not be required until a minimum of ~day 25 of the response, and therefore any additional dispersant stocks could be easily mobilised by vessel or aircraft to Broome within the required timeframe. | | |

**Table 8-16: Impact and risk evaluation – source control**

| Identify hazards and threats |
|---|
| **MODU and vessel activities**<br>Hazards and threats associated with general vessel and MODU drilling activities, when conducting source control activities, are the same as the hazards and threats associated with MODU and vessels conducting routine activities, as described in Section 7 and Section 8.3 of this EP. This includes:<br>• light emissions<br>• atmospheric emissions<br>• routine discharges to sea<br>• waste management<br>• noise and vibration<br>• loss of containment (accidental release)<br>• introduction of invasive marine species<br>• interaction with marine fauna<br>• seabed disturbance<br>• physical presence – disruption to other marine users<br>• vessel collision.<br>The source control activity specific risks are discussed below.<br>**Site survey**<br>The activity of site survey using a vessel and ROV will not result in any additional impacts and/or risk to the marine environment compared to routine vessel/ROV activities.<br>**Debris clearance**<br>Depending on any damage sustained to subsea infrastructure, there is the potential that some debris may need to be removed from the well location in order to safely conduct other source control activities. Debris which is removed may either be recovered to surface, or temporarily stored on the seabed (wet-stored), until it is recovered at a later time. The area of additional seabed disturbed would be proportional to the size of debris which is wet-stored, and is likely to be small, and far less than the area of seabed disturbed due to routine anchoring of the MODU. The impacts and risks associated with seabed disturbance are described in Section 7.6.<br>**BOP intervention**<br>The activity of BOP intervention using a vessel and work-class ROV and a hot-stab will not result in any additional impacts and/or risk to the marine environment compared to routine vessel/ROV activities.<br>**Capping stack deployment**<br>The activity of capping stack deployment using vessels and work-class ROVs will not result in any additional impact and/or risk to the marine environment compared to routine vessel/ROV activities.<br>**Relief well drilling** |

The activity of drilling a relief well is very similar in nature to the drilling of the original well. There are no additional impacts or risks associated with drilling a relief well, compared to drilling the original well, as described in Section 3 and Section 7.

**Subsea Dispersant Injection**

SSDI on condensate wells has traditionally not been considered environmentally acceptable, as under light wind conditions (<5 knots), a high proportion of condensate will evaporate into the atmosphere, removing the hydrocarbons from the marine environment. With increasing wind conditions, more hydrocarbons become entrained. By conducting SSDI, an even higher proportion of the condensate would become entrained in the water column, resulting in a potential increase in impacts associated with entrained hydrocarbons.

SSDI modelling (RPS 2019e) confirmed (using multiple Ichthys Field worst-case blow-out scenarios) that under light wind conditions, up to 80% of the released condensate would evaporate into the atmosphere, and likely exceed VOC safe exposure thresholds in close proximity (<1 km) of the release location. Under the light wind conditions, approximately 20% of the condensate would become entrained in the top ~3 m of the water column, with a very small proportion undergoing biodegradation (<10%).

SSDI modelling (RPS 2019e) also confirmed that when comparing the same scenarios (without SSDI vs with SSDI), under the same light wind conditions, the effect of SSDI would be an increase in condensate entrainment up to ~70%, in the top ~3 m of the water column, with evaporation reduced to ~30%. RPS (2019e) weathering simulations also confirmed that with elevated wind speeds (>10 knots), the natural rate of entrainment of condensate is roughly equivalent to that which occurs when SSDI is in use.

In addition, the SSDI modelling (RPS 2019e) also confirmed that after approximately 1 week of SSDI use, due to the much smaller oil droplet sizes, the rate of biodegradation has increased to ~50% of the rate of entrainment (compared to a biodegradation rate of <10% without SSDI).

As discussed in Table 8-14, SSDI modelling results (RPS 2019e) concluded that SSDI would significantly reduce the risk of VOCs exceeding safe exposure thresholds. Therefore, the use of SSDI to eliminate the VOC risk to source control vessels/workers may increase the likelihood of a successful well kill using a capping stack, instead of a relief well, potentially reducing source control activities by several months.

A credible worst-case scenario could involve the use of SSDI for up to one-month duration, to complete a complex debris removal and capping stack installation activity. If the scenario was less complex, SSDI may only be required for a few days. Therefore, SSDI could result in an increase in entrainment condensate from ~20% to ~70%, in the top ~3 m of the water column, for the days on which SSDI was used. However, the time saved to control the well through the use of SSDI and a successful capping stack installation would result in an overall net reduction in the volume of condensate entrained in the water column over the response period.

In summary, the overall effect of SSDI is considered to be a temporary increase in entrained hydrocarbons in the top ~3 m of the water column, for the duration which SSDI is used. The increase in entrainment from SSDI is similar to normal levels of entrainment expected to occur under higher wind conditions. The effects of increased entrainment due to SSDI are partially offset due to a reduction in oil droplet size, resulting in a very significant increase in biodegradation rates. Any impacts associated with the use of SSDI to achieve a successful well-kill using a capping stack are offset by the significant reduction in the overall duration of the blow-out (and net reduction in entrained hydrocarbons) compared to a relief well-kill scenario.

The potential impacts of entrained hydrocarbons on submerged and intertidal receptors is described in the impact and risk assessment presented in Table 8-5. However, due to the mitigating factors described in the paragraph above, the potential impacts and risks associated with SSDI use are considered Insignificant.

**Combination of source control activities**

| | | | |
|---|---|---|---|
| During source control, there may be times when there is an increase in the number of vessels operating in the licence area, greater than during routine drilling activities. As a result, there is the potential for an increase in risk associated with vessel collisions. The impacts and risks associated with a vessel collision is described in Section 8.3 of this EP. | | | |
| **Potential consequence: Source control** | | | **Severity** |
| The potential consequence associated with vessels and MODUs undertaking source control activities are the same as those described in Section 7 and Section 8.3 of this EP. | | | As per Section 7 and 8.3 of this EP. |
| **Identify existing design safeguards/controls** | | | |
| The existing design safeguards and controls for vessels and MODUs undertaking source control activities are the same as those described in Section 7 and 8.3 of this EP. | | | |
| Propose additional safeguards/control measures (ALARP evaluation) | | | |
| Hierarchy of control | Control measure | Used? | Justification |
| Elimination | There is no ability to eliminate conducting source control activities. | No | Source control activities must be conducted to regain control of the well. Not conducting source control activities may result in a very protracted, ongoing release of hydrocarbons into the marine environment. |
| Substitution | None identified. | N/A | N/A |
| Engineering | None identified. | N/A | N/A |
| Procedures and administration | During source control, manage vessel and MODU activities in accordance with Section 7 and 8.3 of this EP. | Yes | All impacts and risks associated with vessel and MODU activities for source control are the same as the impacts and risks as described in Section 7 and 8.3 of this EP. Therefore, the same management controls will be applied, to ensure the impacts and risks associated with source control activities remain ALARP. |

| | | | |
|---|---|---|---|
| | INPEX will maintain registers, updated on a monthly basis, of the location and availability of support vessels, CSVs, HLVs and MODUs, including their capabilities (ROVs/crane capacity etc) and safety case status, for the duration of the drilling activity. | Yes | As discussed in Table 8-15, the most appropriate method of ensuring the rapid availability of source control vessels and MODUs is through registers, updated on a monthly basis.<br>INPEX will preferentially select MODUs and vessels with the technical capabilities which already have an existing Australian Safety Case. This will enable NOPSEMA to conduct a Safety Case revision (30-day assessment timeframe), instead of a full new Safety Case assessment (90-day assessment timeframe). This control minimises the time taken for safety case approval for source control activities to the minimum possible timeframe, based on the Safety Case approvals process, as specified in the OPGGS (Safety) Regulations 2009, at the time of submission of this EP. |
| | INPEX will maintain an up to date register of relief well LLIs | Yes | By maintaining an up to date register, INPEX will ensure that LLIs are not on the critical path for drilling a relief well. |
| | INPEX will maintain contracts for suitable debris clearance equipment.<br>Debris clearance equipment will be:<br>• certified/rated to shear the largest drill-pipe/riser utilised during the drilling activity<br>• able to be mobilised to Broome within 5 days. | Yes | By maintaining contracts for suitably rated debris clearance equipment and ensuring the debris clearance equipment can arrive in Broome within 5 days, the debris clearance equipment will never be on the critical path for the debris clearance activity. |
| | INPEX will maintain a contract for an SSDI spread, which provides a minimum of access to 500 $m^3$ of dispersant, and dispersant injection equipment | Yes | By maintaining contracts for a suitable SSDI spread and ensuring the equipment can arrive in Broome within 10 days, the SSDI spread is unlikely to be on the critical path, in the event that SSDI is required to support other source control activities.<br>The success of SSDI will be measured through monitoring of the reduction in atmospheric VOC concentrations, confirming VOCs are below safe exposure thresholds. |

| | | | |
|---|---|---|---|
| | INPEX will maintain contracts for suitable capping stack equipment.<br>The capping stack equipment will be:<br>• identified as fit for purpose, capable of being lowered and latched onto the selected BOP, utilising a single HLV<br>• rated to achieve a well-kill, based on the expected pressures of the reservoir<br>• primary stack available to be mobilised onto a HLV within 5 days<br>• primary and secondary capping stack maintained in a suitable state of readiness. | Yes | By maintaining contracts for suitable capping stack equipment, and ensuring the primary capping stack can be mobilised onto a HLV in Singapore within 5 days, the capping stack equipment will never be on the critical path for the capping stack activity. |
| | INPEX will continue to subscribe to the APPEA MoU, between titleholders. | Yes | INPEX has signed the APPEA MoU for mutual assistance between Titleholders. This MoU requires Titleholders to make 'best endeavours' to release and transfer drilling units and well-site services between Operators in a source control event. |
| | Source control documentation will be approved and in place in accordance with the WOMP, prior to spudding including:<br>• Drilling Browse Basin Emergency Response Plan<br>• Blowout Contingency Plan – Browse Basin Wells<br>• Source Control Emergency Response Plan<br>• Well Control Modelling Service Report<br>• Capping Stack Deployment and Installation Procedure<br>• WWCI Logistical Plan. | Yes | To ensure source control activities can be activated and implemented in a safe and efficient manner, source control planning documents will be developed. These source control documents will provide detailed methodologies and resource requirements for the source control options that may be implemented. The documentation will include:<br>• INPEX Drilling Browse Basin emergency response plan<br>  ○ specifies the procedures for managing and responding to potential emergencies<br>  ○ identifies event levels and teams to mobilise for response.<br>• Blowout contingency plan – Browse Basin wells<br>  ○ specifies the procedures for managing and responding to potential source control event<br>  ○ identifies source control structure and team<br>  ○ provides guidance for regulatory management<br>  ○ identifies external and emergency resources and contact details<br>  ○ identifies blowout intervention options. |

| | | | |
|---|---|---|---|
| | | | • Source control emergency response plan<br>○ provides the "Mobilisation Authority Form" to activate services and equipment provided WWCI<br>○ provides technical detail for WWCI equipment and required interfacing for capping stack and well head<br>○ identifies team structures and services provided by WWCI.<br><br>• Well control modelling service report<br>○ presents worst case blow out scenario<br>○ initial relief well and dynamic kill designs for worst case scenario<br>○ minimum capacity of MODU for dynamic kill<br>○ capping stack deployment and installation procedure.<br>○ confirms capping stack can land on well at highest flowing rate<br>○ operating procedures for running, landing and shutting capping stack.<br><br>• WWCI Logistical plan<br>○ inventory weights and dimensions<br>○ minimum vessel/HLV equipment and transit times<br>○ contracted vendors. |
| | In the event of a loss of well control, conduct a site survey of well-head and infrastructure to inform source control planning activities. | Yes | Site surveys are required to ensure the source control team has sufficient information to understand the status of the well head and surrounding area and develop detailed source control plans. Without this information, source control activities will not be able to be implemented in an effective and timely manner.<br>Identification of potential temporary wet-storage location for debris will ensure environmental impacts are reduced to ALARP, should wet-storage be required. |
| | The source control team will utilise the source control planning documentation to develop and implement a source control plan. The source control plan will:<br>• evaluate, define and schedule source control activities | Yes | The source control plan must be developed to support the safe and efficient implementation of the source control activities. |

| | | | |
|---|---|---|---|
| | • utilise the asset registers to identify and safely mobilise suitable assets within the minimum timeframe possible<br>• evaluate the potential to use the site survey vessel/ROV for BOP intervention<br>• evaluate the potential to use the original MODU to drill the top-hole for the relief well. | | |
| | The source control team will develop a SIMOPs plan, to support the source control plan. The SIMOPs plan will specify:<br>• licence area entry requirements, including DP checks<br>• exclusion zones<br>• minimum vessel separations<br>• communications requirements and frequencies<br>• SIMOPs planning meetings. | Yes | A SIMOPs plan is a standard tool utilised in the petroleum industry to control vessel activities and minimise the risk of vessel collisions (assessed in Section 8.3) or other incidents, when multiple vessels/assets are operating in a manner in which their interactions require an increased degree of coordination and communication. |
| | If debris clearance and wet-storage is required, the source control team will use existing site survey data to identify temporary wet storage areas which are not sensitive benthic habitats. | Yes | Debris clearance may be required, to enable other source control activities such as BOP intervention and capping stack installation to occur.<br>Temporary wet-storage of removed debris may be required, if crane capacities/deck-storage/onshore disposal plans aren't immediately available or the handling the debris at surface impact the operational critical path. Delaying source control to avoid temporary seabed impacts from wet-storage would result in greater loss of hydrocarbons to the marine environment. Therefore, where determined appropriate by the source control team, temporary wet-storage in areas which are not sensitive benthic habitat is considered ALARP. |
| | Maintain source control team preparedness through training and exercises. | Yes | To ensure that the INPEX source control team is prepared to respond to a source control event, source control team has received source control training and will participate in source control exercises.<br>External SMEs used for training and facilitation of exercises due to the bespoke nature of source control activities.<br>Training and drills focus on:<br>• understanding of source control planning documents/procedures and organisational chart |

| | | | |
|---|---|---|---|
| | | | • understand the teams and their defined roles and responsibilities in an event<br>• test communication lines and identify external resources available and required. |
| | Maintain a contract with WWCI, to provide technical expertise and support to the INPEX source control team and field activities. | Yes | WWCI are global experts in source control response. They will provide personnel who will provide technical expertise/advice to the INPEX source control team. WWCI will also provide field supervisors to oversee the in-field source control activities. |
| | Address initial source control activities including site survey, debris clearance and BOP intervention in a 'Host Safety Case'. | Pending | INPEX intends to prepare a revision to the INPEX CPF safety case to provide for initial source control activities (as a Host Safety Case). However, until the formal safety assessment is complete, it is uncertain whether this revision will conclude that the risks associated with these activities can be managed to ALARP. In addition, it is uncertain whether NOPSEMA will accept a revision addressing initial source control activities. As such, this control measure cannot be confirmed to be implemented at this stage. |

| | | | |
|---|---|---|---|
| | Develop a Safety Case revision template for source control activities. | Yes | A Safety Case revision template for source control activities will be developed prior to spudding the well. The purpose of the Safety Case revision template is to expedite development and submission of safety case revision(s) for source control activities. The template will provide a starting point for a relief well MODU(s) or intervention vessel (i.e. capping stack deployment) safety case revision to reduce preparation time where the MODU/vessel has an existing accepted Australian safety case.<br>As this is the first time a partially pre-populated Safety Case revision template will be generated by INPEX for an unspecified mobile offshore drilling unit (MODU) or vessel that may be involved in responding to a source control event within Australian Commonwealth waters, the level of detail that will be contained within the final template is currently uncertain.<br>It is expected that sections such as Introduction (including overview, scope and purpose), Safety Management System, Campaign and Site Description can be largely pre-populated with relatively minor updates required prior to submission. Other sections such as the Facility Description, Service Companies involved, and Formal Safety Assessment are expected to only be partially completed and will require major updates including the convening of a HAZID workshop with involved contractors (following reference to vessel/MODU tracking register, making contact and securing services) and potentially conducting further risk studies prior to submission.<br>This proactive commitment to generate a Safety Case revision template, regardless of whether the sections are fully or only partially updated will ultimately save preparation time should a source control event occur. |

| | |
|---|---|
| **Identify the likelihood** | |
| Likelihood | The likelihood of a well control event that would trigger the activation of source control strategies, thereby introducing the potential impacts and risks from implementing source control activities, are evaluated in Table 8-5 of this EP. The likelihood of the impacts and risks of source control are the same as the likelihoods described in Section 7 and 8.3 of this EP. |
| Residual risk | The residual risk of source control activities is the same as the residual risk of all elements described in Section 7 and 8.3 of this EP. |

| | | |
|---|---|---|
| **Residual risk summary** | | |
| Consequence | Likelihood | Residual risk |
| As per Section 7 and 8.3 of this EP. | As per Section 7 and 8.3 of this EP. | As per Section 7 and 8.3 of this EP. |
| **Assess residual risk acceptability** | | |

**Legislative requirements**

The source control activities are compliant with industry standards and relevant Australian legislation/guidance, e.g. OPGGS Act and OPGGS (E) Regulations 2009.

**Stakeholder consultation**

Stakeholders have been engaged and issues/feedback have been incorporated in to the EP regarding potential impacts and risks associated with well control and source control. Stakeholder engagement is an ongoing process.

**Conservation management plans / threat abatement plans**

The conservation management plans and threat abatement plans associated with all impacts and risks associated with implementing source control are described in Section 7 and 8.3 of this EP.

**ALARP summary**

The ALARP statements associated with impacts and risks from vessels and MODUs conducting source control activities are described in Section 7 and 8.3 and Table 8-15 this EP. No additional controls, beyond those identified during the detailed ALARP assessment can reasonably be implemented to further reduce the risk of impact.

**Acceptability summary**

Based on the above assessment, the proposed controls are expected to effectively reduce the risk of impacts to acceptable levels because:

- the activity demonstrates compliance with legislative requirements/industry standards
- the activity takes into account stakeholder feedback
- the activity is managed in a manner that is consistent with the intent of conservation management documents
- the activity does not compromise the relevant principles of ESD
- the predicted level of impact does not exceed the defined acceptable level in that the environmental risk has been assessed as "low or moderate", the consequence does not exceed "C – significant" and the risk has been reduced to ALARP.

| Environmental performance outcomes | Environmental performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| Impacts and risks from vessel and MODU activities will be reduced to acceptable and ALARP levels, through the implementation of the environmental performance standard. | During source control activities, vessel and MODU activities will be conducted in accordance with the relevant environmental performance standards as described in Section 7 and 8.3 of this EP. | Records confirm that during source control activities, vessel and MODU activities were conducted in accordance with the relevant environmental performance standards as described in Section 7 and 8.3 of this EP. | INPEX Ichthys Drilling Manager |

| | | | |
|---|---|---|---|
| INPEX maintain source control preparedness at acceptable levels through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | For the duration of the drilling activity, INPEX will maintain registers as described in Table 8-15, updated on a monthly basis, of the location and availability of support vessels, CSVs, HLVs and MODUs, including their capabilities (ROVs/crane capacity etc) and safety case status and jurisdiction. | Vessel and MODU registers. | INPEX Ichthys Drilling Manager |
| | For the duration of the drilling activity, INPEX will maintain a register of relief well long lead items. | Relief well long lead items register | INPEX Ichthys Drilling Manager |
| | For the duration of the drilling activity, INPEX will maintain contracts for suitable debris clearance equipment. Debris clearance equipment will be able to be mobilised to Broome within 5 days. | Records of contracts for debris clearance equipment. | INPEX Ichthys Drilling Manager |
| | For the duration of the drilling activity, INPEX will maintain a contract for a SSDI spread, which can be mobilised to Broome within 10 days. The SSDI spread will contain a minimum of 500 $m^3$ of dispersant. | Records of contract for SSDI spread. | INPEX Ichthys Drilling Manager |
| | For the duration of the drilling activity, INPEX will maintain contracts for suitable capping stack equipment. The capping stack equipment will be:<br>• identified as fit for purpose, capable of being lowered and latched onto the selected BOP, utilising a single HLV<br>• rated to achieve a well-kill, based on the expected pressures of the reservoir<br>• primary stack available to be mobilised onto a HLV within 5 days<br>• primary and secondary capping stack maintained in a suitable state of readiness. | Records of contracts for capping stack equipment. | INPEX Ichthys Drilling Manager |
| | For the duration of the drilling activity, INPEX will continue to subscribe to the APPEA MoU. | Record of APPEA MoU. | INPEX Ichthys Drilling Manager |

| | | | |
|---|---|---|---|
| | A Safety Case revision template will be developed. The Safety Case revision template will:<br>• be finalised prior to spudding the first well of the campaign<br>• reduce preparation time to revise existing accepted MODU/vessel safety cases for source control activities. | Safety Case revision template for source control activities. | INPEX Ichthys Drilling Manager |
| | Source control team will maintain preparedness through training and exercises to ensure the source control team:<br>• understand the source control planning documents/procedures<br>• understand their defined roles and responsibilities<br>• validate communications with external source control service providers. | Records of training and exercises for the source control team. | Source Control Team Leader |
| | For the duration of the drilling activity, INPEX will maintain a contract with WWCI, for the provision of personnel to:<br>• provide technical expertise to the INPEX source control team<br>• provide in-field supervision of source control activities. | WWCI contract. | INPEX Ichthys Drilling Manager |
| | Prior to spudding the first well of the campaign; source control documentation will be approved and in place in accordance with the WOMP, including:<br>• Drilling Browse Basin Emergency Response Plan<br>• Source Control Emergency Response Plan<br>• Blowout Contingency Plan – Browse Basin Wells<br>• Well Control Modelling Service Report<br>• Capping Stack Deployment and Installation Procedure. | Records confirm source control planning documentation was approved prior to spudding of the first well of the campaign. | INPEX Ichthys Drilling Manager |
| INPEX will re-gain control of a well within 80 days (Brewster)/108 days (Plover) of any source | In the event of a loss of well control, conduct a site survey of well-head infrastructure, to inform source control planning activities. | Records of site survey. | Source Control Team Leader |

| | | | |
|---|---|---|---|
| control event, through implementation of the environmental performance standards and the application of the environmental management implementation strategy. | The source control team will utilise the source control planning documentation to develop and implement a source control plan. The source control plan will:<br>• evaluate, define and schedule source control activities<br>• utilise the asset registers to identify and safely mobilise suitable assets within the minimum timeframe possible<br>• evaluate the potential to use the site survey vessel/ROV for BOP intervention<br>• evaluate the potential to use the original MODU to drill top-hole sections for any relief wells. | Source control plan documentation. | Source Control Team Leader |
| No incidents of loss of hydrocarbons to the marine environment as a result of a vessel collision during source control activities. | The source control team will develop a SIMOPs plan, to support the source control plan. The SIMOPs plan will specify:<br>• licence area entry requirements, including DP checks<br>• exclusion zones<br>• minimum vessel separations<br>• communications requirements and frequencies<br>• SIMOPs planning meetings. | Records confirm SIMOPs plan developed and implemented. | Source Control Team Leader |
| No impacts to sensitive benthic primary producer habitats during temporary wet-storage of debris. | If debris clearance and wet-storage is required, the source control team will use existing site survey data to identify temporary wet storage areas which are not sensitive benthic habitats. | Records confirm any identified wet-storage areas do not contain sensitive benthic habitats. | INPEX Environmental Advisor |
| Impacts to the shallow water column through use of SSDI will be reduced to ALARP through the implementation of the Environmental Performance Standard. | SSDI will only be activated when:<br>• Air quality monitoring and/or modelling determines there is a credible risk of atmospheric VOC concentrations exceeding safe exposure thresholds for source control activities; and<br>• There is a requirement to conduct source control activities in the zone where atmospheric VOCs may present a hazard to the safety of workers, and | Records of:<br>• Air quality monitoring and/or modelling demonstrating a credible risk of atmospheric VOC concentrations exceeding safe exposure thresholds for source control activities<br>• SSDI injection occurring concurrently with source control activities | Source Control Team Leader |

| | | | |
|---|---|---|---|
| | • Air quality monitoring and/or modelling of gas levels and lower explosive limits determines source control activities including SSDI could be safety conducted. | | |
| | SSDI injection concentration will initially be set at 100:1 (based on best estimate of well flow-rate at the time of the blow-out).<br>Effectiveness of SSDI will be monitored through ongoing measurement of VOC concentrations on the surface, by source control vessels. If VOC exposure thresholds are exceeded, SSDI ratio will be incrementally increased, until VOC concentrations are below safe exposure thresholds. | Records of SSDI injection ratio<br>Records of atmospheric VOC concentration monitoring during source control activities | Source Control Team Leader |

# 9 ENVIRONMENTAL MANAGEMENT IMPLEMENTATION STRATEGY

This section provides a description of the INPEX health, safety, environment and quality management system (HSEQ-MS) as it applies to the implementation of this EP and its associated performance outcomes and standards.

## 9.1 Overview

The HSEQ-MS includes standards and procedures from other business areas for its completeness. It is based on the principle of a "plan, do, check, act" (PDCA) continual improvement cycle, and has been developed in accordance with the following Australian standards:

- AS/NZS 4801:2001, *Occupational health and safety management systems—Specification with guidance for use*
- AS/NZS ISO 14001:2004, *Environmental management systems—Requirements with guidance for use*.

It provides mandatory rules and processes for the systematic and consistent management of HSEQ risks, demonstration of compliance, and facilitation of continual improvement. In the context of this EP, the HSEQ-MS enables INPEX to ensure that:

- environmental risks of activities are identified and communicated
- organisational structures and resources are provided to ensure that control measures remain effective in reducing environmental risks to levels that are acceptable and ALARP
- performance outcomes and standards are being met
- continual improvement is achieved through application of lessons learned.

The 13 external elements that influence the HSEQ-MS reflect key aspects of INPEX activities requiring process safety and HSEQ controls (Figure 9-1). These elements have to be managed and implemented properly in order to achieve the desired HSEQ performance and reflect a PDCA cycle, which is applied to every aspect of the 13 elements.

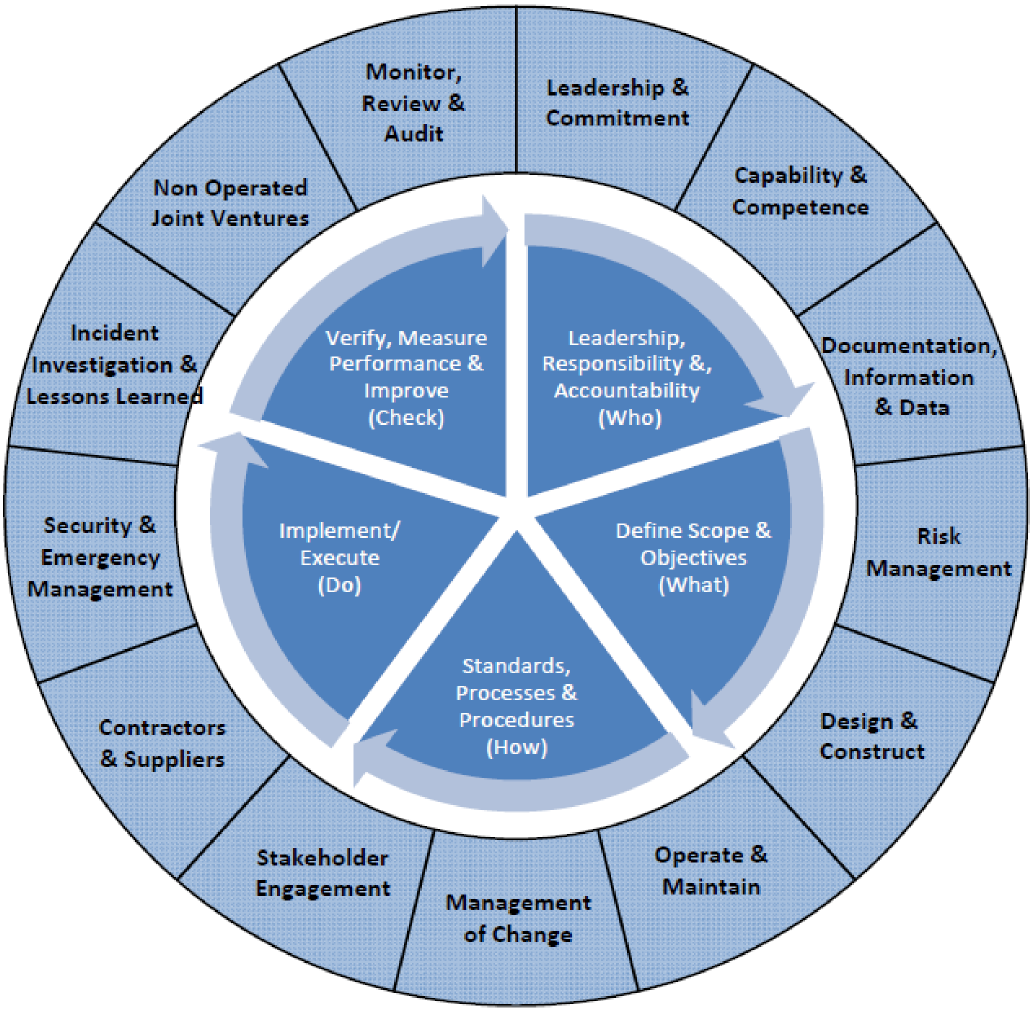



**Figure 9-1: The INPEX health, safety, environment and quality management system**

## 9.2 Leadership and commitment

INPEX environmental performance is achieved through strong visible leadership, commitment and accountability at all levels of the organisation. Leadership includes defining performance targets and providing structures and resources to meet them.

The INPEX Environmental Policy (Figure 9-2) solidifies this commitment and states the minimum expectations for environmental performance. The policy applies to all INPEX-controlled activities in Australia including WA-50-L. All personnel, including contractors, are required to comply with the policy.

The policy is available on the INPEX intranet and displayed at all INPEX workplaces, including the MODU and all contractor vessels in the licence area. It will be communicated to personnel involved in the activities, including contractors, through inductions.

INPEX

# Environmental Policy

## Objective

INPEX is a worldwide oil and gas exploration, development and production company committed to conducting each of its activities in a manner that is environmentally responsible.

Our objective is to develop an environment culture that is recognised as amongst "best in industry" that will exceed the performance expectations of our stakeholders.

We recognise our responsibility to adhere to the principles of sustainable development and we acknowledge that we owe a duty of care to both the natural environment and the communities in which we operate.

## Strategy

To accomplish this, INPEX will:

- comply with applicable laws and regulations, environmental plans and commitments and apply appropriate INPEX standards
- maintain a culture where people are empowered to intervene to prevent environmental harm
- set, measure and review environmental performance objectives and targets and ensure appropriate management of change processes are followed
- ensure our personnel have the necessary awareness, training, knowledge, resources and support, to meet environmental objectives and targets
- identify, manage and review environmental hazards and risks associated with our current and future business activities and manage these to levels that are 'as low as reasonably practicable' (ALARP)
- implement, maintain and regularly test control measures associated with major environmental events
- maintain and regularly test emergency management processes and procedures, including with industry and government emergency response partners
- engage with and communicate openly on environmental issues with internal and external stakeholders
- provide clearly defined environmental performance expectations for our contractors and suppliers, and work collaboratively with them to attain these
- endeavour to prevent pollution and seek continual improvement with respect to emissions, discharges, wastes, energy efficiency and resource consumption
- actively promote the reduction of greenhouse gas emissions across our operations in a safe, technically and commercially viable manner
- endeavour to protect biodiversity and to contribute to increased understanding of our natural environment
- drive continual improvement in environmental performance through monitoring, auditing and reviews.

## Application

This policy applies to all INPEX controlled activities in Australia and related project locations. It will be displayed at all company workplaces and on the company's intranet and it will be reviewed regularly.

**Hitoshi Okawa**
President Director, Australia

Rev: 3
April 2019



**Figure 9-2: INPEX environmental policy**

## 9.3 Capability and competence

INPEX appoints and maintains competent personnel to manage environmental risks and provide assurance that the INPEX Environmental Policy, objectives and performance expectations will be achieved. This applies to both individual competencies and the overall capability of the organisation.

### 9.3.1 Organisation

Figure 9-3 illustrates the organisational structure for onshore and offshore during the drilling campaign.

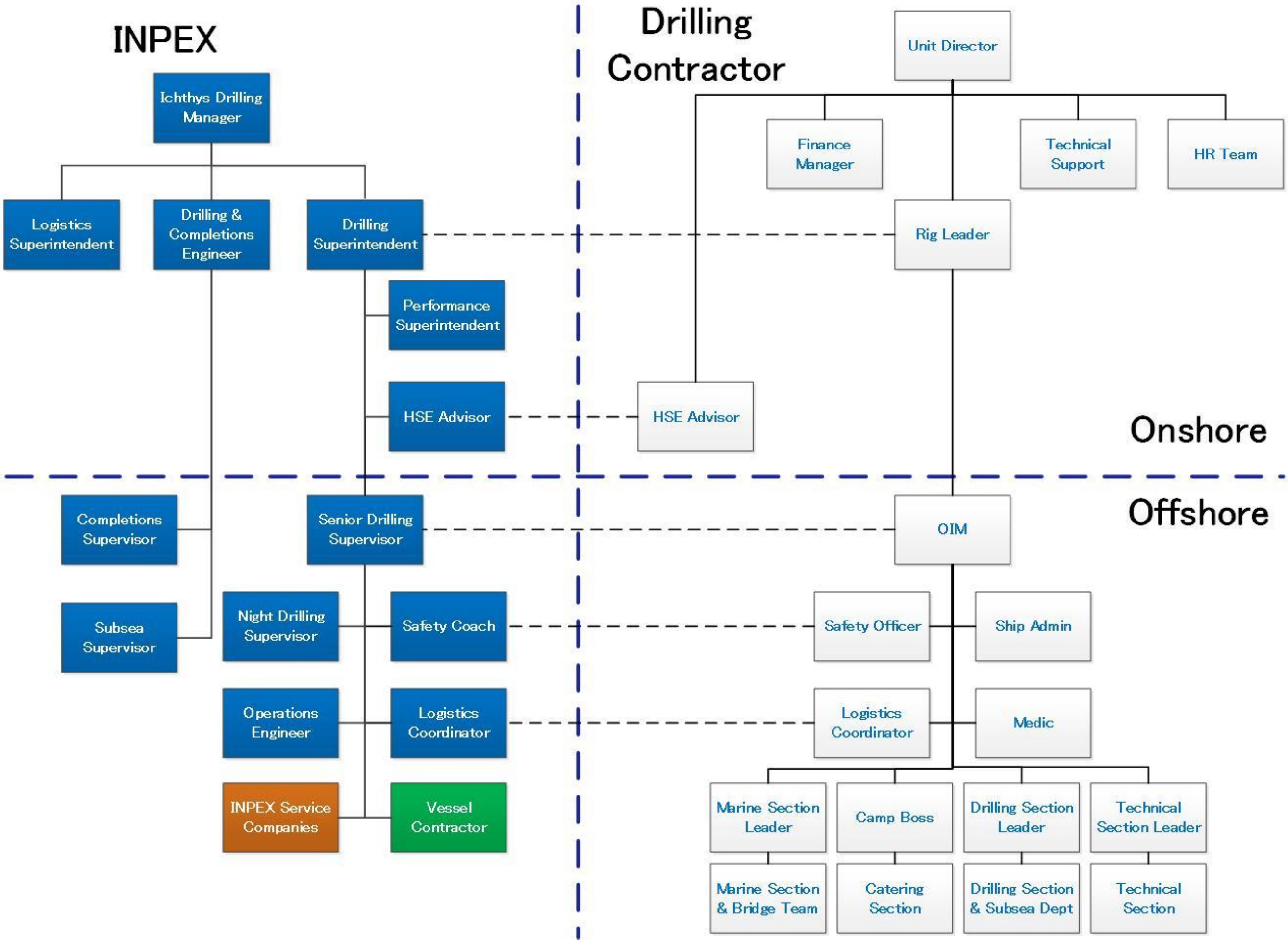



**Figure 9-3: Organisational structure**

Work activities will be conducted by the drilling contractor and service contractors, under the direction of the INPEX drilling supervisor via written work instructions and work programs.

### 9.3.2 Roles and responsibilities

INPEX has established and implements standards, procedures and systems to build and maintain a trained and competent workforce capable of fulfilling its assigned roles and responsibilities, as well as meeting its legislative and regulatory requirements. The selection process for the key INPEX personnel identified in Table 9-1 includes consideration of their previous work experience and recognised qualifications when compared with the INPEX minimum competency standards.

The key roles are responsible for collecting and maintaining the required evidence and monitoring data as specified in the environmental performance standards detailed in sections 7, 8 and 9 of this EP. Additional supporting roles and responsibilities related to HSEQ-MS implementation are also listed in Table 9-1.

Prior to mobilisation of personnel (MODU and vessel), those in key roles (Table 9-1) will be informed of their respective responsibilities in relation to this EP. This information will be disseminated by INPEX (e.g. through workshops, one-on-one sessions or by email) to ensure EP/OPEP awareness and that appropriate competencies and training requirements are met.

INPEX conducts training-needs analysis for each of the key roles listed in Table 9-1 to define minimum training requirements. The analysis is used to develop training plans which document, schedule and record completion of specific HSEQ training for individuals.

**Table 9-1: Key personnel and support roles and responsibilities**

| Key role | Responsibilities |
| --- | --- |
| INPEX Ichthys Drilling Manager (Onshore) | Ensures overall compliance with the INPEX HSEQ-MS including environmental performance outcomes and standards. |
| INPEX Drilling Superintendent<br><br>(Onshore) | Ensures activities are undertaken in accordance with this EP.<br><br>Ensures any changes to the activity that may affect the performance outcomes and environmental management procedures detailed in this EP are communicated to the INPEX HSEQ team.<br><br>Ensures vessel masters are provided with the resources required to ensure that the commitments in this EP are undertaken.<br><br>Ensures the INPEX drilling supervisor is provided with the resources required to ensure that the commitments in this EP are undertaken.<br><br>Ensures reporting of environmental incidents meets external reporting requirements and INPEX incident reporting requirements.<br><br>Ensures corrective actions raised from environmental audits are tracked and closed out. |
| INPEX Drilling Supervisor<br><br>(Offshore) | Ensures contractors perform operations in a manner consistent with the performance outcomes and environmental management procedures detailed in this EP.<br><br>Ensures the implementation of the INPEX Environment Policy, through application of this EP.<br><br>Ensures the OIM, vessels masters and all crews adhere to the requirements of this EP.<br><br>Ensures that the INPEX drilling superintendent is alerted to any changes in activities that could have a negative impact on environmental performance. |

| Key role | Responsibilities |
|---|---|
| | Reports incidents to the INPEX drilling superintendent. |
| INPEX HSE Adviser/ Environmental Adviser<br><br>(Onshore) | Ensures that environmental audits are undertaken.<br><br>Ensures that waste management and containment equipment audits are undertaken.<br><br>Provides HSE induction to personnel.<br><br>Ensures that the OIM and vessels masters have been provided copies of personnel responsibilities as set out in this EP.<br><br>Ensure that any changes to the drilling campaign that may affect EP mitigation and management measures are captured via the management of change process. |
| Field Manager | Issue Field entry permits.<br><br>Ensures that lifting of large infrastructure ('critical lifts') in WA-50-L will be managed under a permit to work issued in accordance with the INPEX *Lifting Standard*.<br><br>Ensures that SPS Isolation Philosophy/Procedures are implemented. |
| Offshore Installation Manager<br><br>(Offshore) | Ensures the MODU management system and procedures are implemented.<br><br>Ensures personnel starting work on the MODU receive an HSE induction that meets the requirements specified in this EP.<br><br>Ensures personnel are competent to undertake the work they have been assigned.<br><br>Ensures emergency drills are conducted as per the MODU's schedule.<br><br>Ensures the MODU's emergency response team has been given sufficient training to implement the MODU's SOPEP/SMPEP.<br><br>Ensures any environmental incidents or breaches of performance outcomes, standards or criteria, are reported immediately to the INPEX drilling supervisor. |
| Vessel masters<br><br>(Offshore) | Conduct vessel operations in accordance with this EP.<br><br>Implement the vessel's SOPEP/SMPEP in an emergency.<br><br>Ensure that environmental incidents or breaches of performance outcomes, standards or criteria on vessels, are reported in line with INPEX's HSEQ performance reporting requirements for contractors. |
| **Support role** | **Responsibilities** |
| All crew<br><br>(Offshore) | Work in accordance with accepted MODU and vessel HSE systems and procedures.<br><br>Comply with EP requirements as applicable to assigned role.<br><br>Report any hazardous condition, near miss, unsafe act, accident or environmental incident immediately to supervisors.<br><br>Attend HSE meetings and training when required. |

### 9.3.3 Inductions

Inductions are conducted for all personnel (including INPEX representatives, contractors, subcontractors and visitors) before they start work on the MODU and vessels described in this EP. Inductions cover the health, safety and environment requirements under the INPEX HSEQ-MS, including information about the commitments contained in this EP.

The environmental content of these inductions includes the following:

- the INPEX Environmental Policy
- a general description of the activity location
- the ecological and socioeconomic values of WA-50-L and the surrounding areas
- legislative requirements, standards and procedures
- adherence to standards and procedures; the use of job hazard analyses (JHAs) and permits to work (PTWs); hazard identification and management process
- oil spill management, including prevention, response and clean-up, location of spill kits and reporting requirements
- waste management requirements and process (segregation of non-hazardous i.e. landfill, recyclable, non-recyclable and hazardous wastes) and location of bins
- reporting of incidents
- chemical management requirements – chemicals to be approved and safety datasheets on board
- direction to contact an HSE representative if personnel believe their actions may have an impact on the environment.

## 9.4 Documentation, information and data

INPEX implements and maintains document and records management procedures and systems. These are in place to ensure that the information required to support safe and reliable drilling operations, is current, reliable and available to those who need it.

Documents and records are stored electronically in INPEX document management systems and databases.

This EP and associated documentation are maintained within a database, with current versions also available via the controlled document repository.

Records to demonstrate implementation of the HSEQ-MS and compliance with legislative requirements and other obligations are identified and maintained for at least five years. These records will include:

- written reports – including risk assessment reports and registers, monitoring reports, audit and review reports – about environmental performance or implementation strategies
- records relating to environmental performance or the implementation strategies
- records of environmental emissions and discharges
- modification and changes authorised by INPEX and/or contractor
- incident and/or near miss investigation reports
- improvement plans (corrective actions, key performance indicators)
- records relating to training and competency in accordance with this EP.

## 9.5 Risk Management

The risks and impacts associated with the petroleum activity are detailed in Section 7 and Section 8. Additional risk assessments will be undertaken on an ongoing basis when triggered by any of the following circumstances:

- when there is a proposed change to the activity, as identified by an INPEX management of change (MoC) request
- when identified as necessary following the investigation of an event
- when additional information about environmental impacts or risks becomes available (e.g. through better knowledge of the receptors present within the EMBA, new scientific information/papers, results of monitoring, other industry events or studies)
- if there is a change in regulations, as necessary
- during scheduled reviews of the documentation associated with this EP.

The risk assessment will be carried out in line with the assessment process described in Section 6 and is aligned to INPEX's HSE Hazard and Risk Management Standard, to ensure hazards related to the activity are systematically identified, assessed, evaluated and controlled. An environmental risk register for the activity is reviewed and updated quarterly. The review includes assessment of any new information and other changes that have been recorded on an ongoing basis in the previous quarter. Where this review results in a change, the changes are documented and communicated.

## 9.6 Operate and maintain

### 9.6.1 Chemical assessment and approval

Chemicals discharged during the drilling campaign will be selected to meet both technical and environmental criteria. The environmental criteria are specified in the INPEX Chemical Assessment and Approval Guideline as summarised below:

- The chemical product is listed in the OSPAR list of substances/preparations used and discharged offshore which are considered to PLONOR. This list is based on assessment of the intrinsic properties of a chemical product and in order for a product to be included on the list the OSPAR Commission must consider that it poses little or no risk to the environment.
- The chemical product is GOLD or SILVER-rated under the OCNS chemical hazardous assessment and risk management (CHARM) model. The CHARM model calculates the ratio of predicted environmental concentration against no effect concentration. This is expressed as a hazard quotient (HQ), which is then used to rank the product.
- The chemical product (if not CHARM-rated, e.g. inorganics, hydraulic fluids or pipeline chemicals) has an OCNS group rating of D or E. Non-CHARM products with a D or E grouping are either readily or inherently biodegradable.
- The chemical product (if not OCNS registered) is assessed as 'green' via the INPEX pseudo ranking system in line with the OCNS CHARM/ non-CHARM criteria (refer Table 9-2).

The assessment process requires that chemical products requested for use on INPEX sites or facilities which would be released to the marine environment under normal operating conditions shall be reviewed by an INPEX environmental adviser.

The INPEX pseudo ranking system, designed for those chemicals that are not OCNS registered, is a chemical assessment tool used to determine a chemical's inherent environmental hazard potential. This is determined by considering toxicity in conjunction with bioaccumulation and biodegradation potentials in line with the OCNS CHARM/non-CHARM criteria. Chemicals falling within the 'green' range are considered to present a low inherent hazard potential as shown in Table 9-2.

**Table 9-2: INPEX chemical assessment tool**

| | | Bioaccumulation | | | | | |
|---|---|---|---|---|---|---|---|
| | | $LogP_{ow}$[1] <3 or BCF[2] ≤100 and with a molecular weight ≥700 | | | $LogP_{ow}$[1] ≥3 or BCF[2] >100 and with a molecular weight <700 | | |
| Toxicity (ppm) | | Biodegradation (in 28 days) | | | | | |
| Aquatic | Sediment | ≥60% | ≥20% to <60% | <20% | ≥60% | ≥20% to <60% | <20% |
| <1 | <10 | | | | | | |
| 1≤ to <10 | 10≤ to <100 | | | | | | |
| 10≤ to <100 | 100≤ to <1000 | | | | | | |
| 100≤ to <1000 | 1000≤ to <10000 | | | | | | |
| ≥1000 | ≥10000 | | | | | | |

Cells highlighted in green represent chemical characteristics associated with low environmental hazard levels.

1 Octanol–water partition coefficient.

2 Bioconcentration factor.

In addition, the assessment process is to consider whether the product, regardless of the ranking, carries with it an OCNS substitution warning. Triggering this would require a further risk assessment of the product in accordance with the INPEX risk management process, which includes consideration of the *INPEX Risk Management Standard* (0000-A0-STD-60020).

Those chemical products considered as having a moderate or above residual risk will be assessed as unsuitable for use and will not be processed for approval and use during the drilling activity. Successful chemical requests will proceed to the approval stage, conducted within the chemical product database (ChemAlert) where all relevant records are maintained.

### 9.6.2 Biofouling risk assessment for domestic movements

The biofouling risk assessment process for domestic vessel movements includes aspects of the vessels history with respect to IMS risk e.g. vessels origin from within Australian waters and previous locations of operation (including whether these Australian locations have reported IMS occurrences), periods out-of-water and inspections/cleaning undertaken, age of anti-fouling coatings, presence and condition of internal treatment systems etc.

While undertaking the INPEX biofouling risk assessment for domestic movements (Figure 9-4), in any instances where potential risks are identified e.g. no anti-fouling coating or extended stays in Port, the process requires INPEX to engage an independent IMS expert and if required a further risk assessment may be undertaken.

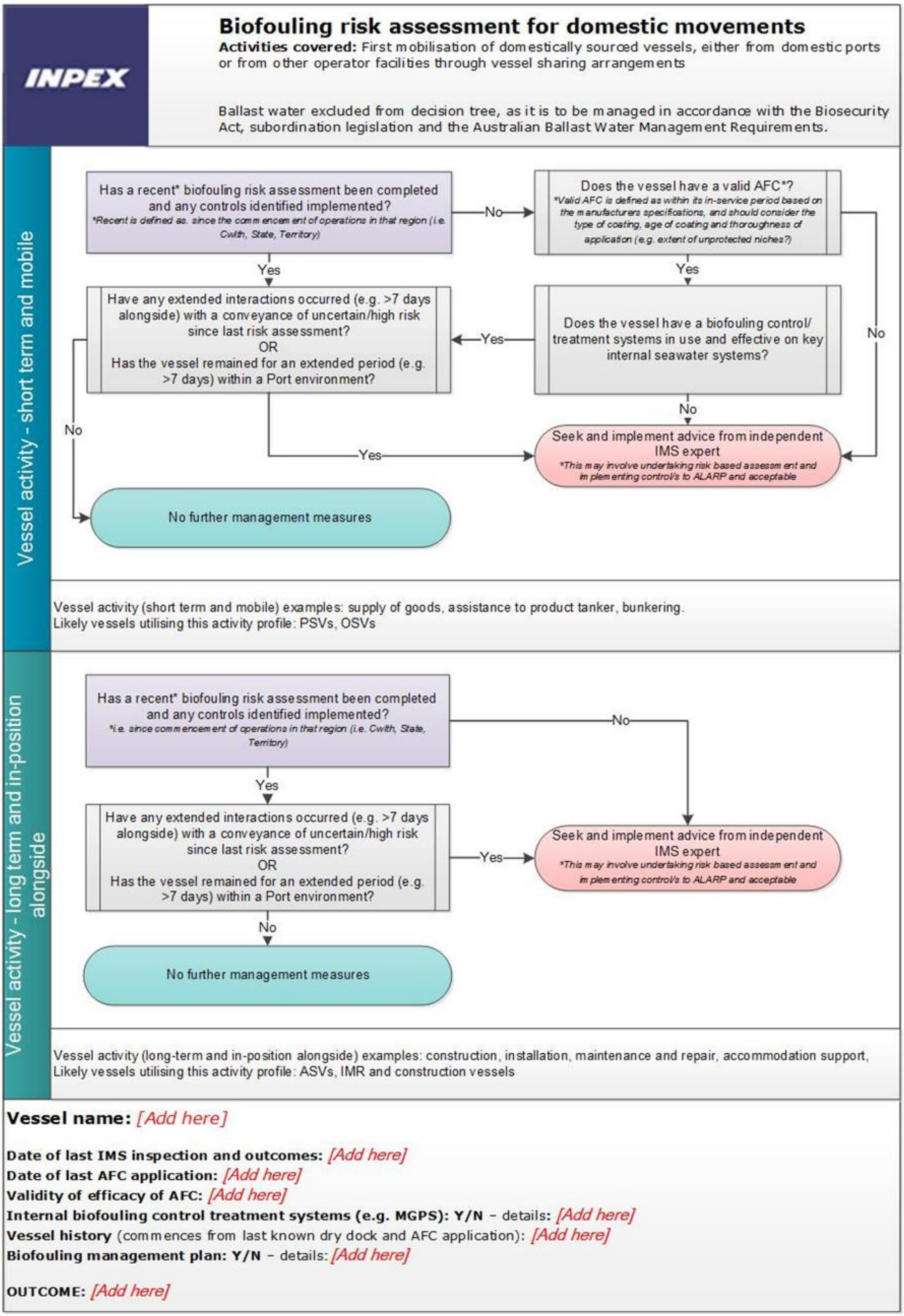



**Figure 9-4: INPEX biofouling risk assessment for domestic movements**

## 9.7 Management of change

Changes to this EP will be managed in accordance with a business-wide standard, and related procedures and guidelines. Where a change to management of an activity is proposed, it will be logged. Internal notification will be communicated via a management of change (MoC) request. The request will identify the proposed change(s) along with the underlying reasons and highlight potential areas of risk or impact. In accordance with the INPEX business rules, it is mandatory to undertake an environmental risk assessment in every case for changes that could affect the environment. The MoC request will be managed by an environmental adviser who will then determine the necessary approval/endorsement pathway, in consultation with the environmental approvals coordinator. Minor changes (such as updating a document or process) that do not invoke a revision trigger are made in document reviews from time to time.

In accordance with Regulation 17 of the OPGGS (E) Regulations 2009, a revision of this EP will be submitted to NOPSEMA where:

- a change is considered to represent a new activity
- a change is considered to represent a significant modification to, or a new stage of, an existing activity
- a change will create a significant new environmental impact or risk that is not provided for in the current EP
- a change will result in a series of new (or increased) environmental impacts or risks that, together, will result in a significant new environmental impact or risk, or a significant increase in an existing environmental impact or risk.

The MoC request process will be periodically checked against NOPSEMA guidance to ensure ongoing compliance and will be undertaken as part of the management review process described in Section 9.13.

## 9.8 Stakeholder engagement

### 9.8.1 Legislative and other requirements

INPEX maintains an approvals and compliance tracking system which identifies future approval requirements and when they must be in place, as well as compliance with existing approvals. Through this system, responsible persons are provided with alerts for required actions and time frames to avoid non-compliance and ensure there are no gaps in approvals.

In addition, INPEX personnel participate in industry and regulator forums, as well as maintain up-to-date knowledge of industry practices and proposed regulatory changes. Changes to legislative and other requirements are reviewed for potential impacts to business operations and communicated, as required, to personnel managing potentially affected activities.

Updates to matters relating to the EPBC Act, including policy statements and conservation management documentation will be achieved through subscription to automated email notifications provided by the DEE. Where required, updates to this EP will be conducted in accordance with the MoC process described in Section 9.7.

### 9.8.2 Communication

The requirements of the INPEX HSEQ-MS are communicated throughout the organisation. This facilitates the cascading and implementation of business policies and standards through the business, and on to contractors who work on behalf of INPEX.

INPEX and its contractors adopt a number of methods to ensure that information relating to HSEQ risks and impacts are communicated to personnel, including:

- daily toolbox meetings
- MODU HSE meetings
- use of noticeboards, intranet, HSE alerts and newsflashes e.g. environmental aspects and events
- internal and external reporting.

### 9.8.3 Ongoing stakeholder consultation

In relation to an EP Implementation Strategy, Regulation 14(9) of the OPPGS (E) Regulations 2009 specifies a requirement for consultation with relevant authorities of the Commonwealth, a state or territory, and other relevant interested persons or organisations. Any objections or claims received from stakeholders while the activity is ongoing will be considered and assessed as detailed in Section 5, using the same process and criteria described for the stakeholder consultation undertaken during the development of this EP. Mechanisms that provide ongoing opportunities for consultation with stakeholders, in relation to the implementation of this EP, are summarised in Table 9-3.

**Table 9-3: Ongoing stakeholder consultation**

| Stakeholder | Information supplied | Frequency |
|---|---|---|
| Australian Hydrographic Office (Cwlth) | The AHO will be notified of the activity commencement and cessation via datacentre@hydro.gov.au, for promulgation of fortnightly Notice to Mariners. | 4 weeks prior to commencement and upon completion |
| Australian Maritime Safety Authority (AMSA; Cwlth) Joint Rescue Coordination Centre (JRCC) | INPEX to notify AMSA JRCC for promulgation of radio-navigation warnings 24-48 hours before operations commence and upon completion of the survey (Email: rccaus@amsa.gov.au; Phone: 1800 641 792 or +61 2 6230 6811).<br>AMSA's JRCC require the vessel names, IMO vessel numbers and call signs, and Maritime Mobile Service Identity (MMSI) numbers. | 24-48 hours before operations commence and upon completion |
| NOPSEMA (Cwlth) | NOPSEMA will be notified of the activity commencement and cessation, using the Regulation 29 Notification Form available at https://www.nopsema.gov.au/environmental management/notification-and-reporting/ | At least 10 days prior to commencement and within 10 days of completion |
| NOPTA (Cwlth) | NOPTA will be notified of the activity commencement and cessation via reporting@nopta.gov.au | 48 hours prior to commencement and upon completion |
| Department of Mines, Industry Regulation and Safety (WA) | DMIRS will be notified of the activity commencement and cessation. | As required |

## 9.9 Contractors and suppliers

Selection and management processes are in place to ensure that contractors working for, or on behalf of, INPEX are able and willing to meet the minimum business expectations of INPEX, including those related to HSEQ and risk management.

The implementation of the INPEX contractor management requirements are achieved via the following processes:

- Contractors undergo an HSE assessment before receipt of an invitation to tender. As part of this process, INPEX carries out an assessment of the suitability of each contractor's management system.
- During the tender evaluation process, each contractor's management system is reviewed, assessed and ranked according to its robustness and ability to meet INPEX performance expectations as relevant to the tender work scope.
- All contractors and their subcontractors are required to meet INPEX HSEQ minimum requirements. These requirements are communicated to the contractors as part of the *Contract HSEQ Exhibits*, *Specifications* and *Terms and Conditions* documents.
- Key contractor and subcontractor personnel must be approved by INPEX under the *Contract HSEQ Exhibits*, *Specifications* and *Terms and Conditions* documents.
- INPEX maintains contract-specific management teams which are responsible for the day–to-day supervision and review of contractor compliance with INPEX requirements.
- Contract compliance audits, and quality control and assurance checks, are conducted throughout the life of the contract as appropriate to the scope of work and risks involved. Contractors are required to provide regular reports to communicate their HSEQ performance and compliance status.
- HSEQ performance of contractors is monitored through regular engagement between INPEX and contractor personnel, and through regular audits of compliance against the contractor HSE management plans.
- Periodic checks and reviews are conducted by INPEX representatives.
- Contractor documents, including environmental certification, procedures, emergency response and HSEQ management plans, need to be reviewed and accepted by INPEX before any work commences.

## 9.10 Security and emergency management

Regulation 14(8) of the OPGGS (E) Regulations 2009 requires the implementation strategy to contain an OPEP and the provision for the OPEP to be updated. The OPEP is designed to be an operational document. As such, some of the content requirements of the regulations are included in this EP. A summary of the regulatory requirements and a reference to where the obligations are met is provided below. The OPEP is presented in Appendix D.

In accordance with Regulation 14 (8AA) of the OPGGS (E) Regulations 2009, the OPEP must include arrangements to respond to and monitor oil pollution, including:

- the control measures necessary for a timely response to an oil pollution emergency (Table 2-1 of the OPEP, and the controls provided in Table 8-5 and Table 8-8 of this EP)
- the arrangements and response capability to implement a timely implementation of those controls, including ongoing maintenance of that capability (Sections 9.10.1, 9.10.3 and 9.10.4 of this EP)

- the arrangements and capability for monitoring the effectiveness of the controls and ensuring that performance standards for those controls are met (Table 8-5 and Table 8-8 of this EP)
- the arrangements and capability for monitoring oil pollution to inform response activities (refer to OPEP (Appendix D) and Section 4.6.2 *Scientific Monitoring*)
- the provision for the OPEP to be updated (Section 9.10.4).

### 9.10.1 Arrangements and capability

INPEX adopts the emergency management principles of prevention, preparedness, response, recovery (PPRR). The aim of PPRR is to ensure that risks are identified and minimised; plans to respond are developed and practised; and recovery plans are in place.

Preparedness also includes ensuring that there are competent personnel available to respond to and manage emergency events and that their competence is maintained through regular training. INPEX achieves this through its adoption of competency-based training and annual 'crisis and emergency' exercise plans.

**Onshore**

INPEX maintains a trained and ready incident management team (IMT) and crisis management team (CMT) to execute the emergency response plans (ERPs) and crisis management plans.

The IMT and CMT will utilise the INPEX Australia Incident Management Plan (0000-AH-PLN-60005), INPEX Australia Crisis Management Plan (0000-AH-PLN-60004) respectively, to respond to the event.

The IMT provides operational management support, and the CMT provides strategic direction with respect to management of reputational damage and impacts to business continuity.

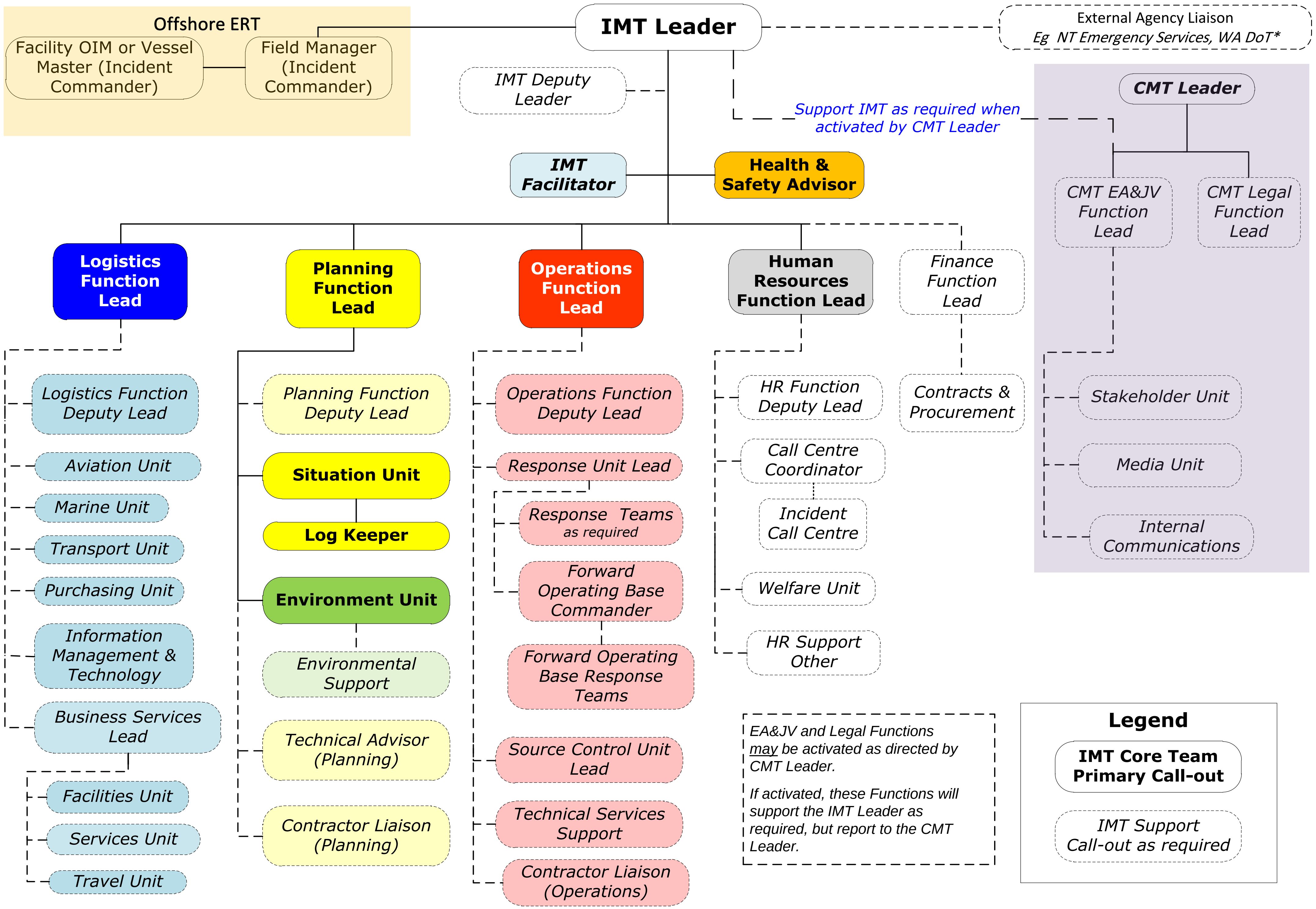
The IMT and CMT teams are large enough so that, during an emergency event, a roster can be operated to avoid fatigue and maintain staff health and well-being.

**Offshore**

There are ERPs for the MODU (Drilling Contractor ERP) and all contractor vessels that are implemented by the relevant facility/vessel emergency response team (ERT). INPEX and contractors nominate and train workplace personnel to form facility and vessel-based ERTs. These will be coordinated by the relevant person in charge (OIM or vessel master) to ensure that there is adequate emergency service cover on board at all times.

The OIM or vessel master will be the point of contact between assets within the licence area and the INPEX IMT. The INPEX IMT leader is the point of contact between the INPEX IMT and the CMT. Contractors are required to notify the INPEX field manager of any emergency.

The emergency response structure is presented in Figure 9-5.




* Department of Transport (WA or NT) have legal right to transfer Control Agency from Titleholder to DoT for level 2/3 oil spills impacting within State or Territory waters. WA DoT will appoint a DoT IMT Leader responsible for managing an oil spill impacting WA state waters in accordance with the State Hazard Plan Maritime Environmental Emergencies (MEE). INPEX resources will be made available to support the WA DoT 'cross jurisdictional arrangements', as specified under the MEE (WA DoT, 2018b), if requested by WA DoT. NT DIPL will appoint a DoT Incident controller (in accordance with the NT OSCP cross jurisdiction interim arrangements) to interface with the INPEX IMT where NT waters may be impacted by a spill. NT IC will become the control agency, supported by the INPEX IMT, if a spill reaches NT shorelines.

Note that the IMT structure presented is flexible and is to be collapsed or expanded at the discretion of the IMT Leader depending on the nature and scale of an emergency.

**Figure 9-5: INPEX emergency response structure**

Environmental performance outcomes, standards and measurement criteria relating to the maintenance of emergency response arrangements and capability are presented in Table 9-4.

**Table 9-4: Environmental performance outcome, standards and measurement criteria for maintenance of emergency response arrangements and capability**

| Environmental performance outcome | Performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| OPEP preparedness is maintained through implementation of the environmental performance standards. | The INPEX Emergency Contacts Directory is maintained with current and relevant contact details for OPEPs on an annual basis. | Records demonstrate that electronic and hard copies of the INPEX Emergency Contacts Directory are updated at least annually. | INPEX Environmental Adviser |
| | The INPEX Oil Spill Forms List is reviewed annually and maintained with current and relevant forms for INPEX OPEPs. | Records demonstrate that electronic and hard copies of the relevant forms list are updated at least annually. | INPEX Environmental Adviser |
| | The Oil Spill Equipment Tracking Register is reviewed on an annual basis, to ensure the capabilities stated in this EP are maintained. Specifically, this includes reviewing the status of:<br>• aviation mobilisation capability<br>• vessel call-off contracts<br>• contracts for additional personnel as general field responders<br>• INPEX personnel oil spill response training<br>• AMOSC capabilities<br>• Oiled wildlife response kit locations<br>• location of containment and recovery spill response equipment<br>• spill tracker buoy batteries and servicing | Records demonstrate that the Oil Spill Equipment Tracking Register is updated at least annually. | INPEX Environmental Adviser |

### 9.10.2 Emergency response training

This section describes the training that will be provided to the INPEX IMT, CMT and relevant offshore personnel (MODU and support vessels) in support of the *Ichthys Development Drilling Campaign WA-50-L OPEP*. Environmental performance outcomes, standards and measurement criteria relating to emergency response training are presented in Table 9-5.

**INPEX incident and crisis management teams**

Specific functions identified within the incident management team (IMT) receive nationally accredited training in line with the Australian Quality Training Framework. In addition to this, certain identified functions, along with some key support members receive specific oil spill response training. This approach ensures that INPEX always has the capability to respond to an oil spill event.

The minimum training provision for an IMT leader is PMAOMIR418 – *Coordinate incident response,* with the course material tailored to align with the INPEX Australia Incident Management Plan (0000-AH-PLN-60005). In addition, there will be at least four IMT Leaders with IMO III – oil spill command & control aligned competency to supplement the minimum IMT leader training requirement.

The minimum training provision for the IMT Core Team (positions as defined in Figure 9-5) is PMAOMIR320 - *Manage Incident Response Information*, with the course material tailored to align with the INPEX Australia Incident Management Plan (0000-AH-PLN-60005). In addition, a minimum of 15 IMT Core Team personnel will have completed an IMO II – oil spill response management aligned competency, to supplement the minimum IMT Core Team personnel training requirement.

The INPEX Crisis Management Team all receive an in-house training package, which is tailored to align with the requirements of the INPEX Australia Crisis Management Plan (0000-AH- PLN-60004).

