
**EEZ100016: Tamarind Taranaki Limited marine consent and
marine discharge consent applications – Tui Field
26 May 2018**

Review of marine environmental impact assessment

1. Qualifications and experience

1. Ian Baxter holds a BSc (Zoology) degree from The University of Western Australia and an MSc (Marine Biology) degree from James Cook University of North Queensland.
2. Ian is a Member of the Environment Institute of Australia and New Zealand (MEIANZ) and has been a Certified Environmental Practitioner (CEnvP) since 2005.
3. He has worked as a marine environmental consultant since 1990. Over that time, he has primarily been engaged on projects in the petroleum and ports sectors.
4. These projects have comprised site selection studies, baseline habitat assessments, environmental impact assessments, project environmental approvals (including significant projects such as the ConocoPhillips and INPEX LNG plants in Darwin Harbour, the Chevron Wheatstone LNG plant in the Pilbara region of WA, and their associated offshore petroleum leases), environmental management plans and environmental monitoring programmes.
5. At the core of the environmental impact assessments undertaken for offshore petroleum developments has been the assessment of risks to the marine environment from their installation, operation and decommissioning.
6. Ian has recent experience in assessing impacts to the marine environment in the South Taranaki Bight (STB). This has been through an initial role for the Environmental Protection Authority (EPA) as their technical expert for benthic ecology in the deliberations attendant to the Trans Tasman Resources Limited application to mine iron sands in the region. In addition to his role in the expert conferencing for the benthic ecology aspects of the project, he also attended (as an observer) the other expert conferencing sessions pertaining to marine environmental issues.
7. Ian's most recent experience in the region was his assessment, on behalf of the EPA, of the marine environmental aspects of the Marine Consent and Marine Discharge Consent applications, and accompanying environmental impact assessment, submitted by Shell Todd Oil Services Limited (now Shell Taranaki Limited) for the use of a jack-up rig within the Māui Field. The Māui Field abuts the south-eastern boundary of the Tui Field.
8. Coupled with his 27 years of experience in assessing the impacts of developments upon the marine environment, his understanding of the marine environment in the STB region places him in a strong position to undertake a robust appraisal of the impact assessment submitted by Tamarind Taranaki Limited (Tamarind).

2. Code of Conduct

9. I confirm that I have read the Code of Conduct for Expert Witnesses as contained in the Environment Court Practice Note dated 1 December 2014 and I agree to comply with this Code.

3. Introduction

10. The purpose of this report is to:
- Provide an analysis of whether the Tamarind impact assessment contains a technically robust identification and reasonable assessment of the potential effects of the proposed activity on the marine environment, and whether these are based on information that is the best available, without unreasonable cost, effort or time (as per section 61 of the *Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012* [EEZ Act]).
 - Recommend what additional information, if any, is required to reach 'best available information'. Any recommendations will identify why the additional information is necessary to understand the proposed activities, and how it will assist with assessing the scale and significance of effects of those activities.
 - Provide a review of mitigation measures proposed by the applicant and an analysis on whether these will be sufficient to address the potential effects of the activity on the marine environment.
 - Provide conclusions as to the risks of the activity that could result in adverse effects and may require management through conditions (should consent be granted).

4. Impact Assessment Review

4.1. Documents Reviewed

11. The following documents were reviewed:
- Tamarind Marine Consent and Marine Discharge Consent Applications, 7 March 2018.
 - Tui Field Drilling Activities Impact Assessment to Support Notified Marine Consent and Marine Discharge Consent Applications, March 2018.
 - Tui Field Drilling Activities Impact Assessment Annexes A to F.

4.2. Summary of Activity

12. On 8 March 2018, Tamarind lodged Application EEZ100016 to seek consent for activities associated with the drilling of side-track development wells, including associated logistic and environmental monitoring activities, within the Tui Field. Activities require both a Marine Consent and a Marine Discharge Consent as they are restricted under sections 20(2) and 20(4) of the EEZ Act (Marine Consent) and section 16(1) of the EEZ and Continental Shelf (Environmental Effects - Discharge and Dumping) Regulations 2015 (Marine Discharge Consent).
13. The activities that Tamarind has described in the impact assessment, and for which consent is sought, comprise the following. Associated activities and discharges not mentioned below are considered by Tamarind to be covered under their existing Marine Consent and Marine Discharge Consent, or will be covered by a future, separate Marine Discharge Consent for which application will be made once a rig is contracted:

- a) Installation, operation and removal of the moored semi-submersible drilling rig:
 - i) With the assistance of offshore support vessels, at each of the four well locations typically four, but up to 12, anchors will be laid over a diameter of approximately 1.5 to 2.5 km. Average anchor dimensions will be 5-6.5 m length, 6-7 m width and 3-4 m height. Anchor drag during deployment and retrieval is generally a maximum of 80 m with a maximum anchor penetration of the seabed of 3 m. Each mooring line typically disturbs some 700-1,000 m of seabed to a width of approximately 1 m.
 - ii) At each well location, it is expected that anchors would be in place for between 40 and 50 days, though this could be longer if significant delays occur due to technical requirements or weather downtime.
 - iii) It is possible that an anchor spread will be pre-laid at the next planned drilling site before activities are completed at the previous drilling site; hence up to 24 anchors could be in place on the seabed at any one time. Once the rig is relocated to the new site, the anchors at the previous site would be removed by anchor handling vessels.
 - iv) It is possible that, in the event of equipment or weather downtime halting drilling operations, the rig may require temporary anchoring at locations other than the well sites. Therefore, Tamarind is seeking consent for up to eight rig placements during the drilling campaign.
 - v) At the completion of drilling at each site, all anchors, chains and wires will be removed from the seabed, leaving no objects behind.
- b) Temporary placement of blow-out preventers (BOPs):
 - i) A BOP will be temporarily connected onto each existing wellhead through which drilling by the rig is to occur. The BOP will be lowered by the rig onto the marine riser and connected directly onto the wellhead; it will not contact the seabed.
 - ii) With the BOP in place, tubulars can be removed from the well without coming into contact with the surrounding seawater. Also, fluids can be circulated into the well via the drill pipe and back up the marine riser without coming into contact with the surrounding seawater.
 - iii) In the event that unexpected well pressures are encountered, or if there is any concern about loss of control of the well fluids, the well is able to be closed via the BOP.
 - iv) If drilling operations are suspended due to weather conditions, the well can be closed via the BOP and, if necessary, the rig can be disconnected from the riser. Before disconnection, the marine riser would be sealed via valves at its base to prevent fluids in the riser from entering the surrounding waters. The rig could then move a short distance from the wellhead location, leaving the BOP in place and the well closed in.
 - v) At the conclusion of drilling at each site, the BOP will be removed for re-use at the next site. At the conclusion of the drilling programme, all BOPs will be removed from the field.
- c) Modification of existing well structures:
 - i) Once the drilling rig is connected to the wellhead via the BOP and marine riser, valve function and high-pressure testing will be undertaken to confirm the integrity of the system.
 - ii) Once integrity testing is completed, the well will be accessed and the upper completion will be removed. Cement plugs and mechanical barriers will be placed within the wellbore, below the planned side-track, to isolate the sections of the wellbore that will no longer be used.

- d) Side-track drilling through existing wells and well commissioning:
- i) Side-tracking of each well is anticipated to take place between 1,400 and 3,600 m below the seabed. Metal debris from the milling of a window in the existing well casing will be recovered to the surface within recirculated water-based milling fluid. Once all steel fragments have been recovered from the milling fluid (which will not contain any ecotoxic substances) it will be discharged into the offshore waters.
 - ii) During drilling of each side-track well, drilling mud (potentially both water-based [WBM] and synthetic-based [SBM]) will be deposited on the wall of the new borehole. Residual WBM may be adhered to the drill cuttings that are deposited on the seabed. Cuttings from sections drilled with SBM will be dried on the rig to remove excess fluid; the recovered SBM, and cuttings with residual SBM, will be brought ashore for testing and disposal – no SBM will be discharged to sea.
 - iii) Drilling fluids will be selected on the basis of factors including the specific application, performance, biodegradability, Offshore Chemicals Notification Scheme ranking, re-usability and availability. I note that there is a pre-existing chemical ranking scheme within New Zealand legislation, with which proponents need to comply; further, approval to import harmful substances is required under the *Hazardous Substances and New Organisms Act 1996*.
 - iv) The volume of drill cuttings to be produced (including a 15% contingency for borehole re-alignment or section re-drill, and the volume of cuttings returned to shore with residual SBM) is predicted to be in the order of 529 m²). The modelled maximum thicknesses of deposited cuttings and WBM ranged from 86 mm to 105 mm. Maximum distances of deposition of >6.5 mm (levels that may smother benthic invertebrates) were predicted to range from 56 m to 90 m from the wellheads.
 - v) Peak total suspended solids (TSS) concentrations of 33 mg/l around each well were predicted from modelling. Peak TSS concentrations of >1 mg/l were predicted to occur at distances ranging from 500 m to 571 m from the wellheads; for TSS concentrations of > 20 mg/l the predicted maximum distances were 17 m to 19 m.
 - vi) Cement from the existing wells, and from cementation of the new side-track liners, will be separated from the drilling fluids and discharged at each drilling location. The quantity of cement to be discharged to the seabed is estimated to be 22 m³. In addition, up to 2 m³ of surplus cement may be discharged if less cement than anticipated is required for a well. If a cement batch is prepared but then deemed unsuitable for use, the full batch (up to 8 m³) may be discharged to sea. In addition, dry cement dust may be blown from the deck of rig into the sea. If, once the anticipated additives have been determined, there is a risk that hazardous substances could be discarded with the cement mixture, then this will be addressed through a subsequent Marine Discharge Consent application.
 - vii) In the order of 120 litres of elastomers and plastic debris (from drilling of plugs separating cement from drilling fluids) is expected to be disposed of with the cement.
 - viii) No new equipment will be placed on the seabed during this development drilling.
- e) Contingent operations (may be required if certain operational situations or circumstances are encountered):
- i) Mechanical cleaning (brushing and jetting) of the existing wellhead electrical connectors may be required. Application of scale solvers (calcium wash fluids) may be required to remove marine organisms that have deposited calcium carbonate scale; if it is determined that the selected wash fluids contain harmful substances,