**Offshore emergency response team**

The MODU and each vessel ERT will maintain its own training in oil spill response, commensurate with the risks and responses required. Vessel masters and the OIM will complete mandatory minimum requirements under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW) which includes oil spill response training.

Vessel masters and OIMs will also ensure facility/vessel ERTs complete drills as scheduled in their relevant Contractor ERP, including SOPEP drills.

In addition, OIMs and vessel bridge crews will be required to participate in an Ichthys Development Drilling Campaign WA-50-L OPEP induction.

**Table 9-5: Environmental performance outcome, standards and measurement criteria for emergency response training**

| Environmental performance outcome | Performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| INPEX IMT, MODU and support vessel ERTs maintain oil spill response training as described in the performance standard. | OIM/vessel masters will complete mandatory minimum training requirements under the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW) which includes oil spill response training. | Records of training. | INPEX Environmental Adviser |
| | MODU ERTs – conduct routine drills in accordance with the Drilling Contractor ERPs, including SOPEP drills. | Records of training. | INPEX Environmental Adviser |
| | Vessel ERTs - conduct routine drills in accordance with the Vessel Contractor ERPs, including SOPEP drills. | Records of training. | INPEX Environmental Adviser |
| | Ichthys Development Drilling Campaign WA-50-L OPEP induction delivered to MODU OIMs and Vessel Bridge Crews. | Records of training. | INPEX Environmental Adviser |
| | All INPEX CMT personnel will receive INPEX in-house CMT training, which is tailored to align with the requirements of the INPEX Australia Crisis Management Plan (0000-AH- PLN-60004). | Records of training. | INPEX Environmental Adviser |
| | INPEX IMT Leaders (all) will have completed the INPEX tailored, nationally accredited course - PMAOMIR418 – *Coordinate incident response*. | Records of training. | INPEX Environmental Adviser |
| | INPEX IMT Leader (minimum of 4) will be trained in IMO-3 aligned oil spill response training. | Records of training. | INPEX Environmental Adviser |

| Environmental performance outcome | Performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| | INPEX IMT Core Team personnel (all) will have completed the INPEX tailored, nationally accredited course - PMAOMIR320 - *Manage Incident Response Information* | Records of training. | INPEX Environmental Adviser |
| | INPEX IMT Core Functions (minimum of 15) will be trained in IMO-2 aligned oil spill response training. | Records of training. | INPEX Environmental Adviser |

### 9.10.3 Testing, drills and exercises

INPEX oil spill response arrangements shall be tested by the IMT:

- before the activity commences
- when the arrangements for an activity are significantly amended
- not later than 12 months following the most recent test.

Notification and call-out drills, that test communications channels and the ability to contact key individuals, shall be conducted at least annually.

Environmental performance outcomes, standards and measurement criteria relating to testing of response arrangements are presented in Table 9-6.

**Table 9-6: Environmental performance outcome, standards and measurement criteria for testing response arrangements**

| Environmental performance outcome | Performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| OPEP preparedness is maintained through the implementation of the performance standards. | The INPEX IMT will conduct a minimum of two oil spill exercises per year, using NOPSEMA-accepted OPEPs. | Exercise records demonstrate that the INPEX IMT tested a NOPSEMA-accepted OPEP at least twice yearly. | INPEX Environmental Adviser |
| | INPEX IMT and drilling source control team will have conducted a well blow-out exercise. The objectives of this exercise will include as a miniumum: | Records demonstrate that a source control exercise has been conducted prior to entering the reservoir. | INPEX Environmental Adviser |

| Environmental performance outcome | Performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| | • practice the interface between the source control team and IMT<br>• source control team verification of availability of rigs, vessels and equipment<br>• source control team verification of logistics plan. | | |
| | The Operational SIMA Templates (from the OPEP) and the environmental sensitivities maps from Section 4 - Existing Environment, will be maintained in hard copy in the Perth IMT room | Records demonstrate the Operational SIMA Templates (from the OPEP) and the environmental sensitivities maps from Section 4 - Existing Environment, will be maintained in hard copy in the Perth IMT room | INPEX Environmental Adviser |
| | IMT exercises will test the IMT's ability to develop an Operational SIMA and IAP. | Exercise records will contain copies of completed Operational SIMAs and IAPs. | INPEX Environmental Adviser |
| | Desktop validation exercises will be conducted to test notifications processes, contracted service provider activations, and logistics assumptions, annually. | Desktop validation exercise records demonstrate that notifications processes, contracted service provider activations, and logistics assumptions were tested annually. | INPEX Environmental Adviser |
| | A communication drill between the MODU and the INPEX IMT within 7 days of arrival in the licence area. | Drill records demonstrate that communication drill has occurred within 7 days of the arrival of the MODU in the licence area. | OIM / INPEX Environmental Adviser |

### 9.10.4 Updating the OPEP

The OPEP will be reviewed following events requiring its activation, in order to identify any lessons learned. OPEPs will be updated accordingly, and the INPEX Emergency Contacts Directory is reviewed as part of this process.

Environmental performance outcomes, standards and measurement criteria relating to updating the OPEP are presented in Table 9-7.

**Table 9-7: Environmental performance outcome, standards and measurement criteria for updating the OPEP**

| Environmental performance outcome | Performance standards | Measurement criteria | Responsibility |
|---|---|---|---|
| The OPEP is reviewed and updated, as needed, with relevant lessons learned. | The OPEP will be reviewed and updated following any INPEX IMT exercise or incident in which the OPEP was used, or with any significant lessons learned from other INPEX OPEPs, as relevant to this OPEP (Appendix D). | Records demonstrate a review and update (if necessary) of the OPEP. | INPEX Environmental Adviser |

## 9.11 Incident investigation and lessons learned

### 9.11.1 HSEQ performance measurement and reporting

HSEQ performance data is monitored in accordance with the INPEX HSEQ Performance Measurement and Reporting Standard. This enables the status of conformance with HSEQ obligations and goals to be determined, and also ensures HSEQ risks are being effectively managed to support continuous improvement. HSEQ is regularly reviewed by senior management.

### 9.11.2 Environmental incident reporting – internal

INPEX refers to environmental incidents and hazards as “environmental events”, which all personnel, including contractors, are required to report as soon as is reasonably practicable. Reporting must be in accordance with the INPEX *Event Reporting and Investigation Standard* and associated procedure.

All events will be documented and reviewed for their actual and potential consequence severity levels and investigated as appropriate. Corrective or preventative actions will be identified and documented, and their completion verified in an action register. These actions may include changes to the risk registers, standards, or procedures, or the need for training, different tools or equipment. Any actions will be recorded and tracked.

### 9.11.3 Environmental incident reporting – external

For the purposes of regulatory reporting to NOPSEMA, an incident is classified as either "Reportable" or "Recordable" based on the definitions contained in Regulation 4 of the OPGGS (E) Regulations 2009.

A "Reportable" incident is defined as "an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage." Environmental damage (or the potential to cause damage) includes social, economic and cultural features of the environment. For the purposes of this EP, such an incident is considered to have an environmental consequence level of Moderate (D) to Catastrophic (A) as defined in the INPEX Risk Matrix (Figure 6-1).

Based on the consequence assessments described in sections 7 and 8 of this EP, incidents identified as having the potential to be "Reportable" (i.e. Moderate (D) or above on the INPEX Risk Matrix) include:

- the introduction of IMS
- a loss of containment – well or SPS.

A "Recordable" incident is defined as "a breach of an environmental performance outcome or environmental performance standard … that is not a reportable incident." In terms of the activities within the scope of this EP, it is a breach of the performance standards and outcomes listed in Section 7, Section 8 or Section 9 of this EP.

For the purposes of regulatory reporting to DEE, any significant impact to matters of national environmental significance (MNES), as classified using the INPEX Risk Matrix, will be reported to DEE. The Director of National Parks will be notified of any oil/gas pollution incidences within or likely to impact a marine park as soon as possible (refer to OPEP Section 2.4.3/Table 2-3).

**Reportable incidents**

*Initial verbal notification*

In the event of a reportable incident, INPEX will give NOPSEMA an initial verbal notification of the occurrence as soon as is practicable; and in any case, not later than two hours after the first occurrence of the reportable incident; or if it is not detected at the time of the first occurrence, within two hours of the time that INPEX becomes aware of the incident.

The initial verbal notification will contain:

- all material facts and circumstances concerning the reportable incident that are known or can, by reasonable search or enquiry, be found out
- any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.

*Written notification*

As soon as possible after an initial verbal notification of a reportable incident, INPEX will provide a written record of the notification to:

- NOPSEMA
- the National Offshore Petroleum Titles Authority (Cwlth)

- the Department of Mines, Industry Regulation and Safety (WA) or the Department of Mines and Energy (NT), depending on the jurisdiction.

In the event of a significant impact to MNES, INPEX will provide an initial notification to DEE within 24 hours of becoming aware of the event.

In the event of a reportable incident, INPEX will provide a written report to NOPSEMA as soon as is practicable; and in any case, not later than three days after the first occurrence of the incident. If, within the three-day period, NOPSEMA specifies an alternative reporting period, INPEX will report accordingly. The report will contain:

- all material facts and circumstances concerning the reportable incident that are known or can, by reasonable search or enquiry, be found out
- any action taken to avoid or mitigate any adverse environmental impacts of the reportable incident
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

Within seven days of giving a written report of a reportable incident to NOPSEMA, INPEX will provide a copy of the report to:

- the National Offshore Petroleum Titles Authority (Cwlth)
- the Department of Mines, Industry Regulation and Safety (WA) or Department of Mines and Energy (NT), depending on the jurisdiction.

Following submission of the above, NOPSEMA may, by notice in writing, request INPEX to submit an additional report(s) of the incident. Where this is the case, NOPSEMA will identify the information to be contained in the report(s) or the matters to be addressed and will specify the submission date for the report(s). INPEX will prepare and submit the report(s) in accordance with the notice given.

In the event of a significant impact to MNES, INPEX will provide a written notification to DEE (Cwlth) within three days of becoming aware of the event, and provide additional information as available, if requested by DEE.

This includes reporting any vessel strike incidents to the National Ship Strike Database at <https://data.marinemammals.gov.au/report/shipstrike>.

Suspected or confirmed presence of any marine pest or disease will be reported to DPIRD within 24 hours by email (biosecurity@fish.wa.gov.au) or telephone. This includes any organism listed in the WA prevention list for introduced marine pests and any other non-indigenous organism that demonstrates invasive characteristics.

**Recordable incidents**

*Reporting*

In the event of a recordable incident, INPEX will report the occurrence to NOPSEMA as soon as is practicable after the end of the calendar month in which it occurs; and in any case, not later than 15 days after the end of the calendar month. The report will contain:

- a record of all the recordable incidents that occurred during the calendar month
- all material facts and circumstances concerning the recordable incidents that are known or can, by reasonable search or enquiry, be found out

- any action taken to avoid or mitigate any adverse environmental impacts of the recordable incidents
- the corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the recordable incident
- the action that has been taken, or is proposed to be taken, to prevent a similar incident occurring in the future.

### 9.11.4 Annual performance reporting – external

In accordance with Regulation 14(2) of the OPGGS (E) Regulations 2009, INPEX will undertake a review of its compliance with the environmental performance outcomes and standards set out in this EP and will provide a written report of its findings for the reporting period to NOPSEMA on an annual basis, as agreed with NOPSEMA. The annual submission date for the environmental performance report will be 12 months after the start of the activity.

## 9.12 Monitor, review and audit

### 9.12.1 Management system audit

An audit and inspection program will be developed and implemented in accordance with the INPEX business standard for auditing. The program will include:

- self-assessment HSEQ audits against the HSEQ-MS
- regular inspections of workplace equipment and activities
- reviews to evaluate compliance with legislative and other requirements.

Unscheduled audits may be initiated by INPEX in the event of an incident, non-compliance or for other valid reasons.

Audit teams will be appropriately qualified, experienced and competent in auditing techniques. They will include relevant technical expertise, as required, and the audit team structure will be commensurate with the scope of the audit. HSEQ audit and inspection findings will be summarised in a report. Non-conformances, actions and improvement plans resulting from audits will be managed in an action tracking system.

### 9.12.2 MODU and vessel inspections

Inspections will be undertaken to ensure that the environmental performance outcomes and standards documented in this EP can be achieved.

Pre-mobilisation inspections will be conducted prior to drilling activities on relevant MODUs and vessels.

During the activity, MODU operational compliance against relevant EPO/EPSs will be assessed and maintained through the implementation of a monthly environmental inspection checklist.

Non-conformances and relevant findings during the inspections will be converted into actions that will be tracked within an action tracking database until closed.

## 9.13 Management review

Through a process of adaptive management, lessons from management outcomes will be used for continual improvement. Formal reviews of the effectiveness and appropriateness of the INPEX HSEQ-MS are performed by senior management on a periodic basis. The things learned from this process and iterative decision-making will then be used as feedback to improve future management.

Together with the annual environmental performance report described in Section 9.11.4, EP management reviews will enable the review of environmental performance, as well the efficacy of the implementation strategy used during the drilling campaign.

Management reviews of this EP shall assess whether:

- the environmental impacts and risks of the activity continue to be identified and reduced to a level that is ALARP
- control measures detailed in this EP are effective in reducing the environmental impacts and risks of the activity to ALARP and an acceptable level
- implementation of the management of change (MoC) process has remained consistent with the commitment to ensuring impacts and risks are reduced to ALARP and are acceptable
- any changes in legislation, or matters relating to the EPBC Act, including policy statements and conservation management documentation, have occurred which affect or need to be taken into consideration in relation to this EP
- any changes in NOPSEMA guidance which may affect or need to be taken into consideration in relation to this EP
- the Operational and Scientific Monitoring Program (within the OPEP) remains fit for purpose
- lessons learned have been communicated and, where applicable, applied across all titleholder activities, as relevant.

Where the documented findings of the EP management reviews have implications for this EP, the EP will be updated in accordance with the EP MoC process.

# 10 REFERENCES


ADB–see Asian Development Bank

Add Energy. 2019. Blowout and Kill Simulation Study, Ichthys Phase 2A Plover Production Well. Add Energy. Stavenager, Norway.

AFMA–see Australian Fisheries Management Authority

AIMS-see Australian Institute of Marine Science

Allen, G.R. and Erdmann, M.V. 2013. *Coral Reef Fishes of Timor-Leste*. Pp. 33-82 in *A Rapid Marine Biological Assessment of Timor-Leste*. Conservation International, Virginia, United States. Available at http://www.bioone.org/doi/full/10.1896/054.066.0103.

Allers E, Abed RMM, Wehrmann LM, Wang T, Larsson AI, Purser A, and de Beer D. 2013. Resistance of Lophelia pertusa to coverage by sediment and petroleum drill cuttings. *Marine Pollution Bulletin* 74:132-140.

AMEC Ltd. 2011. *CPF and FPSO Environmental Conditions Data Sheets* (Doc. No. A075-AH-DAT-5000 Rev G). Report prepared by AMEC Ltd on behalf of INPEX Browse Ltd, Perth, Western Australia.

ANZECC/ARMCANZ–see Australian and New Zealand Environment and Conservation Council and Agriculture and Resources Management Council of Australia and New Zealand.

APASA – see Asia-Pacific Applied Science Associates

Asia-Pacific Applied Science Associates (APASA). 2013. Brewster Development Wells WA 285: Quantative Oil Spill Exposure Modelling. J0203. Report prepared by Asia-Pacific Applied Science Associated. Prepared for INPEX Operations, Perth, Western Australia.

Asia-Pacific Applied Science Associates (APASA). 2015. *INPEX Ichthys FPSO Liquid Effluent Dispersion Modelling.* J0344, Rev 0. Report prepared by RPS Asia-Pacific Applied Science Associates for INPEX Browse, Ltd., Perth, Western Australia.

Asian Development Bank. 2014. *State of the Coral Triangle: Indonesia*. Mandaluyong City, Philippines.

Australian Fisheries Management Authority. 2019a. Western Tuna and Billfish Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 21/06/2019 at https://www.afma.gov.au/fisheries/western-tuna-and-billfish-fishery

Australian Fisheries Management Authority. 2019b. Western Skipjack Tuna Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 21/06/2019 at https://www.afma.gov.au/fisheries/skipjack-tuna-fishery

Australian Fisheries Management Authority. 2019c. Northern Prawn Fishery Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 21/06/2019 at https://www.afma.gov.au/fisheries/northern-prawn-fishery

Australian Fisheries Management Authority. 2019d. North West Slope Trawl Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 21/06/2019 at https://www.afma.gov.au/fisheries/north-west-slope-trawl-fishery

Australian Fisheries Management Authority. 2019e. Joint Authority Fisheries. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 21/06/2019 at https://www.afma.gov.au/fisheries/joint-authority-fisheries.

Australian Fisheries Management Authority. 2019f. Scampi. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 24/06/2019 at https://www.afma.gov.au/fisheries-management/species/scampi

Australian Fisheries Management Authority. 2019g. Southern Bluefin Tuna Fishery. Australian Fisheries Management Authority, Canberra, ACT. Accessed online 10/09/2019 at https://www.afma.gov.au/fisheries/southern-bluefin-tuna-fishery

Australian Institute of Marine Science. 2012. *Montara: 2011 Offshore Banks Assessment Survey.* Final Report prepared by the Australian Institute of Marine Science, Townsville, Queensland for PTTEP Australasia (Ashmore Cartier) Pty. Ltd, Perth, Western Australia.

Australian and New Zealand Environment and Conservation Council and Agriculture and Resources Management Council of Australia and New Zealand. 2000. Australian and New Zealand guidelines for fresh and marine water quality: Volume 1, The Guidelines. Australian and New Zealand Environment and Conservation Council, Canberra and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT.

Australian Maritime Safety Authority. 2015. *National Plan technical guidelines for preparing contingency plans for marine and coastal facilities*. NP-GUI-012. Australian Maritime Safety Authority, Canberra, ACT.

Australian Maritime Safety Authority. 2019. *National plan for maritime environmental emergencies*. Australian Maritime Safety Authority, Canberra, ACT.

Australian Transport and Safety Bureau. 2013. *Australian Shipping Occurrence Statistics 2005 to 2012. Marine Research Report MR-2013-002*. Australian Transport and Safety Bureau, Canberra, ACT. Accessed online on 06/08/2019 at: https://www.atsb.gov.au/media/4119146/mr-2013-002_final.pdf

Azis P., Al-Tisan, I., Daili, M., Green T., Dalvi, A. and Javeed, M. 2003. Chlorophyll and plankton of the Gulf coastal waters of Saudi Arabia bordering a desalination plant. Desalination 154:291–302.

Baker, C., Potter, A., Tran, M. & Heap, A.D. 2008. *Geomorphology and sedimentology of the northwest marine region of Australia*, record 2008/07, Geoscience Australia, Canberra, ACT.

Bakke, T., Klungsoyr, J. and Sanni, S. 2013. Environmental impacts of produced water and drilling waste discharges from the Norwegian offshore petroleum industry. *Marine Environmental Research* 92:154-169.

Bamford M., Watkins D., Bancroft W., Tischler G. and Wahl, J. 2008. *Migratory Shorebirds of the East Asian–Australasian Flyway; Population Estimates and Internationally Important Sites.* Wetlands International. Oceania. Canberra, ACT.

Bannister, J.L., Kemper, C.M. and Warneke, R.M. 1996. *The Action Plan for Australian Cetaceans*. Canberra: The Director of National Parks and Wildlife, Biodiversity Group, Environment Australia, Canberra, ACT.

Beasley I., Robertson, K.M. and Arnold, P. 2005. Description of a new dolphin: The Australian snubfin dolphin *Orcaella heinsohni* sp.n. (Cetacea, Delphinidae). *Marine* Mammal Science 21(3):365–400.

Bennelongia 2010. *Analysis of possible change in ecological character of the Roebuck Bay and Eighty Mile Beach Ramsar sites*. Draft report prepared for the Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT by Bennelongia Pty Ltd, Joilmont, Western Australia.

BirdLife International. 2012. Light pollution has a negative impact on many seabirds including several globally threatened species. Birdlife International, Cambridge, United Kingdom. Accessed online 5/6/2019 at http://datazone.birdlife.org/light-pollution-has-a-negative-impact-on-many-seabirds-including-several-globally-threatened-species

BirdLife International. 2019. *Important Bird Areas factsheet: Lacepede Islands*. Birdlife International, Cambridge, United Kingdom. Accessed online 26/06/2019 at http://datazone.birdlife.org/site/factsheet/lacepede-islands-iba-australia

BMT (2019a) INPEX Drill Cuttings Study – Baseline Report. Prepared for INPEX by BMT Western Australia Pty Ltd, Report No. 1436_001/2_Rev0 X060-AH-REP-60018, Perth, Western Australia.

BMT (2019b) INPEX Drill Cuttings Study – Interim Interpretative Report. Prepared for INPEX by BMT Western Australia Pty Ltd, Report No. 1436_001/3_Rev0 X060-AH-REP-60028, Perth, Western Australia.

BOM–see Bureau of Meteorology.

Brewer, D.T., Lyne, V., Skewes, T.D. & Rothlisberg, P. 2007. *Trophic systems of the north west marine region.* Report prepared by CSIRO Marine and Atmospheric Research, Cleveland, Queensland for the Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Brown, A.M., Smith, J., Salgado-Kent, C., Marley, S., Allen, S.J., Thiele, D., Bejder, L., Erbe, C. & Chabanne, D. 2017. Relative abundance, population genetic structure and acoustic monitoring of Australian snubfin and humpback dolphins in regions within the Kimberley. Report of Project 1.2.4 prepared for the Kimberley Marine Research Program, Western Australian Marine Science Institution, Perth, Western Australia, 61pp plus appendices.

Brunnschweiler, J.M., Baensch, H., Pierce, S. J., and Sims, D.W. 2009. Deep-diving behaviour of a whale shark Rhincodon typus during long-distance movement in the western Indian Ocean. *Journal of Fish Biology*, 74:706-714.

Brunnschweiler, J.M., and Sims, D.W. 2011. Diel oscillations in whale shark vertical movements associated with meso-and bathypelagic diving. *American Fisheries Society Symposium* 76:457–469.

Bureau of Meteorology. 2019. Climate Data Online. Bureau of Meteorology, Melbourne, Victoria. Accessed online on 20/06/2019 from http://www.bom.gov.au/climate/data/.

Burns, K.A., Garrity, S.D. and Levings, S.C. 1993. How many years before mangrove ecosystems recover from catastrophic oil spills? *Marine Pollution Bulletin.* 26(5):239–248.

Campagna, C., Short, F.T., Polidoro, B.A., McManus, R., Collette, B.B., Pilcher, N.J., Mitcheson, Y.S., Stuart, S.N. and Carpenter, K.E. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. *BioScience* 61:393–397.

Cannell, B., Oh, B., Wiley, E., Allen, P., Surman, C. and Rodley, A. 2018. Report describing the diet and composition, forgaging habitat and behabiour and breeding of target seabird species at Lacepede Islands during the breeding season in 2016 and annual comparisons 2014-2016. Applied Research Program 6: Milestone Report #6. Report prepared for Shell Australia, Perth and INPEX Operations Australia Pty Ltd, Perth by the Australian Institute of Marine Science, Perth, Western Australia.

CAPAD–see Collaborative Australian Protected Areas Database

Carlton, J.T. 1996. Pattern, process, and prediction in marine invasion ecology. Biological Conservation 78: 97-106.

Carlton, J.T. 2001. Introduced Species in U.S. Coastal Waters - Environmental Impacts and Management Priorities. Prepared for the Pew Oceans Commission, United States.

Carroll, A.G., Przeslawski, R., Duncan, A., Gunning, M. and Bruce, B. 2017. A critical review of the potential impacts of marine seismic surveys on fish and invertebrates. Marine Pollution Bulletin, 114: 9-24.

CCWA–see Conservation Commission of Western Australia

Christian, J.R., Mathieu, A., Thompson, D.H., White, D., Buchanan, R.A. 2003. Effect of Seismic Energy on SnowCrab (Chionoecetes opilio). Environmental Funds Project No. 144. Fisheries and Oceans Canada. Calgary, Canada.

Clarke, R.H. 2010. *The Status of Seabirds and Shorebirds at Ashmore Reef and Cartier and Browse Islands: Monitoring Program for the Montara Well release – Pre-impact assessment and First Post-Impact Field Survey*. Report prepared for PTTEP Australasia and the Department of the Environment, Water, Heritage and the Arts (now the Department of the Environment), Australia.

Clarke, R. 2015. *Seabirds and shorebirds at Adele Island*. Applied Research Program 6: Milestone Report #2. Shell Australia, Perth and INPEX Operations Australia Pty Ltd, Perth by the Australian Institute of Marine Science, Perth, Western Australia.

Collaborative Australian Protected Areas Database. 2016. CAPAD: protected area data. Department of the Environment and Energy, Canberra, ACT. Accessed online 20/06/2019 at http://www.environment.gov.au/land/nrs/science/capad

Commonwealth of Australia. 2002. Ashmore Reef National Nature Reserve and Cartier Island Marine Reserve Management Plans. Environment Australia, Canberra, ACT.

Connell, D.W., Miller, G.J. and Farrington, J.W. 1981. Petroleum hydrocarbons in aquatic ecosystems—behavior and effects of sublethal concentrations: Part 2. *Critical Reviews in Environmental Science and Technology* 11(2):105–162.

Conservation Commission of Western Australia (CCWA). 2010. *Status Performance Assessment: Biodiversity Conservation on Western Australian Islands, Phase 2 – Kimberley Islands.* Final Report. Conservation Commission of Western Australia, Perth Western Australia.

Cook, K., Gilmour, J., Piggott, C., Oades, D., McCarthy, P., Howard, A., Bessell-Browne, P., Arklie, S. and Foster, T. 2017. *Key ecological processes in Kimberley benthic communities: coral recruitment.* Final report of Project 1.1.2b Kimberley Marine Research Program. Western Australian Marine Science Institution, Perth, Western Australia.

Coral Triangle Atlas. 2014. Savu Sea National Marine Conservation Area information requirements for inclusion in CTMPAs Categories 3 or 4. Accessed online on 20/06/2019 at http://ctatlas.reefbase.org/pdf/monitoring/CTMPAS%20SavuSea%20July%202014.pdf

Crecelius, E., Trefry, J., McKinley, J., Lasorsa, B. and Trocine, R. 2007. *Study of barite solubility and the release of trace components to the marine environment*. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OC5 Study MMS 2007-061. 176 pp.

Dafforn, K. A., Glasby, T. M., and Johnston, E. L., 2009a. Links between estuarine condition and spatial distributions of marine invaders. *Diversity and Distributions* 15(5): 807–821.

Dafforn, K. A., Johnston, E. L., Glasby, T. M., 2009b. Shallow moving structures promote marine invader dominance. *Biofouling* 25:3, 277-287.

DAWR – see Department of Agriculture and Water Resources

Day, R.D., McCauley, R.D., Fitzgibbon, Q.P., Semmens, J.M. 2016. Seismic air gun exposure during early-stage embryonic development does not negatively affect spiny lobster Jasus edwardsii larvae (Decapoda: Palinuridae). *Scientific Reports* 6, 22723.

Dean, T.A., Stekoll, M.S., Jewett, S.C., Smith, R.O. and Hose, J.E. 1998. Eelgrass (*Zostera marina* L.) in Prince William Sound, Alaska: effects of the Exxon Valdez oil spill. *Marine Pollution Bulletin*, 36:201–210.

DEC—*see* Department of Environment and Conservation

DEC and MPRA—*see* Department of Environment and Conservation and Marine Parks and Reserves Authority

DEE- see Department of the Environment and Energy

Department of Agriculture and Water Resources (DAWR). 2017. *Australian Ballast Water Management Requirements, Version 7*. Department of Agriculture and Water Resources, Canberra, ACT.

Department of the Environment. 2015. Conservation Management Plan for the Blue Whale—A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2015-2025, Commonwealth of Australia, Canberra, ACT.

Department of Environment and Conservation. 2007. *Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007–2017: Management Plan* No. 55. Department of Environment and Conservation, Perth, Western Australia.

Department of Environment and Conservation and Marine Parks and Reserves Authority. 2005. *Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005–2015*. Department of Environment and Conservation and Marine Parks and Reserves Authority, Perth, Western Australia.

Department of the Environment. 2015. Conservation Management Plan for the Blue Whale—A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2015-2025, Commonwealth of Australia, Canberra, ACT.

Department of the Environment and Energy (DEE) 2017a. *Recovery Plan for Marine Turtles in Australia*. Commonwealth of Australia, Canberra, ACT.

Department of the Environment and Energy (DEE) 2017b. *EPBC Act Policy Statement 3.21. Industry guidelines for avoiding, assessing and mitigating impacts on EPBC listed migratory shorebird species*. Commonwealth of Australia, Canberra, ACT.

Department of the Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coast and oceans. Commonwealth of Australia 2018, Canberra, ACT.

Department of the Environment and Energy. 2019a. *Continental slope demersal fish communities*. Accessed online 26/06/2019 at https://www.environment.gov.au/sprat-public/action/kef/view/79;jsessionid=01AD87551D0DE1B0248C8722BE137004

Department of the Environment and Energy. 2019b. *SPRAT Profile – Dugong dugon* — Dugong*.* Accessed online 26/06/2019 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=28

Department of the Environment. 2019c. *SPRAT Profile – Sousa sahulensis — Australian Humpback Dolphin.* Accessed online 26/06/2019 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=87942

Department of the Environment. 2019d. *SPRAT Profile – Tursiops aduncus — Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin.* Accessed online 26/06/2019 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=68418

Department of the Environment. 2019e. *SPRAT Profile – Orcaella heinsohni — Australian Snubfin Dolphin* Accessed online 26/06/2019 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=81322

Department of the Environment. 2019f. *Carcharodon carcharias* — White Shark, Great White Shark Accessed online 26/06/2019 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64470

Department of the Environment and Energy. 2019g. *The West Kimberley, Australian Heritage Database*. Accessed online 26/06/2019 at http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;place_id=106063.

Department of the Environment and Energy. 2019h. *Indigenous Protected Areas.* Accessed online 26/06/2019 at https://www.environment.gov.au/land/indigenous-protected-areas

Department of the Environment, Water, Heritage and the Arts. 2008. North Marine Bioregional Plan bioregional profile: a description of the ecosystems, conservation values and uses of the North Marine Region. Commonwealth of Australia, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts. 2009. Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100,000 hectares. Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of Environment, Water, Heritage and the Arts. 2010. Survey guidelines for Australia's threatened birds Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of Environment, Water, Heritage and the Arts, Canberra, ACT.

Department of Environment and Water Resources. 2006. *Sea Turtle Conservation and Education on the Tiwi Islands*. Final National Heritage Trust Report. Department of the Environment and Water Resources. Canberra, ACT.

Department of Parks and Wildlife. 2013. *Lalang-garram / Camden Sounds Marine Park management plan 73 2013-2023*. Department of Parks and Wildlife, Perth Western Australia.

Department of Parks and Wildlife. 2014. Western Australian Oiled Wildlife Response Plan (WA OWRP ). Department of Parks and Wildlife, Perth, Western Australia.

Department of Parks and Wildlife. 2016a. *North Kimberley Marine Parks joint management plan 2016*. Management Plan 89. Department of Parks and Wildlife, Perth, Western Australia.

Department of Parks and Wildlife. 2016b. *Lalang-garram/Horizontal Falls and North Lalang-garram marine parks joint management plan 2016*. Management Plan 88. Department of Parks and Wildlife, Perth, Western Australia.

Department of Primary Industries and Regional Development. 2017. Managing *Didemnun perlucidum*. Dated 26/04/2017. Accessed online 20/06/2019 at http://www.fish.wa.gov.au/Sustainability-and-Environment/Aquatic-Biosecurity/Vessels-And-Ports/Pages/Managing-Didemnum-perlucidum.aspx

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2008. Recommendation Report. *Development of the Ichthys Gas Field*. EPBC 2008/4208. Report prepared by DSEWPaC, Canberra, ACT.

Department of Sustainability, Environment, Water, Population and Communities. 2012a. *Marine bioregional plan for the North-west Marine Region*. 2012. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

Department of Sustainability, Environment, Water, Population and Communities. 2012b. *Marine bioregional plan for the North Marine Region*. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT.

DeVantier, L., Turak, E., Allen, G. 2008. Lesser Sunda Ecoregional Planning Coral Reef Stratification: Reef- and Seascapes of the Lesser Sunda Ecoregion. Report to the Nature Conservancy. Bali, Indonesia. 72 pp.

DEWHA – see Department of Environment, Water, Heritage and the Arts

Director of National Parks. 2018a. *North-west Marine Parks Network Management Plan* 2018. Director of National Parks, Canberra, ACT.

Director of National Parks. 2018b. *North Marine Parks Network Management Plan* 2018. Director of National Parks, Canberra, ACT.

DoE – see Department of the Environment

Dolman, S. and Williams-Grey, V. 2006. *Vessel collisions and cetaceans: What happens when they don't miss the boat. A WDCS Science Report*. The Whale and Dolphin Conservation Society (WDCS), Chippenham, Wiltshire, United Kingdom.

Done, T.J., Williams, D. McB., Speare, P.J., Davidson, J., DeVantier, L.M., Newman, S.J. & Hutchins, J.B. 1994. *Surveys of coral and fish communities at Scott Reef and Rowley Shoals*. Australian Institute of Marine Science, Townsville, Queensland.

Donovan, A., Brewer, D., van der Velde, T. and Skewes, T. 2008. *Scientific descriptions of four selected key ecological features in the North-west Bioregion: final report.* Report to the Australian Government Department of Environment, Water, Heritage and the Arts, Canberra, ACT and CSIRO Marine and Atmospheric Research, Cleveland, Queensland.

Double, M.C, Andrews-Goff, V., Jenner, K.C.S., Jenner, M-N., Laverick, S.M., Branch, T.A. and Gales, N.J. 2014. Migratory Movements of Pygmy Blue Whales (*Balaenoptera musculus brevicauda*) Between Australia and Indonesia as Revealed by Satellite Telemetry. PLoS One. 2014 Apr 9:9(4):e93578. doi: 10.1371/journal.pone.0093578. eCollection 2014.

Dow Piniak W.E. 2012. Acoustic Ecology of Sea Turtles: Implications for Conservation. PhD thesis, Marine Science and Conservation Duke University. pp 136. Accessed online on 07/06/2019 at: https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/6159/Piniak_duke_0066D_11691.pdf?sequence=1

DSEWPaC – see Department of Sustainability, Environment, Water, Population and Communities

Duke, N., Burns, K,. Swannell, J., Dalhaus, O. and Rupp, R. 2000. Dispersant use and a bioremediation strategy as alternative means of reducing impacts of large oil spills on mangroves: the Gladstone field trials. *Marine Pollution Bulletin*. 41, (7–12):403–412.

Duke, N. Wood, A. Hunnam, K. Mackenzie, J. Haller, A. Christiansen, N. Zahmel, K. and Green, T. 2010. *Shoreline Ecological Assessment Aerial and Ground Surveys 7-19 November 2009*. As part of the Scientific Monitoring Study of the Montara Monitoring Plan. A report commissioned by PTTEP Australasia (Ashmore Cartier) PL, Perth, Western Australia for the Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Eckert, S. A. and Stewart, B. S. 2001. Telemetry and satellite tracking of whale sharks, Rhincodon typus, in the Sea of Cortez, Mexico, and the north Pacific Ocean. *Environmental Biology of Fishes* 60(1-3): 299-308.

Ellis JI, Fraser G, and Russell J. 2012. Discharged drilling waste from oil and gas platforms and its effects on benthic communities. *Marine Ecology Progress Series* 456:285-302.

Epstein, N., Bak, R.P.M. and Rinkevich, B. 2000. Toxicity of 3rd generation dispersants and dispersed Egyptian crude oil on Red Sea coral larvae. *Marine Pollution Bulletin*, 40: 497–503.

Evans, K., Bax, N.J. & Smith, D.C. 2016. Marine environment: State and trends of indicators of marine ecosystem health: Physical, biogeochemical and biological processes. In: *Australia state of the environment* 2016 Department of the Environment and Energy, Canberra, ACT.

Falkner, I., Whiteway, T., Przeslawski, R. and Heap, A.D. 2009, *Review of ten key ecological features (KEFs) in the northwest marine region*, record 2009/13. Geoscience Australia, Canberra, ACT.

Fandry, C.B. and Steedman, R.K. 1994. Modelling the dynamics of the transient, barotropic response of continental shelf waters to tropical cyclones. Continental Shelf Research, 14:1723–1750.

Foster, S.J. and Vincent, A.C.J. 2004, Life history and ecology of seahorses: implications for conservation and management, *Journal of Fish Biology* 65 (1–61).

French-McCay, D.P. 2002. Development and application of an oil toxicity and exposure model, OilToxEx. Environmental Toxicology and Chemistry 21(10):2080–2094.

French McCay, D.P. 2003. Development and Application of Damage Assessment Modelling: Example Assessment for the North Cape Oil Spill. *Marine Pollution Bulletin* 47(9–12):341-359.

French-McCay, D.P. 2009. *State of the art and research needs for oil spill impact assessment modelling*. pp. 601-653, in Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, Canada.

Fucik, K.W., Bight, T.J. and Goodman, K.S. 1984. Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil. pp. 115–134 in Cairns Jr., J. and Buikema Jr., A.L. (eds.), *Restoration of Habitats Impacted by Oil Spills*, Butterworth Publishers, Boston, United States.

Fugro Survey Pty Ltd. 2005. *Ichthys Field Development: Western Extension, Browse Basin. Volume 1a – Survey results*. Fugro Survey Job No. P0358. Report prepared by Fugro Survey Pty Ltd, Perth, for INPEX Browse, Ltd., Perth, Western Australia.

Gagnon, M.M. and Bakhtyar, S. 2013. Induction of Fish Biomarkers by Synthetic-Based Drilling Muds. *Plos One* 8:e69489.

Gaughan, D.J. and Santoro, K. (eds). 2018. *Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries*. Department of Primary Industries and Regional Development, Western Australia.

Geraci, J.R. and St. Aubin, D.J. (eds) 1988. *Synthesis of Effects of Oil on Marine Mammals*. Report prepared by the Battelle Memorial Institute for U.S. Department of the Interior, Minerals Management Service, Atlantic OCS Region, OCS Study, MMS 88-0049, Ventura, CA.

Gilmour, J., Smith, L. and Brinkman, R. 2009. Biannual spawning, rapid larval development and evidence of self-seeding for scleractinian corals at an isolated system of reefs*. Marine Biology* 156:1297–1309.

Gilmour, J.P., Travers, M.J., Underwood, J.N., McKinney, D.W., Gates, E.N., Fitzgerald, K.L., Case, M., Ninio, R., Meekan, M.G., O'Leary, R., Radford, B., Ceccarelli, D. and Hoey, A.S. 2010. Long-term Monitoring of Coral and Fish Communities at Scott Reef, AIMS Document No SRRP-RP-RT-045, SRRP Project 1: 2010 Annual Report for Woodside as operator of the Browse LNG Development, Australian Institute of Marine Science, Townsville, pp. 254.

Gilmour, J.P., Travers, M.J., Underwood, J.N., Markey, K.L., Ninio, R., Ceccarelli, D., Hoey, A.S., Case, M. and O'Leary, R. 2011. *Long term Monitoring of Shallow Water Coral and Fish Communities at Scott Reef*. AIMS Document No SRRP-RP-RT-048, SRRP Project 1: 2011. Report prepared for Woodside as operator of the Browse LNG Development, Perth, Western Australia by Australian Institute of Marine Science, Townsville, Queensland.

Gilmour, J., Smith, L., Cook, K. and Pincock, S. 2013. *Discovering Scott Reef: 20 years of exploration and research.* Woodside and the Australian Institute of Marine Science, Perth, Western Australia.

Glasby, T. M., Connell, S. D., Holloway, M. G., Hewitt, C. L., 2007. Nonindigenous biota on artificial structures: could habitat creation facilitate biological invasions. *Marine Biology* 151: 887–895.

Goodbody-Gringley, G., Wetzel, D.L., Gillon, D., Pulster, E. and Miller, A.l. 2013. Toxicity of Deepwater Horizon Source Oil and the Chemical Dispersant, Corexit® 9500, to Coral Larvae. *PLOS ONE* 8(1): e45574.

Gray, C.A., Otway, N.M., Laurenson, F.A., Miskiewicz, A.G. and Pethebridge, R.L. 1992. Distribution and abundance of marine fish larvae in relation to effluent plumes from sewage outfalls and depth of water. *Marine Biology* 113: 549–559.

Greene, C. R. 1986. Underwater Sounds from the submersible drill rig SEDCO 708 drilling in the Aleutian Islands. Polar Research Laboratory, Inc., Santa Barbara, CA.

Gubbay, S. and Earll, R. 2000. *Review of literature on the effects of oil spills on cetaceans. Scottish National Heritage Review No. 3*. Report to Talisman Energy (United Kingdom) Limited and Scottish Natural Heritage, United Kingdom.

Guinea, M. 2006. Sea turtles, sea snakes and dugongs of Scott Reef, Seringapatam Reef and Browse Island with notes on West Lacepede Island. Unpublished report for the Department of the Environment, Water, Heritage and the Arts, Canberra, ACT.

Hale, J. and Butcher, R. 2009. *Ecological Character Description of the Eighty Mile Beach Ramsar Site.* Report to the Department of Environment and Conservation, Perth, Western Australia. Accessed online 20/06/2019 at https://www.dpaw.wa.gov.au/images/documents/conservation-management/wetlands/ramsar/eighty-mile-beach-ecd_final-with-disclaimer.pdf

Hale, J. and Butcher, R. 2013. *Ashmore Reef Commonwealth Marine Reserve Ramsar Site -Ecological Character Description*. A report to the Department of Environment, Canberra, ACT.

Hallegraeff, G.M. 1995. Harmful algal blooms: A global overview. In Hallegraeff, G.M., D.M. Anderson & A.D. Cembella (eds.), pp. 1-22 Manual on Harmful Marine Microalgae, IOC Manuals and Guides No. 33, UNESCO Paris, France.

Hamernik, R. P., Ahroon, W. A., Hsueh, K. D., Lei, S. F. and Davis, R. I. 1993. Audiometric and histological differences between the effects of continuous and impulsive noise exposures. Journal of the Acoustical Society of America, 93(4):2088–2095.

Hamernik, R. P., Qiu, W. and Davis, B. 2003. The effects of the amplitude distribution of equal energy exposures on noise-induced hearing loss: The kurtosis metric. Journal of the Acoustical Society of America, 114:386–395.

Harrison, P.L. 1999. Oil pollutants inhibit fertilisation and larval settlement in the scleractinian reef coral Acropora tenuis from the Great Barrier Reef, Australia in Sources, Fates and Consequences of Pollutants in the Great Barrier Reef and Torres Strait: Conference Abstracts. Great Barrier Reef Marine Park Authority, Townsville, Queensland.

Harte, C. and Curtotti, R. 2018. North West Slope Trawl Fishery. In: Department of Agriculture and Resources ABARES Fishery Status Reports 2018. Commonwealth of Australia, Canberra, ACT.

Hawkins, A.D. and Popper, A.N. 2016. A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates. ICES Journal of Marine Science, doi:10.1093/icesjms/fsw205.

Hearn, C.J. and Holloway, P.E. 1990. A three-dimensional barotropic model of the response of the Australian North West Shelf to tropical cyclones. Journal of Physical Oceanography 20(1):60–80.

Hewitt, C., Campbell, M., Coutts, A., Dahlstrom, A., Shields, D., Valentine, J., 2011. Species Biofouling Risk Assessment, Department of Agriculture, Fisheries and Forestry. Canberra, ACT.

Heyward, A.J., Farrell, P.D. and Seamark, R.F. 1994. The effect of petroleum based pollutants on coral gametes and fertilisation success. p 119 in the *Sixth Pacific Congress on Marine Science and Technology*, Townsville, Australia.

Heyward, A., Moore, C., Radford, B. and Colquhoun, J. 2010a. *Monitoring program for the Montara well release Timor Sea: final report on the nature of Barracouta and Vulcan shoals*. Report prepared by the Australian Institute of Marine Science for PTTEP Australasia, Perth, Western Australia.

Heyward, A., Radford, B., Burns, K., Colquhoun, J. and Morre, C. 2010b. Montara surveys: Final *report on benthic surveys at Ashmore, Cartier and Seringapatam reefs*. Report prepared by the Australian Institute of Marine Science for PTTEP Australasia, Perth, Western Australia.

Heyward, A., Jones, R., Meeuwig, J., Burns, K., Radford, B., Colquhoun, J., Cappo, M., Case, M., O'Leary, R.A., Fisher, R., Meekan, M. and Stowar, M. 2011. *Monitoring Study S5 Banks and Shoals, Montara. 2011. Offshore Banks Assessment Survey*. Report for PTTEP Australasia (Ashmore Cartier) Pty Ltd. Australian Institute of Marine Science, Townsville, Queensland.

Heyward, A., Speed, C., Meekan, M., Cappo, M., Case, M., Colquhoun, J., Fisher, R., Meeuwig, J. and Radford, B. 2013. Montara: Vulcan, Barracouta East and Goeree shoals survey 2013. Report prepared by the Australian Institute of Marine Science for PTTEP Australasia, Perth, Western Australia.

Heyward, A., Wakeford, M., Cappo, M., Olsen, Y., Radford, B., Colquhoun, J., Case, M., and Stowar, M. 2018. *Submerged Shoals 2017*. Applied Research Project 7: Subtidal Benthos: towards benthic baselines in the Browse Basin. Report prepared for Shell/INPEX by the Australian Institute of Marine Science, Perth, Western Australia.

Hick, P. 1995. Spectral measurement of illumination sources at Thevenard Island: a preliminary study of the probable effects of gas flares and oil production facility lights on green *turtles; a subsequent revisit to measure a range of gas-flow rates.* Restricted report prepared for West Australian Petroleum Pty Limited, Perth, by the CSIRO Remote Sensing of Environment Group, Perth, Western Australia. Minesite Rehabilitation Research Program Report No. 516c, CSIRO, Canberra, ACT.

Hoff, R., and Michel, J. 2014. Oil spills in mangroves: planning and response considerations. US Department of Commerce. National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington, United States.

Hook, S.S. and Osborn, H. L. 2012. Comparison of toxicity and transcriptomic profiles in a diatom exposed to oil, dispersants, dispersed oil. *Aquatic Toxicology* 124–125: 139–151.

Hsu, H.H., Joung, S.J., Liao, Y.Y., and Liu, K.M. 2007. Satellite tracking of juvenile whale sharks*, Rhincodon typus, in the Northwestern Pacific. Fisheries Research* 84(1), 25-31.

Huhta, H. K., Rytkonen, J. and Sassi, J. 2009. Estimated nutrient load from waste waters originating from ships in the Baltic Sea area – Updated 2009. VTT-R-07396-08. Report to the Technical Research Centre of Finland (VTT). Helsinki, Finland.

Huffard, C.L., M.V. Erdmann, T.R.P. Gunawan (Eds) 2012. *Geographic Priorities for Marine Biodiversity Conservation in Indonesia*. Ministry of Marine Affairs and Fisheries and Marine Protected Areas Governance Program. Jakarta- Indonesia. 105 pp.

Hutomo M and Moosa M K. 2005. Indonesian marine and Coastal biodiversity: Present Status. *Indian Journal of Marine Sciences* 34(1): 88-97.

IFC – see International Finance Corporation

IFSEC Global. 2014. *Environmental impact of foam*. Accessed online 06/06/2019 at http://www.ifsecglobal.com/environmental-impact-of-foam/

INPEX. 2010. *Ichthys Gas Field Development Project: draft environmental impact statement*. Report prepared by INPEX Browse, Ltd., Perth Western Australia, for the Commonwealth Government, Canberra ACT, and the Northern Territory Government, Darwin, Northern Territory.

International Finance Corporation. 2015. Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development. Accessed online 11/09/2019 at https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

International Petroleum Industry Environmental Conservation Association. 2014. Wildlife response preparedness. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 516. London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2015. *A guide to oiled shoreline clean-up techniques*. IOGP report 521. International Petroleum Industry Environmental Conservation Association, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2017a. *Guidelines on implementing spill impact mitigation assessment (SIMA*). IOGP Report 593. International Petroleum Industry Environmental Conservation Association, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2017b. *Key principles for the protection, care and rehabilitation of oiled wildlife*. IOGP Report 583. International Petroleum Industry Environmental Conservation Association, London, United Kingdom.

International Tanker Owners Pollution Federation. 2011. *Effects of Oil Pollution on Fisheries and Mariculture*. Technical Information Paper 11. International Tanker Owners Pollution Federation, London, United Kingdom. Accessed online on 06/08/2019 at: http://www.itopf.com/fileadmin /data/Documents/TIPS%20TAPS/TIP11EffectsofOilPollutiononFisheriesandMariculture.pdf

International Whaling Commission 2011. *Country Report on Ship Strikes*. Accessed online 18/06/2019 at https://iwc.int/private/downloads/ogt-ONlgW44CXYJphC5vIQ/64-CC%203.pdf

IPIECA - See International Petroleum Industry Environmental Conservation Association

ITOPF – See International Tanker Owners Pollution Federation

IWC – see International Whaling Commission

Jackson, J.B.C., Cubit, J.D., Keller, B.D., Batista, V., Burns, K., Caffey, H.M., Caldwell, R.L., Garrity, S.D., Getter, C.D., Gonzalez, C., Guzman, H.M., Kaufmann, K.W., Knap, A.H., Levings, S.C., Marshall, M.J., Steger, R., Thompson, R.C. and Weil, E. 1989. Ecological effects of a major oil spill on Panamanian coastal marine communities. *Science* 243:37–44.

Jenner, K.C.S., Jenner, M.N., and McCabe K.A. 2001. *Geographical and temporal movements of humpback whales in Western Australian waters*. APPEA Journal 38(1): 692-707.

Jenner, C., Jenner, M. and Pirzl, R. 2008. A study of cetacean distribution and oceanography in the Scott Reef/Browse Basin development areas during the austral winter of 2008, Centre for Whale Research (WA) Inc., Perth, Western Australia.

Jenner, KCS & Jenner, MN. 2009a. Humpback whale distribution and abundance in the near shore SW Kimberley during winter 2008 using aerial surveys. Report produced for Woodside Energy Limited, Perth, Western Australia.

Jenner, KCS & Jenner, MN. 2009b. *Near-shore Vessel Surveys in the SW Kimberley Region During the Humpback Whale Southern Migration, 2008*. Report produced for Woodside Energy Limited, Perth, Western Australia.

Jenssen, B.M. 1994. Review article: Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. *Environmental Pollution*, 86:207–215.

Khalanski, M. 2002. Organic products generated by the chlorination of cooling water at marine power stations. Journe´es d'Etudes du Cebedeau, *Tribune de l'Eau* No. 619-620-621, France.

Knap, A.H., Sleeter, T.D., Dodge, R.E., Wyers, S.C., Frith, H.R. and Smith, S.R. 1985. *The effects of chemically and physically dispersed oil on the brain coral Diploria strigosa (Dana)—a summary review*. pp. 547–551 in American Petroleum Institute, Proceedings 1985 Oil Spill Conference. API Publication Number 4385. Washington D.C.

Kunhold, W.W. 1978. *Effects of the water soluble fraction of a Venezuelan heavy fuel oil (No. 6) on cod eggs and larva*e in Wilson, M.P., McQuin, J.P. and Sherman, K. (eds), In the Wake of the Argo Merchant. Centre for Ocean Management Studies, University of Rhode Island, Rhode Island, United States.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and whales. *Marine Mammal Science* 17:35–75.

Lee, K. 2011. *Toxicity Effects of Chemically Dispersed Crude Oil on Fish*. International Oil Spill Conference Proceedings 2011(1):163.

Limpus, C. J., Miller, J. D., Parmenter, C. J. and Limpus, D. J. 2003. The green turtle, Chelonia mydas, population of Raine Island and the Great Barrier Reef: 1843–2001. *Memoirs of the Queensland Museum*. 49:349–440.

Lohmann, K. J. and Fittinghoff-Lohmann, C. M. 1992. Orientation to oceanic waves by Green Turtle Hatchings. *Journal of Experimental Biology*, 171:1–13.

Lourie, S. A., Vincent, A. C. J. & Hall, H. J. 1999. *Seahorses: an identification guide to the world's species and their conservation*, Project Seahorse, London, United Kingdom.

Loya, Y. and Rinkevich, B. 1980. Effects of oil pollution on coral reef communities. *Marine Ecology Progress*, Series 3:167–180.

Marine Conservation Institute. 2018. Atlas of Marine Protection. KKPN Laut Sawu Marine National Park. Marine Conservation Institute. Accessed online 20/06/2019 at http://www.mpatlas.org/mpa/sites/67705397/.

Marine Pest Sectoral Committee. 2018. National biofouling management guidelines for the petroleum production and exploration industry. December 2018. Department of Agriculture and Water Resources, Canberra, ACT.

Marquenie, J., Donners, M., Poot, H., Steckel, W., de Wit, B. and Nam, A. 2008. *Adapting the Spectral Composition of Artificial Lighting to Safeguard the Environment*, Petroleum and Chemical Industry Conference Europe – Electrical and Instrumentation Applications, 5th PCIC Europe.

Marsh, H., T.J. O'Shea and J.R. Reynolds. 2011. *The ecology and conservation of sirenia; dugongs and manatees*. Cambridge University Press, London, United Kingdom.

Matcott, J., Baylis, S., and Clarke, R.H. 2019. The Influence of Petroleum oil films on the feather structure of tropical and temperate seabird species. Marine Pollution Bulletin 138: 135-144.

Matthews, M.N.R. 2012. Underwater Sound Propagation from an Shallow Coring Operations in Baffin Bay: Shell 2012 Shallow Coring Operations in Baffin Bay. JASCO Applied Sciences.

McCauley, R.D. 1998. Radiated underwater noise measured from the drill ship Ocean General, drill ship tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture and natural sources in the Timor Sea, Northern Australia. Unpublished report prepared by the Centre for Marine Science and Technology, Curtin University, Perth, Western Australia for Shell Australia.

McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and McCabe, K. 2000, *Marine Seismic Surveys – A Study of Environmental Implications*, APPEA Journal 40:692-707.

McCauley, R.D. 2004. *Western Australian Grey Nurse Shark Pop Up Archival Tag Project*. Final Report to Department of Environment and Heritage, Canberra, ACT.

McCauley, R.D. 2009. *Ambient, biological and anthropogenic sea noise sources from Browse and Maret Islands, Kimberley, 2006–2008*. Prepared in association with the Centre for Whale Research and the Centre for Marine Science and Technology, for INPEX Browse, Ltd. Perth, Western Australia.

McCauley, R.D. and Jenner, C. 2010. Migratory patterns and estimated population size of pygmy blue whales (*Balaenoptera musculus brevicauda*) traversing the Western Australian coast based on passive acoustics, Paper SC/62/SH26 presented to the International Whaling Committee Scientific Committee, 2010 (unpublished).

McDonald, S. F., Hamilton, S. J., Buhl, K. J. and Heisinger, J. F. 1996. Acute toxicity of fire control chemicals to Daphnia magna (Straus) and Selenastrum capricornutum (Printz). *Ecotoxicology and Environmental Safety* 33:62–72.

MCI–see Marine Conservation Institute

McIntyre, A.D. and Johnston, J. 1975. *Effects of Nutrient Enrichment from Sewage in the Sea* in Gameson A.L.H. (ed.) Discharge of sewage from sea outfalls. Pergamon Press, Oxford, United Kingdom.

McKinnon, D., Meekan, M., Stevens, J. and Koslow, T. 2002. WA-271-P Biological/Physical Oceanographic and Whale shark movement study: R.V. Cape Ferguson Cruise 2982, 2-24 April 2002. Australian Institute of Marine Science Final Report produced for Woodside Energy Limited Perth, Western Australia.

McLoughlin, R.J., Davis, T.L.O. and Ward, T.J. 1988. Sedimentary provinces, and associated bedforms and benthos on the Scott Reef–Rowley Shoals platform off north-west Australia. *Australian Journal of Marine and Freshwater Research* 39(2):133–144.

Meekan, M.G. and Radford, B. 2010. *Migration patterns of Whale Sharks: A summary of 15 satellite tag tracks from 2005 to 2008.* Report produced for Woodside Energy Ltd, Australian Institute of Marine Science, Perth, Western Australia.

Milton, S., Lutz, P. and Shigenaka G. 2003. Oil Toxicity and Impacts on Sea Turtles. In Shigenaka, G. (ed.), *Oil and Sea Turtles: Biology, Planning, and Response*. National Oceanic and Atmospheric Administration, Seattle, Washington, United States.

Milton, D.A., Fry, G.C, and Quinton, D. 2009. Reducing impacts of trawling on protected sea snakes: by-catch reduction devices improve escapement and survival. *Marine and Freshwater Research* 60: 824-832.

Moody, C.A. and Field, J.A. 2000. Perfluorinated Surfactants and the Environmental Implications of Their Use in Fire-Fighting Foams. *Environmental Science and Technology* 34 (18):3864–3870.

Mrosovsky, N., Ryan G.D. and James M.C. 2009. Leatherback turtles: The menace of plastic. Marine Pollution Bulletin 58(2):287–289.

Mustoe, S. and Edmunds, M. 2008. Coastal and Marine Natural Values of the Kimberley. WWF Australia, Sydney, NSW, cited in Department of State Development. 2010. *Browse Liquefied Natural Gas Precinct – Strategic Assessment Report (draft for public comment)*, *Part 3 Environmental Assessment – Marine Impacts*. Department of State Development, Perth, Western Australia.

NASA - See National Aeronautics and Space Administration.

National Aeronautics and Space Administration. 2019. Global Patterns and Cycles, Earth Observatory. Accessed online 20/06/2019 at https://earthobservatory.nasa.gov/Features/Phytoplankton/page4.php

National Marine Fisheries Service. 2013. Marine Mammals: Interim Sound Threshold Guidance (webpage). National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

National Marine Fisheries Service. 2018. 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Department of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59.

National Oceanic and Atmospheric Administration. 2010. Oil Spills in Mangroves, Planning and Response. National Oceanic and Atmospheric Administration. US Department of Commerce, Office of Response and Restoration.

National Offshore Petroleum Safety Environment Authority (NOPSEMA) 2014. *Issues Paper IP1411 (Consultation Requirements under the OPGGS Environment Regulations 2009 - Rev 2).*

National Research Council. 1985. *Oil in the Sea: Inputs, Fates, and Effects*. The National Academies Press. Washington, DC.

National Research Council. 2005. *Oil Spill Dispersants: Efficacy and Effects*. The National Academies Press. Washington, DC.

National Science Foundation, U.S. Geological Survey, and National Oceanic and Atmospheric Administration (U.S.). 2011. *Final Programmatic Environmental Impact Statement/Overseas.* Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. National Science Foundation, Arlington, VA.

Nedwell, J. R. and Edwards, B. 2004*. A review of measurement of underwater man-made noise carried out by Subacoustech Ltd*, 1993-2003. Subacoustech Rep. 534R0109.

Neff J.M. 1987. *Long-term Environmental Effects of Offshore Oil and Gas Development*, D.F. Boesch, N.N. Rabalais (Eds.), Elsevier Applied Science Publishers, London, United Kingdom.

Neff J.M. 2002. Chapter 4 - *Barium in the Ocean*. In: Neff JM (ed) Bioaccumulation in Marine Organisms. Elsevier, Oxford, United Kingdom.

Neff, J.M. 2008. Estimation of bioavailability of metals from drilling mud barite. *Integrated Environmental Assessment and Management* 4(2): 184–193.

Negri, A.P. and Heyward, A.J. 2000 Inhibition of fertilization and larval metamorphosis of the coral *Acropora millepora* (Ehrenberg, 1834) by petroleum products. *Marine Pollution Bulletin* 41(7–12):420–427.

NMFS – see National Marine Fisheries Service

NOAA – see National Oceanic and Atmospheric Administration

NOPSEMA – see National Offshore Petroleum Safety Environment Authority

Northern Territory Government. 2010. Water Quality Objectives for the Darwin Harbour Region – Background Document. Aquatic Health Unit, Department of Natural Resources, Environment, The Arts and Sport. Darwin, Northern Territory.

Northern Territory Government. 2016. Status of Key Northern Territory Fish Stocks Report 2015. Northern Territory Government. Department of Primary Industry and Resources. Fishery Report No. 118. Darwin, Northern Territory.

NRC–see National Research Council

NSF–see National Science Foundation

NT DPIR-see Northern Territory Department of Primary Industries and Resources

NTG–see Northern Territory Government

NTSC-see Northern Territory Seafood Council

O'Brien, M. 2002. *At-sea recovery of heavy oils - A reasonable response strategy?* 3rd Forum on High Density Oil Spill response. The International Tanker Owners Pollution Federation Limited (ITOPF). London, United Kingdom.

Olsen, Y.S., Kendrick, G.A., Bessay, C., McLaughlin, J., Darnell, R. and Keesing J. 2018. *Baselines of benthic communities, herbivory and reef metabolism at Browse Island*. Shell/INPEX ARP7-2 Final Report. Australian Institute of Marine Science, Perth, Western Australia.

OSPAR Commission. 2012. OSPAR List of Substances Used and Discharged Offshore Which Are Considered to Pose Little or No Risk to the Environment (PLONOR) 2012. OSPAR Agreement 2012-06.

Parks Australia. 2019a. Argo-Rowley Terrace Marine Park. Accessed online 26/06/2019 at https://parksaustralia.gov.au/marine/parks/north-west/argo-rowley-terrace/

Parks Australia. 2019b. Ashmore Reef Marine Park. Accessed online 26/06/2019 at https://parksaustralia.gov.au/marine/parks/north-west/ashmore-reef/

Parks Australia. 2019c. Cartier Island Marine Park. Accessed online 26/06/2019 at https://parksaustralia.gov.au/marine/parks/north-west/cartier-island/

Parks Australia. 2019d. Kimberley Marine Park. Accessed online 26/06/2019 at https://parksaustralia.gov.au/marine/parks/north-west/kimberley/

Parks Australia. 2019e. Mermaid Reef Marine Park. Accessed online 26/06/2019 at https://parksaustralia.gov.au/marine/parks/north-west/mermaid-reef/

Parks Australia. 2019f. Oceanic Shoals Marine Park. Accessed online 26/06/2019 at https://parksaustralia.gov.au/marine/parks/north/oceanic-shoals/

Payne, J.F., Andrews, C., Fancey, L., White, D. and Christian, J. 2008. Potential effects of seismic energy on fish and shellfish: An update since 2003. In: *Canadian Technical Report of Fisheries and Aquatic Sciences No. 2008/060*. Science Branch, Fisheries and Oceans Canada, Calgary, Canada.

Pendoley, K.L. 2005. *Sea turtles and the environmental management of industrial activities in north-west Western Australia*. PhD thesis. Murdoch University, Perth, Western Australia.

Perdanahardja, G. and Lionata, H. 2017. *Nine Years in Lesser Sunda*. Indonesia: The Nature Conservancy, Indonesia Coasts and Oceans Program. Accessed online on 20/06/2019 at http://marineplanning.org/wp-content/uploads/2018/02/Nine_years_Lesser_Sunda.pdf

Peters, E.C., Meyers, P.A., Yevich, P.P. and Blake, N.J. 1981. Bioaccumulation and histopathological effects of oil on a stony coral. *Marine Pollution Bulletin* 12(10):333–339.

Phillips, M., Henriksson, P.J.G., Tran, N., Chan, C.Y., Mohan, C.V., Rodriguez, U-P., Suri, S., Hall, S. and Koeshendrajana, S. 2015. *Exploring Indonesian aquaculture futures*. Penang, Malaysia: WorldFish.Program Report: 2015-39.

Pimental, D.L., Leach, R., Zuniga, Morrison, D. 2000. Environmental and economic costs of nonindigenous species in the United States. *Bioscience* 50:53-65.

Poot, H., Ens, B.J., de Vries, H., Donners, M.A.H., Wernand, M.R. and Marquenie, J.M. 2008. Green light for nocturnally migrating birds. *Ecology and Society* 13(2):47. Accessed online from http://www.ecologyandsociety.org/vol13/iss2/art47/ on 05/06/19.

Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T.J., Coombs, S., Ellison, W.T., Gentry, R.L., Halvorsen, M.B., Løkkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G. and Tavolga, W.N. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles.* Technical report prepared by the ANSI-Accredited Standards Committee S3/SC1 and registered with the American National Standards Institute (ANSI). ASA S3/SC1.4 TR-2014. Springer and ASA Press, Cham, Switzerland.

Protected Planet. 2019. KKPN Laut Sawu, Indonesia. Accessed online 26/06/2019 at https://www.protectedplanet.net/kkpn-laut-sawu-marine-national-park.

Purser, A. 2015. A Time Series Study of *Lophelia pertusa* and Reef Megafauna Responses to Drill Cuttings Exposure on the Norwegian Margin. *Plos One* 10:29.

Qiu, B., Mao, B. and Kashino, Y. 1999. Intraseasonal variability in the Indo-Pacific Throughflow and the regions surrounding the Indonesian Seas. *Journal of Physical Oceanography*, 29:1599–1618.

Reiersen, L.-O. and Fugelli, K. The Effect of the Water-Soluble Fraction of North Sea Crude Oil on the Transport Mechanism of Taurine in Erythrocytes from Flounder, *Platichthys Flesus.* In "Fate and Effects of Oil in Marine Ecosystems": Proceedings of the Conference on Oil Pollution Organized under the auspices of the International Association on Water Pollution Research and Control (IAWPRC) by the Netherlands Organization for Applied Scientific Research TNO Amsterdam., The Netherlands, 23–27 February 1987.

Richardson, W.J., Greene Jr, C., Malme, C. I. and Thomas, D.H. 1995. *Marine mammals and noise*. Academic Press, Sydney. New South Wales.

Ross, A., Stalvies, C., Talukder, A., Trefry, C., Mainson, M., Cooper, L., Yuen, M., Palmer, J. 2017. *Interpretive geochemical data report on samples obtained during ARP2 Trip 6184, May 2015*. Applied Research Program project 2 task 3 report - Applied Research Program project 2 task 4 report. CSIRO confidential report EP173371.

Rowat, D. and Gore, M. 2007. Regional scale horizontal and local scale vertical movements of whale sharks in the Indian Ocean off Seychelles. *Fisheries Research*, 84(1), 32-40.

RPS. 2007. *Environmental baseline survey results*. Report prepared by RPS Environmental Pty Limited for INPEX Browse, Ltd., Perth, Western Australia.

RPS. 2008. *INPEX environmental impact assessment studies – Technical appendix: Marine ecology*. Report prepared by RPS Environmental Pty Limited., Perth, for INPEX Browse Limited, Perth, Western Australia.

RPS. 2019a. Phase 1 Brewster Deterministic Analysis. MAW0796J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.

RPS. 2019b. WA-343-P and WA-50-L Oil Spill Risk Assessment Comparison. MAW0796J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.

RPS. 2019c. INPEX Ichthys Phase 2 Development WA-50-L Oil Spill Risk Assessment. MAW0796J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.

RPS. 2019d. INPEX Phase 1 Brewster Shoreline Statistics. MAW0796J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.

RPS. 2019e. *INPEX VOC & SSDI Modelling. Near-field to far-field investigation stages.* MAW0779J.000. Report prepared by RPS West for INPEX. Perth, Western Australia.

RPS APASA. 2014. *Ichthys Offshore Operations Gap Analysis: Dispersion of exhaust emissions from the Ichthys CPF and FPSO – modelling assessment*. J0312 Rev 0 01/10/2014. Report prepared by RPS APASA Pty Ltd for INPEX Operations Australia, Perth, Western Australia.

RPS Environment and Planning Pty Ltd 2010. *Marine Megafauna 2009 Humpback Whale Survey Report.* Report produced for Woodside Energy Limited, Perth, Western Australia.