then this will be addressed through a subsequent Marine Discharge Consent application.

- ii) If equipment becomes stuck in the well during drilling (considered to be an unlikely event) then it may be released through the use of explosive cutters. As this activity would occur at least 1,400 m below the seabed it was deemed by Tamarind to be unnecessary to consider it in detail during the impact assessment.
- f) Logistic support activities:
- i) Return helicopter flights between New Plymouth and the Tui Field are expected to occur on an average of up to nine times per week. These flights will be additional to those currently supporting the approved FPSO activities in the field. Transit heights will typically be 2,000-5,000 m during the approximately 30-minute flights. If whales or dolphins are sighted, then close approach to these will be avoided.
 - ii) Support and supply vessels will not be moored or anchored in the field during the activities and will use dynamic positioning (DP) when manoeuvring near to the drilling rig. Underwater noise and vibration from the DP systems are considered by Tamarind to be associated with ship propulsion and therefore not subject to Marine Consent requirements.
 - iii) Vessels will use normal propulsion during transit or when holding station away from the rig. It is expected that at least one vessel will be supporting the drilling operations at all times, with additional vessels utilised for activities such as anchor handling or towing. It is anticipated there will be one return trip per day between New Plymouth and the Tui Field.
 - iv) Vessel discharges will accord with the *Maritime Transport Act* and the associated Marine Protection and Maritime Rules; it is considered by Tamarind that no vessel activities will require a Marine Consent or Marine Discharge Consent.
- g) Environmental Monitoring – it is considered by Tamarind that no monitoring will be required that is additional to that undertaken in accordance with their existing approved Environmental Effects Management Plan. Notwithstanding this, in case additional monitoring is required, Tamarind is seeking consent for placement on the seabed of sampling and monitoring equipment (e.g. water quality and benthic grab sampling equipment), disturbance of the seabed and removal of non-living material associated with environmental sampling and surveys.
- h) Marine discharges from drilling rig deck drains:
- i) Offshore processing drainage – there is the potential for residues of harmful substances to enter the deck drainage system (e.g. post-clean-up residues from minor spills and splashes of chemicals during handling and use, or from dust residues). These residues would then be highly diluted (estimated 35,000 times dilution in a 5 mm rainfall event and 630,000 times dilution during a storm event of 90 mm over 24 hours) and washed overboard.
 - ii) Rainwater from areas that may contain potential contamination will be directed via an oily water separator (OWS) to holding tanks – if there is concern that this may contain harmful levels of contaminants, it will be returned ashore for disposal if safely practicable.
 - iii) Rainwater from general deck areas will flow to a centralised location and then pass through an OWS, with the aqueous portion flowing to overboard drains, and the hydrocarbon portion directed to holding tanks.
 - iv) Areas below deck where drilling activities take place, or where hazardous or ecotoxic chemicals are stored, will not have drains that discharge to sea.