RPS Environment and Planning Pty Ltd 2011. *Marine Megafauna Study 2010.* Report produced for Woodside Energy Limited, Perth, Western Australia.

RPS MetOcean Pty Ltd. 2011. *Final Metocean Design Criteria for Ichthys Development Browse Basin.* R1285v6. Report prepared by RPS MetOcean Pty Ltd for INPEX Browse, Ltd., Perth, Western Australia.

Runcie, J.W. and Riddle, M.J. 2006. Diel variability in photosynthesis of marine macroalgae in ice-covered and ice-free environments in East Antarctica. European Journal of Phycology 41(2):223–233.

Ryan, P.G., Connell, A.D., and Gardner, B.D. 1988. Plastic ingestion and PCBs in seabirds: is there a relationship? *Marine Pollution Bulletin* 19:174–176.

Salgado Kent, C., McCauley, R.D., Duncan, A., Erbe, C., Gavrilov, A., Lucke, K. and Parnum, I. 2016. Underwater sounds and vibration from offshore petroleum activities and their potential effects on marine fauna: an Australian perspective. Prepared for APPEA by Centre for Marine Science and Technology, Curtin University, Perth, Western Australia.

Scales, H. 2010. 'Advances in the ecology, biogeography and conservation of seahorses (genus *Hippocampus*)', *Progress in Physical Geography* 34 (443).

Schaefer, T. 2013. *Aquatic Impacts of Firefighting Foams*. Whitepaper. Form Number F-2012007, Solberg, Illinois, United States.

Shell – see Shell Development (Australia) Proprietary Limited.

Shell Development (Australia) Proprietary Limited (Shell) 2009. Prelude Floating LNG Project, Draft Environmental Impact Statement. EPBC 2008/4146. October, 2009. Shell Development (Australia) Proprietary Limited.

Shigenaka, G. 2001. *Toxicity of Oil to Reef Building Corals: A Spill Response Perspective*. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum, National Ocean Service, Office of Research and Restoration 8, Seattle, USA.

Simmonds, M., Dolman, S. and Weilgart, L. 2004. Oceans of Noise. A WDCS Science Report. The Whale and Dolphin Conservation Society (WDCS). Wiltshire, United Kingdom.

Sleeman, J. C., Meekan, M.G., Fitzpatrick, B.J., Steinberg, C.R., Ancel, R., and Bradshaw, C.J.A. 2010. Oceanographic and atmospheric phenomena influence the abundance of whale sharks at Ningaloo Reef, Western Australia. *Journal of Experimental Marine Biology and Ecology*, 383:77–81.

Smit, N., Billyad, R., and Ferns, L. 2000. *Beagle Gulf Benthic Surveys: Characterisation of soft substrates*. Technical Report No. 66 (2000). Parks and Wildlife Commissions of the Northern Territory.

Smit, M.G.D., Holthaus, K.I.E., Trannum, H.C., Neff, J.M., Kjeilen-Eilertsen, G., Jak, R.G., Singsaas, I., Huijbregts, M.A.J. and Hendriks, A.J. 2008. Species sensitivity distributions for suspended clays, sediment burial, and grain size change in the marine environment. *Environmental Toxicology and Chemistry* 27: 1006–1012.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P.L. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals* 33(4):1–121.

Standards Norway. 2013. *NORSOK Standard D-010* Rev.4. June 2013. Standards Norway, Lysaker.

Stout, S. A., Payne, J. R., Emsbo-Mattingly, S. D., and Baker, G. 2016. Weathering of field-collected floating and stranded Macondo oils during and shortly after the Deepwater Horizon oil spill. *Marine Pollution Bulletin* 105(1):7-22.

Suhring, R., Philips, C. Gioia, R. and Rowles, R. 2017. *Perfluorinated compounds in offshore fire-fighting foams – a source for marine contamination?* Organohalogen Compounds Vol 79, 667-669. Dioxin Symposium - August 2017, Vancouver, Canada.

Taylor, J.G. 1996. Seasonal occurrence, distribution and movements of the whale shark, Rhincodon typus, at Ningaloo Reef, Western Australia. *Marine and Freshwater Research* 47 (637-642).

Taylor, C. J. L. 2006. The effects of biological fouling control at coastal and estuarine power stations. *Marine Pollution Bulletin* 53(1–4):30–48.

Taylor, H., and Rasheed, M. 2011. Impacts of a fuel oil spill on seagrass meadows in a subtropical port, Gladstone, Australia – The value of long-term marine habitat monitoring in high risk areas. *Marine Pollution Bulletin* 63:431-437.

Thums, M., Jenner, C., Waples, K., Salgado-Kent, C. and Meekan, M. 2018. *Humpback whale use of the Kimberley: understanding and monitoring spatial distribution*. Report Project 2.1.1 prepared for the Kimberley Marine Research Program. Western Australian Marine Science Institution, Perth, Western Australia.

Tsvetnenko, Y. 1998. Derivation of Australian tropical marine water quality criteria for protection of aquatic life from adverse effects of petroleum hydrocarbons. *Environmental Toxicology and Water Quality* 13(4):273–284.

Tuxbury, S.M. and Salmon, M. 2005. *Competitive interactions between artificial lighting and natural cues during seafinding by hatchling marine turtles*. *Biological Conservation* 121:311–316.

UNEP - see United Nations Environment Programme

Underwood, J.N., Smith, L.D., van Oppen, M.J.H. and Gilmour, J.P. 2009. Ecologically relevant dispersal of corals on isolated reefs: implications for managing resilience. Ecological Applications 19: 18-29.

Underwood, J., Richards, Z., Berry, O. and Gilmour, J. 2017. *Population connectivity and genetic diversity in brooding and broadcast spawning corals in the Kimberley*. Report of Project 1.1.3 - Project 1.1.3.1 Kimberley Marine Research Program. Western Australian Marine Science Institution, Perth, Western Australia.

United Nations Environment Programme. 1985. *GESAMP: Thermal discharges in the marine environment*. United Nations Environment Programme Regional Seas Reports and Studies No. 45.

Vanderlaan, A.S.M. and Taggart, C.T. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. *Marine Mammal Science* 23(1):144–156.

Waayers, D., Mau, R., Mueller, A., Smith, J., and Pet-Soede, L. 2015. *A review of the spatial distribution of marine turtle nesting and foraging areas in western Australia*. In Proceedings of the Second Australian and Second Western Australian Marine Turtle Symposia, Perth 25-27 August 2014. 2015. Science Division, Department of Parks and Wildlife, Perth, Western Australia.

Waples, K., Field, S., Kendrick, A., Johnston, A., Twomey, L. 2019. Strategic Integrated Marine Science for the Kimberley Region: Kimberley Marine Research Program Synthesis Report 2012-2018. Prepared for the Western Australian Marine Science Institution, Perth Western Australia.

Ward, T. 1996. Sea snake by-catch of fish trawlers on the northern Australian continental shelf. *Marine and Freshwater Research* 47: 625-630.

Webb, G.J.W., Whitehead, P.J. and Manolis, S.C. 1987. *Crocodile management in the Northern Territory of Australia. Pp. 107-124 in Wildlife Management: Crocodiles and Alligators*, ed. by G.J.W. Webb, S.C. Manolis and P.J. Whitehead. Surrey Beatty and Sons: Sydney, New South Wales.

Weis, P., Weis, J.S. and Greenberg, A. 1989. Treated municipal wastewaters: effects on development and growth of fishes. *Marine Environmental Research* 28: 527–532.

Wells, F.E. Hanley, J.R. Walker, D.I. 1995. *Marine Biological Survey of the Southern Kimberley, Western Australia.* Western Australian Museum, Perth, Western Australia.

Western Australian Department of Transport. 2018a. *DOT307215 Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities*. Protection Priority Assessment for Zone 1: Kimberley – Draft Report May 2018, Perth, Western Australia.

Western Australian Department of Transport. 2018b. *State Hazard Plan, Maritime Environmental Emergencies.* State Emergency Management Committee, Government of Western Australia, Perth, Western Australia.

Western Australian Fishing Industry Council. 2019a. North Coast Prawn Fishery. Accessed online 21/06/2019 at http://www.wafic.org.au/fishery/north-coast-prawn-fishery/

Western Australian Fishing Industry Council. 2019b. Mackerel Managed Fishery. Accessed online 21/06/2019 at http://www.wafic.org.au/fishery/mackerel-fishery/

Western Australian Fishing Industry Council. 2019c. Pearl Oyster Fishery. Accessed online 28/06/2019 at http://www.wafic.org.au/fishery/pearl-oyster-fishery/

Western Australian Fishing Industry Council. 2019d. Trochus Fishery. Accessed online 28/06/2019 at http://www.wafic.org.au/fishery/trochus-fishery/

Western Australian Fishing Industry Council. 2019e. North Coast Crab Fishery. Accessed online 28/06/2019 at http://www.wafic.org.au/fishery/north-coast-crab-fishery/

Western Australian Fishing Industry Council. 2019f. North Coast Prawn Fishery. Accessed online 28/06/2019 at http://www.wafic.org.au/fishery/north-coast-prawn-fishery/

Western Australian Fishing Industry Council. 2019g. Roe's Abalone Fishery. Accessed online 28/06/2019 at http://www.wafic.org.au/fishery/roes-abalone-fishery/

Western Australian Fishing Industry Council. 2019h. North Coast Nearshore and Estuarine Fishery. Accessed online 10/09/2019 at http://www.wafic.org.au/fishery/north-coast-nearshore-and-estuarine-fishery/

Whiting, S. and Guinea, M. 2005. *Dugongs of Ashmore Reef and the Sahul Banks: a review of current knowledge and a distribution of sightings*. In Russell B., Larson H., Glasby C.J., Willan R.C., and Martin, J. (eds) Understanding the Cultural and Natural Heritage Values and Management Challenges of the Ashmore Region, Proceedings of a Symposium organised by the Australian Marine Sciences Association and the Museum and Art Gallery of the Northern Territory, Darwin, 4–6 April 2001. Museum and Art Galleries of the Northern Territory & Australian Marine Sciences Association, Darwin, Northern Territory.

Whiting, A.U., Thomson, A., Chaloupka, M., and Limpus, C.J. 2008. Seasonality, abundance and breeding biology of one of the largest populations of nesting flatback turtles, Natator depressus: Cape Domett, Western Australia. *Australian Journal of Zoology* 56: 297-303.

Wiese, F. K., Montevecchi, W. A., Davoren, G. K., Huettmann, F., Diamind, A. W., and Linke, J. 2001. Seabirds at risk around offshore oil platforms in the north-west Atlantic. *Marine Pollution Bulletin* Vol 42(12):1285–1290.

Wild Well Control. 2019. Ichthys Phase 2A – Subsea Plume, Gas Dispersion and Capping Stack Landing Study. Wild Well Control Inc, Houston, USA.

Wilson, S.G., Polovina, J.J., Stewart, B. S., and Meekan, M. G. 2006. Movements of Whale Sharks (Rhincodon typus) tagged at Ningaloo Reef, Western Australia. *Marine Biology* 148:1157–1166.

Wilson, J., Darmawan, A., Subijanto, J., Green, A. and Sheppard, S. 2011. *Scientific Design of a Resilient Network of Marine Protected Areas. Lesser Sunda Ecoregion, Coral Triangle*. The Nature Conservancy. Asia Pacific Marine Program Report No. 2/11. March 2011.

Witherington, B.E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica 48:31–39.

Witherington, B. E. and Martin, R. E. 2000. Understanding, Assessing and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches. Florida Fish and Wildlife Conservation Commission FMRI Technical Report TR-2, Second Edition, Revised. Florida Marine Research Institute, Tequesta, Florida.

Wolanski, E. 1994. Physical Oceanographic Processes of the Great Barrier Reef. CRC Press, Florida, United States.

Wolfe M.F., Schwartz, G.F.B., Singaram, S., Mielbrecht, E.E., Tjeerdema, R.S., and Sowby, M.L. 1998a. Influence of dispersants on the bioavailability of naphthalene from the water-accommodated fraction crude oil to the golden-brown algae, *Isochrysis galbana*. Archives of *Environmental Contamination and Toxicology* (35) 274–280.

Wolfe M.F., Schlosser J.A., Schwartz G.F.B., Singaram, S., Mielbrecht, E.E., Tjeerdema, R.S., et al. 1998b. Influence of dispersants on the bioavailability and trophic transfer of petroleum hydrocarbons to primary levels of a marine food chain. *Aquatic Toxicology* 42, 211–227.

Wolfe M.F., Schwartz G.J.B., Singaram, S., Mielbrecht, E.E., Tjeerdema, R.S., and Sowby, M.L. 2001. Influence of dispersants on the bioavailability and trophic transfer of petroleum hydrocarbons to larval topsmelt (*Atherinops affinis*). *Aquatic Toxicology* 52, 49–60.

Woodside – see Woodside Energy Ltd.

Woodside Energy Ltd. 2009. Scott Reef status report 2008. Woodside Energy Ltd., Perth, Western Australia.

Woodside Energy Ltd. 2014. Browse FLNG Development, Draft Environmental Impact Statement. EPBC 2013/7079. November 2014. Woodside Energy Ltd., Perth, Western Australia.

World Health Organization. 2005. Bentonite, Kaolin, and Selected Clay Minerals, Environmental Health Criteria 231. World Health Organization, Geneva 2005. Access online from http://www.who.int/ipcs/publications/ehc/ehc_231.pdf on 06/06/2019.

Zieman, J.C., Orth, R., Phillips, R.C., Thayer, G. and Thorhaug, A. 1984. The effects of oil on seagrass ecosystems. pp. 37–64 in Cairn, J. and Buikema, A.L. (eds), Restoration of Habitats Impacted by Oil Spills. Butterworth, Boston, USA.

# APPENDIX A: EPBC ACT APPROVAL (2008/4208) MINISTERIAL CONDITIONS

On 27 May 2015, INPEX received revised conditions for Approval Decision EPBC 2008/4208 from DoE, to reflect the outcomes of the Commonwealth Government's regulatory streamlining process. Condition 19 was added as a new condition and it requires INPEX to ensure elements of conditions which are no longer required to be implemented are included in Environment Plans submitted to NOPSEMA for assessment. This Appendix demonstrates how Condition 19 has been met.

| **Relevant EPBC 2008/4208 Ministerial Conditions** | **Location in Environment Plan submission** |
|---|---|
| 19. A plan, strategy or program (however described) required by conditions 1, 2, 5, 7, 8, 9 or 15 is automatically deemed to have been submitted to, and approved by, the Minister if the measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that:<br><br>a) was submitted to NOPSEMA after 27 February 2014; and<br><br>b) either:<br>i. is in force under the OPGGS Environment Regulations; or<br>ii. has ended in accordance with Regulation 25A of the OPGGS Environment Regulations. | This EP includes the elements of relevant conditions, as cross-referenced below. |
| 19B. Where an environment plan which includes measures specified in the conditions referred to in conditions 19 and 19A above, is in force under the OPGGS Environment Regulations that relates to the taking of the action, the person taking the action must comply with those measures as specified in that environment plan. | This EP |
| 1. Oil Spill Contingency Plan<br>The person taking the action must develop and submit to the Minister for approval, an Oil Spill Contingency Plan that demonstrates the response preparedness of the person taking the action for any hydrocarbon spills, including the capacity to respond to a spill and mitigate the environmental impacts on the Commonwealth marine area and listed species habitat within offshore areas and Darwin Harbour. The Plan must include, but is not limited to: | This EP |
| a) Oil spill trajectory modelling for potential spills from the action. This should include consideration of a well blow out or uncontrolled release. The modelling should be specific to the characteristics of the hydrocarbons contained in the Ichthys gas field, the likely volumes released in a worst case scenario spill, and the potential time over which the oil may be released in a worst case scenario spill, including a scenario of a minimum eleven (11) week uncontained spill; | Section 8.1, Section 8.2 and Section 8.3<br>Table 8-3, Table 8-4, Table 8-5, Table 8-6, Table 8-7 and Table 8-8<br>Figure 8-1, Figure 8-2, Figure 8-3, Figure 8-41, Figure 8-5, Figure 8-6 |

| **Relevant EPBC 2008/4208 Ministerial Conditions** | **Location in Environment Plan submission** |
|---|---|
| b) A description of resources available for use in containing and minimising impacts in the event of a spill and arrangements for accessing them; | Section 8.2.5, Section 8.5 and Section 8.7 and Section 9.10 and Appendix D (OPEP) of this EP |
| c) A demonstrated capacity to respond to a spill at the site, including application of dispersants, if required and appropriate, and measures that can feasibly be applied within the first 12 hours of a spill occurring; | Section 8.2.5, Section 8.5 and Section 8.7 and Section 9.10, Appendix D (OPEP) and Appendix E (SIMA) of this EP |
| d) Identification of sensitive areas that may be impacted by a potential spill, in particular, Browse Island, specific response measures for those areas and prioritisation of those areas during a response; | Section 4 in particular Section 4.4.2, 8.2.5, 8.3.5 of this EP and Appendix D (OPEP) |
| e) Details of the insurance arrangements that have been made in respect of paying the costs associated with operational and scientific monitoring, as outlined in the Operational and Scientific Monitoring Program required under condition 2 and repairing any environmental damage arising from potential oil spills, as determined necessary from the results of the Operational and Scientific Monitoring Program; | Section 1.5 of this EP |
| f) Training of staff in spill response measures and identifying roles and responsibilities of personnel during a spill response; and | Sections 9.3, 9.10.2 and 9.10.3 of this EP |
| g) Procedures for reporting oil spill incidents to the Department. | Section 9.11.3 and Appendix D (OPEP) of this EP |
| The person taking the action must not commence drilling activities until the Oil Spill Contingency Plan is approved.<br>The approved Oil Spill Contingency Plan must be implemented. | INPEX will not commence activities until this EP is Accepted by NOPSEMA and a commencement notification has been made. The Accepted EP will be implemented as required under the OPGGS Act and OPGGS(E) Regulations. |
| 2. Operational and Scientific Monitoring Program | This EP |

| Relevant EPBC 2008/4208 Ministerial Conditions | Location in Environment Plan submission |
|---|---|
| The person taking the action must develop and submit to the Minister for approval, an Operational and Scientific Monitoring Program that will be implemented in the event of an oil spill to determine the potential extent and ecosystem consequences of such a spill, including, but not limited to: | |
| a) Triggers for the initiation and termination of the Operational and Scientific Monitoring Program, including, but not limited to, spill volume, composition, extent, duration and detection of impacts; | Section 4.6 of Appendix D (OPEP) |
| b) A description of the studies that will be undertaken to determine the operational response, potential extent of impacts, ecosystem consequences and potential environmental reparations required as a result of the oil spill. | Section 4.6 and Appendix A of the OPEP |
| c) Details of the insurance arrangements that have been made in respect of paying the costs associated with operational and scientific monitoring, as outlined in the Operational and Scientific Monitoring Program, and repairing any environmental damage arising from potential oil spills, as determined necessary from the results of the Operational and Scientific Monitoring Program; | Section 1.5 of this EP |
| d) Inclusion of sufficient baseline information on the biota and the environment that may be impacted by a potential hydrocarbon spill, to enable an assessment of the impacts of such a spill; | Section 4, Section 8 particularly Tables 8-5, 8-5, 8-11 and Appendix D (OPEP) of this EP |
| e) A strategy to implement the Operational and Scientific Monitoring Program, including timelines for delivery of results and mechanisms for the timely peer review of studies; | Section 4.6 of Appendix D (OPEP) |
| f) In the event of an oil spill the person taking the action must pay all costs associated with all operational and scientific monitoring undertaken in response to the spill, as outlined in the approved Operational and Scientific Monitoring Program and any environmental remediation determined necessary by the results of the approved Operational and Scientific Monitoring Program; and | Section 1.5 of this EP |
| g) Provision for periodic review of the program. | Section 9.13 of this EP |

| **Relevant EPBC 2008/4208 Ministerial Conditions** | **Location in Environment Plan submission** |
|---|---|
| The Operational and Scientific Monitoring Program must be submitted at least three months prior to the commencement of drilling activities. The person taking the action must not commence drilling activities until the Operational and Scientific Monitoring Program is approved. The approved Operational and Scientific Monitoring Program must be implemented. | INPEX will not commence activities until this EP is Accepted by NOPSEMA and a commencement notification has been made. The Accepted EP will be implemented as required under the OPGGS Act and OPGGS (E) Regulations. |
| 7. Offshore Waste Management Plan<br>The person taking the action must submit for the Minister's approval an Offshore Waste Management Plan or plans to mitigate the environmental effects of any wastes generated from the proposal within the Commonwealth marine area. The Offshore Waste Management Plan(s) must address the following: | |
| a) identify all sources of waste; | Table 3-8 and Section 7.2 of this EP |
| b) describe any impacts associated with disposal of these wastes; | Table 7-10 of this EP |
| c) clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these; | Table 7-10 of this EP |
| d) outline measures to avoid impacts; | Table 7-10 of this EP |
| e) where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts; | Section 7.2 of this EP |
| f) identify all regulatory requirements relating to the disposal of waste and how these will be met; | Table 2-1 and Table 7-10 of this EP |
| g) include a monitoring regime to determine achievement of objectives and success of measures used; | Table 7-10 and Section 9.12 of this EP |
| h) outline reporting and auditing arrangements; and | Section 9.11 and Section 9.12 of this EP |
| i) describe how the plan will apply the principles of adaptive management. | Section 9.13 of this EP |

| **Relevant EPBC 2008/4208 Ministerial Conditions** | **Location in Environment Plan submission** |
|---|---|
| The plan(s) must be submitted prior to the commencement of the relevant activity to which they apply. The relevant activity may not commence until the plan is approved. The approved plan(s) must be implemented. | INPEX will not commence activities until this EP is Accepted by NOPSEMA and a commencement notification has been made. The Accepted EP will be implemented as required under the OPGGS Act and OPGGS (E) Regulations. |
| 8. Liquid Discharge Management Plan<br>The person taking the action must submit for the Minister's approval a Liquid Discharge Management Plan or plans to mitigate the environmental effects of any liquid discharge from the proposal, including sewerage and surface water runoff. The Liquid Discharge Management Plan(s) must be for the protection of the Commonwealth marine area and habitat for listed species in Darwin Harbour and must: | This EP |
| a) identify all sources of liquid discharge; | Table 3-6 and Section 7.1.3 of this EP |
| b) describe any impacts associated with the discharge of liquids, including the cumulative impacts associated with the discharge of sewerage; | Section 7.1.3 of this EP |
| c) clearly articulate the objectives of the plan and set measurable targets to demonstrate achievement of these; | Section 7.1.3 of this EP |
| d) outline measures to avoid impacts; | |
| e) where impacts are unavoidable describe why they are unavoidable and measures to minimise impacts; | |
| f) demonstrate how any discharges into Darwin Harbour are consistent with the guidelines for discharges, and the water quality objectives for Darwin Harbour, developed under the National Water Quality Management Strategy; | N/A |
| g) identify all regulatory requirements relating to the discharge of liquids and how these will be met; | Table 2-1 and Section 7.1.3 of this EP |
| h) include a monitoring regime to determine achievement of objectives and success of measures used; | Section 7.1.3 and Sections 9.12 of this EP |

| Relevant EPBC 2008/4208 Ministerial Conditions | Location in Environment Plan submission |
|---|---|
| i) outline reporting and auditing arrangements; and | Section 9.11 and Section 9.12 of this EP |
| j) describe how the plan will apply the principles of adaptive management. | Section 9.13 of this EP |
| The plan(s) must be submitted prior to the commencement of the relevant activity to which they apply. The relevant activity may not commence until the plan is approved. Separate Liquid Discharge Management plans can be submitted for the management of liquid discharges in the Commonwealth Marine Area and Darwin Harbour. The approved plan(s) must be implemented. | The Accepted EP will be implemented as required under the OPGGS Act and OPGGS(E) Regulations. |

# APPENDIX B: EPBC ACT PROTECTED MATTERS REPORT AND SPECIES RISK EVALUATION

## B.1 EPBC Act protected matters report

Australian Government

Department of the Environment and Energy

# EPBC Act Protected Matters Report

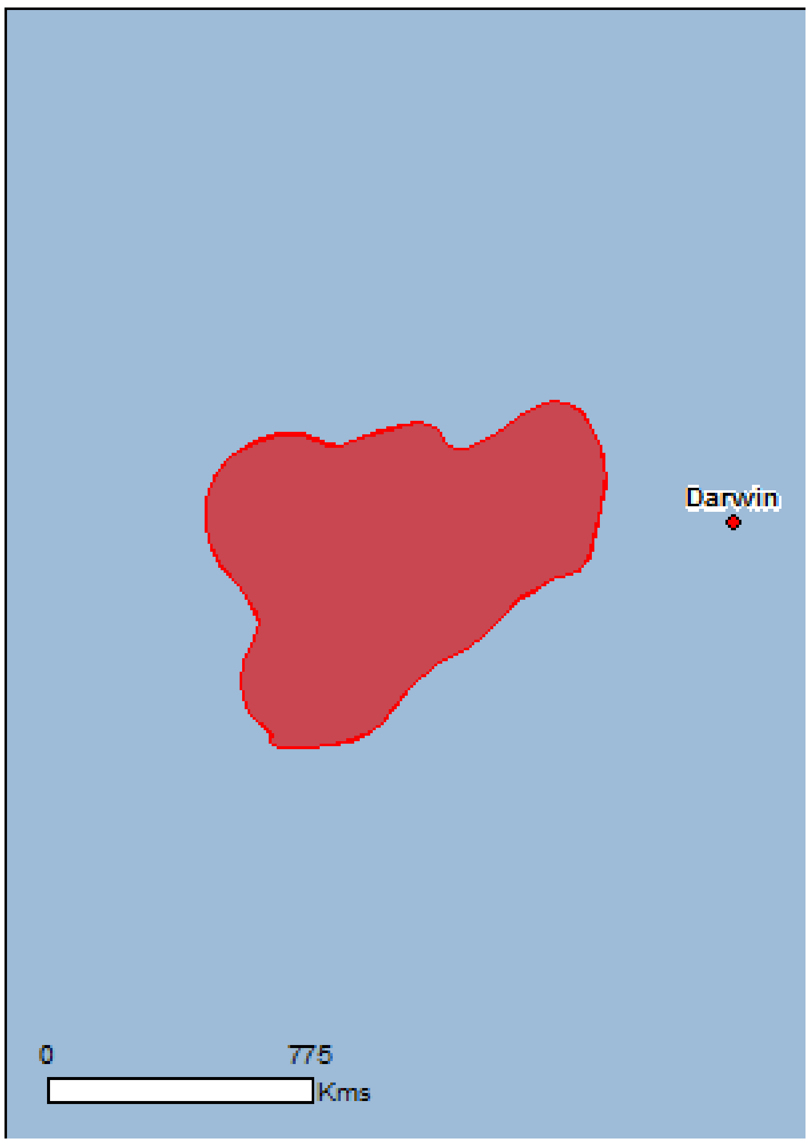
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 25/06/19 18:02:47

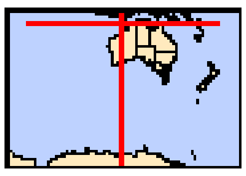

- Summary
- Details
    - Matters of NES
    - Other Matters Protected by the EPBC Act
    - Extra Information
- Caveat
- Acknowledgements




Coordinates

Buffer: 1.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

| | |
|---|---|
| World Heritage Properties: | None |
| National Heritage Places: | 1 |
| Wetlands of International Importance: | 1 |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Area: | 2 |
| Listed Threatened Ecological Communities: | None |
| Listed Threatened Species: | 32 |
| Listed Migratory Species: | 74 |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| | |
|---|---|
| Commonwealth Land: | 1 |
| Commonwealth Heritage Places: | 3 |
| Listed Marine Species: | 121 |
| Whales and Other Cetaceans: | 29 |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Australian Marine Parks: | 11 |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

| | |
|---|---|
| State and Territory Reserves: | 8 |
| Regional Forest Agreements: | None |
| Invasive Species: | 2 |
| Nationally Important Wetlands: | 2 |
| Key Ecological Features (Marine) | 8 |

# Details

## Matters of National Environmental Significance

| National Heritage Properties | | [ Resource Information ] |
|---|---|---|
| Name | State | Status |
| Natural | | |
| The West Kimberley | WA | Listed place |

| Wetlands of International Importance (Ramsar) | [ Resource Information ] |
|---|---|
| Name | Proximity |
| Ashmore reef national nature reserve | Within Ramsar site |

### Commonwealth Marine Area [ Resource Information ]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

| Name |
|---|
| EEZ and Territorial Sea |
| Extended Continental Shelf |

### Marine Regions [ Resource Information ]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

| Name |
|---|
| North-west |

| Listed Threatened Species | | [ Resource Information ] |
|---|---|---|
| Name | Status | Type of Presence |
| Birds | | |
| Anous tenuirostris melanops | | |
| Australian Lesser Noddy [26000] | Vulnerable | Breeding known to occur within area |
| Calidris canutus | | |
| Red Knot, Knot [855] | Endangered | Species or species habitat known to occur within area |
| Calidris ferruginea | | |
| Curlew Sandpiper [856] | Critically Endangered | Species or species habitat known to occur within area |
| Calidris tenuirostris | | |
| Great Knot [862] | Critically Endangered | Species or species habitat known to occur within area |
| Charadrius leschenaultii | | |
| Greater Sand Plover, Large Sand Plover [877] | Vulnerable | Species or species habitat known to occur within area |
| Charadrius mongolus | | |
| Lesser Sand Plover, Mongolian Plover [879] | Endangered | Species or species habitat known to occur within area |
| Erythrotriorchis radiatus | | |
| Red Goshawk [942] | Vulnerable | Species or species habitat may occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Falcunculus frontatus whitei<br>Crested Shrike-tit (northern), Northern Shrike-tit [26013] | Vulnerable | Species or species habitat likely to occur within area |
| Limosa lapponica baueri<br>Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380] | Vulnerable | Species or species habitat may occur within area |
| Limosa lapponica menzbieri<br>Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432] | Critically Endangered | Species or species habitat may occur within area |
| Numenius madagascariensis<br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat known to occur within area |
| Papasula abbotti<br>Abbott's Booby [59297] | Endangered | Species or species habitat may occur within area |
| **Mammals** | | |
| Balaenoptera borealis<br>Sei Whale [34] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Balaenoptera musculus<br>Blue Whale [36] | Endangered | Migration route known to occur within area |
| Balaenoptera physalus<br>Fin Whale [37] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Dasyurus hallucatus<br>Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331] | Endangered | Species or species habitat known to occur within area |
| Megaptera novaeangliae<br>Humpback Whale [38] | Vulnerable | Breeding known to occur within area |
| Saccolaimus saccolaimus nudicluniatus<br>Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889] | Vulnerable | Species or species habitat may occur within area |
| **Reptiles** | | |
| Aipysurus apraefrontalis<br>Short-nosed Seasnake [1115] | Critically Endangered | Species or species habitat known to occur within area |
| Aipysurus foliosquama<br>Leaf-scaled Seasnake [1118] | Critically Endangered | Species or species habitat known to occur within area |
| Caretta caretta<br>Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas<br>Green Turtle [1765] | Vulnerable | Breeding known to occur within area |
| Dermochelys coriacea<br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Breeding likely to occur within area |
| Eretmochelys imbricata<br>Hawksbill Turtle [1766] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Lepidochelys olivacea<br>Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Natator depressus<br>Flatback Turtle [59257] | Vulnerable | Breeding known to occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Sharks | | |
| Carcharodon carcharias<br>White Shark, Great White Shark [64470] | Vulnerable | Species or species habitat may occur within area |
| Glyphis garricki<br>Northern River Shark, New Guinea River Shark [82454] | Endangered | Species or species habitat may occur within area |
| Pristis clavata<br>Dwarf Sawfish, Queensland Sawfish [68447] | Vulnerable | Species or species habitat known to occur within area |
| Pristis pristis<br>Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756] | Vulnerable | Species or species habitat known to occur within area |
| Pristis zijsron<br>Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442] | Vulnerable | Species or species habitat known to occur within area |
| Rhincodon typus<br>Whale Shark [66680] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |

## Listed Migratory Species [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Migratory Marine Birds | | |
| Anous stolidus<br>Common Noddy [825] | | Breeding known to occur within area |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Ardenna pacifica<br>Wedge-tailed Shearwater [84292] | | Breeding known to occur within area |
| Calonectris leucomelas<br>Streaked Shearwater [1077] | | Species or species habitat known to occur within area |
| Fregata ariel<br>Lesser Frigatebird, Least Frigatebird [1012] | | Breeding known to occur within area |
| Fregata minor<br>Great Frigatebird, Greater Frigatebird [1013] | | Breeding known to occur within area |
| Hydroprogne caspia<br>Caspian Tern [808] | | Breeding known to occur within area |
| Onychoprion anaethetus<br>Bridled Tern [82845] | | Breeding known to occur within area |
| Phaethon lepturus<br>White-tailed Tropicbird [1014] | | Breeding known to occur within area |
| Phaethon rubricauda<br>Red-tailed Tropicbird [994] | | Breeding known to occur within area |
| Sterna dougallii<br>Roseate Tern [817] | | Breeding known to occur within area |
| Sternula albifrons<br>Little Tern [82849] | | Breeding known to occur within area |
| Sula dactylatra<br>Masked Booby [1021] | | Breeding known to occur within area |

| Name | Threatened | Type of Presence |
| --- | --- | --- |
| Sula leucogaster<br>Brown Booby [1022] | | Breeding known to occur within area |
| Sula sula<br>Red-footed Booby [1023] | | Breeding known to occur within area |
| **Migratory Marine Species** | | |
| Anoxypristis cuspidata<br>Narrow Sawfish, Knifetooth Sawfish [68448] | | Species or species habitat likely to occur within area |
| Balaenoptera borealis<br>Sei Whale [34] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Balaenoptera edeni<br>Bryde's Whale [35] | | Species or species habitat likely to occur within area |
| Balaenoptera musculus<br>Blue Whale [36] | Endangered | Migration route known to occur within area |
| Balaenoptera physalus<br>Fin Whale [37] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Carcharodon carcharias<br>White Shark, Great White Shark [64470] | Vulnerable | Species or species habitat may occur within area |
| Caretta caretta<br>Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas<br>Green Turtle [1765] | Vulnerable | Breeding known to occur within area |
| Crocodylus porosus<br>Salt-water Crocodile, Estuarine Crocodile [1774] | | Species or species habitat likely to occur within area |
| Dermochelys coriacea<br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Breeding likely to occur within area |
| Dugong dugon<br>Dugong [28] | | Breeding known to occur within area |
| Eretmochelys imbricata<br>Hawksbill Turtle [1766] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Isurus oxyrinchus<br>Shortfin Mako, Mako Shark [79073] | | Species or species habitat likely to occur within area |
| Isurus paucus<br>Longfin Mako [82947] | | Species or species habitat likely to occur within area |
| Lepidochelys olivacea<br>Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Manta alfredi<br>Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994] | | Species or species habitat known to occur within area |
| Manta birostris<br>Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995] | | Species or species habitat likely to occur within area |
| Megaptera novaeangliae<br>Humpback Whale [38] | Vulnerable | Breeding known to occur |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | within area |
| Natator depressus<br>Flatback Turtle [59257] | Vulnerable | Breeding known to occur within area |
| Orcaella heinsohni<br>Australian Snubfin Dolphin [81322] | | Species or species habitat likely to occur within area |
| Orcinus orca<br>Killer Whale, Orca [46] | | Species or species habitat may occur within area |
| Physeter macrocephalus<br>Sperm Whale [59] | | Species or species habitat may occur within area |
| Pristis clavata<br>Dwarf Sawfish, Queensland Sawfish [68447] | Vulnerable | Species or species habitat known to occur within area |
| Pristis pristis<br>Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756] | Vulnerable | Species or species habitat known to occur within area |
| Pristis zijsron<br>Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442] | Vulnerable | Species or species habitat known to occur within area |
| Rhincodon typus<br>Whale Shark [66680] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Sousa chinensis<br>Indo-Pacific Humpback Dolphin [50] | | Breeding known to occur within area |
| Tursiops aduncus (Arafura/Timor Sea populations)<br>Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900] | | Species or species habitat likely to occur within area |
| **Migratory Terrestrial Species** | | |
| Cecropis daurica<br>Red-rumped Swallow [80610] | | Species or species habitat may occur within area |
| Cuculus optatus<br>Oriental Cuckoo, Horsfield's Cuckoo [86651] | | Species or species habitat known to occur within area |
| Hirundo rustica<br>Barn Swallow [662] | | Species or species habitat known to occur within area |
| Motacilla cinerea<br>Grey Wagtail [642] | | Species or species habitat known to occur within area |
| Motacilla flava<br>Yellow Wagtail [644] | | Species or species habitat known to occur within area |
| **Migratory Wetlands Species** | | |
| Acrocephalus orientalis<br>Oriental Reed-Warbler [59570] | | Species or species habitat known to occur within area |
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat known to occur within area |
| Arenaria interpres<br>Ruddy Turnstone [872] | | Species or species habitat known to occur within area |

| Name | Threatened | Type of Presence |
| --- | --- | --- |
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Species or species habitat known to occur within area |
| Calidris alba<br>Sanderling [875] | | Species or species habitat known to occur within area |
| Calidris canutus<br>Red Knot, Knot [855] | Endangered | Species or species habitat known to occur within area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat known to occur within area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat known to occur within area |
| Calidris ruficollis<br>Red-necked Stint [860] | | Species or species habitat known to occur within area |
| Calidris tenuirostris<br>Great Knot [862] | Critically Endangered | Species or species habitat known to occur within area |
| Charadrius leschenaultii<br>Greater Sand Plover, Large Sand Plover [877] | Vulnerable | Species or species habitat known to occur within area |
| Charadrius mongolus<br>Lesser Sand Plover, Mongolian Plover [879] | Endangered | Species or species habitat known to occur within area |
| Charadrius veredus<br>Oriental Plover, Oriental Dotterel [882] | | Species or species habitat may occur within area |
| Glareola maldivarum<br>Oriental Pratincole [840] | | Species or species habitat may occur within area |
| Limosa lapponica<br>Bar-tailed Godwit [844] | | Species or species habitat known to occur within area |
| Limosa limosa<br>Black-tailed Godwit [845] | | Species or species habitat known to occur within area |
| Numenius madagascariensis<br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat known to occur within area |
| Numenius phaeopus<br>Whimbrel [849] | | Species or species habitat known to occur within area |
| Pandion haliaetus<br>Osprey [952] | | Breeding known to occur within area |
| Pluvialis fulva<br>Pacific Golden Plover [25545] | | Species or species habitat known to occur within area |
| Pluvialis squatarola<br>Grey Plover [865] | | Species or species habitat known to occur within area |
| Thalasseus bergii<br>Crested Tern [83000] | | Breeding known to occur |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | within area |
| Tringa brevipes<br>Grey-tailed Tattler [851] | | Species or species habitat known to occur within area |
| Tringa nebularia<br>Common Greenshank, Greenshank [832] | | Species or species habitat known to occur within area |
| Tringa totanus<br>Common Redshank, Redshank [835] | | Species or species habitat known to occur within area |
| Xenus cinereus<br>Terek Sandpiper [59300] | | Species or species habitat known to occur within area |

## Other Matters Protected by the EPBC Act

### Commonwealth Land [ Resource Information ]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

| Name |
|---|
| Commonwealth Land - |

### Commonwealth Heritage Places [ Resource Information ]

| Name | State | Status |
|---|---|---|
| Natural | | |
| Ashmore Reef National Nature Reserve | EXT | Listed place |
| Mermaid Reef - Rowley Shoals | WA | Listed place |
| Scott Reef and Surrounds - Commonwealth Area | EXT | Listed place |

### Listed Marine Species [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Birds | | |
| Acrocephalus orientalis<br>Oriental Reed-Warbler [59570] | | Species or species habitat known to occur within area |
| Actitis hypoleucos<br>Common Sandpiper [59309] | | Species or species habitat known to occur within area |
| Anous minutus<br>Black Noddy [824] | | Breeding known to occur within area |
| Anous stolidus<br>Common Noddy [825] | | Breeding known to occur within area |
| Anous tenuirostris  melanops<br>Australian Lesser Noddy [26000] | Vulnerable | Breeding known to occur within area |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Ardea alba<br>Great Egret, White Egret [59541] | | Species or species habitat known to occur within area |
| Arenaria interpres<br>Ruddy Turnstone [872] | | Species or species habitat known to occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Species or species habitat known to occur within area |
| Calidris alba<br>Sanderling [875] | | Species or species habitat known to occur within area |
| Calidris canutus<br>Red Knot, Knot [855] | Endangered | Species or species habitat known to occur within area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | Critically Endangered | Species or species habitat known to occur within area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat known to occur within area |
| Calidris ruficollis<br>Red-necked Stint [860] | | Species or species habitat known to occur within area |
| Calidris tenuirostris<br>Great Knot [862] | Critically Endangered | Species or species habitat known to occur within area |
| Calonectris leucomelas<br>Streaked Shearwater [1077] | | Species or species habitat known to occur within area |
| Charadrius leschenaultii<br>Greater Sand Plover, Large Sand Plover [877] | Vulnerable | Species or species habitat known to occur within area |
| Charadrius mongolus<br>Lesser Sand Plover, Mongolian Plover [879] | Endangered | Species or species habitat known to occur within area |
| Charadrius ruficapillus<br>Red-capped Plover [881] | | Species or species habitat known to occur within area |
| Charadrius veredus<br>Oriental Plover, Oriental Dotterel [882] | | Species or species habitat may occur within area |
| Fregata ariel<br>Lesser Frigatebird, Least Frigatebird [1012] | | Breeding known to occur within area |
| Fregata minor<br>Great Frigatebird, Greater Frigatebird [1013] | | Breeding known to occur within area |
| Glareola maldivarum<br>Oriental Pratincole [840] | | Species or species habitat may occur within area |
| Haliaeetus leucogaster<br>White-bellied Sea-Eagle [943] | | Species or species habitat known to occur within area |
| Heteroscelus brevipes<br>Grey-tailed Tattler [59311] | | Species or species habitat known to occur within area |
| Hirundo daurica<br>Red-rumped Swallow [59480] | | Species or species habitat may occur within area |
| Hirundo rustica<br>Barn Swallow [662] | | Species or species habitat known to occur |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | within area |
| Larus novaehollandiae<br>Silver Gull [810] | | Breeding known to occur within area |
| Limosa lapponica<br>Bar-tailed Godwit [844] | | Species or species habitat known to occur within area |
| Limosa limosa<br>Black-tailed Godwit [845] | | Species or species habitat known to occur within area |
| Motacilla cinerea<br>Grey Wagtail [642] | | Species or species habitat known to occur within area |
| Motacilla flava<br>Yellow Wagtail [644] | | Species or species habitat known to occur within area |
| Numenius madagascariensis<br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat known to occur within area |
| Numenius phaeopus<br>Whimbrel [849] | | Species or species habitat known to occur within area |
| Pandion haliaetus<br>Osprey [952] | | Breeding known to occur within area |
| Papasula abbotti<br>Abbott's Booby [59297] | Endangered | Species or species habitat may occur within area |
| Phaethon lepturus<br>White-tailed Tropicbird [1014] | | Breeding known to occur within area |
| Phaethon rubricauda<br>Red-tailed Tropicbird [994] | | Breeding known to occur within area |
| Pluvialis fulva<br>Pacific Golden Plover [25545] | | Species or species habitat known to occur within area |
| Pluvialis squatarola<br>Grey Plover [865] | | Species or species habitat known to occur within area |
| Puffinus pacificus<br>Wedge-tailed Shearwater [1027] | | Breeding known to occur within area |
| Sterna albifrons<br>Little Tern [813] | | Breeding known to occur within area |
| Sterna anaethetus<br>Bridled Tern [814] | | Breeding known to occur within area |
| Sterna bengalensis<br>Lesser Crested Tern [815] | | Breeding known to occur within area |
| Sterna bergii<br>Crested Tern [816] | | Breeding known to occur within area |
| Sterna caspia<br>Caspian Tern [59467] | | Breeding known to occur within area |
| Sterna dougallii<br>Roseate Tern [817] | | Breeding known to occur within area |
| Sterna fuscata<br>Sooty Tern [794] | | Breeding known to occur |

| Name | Threatened | Type of Presence |
| --- | --- | --- |
| | | within area |
| Sterna nereis<br>Fairy Tern [796] | | Breeding known to occur within area |
| Stiltia isabella<br>Australian Pratincole [818] | | Species or species habitat known to occur within area |
| Sula dactylatra<br>Masked Booby [1021] | | Breeding known to occur within area |
| Sula leucogaster<br>Brown Booby [1022] | | Breeding known to occur within area |
| Sula sula<br>Red-footed Booby [1023] | | Breeding known to occur within area |
| Tringa nebularia<br>Common Greenshank, Greenshank [832] | | Species or species habitat known to occur within area |
| Tringa totanus<br>Common Redshank, Redshank [835] | | Species or species habitat known to occur within area |
| Xenus cinereus<br>Terek Sandpiper [59300] | | Species or species habitat known to occur within area |
| Fish | | |
| Bhanotia fasciolata<br>Corrugated Pipefish, Barbed Pipefish [66188] | | Species or species habitat may occur within area |
| Campichthys tricarinatus<br>Three-keel Pipefish [66192] | | Species or species habitat may occur within area |
| Choeroichthys brachysoma<br>Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194] | | Species or species habitat may occur within area |
| Choeroichthys suillus<br>Pig-snouted Pipefish [66198] | | Species or species habitat may occur within area |
| Corythoichthys amplexus<br>Fijian Banded Pipefish, Brown-banded Pipefish [66199] | | Species or species habitat may occur within area |
| Corythoichthys flavofasciatus<br>Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200] | | Species or species habitat may occur within area |
| Corythoichthys intestinalis<br>Australian Messmate Pipefish, Banded Pipefish [66202] | | Species or species habitat may occur within area |
| Corythoichthys schultzi<br>Schultz's Pipefish [66205] | | Species or species habitat may occur within area |
| Cosmocampus banneri<br>Roughridge Pipefish [66206] | | Species or species habitat may occur within area |
| Doryrhamphus dactyliophorus<br>Banded Pipefish, Ringed Pipefish [66210] | | Species or species habitat may occur within area |
| Doryrhamphus excisus<br>Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211] | | Species or species habitat may occur within |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | area |
| Doryrhamphus janssi<br>Cleaner Pipefish, Janss' Pipefish [66212] | | Species or species habitat may occur within area |
| Filicampus tigris<br>Tiger Pipefish [66217] | | Species or species habitat may occur within area |
| Halicampus brocki<br>Brock's Pipefish [66219] | | Species or species habitat may occur within area |
| Halicampus dunckeri<br>Red-hair Pipefish, Duncker's Pipefish [66220] | | Species or species habitat may occur within area |
| Halicampus grayi<br>Mud Pipefish, Gray's Pipefish [66221] | | Species or species habitat may occur within area |
| Halicampus nitidus<br>Glittering Pipefish [66224] | | Species or species habitat may occur within area |
| Halicampus spinirostris<br>Spiny-snout Pipefish [66225] | | Species or species habitat may occur within area |
| Haliichthys taeniophorus<br>Ribboned Pipehorse, Ribboned Seadragon [66226] | | Species or species habitat may occur within area |
| Hippichthys penicillus<br>Beady Pipefish, Steep-nosed Pipefish [66231] | | Species or species habitat may occur within area |
| Hippocampus angustus<br>Western Spiny Seahorse, Narrow-bellied Seahorse [66234] | | Species or species habitat may occur within area |
| Hippocampus histrix<br>Spiny Seahorse, Thorny Seahorse [66236] | | Species or species habitat may occur within area |
| Hippocampus kuda<br>Spotted Seahorse, Yellow Seahorse [66237] | | Species or species habitat may occur within area |
| Hippocampus planifrons<br>Flat-face Seahorse [66238] | | Species or species habitat may occur within area |
| Hippocampus spinosissimus<br>Hedgehog Seahorse [66239] | | Species or species habitat may occur within area |
| Hippocampus trimaculatus<br>Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720] | | Species or species habitat may occur within area |
| Micrognathus micronotopterus<br>Tidepool Pipefish [66255] | | Species or species habitat may occur within area |
| Solegnathus hardwickii<br>Pallid Pipehorse, Hardwick's Pipehorse [66272] | | Species or species habitat may occur within area |
| Solegnathus lettiensis<br>Gunther's Pipehorse, Indonesian Pipefish [66273] | | Species or species habitat may occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Solenostomus cyanopterus<br>Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183] | | Species or species habitat may occur within area |
| Syngnathoides biaculeatus<br>Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279] | | Species or species habitat may occur within area |
| Trachyrhamphus bicoarctatus<br>Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280] | | Species or species habitat may occur within area |
| Trachyrhamphus longirostris<br>Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281] | | Species or species habitat may occur within area |
| Mammals | | |
| Dugong dugon<br>Dugong [28] | | Breeding known to occur within area |
| Reptiles | | |
| Acalyptophis peronii<br>Horned Seasnake [1114] | | Species or species habitat may occur within area |
| Aipysurus apraefrontalis<br>Short-nosed Seasnake [1115] | Critically Endangered | Species or species habitat known to occur within area |
| Aipysurus duboisii<br>Dubois' Seasnake [1116] | | Species or species habitat may occur within area |
| Aipysurus eydouxii<br>Spine-tailed Seasnake [1117] | | Species or species habitat may occur within area |
| Aipysurus foliosquama<br>Leaf-scaled Seasnake [1118] | Critically Endangered | Species or species habitat known to occur within area |
| Aipysurus fuscus<br>Dusky Seasnake [1119] | | Species or species habitat known to occur within area |
| Aipysurus laevis<br>Olive Seasnake [1120] | | Species or species habitat may occur within area |
| Aipysurus tenuis<br>Brown-lined Seasnake [1121] | | Species or species habitat may occur within area |
| Astrotia stokesii<br>Stokes' Seasnake [1122] | | Species or species habitat may occur within area |
| Caretta caretta<br>Loggerhead Turtle [1763] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Chelonia mydas<br>Green Turtle [1765] | Vulnerable | Breeding known to occur within area |
| Crocodylus johnstoni<br>Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773] | | Species or species habitat may occur within area |
| Crocodylus porosus<br>Salt-water Crocodile, Estuarine Crocodile [1774] | | Species or species habitat likely to occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Dermochelys coriacea<br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Breeding likely to occur within area |
| Disteira kingii<br>Spectacled Seasnake [1123] | | Species or species habitat may occur within area |
| Disteira major<br>Olive-headed Seasnake [1124] | | Species or species habitat may occur within area |
| Emydocephalus annulatus<br>Turtle-headed Seasnake [1125] | | Species or species habitat may occur within area |
| Enhydrina schistosa<br>Beaked Seasnake [1126] | | Species or species habitat may occur within area |
| Ephalophis greyi<br>North-western Mangrove Seasnake [1127] | | Species or species habitat may occur within area |
| Eretmochelys imbricata<br>Hawksbill Turtle [1766] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Hydrelaps darwiniensis<br>Black-ringed Seasnake [1100] | | Species or species habitat may occur within area |
| Hydrophis atriceps<br>Black-headed Seasnake [1101] | | Species or species habitat may occur within area |
| Hydrophis coggeri<br>Slender-necked Seasnake [25925] | | Species or species habitat may occur within area |
| Hydrophis czeblukovi<br>Fine-spined Seasnake [59233] | | Species or species habitat may occur within area |
| Hydrophis elegans<br>Elegant Seasnake [1104] | | Species or species habitat may occur within area |
| Hydrophis mcdowelli<br>null [25926] | | Species or species habitat may occur within area |
| Hydrophis ornatus<br>Spotted Seasnake, Ornate Reef Seasnake [1111] | | Species or species habitat may occur within area |
| Lapemis hardwickii<br>Spine-bellied Seasnake [1113] | | Species or species habitat may occur within area |
| Lepidochelys olivacea<br>Olive Ridley Turtle, Pacific Ridley Turtle [1767] | Endangered | Foraging, feeding or related behaviour known to occur within area |
| Natator depressus<br>Flatback Turtle [59257] | Vulnerable | Breeding known to occur within area |
| Pelamis platurus<br>Yellow-bellied Seasnake [1091] | | Species or species habitat may occur within area |

## Whales and other Cetaceans [ Resource Information ]

| Name | Status | Type of Presence |
|---|---|---|

| Name | Status | Type of Presence |
|---|---|---|
| Mammals | | |
| Balaenoptera borealis<br>Sei Whale [34] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Balaenoptera edeni<br>Bryde's Whale [35] | | Species or species habitat likely to occur within area |
| Balaenoptera musculus<br>Blue Whale [36] | Endangered | Migration route known to occur within area |
| Balaenoptera physalus<br>Fin Whale [37] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Delphinus delphis<br>Common Dophin, Short-beaked Common Dolphin [60] | | Species or species habitat may occur within area |
| Feresa attenuata<br>Pygmy Killer Whale [61] | | Species or species habitat may occur within area |
| Globicephala macrorhynchus<br>Short-finned Pilot Whale [62] | | Species or species habitat may occur within area |
| Grampus griseus<br>Risso's Dolphin, Grampus [64] | | Species or species habitat may occur within area |
| Indopacetus pacificus<br>Longman's Beaked Whale [72] | | Species or species habitat may occur within area |
| Kogia breviceps<br>Pygmy Sperm Whale [57] | | Species or species habitat may occur within area |
| Kogia simus<br>Dwarf Sperm Whale [58] | | Species or species habitat may occur within area |
| Lagenodelphis hosei<br>Fraser's Dolphin, Sarawak Dolphin [41] | | Species or species habitat may occur within area |
| Megaptera novaeangliae<br>Humpback Whale [38] | Vulnerable | Breeding known to occur within area |
| Mesoplodon densirostris<br>Blainville's Beaked Whale, Dense-beaked Whale [74] | | Species or species habitat may occur within area |
| Mesoplodon ginkgodens<br>Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564] | | Species or species habitat may occur within area |
| Orcaella brevirostris<br>Irrawaddy Dolphin [45] | | Species or species habitat likely to occur within area |
| Orcinus orca<br>Killer Whale, Orca [46] | | Species or species habitat may occur within area |
| Peponocephala electra<br>Melon-headed Whale [47] | | Species or species habitat may occur within area |
| Physeter macrocephalus<br>Sperm Whale [59] | | Species or species |

| Name | Status | Type of Presence |
|---|---|---|
| | | habitat may occur within area |
| Pseudorca crassidens<br>False Killer Whale [48] | | Species or species habitat likely to occur within area |
| Sousa chinensis<br>Indo-Pacific Humpback Dolphin [50] | | Breeding known to occur within area |
| Stenella attenuata<br>Spotted Dolphin, Pantropical Spotted Dolphin [51] | | Species or species habitat may occur within area |
| Stenella coeruleoalba<br>Striped Dolphin, Euphrosyne Dolphin [52] | | Species or species habitat may occur within area |
| Stenella longirostris<br>Long-snouted Spinner Dolphin [29] | | Species or species habitat may occur within area |
| Steno bredanensis<br>Rough-toothed Dolphin [30] | | Species or species habitat may occur within area |
| Tursiops aduncus<br>Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418] | | Species or species habitat likely to occur within area |
| Tursiops aduncus (Arafura/Timor Sea populations)<br>Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900] | | Species or species habitat likely to occur within area |
| Tursiops truncatus s. str.<br>Bottlenose Dolphin [68417] | | Species or species habitat may occur within area |
| Ziphius cavirostris<br>Cuvier's Beaked Whale, Goose-beaked Whale [56] | | Species or species habitat may occur within area |

## Australian Marine Parks [ Resource Information ]

| Name | Label |
|---|---|
| Argo-Rowley Terrace | Multiple Use Zone (IUCN VI) |
| Argo-Rowley Terrace | National Park Zone (IUCN II) |
| Argo-Rowley Terrace | Special Purpose Zone (Trawl) (IUCN VI) |
| Ashmore Reef | Recreational Use Zone (IUCN IV) |
| Ashmore Reef | Sanctuary Zone (IUCN Ia) |
| Cartier Island | Sanctuary Zone (IUCN Ia) |
| Kimberley | Habitat Protection Zone (IUCN IV) |
| Kimberley | Multiple Use Zone (IUCN VI) |
| Kimberley | National Park Zone (IUCN II) |
| Mermaid Reef | National Park Zone (IUCN II) |
| Oceanic Shoals | Multiple Use Zone (IUCN VI) |

# Extra Information

## State and Territory Reserves [ Resource Information ]

| Name | State |
|---|---|
| Adele Island | WA |
| Browse Island | WA |
| Dambimangari | WA |
| Lacepede Islands | WA |
| Unnamed WA41775 | WA |
| Unnamed WA44673 | WA |
| Unnamed WA44674 | WA |
| Uunguu | WA |

## Invasive Species [ Resource Information ]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name | Status | Type of Presence |
|---|---|---|
| Mammals | | |
| Mus musculus | | |
| House Mouse [120] | | Species or species habitat likely to occur within area |
| Rattus exulans | | |
| Pacific Rat, Polynesian Rat [79] | | Species or species habitat likely to occur within area |

## Nationally Important Wetlands [ Resource Information ]

| Name | State |
|---|---|
| Ashmore Reef | EXT |
| Mermaid Reef | EXT |

## Key Ecological Features (Marine) [ Resource Information ]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

| Name | Region |
|---|---|
| Ancient coastline at 125 m depth contour | North-west |
| Ashmore Reef and Cartier Island and surrounding | North-west |
| Canyons linking the Argo Abyssal Plain with the | North-west |
| Carbonate bank and terrace system of the Sahul | North-west |
| Continental Slope Demersal Fish Communities | North-west |
| Mermaid Reef and Commonwealth waters | North-west |
| Pinnacles of the Bonaparte Basin | North-west |
| Seringapatam Reef and Commonwealth waters in | North-west |

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-10.67739 117.5301,-10.30673 118.1655,-10.09493 118.8274,-10.09493 119.4231,-10.37292 120.1777,-10.41263 120.4689,-10.29349 120.8131,-10.02874 121.475,-9.8037 122.5075,-9.83884 122.7972,-9.97579 123.0105,-10.31997 123.262,-10.5053 123.4606,-10.5053 123.7254,-10.13464 124.5196,-9.63161 125.1683,-9.35362 125.6581,-9.208 126.0817,-9.27419 126.492,-9.53895 126.863,-10.0155 127.141,-10.4913 127.334,-10.9432 127.427,-11.1935 127.484,-11.4138 127.457,-12.0037 127.34,-13.2941 127.028,-13.5006 126.879,-13.6422 126.746,-13.718 126.562,-13.8823 125.989,-14.1611 125.603,-14.3662 125.178,-14.7451 124.817,-15.2311 124.308,-15.6283 123.831,-15.8798 123.196,-16.1048 122.905,-16.5814 122.335,-17.1374 121.872,-17.5083 121.557,-17.7463 121.276,-17.9581 120.747,-18.0712 120.189,-18.1302 119.648,-18.1458 119.21,-18.1037 118.854,-17.9872 118.605,-17.8109 118.6326,-17.2565 118.02,-16.5814 117.835,-15.9063 117.901,-15.4165 118.192,-15.1767 118.257,-14.9568 118.292,-14.7058 118.214,-14.3707 118.046,-13.9603 117.768,-13.4838 117.292,-13.0469 117.014,-12.5307 116.908,-11.7629 116.908,-11.2069 117.146,-10.67739 117.5301

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.



Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

## B.2 EPBC-listed species risk evaluation table

This table was developed by:

- Searching the Species Profile and Threats Database (SPRAT) (http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl) for every species identified in the EPBC search related to this EP.
- Through the SPRAT database, identifying the relevant conservation management documents.
- Determining the relevant aspects / threats from the conservation management documents related to the activity
- Listing where the aspect / threat has been addressed in the EP.

| Fauna Type | Conservation management documents | Summary of relevant aspects/threats identified from conservation management documents | Summary of relevant actions from conservation management documents | Relevant exposure / risk evaluation section of EP |
|---|---|---|---|---|
| EPBC-listed fishes and sharks | Whale shark management. 2013 Wildlife management program no. 57. Department of Parks and Wildlife. State of Western Australia.<br>Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Rhincodon typus (whale shark). Commonwealth of Australia.<br>Department of Sustainability, Environment, Water, Population and Communities. 2013. Recovery Plan for the White Shark (Carcharodon carcharias). Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2014. Approved Conservation Advice for Glyphis garricki (northern river shark). Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2009. Commonwealth Conservation Advice on Pristis clavata (Dwarf Sawfish). Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2008. Approved Conservation Advice for Pristis zijsron (Green Sawfish). Commonwealth of Australia.<br>Department of the Environment. 2015. Sawfish and River Sharks - Multispecies Recovery Plan. Commonwealth of Australia.<br>Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia.<br>Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT.<br>Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. | • Waste / marine debris<br>• Noise and vibration<br>• Introduced Marine Species<br>• Vessel strike<br>• Benthic habitat degradation / seabed disturbance<br>• Emissions and discharges<br>• Oil spill | • Identify populations and areas of high conservation priority (sawfishes).<br>• Ensure there is no anthropogenic disturbance / implement measures to reduce adverse impacts of habitat degradation and/or modification (northern river shark).<br>• Ensure all future developments will not significantly impact upon sawfish and river shark habitats critical to the survival of the species or impede upon the migration of individual sawfish or river sharks. Implement measures to reduce adverse impacts of habitat degradation and/or modification.<br>• Review and assess the potential threat of introduced species, pathogens and pollutants.<br>• Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations (Ningaloo Reef,) and along the northward migration route that follows the northern WA coastline along the 200 m isobath.<br>• Contribute to the long-term prevention of the incidence of harmful marine debris. | • EP Section 7.2. – Waste management,<br>• EP Section 7.3 - Noise and vibration<br>• EP Section 7.5.1 - Introduction of invasive marine species<br>• EP Section 7.5.2 - Interaction with marine fauna<br>• EP Section 7.6 - Seabed disturbance<br>• EP Section 7.1.3 - Routine discharges<br>• EP Section 8 - Emergency conditions (oil spills) |
| EPBC-listed marine reptiles | Department of the Environment and Energy 2017. Recovery Plan for Marine Turtles in Australia, Commonwealth of Australia 2017.<br>Threatened Species Scientific Committee. 2011. Commonwealth Conservation Advice on | • Waste / marine debris<br>• Noise and vibration<br>• Introduced Marine Species<br>• Vessel strike | • Manage artificial light from onshore and offshore sources to ensure biologically important behaviours of nesting adults and dispersing hatchlings can continue. | • EP Section 7.2. – Waste management,<br>• EP Section 7.3 - Noise and vibration<br>• EP Section 7.5.1 - Introduction of invasive marine species |

| Fauna Type | Conservation management documents | Summary of relevant aspects/threats identified from conservation management documents | Summary of relevant actions from conservation management documents | Relevant exposure / risk evaluation section of EP |
|---|---|---|---|---|
| | Aipysurus apraefrontalis (Short-nosed Seasnake). Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2011. Commonwealth Conservation Advice on Aipysurus foliosquama (Leaf-scaled Seasnake). Commonwealth of Australia.<br>Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia.<br>Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT.<br>Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. | • Benthic habitat degradation / seabed disturbance<br>• Emissions and discharges<br>• Oil spill<br>• Light emissions | • Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats and implementation of best practice light management guidelines for developments adjacent to marine turtle nesting beaches.<br>• Identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution.<br>• Support retrofitting of lighting at coastal communities and industrial developments, including imposing restrictions around nesting seasons.<br>• Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical for survival.<br>• Contribute to the reduction in the source of marine debris.<br>• Ensure that spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to slow to recover habitats, e.g. seagrass meadows or corals.<br>• Implement best practices to minimise impacts to turtle health and habitats from chemical discharges.<br>• Identify populations and areas of high conservation priority (sea snakes).<br>• Ensure there is no anthropogenic disturbance / implement measures to reduce adverse impacts of habitat degradation and/or modification (sea snakes). | • EP Section 7.5.2 - Interaction with marine fauna<br>• EP Section 7.6 - Seabed disturbance<br>• EP Section 7.1.3 - Routine discharges<br>• EP Section 8 - Emergency conditions (oil spills)<br>• EP Section 7.1.1 - Light emissions |
| EPBC-listed seabirds and shorebirds | Department of the Environment. 2015. EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC listed migratory shorebird species.<br>Department of the Environment. 2015. Wildlife conservation plan for migratory shorebirds. Commonwealth of Australia.<br>Department of the Environment. 2015. Draft referral guideline for 14 birds listed as migratory under the EPBC Act. Commonwealth of Australia. | • Waste / marine debris<br>• Noise and vibration<br>• Introduced Marine Species<br>• Introduced Terrestrial Pests (rodents)<br>• Benthic habitat degradation / seabed disturbance<br>• Emissions and discharges<br>• Oil spill | • Reduce risk of rodents gaining access to key vessels at key ports<br>• Contribute to the long-term prevention of the incidence of harmful marine debris<br>• Identify threats to important (migratory shorebird) habitat and develop conservation measures for managing them. | • EP Section 7.2. – Waste management,<br>• EP Section 7.3 - Noise and vibration<br>• EP Section 7.5.1 - Introduction of invasive marine species<br>• EP Section 8 - Emergency conditions (oil spills)<br>• EP Section 7.1.3 - Routine discharges<br>• EP Section 7.1.1 - Light emissions |

| Fauna Type | Conservation management documents | Summary of relevant aspects/threats identified from conservation management documents | Summary of relevant actions from conservation management documents | Relevant exposure / risk evaluation section of EP |
|---|---|---|---|---|
| | Department of Sustainability, Environment, Water, Population and Communities. 2012. Species group report card - seabirds and migratory shorebirds. Supporting the marine bioregional plan for the North-west Marine Region. Prepared under the Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.<br><br>Department of the Environment, Water, Heritage and the Arts. 2009. Threat abatement plan to reduce the impacts of exotic rodents on biodiversity on Australian offshore islands of less than 100 000 hectares. Commonwealth of Australia.<br><br>Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia.<br><br>Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT.<br><br>Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT.<br><br>Threatened Species Scientific Committee. 2016. Calidris tenuirostris (Great Knot) Approved Conservation Advice. Commonwealth of Australia.<br><br>Threatened Species Scientific Committee. 2016. Calidris canutus (Red Knot) Approved Conservation Advice. Commonwealth of Australia.<br><br>Threatened Species Scientific Committee. 2016. Charadrius leschenaultii (Greater Sand Plover) Approved Conservation Advice. Commonwealth of Australia.<br><br>Threatened Species Scientific Committee. 2016. Charadrius mongolus (Lesser Sand Plover) Approved Conservation Advice. Commonwealth of Australia.<br><br>Threatened Species Scientific Committee. 2015. Calidris ferruginea (Curlew Sandpiper) Approved Conservation Advice. Commonwealth of Australia. | • Light emissions | • Avoid degradation of migratory shorebird habitat that may occur through the introduction of exotic species, changes to hydrology or water quality (including toxic inflows), fragmentation of habitat or exposure to litter, pollutants and acid sulphate soils. Minimise human disturbance, a major threat to migratory shorebirds<br>• Best practice waste management should be implemented. | |

| Fauna Type | Conservation management documents | Summary of relevant aspects/threats identified from conservation management documents | Summary of relevant actions from conservation management documents | Relevant exposure / risk evaluation section of EP |
|---|---|---|---|---|
| | Threatened Species Scientific Committee. 2001. Commonwealth listing advice on Macronectes giganteus. Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2015. Papasula abbotti — Abbott's Booby. Approved Conservation Advice. Commonwealth of Australia.<br>Department of the Environment. 2015. Conservation advice Numenius madagascariensis (eastern curlew). Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Anous tenuirostris melanops (Australian lesser noddy). Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2002. Commonwealth Listing Advice on Sterna albifrons sinensis (Little Tern (western Pacific)). Commonwealth of Australia. | | | |
| EPBC-listed cetaceans | Department of the Environment. 2015. Conservation Management Plan for the Blue Whales - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 (2015-2025). Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2015. Balaenoptera borealis (Sei Whale) Conservation Advice. Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Megaptera novaeangliae (humpback whale). Commonwealth of Australia.<br>Threatened Species Scientific Committee. 2015. Approved Conservation Advice for Balaenoptera physalus — Fin Whale. Commonwealth of Australia.<br>EPBC Act Regulations 2000. Part 8 Interacting with cetaceans and whale watching. Division 8.1 Interacting with cetaceans. Commonwealth of Australia.<br>Department of the Environment and Heritage, 2005. Australian National Guidelines for Whale and Dolphin Watching - Information Sheet. Commonwealth of Australia. | • Waste / marine debris<br>• Noise and vibration<br>• Introduced Marine Species<br>• Vessel strike<br>• Benthic habitat degradation / seabed disturbance<br>• Emissions and discharges<br>• Oil spill | • Ensure all vessel strike incidents are reported in the National Ship Strike Database.<br>• Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.<br>• Protect habitat important to the survival of the species (humpback whales); assess and manage physical disturbance and development activities (such as ship-strike and pollution).<br>• Ensure the risk of vessel strike on humpback whales is considered when assessing actions that increase vessel traffic in areas where humpback whales occur and, if required appropriate mitigation measures are implemented to reduce the risk of vessel strike.<br>• Environmental assessment processes must ensure that existing information about coastal habitat requirements of humpback whales, environmental suitability of coastal locations, historic high use and emerging areas are taken into consideration.<br>• Contribute to the long-term prevention of the incidence of harmful marine debris | • EP Section 7.2. – Waste Management,<br>• EP Section 7.3 - Noise and Vibration<br>• EP Section 7.5.1 - Introduction of invasive marine species<br>• EP Section 7.5.2 - Physical presence of vessels and interaction with marine fauna<br>• EP Section 7.6 - Seabed disturbance<br>• EP Section 7.1.3 - Routine discharges<br>• EP Section 8 - Emergency conditions (oil spills) |

| Fauna Type | Conservation management documents | Summary of relevant aspects/threats identified from conservation management documents | Summary of relevant actions from conservation management documents | Relevant exposure / risk evaluation section of EP |
|---|---|---|---|---|
| | Department of Environment and Energy. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Commonwealth of Australia.<br>Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North-west Marine Region. DSEWPac, Canberra, ACT.<br>Department of Sustainability, Environment, Water, Population and Communities (DSEWPac). 2012. Marine bioregional plan for the North Marine Region. DSEWPac, Canberra, ACT. | | • if a whale or dolphin surfaces in the vicinity of a vessel travelling for a purpose other than whale and dolphin watching, take all care necessary to avoid collisions. This may include stopping, slowing down and/or steering away from the animal. | |

# APPENDIX C: STAKEHOLDER CONSULTATION LOG

| STAKEHOLDER | Date of Correspondence | Type of Correspondence | Activity of Relevance | Attachments | Summary of Correspondence | Assessment of Merit and Relevant Matters |
|---|---|---|---|---|---|---|
| **Authorities** | | | | | | |
| Australian Border Force (ABF), Broome Office (Cwth) | 5/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Australian Border Force (ABF), Darwin Office (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Australian Border Force, Canberra (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Australian Fisheries Management Authority (AFMA) (Cwth) | 5/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development fact sheet<br>- North West Slope Trawl Fishery map | Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L.<br><br>The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019.<br><br>The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information.<br><br>INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the only Commonwealth-managed fishery that operates in the vicinity of WA-50-L, the North West Slope Trawl Fishery, was also provided including a map of the fishery licence area relative to the location of WA-50-L.<br><br>INPEX advised that licence holders of the NDSMF and relevant fishing industry associations, including the Commonwealth Fisheries Association and the Western Australian Fishing Industry Council, are being invited to provide feedback on the proposed Ichthys LNG field development activities.<br><br>INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including:<br>- Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners;<br>- Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process;<br>- Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel.<br><br>INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Australian Maritime Safety Authority (AMSA) - Nautical Advice (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback and requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 7/08/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | AMSA responded with the following information:<br>The Master should notify AMSA's Joint Rescue Coordination Centre (JRCC) by e-mail for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. AMSA's JRCC will require the vessel details, satellite communications details, area of operation, requested clearance from other vessels and any other information that may contribute to safety at sea. JRCC will also need to be advised when operations start and end.<br><br>Contact the Australian Hydrographic Office no less than four working weeks before operations, with details relevant to the operations. The AHO will promulgate the appropriate Notice to Mariners (NTM), which will ensure other vessels are informed of your activities.<br><br>Advised that if INPEX would like to obtain a vessel traffic plot showing Automatic Identification System (AIS) traffic data, they can visit AMSA's spatial data gateway and Spatial@AMSA portal to download digital data sets and maps. | Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. This information has been incorporated into Section 7.7.1 of the EP.<br><br>Relevant matter – stakeholder has requested to be notified of activity commencement or other project activities. This has been incorporated into Section 9 of the EP. |
| Australian Maritime Safety Authority (AMSA) - Marine Environment Pollution Response (Cwth) | 7/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback and provided contact details to do so. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Department of Agriculture and Water Resources (DAWR) – Biosecurity (Marine Pests) (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet<br>- Additional information required by DAWR | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>Advised INPEX has attached a letter to address the information requirements outlined on the DAWR website, including:<br>- Titleholder details<br>- Proposed dates the activity is being undertaken<br>- Map of area the activity is being undertaken<br>- Type of activity being undertaken<br>- Types of vessels that will be servicing the offshore installation and their origin and destination (domestic or international movements).<br>- A description of the marine environment that may be affected by planned aspects of the activity. This may include information of water depth, the surrounding marine habitat (reef, sandy, rocky), and proximity to island or shoals. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | |
|---|---|---|---|---|---|
| | | | | - Details and an evaluation of the environmental impacts including the risks of introducing/spreading an IMS into Australian waters. The titleholder must identify the risks relevant to marine pest biosecurity branch of the departments, and propose appropriate control measures prior to consultation. If the risk is uncertain or unknown the titleholder must identify perceived risks or specific sections of the EP that they wish to enquire about.<br>- A demonstrated understanding of how Australia's ballast water and biofouling requirements apply to the facility and/or vessel(s).<br>- Details of the control measures that will be in place to reduce the risk of introducing or spreading marine pests. Control measures should represent best practice, and includes, but is not limited to, vessel ballast water management plans and certificates (in line with the Australian - - Ballast Water Management Requirements), and biofouling management plans (in line with the IMO biofouling guidelines and Australian biofouling management guidelines).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | |
| 12/08/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | Yes:<br>- Exposed conveyances exceptions determination<br>- Offshore Installations - Biosecurity Guide | DAWR - Biosecurity (Marine Pests) replied, advising the Quarantine Act 1908 was replaced by the Biosecurity Act in 2015. DAWR advised that now where domestic conveyances become exposed through interactions with persons, goods or conveyances outside of Australian Territorial Sea, they automatically become subject to biosecurity control upon their return. If the Department of Agriculture concludes that the level of biosecurity risk associated with the offshore installation is low within the meaning of the determination (attached), an exposed conveyance (the support vessels to the offshore installation) may be eligible for exemption from biosecurity control. This assessment is regarding the topside of the offshore installation only and does not address the marine biosecurity management – which is addressed elsewhere.<br><br>DAWR noted the commencement dates and requested that if INPEX are intending to apply for the low biosecurity risk status for the INPEX proposed activities, DWAR can assist with the application. DAWR attached the installations guide.<br><br>Advised DAWR representative will be in Perth next week and could meet INPEX to go through any initial questions on biosecurity requirements for offshore installations and their support vessels. | Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. This information has been incorporated into Section 7.5.1 of the EP. |
| 13/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | No | Advised INPEX has been through the process of obtaining 'low risk status' for facilities during earlier phases of the Ichthys project and have taken the biosecurity requirements into account for the next phase. Organised to meet with DAWR on 21/08/2019 | Not a relevant matter - correspondence sent by INPEX. |
| 21/08/2019 | Meeting with stakeholder | Ichthys LNG Field Development | No | INPEX and DAWR met to discuss INPEX's biosecurity management approach, which has been developed and implemented in accordance with regulation and industry guidelines as per previous offshore works.<br><br>Discussions were around biosecurity management implications of the proposed offshore developments. No issues or concerns were raised by DAWR. | Not a relevant matter - general correspondence only |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 22/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- slides presented yesterday<br>- an Abstract on Biofouling management<br>- a copy of INPEX's Domestic Biofouling risk assessment process (developed in consultation with DPIRD)<br>- an example of a Biosecurity risk assessment | INPEX provided documents that were discussed during the meeting, including: a copy of the slides presented yesterday; a copy of INPEX's recent APPEA presentation; an Abstract on Biofouling management; a copy of INPEX's Domestic Biofouling risk assessment process developed in consultation with DPIRD; and an example of a Biosecurity risk assessment INPEX prepared for a small scope of work proposed last year. | Not a relevant matter - correspondence sent by INPEX. |
| | 11/09/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | Another officer from the Marine Pests branch responded to the original fact sheet provided 06/08/2019, advising the Marine Biosecurity Unit has reviewed these documents and is comfortable with the management practices specified to manage ballast water and biofouling. Advised Marine Pests branch had contacted the Seaports team and the Inspection Group in Western Australia and they do not have any comments on the documents either. | Not a relevant matter - general correspondence only. |
| Department of Agriculture and Water Resources (DAWR) – Biosecurity (Vessels, aircraft and personnel) (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet<br>- Additional information required by DAWR | Advised INPEX has attached a letter that was sent to the Marine Pest team addressing the additional information requirements stated on the DAWR website. Advised INPEX's plans and controls will be consistent with work recently completed. The same contractor that performed the initial subsea installation will be completing the next phase of subsea installation work, and a new drilling contractor will be conducting the drilling.<br><br>Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| | 13/08/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | Advised that international vessels involved with the drilling and subsea work that have interactions with domestic conveyances will need to put in place processes that will allow them to gain Biosecurity Low Risk status, if the domestic conveyances wish to claim exemption from biosecurity reporting when returning to the Australian mainland. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Department of Agriculture and Water Resources (DAWR) - Fisheries (Cwth) | 5/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development fact sheet<br>- North West Slope Trawl Fishery map | Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L.<br><br>The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019.<br><br>The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information.<br><br>INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the only Commonwealth-managed fishery that operates in the vicinity of WA-50-L, the North West Slope Trawl Fishery, was also provided including a map of the fishery licence area relative to the location of WA-50-L.<br><br>INPEX advised that licence holders of the NDSMF and relevant fishing industry associations, including the Commonwealth Fisheries Association and the Western Australian Fishing Industry Council, are being invited to provide feedback on the proposed Ichthys LNG field development activities.<br><br>INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including:<br>- Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners;<br>- Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process;<br>- Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel.<br><br>INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Department of Biodiversity Conservation and Attractions (DBCA) - Environmental Management Branch (WA) | 5/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 10 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 6/09/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | Confirmed reciept of information provided 05/08/2019. Advised that based on the information provided, DBCA has no comments to provide in relation to its responsibilities under the Conservation and Land Management Act 1984 and Biodiversity Conservation Act 2016. | Not a relevant matter - general correspondence only |
| Department of Defence, Directorate of Property Acquisition, Mining and Native Title (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Department of Defence, RAN Australian Hydrographic Office (AHO) (Cwth) | 7/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| | 7/08/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | Automated confirmation of receipt. | Not a relevant matter - general correspondence only |

| | | | | | | |
|---|---|---|---|---|---|---|
| Department of Environment and Energy (DEE) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 10 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Department of Foreign Affairs and Trade (DFAT) | 9/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>Advised that in accordance with Australian Government Guidance regarding consultation with relevant Australian Government agencies on offshore petroleum and greenhouse gas activities, INPEX believe that it should engage DFAT on Ichthys LNG offshore activities, specifically where: a proposed activity poses any oil spill or other environmental risks that could result in impacts to other international jurisdictions; and relevant persons that may be impacted by a proposed activity include foreign individuals or governments.<br><br>Informed INPEX is aware of the notification arrangements outlined in the N*ational Plan Guidance: Coordination of International Incidents: Notification Arrangements Guidance* (NP–GUI–007), which stipulate that 'in the event a pollution incident is affecting or is likely to affect another country, the Control Agency (in the case of pollution from a ship or unknown source) and the Department of Industry, Innovation and Science (in the case of pollution from an offshore petroleum facility) will contact DFAT as soon as practicable through the contact point advised by DFAT.' Accordingly, INPEX will reflect these arrangements in all offshore oil pollution emergency plans (OPEPs) for the proposed Ichthys LNG field development activities, and will consult AMSA to ensure that roles and responsibilities in all possible scenarios are understood.<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Department of Industry, Innovation and Science (DIIS) (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Department of Mines, Industry Regulation and Safety (DMIRS) (WA) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>Advised INPEX will inform DMIRS of the commencement and cessation of these activities at the appropriate time. INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| | 15/08/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | Advised that DMIRS has reviewed the information provided and acknowledged the proposed drilling and completions activities and installation of umbilicals, risers and flowlines will be regulated by NOPSEMA under the provisions of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.<br>Advised no further information is required at this stage but requested INPEX send through activity commencement and cessation notifications. | Relevant matter - stakeholder has requested to be notified of activity commencement or other project activities. This has been incorporated into Section 9 of the EP. |
| Department of Planning, Lands and Heritage (DPLH) (WA) | 19/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 21/08/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | DPLH confirmed that a review of the Register of Places and Objects as well as the Department of Planning, Lands and Heritage (DPLH) Aboriginal Heritage Database concludes that the proposed works as described in the attached document DO NOT intersect the "Restricted Boundary" of any Aboriginal Sites or Places as administered DPLH. As such, the proposed activity does not affect the heritage values of any DPLH Aboriginal Sites or Places and no statutory approvals are required. | Not a relevant matter - general correspondence only |
| Department of Primary Industries and Regional Development (DPIRD) - Aquatic Environment section (WA) | 5/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development fact sheet<br>- Northern Demersal Scalefish Managed Fishery map | Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L.<br><br>The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019.<br><br>The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information.<br><br>INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the only WA-managed fishery that operates in the vicinity of WA-50-L, the Northern Demersal Scalefish Managed Fishery, was also provided including a map of the fishery licence area relative to the location of WA-50-L.<br><br>INPEX advised that licence holders of the NDSMF and relevant fishing industry associations, including the Commonwealth Fisheries Association and the Western Australian Fishing Industry Council, are being invited to provide feedback on the proposed Ichthys LNG field development activities.<br><br>INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including:<br>- Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners;<br>- Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process;<br>- Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel.<br><br>INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| Department of Primary Industries and Regional Development (DPIRD) - Sustainability and Biosecurity section (WA) | 5/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs. Advised INPEX will continue to implement the Biofouling risk management controls in place for the Ichthys field and apply lessons learned from the initial development phase.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021). Informed stakeholder that to date INPEX have not identified any new IMS as result of our visual observations on vessels and the facility hulls.<br><br>INPEX welcomed feedback, and requested any is provided by 10 September 2019. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| | 5/08/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | Requested clarification on a statement in the fact sheet "In 2019 INPEX will….to support continued field development for Ichthys" - Enquired whether this meant more infrastructure is being installed associated with Ichthys, whether this refers to separate developments. | Not a relevant matter - general correspondence only |
| | 22/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | No | INPEX clarified it is currently in the planning phase for future expansion of the Ichthys subsea system. This will just feed in to the existing CPF and FPSO assets. Advised the subsea installation work is unlikely to happen until 2021 but there is a new Drill rig coming in next year to drill additional wells. INPEX offered to discuss the proposed controls we will put in place for the new activities which include management of biofouling. | Not a relevant matter - correspondence sent by INPEX. |
| | 2/09/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | No | Follow up with stakeholder to see if DPIRD received the additional information and check if DPIRD had any comments or queries. | Not a relevant matter - correspondence sent by INPEX. |
| Department of Transport - Marine (WA DoT) (WA) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021). Advised DoT that INPEX will be in touch with details the required by the guidance note and a copy of the OPEP for each activity once it has been drafted.<br><br>INPEX welcomed feedback and provided contact details to do so. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 7/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- WA DoT consultation table<br>- Phase 2A Development Drilling EP<br>- Strategic SIMA – Subsurface condensate release<br>- Strategic SIMA – Surface Diesel spill | INPEX provided DoT with required documents as part of official stakeholder consultation for the INPEX Ichthys Phase 2A Development Drilling activity. These included the:<br>- WA DoT consultation table<br>- Phase 2A Development Drilling EP<br>- Strategic SIMA – Subsurface condensate release<br>- Strategic SIMA – Surface Diesel spill<br><br>INPEX requested DoT to review and provide comment on the documents. | Not a relevant matter - correspondence sent by INPEX. |
| Department of Water and Environment Regulation (DWER) (WA)<br>Hazard Management Branch<br>Contaminated Sites Branch | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback and requested any be provided by 15 September 2019. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Indonesian Ministry for Marine Affairs and Fisheries (MMAF) | 5/08/2019 | Email / letter to stakeholder | Both Ichthys LNG Field Development and Ichthys 2019 Update | Yes:<br>- Ichthys LNG Field Development Fact Sheet<br>- Ichthys 2019 Update Fact Sheet | INPEX advised the stakeholder of the purpose of engagement, including its commitment to keep stakeholders informed of INPEX's activities and regulatory requirement to consult with stakeholders. INPEX advised the attached fact sheets provide details on a proposed and current activities that may be of interest to the MMAF. INPEX noted the location of these activities overlaps the Australia–Indonesia Memorandum of Understanding (MOU) Box relating to the operations of Indonesian traditional fishermen in the Australian Fishing Zone. INPEX welcomed feedback and provided contact details to do so. | Not a relevant matter - correspondence sent by INPEX. |
| Kimberley Land Council (KLC) | 19/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| National Native Title Tribunal (NNTT) (Cwth) | 15/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX expressed understanding that it is not the NNTT's position to make comment on offshore activities (in line with recommendations of past years). Advised INPEX proposes to provide the attached information sheet to the Kimberley Land Council as the Representative Aboriginal/Torres Strait Islander Body with jurisdiction for Commonwealth waters off the coast of Western Australia.<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| National Offshore Petroleum Titles Administrator (NOPTA) (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 16 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| | 6/08/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | Confirmation of receipt of the above correspondence. | Not a relevant matter - general correspondence only |

| | | | | | | |
|---|---|---|---|---|---|---|
| NT Department of Environment and Natural Resources (DENR) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback provided contact details to do so. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| NT Department of Infrastructure, Planning and Logistics - Transport - Marine Safety Branch (DIPL) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 10 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Office of the Director of National Parks (Cwth) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback, and requested any is provided by 10 September 2019. INPEX requested that the stakeholder advise of any information/comments that are not suitable for public disclosure such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| | 6/09/2019 | Email / letter from stakeholder | Ichthys LNG Field Development | No | DNP observed that the planned activities do not overlap any Australian Marine Parks, and that the activity is approximately 105 km, 145 km and 175 km to Kimberley, Cartier Island and Ashmore Reef marine parks respectively. Advised that therefore there are no authorisation requirements from the DNP. | Not a relevant matter - general corresondence only |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | DNP highlighted the NOPSEMA guidance note that outlines what titleholders need to consider and evaluate in relation to AMPs. DNP advised that when preparing the EP, INPEX should consider the Australian marine parks and their representativeness. INPEX should identify and manage all impacts and risks on Australian marine park values (including ecosystem values) to an acceptable level and has considered all options to avoid or reduce them to as low as reasonably practicable. The EP should clearly demonstrates that the activity will not be inconsistent with the management plan. | Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. NOPSEMA's guidance note that outlines what titleholders need to consider and evaluate in relation to AMPs has been considered in Sections 7 and 8 of the EP. |
| | | | | | | DNP advised the The North-west Marine Parks Network Management Plan 2018 provides further information on values for Kimberley, Cartier Island and Ashmore Reef marine parks. Advised information on the values for the marine parks is also located on the Australian Marine Parks Science Atlas. Advised specific values for the Kimberley, Cartier Island and Ashmore Reef marine parks include (but are not limited to):<br>• the ancient coastline at the 125m depth contour containing diverse and biologically important benthic habitats;<br>• continental slope habitat supporting a high diversity and endemism of demersal fish communities;<br>• critical and biologically important areas for species, including marine turtles (inter-nesting and nesting habitat), seabirds (breeding and foraging habitat), inshore dolphin (breeding, calving and foraging habitat) humpback whales (nursing habitat and migratory pathways), pygmy blue • whales (migratory pathways), dugong (foraging habitat) and whale sharks (foraging habitat);<br>• habitat for an internationally significant abundance and diversity of sea snakes;<br>• coral reef and seagrass ecosystems;<br>• parts of the Kimberly Marine Park is sea country of the Wunambal Gaambera, Dambimangari and Bardi Jawi people. | Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. Values for Kimberley, Cartier Island and Ashmore Reef marine parks have been identified in Section 4.3 of the EP. Potential impacts to these AMPs are considered in Sections 7 and 8 of the EP. |
| | | | | | | DNP confirmed that it does not require further notification of progress made in relation to this activity unless details regarding the activity change and result in an overlap with or new impact to a marine park, or for emergency responses (see details below). | Not a relevant matter - general corresondence only |
| | | | | | | Advised the DNP should be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24 hour Marine Compliance Duty Officer on 0419 293 465. The notification should include:<br>• titleholder details<br>• time and location of the incident (including name of marine park likely to be effected)<br>• proposed response arrangements as per the Oil Pollution Emergency Plan (e.g. dispersant, containment, etc.)<br>• confirmation of providing access to relevant monitoring and evaluation reports when available; and<br>• contact details for the response coordinator. | Relevant matter – stakeholder has provided information relevant to the petroleum activity and/or the stakeholder's functions, interests or activities. Stakeholder's request to be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park have been incorporated in Section 9 of the EP. |
| **Business** | | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Australian Marine Oil Spill Centre (AMOSC) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback and requested any be provided by 10 September 2019. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Oil Spill Response Limited (OSRL) | 6/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development Fact Sheet | Advised INPEX is looking to continue drilling and to expand the subsea infrastructure within WA 50-L and the purpose of the attached information is to provide details on proposed Ichthys LNG field development activities, as part of the development of EPs.<br><br>Advised the Ichthys gas–condensate field (Production Licence WA-50-L) is located in Commonwealth waters in the Browse Basin, approximately 220 kilometres offshore of Western Australia. Identified the key proposed activities as drilling of the production wells (beginning in March 2020 and continuing for 5 years), and installation of subsea umbilicals, risers and flowlines, support structures and control systems (scheduled to commence from 2021).<br><br>INPEX welcomed feedback and requested any be provided by 10 September 2019. Finally, INPEX requested that the stakeholder advise if any information/comments they provide are not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| RPS Asia-Pacific Applied Science Associates (RAPASA) (formerly APASA) | 6/08/2019 | Email / letter to stakeholder | Both Ichthys LNG Field Development and Ichthys 2019 Update | Yes:<br>- Ichthys LNG Field Development fact sheet<br>- Ichthys 2019 Update fact sheet | Advised that a service provider for INPEX's spill response, RAPASA has been identified as a relevant stakeholder to INPEX's activities. Provided RAPASA with the fact sheets on the 2019 Ichthys Project updates and Ichthys Field Development. | Not a relevant matter - correspondence sent by INPEX. |
| | 6/08/2019 | Email / letter from stakeholder | Both Ichthys LNG Field Development and Ichthys 2019 Update | No | Acknowledgement of above correspondence. | Not a relevant matter - general correspondence only |

**Commercial Fishing and Pearling Stakeholders**

**Industry Associations**

| | | | | | | |
|---|---|---|---|---|---|---|
| Commonwealth Fisheries Association | 5/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development fact sheet<br>- North West Slope Trawl Managed Fishery map | Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L.<br><br>The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019.<br><br>The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information.<br><br>INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the Commonwealth-managed North West Slope Trawl Fishery (NWSTF) was provided including a map of the fishery licence area relative to the location of WA-50-L.<br><br>INPEX advised that licence and concession holders of the NWSTF are being invited to provide feedback on the proposed Ichthys LNG field development activities. INPEX noted that other fisheries' licence areas overlap WA-50-L, but as no fishing activities occur in these locations, licence holders in these fisheries are not being contacted .<br><br>INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including:<br>- Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners;<br>- Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process;<br>- Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel.<br><br>INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| Western Australian Fishing Industry Council (WAFIC) | 30/07/2019 | Phone call with stakeholder | Ichthys LNG Field Development | No | Phone call to inform stakeholder of INPEX's intention to pursuer development drilling in the WA-50-L permit area. WAFIC confirmed that fishing licence holders should only be consulted if they have fished in the permit area in the last 5-8 years. WAFIC confirmed that if fishers didn't fall within this category, the could be excluded from receiving activity information but should be retained on a list of potentially affected parties within the EMBA. WAFIC recommended that INPEX contact AFMA to receive a heat map showing effort of Commonwealth fisheries. | Not a relevant matter - general correspondence only (related to relevant stakeholder identification) |
| | 31/07/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | No | INPEX provided a summary of the above phone conversation. INPEX advised that it has analysed FishCube data for individual fisheries to confirm whether fishing had occurred in WA-50-L title block. INPEX advised that no fisheries fish within the title area, however the North West Slope Trawl Fisher and the Northern Demersal Scalefish Managed Fishery both fish in close proximity. INPEX proposed to limit WA/Commonwealth fisheries stakeholder consultation to these two fisheries, excluding the rest due to the planned drilling and construction activities not presenting a risk to the resource overlap with fishing activates. Finally, INPEX provided a table summarising/justifying the relevance of each fishery to the activity. The table included information on the gear used, target species and whether fishing occurs within the permit area. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 5/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development fact sheet<br>- Northern Demersal Scalefish Managed Fishery map<br>- North West Slope Trawl Managed Fishery map | Email informed the stakeholder that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L.<br><br>The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019.<br><br>The proposed field development activities were summarised and the stakeholder was referred to the attached Ichthys LNG field development activities fact sheet for further information.<br><br>INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the WA-managed Northern Demersal Scalefish Managed Fishery (NDSMF) and Commonwealth-managed North West Slope Trawl Fishery (NWSTF) were provided including a map of the fishery licence area relative to the location of WA-50-L.<br><br>INPEX advised that licence and concession holders of the NDSMF and NWSTF are being invited to provide feedback on the proposed Ichthys LNG field development activities. INPEX noted that other fisheries' licence areas overlap WA-50-L, but as no fishing activities occur in these locations, licence holders in these fisheries are not being contacted .<br><br>INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including:<br>- Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners;<br>- Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process;<br>- Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel.<br><br>INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |
| **Commonwealth Managed Fisheries** | | | | | | |
| North West Slope Trawl Fishery | 2/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development fact sheet<br>- North West Slope Trawl Managed Fishery map | Letter informed licence and concession holders of the North West Slope Trawl Fishery that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L.<br><br>The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019.<br><br>The proposed field development activities were summarised and the stakeholder was referred to the enclosed Ichthys LNG field development activities fact sheet for further information.<br><br>INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the Commonwealth-managed North West Slope Trawl Fishery was provided including a map of the fishery licence area relative to the location of WA-50-L. INPEX noted that fishing activities do not typically occur in WA-50-L. | Not a relevant matter - correspondence sent by INPEX. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including:<br> - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners;<br> - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process;<br> - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel.<br><br>INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | |
| **WA Managed Fisheries** | | | | | | |
| Northern Demersal Scalefish Managed Fishery | 2/08/2019 | Email / letter to stakeholder | Ichthys LNG Field Development | Yes:<br>- Ichthys LNG Field Development fact sheet<br>- Northern Demersal Scalefish Managed Fishery Map | Letter informed licence holders of the Northern Demersal Scalefish Managed Fishery that INPEX plans to develop and submit EPs to NOPSEMA for further development well drilling and installation of umbilicals, risers and flowlines (URF) in production licence area WA-50-L.<br><br>The purpose of the engagement was explained to the stakeholder and feedback requested by Friday 6th September 2019.<br><br>The proposed field development activities were summarised and the stakeholder was referred to the enclosed Ichthys LNG field development activities fact sheet for further information.<br><br>INPEX summarised its process of identifying and engaging with commercial fishery stakeholders, noting that commercial fishing activities in the vicinity of production licence area WA-50-L are understood to be limited. A summary of the WA-managed Northern Demersal Scalefish Managed Fishery was provided including a map of the fishery licence area relative to the location of WA-50-L. INPEX noted that WA-50-L and the proposed field development activities are located in Area C of the fishery and understood that fishing activities do not typically occur in this location and water depth.<br><br>INPEX summarised the potential impacts and proposed control measures for managing interactions and impacts to commercial fishers, including:<br> - Physical presence of the MODU and support vessels, including associated safety zones and Notice to Mariners;<br> - Planned discharges, including management of discharges in accordance with legislative requirements and INPEX's chemical selection process;<br> - Prohibition of recreational fishing on any INPEX-operated facility/vessel or contracted vessel.<br><br>INPEX requested that the stakeholder advise of any information/comments that is not suitable for public disclosure - such information will be omitted/redacted from the full EP, but provided separately and privately to NOPSEMA. | Not a relevant matter - correspondence sent by INPEX. |

# APPENDIX D: OIL POLLUTION EMERGENCY PLAN

# Ichthys Development Drilling Campaign WA-50-L

## Oil Pollution Emergency Plan

Document No.: 0000-AD-PLN-60002
Security Classification: Public

| Rev | Date | Description | Prepared | Checked | Endorsed | Approved |
|---|---|---|---|---|---|---|
| 0 | 17 Sept 2019 | Issued to NOPSEMA | S. Cook | E. Law | T. Lee | M. Sessink |
| | | | | | | |

Document distribution

| Copy no. | Name | Hard copy | Electronic copy |
|---|---|---|---|
| 00 | Document control | ☑ | ☑ |
| 01 | | ☐ | ☐ |
| 02 | | ☐ | ☐ |
| 03 | | ☐ | ☐ |
| 04 | | ☐ | ☐ |
| 05 | | ☐ | ☐ |
| 06 | | ☐ | ☐ |
| 07 | | ☐ | ☐ |
| 08 | | ☐ | ☐ |
| 09 | | ☐ | ☐ |
| 10 | | ☐ | ☐ |

**Notice**

All information contained with this document has been classified by INPEX as Public and must only be used in accordance with that classification. Any use contrary to this document's classification may expose the recipient and subsequent user(s) to legal action. If you are unsure of restrictions on use imposed by the classification of this document you must refer to the INPEX Sensitive Information Protection Standard or seek clarification from INPEX.

Uncontrolled when printed.

Table of Contents


**I INITIAL RESPONSE REQUIREMENTS V**

**II ABBREVIATIONS AND ACRONYMS X**

**1 INTRODUCTION 1**

1.1 Purpose 1

1.2 Plan scope 1

**2 SPILL CLASSIFICATION AND RESPONSIBLE AGENCIES 3**

2.1 Spill classification 3

2.2 Jurisdictional authority and control agency 3

2.2.1 Cross jurisdictional arrangements 4

2.3 INPEX response team activation 7

2.4 Incident notification 7

2.4.1 Initial spill notification 7

2.4.2 External agencies notification 7

2.4.3 INPEX emergency contacts directory 7

2.5 Pollution report (POLREP) 11

2.6 Immediate (first strike) response measures 11

**3 INCIDENT ACTION PLAN (IAP) DEVELOPMENT 12**

3.1 Gain situational awareness 12

3.2 Identify sensitive receptors 12

3.3 Identify protection priorities 15

3.4 Operational SIMA 16

3.5 Develop an incident action plan 23

3.6 Response termination 25

**4 SPILL RESPONSE RESOURCES 26**

4.1 Support vessel availability 26

4.2 Aviation asset availability 26

4.3 Oil spill preparedness and response register 26

4.4 Immediate (first strike) response measures and relevant arrangements (resources and equipment) 27

4.4.1 Operational monitoring and evaluation 27

4.5 Secondary response measures and relevant arrangements (resources and equipment) 32

4.5.1 Shoreline clean-up 32

4.5.2 Pre-contact and post-contact oiled wildlife response 35

4.6 Waste management 40

4.7 Operational and scientific monitoring 42

4.7.1 Operational monitoring 44

4.7.2 Scientific monitoring 46

4.7.3 Baseline data to support the OSMP 47

4.8 Health and safety 48
**5 INPEX FORMS AND GUIDANCE 51**
**6 REFERENCES 56**

List of Tables

Table I-1: Initial Response Requirements – MODU or Well (Facility) spill vi
Table I-2: Initial Response Requirements – Vessel spills ix
Table 2-1: Incident classification 3
Table 2-2: Jurisdictional boundaries and Jurisdictional Authority and Control Agencies 6
Table 2-3: External notifications matrix 8
Table 3-1: Seasonality of values and sensitivities 13
Table 3-2: Protection priority matrix 15
Table 3-3: Protection priorities for Group I/Group II spill event 16
Table 3-4: Operational SIMA template - Group II/Diesel spills 17
Table 3-5: Operational SIMA template – Group I/Condensate spills 20
Table 3-6: IAP development 23
Table 4-1: Arrangements and capabilities – Operational Monitoring and Evaluation 31
Table 4-2: Arrangement and capabilities – Shoreline clean-up 34
Table 4-3: Arrangements and capabilities – Pre-contact and post-contact oiled wildlife response 39
Table 4-4: Waste storage, disposal and treatment options for hydrocarbon-contaminated waste. 40
Table 4-5: Arrangements and capabilities – Waste management 41
Table 4-6: Summary of operational monitoring programs 44
Table 4-7: Examples of health and safety risks from spill response 48
Table 5-1: Oil Spill Response Forms 52

List of Figures

Figure 1-1: Location and coordinates of WA-50-L 2
Figure 3-1: Typical response procedure 12
Figure 4-1: Oiled Wildlife Response Division model 36
Figure 4-2: OM and SM activation, termination and communication flowchart 43

List of Appendices

Appendix A: Operational and scientific monitoring program 58
Appendix B: INPEX Incident Action Plan template (PER-2153316130) 65

# I Initial Response Requirements

An overview of the initial response requirements for vessel masters (VM), Offshore Installation Managers (OIM), the INPEX incident management team (IMT) and the INPEX Drilling Supervisor (DS) for vessel and Facility spill scenarios are provided in Table I-1 and Table I-2.

Table I-1 and Table I-2 have been developed to guide the response personnel through the key steps of this OPEP during a Level 2 or Level 3 spill (defined in Section 2.1).

Table I-1 provides an initial response guide for Facility spills, where INPEX is the Control Agency.

Table I-2 contains an initial response guide for vessel spills, where the Australian Maritime Safety Authority (AMSA) is the Control Agency.

Information to support the initial response requirements is included in this OPEP.

**Table I-1: Initial Response Requirements – MODU or Well (Facility) spill**

| Action by | | | Spill from well or MODU (INPEX Control Agency Scenario)<br>Definitions for 'Action by' persons are as follows: **DS** – Drilling Supervisor (INPEX) **OIM** – Offshore Installation Manager (Contractor) **IMT** – Incident Management Team (INPEX) | | |
|---|---|---|---|---|---|
| OIM | DS | IMT | Immediate Response Actions | Information/Resources | Comments |
| ■ | | | Stop the spill. | Activate vessel shipboard oil pollution emergency plan (SOPEP)/emergency response plans. | |
| ■ | | | OIM to alert the DS. | See Section 2.4.1 Initial spill notification. | |
| ■ | ■ | | Classify the spill incident level. | See Section 2.1 Spill classification.<br>See Table 2-1: Incident classification. | |
| | ■ | | DS to verbally notify the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) of Level 2 or Level 3 spills. | Section 2.4.2 External agencies notification.<br>Table 2-2: Jurisdictional boundaries and Jurisdictional Authority and Control Agencies.<br>INPEX Emergency Contact Directory (PER-2153095942). | NOPSEMA is the Jurisdictional Authority for spills from Facilities in Commonwealth Waters.<br>Complete verbal notification to NOPSEMA within two hours of spill occurrence.<br>NOPSEMA's 24-hour incident notification phone number is +61 8 6461 7090. |
| | ■ | ■ | DS to notify IMT Leader via INPEX Emergency Call Centre.<br>IMT Leader notify INPEX Crisis Management Team (CMT) Leader.<br>IMT Leader to activate IMT. | Activate via INPEX Emergency Call Centre.<br>See Section 2.4.1 Initial spill notification.<br>Table 2-2: Jurisdictional boundaries and Jurisdictional Authority and Control Agencies.<br>INPEX Emergency Contact Directory (PER-2153095942). | INPEX is the Control Agency for spills from the Facility in Commonwealth Waters.<br>INPEX is required to coordinate the response to the spill in accordance with this OPEP.<br>INPEX Emergency Call Centre 24-hour activation numbers are:<br>1800 305 789.<br>+61 8 6213 6350<br>+61 439 694 175 |
| ■ | | | OIM to verbally notify AMSA. | See Section 2.4.2 External agencies notification.<br>Table 2-2: Jurisdictional boundaries and Jurisdictional Authority and Control Agencies.<br>Table 2-3: External notifications matrix.<br>INPEX Emergency Contact Directory (PER-2153095942). | AMSA is required to be notified for all Facility spills.<br>Notification of AMSA will be through the incidents through the AMSA Rescue Coordination Centre (RCC) Australia on +61 2 6230 6811. |
| | ■ | | Deploy satellite tracking buoys. | See Section 4.4.1 Operational Monitoring and Evaluation. | If not on the vessel, tracking buoys can be requested for deployment from the INPEX IMT Leader.<br>The location of satellite tracking buoys is maintained in the Oil Spill Preparedness and Response Register (PER-2153236568), available on the INPEX document management system (DMS).<br>Further details on Operational Monitoring and Evaluation are provided in Appendix A – OM03. |
| ■ | ■ | | OIM prepare marine pollution report (POLREP), submit to AMSA and copy to DS.<br>DS to forward POLREP to IMT Leader. | POLREP. (See Section 2.5 and Table 5-1: Oil Spill Response Forms). | |

| Action by | | | Spill from well or MODU (INPEX Control Agency Scenario)<br>Definitions for 'Action by' persons are as follows: **DS** – Drilling Supervisor (INPEX) **OIM** – Offshore Installation Manager (Contractor) **IMT** – Incident Management Team (INPEX) | | |
|---|---|---|---|---|---|
| OIM | DS | IMT | Immediate Response Actions | Information/Resources | Comments |
| | | ■ | IMT Leader to forward POLREP to AMSA, for information. | POLREP. (See Section 2.5 and Table 5-1: Oil Spill Response Forms). | As INPEX is the Control Agency, the INPEX IMT Leader can formally (verbally, or written on the POLREP) request AMSA to activate/mobilise oil spill response resources available under the National Plan for Maritime Environmental Emergencies. |
| | | ■ | Develop situational awareness. | See Section 3.1 Gain situational awareness. | During the initial phase of a spill, obtaining and communicating information to allow the establishment of situational awareness is critical. |
| | | ■ | Notify Australian Marine Oil Spill Centre (AMOSC). | INPEX Emergency Contact Directory (PER-2153095942). | AMOSC will provide support and guidance to the INPEX IMT during any Level 2 or Level 3 spill event.<br>AMOSC's 24-hour mobile number is +61 (0) 438 379 328; email amosc@amosc.com.au<br>Telephone call and e-mail confirmation to AMOSC required for mobilisation of response personnel and equipment, and call-out authorities will be required to confirm they are the IMT Leader to AMOSC.<br>AMOSC will email a service contract which must be completed and signed by the IMT Leader requesting resources / personnel required and emailed to AMOSC prior to mobilisation. |
| | | ■ | Notify additional regulators and stakeholders. | See Section 2.4.2 External agencies notification.<br>Table 2-3: External notifications matrix.<br>INPEX Emergency Contact Directory (PER-2153095942). | External agencies contact information is available in the INPEX Emergency Contacts Directory (PER-2153095942).<br>Mandatory notification required to WA DoT in event of a loss of well containment. |
| | | ■ | Initiate 'Immediate Response Measures' - Operational Monitoring and Evaluation – aerial, vessel, satellite (as appropriate). | See Section 4.4.1 Operational monitoring and evaluation. | Should be implemented prior to the development of Incident Action Plans.<br>Additional details on Operational Monitoring and Evaluation are also provided in Appendix A - OM03. |
| | | ■ | Obtain long-term weather forecasts. | For weather forecast service provider see the INPEX Emergency Contact Directory (PER-2153095942). | Site–specific, long-term weather forecasts are available through the INPEX subscription to the Bureau of Meteorology (BOM). |
| | | ■ | Implement oil spill trajectory modelling – Operational Monitoring and Evaluation. | Transmit to spill modelling provider via Oil Spill Trajectory Modelling Request.<br>Oil Spill Response Forms Register (PER-2153332031). | Additional details on spill trajectory modelling are also provided in Section 4.4.1 and in Appendix A.<br>RPS modelling request activated via 24/7 duty phone – 0408 477 196, followed by email of modelling request form to response@rpsgroup.com.au |
| | | ■ | Identify protection priorities. | See Section 3.3 Identify protection priorities. | Figures of the environmental sensitivities and values as defined in the Environment Plan are attached to this checklist in IMT Room 'Environment' folder. |
| | | ■ | Validate Operational spill impact mitigation assessment (SIMA) template to generate Operational SIMA. | See Section 3.4 Operational SIMA. | |
| | | ■ | Develop Incident Action Plan (IAP). | See Section 3.5 Develop an incident action plan.<br>Appendix B: INPEX Incident Action Plan template. | Resources descriptions, capabilities and activation processes are provided in Section 4 Spill Response Resources. Utilise this information during the development of the IAP. |
| | | ■ | Implement IAP. | See Section 4 Spill response resources. | |

| **Action by** | | | **Spill from well or MODU (INPEX Control Agency Scenario)**<br>Definitions for 'Action by' persons are as follows: **DS –** Drilling Supervisor (INPEX) **OIM –** Offshore Installation Manager (Contractor) **IMT –** Incident Management Team (INPEX) | | |
|---|---|---|---|---|---|
| OIM | DS | IMT | Immediate Response Actions | Information/Resources | Comments |
| | | ■ | Use spill surveillance and reconnaissance data (OM03) to update oil spill trajectory modelling (OM01) outputs. | See Section 4.4.1 Operational monitoring and evaluation.<br>Section 4.7 Operational and scientific monitoring. | |
| | | ■ | Use oil monitoring (OM) program data to determine scientific monitoring (SM) activation. | See Section 4.7.2 Scientific monitoring and Appendix A. | |
| | | ■ | Terminate response. | See Section 3.6 Response termination and Section 4 Spill response resources. | General response termination considerations are provided in Section 3.6 Response termination.<br>Response strategy specific termination criteria considerations are provided in Section 4 Spill response resources.<br>OMs and SMs termination criteria are provided in Appendix A. |

**Table I-2: Initial Response Requirements – Vessel spills**

| **Action by** | | | | **Spill from vessel (AMSA Control Agency)**<br>Definitions for 'Action by' persons are as follows: **VM** – Vessel Master (Contractor) **DS** – Drilling Supervisor (INPEX) **OIM** – Offshore Installation Manager (Contractor)<br>IMT – Incident Management Team (INPEX) | | |
|---|---|---|---|---|---|---|
| OIM | VM | DS | IMT | Immediate Response Actions | Information/Resources | Comments |
| | ■ | | | Stop the spill. | Activate vessel shipboard oil pollution emergency plan (SOPEP). | |
| | ■ | | | Classify the spill incident level. | See Section 2.1 Spill classification.<br>Table 2-1: Incident classification. | |
| | ■ | | | Verbally notify AMSA. | See Section 2.4.2 External agencies notification.<br>Table 2-2: Jurisdictional boundaries and Jurisdictional Authority and Control Agencies.<br>Table 2-3: External notifications matrix.<br>INPEX Emergency Contact Directory (PER-2153095942). | AMSA is the designated Control Agency for oil spills from vessels within Commonwealth jurisdiction and are to be notified immediately of all ship-sourced incidents through the AMSA Rescue Coordination Centre (RCC) Australia on +61 2 6230 6811. Upon notification of an incident involving a ship, AMSA will assume control of the incident and respond in accordance with AMSA's National Plan for Maritime Environmental Emergencies. |
| | ■ | | | Verbally notify the DS and OIM. | See Section 2.4.1 Initial spill notification. | |
| ■ | ■ | | | Deploy satellite tracking buoys. | See Section 4.4.1 Operational Monitoring and Evaluation. | If not on a vessel, tracking buoys can be requested for deployment from the INPEX IMT Leader.<br>The location of satellite tracking buoys is maintained in the Oil Spill Preparedness and Response Register (PER-2153236568), available on DMS. |
| | | ■ | ■ | INPEX DS to notify IMT Leader via INPEX Emergency Call Centre.<br>IMT Leader notify INPEX Crisis Management Team (CMT) Leader.<br>IMT Leader to activate IMT. | Activate via INPEX Emergency Call Centre. (See Section 2.4.1 Initial spill notification).<br>INPEX Emergency Contact Directory (PER-2153095942). | INPEX Emergency Call Centre 24-hour activation numbers are:<br>1800 305 789.<br>+61 8 6213 6350<br>+61 439 694 175 |
| | ■ | ■ | | Prepare marine pollution report (POLREP), submit to AMSA and copy to DS.<br>DS to forward POLREP to IMT Leader. | POLREP. (See Table 5-1: Oil Spill Response Forms). | |
| | | | ■ | IMT to contact AMSA and confirm POLREP and offer support as per memorandum of understanding (MOU). | See Section 2.2 Jurisdictional Authority and Control Agency. | AMSA and INPEX acknowledge that AMSA retains Control Agency responsibility for all ship sourced marine pollution incidents. INPEX agrees to provide all available support to AMSA in AMSA's performance of its Control Agency responsibilities under the National Plan for Maritime Environmental Emergencies.<br>For example, INPEX may offer to provide aviation/aerial observation support to AMSA. |

# II Abbreviations and acronyms

| Abbreviation/acronym | Description |
|---|---|
| AIMS | Australian Institute of Marine Science |
| ALARP | as low as reasonably practicable |
| AMOSC | Australian Marine Oil Spill Centre |
| AMP | Australian Marine Park |
| AMSA | Australian Maritime Safety Authority |
| ANZECC/ARMCANZ | Australian and New Zealand Environment and Conservation Council / Agriculture and Resource Management Council of Australia and New Zealand |
| AODN | Australian Ocean Data Network |
| ARP | applied research program |
| ASTM | American Society for Testing and Materials |
| ASV | accommodation support vessel |
| BACI | before–after, control–impact |
| BIA | biologically important area |
| BOM | Bureau of Meteorology |
| CASA | Civil Aviation Safety Authority |
| CMT | crisis management team |
| Cwlth | Commonwealth |
| DEE | Department of the Environment and Energy (Cwlth) (formerly the Cwlth Department of the Environment) |

| Abbreviation/acronym | Description |
|---|---|
| DENR | Department of Environment and Natural Resources (NT) |
| DWER | Department of Water and Environmental Regulation (WA) |
| DIIS | Department of Industry, Innovation and Science (Cwlth) |
| DMS | document management system |
| DMIRS | Department of Mines, Industry Regulation and Safety (WA) |
| DNP | Director of National Parks (Cwlth) |
| DPaW | Department of Parks and Wildlife (WA) now WA DBCA |
| DPC | Darwin Port Corporation |
| EEZ | exclusive economic zone |
| EMBA | environment that may be affected |
| EP | environment plan |
| EPA | Environment Protection Authority (NT) |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) |
| ERT | emergency response team |
| ESP | environmental service provider |
| FOB | forward operating base |
| FSANZ | Food Standards Australia New Zealand |
| GPS | global positioning system |

| Abbreviation/acronym | Description |
|---|---|
| HSE | health, safety and environment |
| IAP | incident action plan |
| IC | Incident Controller |
| I-GEM | Industry–Government Environmental Metadata |
| IMG | incident management guide |
| IMT | incident management team |
| ITOPF | International Tanker Owners Pollution Federation Limited |
| JHA | job hazard analysis |
| LAT | lowest astronomical tide |
| MARPOL 73/78 | International Convention for the Prevention of Pollution from Ships, 1973/1978 |
| MNES | Matter of National Environmental Significance |
| MODU | mobile offshore drilling unit |
| MoU | memorandum of understanding |
| NATA | National Association of Testing Authorities |
| National Plan (NatPlan) | National Plan for Maritime Environmental Emergencies |
| NAXA | Northern Australia Exercise Area |
| NOAA | National Oceanic and Atmospheric Administration (US) |
| NOPSEMA | National Offshore Petroleum Safety and Environmental Management Authority (Cwlth) |

| Abbreviation/acronym | Description |
|---|---|
| nm | nautical mile |
| NT | Northern Territory |
| NT DIPL | Department of Planning, Infrastructure and Logistics (NT) |
| NT EPA | Environment Protection Authority (NT) |
| NT OSCP | Northern Territory Oil Spill Contingency Plan |
| NT PaWC | Parks and Wildlife Commission (NT) |
| OIM | offshore installation manager |
| OM | Operational Monitoring |
| OPEP | oil pollution emergency plan |
| OPGGS (E) Regulations | Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cwlth) |
| OSCP | oil spill contingency plan |
| OSMP | Operational and Scientific Monitoring Program |
| OSRL | Oil Spill Response Limited |
| OWR | oiled wildlife response |
| PEARS | People, Environment, Assets, Reputation and Sustainability |
| POLREP | marine pollution report |
| PPE | personal protective equipment |
| PTW | permit to work |

| **Abbreviation/acronym** | **Description** |
|---|---|
| RCC | Rescue Coordination Centre |
| ROV | remotely operated underwater vehicle |
| SAR | synthetic aperture radar |
| SCAT | shoreline clean-up and assessment technique |
| SIMA | spill impact mitigation assessment |
| SITREP | situation report |
| SM | scientific monitoring |
| SHP-MEE | State Hazard Plan – Maritime Environmental Emergencies |
| SOPEP | shipboard oil pollution emergency plan |
| TBOSIET | tropical basic offshore safety induction and emergency training |
| US EPA | United States Environmental Protection Agency |
| UXO | unexploded ordnance |
| VM | vessel master |
| WA | Western Australia |
| WA DBCA | Department of Biodiversity, Conservation and Attractions (WA) |
| WA DoT | Department of Transport (WA) |

# 1 Introduction

## 1.1 Purpose

In accordance with Regulation 14(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations), the implementation strategy for an environment plan (EP) must include an oil pollution emergency plan (OPEP).

This OPEP has been developed specifically to respond to emergency conditions as described and defined in the Ichthys Development Drilling Campaign WA-50-L EP (Doc. No. 0000-AD-PLN-60003); hereafter referred to as the EP. The scope of this OPEP is consistent with the activities described in Section 3 of the EP.

The purpose of this OPEP is to:

- describe the oil spill emergency response arrangements and capabilities that are in place for the duration of the petroleum activity
- provide high-level guidance and process support for the INPEX Incident Management Team (IMT)
- demonstrate that the intent of Regulation 14(8) of the OPGGS (E) Regulations has been met.

## 1.2 Plan scope

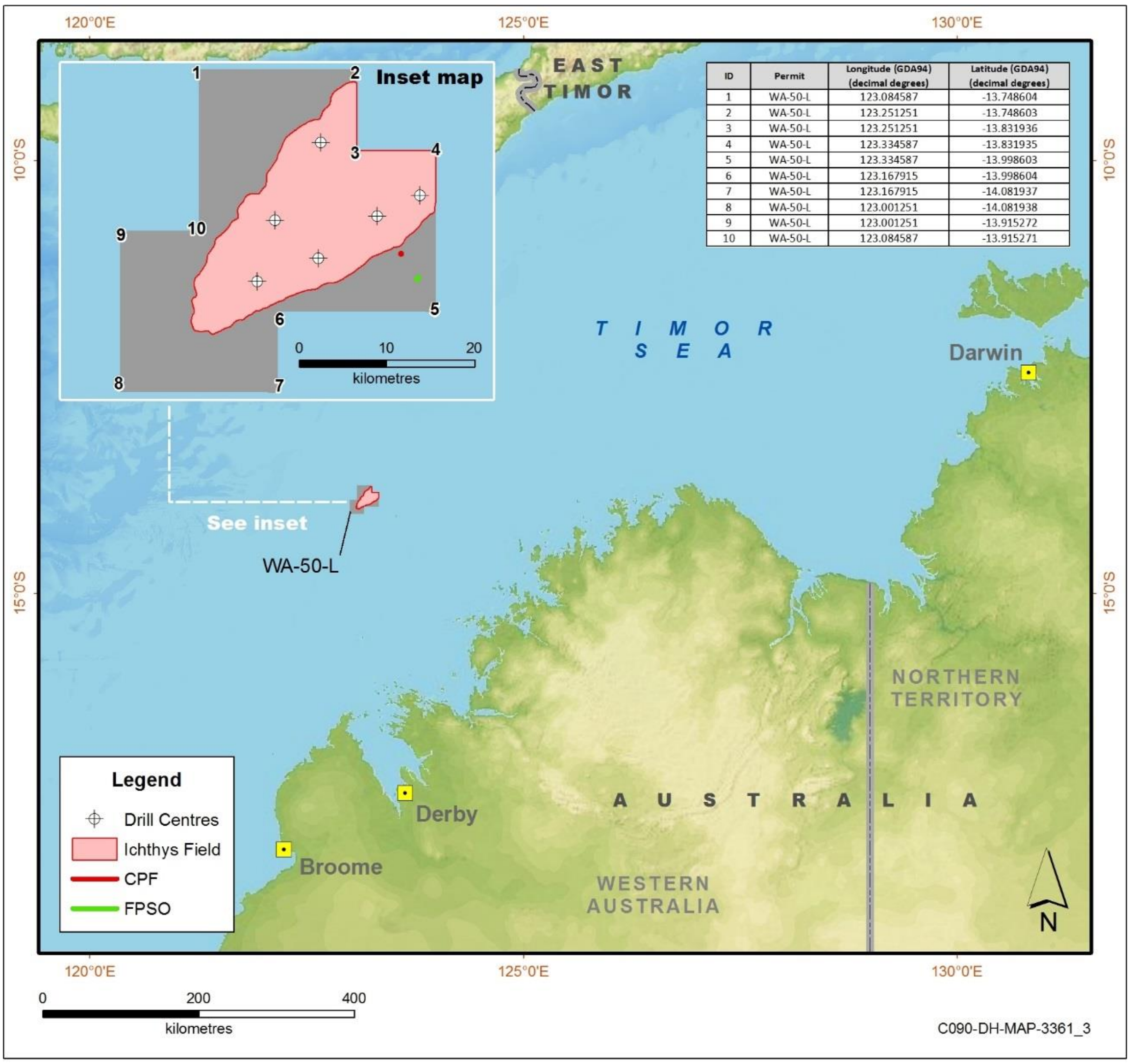
INPEX defines an Emergency Condition as:

'A hazardous situation (or threat of a hazardous situation) where Company standard operating procedures will not resolve the situation safely or prevent harm to the people, environment or assets. Successful management of an emergency situation will require coordinated action to control the event, correct the consequences and return the function to a safe condition.'

The emergency conditions identified in the EP are:

- loss of well containment due to integrity failure resulting in a subsea Group I (condensate) spill to the marine environment
- loss of containment due to rupture/damage to subsea production system from a dropped object resulting in a subsea Group I (condensate) spill to the marine environment
- vessel collision, resulting in a Group II (diesel) spill to the marine environment at the sea surface.

All activities will be undertaken within the production licence area, WA-50-L, located in Commonwealth waters as shown in Figure 1-1.




| ID | Permit | Longitude (GDA94) (decimal degrees) | Latitude (GDA94) (decimal degrees) |
|---|---|---|---|
| 1 | WA-50-L | 123.084587 | -13.748604 |
| 2 | WA-50-L | 123.251251 | -13.748603 |
| 3 | WA-50-L | 123.251251 | -13.831936 |
| 4 | WA-50-L | 123.334587 | -13.831935 |
| 5 | WA-50-L | 123.334587 | -13.998603 |
| 6 | WA-50-L | 123.167915 | -13.998604 |
| 7 | WA-50-L | 123.167915 | -14.081937 |
| 8 | WA-50-L | 123.001251 | -14.081938 |
| 9 | WA-50-L | 123.001251 | -13.915272 |
| 10 | WA-50-L | 123.084587 | -13.915271 |

**Figure 1-1: Location and coordinates of WA-50-L**

# 2 Spill classification and responsible agencies

## 2.1 Spill classification

Under the National Plan for Maritime Environmental Emergencies (AMSA 2019; NatPlan), marine hydrocarbon spills and their response requirements are categorised into three levels, based on a combination of factors:

- the known or inferred spill size, scale and complexity
- the likely fate of the spill
- environmental and socioeconomic values within the vicinity
- the capability of equipment in the field in regard to the spill, and the level of support required to respond.

Table 2-1 summarises the hydrocarbon spill level response models adopted for this OPEP.

In the event of a spill occurring where effective response is considered beyond the immediate response capabilities of INPEX (i.e. a spill above Level 1), the response will be escalated immediately to the next level. Spill volumes are a guide only and not to be strictly applied, especially in the case of a well blowout.

**Table 2-1: Incident classification**

| Incident level | Spill volume ($m^3$) | Description |
|---|---|---|
| 1 | <10 | Generally can be resolved through the application of local or initial response resources (first strike response). |
| 2 | 10 to 1000 | Typically more complex in size, duration, resource management and risk than Level 1 incidents.<br>May require deployment of resources beyond the first strike response. |
| 3 | >1000 | Characterised by a high degree of complexity, requiring strategic leadership and response coordination.<br>May require national and international response resources. |

## 2.2 Jurisdictional authority and control agency

The NatPlan defines the State/Territory and Commonwealth agencies in the following terms.

Jurisdictional Authority

Any agency which has jurisdictional or legislative responsibilities for maritime environmental emergencies is obligated to work closely with the Control Agency to ensure that incident response actions are adequate.

Control Agency

The organisation that directs and manages the spill response (with response assistance provided by other parties under the direction of the Control Agency). The Control Agency responsibility does not always coincide with that of a Jurisdictional Authority. The Control Agency has the operational responsibility to take action in order to respond to an oil spill in the marine environment in accordance with the relevant contingency plan.

Table 2-2 defines the Jurisdictional Authority and Control Agency responsibilities within relevant jurisdictions.

Control Agency in Commonwealth Waters

The NatPlan specifies that for spills in Commonwealth waters, resulting from a 'Facility', the Operator shall become the Control Agency. Where the spill is not from a Facility (i.e. a vessel spill), AMSA will become the Control Agency.

In the instance that AMSA is the Control Agency, INPEX has committed under Clause 7 of a memorandum of understanding (MoU) between INPEX and AMSA, that INPEX 'agrees to provide all available support to AMSA in AMSA's performance of its Combat (Control) Agency responsibilities' (AMSA and INPEX 2013).

The MoU further states that for ship-sourced marine pollution events:

- AMSA is the designated Combat (Control) Agency for oil spills from vessels within the Commonwealth jurisdiction. Upon notification of an incident involving a ship, AMSA will assume control of the incident and respond in accordance with AMSA's Marine Pollution Response Plan.
- AMSA's Marine Pollution Response Plan is the operational response plan for the management of ship-sourced incidents.
- AMSA is to be notified immediately of all ship-sourced incidents through RCC Australia on +61 2 6230 6811.

As the MODU and well are Facilities, INPEX is the Control Agency for any spills from either. The MoU (AMSA and INPEX 2013) notes that for responses relating to non-ship-sourced marine pollution incidents:

- AMSA will coordinate the resources of the National Plan for Maritime Environmental Emergencies on the formal request of the appointed Incident Controller. Notification of AMSA will be through RCC Australia on +61 2 6230 6811.

### 2.2.1 Cross jurisdictional arrangements

Incidents involving an oil spill response could result in more than one agency having jurisdictional control across the oil spill response area. This situation is possible where a significant spill (Level 2 or 3) originates from a Facility in Commonwealth waters (where INPEX is the Control Agency) and transitions into (or threatens) WA/NT State/Territory waters/shorelines.

Cross jurisdictional spill arrangements for WA are described below.

**Western Australia**

Detailed cross jurisdiction arrangements (which are summarised below), are available in the WA State Hazard Plan - Maritime Environmental Emergencies (SHP-MEE) (WA DoT 2018).

This includes:

- WA DoT nominating officers to facilitate aligned communications, share situation awareness and coordinate response actions with the INPEX IMT.

- WA DoT also establishing an Incident Control Centre in Fremantle and INPEX providing a number of emergency management support personnel to work within the WA DoT IMT (the INPEX IMT would still function and lead the response in Commonwealth waters and liaise with WA DoT IMT).

INPEX has prepared a Browse Island Oil Spill Incident Management Guide (IMG) X060-AH-GLN-60015. The IMG provides details of how INPEX would support WA DoT in managing a spill in State waters and demonstrates how the INPEX IMT would integrate into the WA DoT IMT, in accordance with the SHP-MEE (WA DoT 2018), including detailed organisational charts and roles and responsibilities descriptions.

This document also provides specific guidance on logistics and tactics for responses at Browse Island, or other similar offshore island locations in the Browse Basin or remote north west coastlines.

**Table 2-2: Jurisdictional boundaries and Jurisdictional Authority and Control Agencies**

| Jurisdictional boundary | Spill source | Jurisdictional Authority | Control Agency | | | Relevant documentation |
|---|---|---|---|---|---|---|
| | | | Level 1 | Level 2* | Level 3 | |
| Commonwealth waters (3 to 200 nautical miles from territorial sea baseline). | Petroleum Facility (MODU) conducting petroleum activity within the production licence area. | National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) | INPEX<br>Level 1 spill response from MODU, with support provided by MODU contractor. | INPEX<br>With support from AMOSC and AMSA. | INPEX<br>In cooperation with AMOSC, AMSA and Oil Spill Response Limited (OSRL). | MODU SOPEP and (this) INPEX OPEP. |
| | Light Well Intervention (LWI) vessel within the production licence area.<br>Supply vessel within 500 m of the MODU within the production licence area. | AMSA | AMSA<br>With support from vessel contractor and INPEX if required. | AMSA<br>With support from vessel contractor, INPEX and AMOSC if required. | AMSA<br>With support from vessel contractor, INPEX and AMOSC if required. | Vessel SOPEP and (this) INPEX OPEP |
| | MODU in transit†. | AMSA | AMSA<br>With support from MODU contractor. | AMSA<br>With support from MODU contractor and AMOSC if required. | AMSA<br>With support from MODU contractor, AMOSC and OSRL if required. | MODU SOPEP and Nat Plan |
| WA waters and shoreline/waters (territorial sea baseline to 3 nautical miles and some areas around offshore atolls and islands (i.e. Browse Island)). | Petroleum Facility (MODU) conducting petroleum activity within the production licence area. | WA DoT<br>Or<br>NT Department of Environment and Natural Resources (DENR) | INPEX<br>Level 1 spill response from MODU, with support provided by MODU contractor. | WA DoT<br>With support from INPEX (including AMOSC), if required§ | WA DoT<br>With support from INPEX, AMSA, AMOSC and OSRL. | (This) INPEX OPEP and the SHP-MEE. |

*AMOSC and government agencies may assist the relevant Control Agency for Level 2 and Level 3 spills, as appropriate to the spill characteristics. However, INPEX does not anticipate that a government agency would take over an event as the Control Agency in Commonwealth waters for a MODU-based spill (with the exception of AMSA if the spill originates from a supply vessel), given that they have the resources, training, and technical expertise to manage the spill scenarios that have been identified within the risk process. In the event that outside support is required from the relevant response agencies, INPEX will provide cost recovery as outlined in the relevant legal statutes where applicable. In the unlikely event that government agencies take control of the response within the 500 m MODU exclusion zone, INPEX and AMOSC will provide support to them.

† The MODU in transit (when not conducting a petroleum activity) is considered as a vessel for the purposes of spill response and is outside the scope of this OPEP.

§ WA's DoT has advised that, in the event of a spill, under the *Emergency Management Act 2005*, it has the power to take over the role of Control Agency. If the DoT were to take over as the control agency from an INPEX incident spill that originated in Commonwealth waters, the DoT would require INPEX to continue to maintain its resources level to the incident. Under the State Hazard Plan – Maritime Environmental Emergencies (SHP-MEE), the DoT will not have the full support from all agencies unless the DoT is the Control Agency.

## 2.3 INPEX response team activation

Where a spill is assessed to be Level 2 or Level 3, the IMT shall be activated by the INPEX Drilling Supervisor on the MODU via the INPEX Emergency Call Centre.

Once the IMT has been activated it shall become responsible (as Control Agency for Facility spills) or provide support to AMSA (as Control Agency for vessels spills) for implementing spill response control measures, interaction with regulatory authorities and support agencies, monitoring, reporting and response termination.

Further information regarding the INPEX emergency and crisis management organisation can be found within Section 9 of the EP.

## 2.4 Incident notification

### 2.4.1 Initial spill notification

The spill observer shall raise the alarm and take action to stop the spill, if possible:

- for a spill observed or detected from a vessel, the Vessel Master shall be notified
- for a spill observed or detected from a Facility, the OIM shall be notified
- the Vessel Master/OIM shall alert the INPEX Drilling Supervisor
- the INPEX Drilling Supervisor shall alert the IMT Leader
- the IMT Leader shall consult with the CMT (crisis management team) Leader, and jointly determine whether to activate only the IMT or both the IMT and the CMT.

### 2.4.2 External agencies notification

The Vessel Master, OIM, Drilling Supervisor and IMT Leader shall provide verbal notifications of Level 2 or Level 3 spill events from Vessel or Facility to the organisations listed in Table 2-3.

The IMT Leader should consider additional stakeholder notifications, based on values and sensitivities affected. Additional stakeholders for consideration include those listed in Table 5-1 of the EP.

If written forms are required as part of a notification, they can be found in Table 5-1 of this OPEP.

If activated, the IMT shall notify AMOSC of the spill event. AMOSC shall provide technical support to assist and shall also provide access to oil spill response equipment and personnel, if required. Details of resource availability are provided in Section 4 of this OPEP.

Event reporting is described in Section 9 of the EP; however, notification is dependent on the activity being undertaken and the Control Agency status. Jurisdictional Authority and Control Agency status is discussed in Section 2.2 of this OPEP.

### 2.4.3 INPEX emergency contacts directory

All relevant contact details required of this OPEP are contained within the INPEX Emergency Contacts Directory (Doc. No. PER-2153095942), a hard copy of which is maintained in the IMT Room with an electronic copy available on the incident management system (EMQNet).

The INPEX Emergency Contacts Directory is reviewed at least annually to check all relevant call-off contracts (refer to sections 4.1 and 4.2) are included and all contact numbers are kept up to date.