14. These activities are relevant to the following Section 20(2) Restricted Activities:
- a) 2(a) Construction, placement, alteration, extension or removal of structures on or under the seabed. This is pertinent to:
 - i) Alteration of wellheads and wells by temporary removal and replacement of production tubulars, drilling through existing casings, and the attachment and subsequent removal of BOPs.
 - ii) Construction, placement, alteration and removal of the drilling rig (including anchors, chains and wires), re-entry and abandonment of existing wells, and side-track drilling and well completions.
 - iii) Construction, placement, alteration and removal of structures associated with environmental monitoring.
 - b) 2(d) Removal of non-living natural material from the seabed or subsoil. This is pertinent to:
 - i) Drilling the side-track development wells.
 - ii) Environmental monitoring.
 - c) 2(e) Disturbance of the seabed or subsoil in a manner that is likely to have an adverse effect on the seabed or subsoil. This is pertinent to:
 - i) ROV works, and the installation and removal of the rig including anchors, chains and wires.
 - ii) Deposition of drill cuttings, cementing products, metal fragments, elastomer and sediment associated with well drilling.
 - iii) Environmental monitoring, including placement and removal of monitoring equipment.
 - d) 2(f) Deposition of anything in, on or under the seabed. This is pertinent to those factors considered under Sections 20(2)(a) and 20(2)(e), plus the deposition of sediments from the settling of the sediment plume generated from the placement and removal of anchors, chains and wires.
 - e) 2(g) Destruction, damage or disturbance of the seabed or subsoil in a manner that is likely to have an adverse effect on marine species or their habitat. This is pertinent to those factors considered under Section 20(2)(e).
15. In addition, the activities are relevant to the following Section 20(4) Restricted Activities:
- a) 4(a) Construction, mooring or anchoring long-term, placement, alteration, extension, removal or demolition of a structure or part of a structure. This is pertinent to those factors considered under Section 20(2)(a).
 - b) 4(b) Causing vibrations (other than vibrations caused by the propulsion of a ship) in a manner that is likely to have an adverse effect on marine life. This is pertinent to vibrations associated with installation, operation and removal of the drill rig, including placement and retrieval of anchors, DP and well drilling.
16. Section 20B of the EEZ Act requires discharges of harmful substances from structures into the sea, or into or onto the seabed, to be authorised by a Marine Discharge Consent. The key aspect of the Tamarind application to which this section of the Act applies is the discharge into the sea of harmful substances from offshore processing drainage from the deck drains (hazardous and non-hazardous) of the drilling rig. The discharge of other harmful substances (e.g. drilling fluids and other substances associated with drilling and other operations) will be the subject of a separate non-notified Marine Discharge Consent application.

4.2. Key Environmental Features

17. I concur with Tamarind's selection of key environmental features identified as potentially occurring in the general area of the activity, namely:
- water quality and associated planktonic communities
 - sediment quality and associated benthic communities
 - fish, including sharks and species of importance to commercial fishers
 - marine mammals
 - seabirds
 - marine reptiles.
18. I note that there are no protected or managed marine areas identified in the area of influence [AOI] of the proposed activity.
19. I consider that the descriptions of the following aspects of the environment are based upon best available information, as defined in section 61 of the EEZ Act, and are at a level of detail that is appropriate for the purposes of the risk assessment:
- Limited water quality data have been collected by Tamarind's consultants, though I consider that data from sampling of water quality at single points in time are of limited use for impact assessment as they do not provide a picture of variations in analytes over all time scales (from hourly, to seasonally, to inter-annual). However, taking account of the proposed activities I do not consider that a more comprehensive baseline assessment is necessary. Rather, it will be of greater importance to have monitoring of water quality undertaken around the operations, and at control sites distant from the operations. Such monitoring would be required around routine operations if it is considered that there is a risk of hazardous substances on the rig (once contracted) entering the deck drainage system and subsequently entering the marine environment. Monitoring of this nature would also be required in the event of an unplanned release of hydrocarbons or chemicals.

Phytoplankton – I consider that the level of information provided (from satellite-derived estimates) is adequate for the purposes of impact assessment.
 - Seabed sediment physico-chemical characteristics, which are an important determinant of benthic community composition. Sampling of the seabed sediments within the Tui Field was undertaken in 2012, 2013, 2014 and 2016. While the array of sampling sites is centred around the FPSO, some sites are sufficiently close to the wellheads at which side-track drilling is to be undertaken for the sediments to be considered representative of those that would occur around the wellheads. Sediments were determined to be dominated by silt and clay, similar to those found throughout the Taranaki Bight. In 2016, a barium-enriched sediment footprint was described around the FPSO, out to a distance of 6 km (which envelopes the wellhead locations).
 - As there have been no significant spatial differences between the benthic communities at the different monitoring sites within each year of monitoring (2012, 2013, 2014 and 2016), I consider it is reasonable to conclude that the communities at risk of potential impact (from the currently proposed activities) around the wellhead locations have been adequately characterised. The data presented show the high degree of natural spatial variability in benthic community composition that is typical in seabeds primarily comprised of unconsolidated ('soft') sediments. I concur with the assertion by Tamarind's consultants that the benthic fauna communities can be considered typical of those found in the broader Taranaki region.