**Table 2-3: External notifications matrix**

| Contact | Comments | Method | Timing | Responsibility |
|---|---|---|---|---|
| Spill in any location | | | | |
| AMOSC (may assist as a support response agency). | Level 2/Level 3 spill – response agency.<br>Alert and put on standby, as required.<br>Activate if spill response escalates in order to mobilise spill-response resources. | Phone call and email.<br>Service contract with AMOSC to be signed by IMT Leader. | As soon as practicable. | IMT Leader or delegate. |
| OSRL (may assist as a support response agency). | Level 2/Level 3 spill – response agency.<br>Alert and put on standby as required.<br>Activate if spill response escalates in order to mobilise spill-response resources. | Phone call and email. | As soon as practicable. | IMT Leader or delegate. |
| Oil spill modelling service provider. | Provide POLREP and other relevant event information to enact real-time spill modelling as soon as practicable. | Phone call and email.<br>Spill modelling request / activation forms. Refer to Table 5-1. | As soon as practicable. | IMT Leader of delegate. |
| Spill in Commonwealth waters/lands | | | | |
| AMSA duty officer. | Notification is required as soon as possible after the occurrence of the event.<br>If AMSA has already been notified by the vessel ERT, IMT to confirm situational awareness and Control Agency responsibility with AMSA. | Phone call, within two hours.<br>From vessel, the message must begin with the code word "POLREP", then the vessel name, the IMO number and the call sign of the ship.<br>Written report within 24 hours of a request from AMSA, via POLREP form. Refer to Table 5-1.<br>Written update via SITREP as required, via SITREP form. Refer to Table 5-1. | Verbally, within two hours.<br>Written POLREP, within 24 hours.<br>SITREP as required. | Vessel Master/OIM and IMT Leader or delegate (as relevant). |
| NOPSEMA. | Notification of reportable incidents is required under OPPGS (E) Regulations 2009, Regulations 26, 26A and 26AA. | Phone call, as soon as possible and not later than 2 hours after the occurrence of a Level 2 or Level 3 event only.<br>Written report within three days. Use NOPSEMA report form Report of an accident, dangerous occurrence or environmental incident (FM0831). Refer to Table 5-1. | Verbally, within 2 hours.<br>Written within three days. | INPEX Drilling Supervisor or delegate (as relevant). |
| Commonwealth Department of the Environment and Energy (DEE). | Notification is required in cases where matters of national environmental significance (MNES) are at risk including not only listed species but also heritage properties and Ramsar wetlands, and/ or where there is death or injury to protected species.<br>Permits from DEE are required to enter and undertake activities in Australian marine parks (AMPs), heritage properties or Ramsar wetlands. | Phone call notification within 24 hours of becoming aware of the incident or non-conformance resulting in impacts to MNES.<br>Written / email report within 3 days. | Verbally, within 24 hours.<br>Written, within 3 days. | IMT Leader or delegate (as relevant). |

| Contact | Comments | Method | Timing | Responsibility |
|---|---|---|---|---|
| Director National Parks (DNP). | Notification is required for any oil/gas pollution incidences within or likely to impact an Australian marine park (AMP) as soon as possible.<br>INPEX to confirm details of the time and location of the event, any marine parks that are likely to be impacted and will confirm proposed response arrangements and contact details for the IMT.<br>It is acknowledged that some of the information requested by the DNP may not be available at the point of the initial verbal notification and therefore updates will be ongoing throughout the duration of any response that may impact on a marine park. | Phone call (via 24-hour Marine Compliance Duty Officer). | Verbally, as soon as possible and prior to action being taken within an AMP. | IMT Leader or delegate (as relevant). |
| Administrator of the Australian Indian Ocean Territories (IOT). | The Australian Government, through the Department of Infrastructure, Regional Development and Cities, administers Ashmore reef and Cartier Island.<br>On behalf of the Department, the WA Department of Water and Environmental Regulation provides pollution response capability and advice for pollution incidents for Indian Ocean Territories.<br>Notifications as noted below for WA DWER. | Phone call, as soon as practicable by calling the WA DWER pollution watch hotline<br>Email: pollutionwatch@dwer.wa.gov.au | As required. | IMT Leader or delegate (as relevant). |
| Spill heading towards WA State waters (e.g. Browse Island) | | | | |
| WA Department of Transport (WA DoT). | Jurisdictional Authority and Control Agency for spills in WA waters.<br>Notification is required in the event of a hydrocarbon spill which is predicted to enter WA State waters. | Phone call to WA DoT Maritime Environmental Emergency Response (MEER) pollution hotline.<br>Written notification by POLREP.<br>Written update via SITREP, as required.<br>Refer to Table 5-1. | Verbally, within two hours.<br>Written POLREP, within 24 hours.<br>SITREP, as required. | IMT Leader or delegate. |
| WA Department of Water and Environment Regulation (DWER). | Contact in the event of a hydrocarbon spill which is predicted to cause contamination of shorelines. | Phone call, as soon as practicable.<br>Email: pollutionwatch@dwer.wa.gov.au<br>Written report within 21 days. | As required. | IMT Leader or delegate. |
| Spill heading towards defence areas e.g. Northern Australia Exercise Area (NAXA) | | | | |
| Department of Defence. | Notification is required as soon as practicable in the event of a hydrocarbon spill which is predicted to enter defence areas such as NAXA. | Phone call to Department of Defence – Defence Switchboard.<br>Relevant contacts:<br>Director General Maritime Operations, Headquarters Joint Operations Command.<br>Assistant Secretary, Property Management Branch. | As soon as practicable. | IMT Leader or delegate. |

| Contact | Comments | Method | Timing | Responsibility |
|---|---|---|---|---|
| | Notification may be required if significant vessel mobilisations or activities are required within the defence areas to ensure response vessels have clearance to access any currently active Defence Practice Areas. Notification may also be required regarding access restrictions within defence areas in relation to hazardous zones such as unexploded ordnance (UXO). | | | |
| Spill heading towards Indonesia or East Timorese waters | | | | |
| Department of Industry, Innovation and Science (DIIS). | In the event that a spill is predicted to enter Indonesian or East Timorese waters, or the Joint Petroleum Development Area (JPDA), the Australian Government is required to notify the international governments. DIIS will notify the Department of Foreign Affairs and Trade, who will notify the relevant foreign government. | Phone call to DIIS. | As soon as practicable. | IMT Leader or delegate, in consultation with CMT. |

## 2.5 Pollution report (POLREP)

A marine pollution report (POLREP) is required to be sent to AMSA for any Facility or vessel-based spill.

The POLREP should also be sent to the IMT, as it contains the relevant information necessary for the IMT to gain initial situational awareness.

The following information shall be included in the POLREP regarding any vessel or Facility spill for reporting and response planning purposes:

- the name of vessel/Facility
- the date and time of the spill
- the location of the spill
- details of the spilled material
- the source and cause of the spill
- an estimated volume of the spill
- the vessel/Facility status (stability, condition of the ship etc.)
- the estimated rate of release and maximum credible volume if the spill is ongoing
- the condition of the spill, i.e. stopped/ongoing, contained/uncontained
- the meteorological conditions:
  - air temperature
  - wind speed and direction
  - visibility
- the oceanographic conditions:
  - sea temperature
  - current speed and direction
  - Beaufort sea state.

See Table 5-1 for further information regarding POLREP template and submission timeframes.

## 2.6 Immediate (first strike) response measures

The immediate response has been predetermined by the Operational SIMA (see Section 3.4) and must be implemented as soon as practicable, before the development of IAPs.

The immediate response for all Level 2 and Level 3 spill events is Operational Monitoring and Evaluation, as detailed in Section 4.4.1 of this OPEP.

Further details are also provided in Appendix A (OM01 and OM03).

# 3 Incident action plan (IAP) development

The process for identifying appropriate IAPs is illustrated in Figure 3-1.

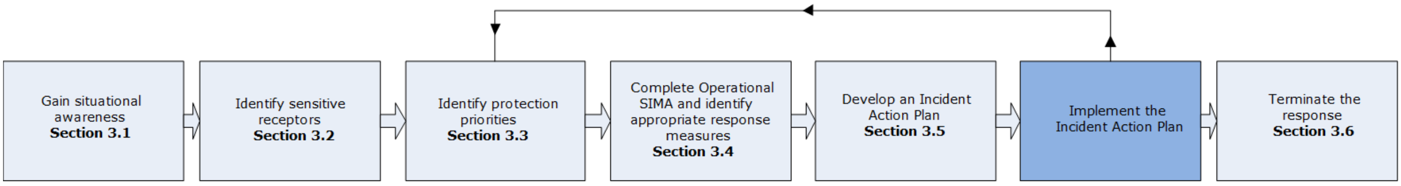



**Figure 3-1: Typical response procedure**

## 3.1 Gain situational awareness

The IMT will gain situational awareness from all available sources including:

- Operational Monitoring and Evaluation data
- vessel or Facility POLREP
- ongoing updates from the vessel/Facility
- long-term weather forecast
- Bureau of Meteorology (BOM) weather stations
- other vessels or Facilities in the vicinity
- other operators' activities.

## 3.2 Identify sensitive receptors

Particular values and sensitivities with the potential to be exposed to a spill event have been identified within Section 4 of the EP.

The INPEX IMT room is equipped with maps and tools to identify actual/real-time exposure risks.

Where there is a seasonal component associated with a particular value or sensitivity, it is shown in Table 3-1.

**Table 3-1: Seasonality of values and sensitivities**

| Values and sensitivities | Example Locations | Month: Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Coral spawning (offshore reefs) | Browse Island, Kimberley coast, Rowley Shoals, Scott Reef, Seringapatam Reef, Rowley Shoals, Hibernia Reef | | | | | | | | | | | | |
| Green turtle breeding and hatching | Browse Island and Scott Reef (Sandy Islet)* | | | | | | | | | | | | |
| | 80 Mile Beach, Adele, Lacepede Islands, Cassini and Maret Islands** | | | | | | | | | | | | |
| | Mainland east of Mary Island to mainland adjacent to Murrara Island including adjacent offshore islands | | | | | | | | | | | | |
| Turtle foraging | Turtle foraging BIA | | | | | | | | | | | | |
| Hawksbill turtle nesting | Scott Reef* | | | | | | | | | | | | |
| Olive ridley turtle nesting | Kimberley coast* | | | | | | | | | | | | |
| Flatback Turtle Nesting | Buccaneer, Bonaparte Archipelago and Eastern Kimberley (including Cape Dommett)** | | | | | | | | | | | | |
| | SW Kimberley including Lacepede Islands, Echo Beach and Eighty Mile Beach* | | | | | | | | | | | | |
| Humpback whale migration | Kimberley coast | | | | | | | Northern then southern migration | | | | | |
| Humpback whale calving | North-west Commonwealth Marine Reserves Network, Lalang-garram / Camden Sound Marine Park and humpback whale Biologically Important Areas (BIA)** | | | | | | | Whales present in calving grounds | | | | | |
| Blue whale and pygmy blue whale migration | Open ocean (approx. 500 m depth contour) | | | | Northern migration | | | | | Southern migration | | | |
| Whale shark | Whale shark BIA | | | | | | | | | | | | |
| Dugong and Inshore Dolphins | WA coast, North Kimberley Marine Park and Roebuck Bay** | | | | | | | | | | | | |
| Seabird feeding, aggregation and breeding | Marine avifauna BIA (e.g Browse Island), Ramsar sites, Kimberley coastline and Pilbara coastline | | | | Breeding and foraging | | | | | | | | |
| Shorebird migration | Migratory birds present in coastal habitats | | | | Northern migration | | | | | Southern migration | | | |
| Shorebird breeding | Marine avifauna BIA and WA coastline | | | | | | | | | | | | |
| Indonesian traditional fishing | Offshore islands and reefs located within the traditional fishing MoU area. | | | | | | | | | | | | |
| Recreational fishing | Open ocean and WA coast | | | | | | | | | | | | |
| Commercial fishing | Within and adjacent to the WA-50-L. | | | | | | | | | | | | |

| Values and sensitivities | Example Locations | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
| Legend | | | | | | | | | | | | | |
| | Peak occurrence/activity (reliable and predictable) | | | | | | | | | | | | |
| | Intermediate occurrence/activity (less reliable and less predictable) | | | | | | | | | | | | |
| | Low occurrence/activity (may vary from year to year) | | | | | | | | | | | | |
| | No occurrence | | | | | | | | | | | | |

* Source: DEE (2017).

** Source: Waples et al. (2019)

### 3.3 Identify protection priorities

In the event of a spill, the primary aims of the response will be aligned with the NatPlan (AMSA 2019) and the INPEX People, Environment, Assets, Reputation and Sustainability (PEARS) model and include protection of the following, in descending order of priority:

- human health and safety
- habitat and cultural resources (environmental sensitivities)
- rare and/or endangered flora and fauna (environmental sensitivities)
- commercial resources
- amenities.

Table 3-2 illustrates how shoreline protection priorities are determined. Each shoreline location is evaluated based on predicted time to contact and consequence of contact.

The level of consequence associated with identified values and sensitivities is defined within Section 8 of the EP.

Time to contact during a spill event will be based on the location and trajectory (model outputs) and visual observations of the spill.

**Table 3-2: Protection priority matrix**

| | | Time to contact | | | |
|---|---|---|---|---|---|
| | | <24 hours | 24-48 hours | 48-72 hours | >72 hours |
| | Multiplier | 4 | 3 | 2 | 1 |
| Catastrophic | 6 | 24 | 18 | 12 | 6 |
| Major | 5 | 20 | 15 | 10 | 5 |
| Significant | 4 | 16 | 12 | 8 | 4 |
| Moderate | 3 | 12 | 9 | 6 | 3 |
| Minor | 2 | 8 | 6 | 4 | 2 |
| Insignificant | 1 | 4 | 3 | 2 | 1 |

Based on the modelling results for the Group I (condensate) (APASA 2013/RPS 2019) and Group II (marine diesel) (RPS 2019) spill scenarios, the shoreline protection priorities are shown in Table 3-3.

Note that only locations with a minimum time to exposure of 336 hours or less were included in the table as anything over two weeks (14 days) is considered outside of the early IMT planning and IAP development cycles.

Note, RPS (2019) did not predict any shoreline contact for Group II spills.

**Table 3-3: Protection priorities for Group I/Group II spill event**

| Location | Minimum time to exposure ($>100\ g/m^2$) | Worst-case consequence evaluation<br>(See Section 8 of the EP) | Priority |
|---|---|---|---|
| Adele Island | 302 hours (Group I) | Significant | Low (4) |
| Ashmore Reef | 228 hours (Group I) | Significant | Low (4) |
| Browse Island | 137 hours (Group I) | Significant | Low (4) |
| Buccaneer Archipelago | 318 hours (Group I) | Significant | Low (4) |
| Cartier Island | 280 hours (Group I) | Significant | Low (4) |
| Scott Reef (Sandy Islet) | 234 hours (Group I) | Significant | Low (4) |

In the event of a spill, the protection priorities identified should be confirmed by reviewing the specific information relating to the spill received from Operational Monitoring and Evaluation data and predicted time to exposure based on spill model outputs.

Note that WA DoT are the Control Agency in the event of a spill in WA State waters and have the final decision regarding protection priorities, response strategies and tactics..

## 3.4 Operational SIMA

Strategic spill impact mitigation assessments (SIMAs) for both loss of well containment and vessel collision spill scenarios are discussed in Section 8 of the EP. This OPEP provides an 'Operational SIMA Template' for each relevant spill scenario (i.e. Group I (condensate) and Group II (marine diesel)). The Operational SIMA template includes a summary of key points from the Strategic SIMA.

During an oil spill emergency event, the IMT will develop an Operational SIMA by evaluating the validity of the assumptions of the Strategic SIMA, which are summarised in the Operational SIMA template including relevant ALARP considerations from Section 8 of the EP. The Operational SIMA would need to consider the specific conditions of the spill event, such as the oil type, spill location and trajectory, the sea state and weather forecast, environmental sensitivities and seasonality, which may have a bearing on the effectiveness and feasibility of implementing various responses.

The outcome of the Operational SIMA will be used in development of the IAP(s).

The Operational SIMA shall remain as a record of the reasoning behind the selection or elimination of various response measures during an actual event.

The Operational SIMA and IAP may need to be revised if additional information arises.

See Table 3-4 and Table 3-5 for the Operational SIMA templates for Group II spills and Group I spills respectively.

**Table 3-4: Operational SIMA template - Group II/Diesel spills**

| Response measure | Strategic SIMA Summary | ALARP Summary | Operational SIMA comments | IMT Leader sign-off |
|---|---|---|---|---|
| Operational Monitoring and Evaluation | Operational Monitoring and Evaluation will provide timely information to the IMT, enabling situational awareness to assist with IAP development, implementation and termination of oil spill response strategies.<br>Operational monitoring and evaluation **shall** be implemented for any Level 2/3 spill. | Prioritise the activation of the following activities: Oil Spill Trajectory Modelling, Aerial Surveillance, and deployment of oil spill tracker buoys. When deploying tracker buoys, preferably deploy 3 during the initial stages (hours) of the spill, in close proximity to each other.<br>Consider the flammability levels and VOC exposure for any oil spill tracker buoy deployments and aerial/vessel observation tasks.<br>Use of crew change helicopters for aerial surveillance should only be during initial stages of a spill, and only when helicopters are not required for other emergency tasks.<br>Longer-term aerial surveillance operations should utilise fixed-wing aircraft.<br>Trained aerial observers should be arranged for longer-term aerial surveillance operations.<br>Vessel surveillance is less efficient than aerial surveillance. Data from opportunistic vessels sightings can be collected, but this should not be a primary strategy for visual observations of slicks over large areas.<br>Consider satellite imagery acquisition to complement longer-term aerial surveillance programs and support OSTM validation. | | |
| Shoreline clean-up | Shoreline clean-up has been consistently found to not enhance ecological recovery of oiled coastlines (Sell et al. 1995) but it may protect other resources in the area, such as birds, marine mammals or subtidal habitats including coral reefs or fish farms (CSIRO 2016). Choosing a particular clean-up technique is dependent on factors such as shoreline type, exposure, sensitivity, amount of oil, persistence of oil, toxicity of oil and rate of natural oil removal (IPIECA 2015).<br>The clean-up of Group II spills on a shoreline is likely to be difficult, generating high volumes of waste in comparison to the volume of oil recovered.<br>Most offshore island shorelines would be expected to 'self-clean' any accumulated Group II oils, due to the lack of adhesiveness of these oil types, the coarse substrate, the high wave energy and high tidal regime.<br>Sensitive shorelines with lower energy, such as mudflats and mangroves on the WA/NT coastline and any coral reefs would likely be damaged by the physical activities associated with shoreline clean-up, and therefore these locations would also be left to self-clean. | Weathered diesel is a relatively non-adhesive oil and is not expected to form a thick adhesive layer on a shoreline.<br>Utilise Operational Monitoring and Evaluation data (including shoreline clean-up assessments) to determine the likely success of any shoreline clean-up response compared to allowing natural weathering to occur.<br>Shoreline clean-up techniques should focus on manual clean-up techniques, such as the use of rakes and shovels.<br>Mechanical clean-up equipment (graders, loaders etc) should not be used to physically collect oil. However, small mechanical aids (e.g. rubber tracked bob-cats) can be used to assist in moving collected oily waste around a shoreline. Careful planning of track routes is required to avoid disturbance of any turtle/bird nesting sites.<br>Personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels.<br>Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities.<br>A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel at remote locations.<br>Upon successful clean-up of the shoreline, bulka bags/IBCs containing oily contaminated waste would be transferred by helicopter or landing barge to a support vessel, for further transport to the mainland for appropriate disposal with a licenced waste contractor.<br>In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired. | | |

| Response measure | Strategic SIMA Summary | ALARP Summary | Operational SIMA comments | IMT Leader sign-off |
|---|---|---|---|---|
| Pre-contact oiled wildlife response | Group II hydrocarbons are not likely to generate a thick surface layer on the ocean surface or on a shoreline. Therefore, there is reduced potential to coat adult nesting turtles or turtle hatchlings as they transit to the ocean, or coat large numbers of seabirds.<br><br>Wildlife hazing can be an effective control measure when deployed across a limited geographical area and against specific wildlife population, where the surface oil resulting from a spill is largely contained, e.g. at a beach/specific shoreline.<br><br>Capture and translocation of turtles (adults and hatchlings) from a shoreline to an area away from the slick may provide an environmental benefit, however minimising the time during which turtles (especially hatchlings) are in captivity is critical to success of the operation. Wildlife hazing in the open ocean is inherently unlikely to be effective due to a number of limitations, including numbers of vessels required and associated safety issues, ongoing spread and movement of the slick and hazed animals moving into adjacent areas of the slick.<br><br>Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW and AMOSC 2014), especially at a remote shoreline location (e.g. Browse Island). There is no practicable method to capture healthy seabirds at sea (DPaW and AMOSC 2014). Potential harm to healthy seabirds could occur during the capture process. Any seabirds released would likely fly back to the shoreline from which they originally were captured. Long term veterinary care (e.g. feeding) would be required for any successfully captured birds, until spill weathering or remediation has occurred, and it was safe to release the animals.<br><br>Animals would be under stress while in veterinary care/rehabilitation facilities and potentially exposed to human and zoonotic diseases, which could be spread to wild populations upon their release. | Wildlife hazing or wildlife capture and translocation in the open ocean should only be considered when Operational Monitoring and Evaluation data clearly indicates that a positive outcome could be achieved.<br><br>The merits of wildlife hazing or wildlife capture and translocation at a shoreline should be considered by the IMT when Operational Monitoring and Evaluation data indicates that populations of wildlife on a shoreline may be at risk of an inbound spill and conditions are suitable for this activity to occur.<br><br>There are significant manual handling risks associated with translocating adult turtles, (adult green turtles are often >100kg), which need to be evaluated and managed if this activity is to occur. Therefore, translocation of turtle hatchlings is more likely to be successful.<br><br>Wildlife response personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels.<br><br>Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities.<br><br>A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel.<br><br>In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired. | | |
| Post-contact oiled wildlife response | Group II hydrocarbons are relatively non-adhesive compared to crude oils, and generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline. They are also not likely to generate a thick surface barrier on a shoreline which would coat adult nesting turtles or turtle hatchlings as they transit to the ocean. | Oiled wildlife capture in the open ocean should only be considered when Operational monitoring and evaluation data clearly indicates that a positive outcome could be achieved.<br><br>The merits of wildlife capture, cleaning and rehabilitation at a shoreline should be considered by the IMT when Operational Monitoring and Evaluation data indicates that populations of wildlife on a shoreline have been impacted by the spill and conditions are suitable for this activity to occur.<br><br>Wildlife response personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels. | | |

| Response measure | Strategic SIMA Summary | ALARP Summary | Operational SIMA comments | IMT Leader sign-off |
|---|---|---|---|---|
| | Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife has the ability to increase the survival of individuals. ITOPF (2011) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water. Once oiled, it is generally agreed that the bird species present in the Browse Basin region will have very low survival rates, even when rescue and cleaning is attempted.<br>Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they were originally captured. Therefore, long-term veterinary care (e.g. rehabilitation, feeding, etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the seabirds.<br>Animals would be under stress while in veterinary care/rehabilitation facilities and potentially exposed to human and zoonotic diseases, which could be spread to wild populations upon their release. | Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities.<br>A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel, including temporary oiled wildlife stabilisation facility.<br>In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired. | | |

**Table 3-5: Operational SIMA template – Group I/Condensate spills**

| Response measure | Strategic SIMA Summary | ALARP Summary | Operational SIMA comments | IMT Leader sign-off |
|---|---|---|---|---|
| Operational Monitoring and Evaluation | Operational Monitoring and Evaluation will provide timely information to the IMT, enabling situational awareness to assist with IAP development, implementation and termination of oil spill response strategies.<br>Operational monitoring and evaluation shall be implemented for any Level 2/3 spill. | Prioritise the activation of the following activities: Oil Spill Trajectory Modelling, Aerial Surveillance, and deployment of oil spill tracker buoys. When deploying tracker buoys, preferably deploy 3 during the initial stages (hours) of the spill, in close proximity to each other.<br>Consider the explosive risks and VOC exposure for any oil spill tracker buoy deployments and aerial/vessel observation tasks.<br>Use of crew change helicopters for aerial surveillance should only be during initial stages of a spill, and only when helicopters are not required for other emergency tasks.<br>Longer term aerial surveillance operations should utilise fixed-wing aircraft.<br>Trained aerial observers should be arranged for longer-term aerial surveillance operations.<br>Vessel surveillance is cost and time intensive and is far less efficient than aerial surveillance. Data from opportunistic vessels sightings can be collected, but this should not be a primary strategy for visual observations of slicks over large areas.<br>Consider satellite imagery acquisition to complement longer-term aerial surveillance programs and support OSTM validation.<br>Loss of well containment modelling results indicate that a limited surface slick would be present and the majority of hydrocarbons in the marine environment would be entrained or dissolved within the water column (RPS 2018), however valuable data will still be gained by implementing this response strategy. | | |
| Shoreline clean-up | Shoreline clean-up has been consistently found to not enhance ecological recovery of oiled coastlines (Sell et al. 1995), but it may protect other resources in the area, such as birds, marine mammals or subtidal habitats including coral reefs or fish farms (CSIRO 2016). Choosing a particular clean-up technique is dependent on factors such as shoreline type, exposure, sensitivity, amount of oil, persistence of oil, toxicity of oil and rate of natural oil removal (IPIECA 2015).<br>The clean-up of Group I spills on a shoreline is likely to be difficult, generating high volumes of waste in comparison to the volume of oil recovered.<br>Most offshore island shorelines would be expected to 'self-clean' any accumulated Group I oils, due to the lack of adhesiveness of these oil types, the coarse substrate, the high wave energy and high tidal regime.<br>Sensitive shorelines with lower energy, such as mudflats and mangroves on the WA/NT coastline would likely be damaged by the physical activities associated with shoreline clean-up, and therefore these locations would also be left to self-clean. | Weathered condensate is likely to arrive on a shoreline as waxy flakes and should not form a thick adhesive layer on a shoreline.<br>Utilise Operational Monitoring and Evaluation data (including shoreline clean-up assessments) to determine the likely success of any shoreline clean-up response compared to allowing natural weathering to occur.<br>Shoreline clean-up techniques should focus on manual clean-up techniques, such as the use of rakes and shovels.<br>Mechanical clean-up equipment (graders, loaders etc) should not be used to physically collect oil. However, small mechanical aids (e.g. rubber tracked bob-cats) can be used to assist in moving collected oily waste around a shoreline. Careful planning of track routes is required to avoid disturbance of any turtle/bird nesting sites.<br>Personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels.<br>Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities.<br>A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel at remote locations.<br>Upon successful clean-up of the shoreline, bulka bags/IBCs containing oily contaminated waste would be transferred by helicopter or landing barge to a support vessel, for further transport to the mainland for appropriate disposal with a licenced waste contractor. | | |

| Response measure | Strategic SIMA Summary | ALARP Summary | Operational SIMA comments | IMT Leader sign-off |
|---|---|---|---|---|
| | | In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired. | | |
| Pre-contact oiled wildlife response | Group I hydrocarbons are not likely to generate a thick surface layer on the ocean surface or on a shoreline. Therefore, there is reduced potential to coat adult nesting turtles or turtle hatchlings as they transit to the ocean, or coat large numbers of seabirds.<br><br>Wildlife hazing can be an effective control measure when deployed across a limited geographical area and against specific wildlife population, where the surface oil resulting from a spill is largely contained, e.g. at a beach/specific shoreline.<br><br>Capture and translocation of turtles (adults and hatchlings) from a shoreline to an area away from the slick may provide an environmental benefit, however minimising the time during which turtles (especially hatchlings) are in captivity is critical to success of the operation. Wildlife hazing in the open ocean is inherently unlikely to be effective due to a number of limitations, including numbers of vessels required and associated safety issues, ongoing spread and movement of the slick and hazed animals moving into adjacent areas of the slick.<br><br>Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW and AMOSC 2014), especially at a remote shoreline location (e.g. Browse Island). There is no practicable method to capture healthy seabirds at sea (DPaW and AMOSC 2014). Potential harm to healthy seabirds could occur during the capture process. Any seabirds released would likely fly back to the shoreline from which they originally were captured. Long term veterinary care (e.g. feeding) would be required for any successfully captured birds, until spill weathering or remediation has occurred, and it was safe to release the animals.<br><br>• Animals would be under stress while in veterinary care/rehabilitation facilities and potentially exposed to human and zoonotic diseases, which could be spread to wild populations upon their release. | Wildlife hazing or wildlife capture and translocation in the open ocean should only be considered when Operational Monitoring and Evaluation data clearly indicates that a positive outcome could be achieved.<br><br>The merits of wildlife hazing or wildlife capture and translocation at a shoreline should be considered by the IMT when Operational Monitoring and Evaluation data indicates that populations of wildlife on a shoreline may be at risk of an inbound spill and conditions are suitable for this activity to occur.<br><br>There are significant manual handling risks associated with translocating adult turtles, (adult green turtles are often >100 kg), which need to be evaluated and managed if this activity is to occur. Therefore, translocation of turtle hatchlings is more likely to be successful.<br><br>Wildlife response personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels.<br><br>Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities.<br><br>A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel.<br><br>In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired. | | |
| Post-contact wildlife response | Group I hydrocarbons are relatively non-adhesive compared to crude oils, and generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline. They are also not likely to generate a thick surface barrier on a shoreline which would coat adult nesting turtles or turtle hatchlings as they transit to the ocean. | Oiled wildlife capture in the open ocean should only be considered when Operational monitoring and evaluation data clearly indicates that a positive outcome could be achieved. | | |

| Response measure | Strategic SIMA Summary | ALARP Summary | Operational SIMA comments | IMT Leader sign-off |
|---|---|---|---|---|
| | Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife has the ability to increase the survival of individuals. ITOPF (2011) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water. Once oiled, it is generally agreed that the bird species present in the Browse Basin region will have very low survival rates, even when rescue and cleaning is attempted.<br>Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they were originally captured. Therefore, long-term veterinary care (e.g. rehabilitation, feeding, etc.) would be required for any successfully captured birds, until spill weathering or remediation had occurred, and it was safe to release the seabirds.<br>Animals would be under stress while in veterinary care/rehabilitation facilities and potentially exposed to human and zoonotic diseases, which could be spread to wild populations upon their release. | The merits of wildlife capture, cleaning and rehabilitation at a shoreline should be considered by the IMT when Operational Monitoring and Evaluation data indicates that populations of wildlife on a shoreline have been impacted by the spill and conditions are suitable for this activity to occur.<br>Wildlife response personnel and equipment transport to and from the shoreline would be by small utility helicopter and/or vessels.<br>Low sea-states and calm weather are required for use of vessels for shoreline landings. Tide forecasts should also be consulted to ensure appropriate and safe vessel activities.<br>A large support vessel or Facility (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel, including temporary oiled wildlife stabilisation facility.<br>In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective is desired. | | |

## 3.5 Develop an incident action plan

The IMT shall prepare an IAP once it has gained accurate and reliable situational awareness, reviewed protection priorities and completed the Operational SIMA. Note that this section should be read in conjunction with the INPEX Australia Incident Management Plan (0000-AH-PLN-60005) which contains descriptions of IMT roles and the emergency management competency training associated with these roles.

An IAP is typically prepared for response activities beyond the immediate response measures (first strike) timeframe.

The IAP shall:

- establish the overall incident response objectives and strategies – determine what is to be achieved, where, when and by whom?
- ensure continuity of incident control – decisions are made and agreed at one location and cascaded down
- provide for effective use of resources – usage is coordinated from one central location, facilitating more accurate planning and resource allocation.

The IAP shall be the mechanism for oil spill management from the moment it comes into force through to the termination of the response. The intent is that it is used to direct response operations while ensuring that everyone involved in the response is mitigating identified risks and working towards the same objectives and priorities. It shall therefore:

- provide responders with clear strategies on what needs to be done
- supply information on the resources, methods and protocols to be used in order to keep the entire response effective
- provide documentation regarding the decisions, strategies, safety concerns, plans and other key pieces of information critical to achieving the incident response objectives. It will be the document referred to when dealing with post-incident analysis on issues such as cost and legal requirements, as well as the overall effectiveness of the response and its personnel.

The IAP shall be documented and given a period of operational validity (from–to date and time). The plan shall be revisited and updated prior to the next operational period.

The basic steps for IAP development are provided in Table 3-6 and a copy of the INPEX IAP template (PER-20153316130) is provided in Appendix B.

**Table 3-6: IAP development**

| Step | Action |
|---|---|
| 1. | Incident objectives are set.<br>The IMT Leader shall approve the objectives. |
| 2. | IMT tactics meeting to develop supporting strategies and tactics to achieve incident objectives.<br>This involves identifying strategies and tactics that when implemented will achieve incident objectives. |
| 3. | Information is collected in preparation for a planning meeting. |

| | |
|---|---|
| | Includes resource identification and availability, safety requirements, environmental impact, potential and current situation reports and maps to support the plan to achieve the identified objectives. |
| 4. | Planning meeting to compile information to complete IAP.<br>An overview of the proposed plan is given to the full IMT. This includes the general concept, work assignments, resources, incident projections and an estimated impact of strategies in containing/controlling the incident. After review, any amendments should be captured and incorporated into an overall plan. |
| 5. | IAP developed and approved by IMT Leader.<br>IMT members responsible for areas of plan development provide information for inclusion in the IAP. The IAP is approved by the IMT Leader. |
| 6. | Operations briefing.<br>A briefing is given to inform all members of the IMT and those implementing the plan so they are aware of the planned actions and any specific task allocations they are required to complete. This shall include any safety considerations and need to provide status updates and briefings on incident progress. In early stages of an incident this may be an oral briefing only. In later stages, it is anticipated this will involve written material to support the oral briefing. |
| 7. | IAP dissemination and execution.<br>The IAP is circulated and planned actions and tasks to meet plan objectives are completed as per plan requirements. |
| 8. | Progress against incident objectives is assessed.<br>Situation reports and status briefings provide progress against the objectives and identify any obstacles to achieving objectives. This information is the commencement point for the development of the IAP for the next operational period. |
| 9. | Return to item 1 and develop plan for next operational period as defined by the IMT Leader. |

### 3.6 Response termination

The termination of a response to a Level 2 or Level 3 spill within Commonwealth waters shall be only when the following conditions have been fulfilled, as determined by the IMT Leader, in consultation with AMSA, DEE and AMOSC:

- when the source of the spill has been stopped
- when the objectives of the Incident Action Plans have been met
- when there are no further practicable steps that can be taken to respond to a spill.

The termination of a response to a spill which has entered WA State waters will be the responsibility of WA DoT.

Relevant factors to consider for termination of each response strategy is provided within each strategy sub-section in Section 4.

Termination criteria for the Operational and Scientific Monitoring Programs (OSMP) are detailed in Appendix A.

# 4 Spill response resources

## 4.1 Support vessel availability

INPEX maintain a range of support vessel call-off contracts with various support vessel providers. Call-off contracts allow for mobilisation of available support vessels, including for oil spill response.

Support vessel contracts range from small ~10–40 m support vessels and landing barges for coastal/nearshore, or light weight equipment activities offshore, to larger ~50–130 m offshore support vessels capable of long-duration responses activities.

Large offshore support vessels can be used as accommodation support vessels, for shoreline response activities. Large vessels with helicopter pads will facilitate faster, more efficient crew changes, which could be required during long duration response activities, or support a light utility helicopter, if required for shoreline response activities.

INPEX requires all vessels to comply with the INPEX Marine Standard (0000-AG-STD-60002) and Vessel Inspection Work Instruction (0000-AG-WIN-60029), which includes processes to enable rapid inspection and approval for use of vessels in emergency situations. In an emergency event where a vessel may be required immediately and is unable to meet marine inspection procedure requirements, the Marine Manager or delegate shall perform a suitable audit of the vessel, which may be performed as a desktop exercise.

The IMT Leader is responsible for the activation and mobilisation of support vessels under the 'manual of authorities' specified in the INPEX Emergency Management Guideline (Doc. No. PER-2150838677).

Contact details to activate the available support vessel contractors are listed in the INPEX Emergency Contacts Directory (Doc. No. PER-2153095942).

## 4.2 Aviation asset availability

INPEX maintains a range of aviation support call-off contracts with various fixed-wing aircraft and helicopter providers. These call-off contracts allow for mobilisation of available aviation assets, including for oil spill response.

Crew change helicopters can be used for routine crew change activities to approved helicopter pads.

Fixed wing aircraft are best suited to ongoing aerial observations.

Light utility helicopters can be mobilised for specific tasks such as mobilisation of personnel and equipment and removal of waste from remote shoreline locations, or for operational monitoring and evaluation at remote shorelines, where close inspection is required.

INPEX requires all aircrafts to comply with the INPEX Aviation Standard (Doc. No. 0000-AG-STD-60003). In an emergency event where an aircraft may be required and is unable to meet the INPEX Aviation Standard, the Aviation Manager or delegate shall perform a desktop risk assessment, taking into account the nature of the proposed activity and its urgency, before making any exemption.

Contact details for the available aviation asset contractors are listed in the INPEX Emergency Contacts Directory (Doc. No. PER-2153095942).

## 4.3 Oil spill preparedness and response register

INPEX maintains an internal Oil Spill Preparedness and Response Register (PER-2153236568).

This register is maintained on INPEX's Document Management System (DMS) https://dms.inpex.com.au/D2/?docbase=INPEX_per_prod&locateId=0901e2408085789c

It can be accessed during any spill event and includes the following information:

- INPEX oil spill response key contracts
- INPEX personnel trained in oil spill response and their level of training
- INPEX oil spill satellite tracking buoys – including their location, servicing schedule and log-in details to the satellite tracking website
- AMOSC equipment register(s) and trained aerial observers
- OSRL support capabilities and activation processes
- Broome, Darwin Port and AMSA stockpile inventory lists, including oiled wildlife response kits.

## 4.4 Immediate (first strike) response measures and relevant arrangements (resources and equipment)

For the recommended response strategies identified within Operational SIMAs (Section 3.4), a summary and demonstration of preparedness is provided below.

### 4.4.1 Operational monitoring and evaluation

Operational monitoring and evaluation does not in itself control or reduce the impacts of the spill; however, it allows response team managers/IMT to maintain situational awareness. This is vital in a number of respects as it:

- addresses some of the key information requirements necessary for spill management:
  - where the spill is
  - how big it is
  - where it is going
  - how long it will take to get there.
- facilitates internal and external initial notification and subsequent reporting
- provides information critical for identifying sensitive receptors under threat, identifies protection priorities, and informs Operational SIMA and IAP development
- identifies the trajectory of the spill and thereby defines the potential stakeholders and environment that may be affected (EMBA) by the oil. This will inform any subsequent scientific monitoring and recovery phase actions.

Depending on the spill type and volume, operational monitoring and evaluation techniques that may be used to gain situational awareness could include:

- oil spill trajectory modelling
- electronic surface tracking buoy(s)
- aerial surveillance
- vessel surveillance
- satellite imagery analysis.

The operational monitoring and evaluation program is effectively comprised of Oil Spill Trajectory Modelling (OM01) and Oil Spill Surveillance and Reconnaissance (OM03). Additional details are provided in Section 4.7 and Appendix A.

Termination of the response will be determined by the IMT in collaboration with relevant stakeholders. This decision will take into consideration factors such as whether:

- the source of the spill has been stopped
- the objectives of the IAPs have been met
- there are no further practicable steps that can be taken to respond to a spill
- whether cleaning techniques have become ineffective
- whether pre-agreed criteria on the level of clean have been achieved and thus situational awareness can be terminated or scaled down
- termination criteria for OM01 and OM03 specified in Appendix A.

**Oil spill trajectory modelling**

Oil spill modelling can be used to forecast the trajectory and fate of oil plumes resulting from surface or subsurface releases. It can be initiated almost immediately and provides rapid results. However, its accuracy depends on the spill estimates and the predicted metocean data, as well as the reliability of forecasts of wind speed and direction.

Oil spill trajectory modelling is an iterative process, whereby real-time observations from vessel/aerial surveillance, electronic surface tracking buoy data and/or satellite imagery, is used to refine modelling predictions, using both hindcast and forecasting techniques.

INPEX maintain a contract with an oil spill trajectory modelling provider, which enables 24-hour per day access to real-time oil spill modelling capability. Contact details for the provider are contained in the INPEX Emergency Contacts Directory (PER-2153095942) and oil spill trajectory modelling activation forms can be accessed via the INPEX Oil Spill Forms Register (PER-2153332031) (Table 5-1).

Further details regarding oil spill trajectory modelling are provided in Appendix A (refer OM01).

**Electronic surface tracking buoys**

Electronic surface tracking buoys can be rapidly deployed at, or near to, the site of a spill, from support vessels or helicopters. Thereafter, they drift with the surface currents (their design minimises wind influence). The buoys transmit their global positioning system (GPS) location in near real-time, and the data is delivered to an online data management portal. The buoys enable the trajectory of surface oil to be tracked.

When deploying tracker buoys, preferably three should be deployed during the initial stages (hours) of the spill, in close proximity to each other as their dispersion over time will assist with longer term model validation. Note that tracker buoys are not able to provide information on the direction or strength of subsurface currents, nor the trajectory of dissolved and entrained oil resulting from a subsurface spill.

INPEX maintains ten electronic surface tracking buoys to be strategically placed across various work activities. At least one tracking buoy will remain onshore so it could be deployed from the air to any spill location. It should be noted, however, that deployment of articles from aircraft, including satellite tracking buoys, require Civil Aviation Safety Authority (CASA) permission. INPEX will consider initiating a special helicopter deployment from Broome/Darwin if required, and if CASA permission can be achieved.

### Aerial surveillance

Aerial observation is a very effective way of establishing the location and extent of a spill and verifying predictions of its movement and fate. The INPEX Oil Spill Observation and Dispersant Application Guide (refer to Table 5-1) provides additional guidance on estimating extent and volume of the spill. Key considerations associated with this activity are as follows:

- flights shall be made regularly and where possible timed at the beginning or end of each day so that results can be used by the IMT and other response agencies.
- flight paths and timetables should be coordinated.
- aerial observers shall be trained, experienced and able to reliably detect, recognise and record oil pollution at sea.
- preferably, there should be a consistency of at least one observer throughout a series of flights, so that variations in reports reflect changes in the state of oil pollution and not differences between the perceptions of observers.
- aircraft used for aerial observation should preferably feature good, all-round visibility.
- over the open sea, the use of fixed-wing aircraft (rather than helicopters) is preferable, due to their superior speed and range. The extra margin of safety afforded by a twin-engine or multi-engine aircraft is essential. However, helicopter observations may be required to allow for closer inspection of shorelines, such as at Browse Island or WA/NT coastlines.
- weather conditions can affect visibility and may therefore make surveillance flying impractical.
- the minimum deployment time of surveillance aircraft and personnel is typically in the order of 24 hours.
- aircraft of opportunity with untrained observers, such as helicopter flights on crew change and Coastwatch aircraft (via AMSA) can also be requested to provide any relevant information available to them, which may improve situational awareness.

### Vessel surveillance

Oil spill surveillance can be carried out from vessels, although its practicality is limited by the number of available vessels and the scale of the spill.

For smaller spills, their dimensions, direction of travel, colour and state of weathering can be reasonably well estimated and reported. For large spills, it would be difficult to accurately estimate the size of a slick from the bridge of a vessel because sight is limited to the horizon. However, it would be possible to determine what is happening to the oil, such as its colour, thickness, weathering and the slick’s direction of travel.

### Satellite imagery analysis

Satellite-based remote sensors can be used to detect oil on water and, because such images cover extensive sea areas, they can provide a comprehensive picture of the overall extent of pollution from a spill. The sensors used include those operating in the visible and infrared regions of the spectrum, and synthetic aperture radar (SAR).

Optical observations of oil require clear, daylight skies, thereby severely limiting the application of such systems. SAR, on the other hand, is not limited by the presence of cloud and, since it does not rely on reflected light, remains operational at night. However, radar imagery often includes a number of anomalous features, or false positives, such as algal blooms, wind shadows and rain squalls, which can be mistaken for oil. Consequently, the imagery requires expert interpretation.

The minimum time for satellite imagery in the production licence area from commercial suppliers is anticipated to be between 24 and 48 hours.

**Arrangements and capabilities**

The arrangements and capabilities as described in the subsections above are summarised in Table 4-1.

**Table 4-1: Arrangements and capabilities – Operational Monitoring and Evaluation**

| Technique | Resource capability and availability | Implementation time | Activation |
|---|---|---|---|
| Oil spill trajectory modelling (OSTM) | INPEX maintain a contracted spill modelling service provider for 24-hour support. | OSTM activated within 2 hours of IMT formation. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942).<br>Trajectory modelling activation forms in Table 5-1. |
| Aerial surveillance | Aviation assets, crew change helicopters and fixed wing aircraft. | Information from project assets (crew change helicopters) will be available within 5 hours (daylight hours only). | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| | Trained aerial observers can be sourced via AMOSC/AMSA and mobilised to an aircraft. | Within 48 hours. | |
| Vessel surveillance | Smaller support vessel assets less than 40 m in length. | Commence mobilisation in Broome/Darwin within 24 hours. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| | Larger platform support vessels. | Commence mobilisation in Broome/Darwin within 48 hours. | |
| Electronic surface tracking buoy(s) | INPEX has several surface tracking buoys which it positions at high-risk locations, such as drilling rigs/MODU(s), as deemed appropriate by INPEX. At least one tracking buoy will be maintained onshore (i.e. at Broome or Darwin) which can be deployed from an aircraft to any spill location (provided that CASA has granted permission to undertake this aerial deployment activity). | Immediately where available on the vessels supporting the MODU.<br>24 hours for tracking buoys located on CPF/FPSO to be deployed by other vessels of opportunity. | Tracking buoy locations managed via the Oil Spill Preparedness and Response Register.<br>Tracking buoys deployed from vessels or aircraft, as directed by the OIM or IMT.<br>Tracking buoy online tracking tool activated by IMT. |
| Satellite imagery analysis | Sourced via OSRL, AMOSC and/or AMSA. | Images within 48 hours. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register. |

## 4.5 Secondary response measures and relevant arrangements (resources and equipment)

### 4.5.1 Shoreline clean-up

The IMT shall consider all Operational Monitoring and Evaluation data to determine potential or actual shoreline contact and potential impacts. The INPEX IMT will need to consider, in consultation with WA DoT/NT DIPL, the practicalities, likely success and risks associated with a shoreline clean-up operation, compared with allowing stranded oil to naturally weather.

If a shoreline clean-up response is required at a Commonwealth shoreline (e.g. Ashmore Reef, Cartier Island), the activation will occur in consultation with AMSA and DEE.

More detailed planning regarding a shoreline clean-up are available in the Browse Island Oil Spill IMG (X060-AH-GLN-60015). This document also provides guidance on response at any remote shoreline.

There are several logistical options available to conduct shoreline clean-up at Browse Island or other remote shoreline locations.

If weather/sea state conditions are benign, a fully vessel based logistical solution may be practicable. This would involve the use of an accommodation support vessel (ASV) as the FOB, and tenders/landing barges to move people and equipment between the FOB and the shoreline.

If weather conditions or other factors preclude the use of small landing craft, light utility helicopters, launched from an ASV helideck would be required.

Crew changes could occur via vessel or crew change helicopter, depending on the situation.

A shoreline clean-up would most likely involve the mobilisation of personnel and manual cleaning equipment such as rakes and shovels, to remove the oil from the shoreline. Oily contaminated waste would be stored in impermeable bulka bags or other similar small impermeable waste collection containers. The oily waste containers would then most likely be backloaded to the ASV, either using a landing barge or slung underneath a light utility helicopter. The waste would then transport to shore for appropriate disposal.

Large mechanical equipment such as graders would not be appropriate for remote shoreline clean-up (risk of secondary contamination and general difficulty in mobilising this equipment). However, smaller machines such as rubber tracked bob-cats could be used to help transport collected oily waste and other response equipment around the shoreline.

There are significant logistical constraints and HSE risks with flying personnel in light utility helicopters to remote offshore locations or operating out of small vessels at remote offshore locations. Also, there is the potential to disturb wildlife populations on small islands by landing large numbers of response personnel. Therefore, the number of shoreline response personnel working in remote locations at any one time will be agreed in consultation with the WA DoT/NT DIPL but is likely to be limited to between 20 and 30 people at any one location.

In a typical shoreline response, a worker is expected to clean between 0.5 to 1.0 $m^3$ of oily waste per day. Given the hot climates of the Browse Basin, a lower estimate of 0.5 $m^3$ of oily waste, per person, per day would be appropriate.

Depending on the duration of the operations, this may require the establishment of a one or two week on/off roster system, drawing on trained personnel from AMOSC, and other labour hire sources, until the response is terminated.

A decontamination staging post would be established at the clean-up location to enable decontamination of equipment and personnel before demobilisation at the end of each day. Ultimately, all contaminated equipment and personal protective equipment (PPE) would be back-loaded from the location to the mainland for cleaning or appropriate disposal.

During any shoreline clean-up, a daily progress report will be provided by the response team to the IMT Leader regarding the effectiveness of the activity. The report shall include, as a minimum:

- date(s), time(s) and location(s) of shoreline clean-up activities
- the volume of oily waste generated and disposed of
- the overall effectiveness of shoreline clean-up activities (including photographic evidence, where possible).

Shoreline clean-up operations are often considered in three stages; Stage 1 - bulk oil is removed from the shore to prevent remobilisation; Stage 2 - removal of stranded oil and oiled shoreline material which is often the most protracted part of shoreline clean-up, and; Stage 3 - final clean-up of light contamination and removal of stains, if required. Depending upon the nature of the contamination, progression through each of these stages may not be required, depending on the termination criteria set by the IMT.

Termination criteria outline when continuing clean-up activities may be detrimental to recovery as well as costly (Ecosystem Management and Associates 2008). Termination of response will be determined by the IMT in collaboration with relevant stakeholders and will consider factors including the following:

- the safety of responders
- the current effectiveness of the response
- deteriorating weather conditions (including wind, visibility and sea conditions).

AMSA present guidelines for agreed environmental values and acceptable levels of clean which are useful in guiding the IMT. AMSA (2015) note that the response for shorelines should be terminated when remaining residues are not going to inhibit potential recovery through toxic or smothering effects. Also, ITOPF (2002) suggest the use of three questions to determine when termination of the response should occur:

1) Is the remaining oil likely to damage environmentally sensitive resources?
2) Does it interfere with the aesthetic appeal and amenity use of the shoreline?
3) Is this oil detrimental to economic resources or disrupting economic activities?

If the answers to the questions are no, then there is no rationale to continue shoreline clean up. Ecosystem Management and Associates (2008) suggest that activities can conclude on exposed rocky shores when the shoreline no longer generates sheens that affect sensitive wildlife.

The final decision on whether to activate and terminate a shoreline clean-up response will remain with the WA DoT/NT DIPL, as the Control Agency for the WA/NT shorelines. If a shoreline clean-up response is required at a Commonwealth shoreline (e.g. Ashmore Reef, Cartier Island), the response termination will occur in consultation with AMSA and DEE.

**Arrangements and capabilities**

The arrangements and capabilities as described in the subsections above are summarised in Table 4-2.

**Table 4-2: Arrangement and capabilities – Shoreline clean-up**

| Technique | Resource capability and availability | Implementation time | Activation |
|---|---|---|---|
| Shoreline clean-up personnel | Under the WA DoT State Hazard Plan – Marine Environmental Emergency the relevant Control Agency (WA DoT or INPEX for Commonwealth lands) will provide the On Scene Commander / Division Commander.<br>Trained shoreline response personnel would be available through AMOSC Core Group.<br>• Additional personnel, who would receive on the job training would be sourced from:<br>o INPEX environmental service providers<br>o INPEX general offshore labour hire contracts | 24 hours to mobilise personnel to Broome/Darwin to board vessels and/or helicopters. | IMT via the Emergency Contacts Directory (PER-2153095942). |
| Shoreline clean-up equipment | Shoreline clean-up equipment can be mobilised from the Broome or Darwin stockpiles.<br>Additional shoreline clean-up equipment can be mobilised through AMOSC/AMSA Tier 2/3 stockpiles, or it can be purchased/hired from retail outlets in Broome/Darwin. | 24 hours to mobilise shoreline response equipment from the warehouse to a support vessel alongside in Broome/Darwin Port. | IMT via Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| Helicopters | Crew transfer helicopters (for personnel transfer to designated landing zones only, not to remote shoreline beaches). | Within 5 hours. | IMT via the Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| | Utility helicopters suitable for landing on remote shorelines are available via INPEX aviation call-off arrangements. | Within 7 days. | |
| Vessels | Smaller support vessel assets <40 m in length. | Commence mobilisation in Broome/Darwin within 24 hours. | IMT via the Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| | Larger platform support vessels / accommodation support vessels. | Commence mobilisation in Broome/Darwin within 48 hours. | |

### 4.5.2 Pre-contact and post-contact oiled wildlife response

The INPEX IMT shall consult AMOSC for advice regarding any wildlife response activities, as well as consult the DEE (as the Jurisdictional Authority for wildlife in Commonwealth waters), for any risks from the spill to MNES (including oiled wildlife). In the event that wildlife is oiled on islands which are not WA/NT State/Territory lands (e.g. Ashmore Reef, Cartier Island) the Commonwealth may delegate oiled wildlife management responsibilities to the WA Department of Biodiversity, Conservation and Attractions (WA DBCA).

The INPEX IMT shall also consult, via WA DoT, a WA DBCA 'oiled wildlife adviser' to provide support to for any wildlife response activities, including obtaining permits to conduct an OWR in WA State waters and/or Commonwealth waters, as stated above. OWRs along the WA shoreline areas are managed under the West Kimberley Region Oiled Wildlife Response Plan (DPaW and AMOSC 2015).

More detailed planning regarding a remote shoreline wildlife response is also available in the Browse Island Oil Spill IMG (X060-AH-GLN-60015). This document also provides guidance on response at any remote shoreline location.

Detailed shoreline sectors and oiled wildlife response priorities are defined in the West Kimberley Region Oiled Wildlife Response Plan (DPaW and AMOSC 2015). These plans should be utilised during the planning and execution of any wildlife response along the Kimberley coastline.

AMOSC maintains an 'oiled wildlife response capability register' on behalf of industry to support OWRs. The AMOSC register maintains currency of potential resources, such as:

- equipment and the locations of stockpiles
- response personnel (including global OWR specialists such as Sea Alarm)
- training/exercise materials
- aid (national and international).

WA DBCA and AMOSC have collaboratively developed an OWR model (shown in Figure 4-1) that is based on a small number of OWR adviser(s) who receive specific training at an IMT level to manage an OWR. At a site-management level this is further broken into 'OWR Field Management' who are moderately trained to supervise field response, such as the WA DBCA oiled wildlife advisors and the AMOSC OWR team.

The Oiled Wildlife Rehabilitators Network (fauna care/rehabilitation volunteers, vets, zoo personnel, etc.) is a group of more than 100 Western Australian personnel who have been trained in physical oiled wildlife capture, cleaning, rehabilitation and using the dedicated OWR containers maintained by AMOSC and WA DoT. The Oiled Wildlife Rehabilitators Network personnel are available on a volunteer basis. The list of current personnel is maintained and activated by the WA DBCA. Oiled Wildlife Rehabilitators Network personnel from the Kimberley region could potentially be utilised to support OWR in the NT.

Philip Island Nature Park (Victoria) have over 100 personnel also trained in OWR. These personnel are available, under a 'best endeavours' MoU agreement with AMOSC.

'General Field Responders' are personnel who receive basic 'just-in-time training' to carry out tasks as directed by personnel with higher levels of OWR training. INPEX maintain service agreements with various environmental service providers and general labour hire companies who can provide personnel to assist as general field responders, who would receive on-the-job training to assist with wildlife response activities.

The OWR Division Coordinator (within the IMT) may engage with qualified veterinarian specialists to provide in-field expertise and technical support to the OWR Coordinator.

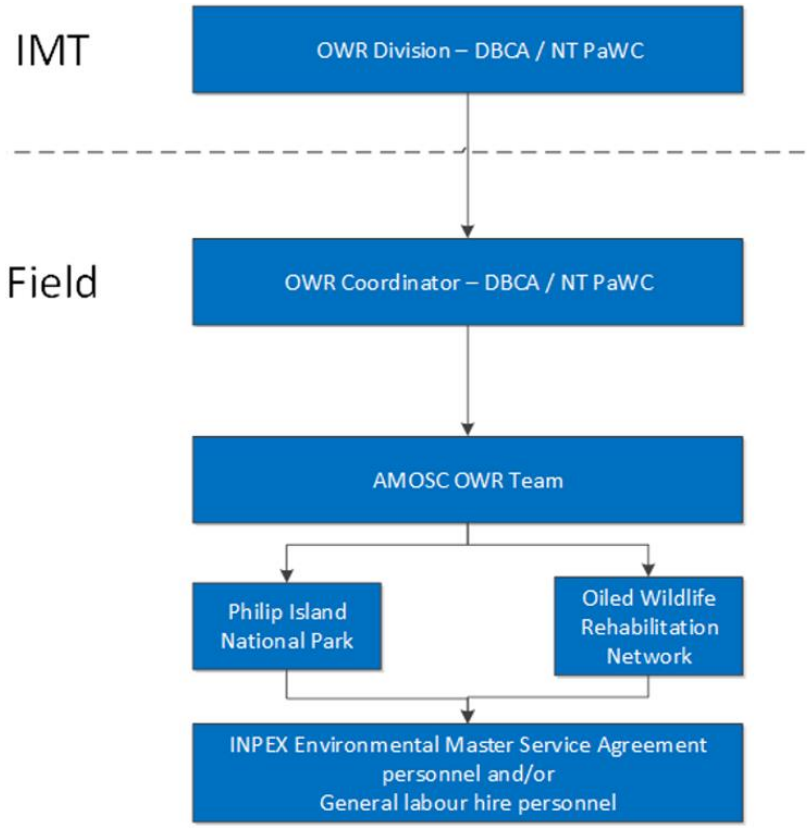



**Figure 4-1: Oiled Wildlife Response Division model**

There are significant logistical constraints and HSE risks with flying personnel in light utility helicopters to remote offshore locations or operating out of small vessels at remote offshore locations. Also, there is the potential to disturb wildlife populations on small islands by landing large numbers of response personnel. Therefore, the number of oiled wildlife responders working in remote locations at any one time will be agreed in consultation with the WA DBCA/NT PaWC oiled wildlife adviser but is likely to be limited to between 20 and 30 people at any one location. Depending on the duration of the operations, this may require the establishment of a one or two week on/off roster system, drawing on trained personnel from AMOSC, Oiled Wildlife Rehabilitators Network, WA DBCA and WA DoT (as discussed above), until the response is terminated.

WA DBCA (previously DPaW) (DPaW pers. comm. 2016)[1] indicates that shore-based response priorities would generally consider the following fauna:

- Priority 1: birds endangered, threatened or protected by treaty
- Priority 2: common birds
- Priority 3: adult nesting female turtles (wipe down only)
- Priority 4: turtle hatchlings (potential translocation).

[1] Personal communication, Mr Brad Daws, Department of Parks and Wildlife, Oil Spill Response Wildlife Management Course, Fremantle, pers. comm. 24-26 May 2016

Response priorities at the time will be finalised in consultation with the WA DBCA/NT PaWC 'oiled wildlife adviser'.

Under specific circumstances, pre-contact wildlife response could potentially be used to prevent or reduce the impacts of a spill on populations of seabirds and turtles. It is most suitable when used on wildlife affected by persistent oily slicks; however, it may also be considered for residuals from Group I or Group II spills. Operational Monitoring and Evaluation of the spill would provide data regarding spill trajectory and potential wildlife that may be affected by the spill.

Wildlife hazing can be an effective control measure when deployed across limited geographical areas and against specific populations, where the surface oil resulting from a spill is largely contained. Hazing could potentially be used to deter marine fauna, seabirds and shorebirds from entering a spill area. It is not an effective measure against volatile spills which rapidly evaporate, nor does it have particular application against dissolved or dispersed oils.

Techniques include:

- vessel traffic that generates underwater noise and motion
- vessel air horns (where available) to create above-water noise
- vessel fire hoses that direct streams of water in front of whales and other fauna.

Oiled wildlife capture at sea is also theoretically possible; however, it would present significant challenges. The capture and relocation of turtle nests/eggs prior to oil arrival or following oil arrival onshore to prevent oiling of emerging hatchlings could be achieved using translocation and release. Onshore incubation and release of hatchlings at alternative locations away from the oil spill is possible, as noted in the Gulf of Mexico oil spill where personnel successfully relocated and incubated approximately 25,000 turtle eggs and successfully released approximately 15,000 turtle hatchlings (which is roughly the same proportion as natural hatchling success) (Gaskill 2010).

Helicopter transport is preferred over vessel transport due to the latter being more likely to disturb egg orientation. An option that is easier, cheaper and less logistically challenging than nest relocation is using drift fencing above high tide line to fence off potential nesting areas, then monitoring fences (particularly at dawn, following night-time hatching events) to capture and relocate hatchlings out of oiled areas.

Under specific circumstances, post-contact OWR (wildlife capture, cleaning and rehabilitation) could potentially be used to prevent or reduce the impacts of a spill on populations of seabirds and potentially other marine megafauna. It is most suitable when used on wildlife affected by persistent oily slicks, however it may also be considered for residuals from Group I and II spills.

In scenarios where an onshore treatment or rehabilitation facility cannot be located close enough to the site of wildlife collection to be acceptable in terms of wildlife welfare (such as the case at Browse Island and many other WA/NT coastline locations) an 'on-water' facility would need to be established. Details of how to activate this are contained in the Browse Island Oil Spill IMG (X060-AH-GLN-60015).

According to DPaW and AMOSC 2015, an ideal 'on-water' OWR centre would:

- accommodate a minimum of 30 oiled wildlife responders
- have suitable deck space to house at least one 20 metre OWR sea container and air-conditioned holding containers
- have an ability to safely load/unload wildlife to and from adjacent vessels (i.e. through rescue hatches or by using a loading crane)

- be able to facilitate washdown of animals and have the ability to store oily waste or have an oil-in-water separator and holding tanks for waste oil.

Following a pre or post-contact OWR activity, a report will be provided by the response team to the IMT Leader regarding the effectiveness of the activity. The report shall include, as a minimum:

- date(s), time(s) and location(s) of wildlife capture and release activities
- statistics of daily and total number of wildlife capture, cleaning, rehabilitation, per species
- the overall effectiveness of wildlife response activities (including photographic evidence, where possible).

The final decision on whether to terminate a shoreline wildlife response will remain with the WA DoT/NT DIPL, as the Control Agency for the WA/NT shorelines. If a shoreline wildlife response is required in Commonwealth waters or shoreline (e.g. Ashmore Reef, Cartier Island, the response termination will occur in consultation with AMSA and DEE.

Termination of response will be determined by the IMT in collaboration with relevant stakeholders and will consider factors including the following:

- the safety of responders
- the current effectiveness of the response
- deteriorating weather conditions (including wind, visibility, sea conditions)
- habitats are deemed clear from risk of oiling
- lack of presence of oiled wildlife remaining in the affected area; or the numbers of affected wildlife being captured fall towards the agreed threshold for ceasing operations
- stabilisation and transportation of all captured wildlife has taken place
- collection and removal of carcasses has occurred.

The Western Australian Oiled Wildlife Response Plan (DPaW and AMOSC 2014) notes that options to assist the IMT make a decision on response termination include setting an agreed threshold for ceasing operations, as well as thresholds for scaling back rescue operations.

The final decision on whether to terminate a shoreline wildlife response will remain with the WA DoT/NT DIPL, as the Control Agency for the WA/NT shorelines. If a shoreline wildlife response is required at a Commonwealth shoreline (e.g. Ashmore Reef, Cartier Island), the response termination will occur in consultation will occur with AMSA and DEE.

**Arrangements and capabilities**

The arrangements and capabilities as described in the subsections above are summarised in Table 4-3.

**Table 4-3: Arrangements and capabilities – Pre-contact and post-contact oiled wildlife response**

| Technique | Resource capability and availability | Implementation time | Activation |
|---|---|---|---|
| Oiled wildlife response personnel | Under the WA DoT State Hazard Plan – Marine Environmental Emergency, the relevant Control Agency (WA DoT, or INPEX for Commonwealth waters/lands) will provide the On Scene Commander / Division Commander.<br>WA DBCA will provide the in-field Oiled Wildlife Coordinator, and potentially additional wildlife response personnel (via WA DoT, under the West Australian Oiled Wildlife Response Plan, West Kimberley Region Oiled Wildlife Response Plan).<br>Approximately 20–30 trained OWR personnel would be available through the following sources:<br>• AMOSC Oiled Wildlife Response Team<br>• WA DBCA/NT PaWC OWR personnel<br>• Oiled Wildlife Rehabilitators Network<br>• Philip Island Nature Park<br>• Additional personnel, who would receive on the job training would be sourced from:<br>o AMOSC core-group<br>o INPEX environmental service providers<br>o INPEX general offshore labour hire contracts. | 24 hours to mobilise personnel to Broome/Darwin, to board vessels and/or helicopters. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| Oiled wildlife response kit | Section 3 of the West Kimberley Oiled Wildlife Response Plan identifies a large number of OWR kits, including those located in Broome, Exmouth and Dampier.<br>AMOSC maintains an 'oiled wildlife response capability register' on behalf of industry to support an OWR. | The AMOSC Broome OWR kit is available to mobile to a vessel in Broome Port within 24 hours. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| Helicopters | Crew transfer helicopters (for personnel transfer to designated landing zones only, not to remote shoreline beaches). | Within 5 hours (daylight only). | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| | Utility helicopters suitable for landing on remote shorelines. | Within 7 days. | |
| Vessels | Smaller support vessel assets < 40 m in length. | Commence mobilisation in Broome/Darwin within 24 hours. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| | Larger platform support vessels / accommodation support vessels. | Commence mobilisation in Broome/Darwin within 48 hours. | |

### 4.6 Waste management

Waste will be managed in accordance with the INPEX Waste Management Standard (0000-AH-STD-60047), MARPOL 73/78 Annex V – Garbage, relevant Commonwealth and State/Territory regulations regarding disposal of waste generated as a result of spill-response strategies.

**On-site transportation and storage of waste**

As soon as the details of a spill become evident, a Waste Management Plan, developed in consultation with AMOSC and the relevant control agency shall be developed, to ensure the ongoing supply and backload of appropriate waste management equipment.

Based on the maximum credible spill scenarios modelled, large volumes of waste are not expected to be generated. Therefore, waste storage on remote shorelines and support vessels can be manage with small, easily transportable waste receptacles.

Table 4-4 outlines the waste storage, disposal and treatment options available for the various oily waste streams.

All waste stored or transferred will be fully documented, including details of exact volume and nature of the waste, date and time, receiver of the waste and destination of the waste, in accordance with vessel Garbage Management Plans and the onshore licenced waste contractor's waste tracking process.

**Table 4-4: Waste storage, disposal and treatment options for hydrocarbon-contaminated waste.**

| Waste category | On-site storage option | Transport and disposal options | Location of waste management capabilities | End destination |
|---|---|---|---|---|
| Solid wastes, including oily residue (e.g. waxy residual condensate and diesel; oiled organic materials such as sand and seagrass). | Impermeable bulka bags<br>Lined skips<br>Oil drums<br>1 $m^3$ IBCs<br>Industrial waste bags | Oily waste containers will be back-loaded by tender or light utility helicopter to the support vessel for temporary storage offshore, prior to transport to shore.<br><br>The waste would then transport to shore for appropriate disposal:<br>• recovery and recycling<br>• bioremediation<br>• land farming<br>• incineration<br>• landfill | INPEX Broome supply base | Licensed waste contractor – Broome and/or Darwin. |
| Solid wastes, including oiled man-made materials (e.g. PPE, booms and sorbent pads). | Impermeable bulka bags<br>Lined skips<br>Oil drums<br>1 $m^3$ IBCs<br>Industrial waste bags | Oily waste containers will be back-loaded by tender or light utility helicopter to the support vessel for temporary storage offshore, prior to transport to shore.<br><br>The waste would then transport to shore for appropriate disposal:<br>• recovery and recycling<br>• incineration<br>• landfill | INPEX Broome supply base | Licensed waste contractor – Broome and/or Darwin. |
| Liquid wastes, including condensate, diesel and oily water. | Oil drums<br>1 $m^3$ IBCs<br>Slops tanks on vessels | Oily waste containers will be back-loaded by tender or light utility helicopter to the support vessel for temporary storage offshore, prior to transport to shore.<br><br>The waste would then transport to shore for appropriate disposal:<br>• recovery and recycling<br>• incineration<br>Alternatively, a support vessel may use its MARPOL compliant oily water treatment system to treat and dispose of oily water offshore. | Onboard vessels/MODU and INPEX Broome supply base | Licensed waste contractor – Broome and/or Darwin. |
| Biological oiled waste (e.g. euthanised oiled wildlife). | Impermeable bulka bags<br>Oil drums<br>1 $m^3$ IBCs<br>Industrial waste bags | Oily waste containers will be back-loaded by tender or light utility helicopter to the support vessel for temporary storage offshore, prior to transport to shore.<br><br>The waste would then transport to shore for appropriate disposal:<br>• incineration<br>• landfill | INPEX Broome supply base | Licensed waste contractor – Broome and/or Darwin. |

**Arrangements and capabilities**

The arrangements and capabilities as described in the subsections above are summarised in Table 4-5.