- d) Given the distances of reefs and estuaries from the AOI, I consider that no greater level of detail is required than that provided. I note that Tamarind recognises that reefs and estuaries would be at risk of impact from an unplanned event (such as a spill); however, given the distance from the field there would be an adequate period of time (in the order of two days, if the modelling undertaken for Tamarind is accurate) to establish a baseline characterisation of the communities present at sites at risk of impact. Given the broad geographic distribution of reefs and estuaries that may be impacted by a spill, it would be unreasonable to expect Tamarind to have baseline surveys undertaken (to the level of detail required to assess the impacts from a spill) at all locations at risk of impact. Rather, in the event of a spill, baseline monitoring should be undertaken at locations where observations of spill trajectory indicate that contact is most likely.
 - e) While no individuals of rare or threatened fish species have been observed in ROV video records from around the wellheads, I note that these records did not come from specific surveys for fish species. I recognise, however, that a conservative assumption has been adopted by Tamarind that some individuals of some rare or threatened species may be present in the AOI. Hence, I consider that the general description provided of the fish species (including commercial species and sharks) potentially present in the AOI is adequate. Given the nature of the proposed activities, I do not believe that fish-specific surveys are required in order to undertake a robust impact assessment.
 - f) The information presented on marine mammals is drawn from a wide range of sources, including recent expert advice provided during a hearing pertaining to the neighbouring Māui Field. Given the nature of the proposed activities, I consider that an adequate level of detail has been provided.
 - g) Limited information on seabirds is provided in the impact assessment. Tamarind acknowledges it is likely that certain 'threatened' and 'at risk' taxa could occur in the STB, and that "bird species may migrate through the AOI". However, they do not indicate whether these bird species include endemic, endangered or protected species, and whether the species are valued locally/regionally or nationally/globally. This has implications for the impact assessment process implemented, as discussed in the next section. While I do not believe that further studies of seabirds are required, more detailed information on the conservation status of each species that may migrate through the AOI will assist in determining the veracity of the impact assessment outcomes.
 - h) I concur with Tamarind's assessment that there is a low likelihood of marine reptiles being present in significant numbers within the AOI. Hence, I consider that an appropriate level of detail has been provided in the impact assessment, especially taking into account the nature of the proposed activities.
20. In summary, I do not consider that there are any further studies required of the existing environment in order for a robust impact assessment to be undertaken.

4.3. Potential Key Effects

4.3.1 Planned activities

21. I concur with Tamarind's identification of the aspects of the activities that may affect the marine environment, as presented below. Tamarind's residual impact (RI) designations are included; these represent the predicted impacts on receptors once mitigation measures to avoid, reduce or remediate potential impacts are implemented.
22. Underwater noise and vibration effects from DP of the rig; deployment and retrieval of rig anchors, chains and cable; and drilling activities (including re-entry and sectional abandonment of the existing wells). Tamarind's RI designations are as follow:
- a) Marine mammals - Minor RI, based upon their sensitivity to disturbance being designated as Medium and a designated magnitude of Small. However, in section 6.2.2. of the impact assessment it is indicated that some of the marine mammal species "are vulnerable and of high intrinsic value", in which case a sensitivity of High ("species... are listed as endangered or protected") rather than Medium ("species... may be endemic, endangered or protected") should be applied; in which case the resultant RI would be Moderate, rather than Minor. As a significance designation of Moderate does not indicate the need to implement further mitigation measures to reduce the potential for impacts to ALARP, this discrepancy in the information presented does not require any amendment of the impact assessment. Further, as the identity of all marine mammals in any area can never be definitively determined, even with a high degree of survey effort, it is not suggested that any surveys to attempt to locate listed species are warranted.
 - b) Fish - Negligible RI, based upon their sensitivity to disturbance being designated as Low. It should be noted, though, that the Low designation is, in part, due to species within the AOI being considered "not endangered or protected". However, in section 4.3.3 of the impact assessment, in relation to 45 fish species (not including sharks) included on the NZ Threat Classification Listing as 'in gradual decline, sparse or range restricted' it is indicated that "it has been assumed that some individuals of these species may occur within the AOI". On the basis of this assumption, the sensitivity should be increased to High. Coupled with an impact magnitude of Small, the resultant RI would be designated as Moderate, rather than Negligible. As for marine mammals, though, the need for surveys of listed fish species is not indicated.
 - c) Sharks – appear to be included with fish, in which case the RI is designated as Negligible. However, the impact assessment indicates that the distributions of 14 species of sharks listed on the National Aquatic and Biodiversity Information System include the AOI. As these species are also included on the IUCN Red List, it follows that the sensitivity should be designated as High. Coupled with an impact magnitude of Small, the resultant RI would be Moderate. As for marine mammals and fish, though, the need for surveys of shark species is not indicated.
23. Effects of turbidity generated as a result of deployment and retrieval of rig anchors, chains and cables; ROV activities; and disposal of cuttings (including WBM adhered thereto) and cement. Tamarind's RI designations are as follow:
- a) Water quality and plankton – Negligible RI, based upon a Small magnitude of impacts and a Low sensitivity. However, modelling results indicate that elevated turbidity may occur up to 20 m from the source, which I consider (based upon Tamarind's consultant's criteria for assessing impact magnitudes) to indicate a Medium magnitude of impacts as water quality is predicted to return to background levels beyond 'a few metres' (the criterion for a Small magnitude). This would elevate the RI to Minor.
 - b) Fish - Negligible RI, based upon a Small magnitude of impacts and a Low sensitivity. As discussed in item 22b above, the assumption that some protected species may be