**Table 4-5: Arrangements and capabilities – Waste management**

| Technique | Resource capability and availability | Implementation time | Activation |
|---|---|---|---|
| Waste receptacles | MARPOL compliant vessel oily water storage/treatment systems. | Already onboard vessel. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| | Impermeable bulka bags<br>Lined skips<br>Oil drums<br>Industrial waste bags<br>1 m$^3$ IBCs<br>Oil barges<br>Flexible bladders | Available from licenced waste contractor, to be delivered to Broome supply base within 24 hours. | |
| Waste disposal | Undertaken by a licensed waste contractor in Broome and/or Darwin. Waste disposal includes:<br>• recovery and recycling<br>• bioremediation<br>• land farming<br>• incineration<br>• landfill<br>• water treatment and discharge. | N/A. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| Helicopters | Utility helicopters suitable for landing on remote shorelines. | Within 7 days. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| Vessels | Smaller support vessel assets < 40 m in length. | Commence mobilisation in Broome/Darwin within 24 hours. | IMT via the INPEX Emergency Contacts Directory (PER-2153095942) and the Oil Spill Preparedness and Response Register (PER-2153236568). |
| | Larger platform support vessels / accommodation support vessels. | Commence mobilisation in Broome/Darwin within 48 hours. | |

### 4.7 Operational and scientific monitoring

In 2011, an Operational and Scientific Monitoring Program (OSMP) was developed by the Environment Group Browse Basin (of which INPEX is a member). The program encompasses a number of individual Operational Monitoring (OM) and Scientific Monitoring (SM) programs to guide a spill response, assess potential environmental impacts and inform any remediation activities. The OSMP described in this OPEP has been reviewed and refined for the emergency conditions described in Section 8 of the EP. The OSMP is presented in Appendix A, with a division of the OM and SM programs, as follows:

- Operational monitoring is to commence as soon as a spill occurs and aims to characterise the nature and scale of the spill for the duration of the spill. Monitoring is designed to collect information on the predicted spread of the oil and the locations it may impact and, in turn, the OM informs and supports a secondary oil spill response, such as wildlife hazing, as well as the scientific monitoring.
- Scientific monitoring is the investigation component which assesses the overall impact and recovery of the ecosystems which have been exposed to hydrocarbons and response activities, as informed by the OM program.

The OM and SM programs are summarised in sections 4.7.1 and 4.7.2 with further program-specific details, including objectives and triggers for activating and terminating each OM and SM, provided in Appendix A.

Each OM/SM will be tailored, activated and terminated as appropriate to the characteristics, nature and scale of the spill under the supervision of the INPEX IMT Leader, in consultation with:

- the INPEX IMT environmental adviser
- AMOSC
- environmental service providers
- AMSA (for vessel-based spills)
- environmental science coordinators (WA DoT) for spills entering WA waters.

INPEX will maintain a contract with an environmental service provider (ESP) to allow the timely implementation of the OM/SM programs following notification of a Level 2 or Level 3 spill. Details of the ESPs Operational and Scientific Monitoring programs will be maintained in the ESPs Project Execution Plan.

This contract ensures the timely activation of field surveys and delivery of results from survey activities/studies. Results arising from OSMP will be technically reviewed by subject matter experts as determined by the ESPs project manager and technical lead prior to submission to the INPEX environment team.

The monitoring programs will be designed to be repeatable so that in the event of a Level 2 or Level 3 spill there is continuity throughout all monitoring phases to detect potential impacts and subsequent recovery. This will include the use of before–after, control–impact (BACI) design or gradient design monitoring programs for impact detection, as appropriate. However, it is important to note that the actual OSMP design will be dependent on the outcomes and any recommendation from baseline monitoring; receptors potentially to be impacted and the nature and scale of the spill. Further details on baseline information are provided in Section 4 of the EP. INPEX will organise and implement the OSMP for spills for which INPEX is the Control Agency (i.e. Facility based spills), as displayed in Figure 4-2.

While AMSA is responsible for monitoring in instances where AMSA is the Control Agency (i.e. vessel-based spills), INPEX will provide support to AMSA in accordance with the MoU (AMSA and INPEX 2013).

The person responsible for activating and terminating the OSMP is the INPEX IMT Leader (in consultation with those personnel listed above), as shown in Figure 4-2. Consultation with relevant regulatory authorities, regarding progress and outcomes of the OSMP, will occur as part of ongoing notifications and reporting during a Level 2 or Level 3 spill.

All scientific report outputs associated with this OSMP will undergo timely peer review by appropriate subject matter experts; for example, those from contracted environmental service providers.

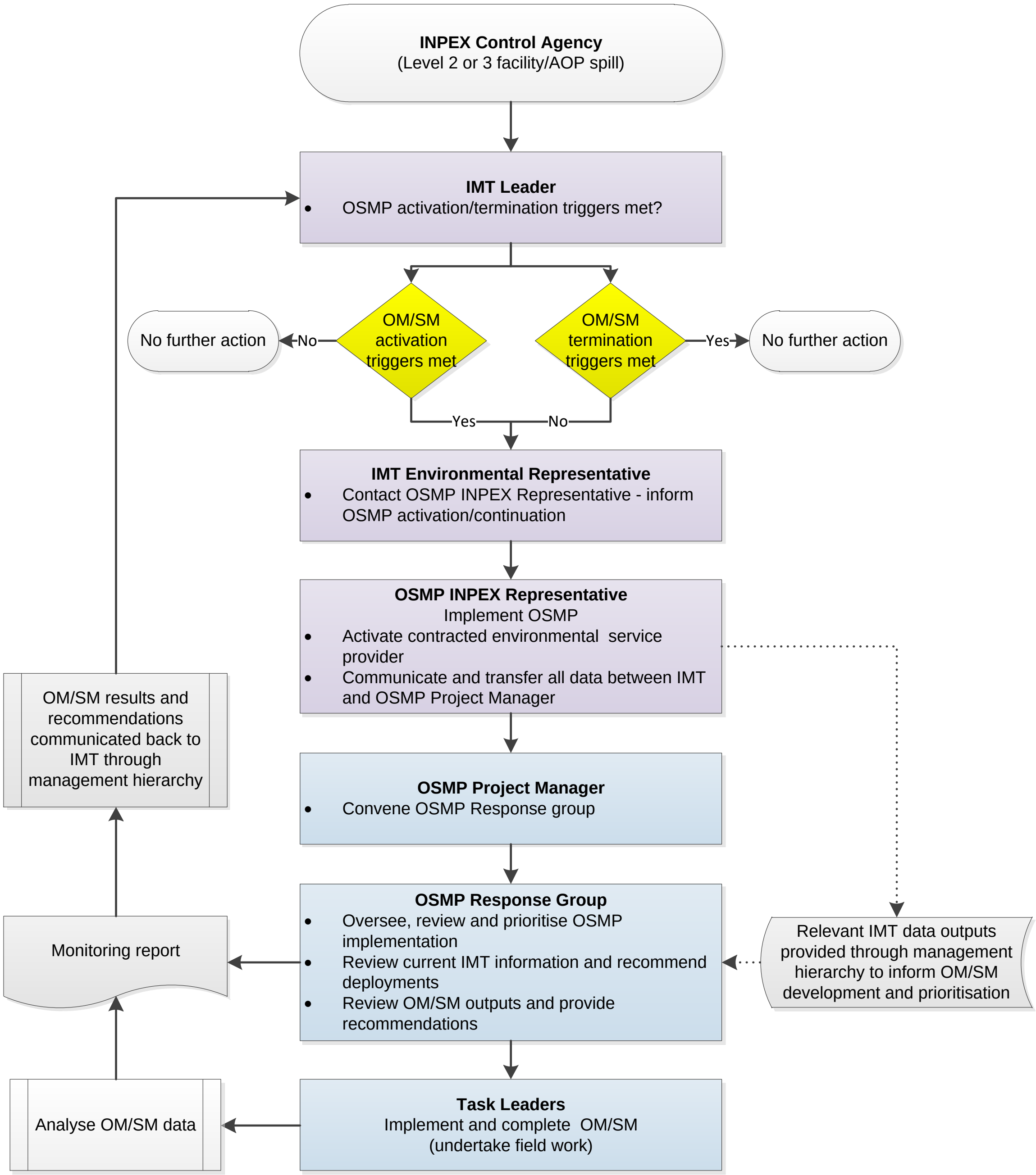



**Figure 4-2: OM and SM activation, termination and communication flowchart**

### 4.7.1 Operational monitoring

The focus of the OM program is to assist the IMT to maintain situational awareness by providing information regarding the nature and scale of a spill, and the values and sensitivities at risk.

Information from the OM program also drives the response strategy with regards to triggering and monitoring the effectiveness of secondary response measures, such as wildlife hazing (if required). The data outputs will also be used to trigger the longer-term SM programs (as required).

A summary of the OM programs is provided in Table 4-6. In summary, OM03 and OM01 will be supported by OM04 and OM06. OM04 and OM06 require analysis of water and sediment quality (e.g. laboratory analysis of samples, calibrated field instruments) and will be completed as soon as it is practical to mobilise vessels to the area (nominally seven days). Surface slicks tracked or modelled as part of OM03 and OM01 respectively, may provide an initial indication of the location of any entrained or dissolved hydrocarbons. This will then drive the desktop review of key areas and environmental sensitives at risk from the spill (OM05). Additional details are provided in Appendix A.

**Table 4-6: Summary of operational monitoring programs**

| OM # | Monitoring program | Monitoring method(s) | Data output |
|---|---|---|---|
| OM01 | Oil Spill Trajectory Modelling | Forecast and hindcast modelling. | Forecast and hindcast modelling of movement and weathering of oil. This enables the identification of values and sensitivities that may be impacted and drives the response strategy with regards to any secondary response measures and scientific monitoring that may be implemented. |
| OM03 | Oil Spill Surveillance and Reconnaissance | Vessel and aerial surveillance, satellite imagery and satellite tracking buoys. | Assess the colour, consistency, distribution and locations of the surface slicks. Identify values and sensitivities likely to be impacted by the spill. This assists in validation of the model. |
| OM04 | Operational Monitoring of Oil Properties, Behaviour and Weathering at Sea | Vessel-based water sampling. | Assess hydrocarbon physical and chemical properties, as well as the spatial and temporal extent. This assists in validation of the model and identifies any scientific monitoring that may be implemented. |
| OM05 | Pre-emptive Desktop Assessment of Sensitive Resources | Desktop analysis of baseline data. | Detailed analysis of values and sensitivities that may be impacted. Identifies any secondary response measures and scientific monitoring that may be implemented. |

| OM # | Monitoring program | Monitoring method(s) | Data output |
|---|---|---|---|
| OM06 | Assessment of the Presence and Quantity of Petroleum Hydrocarbons in Water and Sediments | Vessel-based water and sediment sampling. | Assess hydrocarbon physical and chemical properties, as well as the spatial and temporal extent in water and sediment. This assists in validation of the model and identifies any scientific monitoring that may be implemented. |

### 4.7.2 Scientific monitoring

The SM program does not directly inform spill response operations directed by the INPEX IMT. It does, however, assess the overall impact and subsequent recovery of the identified values and sensitivities to hydrocarbon exposure and oil spill response activities.

SM will only be undertaken in the event of a Level 2 or Level 3 spill and where the information obtained through the OM program indicates values and sensitivities are predicted to be impacted or have been impacted.

SM will be consistent with the nature and scale of the spill and sufficient to inform any remediation activities, where appropriate. It may begin before the termination of similar OM activities. Details on the SM program are provided in Appendix A.

As discussed in Section 8 of the EP, any wind driven entrained components of a Group II surface spill, including dispersed oils, will remain within the top 30 m (with the vast majority in the top 10 m) of the water column. Therefore, for all surface spills, SM relating to water quality (SM05), sediment quality (SM06) and intertidal and benthic environments (SM07 and SM08) will only be activated where OM indicates potential impacts to areas shallower than –30 m LAT.

However, entrained and dissolved hydrocarbons will potentially be present through the full depth of the water column in the event of a seabed release of condensate. Therefore, all SM programs could potentially be activated because of a loss of well containment.

All Level 2 and Level 3 spills have the potential to impact planktonic communities. Therefore, SM09 has been included.

A seabed release of condensate and a surface diesel spill could potentially impact marine megafauna such as cetaceans, dugongs, turtles, whale sharks and marine avifauna. Therefore, SM10 and SM11 have been included in order to monitor for potential impacts and recovery of MNES within Biologically Important Areas (BIAs) or other identified populations.

As commercial, recreational and traditional fishing all occur within the EMBA, SM12 has been included to understand potential impacts to this sensitivity.

During a loss of well containment, subsea dispersant injection (SSDI) may be undertaken for the purposes of reducing VOC risks to source control response teams. Monitoring of VOC concentrations in atmosphere from a safety perspective will determine the dispersant concentrations used, as described in Section 8 of the EP. Monitoring of residual dispersant concentrations in the water column, to validate impact predictions provide in Section 8 of the EP, will be implemented via activation of SM04.

Note that limited information is presented in Appendix A with respect to timings for implementation of the SM program. Unlike the OM program, in order to implement an effective SM program, thorough planning is required to ensure the correct data is collected with respect to confirming potential lasting impacts from a spill. This relies on data outputs generated from the OM program and therefore the planning stage may take additional time. Mobilisation times for the SM program will be as soon as practicable given the context of the area and mobilisation will generally commence within 7 days of receipt of notification.

### 4.7.3 Baseline data to support the OSMP

A range of data has been used to establish the environmental baseline in the Browse Basin as described in Section 4 of the EP. This includes information collected during various environmental surveys completed by INPEX (2006-2009) and the Applied Research Program (ARP) partnership between Shell, INPEX and the Australian Institute of Marine Science (AIMS) (2014–2018). The focus of the ARP was to collect baseline data to inform understanding of the extent, severity and persistence of impacts in the unlikely event that a significant spill occurs during the activity.

In addition to INPEX-collected data, INPEX is also a member of the Industry-Government Environmental Metadata (I-GEM) project. The pilot I-GEM project was completed in 2014 and contains accessible metadata from industry, research institutes and government organisations Australia-wide, which were uploaded to the Australian Ocean Data Network (AODN) portal. Metadata searches can be conducted via the AODN portal and the standalone I-GEM website which contain data sets from the Abrolhos Islands to the Timor Sea, out to the extent of Australia’s exclusive economic zone (EEZ).

Published monitoring reports from the Montara spill augment this data both spatially and temporally. Further to this, extensive multi-year monitoring programs have been undertaken by other operators (e.g. Woodside and Shell) in the Browse Basin, which also augment the INPEX data, spatially and temporally, for physical and biological aspects of the environment.

Research institutes and organisations such as AIMS, the Western Australian Museum and Monash University have also conducted long-term monitoring programs in the Browse Basin. This data further increases the environmental understanding of the region. INPEX has also formalised an agreement with WA DBCA which confirms WA DBCA will supply environmental data (including Western Australian Marine Science Institution data (C075-PAW-IPX-LE-00001)) to INPEX Australia in the event of an incident or oil spill in the nearshore/coastal waters of the region.

Information collected from these surveys, as well as the ARP program, provide a substantial baseline on the marine flora, fauna and habitats which may be referenced in the event of a Level 2 or Level 3 spill event. The current states of knowledge for receptors in the Browse region relevant to this OPEP are described in Section 4 of the EP.

## 4.8 Health and safety

Health and safety considerations will be incorporated into any spill response.

INPEX health and safety objectives are to:

- adhere to the INPEX PEARS philosophy as detailed in the INPEX Emergency and Crisis Management Standard (Doc. No. PER-0000-AH-STD-60051)
- provide a safe working environment and prevent workplace incidents by managing risks to ALARP
- eliminate, or minimise all environment and community risks to ALARP and ensure any impacts are neither serious nor long-lasting
- ensure the security of INPEX personnel, assets and information.

The IMT should develop a Safety Management Plan utilising the National Plan Guidance on Marine Oil Spill Response Health and Safety document (AMSA 2018).

Contractors are responsible for the development of site-specific risk assessments before undertaking any activities.

The safety of personnel is the primary concern in a spill incident. An individual risk assessment, such as a job hazard analysis (JHA), will always be conducted by a response contactor or other appointed or responsible personnel, such as the HSE manager or supervisor.

If the response is conducted by a Control Agency other than INPEX (i.e. AMSA), that agency is expected to adhere to stringent safety procedures as outlined in their respective oil spill response plans (i.e. the NatPlan).

Table 4-7 provides examples of hazards and risks that may be encountered during a response to a spill.

**Table 4-7: Examples of health and safety risks from spill response**

| Hazards | Risks | Prevention and mitigation considerations |
|---|---|---|
| Inadequately trained personnel carrying out the response | Lack of appropriate training | Prior to any response being implemented, a HSE Plan must be prepared, and will identify induction/on-the-job training requirements, and associated JHAs etc.<br><br>All personnel must complete the induction/on-the-job training and sign onto the JHA prior to commencing work.<br><br>Appropriately qualified personnel, such as AMOSC core-group members, will be appointed as field response team leaders, and will provide on-the-job supervision and training (as required) to other response team members. |
| Flammability | Fire and explosion | Avoidance/exclusion zone around the well/MODU associated loss of containment. |
| | | Firefighting capacity of INPEX-contracted vessels and their tenders as per flag state requirements and INPEX standards. |
| | | Permit to work (PTW) system and JHAs applied to all activities. |

| Hazards | Risks | Prevention and mitigation considerations |
|---|---|---|
| Toxicity of hydrocarbon | Inhalation, ingestion or contact with skin or eyes leading to dermal irritation or illness | Air quality monitoring equipment, to protect the health of oil spill responder personnel, is available as part of the Broome Supplementary Stockpile. |
| | | PPE including respiratory protection, coveralls, gloves, glasses, boots and barrier gels, to be provided to all personnel working on the response. |
| | | Clean-up area provided for responders to decontaminate and remove soiled clothing. Ample quantity of clean PPE available. |
| Manual handling | Manual handling injuries | Use of cranes, or large teams of trained personnel, to lift response materials as required. |
| Slips, trips and falls | General injury | Hydrocarbon waste and used absorption equipment will have dedicated waste receptacles. Additional supply of absorption material to be located at access and egress points from vessels and/or in and out of offices, to mitigate the additional risk of slipping on oily surfaces, and to minimise the spread of hydrocarbons. |
| | | Designated and separate, clean and contaminated work areas and movement routes in all work areas. |
| Working over water | Drowning | Mandatory use of lifejackets when working over water and independent sentry posted to monitor activity.<br>"Man overboard" procedures clearly defined and included in personnel inductions and ongoing training.<br>PTW from vessel master to be in place for personnel working over water. |
| Dangerous marine fauna | Bites, stings and other injury from marine fauna | No personnel are permitted in the water.<br>Sentry in place whenever personnel are working over the water and to watch for fauna. All work will be done under a PTW from a response contractor.<br>Any personnel retrieving equipment or wildlife from the water will be alert to marine animals.<br>All personnel working to retrieve equipment or wildlife from the water will be equipped with gloves and protective clothing, and all retrieved equipment will be washed to remove any marine life. |
| Working from helicopters | Helicopter downed | As a minimum, any helicopter working for an INPEX response must meet the INPEX minimum aviation standards.<br>Any personnel working from a helicopter over water must have a completed Tropical Basic Offshore Safety Induction and Emergency Training (TBOSIET) certificate or equivalent. |

| Hazards | Risks | Prevention and mitigation considerations |
|---|---|---|
| Excessive working hours | Fatigue | Personnel will work under the applicable working-hour limitations. As a minimum, the INPEX fitness-for-work standard will be used as a template for all INPEX employees.<br>There will be monitoring of fatigue and personnel fitness by work supervisors.<br>A roster will be established to allow change-out of personnel as required, depending on the nature and duration of the spill response. |
| Weather | Dehydration, heatstroke | The INPEX fitness-for-work standard and the fatigue guidelines will be used as minimum requirements. |
| Quarantine | Human communicable diseases | Browse Island and other locations within the traditional fishing MoU box have the potential for contact between spill response personnel and Indonesian fishermen. Communicable diseases, such as tuberculosis can be transmitted from human to human.<br>Inductions need to communicate that no contact with Indonesian fishermen is permitted, and appropriate controls will be implemented to mitigate this risk. |
| Unexploded Ordnance (Cartier Island) | Vessel damage / fatality | Cartier Island and the surrounding marine area within a 10 km radius was a Defence Practice Area up to 2011.<br>Although the site is no longer an active weapons range there is a SUBSTANTIAL RISK that UXO remains in the area.<br>Due to the risk posed by UXO, landing on Cartier Island or anchoring anywhere within the Cartier Island Commonwealth Marine Reserve is strictly prohibited without express, prior written approval. If anchoring is unavoidable due to an emergency (e.g. extreme weather conditions), great care should be taken to ensure anchoring is on sand and that anchors do not drag.<br>Any metal objects or suspicious objects found in the reserve should not be touched or disturbed and reported immediately to the police and the Parks Australia Work Health and Safety Advisor on (02) 6274 2369 or parks.healthandsafety@environment.gov.au |

The Browse Island Oil Spill IMG (X060-AH-GLN-60015) contains completed HAZID reports for helicopter, vessel and shoreline response activities. These HAZID reports should be used to generate HSE plans and associated JHAs for shoreline response activities.

# 5 INPEX forms and guidance

Table 5-1 has been copied from the Oil Spill Forms Register (PER-2153332031).

The table provides rapid access for IMT personnel to forms needed during an oil pollution emergency event. Not all of the forms on this table are relevant to the spill event described in the EP. Please use the most recent version of the controlled copy of the Oil Spill Forms Register (PER-2153332031) during an emergency response.

**Table 5-1: Oil Spill Response Forms**

| Form type | Form title | Purpose | Reporting timeframe | Applicable for oil spills in | | | | Document reference (Coreworx, DMS or URL) |
|---|---|---|---|---|---|---|---|---|
| | | | | Darwin Harbour | NT | WA | Cwlth Waters | |
| Notify & Report | NT Oil spill notification report (POLREP) - as per NT OSCP | Notify the following external parties of an oil spill in NT waters:<br>• Darwin Port Corporation (DPC) for spills inside Darwin Port limits<br>• NT Department of Infrastructure, Planning and Logistics (NT DIPL) – Marine Safety Branch for spills inside Territory waters (but outside Darwin Port limits)<br>• NT Environment Protection Authority (NT EPA) for spills inside Territory waters and/or Darwin Port limits<br>(NOTE: The NT POLREP is a modified version of AMSA's Marine Pollution Report (POLREP).<br>(IMT Environment to obtain copy). | < 2hrs | ✓ | ✓ | | | C020-AG-FRM-0008 |
| | NT Incident update report (SITREP) – as per NT OSCP | Notify the following external parties of an oil spill in NT waters:<br>DPC for spills inside Darwin Port limits<br>NT DIPL – Marine Safety Branch for spills inside Territory waters (but outside Darwin Port limits)<br>NT EPA for spills inside Territory waters and/or Darwin Port limits<br>(NOTE: The NT SITREP is a modified version of AMSA's Marine Pollution Situation Report (SITREP) available at www.amsa.gov.au)<br>(IMT Environment to obtain copy). | Daily<br>Or as situation changes significantly | ✓ | ✓ | | | C020-AG-FRM-0010 |
| | AMSA harmful substances report (POLREP) | Facility OIM / Vessel master to report marine pollution incidents in Commonwealth waters to AMSA.<br>(IMT Environment to obtain copy). | < 2hrs | | | | ✓ | C075-AH-FRM-10009 |
| | WA Department of Transport - POLREP<br><br>WA Department of Transport - SITREP | Facility OIM / Vessel master to report marine pollution incidents, which **may** threaten WA waters / lands to WA DoT.<br>(IMT Environment to obtain copies of POLREP/SITREP). | Immediately | | | ✓ | | https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf<br>https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-SituationReport.pdf |
| | WA Department of Water and Environment Regulation (DWER) - Online Pollution Report | Pollution onto WA land (i.e. oil contacting WA shoreline) is to be reported online.<br>(IMT Environment to complete). | < 12 hrs | | | ✓ | | http://www.der.wa.gov.au/your-environment/reporting-pollution/report-pollution-form |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Offshore occurrence report form (Western Australian Department of Mines & Petroleum (DMP)) | Report to DMP for marine incidents within the 3 nautical mile limit (WA State waters) by INPEX IMT Leader.<br>This includes reporting oil spill incidents that originated in commonwealth or NT waters, but moved into WA State waters.<br>(IMT Environment to complete). | < 3 days | | | ✓ | | DEV-CEX-FM-0002 |
| | Report of a known or suspected contaminated site (*Contaminated Sites Act 2003 (WA)*) | Report to WA DWER of a contaminated site on land, shoreline or seabed within WA State waters (within 3 nm).<br>(IMT Environment to complete). | < 21 days | | | ✓ | | DEV-CEX-FM-0001 |
| | NOPSEMA incident report form<br>(FM0831) | Report to NOPSEMA offshore incidents in accordance with relevant OPEP (typically this is only required for Level 2 or 3 spills).<br>(INPEX IMT Leader to issue report)<br>NOTE: NOPSEMA must be verbally notified within 2 hours after becoming aware of the incident | < 3 days | | | | ✓ | C075-AH-FRM-10007 |
| Log | Emergency incident log | Record the specific activities undertaken by personnel during an oil spill response<br>(Individual form optional for IMT<br>Carbon copy incident log books also available) | Ongoing during emergency | ✓ | ✓ | ✓ | ✓ | C020-AG-FRM-0005 |
| | Telephone call record | Record all phone calls, both incoming and outgoing, particularly those to and from government agencies, external support agencies, employees' families, etc.<br>(Individual form optional for IMT<br>Carbon copy incident log books also available) | Ongoing during emergency | ✓ | ✓ | ✓ | ✓ | C020-AG-FRM-0007 |
| | Dispersant Activity Log | To be completed by vessel master (for dispersant applied by vessel) or by an aerial observer (for dispersant applied by aircraft)<br>(Field personnel to prepare) | Ongoing during emergency | ✓ | ✓ | ✓ | ✓ | C075-AH-LOG-10000 |
| Situational Awareness | Oil Spill Observation and Visual Dispersant Guide for Aircraft and Vessels | Provide guidance to vessel and aircraft operators on how to identify oil spills; record their location; estimate the oil thickness, quantity of oil and area affected; look for colour changes to oil once dispersant has been applied and assess effectiveness; instructions to take photos or video footage; and reporting protocols.<br>(Field personnel to prepare) | Ongoing during emergency | ✓ | ✓ | ✓ | ✓ | 0000-AH-GLN-60054 |
| | Shoreline clean-up and assessment technique (SCAT) | Assess the state of the shoreline or commonwealth shoals (i.e. Carter Island, Ashmore Reef) should a spill make contact (or if there is a significant threat of a spill making contact)<br>(Field personnel to prepare ). | Prior to shoreline contact (i.e. <12-24 hrs) | ✓ | ✓ | ✓ | ✓ | C020-AG-FRM-0012 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Ongoing until termination | | | | | |
| Modelling | RPS Search & Rescue request form | Search & request form to activate RPS to conduct trajectory modelling under Contract # 800767<br>(IMT Environment to request) | Info only | NA | NA | NA | NA | C075-AH-FRM-10001 |
| | RPS Oil Spill Modelling Response Procedures and Interpret Subsequent Results | Procedure: How to Activate RPS Oil Spill Modelling Response Procedures and Interpret Subsequent Results<br>(info only) | Info only | NA | NA | NA | NA | PER-2153332031 |
| | RPS oil spill trajectory modelling request form | Modelling request form to activate RPS to conduct oil spill trajectory modelling under Contract # 800767<br>(IMT Environment to request) | < 2 hrs | ✓ | ✓ | ✓ | ✓ | C020-AG-FRM-0015 |
| | RPS oil spill trajectory model update form | Update of oil-spill trajectory to RPS<br>(IMT Environmental to request) | Daily | ✓ | ✓ | ✓ | ✓ | PER-2153332031 |
| | RPS Gas or Vapour Plume Modelling request form | Modelling request form to activate RPS to conduct gas and vapour modelling under Contract # 800767<br>(IMT HS Officer to request) | < 2 hrs | ✓ | ✓ | ✓ | ✓ | C075-AH-FRM-10003 |
| | RPS Chemical Spill Trajectory Modelling Request Form | Modelling request form to activate RPS to conduct chemical spill trajectory modelling under Contract # 800767<br>(IMT Environmental to request) | < 2 hrs | ✓ | ✓ | ✓ | ✓ | C075-AH-FRM-10004 |
| AMOSC/OSRL | AMOSC mobilisation and authorisation form | In order to mobilise AMOSC, a service contract must be completed by the IMT Leader to identify AMOSC requirements for equipment, consumables, personnel, advice and estimated duration.<br>(IMT Leader to sign) | > Level 2 incident | ✓ | ✓ | ✓ | ✓ | NA |
| | OSRL notification form | To notify Oil Spill Response Limited of an incident that may requires support under the terms of the Agreement (ORSL #129).<br>(IMT Environmental to request) | > Level 2 incident | ✓ | ✓ | ✓ | ✓ | C075-AH-FRM-10005 |
| | OSRL mobilisation form | To authorise activation of Oil Spill Response Limited and its resources in connection with an incident under the terms of the Agreement (ORSL #129).<br>(IMT Environmental to request) | > Level 2 incident | ✓ | ✓ | ✓ | ✓ | C075-AH-FRM-10006 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Wildlife Permit | Permit to interfere with EPBC listed species | General permit application for interfering with threatened species and ecological communities, migratory species, whales and dolphins and listed marine species.<br>(IMT Environmental to prepare) | As required | NA | NA | NA | ✓ | C075-AH-FRM-10010 |
| | Wildlife Status and Situation Report | To record situation of wildlife found, whether they are alive (or dead) and if they have been (or are planned to be) cleaned and/or released.<br>(IMT Environmental to prepare) | As required | | | ✓ | ✓ | Appendix J of<br>C075-AH-REP-10086 (WA Oiled Wildlife Response Plan) |
| | Wildlife Rescue & Release Form | This form is to accompany any live oiled wildlife from the time it is rescued until it is released or euthanized. The form should record each time an animal is cleaned, transported etc and any general observations (of improvement, decline) made during its rehabilitation.<br>(IMT Environmental to prepare) | As required, per oiled wildlife | | | ✓ | ✓ | Appendix J of<br>C075-AH-REP-10086<br>(WA Oiled Wildlife Response Plan) |
| | Fauna Admission Form (Vet to complete) | This form is to be used to when admitting the oiled wildlife to a veterinary clinic.<br>(Vet to prepare) | As required, per oiled wildlife admitted to vet | | | ✓ | ✓ | Appendix J of<br>C075-AH-REP-10086<br>(WA Oiled Wildlife Response Plan) |
| WA DoT Cross Jurisdiction Spill | IMT Handover Checklist (cross jurisdictional arrangements) | For use by IPX IMT-Leader, to check handover of relevant incident information to WA DoT IMT-Leader, when INPEX spill moved into WA Waters | | | | ✓ | | PER-2153261255 |
| | IMT Functions and Lead IMT Designations (cross jurisdictional arrangements) | For use by IPX IMT-Leader, and WA DoT IMT-Leader, to define each IMT 'lead' roles, when INPEX spill moved into WA State waters and a cross jurisdictional spill response is underway. | | | | ✓ | | PER-2153261254 |

# 6 References

AMOSC–see Australian Marine Oil Spill Centre.

AMSA—see Australian Maritime Safety Authority.

AMSA and INPEX—see Australian Maritime Safety Authority and INPEX Operations Australia Pty. Ltd.

ANZECC/ARMCANZ—see Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

APASA—see Asia-Pacific Applied Science Associates.

Asia-Pacific Applied Science Associates (APASA). 2013. Brewster Development Wells WA 285: Quantitative Oil Spill Exposure Modelling. J0203. Report prepared by Asia-Pacific Applied Science Associated. Prepared for INPEX Operations, Perth, Western Australia.

Australian and New Zealand Environment and Conservation Council / Agriculture and Resource Management Council of Australia and New Zealand. 2000. *Australian and New Zealand guidelines for fresh and marine water quality*. Australian and New Zealand Environment and Conservation Council, Canberra, and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT.

Australian Marine Oil Spill Centre. 2019. *Northern Territory Oiled Wildlife Response Plan*. Australian Marine Oil Spill Centre, Geelong, Victoria.

Australian Maritime Safety Authority. 2018. *National Plan Guidance on: Marine Oil Spill Response Health and Safety.* Reference NP-GUI-026. Australian Maritime Safety Authority, Canberra, Australian Capital Territory.

Australian Maritime Safety Authority. 2019. National plan for maritime environmental emergencies*.* Australian Maritime Safety Authority, Canberra, ACT. Viewed online on 19 June 2019 at https://www.amsa.gov.au/sites/default/files/amsa-496-national-plan.pdf.

Australian Maritime Safety Authority. 2015. *Fixed Wing Aerial Dispersant Capability Joint Standard Operating Procedures*. Version 1.2. Australian Maritime Safety Authority, Canberra, Australian Capital Territory.

Australian Maritime Safety Authority and INPEX Operations Australia Pty. Ltd. 2013. Memorandum of Understanding between the Australian Maritime Safety Authority and INPEX Operations Australia Pty. Ltd. (ABN 48 150 217 262) on support for oil spill preparedness and response. INPEX document number C091-IPX-ARA-ME-00001. Document prepared and signed by the Australian Maritime Safety Authority and INPEX Operations Australia Pty. Ltd., Perth, Western Australia.

Commonwealth Scientific and Industry Research Organisation. 2016. *Oil spill monitoring handbook*. CSIRO Publishing, Clayton South, Victoria.

Department of the Environment and Energy. 2017. *Recovery plan for marine turtles in Australia, Commonwealth of Australia 2017*. Department of Environment and Energy, Canberra, ACT.

Department of Parks and Wildlife and Australian Marine Oil Spill Centre. 2014. *Western Australian Oiled Wildlife Response Plan*. Department of Parks and Wildlife, Perth, Western Australia.

Department of Parks and Wildlife and Australian Marine Oil Spill Centre. 2015. *West Kimberley Region Oiled Wildlife Response Plan*. Version 1.1. Department of Parks and Wildlife, Perth, Western Australia, and Australian Marine Oil Spill Centre, Canberra, ACT.

DPaW—see Department of Parks and Wildlife.

DPaW and AMOSC–see Department of Parks and Wildlife and Australian Marine Oil Spill Centre.

Ecosystem Management and Associates. 2008. Criteria for evaluating oil spill planning and response operations. A report to IUCN, The World Conservation Union. Report 07-02. Lusby, Maryland.

Gaskill, M. 2010. Turtle rescue plan succeeds. Nature. Viewed online on 19 June 2019 at https://www.nature.com/news/2010/101008/full/news.2010.528.html

ITOPF—see International Tanker Owners Pollution Federation Limited

International Tanker Owners Pollution Federation Limited. 2002. *Termination of shoreline cleanup – A technical perspective.* International Tanker Owners Pollution Federation Limited, London, United Kingdom.

International Tanker Owners Pollution Federation Limited. 2011. *Clean-up of oil from shorelines*. Technical Information Paper 7. International Tanker Owners Pollution Federation Limited, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association. 2015. A guide to oiled shoreline clean-up techniques. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project. IOGP report 521. International Petroleum Industry Conservation Association, London, United Kingdom.

RPS. 2019. INPEX Ichthys Phase 2 Development WA-50-L Oil Spill Risk Assessment. MAW0796J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.

Sell, D., Conway, L., Clark, T., Picken, G.B., Baker, J.M., Dunnet, G.M. 1995. Scientific criteria to optimize oil spill cleanup. *International Oil Spill Conference Proceedings* 1:595-610.

WA DoT—see Western Australian Department of Transport.

Waples, K. Field, S. Kendrick, A. Johnston, A. and Twomey, L. 2019. *Strategic Integrated Marine Science for the Kimberley Region: Kimberley Marine Research Program Synthesis Report 2012 – 2018.* Prepared by the Western Australian Marine Science Institution, Perth Western Australia.

Warne, M.S., Batley, G.E., van Dam, R.A., Chapman, J.C., Fox, D.R., Hickey, C.W. and Stauber, J.L. 2018. *Revised Method for Deriving Australian and New Zealand Water Quality Guideline Values for Toxicants – update of 2015 version*. Australian and New Zealand Governments and Australian State and Territory Governments, Canberra, ACT.

Western Australian Department of Transport. 2018. *State Hazard Plan Maritime Environmental Emergencies*. Prepared by Western Australian Department of Transport, Perth, for the State Emergency Management Committee, Perth, Western Australia.

# APPENDIX A: OPERATIONAL AND SCIENTIFIC MONITORING PROGRAM

The decision-making process for termination of the OM and SM is undertaken by the INPEX IMT Leader, in consultation with AMOSC and the designated ESP. In addition, relevant jurisdictional agencies, including AMSA, WA DoT and WA DBCA (via WA DoT), as relevant to the nature and scale of the spill, will be consulted.

The termination decision-making process includes the following steps:

- Step 1: Review the data collected by the OM and SM against the OM and SM objectives.
- Step 2: Evaluate whether the OM and SM objectives have been achieved and provide the evaluation to the INPEX IMT Leader.
- Step 3: Reach agreement with the INPEX IMT Leader that the termination criteria have been satisfied.
- Step 4: Sign off for termination of the OM and SM by the INPEX IMT Leader.

| Code | Title | Aim of the plan | Key objectives | Activation triggers | Termination criteria | Mobilisation time | Service provider |
|---|---|---|---|---|---|---|---|
| OM01 | Oil Spill Trajectory Modelling | To use computer-based forecasting methods to predict oil-spill movement and guide the management and execution of oil spill response strategies to maximise the protection of environmental and other resources at risk. | Provide forecasting of the movement and weathering of spilled oil (and oil with dispersant applied, where applicable).<br>Assist in identifying values and sensitivities that are at risk of contamination. | All Level 2 and Level 3 spills | The oil discharge has ceased and spill modelling outputs (as verified by OM03, OM04 and OM06, where applicable) show no additional values and sensitivities are at risk of oil spill contact. | <2 hours | Oil spill modelling provider (Refer to Table 5-1 (modelling)). |
| OM03 | Oil Spill Surveillance and Reconnaissance | To provide regular, ongoing oil spill surveillance in the event of a spill (aerial, vessel, satellite imagery, oil spill tracking buoys), as appropriate.<br>Identify key breeding/ aggregation/ foraging areas for wildlife groups that may be at risk from the oil spill. | To assess the colour, consistency, distribution and locations of the surface slick.<br>To identify values and sensitivities likely to be impacted by the spill. | All Level 2 and Level 3 spills | Upon completion of the oil spill response operations (Refer to Section 4.5)<br>AND<br>Spill surveillance indicates (and is supported by OM01 outputs) no additional values and sensitivities are at risk of oil spill contact. | <48 hours | Aircraft providers<br>Vessel providers<br>AMOSC/OSRL satellite imagery provider<br>INPEX oil spill tracking buoys. |
| OM04 | Operational Monitoring of Oil Properties, Behaviour and Weathering at Sea | To provide in-field information on the properties, behaviour, extent and weathering of the spilled oil. | Establish the case-specific situation for the released oil, including:<br>• surface and subsurface extent<br>• density<br>• viscosity<br>• wax and asphaltene content<br>• water content (as water-in-oil emulsion)<br>• proportion of residual hydrocarbons over time | All Level 2 and Level 3 spills | Monitoring of the evolution of the oil properties indicates that the released oil has undergone weathering to reach a steady weathered state*. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that this OM has been triggered.<br>Deployment of field personnel and equipment into the field within 7 days of receipt of notification. | Environmental service provider under contract for duration of activities.<br>NATA laboratory for sample analysis. |

| Code | Title | Aim of the plan | Key objectives | Activation triggers | Termination criteria | Mobilisation time | Service provider |
|---|---|---|---|---|---|---|---|
| | | | • proportion of volatile hydrocarbons<br>• proportion of soluble hydrocarbons.<br>Monitor the evolution of these oil properties through time and assess the rate of their reduction or increase. | | *Steady weathered state is defined as <10% change in percentage of mass for weathering processes for 3 consecutive days (measured weathering rates compared with weathering curves for the spilled product, generated through the US National Oceanic and Atmospheric Administration (NOAA) oil spill weathering model ADIOS). | | |
| OM05 | Pre-emptive Desktop Assessment of Sensitive Resources | To undertake a rapid desktop assessment of the broad character and ecological integrity of sensitive receptors at risk of impact from a moving oil slick. | Undertake a desktop assessment, to obtain all relevant information in relation to the values and sensitivities that may be affected by the spill.<br>Note: Values and sensitivities for OM05 are defined as those described in Section 4 of the EP, including islands, reefs, shoals and banks, and areas of conservation significance, and BIAs associated with MNES. | All Level 2 and Level 3 spills. | Completion of the desktop assessment of values and sensitivities that were identified by Operational Monitoring (OM01, OM03, OM04 and OM06) as being potentially impacted or contacted by the oil spill. | 24 hours | Environmental service provider under contract for duration of activities. |
| OM06 | Assessment of the Presence and Quantity of Petroleum Hydrocarbons in Water and Sediments | To provide a rapid assessment of the presence, type, quantity and character of hydrocarbons in the water and marine sediments to assess the extent of the impact and verify impact predictions for other monitoring plans. | Detect the presence of oil and oil-derived (petrogenic) hydrocarbons in the water column and marine sediments.<br>Determine, if possible, the source of these (i.e. the slick or some other sources).<br>Determine the spatial and temporal distribution of the hydrocarbons.<br>Distinguish between petrogenic and non-petrogenic (natural background) hydrocarbons that are present.<br>Determine the concentrations of the hydrocarbons.<br>Benchmark the level of individual hydrocarbons against trigger levels of concern for aquatic life and human health. | All Level 2 and Level 3 spills | Upon completion of the oil spill response<br>OR<br>Rapid assessment of the hydrocarbons in water and marine sediments has been completed and the operational monitoring has been superseded by relevant SM programs. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that this OM has been triggered.<br>Deployment of field personnel and equipment into the field within 7 days of receipt of notification. | Environmental service provider under contract for duration of activities. |

| Code | Title | Aim of the plan | Key objectives | Activation triggers | Termination criteria | Mobilisation time | Service provider |
|---|---|---|---|---|---|---|---|
| SM02 | Detailed Characterisation of the Oil Properties and Ecotoxicological Assessment | To provide a toxicological assessment of the spilled oils.<br>To assess the risks posed by short-term exposure (acute effects) or longer term exposure (chronic effects), or both, to potentially impacted values and sensitivities. | Determine the chemical characteristics of the spilled oil throughout a spill response and the character of residual oils as they continue to weather, post-response.<br>Determine the potential adverse effects on values and sensitivities of exposure to fresh, weathered and chemically dispersed oil, based on the chemical and physical character of the oil. | Other scientific monitoring programs are triggered that require information on the ecotoxicity of hydrocarbons in the water column and sediments (SM07, SM08, SM10, SM11 and SM12). | Laboratory results have defined the chemical characteristics of fresh and weathered oil (which has reached a steady weathered state, as defined in OM04);<br>AND<br>Results have provided contextual information for the potential adverse effects on values and sensitivities exposed to be quantified. | Laboratory testing only; using water and sediment samples collected from OM04, SM05 and SM06. | Environmental service provider under contract for duration of activities. |
| SM04 | Impact of Dispersant Operations | To determine and quantify the impacts of dispersant operations on values and sensitivities. | Monitor the initial and longer term spatial and temporal distribution, concentration, and breakdown (fate) of dispersed oil to determine the potential acute and chronic exposures of values and sensitivities to dispersed oil. | When any chemical dispersants are applied to an oil spill. | Monitoring results have determined the spatial and temporal distribution, persistence and fate of dispersed oil and indicate no further shoreline, intertidal or shallow subtidal receptors will be contacted;<br>AND<br>Monitoring results have quantified the potential acute and chronic exposures of values and sensitivities to dispersed oil. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Deployment of field personnel and equipment into the field within 7 days of receipt of notification. | Environmental service provider under contract for duration of activities. |
| SM05 | Monitoring for Hydrocarbons in Marine Waters | To quantify presence and extent, as well as the longer term weathering, persistence and toxicity of hydrocarbon compounds in marine waters, and to assess and verify predicted impacts on values and sensitivities for other SM. | Quantify the temporal and spatial distribution and concentration of hydrocarbon compounds in marine waters in relation to background or reference levels, e.g. ANZECC/ARMCANZ (2000)<br>Determine the sources of any identified hydrocarbons in the water column, e.g. natural, pyrogenic, or petrogenic spill sources.<br>Provide samples to enable toxicity of the hydrocarbon compounds in marine waters to be assessed under SM02. | All Level 2 and Level 3 spills from subsea production system<br>OR<br>For surface spills, OM indicates oil contact within 2 km of a shallow, subtidal (–30 m LAT or above) or intertidal location or BIAs associated with MNES;<br>OR<br>Other Scientific Monitoring programs (SM07, SM08, SM09, SM10, SM11 and SM12) are triggered that require information on the presence, extent and toxicity or persistence of hydrocarbons in the water column. | Monitoring results have confirmed the temporal and spatial distribution, concentration and source of hydrocarbons in the water column;<br>AND<br>OM indicates no further values and sensitivities are likely to be contacted;<br>AND<br>Monitoring results have determined petrogenic hydrocarbon concentrations in marine waters are consistent with background or reference levels e.g.<br>ANZECC/ARMCANZ (2000);<br>AND | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Mobilisation of field personnel and equipment within 7 days of receipt of notification. | Environmental service provider under contract for duration of activities. |

| Code | Title | Aim of the plan | Key objectives | Activation triggers | Termination criteria | Mobilisation time | Service provider |
|---|---|---|---|---|---|---|---|
| | | | | | Water samples have been provided for SM02. | | |
| SM06 | Monitoring for Hydrocarbons in Subtidal and Intertidal Sediments | To understand the behaviour, persistence and fate of hydrocarbons in sediments to provide data to assist in assessing and verifying predicted impacts on key habitats and sensitive receptors. | Determine the distribution (spatial and temporal extent) of oil in shallow, subtidal and intertidal sediments in relation to background or reference levels, e.g. ANZECC/ARMCANZ (2000)<br>Determine the sources of any identified hydrocarbons in sediment, e.g. natural, pyrogenic or petrogenic spill sources.<br>Provide samples to enable toxicity of the hydrocarbon compounds in marine sediments to be assessed under SM02. | All Level 2 and Level 3 spills from subsea production system;<br>OR<br>For surface spills, OM indicates oil contact within 2 km of a shallow, subtidal (−30 m LAT or above) or intertidal location;<br>OR<br>Other Scientific Monitoring programs (SM07, SM08, SM12) are triggered that require information on the presence, extent and toxicity or persistence of hydrocarbons in benthic sediments. | Monitoring results have confirmed the temporal and spatial distribution, concentration and source of hydrocarbons in the sediments;<br>AND<br>OM indicates no further values and sensitivities are likely to be contacted;<br>AND<br>Monitoring results have determined petrogenic hydrocarbon concentrations in sediments are consistent with background or reference levels e.g. ANZECC/ARMCANZ (2000);<br>AND<br>Sediment samples have been provided for SM02. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Mobilisation of field personnel and equipment within 7 days of receipt of notification. | Environmental service provider under contract for duration of activities. |
| SM07 | Monitoring of Shoreline and Intertidal Benthos to Determine Impacts of Oil Spill and Recovery | To determine and monitor the potential impact of a hydrocarbon spill or response activities and recovery of intertidal benthos and associated organisms. | Collect quantitative data on intertidal habitats and organisms that are at risk from, or have been exposed to, oil and/or dispersant and activities.<br>Detect and quantify lethal or sublethal impacts of the spill on intertidal habitats and organisms and monitor recovery to baseline or reference levels. | OM indicates oil contact within 2 km of an intertidal location where sensitive organisms are known to occur. | Impacts to shoreline and intertidal benthos have been quantified and monitoring results indicate no further shoreline and intertidal coastal habitats and organisms are at risk from, or have been exposed to, oil and/or dispersant;<br>AND<br>Impacted intertidal benthos indicators have returned to baseline or reference levels. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Mobilisation of field personnel and equipment within 7 days of receipt of notification. | Environmental service provider under contract for duration of activities. |
| SM08 | Monitoring of Subtidal Marine Benthos to Determine Impacts of Oil Spill and Recovery | To determine and monitor the potential impact of a hydrocarbon spill or response activities and recovery of shallow, subtidal benthos and associated organisms. | Collect quantitative data on shallow subtidal habitats and organisms that are at risk from, or have been exposed to, oil and/or dispersant and activities.<br>Detect and quantify lethal or sublethal impacts of the spill on intertidal habitats and organisms and monitor recovery to baseline or reference levels. | All Level 2 and Level 3 spills from subsea production system;<br>OR<br>For surface spills, OM indicates oil contact within 2 km of a shallow, subtidal (−30 m LAT or above) location where sensitive organisms are known to occur. | Impacts to shallow, subtidal benthos have been quantified and monitoring results indicate no further shallow subtidal benthos and organisms are at risk from, or have been exposed to, oil and/or dispersant;<br>AND<br>Impacted subtidal benthos indicators have returned to baseline or reference levels. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Mobilisation of field personnel and equipment within 7 days of receipt of notification. | Environmental Service Provider under contract for duration of activities. |

| Code | Title | Aim of the plan | Key objectives | Activation triggers | Termination criteria | Mobilisation time | Service provider |
|---|---|---|---|---|---|---|---|
| SM09 | Determine Impacts of Oil Spill on Plankton Populations and Recovery | To investigate the possible scale of impacts to plankton and the degree to which hydrocarbons may accumulate in populations as a result of a spill event. | Quantify plankton in the vicinity of a spill and at reference sites in the wider region.<br>Determine if there are oil-derived hydrocarbons in plankton.<br>Evaluate the potential for impacts to plankton by the oil spill or response activities.<br>If possible, detect and quantify lethal and, where appropriate, sublethal effects to plankton. | There is a plankton community in the spill vicinity (identified during the course of remote sensing undertaken in OM03) that is likely to support the regionally important natural or commercial resources in the area, or is an important source of recruitment for plankton communities;<br>AND<br>The nature (composition) and magnitude of the spill (volume, area of impact, components, etc.) are sufficient to present a significant risk of exposure and lethal impacts to plankton communities (identified in OM03);<br>OR<br>Use of dispersants in proximity to plankton communities identified above;<br>OR<br>A mass spawning event has taken place or is likely to occur within the area of impact. | Plankton communities in the vicinity the spill and at reference sites in the wider region have been quantified.<br>Oil-derived hydrocarbon presence in plankton has been determined.<br>Impacts to plankton by the oil spill or response activities have been evaluated.<br>Lethal and sublethal effects to plankton have been quantified. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Mobilisation of field personnel and equipment within 7 days of receipt of notification. | Environmental Service Provider under contract for duration of activities. |
| SM10 | Determine Impact of Oil Spill on Seabirds and Shorebird Populations and Recovery | To assess potential impacts on seabird and shorebird populations within the marine avifauna BIAs, or populations identified by OM01 and/or OM03, which may have been affected by the oil spill or response activities. | Quantify and assess potential impacts to seabirds and coastal bird populations (in particular known breeding colonies) by the spill, and associated response activities, including abundance, mortality, sublethal effects, sickness and oiling.<br>Determine whether oil or response activities were the cause of observed impacts.<br>Monitor the recovery of key behaviour and breeding activities of seabirds and coastal bird populations over time, with regard to reference or baseline levels.<br>Provide information to feed into any restoration or remediation activities that need to be implemented for marine avifauna. | OM indicates oil contact within 2 km of an intertidal location or within a marine avifauna BIA;<br>OR<br>Likely spill contact with any other identified marine avifauna population. | Monitoring results have quantified the lethal or sublethal impacts to seabirds and shorebirds as a result of the oil spill and indicate no new populations are at risk from, or have been exposed to, oil or response activities;<br>AND<br>Key seabird and shorebird behaviour and breeding activities or habitat have been measured and are comparable to baseline or reference levels. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Mobilisation of field personnel and equipment within 7 days of receipt of notification. | Environmental Service Provider under contract for duration of activities. |

| Code | Title | Aim of the plan | Key objectives | Activation triggers | Termination criteria | Mobilisation time | Service provider |
|---|---|---|---|---|---|---|---|
| SM11 | Determine Impact of Oil Spill on Non-Avian Marine Megafauna and Recovery | To assess potential impacts on non-avian marine megafauna within their relevant BIAs, or populations identified by OM01 and/or OM03, which may have been affected by the oil spill or response activities. | Quantify and assess impacts of the spill and associated response activities on non-avian marine megafauna, including abundance, mortality, sublethal effects, sickness and oiling.<br>Determine whether oil or response activities were the cause of observed impacts.<br>Monitor the recovery of key behaviour and breeding activities of non-avian marine megafauna over time, with regard to baseline or reference levels.<br>Provide information to feed into any restoration or remediation activities that need to be implemented for non-avian marine megafauna. | OM indicates oil contact within 2 km of an intertidal location or within a non-avian marine megafauna BIA;<br>OR<br>Likely spill contact with any other identified non-avian marine megafauna population. | Monitoring results have quantified the lethal or sublethal impacts to non-avian marine megafauna to the oil spill and indicate no new populations are at risk from, or have been exposed to, oil or response activities;<br>AND<br>Key non-avian marine megafauna behaviour and breeding activities or habitat have been measured and are comparable to baseline or reference levels. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Mobilisation of field personnel and equipment within 7 days of receipt of notification. | Environmental Service Provider under contract for duration of activities. |
| SM12 | Determination of the Impact of the Oil Spill on Commercial, Traditional and Recreational Fisheries | To monitor potential impacts of the oil spill and response activities on commercial, traditional and recreational fisheries and subsequent recovery. | Determine the potential impacts of the oil spill and response activities on commercial, traditional and recreational fisheries and follow their recovery in relation to baseline or reference levels.<br>Evaluate the type and severity of physiological or biochemical changes (as measured by biomarkers of fish health) in commercial, traditional and recreational fisheries species affected by the spill, including the identification of potential reproductive impairment.<br>Determine whether oil or response activities were the cause of observed impacts. | For surface spills, OM indicates oil contact within 2 km of a shallow, subtidal (–30 m LAT or above) or intertidal location;<br>OR<br>For Level 2 and Level 3 spills from the subsea production system;<br>AND<br>OM predicts contact is possible to commercial, traditional or recreational fisheries species;<br>OR<br>Advice has been provided to government to restrict, ban or close a fishery.<br>SM12 will commence to provide data for government to enable decisions to be made on when a fishery can be reopened;<br>OR<br>Declarations of intent by commercial fisheries or government agencies to seek compensation for alleged or possible damage. | Monitoring results have quantified the physiological or biochemical changes and sublethal impacts of the oil spill and clean-up methods on, commercial, traditional and recreational fisheries;<br>AND<br>Contamination in the edible portion or in the stomach/intestinal contents attributable to the spill is no longer detected;<br>OR<br>No differences are detected in commercial, traditional or recreational fisheries from reference levels;<br>OR<br>The physiological and biochemical parameters in the studied species have returned to baseline levels. | Preparation to deploy field personnel and equipment will commence on notification from INPEX that the SM has been triggered.<br>Mobilisation of field personnel and equipment within 7 days of receipt of notification. | Environmental Service Provider under contract for duration of activities. |

# APPENDIX B: INPEX INCIDENT ACTION PLAN TEMPLATE (PER-2153316130)

<table>
<tr><td colspan="4">INPEX – Incident Action Plan</td></tr>
<tr><td>IAP Sequence #</td><td></td><td>IAP Issue Date / Time</td><td></td></tr>
<tr><td colspan="2">Incident Name</td><td colspan="2">Operational Period</td></tr>
<tr><td colspan="2"></td><td colspan="2">From ____ to ____</td></tr>
<tr><td colspan="2">IAP Developer - Planning Function Lead</td><td colspan="2">IAP Approver - IMT Leader</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Mission Statement</td><td colspan="3">Responsible: IMT Leader</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Situation</td><td colspan="3">Responsible: IMT Leader/Operations<br>Information from: Incident Status Board</td></tr>
<tr><td>Incident Level:</td><td colspan="3"></td></tr>
<tr><td>Incident Location</td><td colspan="3"></td></tr>
<tr><td>Status:</td><td colspan="3">Is incident contained, escalating, under control</td></tr>
<tr><td>Incident Commenced</td><td colspan="3">Time /Date</td></tr>
<tr><td>Incident Commander Contact Details:</td><td colspan="3"></td></tr>
<tr><td>Brief Description of Incident</td><td colspan="3"></td></tr>
<tr><td>Actions Completed</td><td colspan="3"></td></tr>
<tr><td>Current Situation</td><td colspan="3"></td></tr>
<tr><td>Actions Underway</td><td colspan="3"></td></tr>
<tr><td>Predicted Situation<br>(at end of operational period)</td><td colspan="3"></td></tr>
<tr><td>Safety Message / Risks</td><td colspan="3">Responsible: H&S Advisor</td></tr>
<tr><td colspan="4">Key message to prevent further injury or hazard exposure for responders plus key risk areas over the operational period</td></tr>
</table>

| | Ref | People | Ref | Environment | Ref | Assets | Ref | Reputation | Ref | Sustainability |
|---|---|---|---|---|---|---|---|---|---|---|
| **Incident Objectives** | *PO 1* | | *EO 1* | | *AO 1* | | *RO 1* | | *SO 1* | |
| | *PO 2* | | *EO 2* | | *AO 2* | | *RO 2* | | *SO 2* | |
| | *P0 3* | | *EO 3* | | *AO 3* | | *RO 3* | | *SO 3* | |
| | *PO 4* | | *EO 4* | | *AO 4* | | *RO 4* | | *SO 4* | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Strategies** | | | | | | | *RO 1* | | *SO 1* | |
| | | | *EO 1* | | *AO 1* | | | | | |
| | *PO1* | | | | | | *RO 2* | | *SO 2* | |
| | | | | | | | | | | |
| | | | *EO 2* | | *AO 2* | | | | | |
| | *PO2* | | | | | | | | | |
| | | | | | | | | | | |
| | *PO3* | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| **Tasks** | | IMT Function responsible | | IMT Function responsible | | IMT Function responsible | | IMT Function responsible | | IMT Function responsible |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| **Resources** | *Responsible:<br>Logistics Function* | *Information from:<br>Resources Summary Board* |
|---|---|---|
| *A summary of resources required and being used during Operational period ETD and ETA are to be included.* | | |
| **Medical Plan** | *Responsible:<br>HR Function* | *Information from:<br>Medical Planning Board* |
| *A summary of casualties, medevacs and medical facilities* | | |
| **Communications Plan** | *Responsible:<br>IMT Leader (EA&JV Function can assist if activated by P-CMT Leader)* | *Information from:<br>Stakeholder Management Board* |
| *A summary of key stakeholder deadlines and planned engagements or updates required during Operational Period* | | |
| **Key Timings** | *Responsible:<br>IMT Leader/Planning* | |
| *A summary of key timings within this Operational Period such as next IMT Update Briefing, Shift Change, etc.* | | |
| **Administration** | *Responsible:<br>All* | |
| *Additional specialist functions activated to support incident management.<br>A summary of administrative arrangements such as feeding, accommodation, security, travel etc.* | | |