present within the AOI indicates that the sensitivity needs to be increased to High, with a resultant Moderate RI.

24. Effects of deposition of equipment and material on the seabed, including placement of rig anchors; deposition of marine growth from existing subsea structures; deposits of cuttings (including WBM adhered thereto); deposition of composite plastic and elastomeric plug drill chips (with drill cuttings); and cement released into the water column. Tamarind's RI designations are as follow:
- a) Benthic communities - Minor RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Medium. I concur with these designations. With respect to the model assumptions and environmental thresholds used for the modelling of muds and cuttings, I note that Tamarind's consultants provide no evidence of the source of their assumed background sedimentation rate, or why it should be considered 'conservative'. However, the resultant threshold of 0.4 mm seems reasonable as such low levels of sedimentation would not be anticipated to result in significant impacts to benthic communities. Also, the background sedimentation rate is only one of the many assumptions that go into the model. If the activity was in closer proximity to ecologically significant benthic communities, then these assumptions would need to be thoroughly investigated. In this instance, though, the habitat (and, therefore, the associated benthic communities) is widely distributed across the STB, so even if the model outputs were incorrect by an order of magnitude then this would not be a cause for significant concern.
 - b) Fish – A sensitivity of Low has been designated by Tamarind's consultants, but a magnitude and RI have not been designated. As discussed in item 22b above, adopting the assumptions made by Tamarind's consultants with respect to the presence of protected species, the sensitivity designation should be High. Following their criteria for assessing impact magnitudes, I suggest a designation of Small would be appropriate, resulting in a Moderate RI. The key risk to fish would be the ingestion of chips of plastic deposited with drill cuttings.
25. Effects of the spill of artificial light from the rig deck, supply and support vessels, and ROV operations. Tamarind's RI designations are as follow:
- a) Seabirds - Minor RI, based upon their sensitivity to disturbance being designated as Medium and a designated magnitude of Small. As discussed in item 19h, Tamarind's consultants indicate that seabirds may migrate through the AOI, but do not specify whether these include endemic, endangered or protected species and whether the species are valued locally/regionally or nationally/globally. If a conservative assumption is made that at least one of the species does fit such a designation, then (in accordance with the consultants' criteria for assessing sensitivity to impact) a sensitivity of High would apply. This results in a Moderate RI.
 - b) Fish - Negligible RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Small. As discussed above, if the assumption made by Tamarind's consultants is followed, then the sensitivity designation will be High, resulting in a Moderate RI.
 - c) Plankton - Negligible RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Small. I concur with these designations.

26. Effects of physical disturbance due to the presence of the rig and supply and support vessels; the deployment and retrieval of anchors; ROV activities; and survey and measurement activities. Tamarind's RI designations are as follow:
- Marine mammals - Minor RI, based upon their sensitivity to disturbance being designated as Medium and a designated magnitude of Small. As discussed in item 22a above, the sensitivity criteria of Tamarind's consultants indicate that a High sensitivity is more appropriate, leading to Moderate RI.
 - Seabirds - Negligible RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Negligible. If, as discussed in item 25a above, a conservative sensitivity of High is applied, then it does not change the Negligible RI designation.
 - Fish - Negligible RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Small. As discussed above, if the assumption made by Tamarind's consultants is followed, then the sensitivity designation will be High, resulting in a Moderate RI.
 - Benthic communities - Minor RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Medium. I concur with these designations.
27. Effects of localised discharges of harmful substances from deck drains. It is notable that the assessment of these potential effects has been conducted in the absence of information on the specific substances that may be discharged. Hence, I support Tamarind's proposition that, once a rig is selected, further details be provided to the EPA, including the specifics of hazardous substances used on the rig and the details of deck drainage and discharge systems, prior to any discharges occurring. Tamarind's RI designations are as follow:
- Fish - Negligible RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Negligible. As discussed above, if the assumption made by Tamarind's consultants is followed, then the sensitivity designation will be High, though the RI remains Negligible.
 - Seabirds - Negligible RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Negligible. If, as discussed in item 25a above, a conservative sensitivity of High is applied, then it does not change the Negligible RI designation.
 - Marine mammals - Negligible RI, based upon their sensitivity to disturbance being designated as Medium and a designated magnitude of Negligible. As discussed in item 22a above, the sensitivity criteria of Tamarind's consultants indicate that a High sensitivity is more appropriate, though the RI remains Negligible.
 - Water quality and plankton – Negligible RI, based upon a Small magnitude of impacts and a Low sensitivity. I concur with these designations.
 - Sediment quality and benthic communities - Negligible RI, based upon their sensitivity to disturbance being designated as Low and a designated magnitude of Negligible. I concur with these designations.
28. In considering Tamarind's summary of impacts from planned activities, with the exception of impacts from deck drain discharges I note that the rigorous adoption of the sensitivity criteria proposed by Tamarind's consultants results in most RIs being designated as Moderate rather than as Negligible or Minor. This typically arises through apparent discrepancies between the assumptions made by the consultants and the wording of the criteria. I have taken the higher RIs into account when considering the potential efficacy of Tamarind's proposed mitigation measures (refer Section 4.5 of this report).

4.3.2 Unplanned events

29. I concur with Tamarind's identification of the potential key effects on the marine environment from unplanned events during the activities; however, I disagree with some of the severity and RI designations:
- a) Accidental spills of hydrocarbons or chemicals, other than a loss of well control – the RI designation of Minor for marine receptors is a product of Medium severity and Unlikely likelihood of occurrence. However, as sensitive marine environmental resources will be impacted to some extent the severity criteria adopted by Tamarind's consultants indicate that a High severity must be ascribed. Hence a Moderate RI is indicated.
 - b) Loss of well control leading to reduced water quality, potential impacts to marine biota and potential shoreline oiling - I concur with the RI designation of ALARP for marine receptors, noting that the RI is based upon the assumption that mitigation and control measures are effective. The RI is a product of High severity and Extremely Unlikely likelihood of occurrence.
 - c) Dropped objects – the RI designation of ALARP is based upon Low severity and Unlikely likelihood. Although not stated, I believe that the release of hydrocarbons or chemicals from dropped objects is included within item 29a above. However, as some dropped objects (e.g. plastics) could be ingested by marine fauna (including protected fish, mammal and reptile species) I believe that a High severity is indicated. In addition, the impact assessment focusses upon larger objects, whilst it is the smaller dropped objects (e.g. plastics) which pose a greater risk of impact to marine receptors. I believe that a likelihood of Possible will apply to smaller dropped objects, resulting in a Major RI.
 - d) Vessel collision with marine mammals – in the impact assessment, this event is assessed in conjunction with all other potential vessel incidents. The overall RI for vessel incidents is designated as ALARP (Medium severity and Extremely Unlikely likelihood). If a collision with a marine mammal is considered separately, a High severity is indicated as a sensitive resource (the marine mammal) would be impacted. However, as I consider a likelihood of Extremely Unlikely to be appropriate (provided effective mitigation measures and controls are in place), the RI remains ALARP. Whilst not included in the impact assessment, I contend that an equivalent RI would be applicable to collisions with marine turtles – while the likelihood of this occurrence is probably marginally greater than a collision with a marine mammal, I do not believe that the likelihood would reach a designation of Unlikely (which, coupled with High severity, would result in a Moderate RI).
30. In considering Tamarind's summary of impacts from unplanned activities, I note that the rigorous adoption of the severity criteria proposed by their consultants indicates that the RI for spills of hydrocarbons or chemicals (other than a loss of well control) should be Moderate rather than ALARP, and for dropped objects should be Major rather than ALARP.