# APPENDIX E: SPILL IMPACT MITIGATION ASSESSMENT

## X060-AH-LIS-60034 Spill Impact Mitigation Assessment Offshore Condensate Well Blowout

| Location | Commonwealth Waters - Tropic Environment | Spill Scenario | Offshore condensate well blowout - ongoing release |
|---|---|---|---|

| | SIMA Stage 2: Predict Outcomes – Potential Relative Impact | | SIMA Stage 3: Balance Trade-Offs - Impact Modification Factors – Prediction of the effectiveness and impact modification potential of the response options | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resource Compartment (including values dependent on the resource compartment) | No Intervention (natural weathering) | | Contain and Recover | | Protect and Deflect | | Shoreline Clean-up | | Chemical Dispersant - Subsea Injection (at wellhead) | | Chemical Dispersant - Surface | | Pre-Contact Wildlife Response (Hazing & Translocation) | | Post Contact Wildlife Response | | In-situ Burn (near spill location) | Operational monitoring and evaluation |
| | | A | B1 | A x B1 | B2 | A x B2 | B3 | A x B3 | B4 | A x B4 | B5 | A x B5 | B6 | A x B6 | B7 | A x B7 | | |
| Subtidal Benthic Communities | | | | | | | | | | | | | | | | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)* | Significant | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -4 | 0 | 0 | 0 | 0 | | |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | None / Insignificant | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| *Deep-sea unconsolidated muds and sands* | None / Insignificant | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Intertidal seabed | | | | | | | | | | | | | | | | | | |
| *Intertidal Coral Reef* | Moderate | 3 | 0 | 0 | -2 | -6 | -1 | -3 | 0 | 0 | -1 | -3 | 0 | 0 | 0 | 0 | | |
| *Mangrove/Mudflats/Samphires* | Moderate | 3 | 0 | 0 | -1 | -3 | -1 | -3 | 0 | 0 | -1 | -3 | 0 | 0 | 0 | 0 | | |
| *Sandy Beach* | Minor | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 2 | -1 | -2 | 0 | 0 | 0 | 0 | | |
| *Rocky Shoreline* | Minor | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 2 | -1 | -2 | 0 | 0 | 0 | 0 | | |
| *Macro-Algae and Seagrass* | Moderate | 3 | 0 | 0 | -1 | -3 | -1 | -3 | 0 | 0 | -1 | -3 | 0 | 0 | 0 | 0 | | |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Significant | 4 | 0 | 0 | -1 | -4 | 1 | 4 | 0 | 0 | -1 | -4 | 1 | 4 | 1 | 4 | In-situ burning is not considered to be safe, effective or feasible. | Operational monitoring and evaluation is implemented under all oil spill scenarios |
| Water column | | | | | | | | | | | | | | | | | | |
| *Lower water column (below photic zone)* | Moderate | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| *Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)* | Significant | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | -4 | 0 | 0 | 0 | 0 | | |
| *Water surface, including foraging areas for EPBC listed species.* | Moderate | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 9 | -1 | -3 | 0 | 0 | 1 | 3 | | |
| *Air* | Minor | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Socio-economic | | | | | | | | | | | | | | | | | | |
| *Commercial demersal fisheries* | Significant | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| *Shallow commercial fisheries (including aquaculture)* | Significant | 4 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | -1 | -4 | 0 | 0 | 0 | 0 | | |
| *Recreational fisheries* | Minor | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | -1 | -2 | 0 | 0 | 0 | 0 | | |
| Cultural heritage | | | | | | | | | | | | | | | | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | Minor | 2 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| *Indonesian traditional fishing* | Significant | 4 | 0 | 0 | 0 | 0 | 1 | 4 | 0 | 0 | -1 | -4 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | 0 | 0 | | | | | | |
| | | **Total Impact Mitigation Score** | | 0 | | -16 | | 11 | | 19 | | -38 | | 4 | | 7 | - | - |
| | | **Carried to ALARP evaluation yes/no** | | No | | No | | Yes | | No | | No | | Yes | | Yes | No | Yes |

| Resource Compartment (including values dependent on the resource compartment) | No Intervention (natural weathering) | | Justification for Potential Relative Impact Score |
|---|---|---|---|
| | | A | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)* | Significant | 4 | Subtidal benthic primary producer habitat (BPPH) may be exposed to entrained and dissolved condensate above impact thresholds from a well-blowout in the Browse Basin. The effect of the toxic fractions of entrained/dissolved oil on intertidal coral includes partial mortality of colonies, reduced growth rates, bleaching, reduced photosynthesis, interruption of chemical communication necessary for mass spawning, premature explosion of larvae, decreased growth rates, decreased lipid content, decreased survival of larvae, decreased gonadal development, negative impacts to coral settlement, increased susceptibility to algae colonisation, epidemic diseases, localised tissue rupture, reduced reef resilience and mortality (Hayes et al 1992; Peters et al 1997; Negri & Heyward 2000; Shigenaka 2001; CSIRO 2016). WA DoT (2018) note that coral is sensitive to dissolved hydrocarbons as it causes toxicity at a cellular level. Corals accumulate oil from the water column (Pie et al 2015) making it biologically available to EPBC species foraging in this habitat.<br>Seagrass and macroalgae may be subject to lethal or sublethal toxic effects, including mortality, reduced growth rates and impacts to seagrass flowering. BPPH is collectively considered to be an important resource as it supports a high biomass of fish, cetaceans and seabirds, including foraging EPBC species (DEWHA 2008). Several studies have indicated rapid recovery rates for seagrass and macroalgae may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006), but coral is sensitive to oil (and dispersants), making recovery from spills potentially slow (Guzman et al 1994). The consequence to benthic primary producer habitat is considered to be Significant. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | None / Insignificant | 1 | Deep water filter feeding communities (below photoic zone / 50m water depth), deep water EPBC species and KEFs are highly unlikley to be exposed to entrained and dissolved condensate, above impact thresholds (RPS 2019a) from a well-blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a). If exposed above impact thresholds, hydrocarbons may cause chemical toxicity (i.e. lethal or sub-lethal effects, or impairing cellular functions) and ecological changes (i.e. losing key organisms then opportunistic species take over). Benthic marine invertebrates can take up oil via diffusion from dissolved oil, ingesting of contaminated food items and contact with contaminated sediment. Entrained/dissolved oil (including dispersed oil) affects the health of filter feeding communities, leading to potential accumulation (Law et al 2011) which makes them a poorer food source for higher trophic level organisms including deep water EPBC foraging species. The toxic fractions of oil can be detrimental to marine invertebrates as they are susceptible to its narcotic impacts due to their high surface to volume ratio, often resulting in outright mortality, as well as decreases in reproduction rates (Hook et al 2014), oxidative damage to macromolecules, altered lipid ratios, deleterious effects on embryo development (Lee et al 2004) and changes to community structure (CSIRO 2016). Filter feeding communities are commonly, but sparsely distributed, throughout the region and WA DoT (2018) note that they play an important role in purifying water and creating habitat. As entrained/dissolved hydrocarbons from a well blowout are expected to remain in the top 50m of the water column, the impact of an oil spill is not expected to cause any significant impact at a local or regional scale. As such, the consequence to deep sea features is considered to be Insignficant. |
| *Deep-sea unconsolidated muds and sands* | None / Insignificant | 1 | Species that inhabit or rely on deep-sea unconsolidated muds and sands are highly unlikley to be exposed to entrained and dissolved condensate above impact thresholds (RPS 2019a) from a well-blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a). CSIRO (2016) notes that benthic marine invertebrates can take up oil via diffusion from dissolved oil, ingesting contaminated food and contact with contaminated sediment. Small invertebrates (micro and meiofauna) are considered very susceptible to the narcotic impact of oil due to their high surface to volume ratio, often resulting in outright mortality, as well as decreases in reproduction rates (Hook et al 2014). Further deleterious effects to invertebrate embryo development result from exposure to sediments affected by entrained and dissolved oil (Lee et al 2004). Montagna et al (2013) state that after the Deepwater Horizon blowout, biodiversity loss resulted in the deep-sea sediments surrounding the wellhead (i.e. severe losses occurring within 3 km and losses due to elevated TPHs and PAHs up to 17 km away from the wellhead). However, as modelling (RPS 2019a) of gas/condensate well blowouts in the Browse Basin are not expected to result in exposures above impact thresholds deeper than 50m, these types of impacts are not anticiptaed. Communities in the Browse Basin region are considered low in diversity and abundance, and generally common throughout the area. Large sand waves and local strong seabed currents exist in the area and are likely to move seasonally causing substrate instability that limits development of infaunal communities. Therefore, exposure to hydrocarbons above impact thresholds from a well blowout is not expected to occur at a local or regional scale. If any impacts occur, the area is expected to recover, though recovery times in the deep sea are generally slow due to the low levels of recruitment and slow growth of biota (Montagna et al 2013). The potential consequence is considered to be Insignificant. |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | Moderate | 3 | Intertidal coral reefs could be impacted by surface fresh, weathered, entrained and dissolved condensate from a well blow-out in the Browse Basin. The effect of condensate on intertidal coral is unlikely to result in significant smothering as condensate is expected to be weathered and in the form of wax flakes/residues when it arrives in intertidal coral areas. In this form, toxicity is less than fresh condensate (Woodside 2014). The effect of the toxic fractions of entrained/dissolved oil on intertidal coral include partial mortality of colonies, reduced growth rates, bleaching, reduced photosynthesis, interruption of chemical communication necessary for mass spawning, premature explosion of larvae, decreased growth rates, decreased lipid content, decreased survival of larvae, decreased gonadal development, negative impacts to coral settlement, increased susceptibility to algae colonisation, epidemic diseases, localised tissue rupture, reduced reef resilience and mortality (Hayes et al 1992; Peters et al 1997; Negri & Heyward 2000; Shigenaka 2001; CSIRO 2016). WA DoT (2018) note that coral is sensitive to dissolved hydrocarbons as it causes toxicity at a cellular level. Coral reefs are found close to the permit area in isolated locations and are considered to be significant benthic primary producers that play a key role in the ecosystem and have an iconic status in the environment (WA DoT 2018). They are considered of high importance to EPBC species that aggregate, nest, roost and forage in the area, hence isolated populations could potentially be exposed in the event of a spill. As spills disperse, intertidal communities are expected to recover (Dean et al. 1998), though the rate of recovery of coral reefs depends on the level or intensity of the disturbance, with recovery rates ranging from 1 or 2 years, to decades (Fucik et al. 1984, French McCay 2009). Impact on the receptor is considered to be Moderate. |
| *Mangrove/Mudflats/Samphires* | Moderate | 3 | Mangrove, mudflats and samphire communities may be exposed to entrained/dissolved condensate above impact thresholds from a well-blowout in the Browse Basin. Given that mangroves are remote from permit areas, fresh or weathered condensate is unlikely to reach this receptor. The potential effects of entrained and dissolved oil include defoliation and mortality of mangroves (Burns et al. 1993; Duke et al. 2000). Entrained and dissolved oil exposure is only likely to occur at isolated locations amongst a very large and generally contiguous population. The recovery of mangroves from shoreline oil accumulation can be a slow process, due to the long-term persistence of oil trapped in anoxic sediments and subsequent release into the water column (Burns et al. 1993). Any impacts to benthic habitats are expected to be localised and of short to medium term with a Moderate consequence. |
| *Sandy Beach* | Minor | 2 | Sandy beaches may be exposed to weathered waxy flakes and residues above impact thresholds in the event of a well-blowout in the Browse Basin. The effect of gradual accumulation of oil on the receptor could lead to harm including the increased prevalence of tumours in species (CSIRO 2016). Sandy beaches are the dominant shoreline habitat on offshore islands in the Browse Basin and are considered significant habitat for turtles and seabird nesting. Organisms such as polychaete worms, bivalves and crustaceans generally inhabit sandy beaches but the mobile nature of the sands generally limits diversity. These species provide a valuable food source for resident and migratory sea and shorebirds (DEC/MPRA 2005). Law et al (2011) note that when grain size is between 2 and 64 mm, beaches are not considered especially sensitive to oil spills as they are regularly cleaned by wave action and oil is generally not retained. Offshore island beaches of the Browse Basin are generally coarse grained, due to high wave energy. WA DoT (2018) assessed Kimberley sandy beaches and concluded that they are moderately ecologically sensitive and are moderately difficult to rehabilitate from an oil spill. The potential consequence is considered to be Minor. |
| *Rocky Shoreline* | Minor | 2 | Rocky shorelines may be exposed to weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. This receptor is typically characterised as being a high wind and wave energy environment (CSIRO 2016). Condensate from a spill has the potential to coat the substrate or become stranded by receding tides – but incoming tides also have the potential to remove deposited condensate (Law et al 2011). CSIRO (2016) note that rocky shorelines are not considered sensitive environments, and IPIECA (2017) state that rocky shorelines generally have a diverse and productive intertidal community which are considered resilient to oil spills and short-term oil persistence. WA DoT (2018) note that rocky shorelines are the least susceptible of shoreline types to long term impacts from a spill of both floating and dissolved oil. As such, this receptor is not expected to have issues relating to recovery from an oil spill. The potential consequence for rocky shorelines is considered to be Minor. |

| | | | |
|---|---|---|---|
| *Macro-Algae and Seagrass* | Moderate | 3 | Macroalgae and seagrass may be exposed to entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. This receptor is unlikely to come into contact with significant amounts of fresh floating surface hydrocarbons, but could potentially be exposed to weathered waxy flakes and residues. WA DoT (2018) note that dissolved oil causes more impacts to algae than floating oil, as it results in cellular level poisoning. The effect of subjecting seagrass and macroalgae to lethal or sublethal toxic effects of condensate can result in mortality, reduced growth rates and impacts to seagrass flowering. Several studies have indicated rapid recovery rates may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006). Taylor and Rasheed (2011) reported that seagrass meadows were not significantly affected by an oil spill when compared to a non-impacted reference seagrass meadow. Macroalgae support diverse small invertebrates that are the principal food source for a number of inshore fish (WA DoT 2018). Seagrasses provide energy and nutrients for detrital grazing food webs (WA DoT 2018), act as a refuge for fish and invertebrates, and provide a food source for EPBC species such as dugongs and green turtles (DEC 2007). The potential consequence is considered to be Moderate. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Significant | 4 | Intertidal habitat may be exposed to weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. The effect of condensate on this receptor can result in mortality or harm to benthic primary producers and organisms such as EPBC species that rely on these species for food, or rely on the habitat for nesting and roosting. IPIECA (2014) note that dehydration, gastrointestinal problems and anaemia are commonly found in oiled animals, causing potential long-term effects on reproductive success. They further note that the toxic effects of ingested oil generally impacts the liver, whilst volatile fumes damage lungs resulting in debilitating effects (IPIECA 2014). Oiled aquatic EPBC fauna can further suffer hypothermia, irritations, burns, respiratory problems and loss of waterproofing, leading to them moving onto land (i.e. away from their food source) where they have further difficulty thermoregulating and feeding (IPIECA 2017). Specifically, marine reptiles, including turtles and crocodiles can be exposed to hydrocarbons externally in intertidal areas through direct contact; or internally, by ingesting oil, consuming prey containing oil, or inhaling volatile compounds (Milton et al. 2003). Turtle hatchlings may be particularly vulnerable to toxicity and smothering, as they emerge from nests and make their way over the intertidal area to the water (AMSA 2015; Milton et al. 2003). Birds coated in hydrocarbons can suffer damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs (AMSA 2015; WA DoT 2018). Toxic effects may also result where the product is ingested, either through birds' attempts to preen their feathers (Jenssen 1994; Matcott et al. 2019) or ingested as weathered waxy flakes/residues present on shorelines. There is the potential for short to medium term impacts; however, it is not expected that the overall population viability for any protected species would be threatened from a well blowout spill. The cumulative potential consequence is considered to be Significant. |
| **Water column** | | | |
| *Lower water column (below photic zone)* | Moderate | 3 | The lower water column may be exposed to entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. Note, below 100m, exposure above threshols is not predicted to occur (RPS 2019a). EPBC species that use this habitat could be negatively impacted by entrained and dissolved oil including impacts to juvenile fish, larvae and planktonic organisms due to their sensitivity during these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018). In the Gulf of Mexico, Murawski et al (2014) found that spilled oiled resulted in an increased incidence of skin lesions in fish attributed to PAH. The lower water column has a high level of species diversity and endemism for demersal fish communities in the Browse Basin region, as cold nutrient-rich deep ocean current upwellings are found in canyon areas and attract fish aggregations, which in turn attract larger predatory fish, sharks, toothed whales and dolphins (DEWHA 2008). There is potential for short–to-medium term impacts on the environment from entrained and dissolved condensate, but it is not expected that the overall population viability for any protected species would be threatened. The potential consequence is considered to be Moderate. |
| *Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)* | Significant | 4 | The upper water column may be exposed to entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. The effect of entrained and dissolved oil on this receptor include chronic impacts to juvenile fish, larvae and planktonic organisms due to their sensitivity during these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018). Whale sharks are filter feeders and are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al 2011) with potential effects including damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). Marine mammals, marine reptiles and marine avifauna could also be impacted through entrained and dissolved hydrocarbon exposure, primarily through ingestion during foraging activities (AMSA 1998). The upper water column is considered to be very important habitat for EPBC species as a large number of BIAs for marine fauna are present in the Browse Basin. Whilst it is expected that the upper water column will recover with time, it is likely that there will be cumulative impacts such as bioaccumulation up the food chain. The consequence is considered to be Significant. |
| *Water surface, including foraging areas for EPBC listed species.* | Moderate | 3 | The water surface may be exposed to fresh and weathered surface condensate above impact thresholds from a well blowout in the Browse Basin. Fresh condensate and weathered waxy flakes/residues can impact marine mammals surfacing, as they are vulnerable to oil exposure. Blue whales and humpback whales (baleen whales), that filter-feed near the surface, could potentially ingest condensate. Spilled hydrocarbons may also foul the fibres of baleen whales impairing food gathering efficiency or fouling prey with hydrocarbons (AMSA 2015). Turtles can be exposed to hydrocarbons if they surface within the spill, resulting in direct contact with the skin, eyes, and other membranes, as well as the inhalation of vapours or ingestion (Milton et al. 2003). Floating oil is considered to impact reptiles more than entrained/dissolved oil because reptiles hold their breath underwater and are unlikely to directly ingest dissolved oil (WA DoT 2018). Other aspects of turtle behaviour, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large, pre dive inhalations, make them vulnerable to spilled oil (AMSA 2015). Hatchlings spend more time on the surface than older turtles, thus increasing the potential for contact with oil slicks (Milton et al. 2003).<br>Aquatic migratory birds are among the most vulnerable and visible species to be affected by surface oil, with oil impacts frequently leading to long-term physiological changes potentially resulting in lower reproductive rates or survival rates (Fingas 2012). The probability of lethal effects is dependent on factors such as timing, location, oceanographic and weather patterns, and the movements of species that forage, feed, nest and inhabit that area (IPIECA 2014), the amount of time spent on the water surface as well as any oil avoidance behaviour (French-McCay 2009). Direct contact with surface hydrocarbons may break down the ability of plumage to maintain body heat, resulting in direct and indirect impacts such as hypothermia, dehydration, drowning and starvation (AMSA 2015; Matcott et al, 2019; Jenssen 1994; IPIECA 2014; ITOPF 2011). Birds resting at the sea surface or surface plunging can be impacted by oil resulting in damage to external tissues, including skin and eyes, and internal tissue irritation in lungs and stomachs (Clark 1984; WA DoT 2018). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (Jenssen 1994; Matcott et al. 2019). The water surface is considered an important receptor where EPBC listed species forage. It is expected to recover from oil impacts with time, though there may be cumulative impacts through bioaccumulation up the food chain. The consequence is considered to be Moderate. |
| *Air* | Minor | 2 | Air may be exposed to fresh surface condensate above impact thresholds from a well blowout in the Browse Basin. RPS (2018 and 2019b) note that the ongoing nature of a condensate spill combined with the high potential for gas and oil to volatize from the water surface may lead to high local concentrations of atmospheric volatiles that have the potential to cause harmful impacts to species such as cetaceans if inhaled. Turtles could also be affected by harmful vapours during pre-dive inhalations (Milton et al. 2003). The receptor is not considered to be sensitive, thus is expected to recover in a very short period of time, as the evaporated hydrocarbons are rapidly dispersed by the wind, and evaporation rapidly reduce with time as oil weathers and entrains. Only a very localised area, immediately above the freshest parts of the oil slick would be impacted by evaporating hydrocarbons. The potential consequence is considered to be Minor. |

| | | | |
|---|---|---|---|
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | Significant | 4 | Commercial demersal fisheries may be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a). The effect of condensate on this receptor includes the ability to cause economic loss (through indirect loss of stock and perceived tainting of stock by oil) (WA DoT 2018), impede access to fishing areas from the implementation of an exclusion zone during a spill response; impact seafood quality and employment; plus negatively impact lines and nets (ITOPF 2011). The economic impact from an oil spill is dependent on the species being cultured, as species have different recovery rates. WA DoT (2018) note that dissolved oil will impact finfish, taking 6-8 years for fisheries to recover (due to the time it takes for hatchlings to reach maturity) (WA DoT 2018). This receptor is considered to be important, and effects from a well blowout can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts to commercial demersal fisheries, shallower than 100m, are expected to be short to medium term. The real and perceived consequence is considered to be Significant. |
| *Shallow commercial fisheries (including aquaculture)* | Significant | 4 | Shallow commercial fisheries (including aquaculture) may be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. The effect of condensate on this receptor includes the ability to cause economic loss (through indirect loss of stock and perceived tainting of stock by oil) (WA DoT 2018), impede access to fishing areas from the implementation of an exclusion zone during a spill response; impact seafood quality and employment; plus negatively impact lines and nets (ITOPF 2011). The economic impact from an oil spill is dependent on the stock being cultured, as species have different recovery rates. DoT (2018) note that dissolved oil will have the greatest impact with oyster farms potentially taking 3-4 years to recover from a spill (DoF 2013), whilst finfish farms could take 6-8 years to recover due to the time it takes for hatchlings to reach maturity. WA DoT (2018) note that the pearling industry relies almost exclusively on sourcing pearl oysters from Eighty Mile Beach (south of Broome) and an area off the Lacepede Islands. There is also other aquaculture in the region including trochus and barramundi (Fletcher et al 2017). WA DoT (2018) note that some wild stocks aquaculture species such as mussels are impacted more by dissolved oil than floating oil due to being filter feeders. This receptor is considered to be important, and effects from a well blowout can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts to shallow commercial fisheries (including aquaculture) are expected to be short to medium term. The real and perceived consequence is considered to be Significant. |
| *Recreational fisheries* | Minor | 2 | Recreational fisheries may be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a).The effect of condensate on this receptor includes negatively impacting nets and lines (ITOPF 2011), impeding access to fishing areas from the implementation of an exclusion zone during a spill response and impacting seafood quality and quantity. Recreational fishing is generally concentrated around readily accessible coastal settlements along the Kimberley and NT coastlines (such as Broome, Wyndham and Darwin) and there is little recreational fishing around the offshore Browse Basin due to the distance from land, lack of features of interest and deep waters. Offshore islands, coral reef systems and continental shelf waters of the Browse Basin however are increasingly being targeted by fishing based charter vessels (Fletcher and Santoro 2014) with extended fishing charters operating during certain times of the year. This receptor is considered to be important, and effects from a well blowout can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts to shallow recreational fisheries, shallower than 100m, are expected to be short to medium term. The real and perceived consequence is considered to be Minor. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | Minor | 2 | Aboriginal heritage including special places, cultural landscapes, practices and fishing/foraging along the Kimberley and NT coastline may be impacted by surface and weathered condensate above impact thresholds from a well blowout in the Browse Basin. The effect of surface condensate on this receptor includes physically degrading a site, disrupting the harvesting of fish, and area closures could displace Aboriginal people and have implications on cultural identity, health and wellbeing. The receptor is important and the potential for recovery is expected to be short to medium term and the receptor is generally remote from any potential well blow-out location. The consequence is considered to be Minor. |
| *Indonesian traditional fishing* | Significant | 4 | Indonesian traditional fishing may be impacted by weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. Indonesian traditional fishing occurs within the MoU box which covers Scott Reef and surrounds, Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks and shoals. The effect of condensate on these receptor could include reduction and contamination of target species such as sea cucumbers (bêche-de-mer), trochus (top shell snail), reef fish and sharks. Exclusion zones during the spill response may also affect access to fishing locations, even if the target species are not affected by the condensate. This receptor is considered to be important, and effects from a well blowout can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts are expected to be short to medium term. The real and perceived consequence is considered to be Significant. |

## Contain and Recovery

**Overall statement of likelihood of success of Contain and Recovery (C&R):**

***Aim:*** This strategy aims to collect oil from the ocean surface using booms and skimmers, generally at or near the release location, where oil concentrations are highest. Floating booms are used to corral and concentrate spilled floating oil into a surface thickness that will allow for mechanical removal (i.e. skimming and pumping oil into temporary storage) (IPIECA 2015).

***Type of slick:*** Surface oil is in the form of Group I floating slicks which have a low viscosity and rapidly spread into a thin sheen. Surface oil concentrations will be up to approximately 10 g/m$^2$ (~0.01mm, which equates to Bonn code 1/2) for up to 10 to 15 kilometres from the spill site and weathered oil concentrations reduce down to below 1 g/m$^2$ up to approximately 1,200 km from the spill site.

***Likely success/effectiveness against slick:*** O'Brien (2002) notes that spreading of oil is the main obstacle to a successful at sea contain and recovery response, with this type of oil tending to spread so thinly and quickly that skimmers are unable to efficiently skim and recover meaningful quantities. Generally oil needs to be >100 g/m$^2$ (>0.1mm, which equates to Bonn code 4/5) to feasibly corral oil with a boom and achieve any significant level of oil recovery with skimmers (O'Brien 2002), as booms have limited effect against thin oil films and no effect against a subsurface plume (ITOPF 2011). Condensate spills from a well blowout would be unlikely to surface at >100g/m$^2$, and would rapidly evaporate and spread upon surfacing, resulting in very thin surface slicks making this technique inefficient and impractical (IPIECA 2017). Where there is any significant condensate slick, flammable/toxic vapours will also be present, and will likely exceed safe exposure thresholds, further reducing response efficiency (as vessels will not be permitted to operate in areas where explosive limits or VOC exposure thresholds are exceeded). Due to the very thin surface slicks, very low rates of recovery would be expected. Note that IPIECA (2015) state that efficiency of contain and recover operations (for any oil type) can vary widely due to operational, environmental and logistical constraints, but usually it is limited to recovering approximately only 5-20% of the initial spilled volume. Contain and recovery is therefore unlikely to be an effective response strategy, with limited chance of any significant surface slick recovery from a Group I spill.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | C&R occurs on the surface and has no impact on entrained oil affecting fully submerged benthic primary producer habitat. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | C&R occurs on the surface and has no impact on entrained oil affecting deep sea features. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | C&R occurs on the surface and has no impact on entrained oil affecting deep sea unconsolidated muds and sands. |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | No or insignificant alteration of impact | 0 | C&R would result in an insignificant reduction of surface/floating oil and no effect on entrained oil at the spill location, thus resulting in no change to the amount of oil reaching the intertidal/shoreline zones. |
| *Mangrove/Mudflats/Samphires* | No or insignificant alteration of impact | 0 | |
| *Sandy Beach* | No or insignificant alteration of impact | 0 | |
| *Rocky Shoreline* | No or insignificant alteration of impact | 0 | |
| *Macro-Algae and Seagrass* | No or insignificant alteration of impact | 0 | |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | No or insignificant alteration of impact | 0 | |

| | | | |
|---|---|---|---|
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | C&R occurs on the surface and has no impact on entrained oil affecting the lower water column. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | C&R occurs on the surface and would result in an insignificant reduction in condensate on the surface which could potentially become entrained in the future. Therefore C&R would result in no reduction in the volume of entrained oil affecting the upper water column. |
| *Water surface* | No or insignificant alteration of impact | 0 | C&R would result in an insignificant reduction of surface/floating oil on the water surface due to inability of booms and skimmers to revcovery very thin slicks. |
| Air | No or insignificant alteration of impact | 0 | C&R would result in an insignificant reduction of oil on surface, and therefore no significant change to the evaporation of oil into the local atmosphere. VOC concentrations at locations where fresh oil slicks are present would likely be above safe exposure levels. Collection of condensate on vessels would likely result in further increase in exposure of workers to high concentrations of VOCs, above safe exposure levels. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to demersal fish communities. |
| *Shallow commercial fisheries (including aquaculture)* | No or insignificant alteration of impact | 0 | C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to shallow commercial fisheries including aquaculture. |
| *Recreational fisheries* | No or insignificant alteration of impact | 0 | C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to recreational fishing areas. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to Aboriginal cultural heritage receptors. |
| *Indonesian traditional fishing* | No or insignificant alteration of impact | 0 | C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to traditional fishing areas. |

## Protect and Deflect

**Overall statement of likelihood of success of Protect and Deflect (P&D):**

***Aim:*** This strategy aims to use physical barriers to exclude or restrict the spill contacting specific sensitive receptors or to deflect the spill from these locations; typically onto less sensitive areas.

***Type of slick:*** Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered condensate which could accumulate over time**.** Weathered oil would be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than fresh oil (Woodside 2014).

***Likely success/effectiveness against slick:*** Booms could be used to protect and deflect surface spills away from sensitive habitats, but they have limited effect against thin Group I oil films and no effect against subsurface entrained plumes (ITOPF 2011). Generally oil needs to be >100 g/m2 (>0.1mm, which equates to Bonn Code 4/5) to feasibly corral oil with a boom (O'Brien 2002), as would be required for a P&D response. However condensate arriving on the ocean surface from a well-blowout will never appear in slicks >100 g/$m^2$, and would generally be <10 g/$m^2$. Even in a scenario where the best equipment is available, shoreline protect and deflect activities at Browse Island or other exposed remote shoreline locations, would be technically challenging due to the general exposure to unfavourable sea conditions, large tidal range and shallow coral reefs. Generally protect and deflect is limited to sheltered waters, not exposed reef/beach environments. Only under exceptionally calm sea-states and appropriate tides would it be safe to conduct vessel activities to carry-out an effective protect and deflect operation at remote shorelines. MetOcean conditions required for this technique to be successful include <1 m sea-state and low surface currents - but these are frequently exceeded at remote offshore locations in the Browse Basin region. In addition, given the size of the offshore island shorelines (e.g. Browse Island, one of the smallest offshore islands, has an intertidal zone 3km in diameter, 7km in circumference), a substantial number of booms would be needed to be deployed to protect the shorelines, or deflect oil into a collection point on a beach. Anchoring of booms would most likely result in additional damage to the subtidal and intertidal environment (coral reef) surrounding most offshore islands, due to anchor chain drag. Booms themselves would also drag around on the coral intertidal reef during periods of lower tides, potentially resulting in significant physical damage to the benthos of the reef platform and also result in damage to booms. Booms could potentially be held in place by vessels however due to widths of shorelines requiring protection this would most likely require an unfeasibly large number of vessels, and at low tide this isn't practicable in intertidal zones. Most offshore island shorelines would be expected to 'self clean' any accumulated Group I oil due to the lack of adhesiveness, the coarse substrate, the high wave energy and high tidal regime (Fingas 2012), further reducing the impact mitigation potential of protect and deflect at these locations. As a result of the above mentioned factors, protect and deflect would be unlikely to result in any significant deflection or recovery of Group I condensate at remote intertidal/shoreline habitats.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | P&D occurs on the surface at a shoreline location and will have insignificant impact on entrained oil affecting subtidal benthic primary producer habitat. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | P&D occurs on the surface at a shoreline location and has insignificant impact on entrained oil affecting deep sea features. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | P&D occurs on the surface at a shoreline location and has insignificant impact on entrained oil affecting deep sea unconsolidated muds and sands. |

| **Intertidal seabed** | | | |
|---|---|---|---|
| *Intertidal Coral Reef* | Moderate additional impact | -2 | P&D would be ineffective against thin surface slicks, thus resulting in insignificant oil reduction on surface. Anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal coral reefs. |
| *Mangrove/Mudflats/Samphires* | Minor additional impact | -1 | Prevention of oil entering mangroves/samphires would be of benefit, however due to the thin surface slick, the extensive scale of mangrove communities along the mainland and islands of the Kimberley and NT coastline, the ability to successfully achieve a benefit from P&D is extremely limited. Anchors/anchor chains also have the potential to damage mangrove aerial root structures and disturb other fragile low-energy shorelines. |
| *Sandy Beach* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction of thin surface slicks or entrained oil, thus resulting in no change to the amount of oil reaching sandy beaches. |
| *Rocky Shoreline* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction of thin surface slicks or entrained oil, thus resulting in no change to the amount of oil reaching rocky shorelines. |
| *Macro-Algae and Seagrass* | Minor additional impact | -1 | P&D would result in insignificant reduction of thin surface slicks or entrained oil, thus resulting in no change to the amount of oil affecting macro-algae and seagrass. Anchors/anchor chains would also most likely result in physical damage to seagrass / algal beds. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor additional impact | -1 | Due to the thin surface slick, P&D would not be effective at deflecting oil from intertidal zones and reducing the impact on benthic primary producers. Additional impacts could also occur to sensitive habitats such as coral reefs and fragile low energy environments such as mangroves and mudflats. Therefore, additional impacts could occur to habitats which support protected species. |

| | | | |
|---|---|---|---|
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | P&D does not reduce the amount of entrained oil affecting the lower water column. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | P&D does not reduce the amount of entrained oil affecting the upper water column. |
| *Water surface* | No or insignificant alteration of impact | 0 | P&D would only occur near shorelines and would not result in any significant reduction to the volume of oil on the water surface. |
| *Air* | No or insignificant alteration of impact | 0 | P&D would only occur at shorelines remote form the spill release location. The weathered slick will not have any significant volatile components remaining, and therefore P&D would have no effect on local atmospheric conditions. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in entrained oil, resulting in no change to oil exposure to commercial demersal fisheries. |
| *Shallow commercial fisheries (including aquaculture)* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to shallow commercial fisheries including aquaculture sites. |
| *Recreational fisheries* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to fish communities, thus no change to recreational fishing. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in oil on surface and entrained oil, resulting in no change to impacts on Aboriginal heritage. |
| *Indonesian traditional fishing* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in oil on surface and entrained oil, resulting in no change to impacts on Indonesian traditional fishing areas. |

## Shoreline Clean-Up

**Overall statement of likelihood of success of Shoreline Clean-Up:**

***Aim:*** Using various physical means to clean up oil from affected shorelines to reduce impacts on sensitive receptors or to avoid any reintroduction of the hydrocarbon to the marine environment. It is often viewed as a three step process, with the first phase involving bulk collection of oil floating against the shoreline or stranded on it; phase two involving in-situ treatment of shoreline substrate and phase three involving removal of any remaining residues (final polish) (IPIECA 2015).

***Type of slick:*** Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered oil which could accumulate over time. Given the time to reach shorelines, a condensate spill is expected to have undergone several physical and biological weathering processes, such as photo oxidation and biodegradation. Impacts to ecological receptors from exposure to weathered oil (waxy flakes and residues) are far less than those associated with exposure to fresh oils, which have higher levels of toxicity (Milton et al, 2003; Hoff & Michel 2014; Woodside 2014). Group I oils are relatively non-adhesive and will not form a thick adhesive barrier on a shoreline (Fingas 2012).

***Likely success/effectiveness against slick:*** Shoreline clean-up has been consistently found to not enhance ecological recovery of oiled coastlines (Sell et al 1995) but it may protect other resources in the area, such as birds, marine mammals or subtidal habitats including coral reefs or fish farms (CSIRO 2016). Choosing a particular clean-up technique is dependent on factors such as shoreline type, exposure, sensitivity, amount of oil, persistence of oil, toxicity of oil and rate of natural oil removal (IPIECA 2015). Mechanical cleaning is generally not an appropriate technique for offshore/remote shorelines, and manual techniques involving rakes and shovels would likely be required. The clean-up of Group I spills from a beach or shoreline is likely to be difficult, generating high volumes of waste in comparison to the oil recovered. Browse Island and other similar offshore shorelines would be expected to naturally 'self-clean' any accumulated Group I oils, due to factors such as the lack of adhesiveness of these oil types, the coarse substrate present and the high wave energy and high tidal regime (Fingas 2012). Typically, inaccessible rocky coves are highly exposed and are best left to naturally clean (IPIECA 2015). ITOPF (2011) also note that for a number of sensitive shoreline types, such as mangroves, natural cleaning is the preferred option in order to minimise the damage caused from clean-up activities. Thus shoreline clean-up would be most effective in areas which are expected to receive large amounts of shoreline oil; where chosen activities don't physically break/damage sensitive habitat such as coral or mangroves; and in areas which are not expected to self clean.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have no impact on entrained oil in benthic primary producer habitat within subtidal areas. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have no impact on entrained oil affecting filter feeding communities within subtidal areas. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have no impact on entrained oil affecting deep-sea unconsolidated muds and sands in subtidal areas. |

| Intertidal seabed | | | |
|---|---|---|---|
| *Intertidal Coral Reef* | Minor additional impact | -1 | Shoreline clean-up on an intertidal coral reef would result in physical damage/breaking of coral structures, therefore a net damage to the coral eco-system. |
| *Mangrove/Mudflats/Samphires* | Minor additional impact | -1 | Shoreline clean-up within mangrove/low energy ecosystems is likely to result in more physical damage/breaking of mangrove root structures than benefit from any oil removed. |
| *Sandy Beach* | Minor mitigation of impact | 1 | Shoreline clean-up of sandy beaches is a well understood, well documented spill response technique, which can reliably remove thick oil from the eco-system. This is beneficial for species such as turtles who nest on sandy beaches. However, in the case of a condensate spill, the likely oil accumulating on a shoreline remote from the release location is likely to be very thin, and possibly not recoverable. Natual weathering on high energy beaches may be just as effective as attempting to clean-up very thin, non-adhesive slicks. |
| *Rocky Shoreline* | Minor mitigation of impact | 1 | Shoreline clean-up of rocky shorelines is a well understood, well documented spill response technique, which has the ability to remove some oil from the eco-system. However, certain techniques like steam cleaning and high pressure blasting are known to cause more harm than allowing the oil to naturally weather. Therefore, this technique would likely be successful, provided the correct clean-up techniques are chosen. |
| *Macro-Algae and Seagrass* | Minor additional impact | -1 | Shoreline clean-up within intertidal macro-algae/seagrass ecosystems would likely result in more physical disturbance to plant/root structures than benefit from any oil removed. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor mitigation of impact | 1 | If it is deemed that the amount of hydrocarbons expected to impact shorelines is large enough that a shoreline clean up will have positive impacts, then the removal of oil from the intertidal zones would likley result in reduction in harm to the benthic primary producers and associated food sources utilised by foraging protected fauna such as seabirds. Also, removal of oil reaching a turtle nesting beach would be of benefit to turtle nesting success. However, due to the type (generally non-toxic and non-adhesive weathered oil), shoreline clean-up of weathered condensate may only have limited positive effect compared to natural weathering. Caution is required, as additional physical damage can occur in sensitive intertidal environments, and the general presence of responders can result in additional disturbance to natural wildlife behaviours and processes, espeically seabirds and turtle nesting etc. |

| | | | |
|---|---|---|---|
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have insignificant impact on entrained oil in the lower water column. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have insignificant impact on entrained oil in the upper water column. |
| *Water surface* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have insignificant impact on thin surface slicks on the water surface. |
| Air | No or insignificant alteration of impact | 0 | As oil will have significantly weathered by the time it reaches a shoreline, clean-up activities will result in no net change to impacts to air quality. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | There would be no reduction in entrained oil, resulting in no significant change to fish communities, and thus commercial demersal fisheries. |
| *Shallow commercial fisheries (including aquaculture)* | Minor mitigation of impact | 1 | Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments. |
| *Recreational fisheries* | Minor mitigation of impact | 1 | Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | Minor mitigation of impact | 1 | Shoreline clean-up may reduce oil damage to Aboriginal heritage sites along the Kimberley / NT coastline, however care would be required to ensure important sites are not damaged during the clean-up process. |
| *Indonesian traditional fishing* | Minor mitigation of impact | 1 | Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments. |

## Chemical Dispersant - Subsea Injection

**Overall statement of likelihood of success of Subsea Dispersant Injection:**

**Aim**: Subsea dispersant injection (SSDI) involves using dispersant injection wands to inject dispersant into the oil/gas stream directly at the release location on the seabed. The dispersant will act to reduce the oil droplet sizes, resulting in an increase in oil entrainment in the water column. The reduction in oil droplet size will result in a reduction in oil arriving on the ocean surface, and therefore reducing the rates of evaporation, and subsequently reducing the local atmospheric concentration of Volitile Organic Carbon (VOC) around the release location (RPS 2019b).

**Type of slick:** Condensate (from a well-blowout) reaching the surface will form thin, patchy surface slicks within a few kilometers of the release location. Under very light wind conditions, weathering curves predict that up to 80% of the oil would evaporate. The remaining ~20% entraining in the top 3m of the water column, with a small fraction (<10%) undergoing biological degradation over time. With increasing wind conditions (>6 knots), a higher proportion of oil would become entrained, reducing the rates of evaporation and associated VOC exposure to the atmosphere (RPS 2019b).

**Likely success/effectiveness against slick:** Atmospheric modelling (RPS 2019b) of several worst-case well-blowout scenarios indicates that VOC concentrations would routinely be expected to exceed the 500 ppm VOC 15 minute short-term exposure threshold, resulting in the shut-down of any vessel activities near the well blowout location. This VOC risk would therefore potentially stop 'source control' activities, such as debris clearance or capping stack installation, potentially prolonging the duration of a well blowout and associated slicks and entrained oils. If SSDI were used during a well blow-out, for the time that SSDI was applied, modelling (RPS 2019b) indicates the rates of entrainment would increase and rates of evaporation would decrease. During light wind condtions, ~70% of the condensate would entrain in the shallow water colum (top 3m), with evaporation (and associated atmospheric VOC exposure) reducing to ~30%. Under increased wind conditions (>6 knots), evaporation becomes close to zero (RPS 2019b). Therefore SSDI will cause a reduction in atmospheric VOC concentration, enabling a safe debris clearance/capping stack installation. Any impacts associated with the use of SSDI to achieve a successful well-kill using a capping stack are offset by the significant reduction in the overall duration of the blow-out (and net reduction in entrained hydrocarbons) compared to a relief well-kill scenario.

The increase in entrainment from SSDI is similar to normal levels of entrainment expected to occur under higher wind conditions, and the effects of increased entrainment due to SSDI are partially offset due to a reduction in oil droplet size, resulting in a significant increase in biodegradation rates (up to 50%).

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | SSDI may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing BPPH to increased entrained hydrocarbons, for the duration of SSDI use. However, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | SSDI will not result in any increase in entrained hydrocarbons reaching deep water recetors. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | No or insignificant alteration of impact | 0 | SSDI may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing intertidal coral reef to increased entrained hydrocarbons for the duration of SSDI use. However, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used. |
| *Mangrove/Mudflats/Samphires* | No or insignificant alteration of impact | 0 | SSDI would result in a reduction in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing mangroves, samphires etc to increased entrained hydrocarbons for the duration of SSDI use. However, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used. |

| | | | |
|---|---|---|---|
| *Sandy Beach* | Minor mitigation of impact | 1 | SSDI would result in a reduction in increased entraimnet for the duraiton that SSDI was used, reducing oil load on beaches, for the duration which SSDI was used. |
| *Rocky Shoreline* | Minor mitigation of impact | 1 | SSDI would result in a reduction in increased entraimnet for the duraiton that SSDI was used, reducing oil load on rocky shorelines, for the duration which SSDI was used. |
| *Macro-Algae and Seagrass* | No or insignificant alteration of impact | 0 | SSDI may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing macro-algae and seagrass to increased entrained hydrocarbons, for the duration that SSDI is used. However, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | No or insignificant alteration of impact | 0 | SSDI may have a combination of positive and negative effects to intertidal seabed habitats. As a result, a 'no or insignificant alteration of impact' has been assigned for habitats important for protected species. |
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | SSDI will not result in any increase in entrained hydrocarbons reaching deep water recetors. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | SSDI may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing receptors to increased entrained hydrocarbons, for the duration that SSDI was used. However, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used. |
| *Water surface* | Major mitigation of impact | 3 | SSDI would result in a very significant reduction in oil arriving on the surface, resulting in a significant reduction in exposure of wildlife using the ocean surface, for the days on which SSDI was used. |
| Air | Major mitigation of impact | 3 | SSDI would result in a very significant reduction in VOCs in the atmosphere, making it safer for air breathing animals, including marine fauna and humans conducting the source control activities, for the days on which SSDI was used. |

| | | | |
|---|---|---|---|
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | SSDI will not result in any increase in entrained hydrocarbons reaching deep water recetors. |
| *Shallow commercial fisheries (including aquaculture)* | No or insignificant alteration of impact | 0 | SSDI may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing shallow commerical fisheries to increased entrained hydrocarbons, for the duration of SSDI use. However, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used. |
| *Recreational fisheries* | No or insignificant alteration of impact | 0 | SSDI may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing shallow recreational fisheries to increased entrained hydrocarbons, for the duration of SSDI use. However, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | As any SSDI application would occur within offshore waters, and as there would be significant oil already entrained from any well-blowout event, SSDI application over a short period of the overall blow-out would result in an insignificant change in dispersed oil reaching traditional Aboriginal areas of the Kimberley and NT coastline. In addition, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. |
| *Indonesian traditional fishing* | No or insignificant alteration of impact | 0 | SSDI may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing shallow Indonesian traditional fisheries to increased entrained hydrocarbons, for the duration of SSDI use. However, any instantaneous increase in impact is likley offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used. |

## Chemical Dispersant - Surface

**Overall statement of likelihood of success of Chemical Dispersant - Surface:**

**Aim:** To remove oil from the sea's surface via dispersant spraying from vessels and aircraft, thus reducing the amount of oil reaching birds, mammals and other organisms - as well as coastal habitats, socioeconomic features and shorelines (IPIECA 2015).

**Type of slick:** Surface oil is in the form of Group I floating slicks which have low viscosity and rapidly spread into a thin sheen. Surface oil concentrations will be approximately 10 $g/m^2$ for up to 10 to 15 kilometres from the spill site and weathered oil concentrations reduce down to below 1 $g/m^2$ approximately 1,200 km from the spill site.

**Likely success/effectiveness against slick:** The National Research Council (2010) notes that the window to use dispersants is early, typically within hours to 2 days of a spill, then after that, weathering makes oil more difficult to disperse (due to increased viscosity). Rapid dispersion of dispersant-treated oil begins at a wind speed of approximately 7 knots with wave heights of 0.2 to 0.3 metres (IPIECA 2015). Conditions where wave energy is too low, oil droplets may resurface after being applied with dispersant due to oil not being effectively dispersed into the water column. Dispersant becomes challenging in high winds and rough seas, where floating oil will be over-washed or temporarily submerged (IPIECA 2015). Whilst dispersants reduce the amount of oil on the surface that can affect wildlife, they also increase the exposure of dispersed oil in the upper water column to other wildlife. It is expected that dispersant will not significantly change the proportion of surface oil which would become entrained as the sea-state changes.

Generally oil slicks needs to be >100 $g/m^2$ (>0.1mm, which equates to Bonn code 4/5) to feasibly achieve a successfuly dispersant operation. However condensate arriving on the ocean surface from a well-blowout will never appear in slicks >100 $g/m^2$, and would generally be <10 $g/m^2$. Where there are any significant condensate slick, flammable/toxic vapours will also be present, and will likely exceed safe exposure thresholds, further reducing response efficiency (as vessels will not be permitted to operate in areas where explosive limits or VOC exposure thresholds are exceeded). Due to the very thin surface slicks, very low rates of succesful dispersal would be expected. During a well blow-out, significant volumes of oil/condensate would already be entrained, therefore surface dispersant application will result in further increases in entrained oil concentration. Therefore, surface dispersant application on a condensate slick would not be an effective response strategy.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | Minor additional impact | -1 | Chemical dispersant and additional entrained oil would result in negative impacts to shallow water BPPH. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | Chemical dispersant would result in an insignificant increase in any additional oil reaching deep water locations, regardless of chemical dispersant application on the surface. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | Minor additional impact | -1 | Dispersant is generally considered ineffective at significantly increasing entrainment of thin sheens of condensate, compared to natural rates of entrainment. A significant volume of dispersant would need to be applied to result in any change, therefore this would result in negative impacts, due to additional chemicals on the surface and in the shallow water column, which could negatively impact on sensitive shallow/intertidal receptors such as corals, seagrass etc, and the biota who depend on them, including invertebrates, and mega-fauna who forage in these zones. |
| *Mangrove/Mudflats/Samphires* | Minor additional impact | -1 | |
| *Sandy Beach* | Minor additional impact | -1 | |
| *Rocky Shoreline* | Minor additional impact | -1 | |
| *Macro-Algae and Seagrass* | Minor additional impact | -1 | |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor additional impact | -1 | |

| | | | |
|---|---|---|---|
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | No oil reaching deep water locations, regardless of dispersant application on surface. |
| *Upper water column (in photic zone)* | Minor additional impact | -1 | Dispersed oil can cause marine organisms inhabiting the upper water column to be briefly exposed to dispersed oil which can potentially have toxic effects. Dispersant is generally considered ineffective at significantly increasing entrainment of thin sheens of condensate, compared to natural rates of entrainment. A significant volume of dispersant would need to be applied to result in any change, therefore this would result in negate impacts, due to additional chemicals on the surface and in the shallow water column. |
| *Water surface* | Minor additional impact | -1 | |
| Air | No or insignificant alteration of impact | 0 | A very slight reduction in VOCs at the point of application of surface disperant could occur, however it would not affect the broader local atmosphere of the area around the surfacing slick over time. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | No oil reaching deep water locations, including demersal fish habitat, regardless of chemical dispersant application on surface. |
| *Shallow commercial fisheries (including aquaculture)* | Minor additional impact | -1 | Chemical dispersant and additional entrained oil would result in negative impacts to shallow commercial fisheries. |
| *Recreational fisheries* | Minor additional impact | -1 | Chemical dispersant and additional entrained oil would result in negative impacts to recreational fisheries. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | As any dispersant application would occur within offshore waters, and as there would be significant oil entrained from any well-blowout event, surface dispersant application would result in an insignificant change in dispersed oil reaching traditional Aboriginal areas of the Kimberley and NT coastline. |
| *Indonesian traditional fishing* | Minor additional impact | -1 | Chemical dispersant and additional entrained oil would result in negative impacts to shallow water BPPH which support indonesian traditional fishing target species. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH. |

## Pre-Contact Wildlife Response (Hazing and Translocation/Displacement)

**Overall statement of likelihood of success of Pre-contact OWR (hazing and translocation):**

***Aim:*** Hazing involves discouraging animals from entering oiled areas by encouraging them to move into low-risk unoiled areas, in an attempt to prevent them from becoming oiled (IPIECA 2017). Hazing techniques include vessels generating underwater noise and motion, vessel air horns making above-water noise and fire hoses directing streams in front of fauna. Translocation/displacement involves removing wildlife who are at risk of becoming oiled from the spill environment in an attempt to prevent them from becoming oiled (IPIECA 2017). This includes holding animals in captivity until the risk of oiling is over, or relocating them to another area not affected by the oil spill (IPIECA 2017).

***Type of slick:*** Floating oil is in the form of Group I slicks which have a low viscosity and rapidly spread into a thin sheen. Slicks will be approximately 10 g/m$^2$ up to approximately thirteen to fifteen kilometres from the spill site. Weathered oil concentrations reduce down to below 1 g/m$^2$ up to approximately 1200 km from the spill site. Group I oils are relatively non-adhesive, and oil reaching shorelines is likely to have undergone weathering and will be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than their unweathered counterparts (Milton et al, 2003; Hoff & Michel 2014; Woodside 2014).

***Likely success/effectiveness against slick:*** Wildlife hazing in the open ocean is inherently unlikely to be effective due to a number of limitations;
1) effectiveness depends upon the deployment of numerous ocean-going vessels (as opposed to smaller vessels which can be used near to the shore);
2) against a spreading plume (i.e. away from the immediate source of the spill), the technique becomes entirely impracticable;
3) there are significant safety issues associated with a spill of condensate and vessel masters will not approach the source of the spill, or fresh areas of slick, while the spill is still ongoing; and
4) without the constraints of a shoreline or other geographical feature, the technique may cause wildlife to move into other areas of the spill area instead of away from it.

Wildlife hazing is most suitable when used near sensitive shoreline habitats against persistent oily slicks, such as IFO, HFO or crude oil spills - but in the case of a subsea condensate well blowout, oil slicks are thin and not considered particularly adhesive, therefore reducing the likelihood and severity of impacts on wildlife. Additionally, hazing isn't considered an effective measure against volatile spills which rapidly evaporate.

In regard to wildlife translocation**,** IPIECA (2014) advise that the difficulty of capturing wildlife safely and maintaining their health during relocation should not be underestimated, and that working with live or dead animals has health and safety issues including potential injuries (bites, scratches) or zoonotic diseases. Risks to wildlife are high during pre-emptive capture and the risks of oiling need to be weighed against the risk of injury, death etc. (IPIECA 2014). The translocation of turtles from beaches and islands would likely require the capture of large numbers of hatchlings, followed by translocation to a location far from the slick (to prevent surface oil impacts on released hatchlings). The prolonged retention of hatchlings has been demonstrated to be detrimental to hatchling swimming speed and survival, even in short periods (6 hours) of retention (Pilcher and Enderby 2001). Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW 2014), especially at a remote shoreline location (such as Browse or Cartier Island). There is no practicable method to capture healthy seabirds at sea (DPaW 2014). Potential harm to healthy seabirds could occur during the capture process. Any seabirds released would likely fly back to the shoreline from which they originally were captured. Therefore, long term veterinary care (feeding etc.) would be required for any successfully captured birds, until spill weathering or remediation has occurred and it was safe to release the animals. An evaluation would need to be undertaken, to ensure the released animals do not pose a disease risk (human/zoonotic diseases), to the wild population into which they are released.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |

| | | | |
|---|---|---|---|
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Mangrove/Mudflats/Samphires* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Sandy Beach* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Rocky Shoreline* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Macro-Algae and Seagrass* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor mitigation of impact | 1 | Wildlife hazing of flocks of seabirds may temporarily prevent oiling of individuals or small proportions of a local/regional populations, however it is not likely effective across a broad geographical area. Even conducting wildlife hazing in the nearshore environment at an isolated location such as Browse Island would be of logistically challenging and potentially not result in any significant impact mitigation. Hazing of seabirds to prevent them landing on an oiled shoreline may temporarily prevent impacts, whilst shoreline clean-up is occurring. Capture and translocation of turtle hatchlings away from the oiled shoreline, and release in the open ocean is potentially feasible. Therefore, undertaking pre-contact oiled wildlife response at a shoreline may reduce the number of protected species of a local population from being oiled. |
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Water surface* | No or insignificant alteration of impact | 0 | Wildlife hazing and/or translocation of seabirds or other megafauna, such as cetaceans and turtles in the open ocean, using vessel presence, vessel noise or at sea capture is highly unlikely to be successful. It may be possible to temporarily (minutes / hours), prevent a few individuals of a protected species from entering a small geographic area affected by a slick. However, over the longer term duration and geographic area of a well-blowout scenario, there would be no alteration to the level of oiling of wildlife populations using this strategy in the open ocean. |
| Air | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Shallow commercial fisheries (including aquaculture)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Recreational fisheries* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Indonesian traditional fishing* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |

## Post Contact Oiled Wildlife Response

**Overall statement of likelihood of success of Post-contact OWR:**

***Aim:*** Post-contact oiled wildlife response involves capturing oiled wildlife - and if necessary, cleaning, rehabilitating and releasing them.

***Type of slick:*** Floating oil is in the form of Group I floating slicks which have a low viscosity and rapidly spread into a thin sheen. Slicks will be approximately 10 $g/m^2$ up to approximately thirteen to fifteen kilometres from the spill site. Weathered oil concentrations reduce down to below 1 $g/m^2$ up to approximately 1200 km from the spill site. Group I oils are relatively non-adhesive, and oil reaching shorelines is likely to have undergone weathering and will be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than fresh oil (Milton et al, 2003; Hoff & Michel 2014; Woodside 2014). Note that Group I hydrocarbons are relatively non-adhesive compared to crude oils, and are generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline.

***Likely success/effectiveness against slick:*** Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife has the ability to increase the survival of individuals. ITOPF (2011) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water. Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they originally were captured. Once oiled, it is generally agreed that birds have a very low survival rate, even when rescue and cleaning is attempted (Bourne et al. 1967; Holmes and Cronshaw 1977; Croxall 1977; Ohlendorf et al. 1978; Chapman, 1981; Ford et al., 1982; Samuels and Lanfear, 1982; Varoujean et al., 1983; Ford, 1985; Evans and Nettleship 1985; Fry 1987; Seip et al. 1991; Anderson et al. 2000). French-McCay (2009) produced mortality estimates of 99% for surface swimmers, 35% for aerial divers and raptors, and 5% for aerial seabirds. Samuels and Lanfear (1982) estimated that 95% of oiled seabirds die. ITOPF (2011) note that penguins and pelicans are often the exception as they are generally more resilient than many other species, however they are not present in the Browse Basin. IPIECA (2014) advise working with live or dead animals has health and safety issues including potential injuries (bites, scratches) or zoonotic diseases. An evaluation would need to be undertaken, to ensure any released animals do not pose a disease risk (human/zoonotic diseases), to the wild population into which they are released.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Mangrove/Mudflats/Samphires* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Sandy Beach* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Rocky Shoreline* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Macro-Algae and Seagrass* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor mitigation of impact | 1 | Post-contact OWR has the ability to increase the likelihood of survival of oil-affected EPBC species (individuals, or small proportion of a local population) in the intertidal/shoreline habitats. However, the seabird species of the Browse Basin are generally not expected to survive the capture, cleaning and rehabilitation process. Capture, cleaning and release of marine turtles would have a greater likelihood of success. |

| | | | |
|---|---|---|---|
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Water surface* | Minor mitigation of impact | 1 | It is possible that some individuals of protected species, which have been oiled and are unable to fly, could be captured in the open ocean and relocated to an oiled wildlife treatment facility. Therefore, whilst there is a very low probability of survival, under the right circumstances a positive environmental outcome, for a limited number of individuals of a protected species could be achieved. |
| Air | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Shallow commercial fisheries (including aquaculture)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Recreational fisheries* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Indonesian traditional fishing* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |

## In-situ Burn

**Overall statement of likelihood of success of In-situ burn (ISB):**

***Aim:*** In-situ burning rapidly removes the volume of spilled oil's hydrocarbon vapours in place, via combustion or burning (IPIECA 2016). This technique reduces the need to collect, store, transport and dispose recovered oil, plus it can shorten the overall response time (IPIECA 2016).

***Type of slick:*** Floating oil is in the form of Group I floating slicks which have a low viscosity and rapidly spread into a thin sheen. Slicks will be approximately 10 $g/m^2$ up to approximately ten to fifteen kilometres from the spill site, reducing to weathered oil below 1 $g/m^2$ up to approximately 1,200 km from the spill site.

***Likely success/effectiveness against slick:*** ISB requires wave heights typically below 1 m and wind speeds below 10 knots (IPIECA 2016) which are frequently exceeded at remote offshore locations in the Browse Basin region. Overseas experience shows that burns can be conducted safely, but the most discernible disadvantage is the resulting dark smoke plumes caused by the combustion of oil (IPIECA 2016). Carbon dioxide, soot (PM 2.5), water, polyaromatic hydrocarbons, volatile organic compounds, carbonyls, carbon monoxide, sulphur dioxide and potentially other gases can result from an in-situ burn, which has the potential to affect human and animal health (IPIECA 2016). IPIECA (2016) note that tests and information from previous burns indicate that ISB has little effect on water quality. Burn residue (i.e. burned oil depleted of volatiles and precipitated soot) rarely sinks and smothers benthic species (IPIECA 2016). Plus it is unlikely that Group I burn residue will cause smothering as this generally only occurs for heavier crudes (IPIECA 2016). IPIECA (2016) further note that burn residue is less toxic to aquatic biota than weathered oil.

To implement an effective in-situ burn response, a minimum surface hydrocarbon thickness of 2-5 mm (2000 - 5000 $g/m^2$) is required to be present. In the case of a well blowout, the surface slick is not expected to meet the required thickness (i.e. only 10 $g/m^2$ or 0.1 mm expected thickness in the immediate area of the release). Booms would be required to corral the spill, in an attempt to generate additional oil thickness, but this in turn is expected to exceed the VOC exposure thresholds for the workforce, and also may result in concentrations exceeding the lower explosive limit. Given this, and the lack of suitable booms available for in-situ burns in Australia, implementation of this response in an open ocean, high current environment is not considered to be safe, effective or feasible, especially against the thin sheen and hazardous atmospheric conditions associated with a condensate spill.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | | | |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | | | |
| *Deep-sea unconsolidated muds and sands* | | | |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | | | |
| *Mangrove/Mudflats/Samphires* | | | |
| *Sandy Beach* | | | |
| *Rocky Shoreline* | | | |
| *Macro-Algae and Seagrass* | | | |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | | | |

| | | | |
|---|---|---|---|
| **Water column** | | | |
| *Lower water column (below photic zone)* | | | |
| *Upper water column (in photic zone)* | | | |
| *Water surface* | | | |
| *Air* | | | |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | | | |
| *Shallow commercial fisheries (including aquaculture)* | | | |
| *Recreational fisheries* | | | |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | | | |
| *Indonesian traditional fishing* | | | |

**References**

Anderson, D. W., Newman, S.H., Kelly, P.R., Herzog, S.K. and Lewis, K.P. 2000. An Experimental Soft-Release of Oil-Spill Rehabilitated American Coots (Fulica americana): I. Lingering Effects on Survival, Condition and Behavior. Environmental Pollution 107: 285–294.

Asia-Pacific Applied Science Associates (APASA). 2012. Basset Deep Well: Quantitative Spill Risk Assessment. J0172 Rev 2. Prepared for INPEX Operations Australia Pty 27/11/2012

Australian Maritime Safety Authority (AMSA). 2015. *The Effects of Maritime Oil Spills on Wildlife including Non-avian Marine Life*. Accessed online 14/11/2018 at <http://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/general-information/oiled-wildlife/marine-life/index.asp>.

Australian Maritime Safety Authority (AMSA). 1998. National Plan (document now superseded): *The effects of maritime oil spills on wildlife including non-avian marine life*. Accessed 16 July 2015 at <https://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/General-Information/oiled-wildlife/marine-life/index.asp>.

Bourne, W.R.P., Parrack J.D. and Potts G.R. 1967. Birds Killed in the Torrey Canyon Disaster. Nature 215: 1123–1125.

Burns, K.A., Garrity, S.D. and Levings, S.C. 1993. How many years before mangrove ecosystems recover from catastrophic oil spills? *Marine Pollution Bulletin.* 26(5):239–248

Campagna, C., Short, F.T., Polidoro, B.A., McManus, R., Collette, B.B., Pilcher, N.J., Mitcheson, Y.S., Stuart, S.N. and Carpenter, K.E. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. *BioScience* 61:393–397.

Chapman, B.R. 1981. *Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations*. pp. 461–465 in American Petroleum Institute, Proceedings of the 1981 Oil Spill Conference. American Petroleum Institute, Washington, D.C.

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environmental Pollution 33:1–22.

Connell, D.W., Miller, G.J. and Farrington, J.W. 1981. Petroleum hydrocarbons in aquatic ecosystems—behavior and effects of sublethal concentrations: Part 2. *Critical Reviews in Environmental Science and Technology* 11(2):105–162.

Commonwealth Scientific and Industry Research Organisation (CSIRO). 2016. Oil spill monitoring handbook. CSIRO Publishing, Clayton South, Victoria.

Croxall, J.P. 1977. *The Effects of Oil on Seabirds*. Rapport Procès-Verbal Reunion Conseil International pour L'Exploration de la Mer 171: 191–195.

Dean, T.A., Stekoll, M.S., Jewett, S.C., Smith, R.O. and Hose, J.E. 1998. Eelgrass (Zostera marina L.) in Prince William Sound, Alaska: effects of the Exxon Valdez oil spill. Marine Pollution Bulletin 36: 201–210.

DoF. 2013. Pearl Oyster, Webpage managed by the Department of Fisheries Western Australia, accessed December 2017. Last updated 24 April 2013. [http://www.fish.wa.gov.au/Species/Pearl-Oyster/Pages/default.aspx]

Department of Environment and Conservation (DEC). 2007. Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007–2017: Management Plan No. 55. Department of Environment and Conservation, Perth, Western Australia

Department of Environment and Conservation (DEC) and Marine Parks and Reserves Authority (MPRA). 2005. Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005–2015. Department of Environment and Conservation and Marine Parks and Reserves Authority. Perth,
Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008. North Marine Bioregional Plan bioregional profile: a description of the ecosystems, conservation values and uses of the North Marine Region.

Department of Parks and Wildlife (DPaW). 2014. *Western Australian Oiled Wildlife Response Plan (WAOWRP* ). Department of Parks and Wildlife, Perth, WA.

Duke, N., Burns, K,. Swannell, J., Dalhaus, O. and Rupp, R. 2000. Dispersant use and a bioremediation strategy as alternative means of reducing impacts of large oil spills on mangroves: the Gladstone field trials. *Marine Pollution Bulletin* . Vol 41, Issues 7–12:403–412.

Evans, P.G.H. and Nettleship, D.N. 1985. *Conservation of the Atlantic Alcidae* . pp. 427–488 in Nettleship, D.N. and Birkhead, T.R. (eds.). The Atlantic Alcidae. Academic Press, London, UK.

Fingas. 2012. The Basics of Oil Spill Cleanup – Third Edition. CRC Press. Boca Raton, Florida.

Fletcher WJ, Mumme MD and Webster FJ (eds). 2017. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2015/6: The State of the Fisheries. Department of Fisheries, Western Australia.

Fletcher, W.J. and Santoro, K. (eds). 2014. Status reports of the fisheries and aquatic resources of Western Australia 2013/14: The state of the fisheries. Department of Fisheries, Western Australia.

Ford, R.G., Wiens, J.A., Heinemann D. and Hunt G.L. 1982. Modelling the Sensitivity of Colonially Breeding Marine Birds to Oil Spills: Guillemot and Kittiwake Populations on the Pribilof Islands, Bering Sea. *Journal of Applied Ecology* 19:1–31.

Ford, R.G. 1985. *A Risk Analysis Model for Marine Mammals and Seabirds: A Southern California Bight Scenario* . Final Report to U.S. Department of the Interior, Minerals Management Service MMS 85-0104, Pacific OCS Region, Los Angeles, CA.

French-McCay, D.P. 2009. State of the art and research needs for oil spill impact assessment modelling. pp. 601-653, 2009 in Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada.

Fry, D.M. 1987. *Seabird Oil Toxicity Study* . Report submitted by Nero and Associates, Inc. to Minerals Management Service, U.S. Department of Interior, Washington, D.C., USA.

Fucik, K.W., Bight, T.J. and Goodman K.S. 1984. Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil. pp. 115–134 in Cairns Jr., J. and Buikema Jr., A.L. (eds.), *Restoration of Habitats Impacted by Oil Spills* , Butterworth Publishers, Boston, MA.

Guzman H.M., Burns K.A., Jackson B.C. 1994. Injury, regeneration and growth of Caribbean reef corals after a major oil spill in Panama. Marine Ecology Progress Series 105, 231–241.

Hayes M., Hoff R., Michel J., Scholz D. and Shigenaka G. 1992. An introduction to Coastal Habitats and Biological Response to an Oil Spill. Report prepared by the Hazardous Materials Response and Assessment Division National Oceanic and Atmospheric Administration.

Hoff, R. and Michel, J. 2014. Oil spills in mangroves: planning and response considerations. US Department of Commerce. National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington.

Holmes, W.N. and Cronshaw, J. 1977. *Biological Effects of Petroleum on Marine Birds* . pp. 359–398 in Malins, D.C. (ed.), Effect of petroleum on arctic and subarctic marine environments and organisms. Vol. II: Biological effects. Academic Press, New York, USA.

Hook S.E., Osborn H.L., Spadaro D.A., Simpson S.L. 2014b. Assessing mechanisms of toxicant response in the amphipod Melita plumulosa through transcriptomic profiling. Aquatic Toxicology 146, 247–257. doi:10.1016/j.aquatox.2013.11.001

International Petroleum Industry Environmental Conservation Association (IPIECA). 2014. Wildlife resopnse preparedness. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 516. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015a. A guide to oiled shoreline clean-up techniques. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 521. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015b. At-sea containment and recovery. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 522. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015c. Dispersants: surface application. IOGP report 532. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2017b. Key principles for the protection, care and rehabilitation of oiled wildlife. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 583. London, UK.

International Tanker Owners Pollution Federation (ITOPF). 2011. Effects if Oil Pollution on the Marine Environment - Technical Information Paper. Published by the International Tanker Owners Pollution Federation Limited, London UK.

Jenssen, B.M. 1994. Review article: Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. *Environmental Pollution* , 86:207–215.

Law R.J., Kirby M.F., Moore J., Barry J., Sapp M., Balaam J. 2011. PREMIAM – pollution response in emergencies marine impact assessment and monitoring: post-incident monitoring guidelines. In Science Series Technical Report No. 146. Cefas, Lowestoft, UK, <www.cefas.defra.gov.uk/premiam>.

Lee, K. 2011. *Toxicity Effects of Chemically Dispersed Crude Oil on Fish* . International Oil Spill Conference Proceedings 2011(1):163.

Matcott, J., Baylis, S., and Clarke, R.H. 2019. The Influence of Petroleum oil films on the feather structure of tropical and temperate seabird species. Marine Pollution Bulletin 138: 135-144.

Milton, S., Lutz, P. and Shigenaka G. 2003. Oil Toxicity and Impacts on Sea Turtles. In Shigenaka, G. (ed.), *Oil and Sea Turtles: Biology, Planning, and Response* . National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington.

Montagna P.A., Baguley J.G., Cooksey C., Hartwell I., Hyde .LJ., Hyland J.L. et al. 2013. Deep-sea benthic footprint of the Deepwater Horizon blowout. PLoS One 8, e70540. doi:10.1371/journal.pone.0070540

Murawski S.A., Hogarth W.T., Peebles EB, Barbeiri E. 2014. Prevalence of external skin lesions and polycyclic aromatic hydrocarbon concentrations in Gulf of Mexico fishes, post Deepwater Horizon. Transactions of the American Fisheries Society 143, 1084–1097.

National Research Council (NRC). 2005. Oil Spill Dispersants: Efficacy and Effects. The National Academies Press. Washington, DC.

Negri, A.P. and Heyward, A.J. 2000 Inhibition of fertilization and larval metamorphosis of the coral *Acropora millepora* (Ehrenberg, 1834) by petroleum products. *Marine Pollution Bulletin* 41(7–12):420–427.

O'Brien, M. 2002. At-sea recovery of heavy oils - A reasonable response strategy? 3rd Forum on High Density Oil Spill response. The International Tanker Owners Pollution Federation Limited (ITOPF). London, UK.

Ohlendorf, H.M., Risebrough R.W. and Vermeer, K. 1978. *Exposure of Marine Birds to Environmental Pollutants* . U.S. Fish and Wildlife Service Wildlife Research Report 9.

Peters E.C., Gassman N.J., Firman J.C., Richmond R.H., Power EA .1997. Ecotoxicology of tropical marine ecosystems. Environmental Toxicology and Chemistry 16, 12–40. doi:10.1002/etc.5620160103

Pie HV, Heyes A, Mitchelmore C.L. 2015. Investigating the use of oil platform marine fouling invertebrates as monitors of oil exposure in the Northern Gulf of Mexico. The Science of the Total Environment 508, 553–565. doi:10.1016/j.scitotenv.2014.11.050

Pilcher N.J., and Enderby. S. 2001. Effects of prolonged retention in hatcheries of green turtle (Chelonia mydas) hatchling swimming speed and survival. Journal of Herpetology. 35(4): 633–638.

RPS. 2018. WA-343-P Quantitative Spill Risk Assessment. West Perth, Western Australia.

RPS. 2019a. INPEX Ichthys Phase 2A Development Drilling WA-50-L Oil Spill Risk Assessment. MAW0796J. Prepared by RPS Australia West Pty Ltd. Prepared for INPEX, Perth, Western Australia.

RPS. 2019b. INPEX VOC & SSDI Modelling - Near-field to far-field investigation stages. MAW0779J.000. Prepared by RPS Australia West Pty Ltd. Prepared for INPEX, Perth, Western Australia.

Runcie, J.W. and Riddle, M.J. 2006. Diel variability in photosynthesis of marine macroalgae in ice-covered and ice-free environments in East Antarctica. European Journal of Phycology 41(2):223–233.

Samuels, W.B. and Lanfear K.J. 1982. Simulations of seabird damage and recovery from oil spills in the northern gulf of Alaska. Journal of Environmental Management 15: 169–182.

Seip, K.L., Sandersen, E., Mehlum, F. and Ryssdel, J. 1991. Damages to seabirds from oil spills: comparing simulation results and vulnerability indexes. Ecological Modellin, 53: 39–59.

Sell D, Conway L, Clark T, Picken GB, Baker JM, Dunnet GM. 1995 Scientific criteria to optimize oil spill cleanup. International Oil Spill Conference Proceedings 1995(1), 595–610.

Shigenaka, G. 2001. *Toxicity of Oil to Reef Building Corals: A Spill Response Perspective* . National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum, National Ocean Service, Office of Research and Restoration 8, Seattle, USA.

Simberloff, D. 2009. The role of propagule pressure in biological invasions. The Annual Review of Ecology, Evolution, and Systematics 40:81-102.

Taylor H and Rasheed M. 2011. Impacts of a fuel oil spill on seagrass meadows in a subtropical port, Gladstone, Australia – The value of long-term marine habitat monitoring in high risk areas. Marine Pollution Bulletin 63:431-437.

Varoujean, D.H., Baltz, D.M., Allen, B., Power, D., Schroeder, D.A. and Kempner, K.M. 1983. *Seabird-Oil Spill Behavior Study* . Report by Nero and Associates, Inc. to U.S. Department of the Interior, Minerals Management Service, Reston, VA.

WA Department of Transport (WA DoT). 2018. Provision of Western Australian Marine Oil Pollution Risk Assessment - Protection Priorities - Protection Priority Assessment for Zone 1: Kimberley - Draft Report. Perth, Western Australia.

Woodside Energy Ltd. 2014. Browse FLNG Development, Draft Environmental Impact Statement. EPBC 2013/7079. November 2014. Woodside Energy Ltd., Perth, Western Australia.

Zieman, J.C., Orth, R., Phillips, R.C., Thayer, G. and Thorhaug, A. 1984. The effects of oil on seagrass ecosystems. pp. 37–64 in Cairn, J. and Buikema, A.L. (eds), Restoration of Habitats Impacted by Oil Spills. Butterworth, Boston, USA.

## X060-AH-LIS-60032 Spill Impact Mitigation Assessment Surface Diesel Release

| Location | N/W WA and NT Waters | Spill Scenario | <500m$^3$ Marine Diesel Instantaneous Surface Release |
|---|---|---|---|

| | SIMA Stage 2: Predict Outcomes | | SIMA Stage 3: Balance Trade-Offs - Impact Modification Factors | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Potential Relative Impact | | Prediction of the effectiveness and impact modification potential of the response options | | | | | | | | | | | | | |
| Resource Compartment (including values dependent on the resource compartment) | No Intervention (natural weathering) | | Contain and Recover | | Protect and Deflect | | Shoreline Clean-up | | Chemical Dispersant (near spill location) | | Pre-Contact Wildlife Response (Hazing & Translocation) | | Post Contact Wildlife Response | | In-situ Burn (near spill location) | Operational monitoring and evaluation |
| | | A | B1 | A x B1 | B2 | A x B2 | B3 | A x B3 | B4 | A x B4 | B5 | A x B5 | B6 | A x B6 | | |
| **Subtidal Benthic Communities** | | | | | | | | | | | | | | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)* | Moderate | 3 | 1 | 3 | 0 | 0 | 0 | 0 | -1 | -3 | 0 | 0 | 0 | 0 | | |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | None / Insignificant | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| *Deep-sea unconsolidated muds and sands* | None / Insignificant | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| **Intertidal seabed** | | | | | | | | | | | | | | | | |
| *Intertidal Coral Reef* | Moderate | 3 | 1 | 3 | -2 | -6 | -1 | -3 | -1 | -3 | 0 | 0 | 0 | 0 | | |
| *Mangrove/Mudflats/Samphires* | Minor | 2 | 1 | 2 | -1 | -2 | -1 | -2 | -1 | -2 | 0 | 0 | 0 | 0 | | |
| *Sandy Beach* | Minor | 2 | 1 | 2 | 1 | 2 | 1 | 2 | -1 | -2 | 0 | 0 | 0 | 0 | | |
| *Rocky Shoreline* | Minor | 2 | 1 | 2 | 1 | 2 | 1 | 2 | -1 | -2 | 0 | 0 | 0 | 0 | | |
| *Macro-Algae and Seagrass* | Minor | 2 | 1 | 2 | 1 | 2 | -1 | -2 | -1 | -2 | 0 | 0 | 0 | 0 | | |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Moderate | 3 | 1 | 3 | 1 | 3 | 1 | 3 | -1 | -3 | 1 | 3 | 1 | 3 | | |
| **Water column** | | | | | | | | | | | | | | | In-situ is not considered to be safe, effective or feasible. | Operational monitoring and evaluation is implemented under all oil spill scenarios |
| *Lower water column (below photic zone)* | None / Insignificant | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| *Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)* | Minor | 2 | 1 | 2 | 0 | 0 | 0 | 0 | -1 | -2 | 0 | 0 | 0 | 0 | | |
| *Water surface, including foraging areas for EPBC listed species* | Moderate | 3 | 1 | 3 | 0 | 0 | 0 | 0 | -1 | -3 | 0 | 0 | 1 | 3 | | |
| *Air* | Minor | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| **Socio-economic** | | | | | | | | | | | | | | | | |
| *Commercial demersal fisheries* | None / Insignificant | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| *Shallow commercial fisheries (including aquaculture)* | None / Insignificant | 1 | 1 | 1 | 0 | 0 | 1 | 1 | -1 | -1 | 0 | 0 | 0 | 0 | | |
| *Recreational fisheries* | None / Insignificant | 1 | 1 | 1 | 0 | 0 | 1 | 1 | -1 | -1 | 0 | 0 | 0 | 0 | | |
| **Cultural heritage** | | | | | | | | | | | | | | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | None / Insignificant | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| *Indonesian traditional fishing* | None / Insignificant | 1 | 1 | 1 | 0 | 0 | 1 | 1 | -1 | -1 | 0 | 0 | 0 | 0 | | |
| | | | | | | | | | | | | | | | | |
| | | **Total Impact Mitigation Score** | | 25 | | 1 | | 4 | | -25 | | 3 | | 6 | - | - |
| | | **Carried to ALARP evaluation yes/no** | | Yes | | Yes | | Yes | | No | | Yes | | Yes | No | Yes |

| Resource Compartment (including values dependent on the resource compartment) | No Intervention (natural weathering) | | Justification for Potential Relative Impact Score |
|---|---|---|---|
| | | A | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)* | Moderate | 3 | Subtidal benthic primary producer habitat (BPPH) may be exposed to entrained/dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. The effect of the toxic fractions of entrained/dissolved oil on intertidal coral includes partial mortality of colonies, reduced growth rates, bleaching, reduced photosynthesis, interruption of chemical communication necessary for mass spawning, premature explosion of larvae, decreased growth rates, decreased lipid content, decreased survival of larvae, decreased gonadal development, negative impacts to coral settlement, increased susceptibility to algae colonisation, epidemic diseases, localised tissue rupture, reduced reef resilience and mortality (Hayes et al 1992; Peters et al 1997; Negri & Heyward 2000; Shigenaka 2001; CSIRO 2016). WA DoT (2018) note that coral is sensitive to dissolved hydrocarbons as it causes toxicity at a cellular level. Corals accumulate oil from the water column (Pie et al 2015) making it biologically available to EPBC species foraging in this habitat.<br>Seagrass and macroalgae may be subject to lethal or sublethal toxic effects, including mortality, reduced growth rates and impacts to seagrass flowering. BPPH is collectively considered to be an important resource as it supports a high biomass of fish, cetaceans and seabirds, including foraging EPBC species (DEWHA 2008). Several studies have indicated rapid recovery rates for seagrass and macroalgae may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006), but coral is sensitive to oil (and dispersants), making recovery from spills potentially slow (Guzman et al 1994). RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. Therefore, the consequence to benthic primary producer habitat is considered to be Moderate. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | None / Insignificant | 1 | No impact from surface spill of diesel below 25m (RPS 2019). |
| *Deep-sea unconsolidated muds and sands* | None / Insignificant | 1 | No impact from surface spill of diesel below 25m (RPS 2019). |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | Moderate | 3 | Intertidal coral reefs could be impacted by surface fresh, weathered, entrained and dissolved diesel from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of diesel on intertidal coral is unlikely to result in significant smothering as diesel is expected to be weathered and in the form of waxy flakes/residues when it arrives in intertidal coral areas. In this form, toxicity is less than fresh diesel (Woodside 2014). The effect of the toxic fractions of entrained/dissolved oil on intertidal coral include partial mortality of colonies, reduced growth rates, bleaching, reduced photosynthesis, interruption of chemical communication necessary for mass spawning, premature explosion of larvae, decreased growth rates, decreased lipid content, decreased survival of larvae, decreased gonadal development, negative impacts to coral settlement, increased susceptibility to algae colonisation, epidemic diseases, localised tissue rupture, reduced reef resilience and mortality (Hayes et al 1992; Peters et al 1997; Negri & Heyward 2000; Shigenaka 2001; CSIRO 2016). WA DoT (2018) note that coral is sensitive to dissolved hydrocarbons as it causes toxicity at a cellular level. Coral reefs are found in isolated locations within the Browse Basin and are considered to be significant benthic primary producers that play a key role in the ecosystem and have an iconic status in the environment (WA DoT 2018). They are considered of high importance to EPBC species that aggregate, nest, roost and forage in the area, hence isolated populations could potentially be exposed in the event of a spill. As spills disperse, intertidal communities are expected to recover (Dean et al. 1998), though the rate of recovery of coral reefs depends on the level or intensity of the disturbance, with recovery rates ranging from 1 or 2 years, to decades (Fucik et al. 1984, French McCay 2009). Impact on the receptor is considered to be Moderate. |
| *Mangrove/Mudflats/Samphires* | Minor | 2 | Mangrove, mudflats and samphire communities may be exposed to entrained/dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. Given that mangrove habitats are remote from permit areas, fresh or weathered diesel (both surface and entrained) are unlikely to reach this receptor. The potential effects of entrained and dissolved oil include defoliation and mortality of mangroves (Burns et al. 1993; Duke et al. 2000). Entrained and dissolved oil exposure is only likely to occur at isolated locations amongst a very large and generally contiguous population. The recovery of mangroves from shoreline oil accumulation can be a slow process, due to the long-term persistence of oil trapped in anoxic sediments and subsequent release into the water column (Burns et al. 1993). Any impacts to benthic habitats are expected to be localised and of short to medium term. The potential consequence is considered to be Minor. |
| *Sandy Beach* | Minor | 2 | Sandy beaches could be impacted by surface fresh, weathered, entrained and dissolved diesel from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of gradual accumulation of oil on the receptor could lead to harm including the increased prevalence of tumours in species (CSIRO 2016). Sandy beaches are the dominant shoreline habitat on offshore islands in the Browse Basin and are considered significant habitat for turtles and seabird nesting. Organisms such as polychaete worms, bivalves and crustaceans generally inhabit sandy beaches but the mobile nature of the sands generally limits diversity. These species provide a valuable food source for resident and migratory sea and shorebirds (DEC/MPRA 2005). Law et al (2011) note that when grain size is between 2 and 64 mm, beaches are not considered especially sensitive to oil spills as they are regularly cleaned by wave action and oil is generally not retained. Offshore island beaches of the Browse Basin are generally coarse grained, due to high wave energy. WA DoT (2018) assessed Kimberley sandy beaches and concluded that they are moderately ecologically sensitive and are moderately difficult to rehabilitate from an oil spill. The potential consequence is considered to be Minor. |
| *Rocky Shoreline* | Minor | 2 | Rocky shorelines could be impacted by surface fresh, weathered, entrained and dissolved diesel from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. This receptor is typically characterised as being a high wind and wave energy environment (CSIRO 2016). Diesel from a spill has the potential to coat the substrate or become stranded by receding tides – but incoming tides also have the potential to remove deposited diesel (Law et al 2011). CSIRO (2016) note that rocky shorelines are not considered sensitive environments, and IPIECA (2017) state that rocky shorelines generally have a diverse and productive intertidal community which are considered resilient to oil spills and short-term oil persistence. WA DoT (2018) note that rocky shorelines are the least susceptible of shoreline types to long term impacts from a spill of both floating and dissolved oil. As such, this receptor is not expected to have issues relating to recovery from an oil spill. The potential consequence for rocky shorelines is considered to be Minor. |

| | | | |
|---|---|---|---|
| *Macro-Algae and Seagrass* | Minor | 2 | Macroalgae and seagrass may be exposed to entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. This receptor is unlikely to come into contact with significant amounts of fresh floating surface hydrocarbons, but could potentially be exposed to weathered waxy flakes and residues. WA DoT (2018) note that dissolved oil causes more impacts to algae than floating oil, as it results in cellular level poisoning. The effect of subjecting seagrass and macroalgae to lethal or sublethal toxic effects of oil can result in mortality, reduced growth rates and impacts to seagrass flowering. Several studies have indicated rapid recovery rates may occur even in cases of heavy oil contamination (Connell et al, 1981; Burns et al. 1993; Dean et al. 1998; Runcie & Riddle 2006). Taylor and Rasheed (2011) reported that seagrass meadows were not significantly affected by an oil spill when compared to a non-impacted reference seagrass meadow. Macroalgae support diverse small invertebrates that are the principal food source for a number of inshore fish (WA DoT 2018). Seagrasses provide energy and nutrients for detrital grazing food webs (WA DoT 2018), act as a refuge for fish and invertebrates, and provide a food source for EPBC species such as dugongs and green turtles (DEC 2007). Therefore, the potential consequence is considered to be Minor. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Moderate | 3 | Intertidal habitat may be exposed to fresh, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of diesel on this receptor can result in mortality or harm to benthic primary producers and organisms such as EPBC species that rely on these species for food, or rely on the habitat for nesting and roosting. IPIECA (2014) note that dehydration, gastrointestinal problems and anaemia are commonly found in oiled animals, causing potential long-term effects on reproductive success. They further note that the toxic effects of ingested oil generally impacts the liver, whilst volatile fumes damage lungs resulting in debilitating effects (IPIECA 2014). Oiled aquatic EPBC fauna can further suffer hypothermia, irritations, burns, respiratory problems and loss of waterproofing, leading to them moving onto land (i.e. away from their food source) where they have further difficulty thermoregulating and feeding (IPIECA 2017). Specifically, marine reptiles, including turtles and crocodiles can be exposed to hydrocarbons externally in intertidal areas through direct contact; or internally, by ingesting oil, consuming prey containing oil, or inhaling volatile compounds (Milton et al. 2003). Turtle hatchlings may be particularly vulnerable to toxicity and smothering, as they emerge from nests and make their way over the intertidal area to the water (AMSA 2015; Milton et al. 2003). Birds coated in hydrocarbons can suffer damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs (AMSA 2015; WA DoT 2018). Toxic effects may also result where the product is ingested, either through birds' attempts to preen their feathers (Jenssen 1994; Matcott et al. 2019) or ingested as weathered waxy flakes/residues present on shorelines. There is the potential for short to medium term impacts; however, the overall population viability for any protected species would not be threatened from a vessel collision spill. The cumulative potential consequence is considered to be Moderate. |
| **Water column** | | | |
| *Lower water column (below photic zone)* | None / Insignificant | 1 | No impact from surface spill of diesel below 25m (RPS 2019). |
| *Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)* | Minor | 2 | The upper water column may be exposed to entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of entrained and dissolved oil on this receptor include chronic impacts to juvenile fish, larvae and planktonic organisms due to their sensitivity during these life stages, with the worst impacts predicted to occur in smaller species (WA DoT 2018). Whale sharks are filter feeders and are expected to be highly vulnerable to entrained hydrocarbons (Campagna et al 2011) with potential effects including damage to the liver and lining of the stomach and intestines, as well as toxic effects on embryos (Lee 2011). Marine mammals, marine reptiles and marine avifauna could also be impacted through entrained and dissolved hydrocarbon exposure, primarily through ingestion during foraging activities (AMSA 1998). The upper water column is considered to be very important habitat for EPBC species as a large number of BIAs for marine fauna are present in the Browse Basin. It is expected that the upper water column will recover quickly as a vessel collision spill is unlikely to cause significant or cumulative impacts. The consequence is considered to be Minor. |
| *Water surface, including foraging areas for EPBC listed species* | Moderate | 3 | The water surface may be exposed to fresh and weathered surface diesel above impact thresholds from a vessel collision in the Browse Basin. Fresh diesel and weathered waxy flakes/residues can impact marine mammals surfacing, as they are vulnerable to oil exposure. Blue whales and humpback whales (baleen whales), that filter-feed near the surface, could potentially ingest diesel. Spilled hydrocarbons may also foul the fibres of baleen whales impairing food gathering efficiency or fouling prey with hydrocarbons (AMSA 2015). Turtles can be exposed to hydrocarbons if they surface within the spill, resulting in direct contact with the skin, eyes, and other membranes, as well as the inhalation of vapours or ingestion (Milton et al. 2003). Floating oil is considered to impact reptiles more than entrained/dissolved oil because reptiles hold their breath underwater and are unlikely to directly ingest dissolved oil (WA DoT 2018). Other aspects of turtle behaviour, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large, pre dive inhalations, make them vulnerable to spilled oil (AMSA 2015). Hatchlings spend more time on the surface than older turtles, thus increasing the potential for contact with oil slicks (Milton et al. 2003).<br>Aquatic migratory birds are among the most vulnerable and visible species to be affected by surface oil, with oil impacts frequently leading to long-term physiological changes potentially resulting in lower reproductive rates or survival rates (Fingas 2012). The probability of lethal effects is dependent on factors such as timing, location, oceanographic and weather patterns, and the movements of species that forage, feed, nest and inhabit that area (IPIECA 2014), the amount of time spent on the water surface as well as any oil avoidance behaviour (French-McCay 2009). Direct contact with surface hydrocarbons may break down the ability of plumage to maintain body heat, resulting in direct and indirect impacts such as hypothermia, dehydration, drowning and starvation (AMSA 2015; Matcott et al, 2019; Jenssen 1994; IPIECA 2014; ITOPF 2011). Birds resting at the sea surface or surface plunging can be impacted by oil resulting in damage to external tissues, including skin and eyes, and internal tissue irritation in lungs and stomachs (Clark 1984; WA DoT 2018). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (Jenssen 1994; Matcott et al. 2019). The water surface is considered an important receptor where EPBC listed species forage. It is expected to recover from oil impacts with time, and it is unlikely that there will be cumulative impacts through bioaccumulation up the food chain. The consequence is considered to be Moderate. |
| *Air* | Minor | 2 | Air may be exposed to fresh surface diesel above impact thresholds from a vessel collision in the Browse Basin. Surface oil may lead to high local concentrations of atmospheric volatiles that have the potential to cause harmful impacts to species such as cetaceans if inhaled. Turtles could also be affected by harmful vapours during pre-dive inhalations (Milton et al. 2003). The receptor is not considered to be sensitive, thus is expected to recover in a very short period of time, as the evaporated hydrocarbons are rapidly dispersed by the wind, and evaporation rapidly reduce with time as oil weathers and entrains. Only a very localised area, immediately above the freshest parts of the oil slick would be impacted by evaporating hydrocarbons. The potential consequence is considered to be Minor. |

| | | | |
|---|---|---|---|
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | None / Insignificant | 1 | No impact to fish stocks deeper 25 metres (RPS 2019). Commercial demersal fisheries may be exposed to surface, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of diesel on this receptor includes the ability to cause economic loss (through indirect loss of stock and perceived tainting of stock by oil) (WA DoT 2018), impede access to fishing areas from the implementation of an exclusion zone during a spill response; impact seafood quality and employment; plus negatively impact lines and nets (ITOPF 2011). The economic impact from an oil spill is dependent on the species being cultured, as species have different recovery rates. WA DoT (2018) note that dissolved oil will impact finfish, taking 6-8 years for fisheries to recover (due to the time it takes for hatchlings to reach maturity) (WA DoT 2018). This receptor is considered to be important, however a vessel collision spill is unlikely to cause significant impacts to demersal fisheries due to the shallow and localised entrained oil affected area. The real and perceived consequence is considered to be Insignificant. |
| *Shallow commercial fisheries (including aquaculture)* | None / Insignificant | 1 | Shallow commercial fisheries including aquaculture (shallower than 25m, (RPS 2019)) may be exposed to surface, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effect of diesel on this receptor includes the ability to cause economic loss (through indirect loss of stock and perceived tainting of stock by oil) (WA DoT 2018), impede access to fishing areas from the implementation of an exclusion zone during a spill response; impact seafood quality and employment; plus negatively impact lines and nets (ITOPF 2011). The economic impact from an oil spill is dependent on the stock being cultured, as species have different recovery rates. DoT (2018) note that dissolved oil will have the greatest impact, with oyster farms potentially taking 3-4 years to recover from a spill (DoF 2013), whilst finfish farms could take 6-8 years to recover due to the time it takes for hatchlings to reach maturity. WA DoT (2018) note that the pearling industry relies almost exclusively on sourcing pearl oysters from Eighty Mile Beach (south of Broome) and an area off the Lacepede Islands. There is also other aquaculture in the region including trochus and barramundi (Fletcher et al 2017). WA DoT (2018) note that some wild stocks aquaculture species such as mussels are impacted more by dissolved oil than floating oil due to being filter feeders. This receptor is considered to be important however a vessel collision spill in the Browse Basin unlikely to cause any significant impacts to shallow commercial fisheries (including aquaculture) due to the limited and localised surface and shallow entrained oil and remoteness of the shallow commercial fishing areas and aquaculture to potential release locations. Therefore, the real and perceived consequence is considered to be Insignificant. |
| *Recreational fisheries* | None / Insignificant | 1 | Recreational fisheries (shallower than 25m, RPS 2019)) may be exposed to surface, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. The effects of diesel on this receptor includes negatively impacting nets and lines (ITOPF 2011), impeding access to fishing areas from the implementation of an exclusion zone during a spill response and impacting seafood quality and quantity. Recreational fishing is generally concentrated around readily accessible coastal settlements along the Kimberley and NT coastlines (such as Broome, Wyndham and Darwin) and there is little recreational fishing around the offshore Browse Basin due to the distance from land, lack of features of interest and deep waters. Offshore islands, coral reef systems and continental shelf waters of the Browse Basin however are increasingly being targeted by fishing based charter vessels (Fletcher and Santoro 2014) with extended fishing charters operating during certain times of the year. This receptor is considered to be important, however a vessel collision spill is unlikely to cause significant impacts to recreational fisheries due to the limited and localised surface and shallow entrained oil affected area and very limited recreational fishing in the offshore Browse Basin. The real and perceived consequence is considered to be Insignificant. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | None / Insignificant | 1 | Aboriginal heritage including special places, cultural landscapes, practices and fishing/foraging along the Kimberley and NT coastline are unlikely to be impacted by surface and weathered diesel above impact thresholds from a vessel collision in the Browse Basin. The effect of surface weathered diesel on this receptor includes physically degrading a site, disrupting the harvesting of fish, and area closures could displace Aboriginal people and have implications on cultural identity, health and wellbeing. The receptor is important however is generally remote from any potential vessel collision locations, limiting the scale of imact, and the recovery is expected to be short to medium term. Therefore, consequence is considered to be Insignificant. |
| *Indonesian traditional fishing* | None / Insignificant | 1 | Indonesian traditional fishing areas shallower than 25m (RPS 2019) may be exposed to fresh, weathered surface oil and entrained/dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. RPS (2019) modelling of a 250m3 MGO spill confirmed that at no point would dissolved oil exceed the 500 ppb impact threshold, limiting the potential for toxic effects from an MGO spill. Indonesian traditional fishing occurs within the MoU box which covers Scott Reef and surrounds, Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks and shoals. The effect of diesel on these receptor could include reduction and contamination of target species such as sea cucumbers (bêche-de-mer), trochus (top shell snail), reef fish. Exclusion zones during the spill response may also affect access to fishing locations, even if the target species are not affected by diesel. This receptor is considered to be important however a vessel collision spill is unlikely to cause significant impacts to Indonesian traditional fishing due to the limited and localised surface and shallow entrained oil affected area. The real and perceived consequence is considered to be Insignificant. |

## Containment and Recovery

**Overall statement of likelihood of success of Contain and Recovery (C&R):**

**Aim:** This strategy aims to collect oil from the ocean surface using booms and skimmers, generally at or near the release location, where oil concentrations are highest. Floating booms are used to corral and concentrate spilled floating oil into a surface thickness that will allow for mechanical removal (i.e. pumping oil into temporary storage) by devices such as skimmers (IPIECA 2015).

**Type of slick:** Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. Surface oil concentrations will be approximately 10 $g/m^2$ (~0.01mm, which equates to Bonn code 1/2) up to approximately 160 km from the spill site and weathered oil concentrations reduce down to below 1 $g/m^2$ up to approximately 300 km from the spill site.

**Likely success/effectiveness against slick:** O'Brien (2002) notes that spreading of oil is the main obstacle to a successful at sea contain and recovery response, with this type of oil tending to spread so thinly and quickly that skimmers are unable to efficiently skim and recover meaningful quantities. Generally oil needs to be >100 $g/m^2$ (>0.1mm, which equates to Bonn code 4/5) to feasibly corral oil with a boom and achieve any significant level of oil recovery with skimmers (O'Brien 2002), as booms have limited effect against thin oil films and no effect against a subsurface plume (ITOPF 2011). The initial, gravity-dominated release and spreading is generally complete within minutes to hours after a release (O'Brien 2002)). In the context of the Browse Basin, with high sea surface and air temperatures in all seasons, the spreading of any diesel spill would be very rapid. Diesel spilled from a vessel collision would therefore remain at a thickness of >100$g/m^2$ for only a very brief period of time, before evaporation and spread effects generating very thin surface slicks, making C&R inefficient and impractical (IPIECA 2017). Where there is any significant diesel slick, flammable/toxic vapours will also be present, and will likely exceed safe exposure thresholds, further reducing response efficiency (as vessels will not be permitted to operate in areas where explosive limits or VOC exposure thresholds are exceeded). Due to the very thin surface slicks, very low rates of recovery would be expected. Note that IPIECA (2015) state that efficiency of contain and recover operations (for any oil type) can vary widely due to operational, environmental and logistical constraints, but usually it is limited to recovering approximately only 5-20% of the initial spilled volume. Contain and recovery is therefore unlikely to be an effective response strategy, with limited chance of any significant surface slick recovery from a Group II spill.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | Minor mitigation of impact | 1 | C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including submerged BBPH. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | C&R occurs on the surface and has no impact on entrained oil affecting deep sea features. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | C&R occurs on the surface and has no impact on entrained oil affecting deep sea unconsolidated muds and sands. |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | Minor mitigation of impact | 1 | C&R may result in a minor reduction on oil on surface, resulting in very minor reduction in surface and entrained oil reaching intertidal zones. |
| *Mangrove/Mudflats/Samphires* | Minor mitigation of impact | 1 | |
| *Sandy Beach* | Minor mitigation of impact | 1 | |
| *Rocky Shoreline* | Minor mitigation of impact | 1 | |
| *Macro-Algae and Seagrass* | Minor mitigation of impact | 1 | |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor mitigation of impact | 1 | |
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | C&R occurs on the surface and has no impact on entrained oil affecting fully submerged benthic primary producer habitat. |
| *Upper water column (in photic zone)* | Minor mitigation of impact | 1 | C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column. |
| *Water surface* | Minor mitigation of impact | 1 | C&R may result in a minor reduction in localised surface oil. |
| Air | No or insignificant alteration of impact | 0 | Due to the rapid evaporation of diesel and low expected recovery rates of surface oil, C&R activities would not result in any significant change to local atmospheric VOC concentrations. |

| | | | |
|---|---|---|---|
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome on entrained oil, resulting in no change to oil exposure to demersal fish |
| *Shallow commercial fisheries (including aquaculture)* | Minor mitigation of impact | 1 | C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including shallow commercial and recreational fisheries. |
| *Recreational fisheries* | Minor mitigation of impact | 1 | |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column. However, due to distance to aboriginal cultural heritage receptors, the impact mitigation potential is considered to be insignificant. |
| *Traditional Indonesian fishing* | Minor mitigation of impact | 1 | C&R may result in a minor reduction in localised surface oil which may have a minor positive outcome in reducing future entrained oil in the upper water column including shallow traditional fishing habitats. |

## Protect and Deflect

**Overall statement of likelihood of success of Protect and Deflect (P&D):**

**Aim:** This strategy aims to use physical barriers to exclude or restrict the spill contacting specific sensitive receptors or to deflect the spill from these locations; typically onto less sensitive areas.

**Type of slick:** Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered diesel which could accumulate over time. Weathered oil would be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than fresh oil (Woodside 2014).

**Likely success/effectiveness against slick**: Booms could be used to protect and deflect surface spills away from sensitive habitats, but they have limited effect against thin Group II oil films and no effect against subsurface entrained plumes (ITOPF 2011). Generally oil needs to be >100 $g/m^2$ (>0.1mm, which equates to Bonn Code 4/5) to feasibly corral oil with a boom (O'Brien 2002), as would be required for a P&D response. However diesel on the ocean surface from a vessel collision is unlikely to have slicks >100 $g/m^2$. Even in a scenario where the best equipment is available, shoreline protect and deflect activities at Browse Island or other exposed remote shoreline locations, would be technically challenging due to the general exposure to unfavourable sea conditions, large tidal range and shallow coral reefs. Generally protect and deflect is limited to sheltered waters, not exposed reef/beach environments. Only under exceptionally calm sea-states and appropriate tides would it be safe to conduct vessel activities to carry-out an effective protect and deflect operation at remote shorelines. MetOcean conditions required for this technique to be successful include <1 m sea-state and low surface currents - but these are frequently exceeded at remote offshore locations in the Browse Basin region. In addition, given the size of the offshore island shorelines (e.g. Browse Island, one of the smallest offshore islands, has an intertidal zone 3km in diameter, 7km in circumference), a substantial number of booms would be needed to be deployed to protect the shorelines, or deflect oil into a collection point on a beach. Anchoring of booms would most likely result in additional damage to the subtidal and intertidal environment (coral reef) surrounding most offshore islands, due to anchor chain drag. Booms themselves would also drag around on the coral intertidal reef during periods of lower tides, potentially resulting in significant physical damage to the benthos of the reef platform and also result in damage to booms. Booms could potentially be held in place by vessels however due to widths of shorelines requiring protection this would most likely require an unfeasibly large number of vessels, and at low tide this isn't practicable in intertidal zones. Most offshore island shorelines would be expected to 'self clean' any accumulated Group II oil due to the lack of adhesiveness, the coarse substrate, the high wave energy and high tidal regime (Fingas 2012), further reducing the impact mitigation potential of protect and deflect at these locations. As a result of the above mentioned factors, protect and deflect would be unlikely to result in any significant deflection or recovery of Group II diesel at remote intertidal/shoreline habitats.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | P&D occurs on the surface at a shoreline location and will have insignificant impact on entrained oil affecting subtidal benthic primary producer habitat. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | P&D occurs on the surface at a shoreline location and has insignificant impact on entrained oil affecting deep sea features. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | P&D occurs on the surface at a shoreline location and has insignificant impact on entrained oil affecting deep sea unconsolidated muds and sands. |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | Moderate additional impact | -2 | P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. However, anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal coral reefs. |
| *Mangrove/Mudflats/Samphires* | Minor additional impact | -1 | P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. However, due to the extensive scale of mangrove communities along the mainland and islands of the Kimberley and NT coastline, the ability to successfully achieve a benefit from P&D is extremely limited. Anchors/anchor chains also have the potential to damage mangrove aerial root structures and disturb other fragile low-energy shorelines. |
| *Sandy Beach* | Minor mitigation of impact | 1 | P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. A correctly executed shoreline clean-up may result in a positive outcome compared to natural weathering. |

| | | | |
|---|---|---|---|
| *Rocky Shoreline* | Minor mitigation of impact | 1 | P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. A correctly executed clean-up on a rocky shoreline may result in a positive outcome compared to natural weathering. |
| *Macro-Algae and Seagrass* | Minor mitigation of impact | 1 | P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. However, anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal coral reefs. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor mitigation of impact | 1 | P&D may result in a minor reduction of thin slicks of weathered diesel reaching intertidal receptors. A correctly executed clean-up on a sandy beach or rocky shoreline may result in a positive outcome, including protected species such as marine avifauna and turtles who utilise these habitats. |
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | P&D does not reduce the amount of entrained oil affecting the lower water column. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | P&D does not reduce the amount of entrained oil affecting the upper water column. |
| *Water surface* | No or insignificant alteration of impact | 0 | P&D would only occur near shorelines and would not result in any significant reduction to the volume of oil on the water surface. |
| *Air* | No or insignificant alteration of impact | 0 | P&D would only occur at shorelines remote form the spill release location. The weathered slick will not have any significant volatile components remaining, and therefore P&D would have no effect on local atmospheric conditions. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in entrained oil, resulting in no change to oil exposure to commercial demersal fisheries. |
| *Shallow commercial fisheries (including aquaculture)* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to shallow commercial fisheries including aquaculture sites. |
| *Recreational fisheries* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to fish communities, thus no change to recreational fishing. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in oil on surface and entrained oil, resulting in no change to impacts on Aboriginal heritage. |
| *Traditional Indonesian fishing* | No or insignificant alteration of impact | 0 | P&D would result in insignificant reduction in oil on surface and entrained oil, resulting in no change to impacts on Indonesian traditional fishing areas. |

## Shoreline Clean-Up

**Overall statement of likelihood of success of Shoreline Clean-Up:**

**Aim:** Using various physical means to clean up oil from affected shorelines to reduce impacts on sensitive receptors or to avoid any reintroduction of the hydrocarbon to the marine environment. It is often viewed as a three step process, with the first phase involving bulk collection of oil floating against the shoreline or stranded on it; phase two involving in-situ treatment of shoreline substrate and phase three involving removal of any remaining residues (final polish) (IPIECA 2015).

**Type of slick:** Diesel spilled from a vessel collision in the Browse Basin is expected to have undergone several physical and biological weathering processes, such as photo oxidation and biodegradation by the time it strands on a shoreline. Weathered diesel reaching a remote shoreline will be in the form of thin floating slicks which could accumulate over time. Impacts to ecological receptors from exposure to weathered oil (waxy flakes and residues) are far less than those associated with exposure to fresh oils, which have higher levels of toxicity (Milton et al, 2003; Hoff & Michel 2014; Woodside 2014). Group II oils are relatively non-adhesive and will not form a thick adhesive barrier on a shoreline (Fingas 2012).

**Likely success/effectiveness against slick:** Shoreline clean-up has been consistently found to not enhance ecological recovery of oiled coastlines (Sell et al 1995) but it may protect other resources in the area, such as birds, marine mammals or subtidal habitats including coral reefs or fish farms (CSIRO 2016). Choosing a particular clean-up technique is dependent on factors such as shoreline type, exposure, sensitivity, amount of oil, persistence of oil, toxicity of oil and rate of natural oil removal (IPIECA 2015). Mechanical cleaning is generally not an appropriate technique for offshore/remote shorelines, and manual techniques involving rakes and shovels would likely be required. The clean-up of Group II spills from a beach or shoreline is likely to be difficult, generating high volumes of waste in comparison to the oil recovered. Browse Island and other similar offshore shorelines would be expected to naturally 'self-clean' any accumulated Group II oils, due to factors such as the lack of adhesiveness of these oil types, the coarse substrate present and the high wave energy and high tidal regime (Fingas 2012). Typically, inaccessible rocky coves are highly exposed and are best left to naturally clean (IPIECA 2015). ITOPF (2011) also note that for a number of sensitive shoreline types, such as mangroves, natural cleaning is the preferred option in order to minimise the damage caused from clean-up activities. Thus shoreline clean-up would be most effective in areas which are expected to receive large amounts of shoreline oil; where chosen activities don't physically break/damage sensitive habitat such as coral or mangroves; and in areas which are not expected to self clean.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have no impact on entrained oil in benthic primary producer habitat within subtidal areas. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have no impact on entrained oil affecting filter feeding communities within subtidal areas. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have no impact on entrained oil affecting deep-sea unconsolidated muds and sands in subtidal areas. |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | Minor additional impact | -1 | Shoreline clean-up on an intertidal coral reef would result in physical damage/breaking of coral structures, therefore a net damage to the eco-system. |
| *Mangrove/Mudflats/Samphires* | Minor additional impact | -1 | Shoreline clean-up within mangrove/low energy ecosystems is likely to result in more physical damage/breaking of mangrove root structures than benefit from any oil removed. |
| *Sandy Beach* | Minor mitigation of impact | 1 | Shoreline clean-up of sandy beaches is a well understood, well documented spill response technique, which can reliably remove thick oil from the eco-system. This is beneficial for species such as turtles who nest on sandy beaches. However, in the case of a condensate spill, the likely oil accumulating on a shoreline remote from the release location is likely to be very thin, and possibly not recoverable. Natural weathering on high energy beaches may be just as effective as attempting to clean-up very thin, non-adhesive slicks. |
| *Rocky Shoreline* | Minor mitigation of impact | 1 | Shoreline clean-up of rocky shorelines is a well understood, well documented spill response technique, which has the ability to remove some oil from the eco-system. However, certain techniques like steam cleaning and high pressure blasting are known to cause more harm than allowing the oil to naturally weather. Therefore, this technique would likely be successful, provided the correct clean-up techniques are chosen. |

| | | | |
|---|---|---|---|
| *Macro-Algae and Seagrass* | Minor additional impact | -1 | Shoreline clean-up within intertidal macro-algae/seagrass ecosystems would likely result in more physical disturbance to plant/root structures than benefit from any oil removed. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor mitigation of impact | 1 | If it is deemed that the amount of hydrocarbons expected to impact shorelines is large enough that a shoreline clean up will have positive impacts, then the removal of oil from the intertidal zones would likely result in reduction in harm to the benthic primary producers and associated food sources utilised by foraging protected fauna such as seabirds. Also, removal of oil reaching a turtle nesting beach would be of benefit to turtle nesting success. However, due to the type (generally non-toxic and non-adhesive weathered oil), shoreline clean-up of weathered diesel may only have limited positive effect compared to natural weathering. Caution is required, as additional physical damage can occur in sensitive intertidal environments, and the general presence of responders can result in additional disturbance to natural wildlife behaviours and processes, especially seabirds and turtle nesting etc. |
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have insignificant impact on entrained oil in the lower water column. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have insignificant impact on entrained oil in the upper water column. |
| *Water surface* | No or insignificant alteration of impact | 0 | Shoreline clean-up will have insignificant impact on thin surface slicks on the water surface. |
| Air | No or insignificant alteration of impact | 0 | As oil will have significantly weathered by the time it reaches a shoreline, clean-up activities will result in no net change to impacts to air quality. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | There would be no reduction in entrained oil, resulting in no significant change to fish communities, and thus commercial demersal fisheries. |
| *Shallow commercial fisheries (including aquaculture)* | Minor mitigation of impact | 1 | Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments. |
| *Recreational fisheries* | Minor mitigation of impact | 1 | Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | Minor mitigation of impact | 1 | Shoreline clean-up may reduce oil damage to Aboriginal heritage sites along the Kimberley / NT coastline, however care would be required to ensure important sites are not damaged during the clean-up process. |
| *Traditional Indonesian fishing* | Minor mitigation of impact | 1 | Reduction in oil remobilising from a shoreline into intertidal habitats may result in less harm to intertidal fish nurseries and foraging habitats. However damage to these ecosystems could occur, through physical damage associated with shoreline clean-up in sensitive intertidal environments. |

## Chemical Dispersant - Surface

**Overall statement of likelihood of success of Chemical Dispersant:**

**Aim:** To remove oil from the sea's surface via dispersant spraying from vessels and aircraft, thus reducing the amount of oil reaching birds, mammals and other organisms - as well as coastal habitats, socioeconomic features and shorelines (IPIECA 2015).

**Type of slick:** Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 $g/m^2$ up to approximately 160 km from the spill site and approximately 1 $g/m^2$ up to approximately 300 km from the spill site.

**Likely success/effectiveness against slick:** The National Research Council (2005) notes that the window to use dispersants is early, typically within hours to 2 days of a spill, then after that, weathering makes oil more difficult to disperse (due to increased viscosity). Rapid dispersion of dispersant-treated oil begins at a wind speed of approximately 7 knots with wave heights of 0.2 to 0.3 metres (IPIECA 2015). Conditions where wave energy is too low, oil droplets may resurface after being applied with dispersant due to oil not being effectively dispersed into the water column. Dispersant becomes challenging in high winds and rough seas, where floating oil will be over-washed or temporarily submerged (IPIECA 2015). Whilst dispersants reduce the amount of oil on the surface that can affect wildlife, they also increase the exposure of dispersed oil in the upper water column to other wildlife. It is expected that dispersant will not significantly change the proportion of surface oil which would become entrained as the sea-state changes. Therefore, given surface diesel slicks will rapidly entrain with increasing wind-speed, dispersant will have limited effect when compared with natural entrainment processes.

Generally oil slicks needs to be >100 $g/m^2$ (>0.1mm, which equates to Bonn code 4/5) to feasibly achieve a successfully dispersant operation. However diesel from a vessel collision on the ocean surface is unlikely to have slicks >100 $g/m^2$. Where there are any significant diesel slick, flammable/toxic vapours will also be present, and will likely exceed safe exposure thresholds, further reducing response efficiency (as vessels will not be permitted to operate in areas where explosive limits or VOC exposure thresholds are exceeded). Due to the very thin surface slicks, very low rates of successful dispersal would be expected. Therefore, surface dispersant application on a diesel vessel slick would not be an effective response strategy.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | Minor additional impact | -1 | Chemical dispersant and additional entrained oil would result in negative impacts to shallow water BPPH. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | Chemical dispersant would result in an insignificant increase in any additional oil reaching deep water locations, regardless of chemical dispersant application on the surface. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | Minor additional impact | -1 | Dispersant is generally considered ineffective at significantly increasing entrainment of thin sheens of marine diesel, compared to natural rates of entrainment. A significant volume of dispersant would need to be applied to result in any change, therefore this would result in negative impacts, due to additional chemicals on the surface and in the shallow water column, which could negatively impact on sensitive shallow/intertidal receptors such as corals, seagrass etc, and the biota who depend on them, including invertebrates, and mega-fauna who forage in these zones. |
| *Mangrove/Mudflats/Samphires* | Minor additional impact | -1 | |
| *Sandy Beach* | Minor additional impact | -1 | |
| *Rocky Shoreline* | Minor additional impact | -1 | |
| *Macro-Algae and Seagrass* | Minor additional impact | -1 | |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor additional impact | -1 | |

| | | | |
|---|---|---|---|
| **Water column** | | | |
| *Lower water column (below photoic zone)* | No or insignificant alteration of impact | 0 | No oil reaching deep water locations, regardless of dispersant application on surface. |
| *Upper water column (in photic zone)* | Minor additional impact | -1 | Dispersed oil can cause marine organisms inhabiting the upper water column to be briefly exposed to dispersed oil which can potentially have toxic effects. Dispersant is generally considered ineffective at significantly increasing entrainment of thin sheens of marine diesel, compared to natural rates of entrainment. A significant volume of dispersant would need to be applied to result in any change, therefore this would result in negate impacts, due to additional chemicals on the surface and in the shallow water column. |
| *Water surface* | Minor additional impact | -1 | |
| Air | No or insignificant alteration of impact | 0 | A very slight reduction in VOCs in local atmosphere could occur as a result of dispersant application and additional entrainment. However additional chemical dispersant mist in the local atmosphere would likely offset any reduction in VOCs. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | No oil reaching deep water locations, including demersal fish habitat, regardless of chemical dispersant application on surface. |
| *Shallow commercial fisheries (including aquaculture)* | Minor additional impact | -1 | Chemical dispersant and additional entrained oil would result in negative impacts to shallow commercial fisheries. |
| *Recreational fisheries* | Minor additional impact | -1 | Chemical dispersant and additional entrained oil would result in negative impacts to recreational fisheries. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | As any dispersant application would occur within offshore waters, and as there would likely be significant  naturally entrained of a diesel spill due to natural wind effects, surface dispersant application would result in an insignificant change in dispersed/entrained oil reaching traditional Aboriginal areas of the Kimberley and NT coastline. |
| *Traditional Indonesian fishing* | Minor additional impact | -1 | Chemical dispersant and additional entrained oil could result in negative impacts to shallow water BPPH which support Indonesian traditional fishing target species. However, impacts would be minor, provided dispersant applied at a significant distance from the BPPH. |

## Pre-Contact Wildlife Response (Hazing and Translocation)

**Overall statement of likelihood of success of Pre-contact OWR (hazing and relocation/displacement):**

**Aim:** Hazing involves discouraging animals from entering oiled areas by encouraging them to move into low-risk unoiled areas, in an attempt to prevent them from becoming oiled (IPIECA 2017). Hazing techniques include vessels generating underwater noise and motion, vessel air horns making above-water noise and fire hoses directing streams in front of fauna. Translocation/displacement involves removing wildlife who are at risk of becoming oiled from the spill environment in an attempt to prevent them from becoming oiled (IPIECA 2017). This includes holding animals in captivity until the risk of oiling is over, or relocating them to another area not affected by the oil spill (IPIECA 2017).

**Type of slick:** Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 g/m$^2$ up to approximately 160 km from the spill site and approximately 1 g/m$^2$ up to approximately 300 km from the spill site. Group II oils are relatively non-adhesive, and oil reaching shorelines is likely to have undergone weathering and will be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than their unweathered counterparts (Milton et al, 2003; Hoff & Michel 2014; Woodside 2014).

**Likely success/effectiveness against slick:** Wildlife hazing in the open ocean is inherently unlikely to be effective due to a number of limitations;

1) effectiveness depends upon the deployment of numerous ocean-going vessels (as opposed to smaller vessels which can be used near to the shore);
2) against a spreading plume (i.e. away from the immediate source of the spill), the technique becomes entirely impracticable;
3) there are significant safety issues associated with a spill of diesel and vessel masters will not approach the source of the spill, or fresh areas of slick, while the spill is still ongoing; and
4) without the constraints of a shoreline or other geographical feature, the technique may cause wildlife to move into other areas of the spill area instead of away from it.

Wildlife hazing is most suitable when used near sensitive shoreline habitats against persistent oily slicks, such as IFO, HFO or crude oil spills - but in the case of a Group II vessel collision, oil slicks are thin and not considered particularly adhesive, therefore reducing the likelihood and severity of impacts on wildlife. Additionally, hazing isn't considered an effective measure against volatile spills which rapidly evaporate.

In regard to wildlife translocation, IPIECA (2014) advise that the difficulty of capturing wildlife safely and maintaining their health during relocation should not be underestimated, and that working with live or dead animals has health and safety issues including potential injuries (bites, scratches) or zoonotic diseases. Risks to wildlife are high during pre-emptive capture and the risks of oiling need to be weighed against the risk of injury, death etc. (IPIECA 2014). The translocation of turtles from beaches and islands would likely require the capture of large numbers of hatchlings, followed by translocation to a location far from the slick (to prevent surface oil impacts on released hatchlings). The prolonged retention of hatchlings has been demonstrated to be detrimental to hatchling swimming speed and survival, even in short periods (6 hours) of retention (Pilcher and Enderby 2001). Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW 2014), especially at a remote shoreline location (such as Browse or Cartier Island). There is no practicable method to capture healthy seabirds at sea (DPaW 2014). Potential harm to healthy seabirds could occur during the capture process. Any seabirds released would likely fly back to the shoreline from which they originally were captured. Therefore, long term veterinary care (feeding etc.) would be required for any successfully captured birds, until spill weathering or remediation has occurred and it was safe to release the animals. An evaluation would need to be undertaken, to ensure the released animals do not pose a disease risk (human/zoonotic diseases), to the wild population into which they are released.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Mangrove/Mudflats/Samphires* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Sandy Beach* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Rocky Shoreline* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Macro-Algae and Seagrass* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |

| | | | |
|---|---|---|---|
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor mitigation of impact | 1 | Wildlife hazing of flocks of seabirds may temporarily prevent oiling of individuals or small proportions of a local/regional populations, however it is not likely effective across a broad geographical area.  Even conducting wildlife hazing in the nearshore environment at an isolated location such as Browse Island would be of logistically challenging and potentially not result in any significant impact mitigation. Hazing of seabirds to prevent them landing on an oiled shoreline may temporarily prevent impacts, whilst shoreline clean-up is occurring. Capture and translocation of turtle hatchlings away from the oiled shoreline, and release in the open ocean is potentially feasible. Therefore, undertaking pre-contact oiled wildlife response at a shoreline may reduce the number of protected species of a local population from being oiled. |
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Water surface* | No or insignificant alteration of impact | 0 | Wildlife hazing and/or translocation of seabirds or other megafauna, such as cetaceans and turtles in the open ocean, using vessel presence, vessel noise or at sea capture is highly unlikely to be successful. It may be possible to temporarily (minutes / hours), prevent a few individuals of a protected species from entering a small geographic area affected by a slick. However, over the longer term duration and geographic area of a well-blowout scenario, there would be no alteration to the level of oiling of wildlife populations using this strategy in the open ocean. |
| Air | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Shallow commercial fisheries (including aquaculture)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Recreational fisheries* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |
| *Traditional Indonesian fishing* | No or insignificant alteration of impact | 0 | Not relevant for pre-contact oiled wildlife response. |

## Post Contact Oiled Wildlife Response

**Overall statement of likelihood of success of Post-contact OWR:**

**Aim:** Post-contact wildlife response involves capturing oiled wildlife - and if necessary, cleaning, rehabilitating and releasing them.

**Type of slick:** Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 $g/m^2$ up to approximately 160 km from the spill site and approximately 1 $g/m^2$ up to approximately 300 km from the spill site. Group II oils are relatively non-adhesive, and oil reaching shorelines is likely to have undergone weathering and will be in the form of waxy flakes and residues which are generally considered to be of lower toxicity than fresh oil (Milton et al, 2003; Hoff and Michel 2014; Woodside 2014). Note that Group II hydrocarbons are relatively non-adhesive compared to crude oils, and are generally not considered an oil product that would 'coat' the feathers of birds, requiring a full wildlife cleaning response on a shoreline.

**Likely success/effectiveness against slick:** Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife has the ability to increase the survival of individuals. ITOPF (2011) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water. Any seabirds captured, cleaned and released would likely fly back to the shoreline from which they originally were captured. Once oiled, it is generally agreed that birds have a very low survival rate, even when rescue and cleaning is attempted (Bourne et al. 1967; Holmes and Cronshaw 1977; Croxall 1977; Ohlendorf et al. 1978; Chapman, 1981; Ford et al., 1982; Samuels and Lanfear, 1982; Varoujean et al., 1983; Ford, 1985; Evans and Nettleship 1985; Fry 1987; Seip et al. 1991; Anderson et al. 2000). French-McCay (2009) produced mortality estimates of 99% for surface swimmers, 35% for aerial divers and raptors, and 5% for aerial seabirds. Samuels and Lanfear (1982) estimated that 95% of oiled seabirds die. ITOPF (2011) note that penguins and pelicans are often the exception as they are generally more resilient than many other species, however they are not present in the Browse Basin. IPIECA (2014) advise working with live or dead animals has health and safety issues including potential injuries (bites, scratches) or zoonotic diseases. An evaluation would need to be undertaken, to ensure any released animals do not pose a disease risk (human/zoonotic diseases), to the wild population into which they are released.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Deep-sea unconsolidated muds and sands* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Mangrove/Mudflats/Samphires* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Sandy Beach* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Rocky Shoreline* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Macro-Algae and Seagrass* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | Minor mitigation of impact | 1 | Post-contact OWR has the ability to increase the likelihood of survival of oil-affected EPBC species (individuals, or small proportion of a local population) in the intertidal/shoreline habitats. However, the seabird species of the Browse Basin are generally not expected to survive the capture, cleaning and rehabilitation process. Capture, cleaning and release of marine turtles would have a greater likelihood of success. |

| | | | |
|---|---|---|---|
| **Water column** | | | |
| *Lower water column (below photic zone)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Upper water column (in photic zone)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Water surface* | Minor mitigation of impact | 1 | It is possible that some individuals of protected species, which have been oiled and are unable to fly, could be captured in the open ocean and relocated to an oiled wildlife treatment facility. Therefore, whilst there is a very low probability of survival, under the right circumstances a positive environmental outcome, for a limited number of individuals of a protected species could be achieved. |
| Air | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Shallow commercial fisheries (including aquaculture)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Recreational fisheries* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |
| *Traditional Indonesian fishing* | No or insignificant alteration of impact | 0 | Not relevant for post-contact oiled wildlife response. |

## In Situ Burn

**Overall statement of likelihood of success of In-situ burn (ISB):**

**Aim:** In-site burning rapidly removes the volume of spilled oil's hydrocarbon vapours in place, via combustion or burning (IPIECA 2016). This technique reduces the need to collect, store, transport and dispose recovered oil, plus it can shorten the overall response time (IPIECA 2016).

**Type of slick:** Surface oil is in the form of Group II floating slicks which have a low viscosity and rapidly spread into a thin sheen. They will be approximately 10 $g/m^2$ up to approximately 25 km from the spill site and approximately 1 $g/m^2$ up to approximately 110 km from the spill site.

**Likely success/effectiveness against slick**: ISB requires wave heights typically below 1 m and wind speeds below 10 knots (IPIECA 2016) which are frequently exceeded at remote offshore locations in the Browse Basin region. Overseas experience shows that burns can be conducted safely, but the most discernible disadvantage is the resulting dark smoke plumes caused by the combustion of oil (IPIECA 2016). Carbon dioxide, soot (PM 2.5), water, polyaromatic hydrocarbons, volatile organic compounds, carbonyls, carbon monoxide, sulphur dioxide and potentially other gases can result from an in-situ burn, which has the potential to affect human and animal health (IPIECA 2016). IPIECA (2016) note that tests and information from previous burns indicate that ISB has little effect on water quality. Burn residue (i.e. burned oil depleted of volatiles and precipitated soot) rarely sinks and smothers benthic species (IPIECA 2016). Plus it is unlikely that Group II burn residue will cause smothering as this generally only occurs for heavier crudes (IPIECA 2016). IPIECA (2016) further note that burn residue is less toxic to aquatic biota than weathered oil.

To implement an effective in-situ burn response, a minimum surface hydrocarbon thickness of 2-5 mm (2000 - 5000 $g/m^2$) is required to be present. In the case of a vessel collision, the surface slick is not expected to meet the required thickness (i.e. only 10 $g/m^2$ or 0.1 mm expected thickness in the immediate area of the release). Booms would be required to corral the spill, in an attempt to generate additional oil thickness, but this in turn is expected to exceed the VOC exposure thresholds for the workforce, and also may result in concentrations exceeding the lower explosive limit. Given this, and the lack of suitable booms available for in-situ burns in Australia, implementation of this response in an open ocean, high current environment is not considered to be safe, effective or feasible, especially against the thin sheen and hazardous atmospheric conditions associated with a diesel spill.

| Resource Compartment (including values dependent on the resource compartment) | Impact Modification Score | | Justification for Impact Modification Score |
|---|---|---|---|
| | | B | |
| **Subtidal Benthic Communities** | | | |
| *Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)* | | | |
| *Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)* | | | |
| *Deep-sea unconsolidated muds and sands* | | | |
| **Intertidal seabed** | | | |
| *Intertidal Coral Reef* | | | |
| *Mangrove/Mudflats/Samphires* | | | |
| *Sandy Beach* | | | |
| *Rocky Shoreline* | | | |
| *Macro-Algae and Seagrass* | | | |
| *Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)* | | | |
| **Water column** | | | |
| *Lower water column (below photic zone)* | | | |
| *Upper water column (in photic zone)* | | | |
| *Water surface* | | | |
| Air | | | |

| | | | |
|---|---|---|---|
| **Socio-economic** | | | |
| *Commercial demersal fisheries* | | | |
| *Shallow commercial fisheries (including aquaculture)* | | | |
| *Recreational fisheries* | | | |
| **Cultural heritage** | | | |
| *Aboriginal heritage (cultural practices, sites and fishing / foraging)* | | | |
| *Traditional Indonesian fishing* | | | |

**References**


Anderson, D. W., Newman, S.H., Kelly, P.R., Herzog, S.K. and Lewis, K.P. 2000. An Experimental Soft-Release of Oil-Spill Rehabilitated American Coots (Fulica americana): I. Lingering Effects on Survival, Condition and Behavior. Environmental Pollution 107: 285–294.

Asia-Pacific Applied Science Associates (APASA). 2012. Basset Deep Well: Quantitative Spill Risk Assessment. J0172 Rev 2. Prepared for INPEX Operations Australia Pty 27/11/2012

Australian Maritime Safety Authority (AMSA). 2015. *The Effects of Maritime Oil Spills on Wildlife including Non-avian Marine Life*. Accessed online 14/11/2018 at <http://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/general-information/oiled-wildlife/marine-life/index.asp>.

Australian Maritime Safety Authority (AMSA). 1998. National Plan (document now superseded): *The effects of maritime oil spills on wildlife including non-avian marine life*. Accessed 16 July 2015 at <https://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/General-Information/oiled-wildlife/marine-life/index.asp>.

Bourne, W.R.P., Parrack J.D. and Potts G.R. 1967. Birds Killed in the Torrey Canyon Disaster. Nature 215: 1123–1125.

Burns, K.A., Garrity, S.D. and Levings, S.C. 1993. How many years before mangrove ecosystems recover from catastrophic oil spills? *Marine Pollution Bulletin.* 26(5):239–248

Campagna, C., Short, F.T., Polidoro, B.A., McManus, R., Collette, B.B., Pilcher, N.J., Mitcheson, Y.S., Stuart, S.N. and Carpenter, K.E. 2011. Gulf of Mexico oil blowout increases risks to globally threatened species. *BioScience* 61:393–397.

Chapman, B.R. 1981. *Effects of the Ixtoc I Oil Spill on Texas Shorebird Populations*. pp. 461–465 in American Petroleum Institute, Proceedings of the 1981 Oil Spill Conference. American Petroleum Institute, Washington, D.C.

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environmental Pollution 33:1–22.

Connell, D.W., Miller, G.J. and Farrington, J.W. 1981. Petroleum hydrocarbons in aquatic ecosystems—behavior and effects of sublethal concentrations: Part 2. *Critical Reviews in Environmental Science and Technology* 11(2):105–162.

Commonwealth Scientific and Industry Research Organisation (CSIRO). 2016. Oil spill monitoring handbook. CSIRO Publishing, Clayton South, Victoria.

Croxall, J.P. 1977. *The Effects of Oil on Seabirds*. Rapport Procès-Verbal Reunion Conseil International pour L'Exploration de la Mer 171: 191–195.

Dean, T.A., Stekoll, M.S., Jewett, S.C., Smith, R.O. and Hose, J.E. 1998. Eelgrass (Zostera marina L.) in Prince William Sound, Alaska: effects of the Exxon Valdez oil spill. Marine Pollution Bulletin 36: 201–210.

DoF. 2013. Pearl Oyster, Webpage managed by the Department of Fisheries Western Australia, accessed December 2017. Last updated 24 April 2013. [http://www.fish.wa.gov.au/Species/Pearl-Oyster/Pages/default.aspx]

Department of Environment and Conservation (DEC). 2007. Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007–2017: Management Plan No. 55. Department of Environment and Conservation, Perth, Western Australia

Department of Environment and Conservation (DEC) and Marine Parks and Reserves Authority (MPRA). 2005. Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005–2015. Department of Environment and Conservation and Marine Parks and Reserves Authority. Perth, Western Australia.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008. North Marine Bioregional Plan bioregional profile: a description of the ecosystems, conservation values and uses of the North Marine Region.

Department of Parks and Wildlife (DPaW). 2014. *Western Australian Oiled Wildlife Response Plan (WAOWRP)*. Department of Parks and Wildlife, Perth, WA.

Duke, N., Burns, K,. Swannell, J., Dalhaus, O. and Rupp, R. 2000. Dispersant use and a bioremediation strategy as alternative means of reducing impacts of large oil spills on mangroves: the Gladstone field trials. *Marine Pollution Bulletin*. Vol 41, Issues 7–12:403–412.

Evans, P.G.H. and Nettleship, D.N. 1985. *Conservation of the Atlantic Alcidae*. pp. 427–488 in Nettleship, D.N. and Birkhead, T.R. (eds.). The Atlantic Alcidae. Academic Press, London, UK.

Fingas. 2012. The Basics of Oil Spill Cleanup – Third Edition. CRC Press. Boca Raton, Florida.

Fletcher WJ, Mumme MD and Webster FJ (eds). 2017. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2015/6: The State of the Fisheries. Department of Fisheries, Western Australia.

Fletcher, W.J. and Santoro, K. (eds). 2014. Status reports of the fisheries and aquatic resources of Western Australia 2013/14: The state of the fisheries. Department of Fisheries, Western Australia.

Ford, R.G., Wiens, J.A., Heinemann D. and Hunt G.L. 1982. Modelling the Sensitivity of Colonially Breeding Marine Birds to Oil Spills: Guillemot and Kittiwake Populations on the Pribilof Islands, Bering Sea. *Journal of Applied Ecology* 19:1–31.

Ford, R.G. 1985. *A Risk Analysis Model for Marine Mammals and Seabirds: A Southern California Bight Scenario*. Final Report to U.S. Department of the Interior, Minerals Management Service MMS 85-0104, Pacific OCS Region, Los Angeles, CA.

French-McCay, D.P. 2009. State of the art and research needs for oil spill impact assessment modelling. pp. 601-653, 2009 in Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada.

Fry, D.M. 1987. *Seabird Oil Toxicity Study*. Report submitted by Nero and Associates, Inc. to Minerals Management Service, U.S. Department of Interior, Washington, D.C., USA.

Fucik, K.W., Bight, T.J. and Goodman K.S. 1984. Measurements of damage, recovery, and rehabilitation of coral reefs exposed to oil. pp. 115–134 in Cairns Jr., J. and Buikema Jr., A.L. (eds.), *Restoration of Habitats Impacted by Oil Spills*, Butterworth Publishers, Boston, MA.

Guzman H.M., Burns K.A., Jackson B.C. 1994. Injury, regeneration and growth of Caribbean reef corals after a major oil spill in Panama. Marine Ecology Progress Series 105, 231–241.

Hayes M., Hoff R., Michel J., Scholz D. and Shigenaka G. 1992. An introduction to Coastal Habitats and Biological Response to an Oil Spill. Report prepared by the Hazardous Materials Response and Assessment Division National Oceanic and Atmospheric Administration.

Hoff, R. and Michel, J. 2014. Oil spills in mangroves: planning and response considerations. US Department of Commerce. National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington.

Holmes, W.N. and Cronshaw, J. 1977. *Biological Effects of Petroleum on Marine Birds* . pp. 359–398 in Malins, D.C. (ed.), Effect of petroleum on arctic and subartic marine environments and organisms. Vol. II: Biological effects. Academic Press, New York, USA.

Hook S.E., Osborn H.L., Spadaro D.A., Simpson S.L. 2014b. Assessing mechanisms of toxicant response in the amphipod Melita plumulosa through transcriptomic profiling. Aquatic
Toxicology 146, 247–257. doi:10.1016/j.aquatox.2013.11.001

International Petroleum Industry Environmental Conservation Association (IPIECA). 2014. Wildlife resopnse preparedness. IPIECA-IOGP Good Practice Guide Series,
Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 516. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015a. A guide to oiled shoreline clean-up techniques. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 521. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015b. At-sea containment and recovery. IPIECA-IOGP Good Practice Guide Series,
Oil Spill Response Joint Industry Project (OSR-JIP). IOGP report 522. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2015c. Dispersants: surface application. IOGP report 532. London, UK.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2017b. Key principles for the protection, care and rehabilitation of oiled wildlife. IPIECA-IOGP Good Practice Guide Series, Oil Spill Response Joint Industry Project (OSR-JIP). IOGP Report 583. London, UK.

International Tanker Owners Pollution Federation (ITOPF). 2011. Effects if Oil Pollution on the Marine Environment - Technical Information Paper. Published by the International Tanker Owners Pollution Federation Limited, London UK.

Jenssen, B.M. 1994. Review article: Effects of oil pollution, chemically treated oil, and cleaning on the thermal balance of birds. *Environmental Pollution* , 86:207–215.

Law R.J., Kirby M.F., Moore J., Barry J., Sapp M., Balaam J. 2011. PREMIAM – pollution response in emergencies marine impact assessment and monitoring: post-incident monitoring guidelines. In Science Series Technical Report No. 146. Cefas, Lowestoft, UK, <www.cefas.defra.gov.uk/premiam>.

Lee, K. 2011. *Toxicity Effects of Chemically Dispersed Crude Oil on Fish* . International Oil Spill Conference Proceedings 2011(1):163.

Matcott, J., Baylis, S., and Clarke, R.H. 2019. The Influence of Petroleum oil films on the feather structure of tropical and temperate seabird species. Marine Pollution Bulletin 138: 135-144.

Milton, S., Lutz, P. and Shigenaka G. 2003. Oil Toxicity and Impacts on Sea Turtles. In Shigenaka, G. (ed.), *Oil and Sea Turtles: Biology, Planning, and Response* . National Oceanic and Atmospheric Administration (NOAA), Seattle, Washington.

Montagna P.A., Baguley J.G., Cooksey C., Hartwell I., Hyde .LJ., Hyland J.L. et al. 2013. Deep-sea benthic footprint of the Deepwater Horizon blowout. PLoS One 8, e70540. doi:10.1371/journal.pone.0070540

Murawski S.A., Hogarth W.T., Peebles EB, Barbeiri E. 2014. Prevalence of external skin lesions and polycyclic aromatic hydrocarbon concentrations in Gulf of Mexico fishes, post
Deepwater Horizon. Transactions of the American Fisheries Society 143, 1084–1097.

National Research Council (NRC). 2005. Oil Spill Dispersants: Efficacy and Effects. The National Academies Press. Washington, DC.

Negri, A.P. and Heyward, A.J. 2000 Inhibition of fertilization and larval metamorphosis of the coral *Acropora millepora* (Ehrenberg, 1834) by petroleum products. *Marine Pollution Bulletin* 41(7–12):420–427.

O'Brien, M. 2002. At-sea recovery of heavy oils - A reasonable response strategy? 3rd Forum on High Density Oil Spill response. The International Tanker Owners Pollution Federation Limited (ITOPF). London, UK.

Ohlendorf, H.M., Risebrough R.W. and Vermeer, K. 1978. *Exposure of Marine Birds to Environmental Pollutants*. U.S. Fish and Wildlife Service Wildlife Research Report 9.

Peters E.C., Gassman N.J., Firman J.C., Richmond R.H., Power EA .1997. Ecotoxicology of tropical marine ecosystems. Environmental Toxicology and Chemistry 16, 12–40. doi:10.1002/etc.5620160103

Pie HV, Heyes A, Mitchelmore C.L. 2015. Investigating the use of oil platform marine fouling invertebrates as monitors of oil exposure in the Northern Gulf of Mexico. The Science of the Total Environment 508, 553–565. doi:10.1016/j.scitotenv.2014.11.050

Pilcher N.J., and Enderby. S. 2001. Effects of prolonged retention in hatcheries of green turtle (Chelonia mydas) hatchling swimming speed and survival. Journal of Herpetology. 35(4): 633–638.

RPS. 2018. WA-343-P Quantitative Spill Risk Assessment. West Perth, Western Australia.

RPS. 2019. INPEX Ichthys Phase 2 Development WA-50-L Oil Spill Risk Assessment. MAW0796J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.

Runcie, J.W. and Riddle, M.J. 2006. Diel variability in photosynthesis of marine macroalgae in ice-covered and ice-free environments in East Antarctica. European Journal of Phycology 41(2):223–233.

Samuels, W.B. and Lanfear K.J. 1982. Simulations of seabird damage and recovery from oil spills in the northern gulf of Alaska. Journal of Environmental Management 15: 169–182.

Seip, K.L., Sandersen, E., Mehlum, F. and Ryssdel, J. 1991. Damages to seabirds from oil spills: comparing simulation results and vulnerability indexes. Ecological Modellin, 53: 39–59.

Sell D, Conway L, Clark T, Picken GB, Baker JM, Dunnet GM. 1995 Scientific criteria to optimize oil spill cleanup. International Oil Spill Conference Proceedings 1995(1), 595–610.

Shigenaka, G. 2001. *Toxicity of Oil to Reef Building Corals: A Spill Response Perspective*. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum, National Ocean Service, Office of Research and Restoration 8, Seattle, USA.

Simberloff, D. 2009. The role of propagule pressure in biological invasions. The Annual Review of Ecology, Evolution, and Systematics 40:81-102.

Taylor H and Rasheed M. 2011. Impacts of a fuel oil spill on seagrass meadows in a subtropical port, Gladstone, Australia – The value of long-term marine habitat monitoring in high risk areas. Marine Pollution Bulletin 63:431-437.

Varoujean, D.H., Baltz, D.M., Allen, B., Power, D., Schroeder, D.A. and Kempner, K.M. 1983. *Seabird-Oil Spill Behavior Study*. Report by Nero and Associates, Inc. to U.S. Department of the Interior, Minerals Management Service, Reston, VA.

WA Department of Transport (WA DoT). 2018. Provision of Western Australian Marine Oil Pollution Risk Assessment - Protection Priorities - Protection Priority Assessment for Zone 1: Kimberley - Draft Report. Perth, Western Australia.

Woodside Energy Ltd. 2014. Browse FLNG Development, Draft Environmental Impact Statement. EPBC 2013/7079. November 2014. Woodside Energy Ltd., Perth, Western Australia.

Zieman, J.C., Orth, R., Phillips, R.C., Thayer, G. and Thorhaug, A. 1984. The effects of oil on seagrass ecosystems. pp. 37–64 in Cairn, J. and Buikema, A.L. (eds), Restoration of Habitats Impacted by Oil Spills. Butterworth, Boston, USA.