4.3.3 Cumulative effects

31. I note the following with respect to Tamarind's assessment of potential cumulative effects:
- a) Underwater noise – whilst noise associated with the activities will add to the noise levels to which marine fauna are exposed, I agree that any incremental increases that arise will be temporary and are unlikely to significantly elevate the level of risk of impacts to marine fauna in the vicinity of the AOI. I note that noise levels emitted from different sources are not necessarily simply additive and, depending upon their frequencies and amplitudes, may act to 'dampen' each other to some extent.
 - b) Turbidity – I agree that rapid dilution and dispersion of turbidity generated by the activities in the open ocean setting will mitigate the risk of cumulative impacts as turbidity

will not 'build up' over time. It is noted that the activities that generate the highest turbidity will not occur concurrently and that generation of turbid plumes will be intermittent.

- c) Deposition and seabed disturbance – I concur with the designation of Negligible for cumulative impact significance. Whilst the individual activities will impact the seabed in a cumulative manner, the disturbance footprints will be localised around each activity. Given the nature of the seabed and its associated benthic communities, which are well represented regionally, I do not consider there to be a credible risk of significant regional impact to the marine environment.
- d) Physical disturbance – I agree that the presence of the rig and the support vessel movements will not contribute significantly to the level of existing activities within, and in the vicinity of, the AOI.
- e) Artificial light – I agree that, provided shielding and directional lighting is used, the additional light generated by the rig and support vessels is unlikely to pose a risk of significant impact upon receptors in the marine environment.
- f) Deck drain discharges – if, as predicted by Tamarind, the discharges are highly diluted by rainfall and the receiving environment, then I agree that they do not pose a risk of significant cumulative impacts to the marine environment within, or beyond, the AOI.

4.4 Information principles

32. I consider that the assessment of potential impacts upon the marine environment has generally been based upon 'best available information', as defined in section 61 of the EEZ Act, at this time. Tamarind has indicated that the actual rig to be used has not yet been contracted and the composition of products to be used during the drilling activities are presently unknown.

4.5. Mitigation

33. I consider that the mitigation hierarchy presented in the impact assessment is generally appropriate for application to the proposed activities, with two exceptions (see item 36 below).
34. I note that, following the impact assessment process of Tamarind's consultants, RI designations of Moderate apply to the following potential effects on the marine environment from planned activities:
- a) Underwater noise effects on marine mammals (designated by Tamarind as Minor) and fish, including sharks (Negligible).
 - b) Turbidity effects on fish (Negligible).
 - c) Deposition of material (especially plastic) on the seabed (RI not designated by Tamarind).
 - d) Artificial light effects on seabirds (Minor) and fish (Negligible).
 - e) Physical presence effects on marine mammals (Minor) and fish (Negligible).
35. It is notable that these discrepancies in RIs for some planned activities arise from the application by Tamarind of sensitivity designations which are not consistent with the assumptions adopted within their impact assessment process. However, the magnitude designations appear reasonable and do not indicate the need to implement further mitigation measures to reduce the potential for impacts to ALARP (as defined within Tamarind's impact assessment process).
36. I also note that, again following the impact assessment process of Tamarind's consultants, different RI designations apply to the following potential effects on the marine environment from unplanned events:

- a) Accidental spills of hydrocarbons or chemicals, other than a loss of well control - Moderate rather than Minor. This is based upon a severity of High rather than Medium, which arises from the potential for impacts upon 'sensitive resources'. In order to reduce the RI to ALARP, additional mitigation measures will be required to reduce the likelihood to Extremely Unlikely.
- b) Dropped objects – Major rather than ALARP. This is based upon a severity of High rather than Low as, once again, there is the potential for impacts upon 'sensitive resources'. This is coupled with a likelihood of Possible rather than Unlikely as I do not believe the impact assessment has given due consideration to the dropping of small objects (e.g. plastic) which can be ingested by marine fauna. Again, additional mitigation measures will be required to reduce the likelihood to Extremely Unlikely.

5. Conclusions

37. I consider that the impact assessment undertaken by Tamarind adequately addresses the potential effects on the marine environment in relation to the relevant decision-making matters in section 59 of the EEZ Act. Specifically, I consider that the information presented is adequate to conclude that, with the rigorous implementation of the mitigation measures described in the impact assessment, plus additional mitigation measures to reduce the likelihood of hydrocarbon and chemical spills and the dropping of small objects, the Project will not pose a significant risk of:
 - a) Cumulative effects on the marine environment.
 - b) Effects in the waters above or beyond the continental shelf beyond the outer limits of the EEZ, which are far beyond the potential AOI from the activities.
 - c) Effects on biological diversity or on the integrity of marine species, ecosystems or processes. I consider that any effects on biological diversity will be temporary, intermittent and reversible; and that the proposed activities do not pose a risk to the integrity of marine species, ecosystems or processes.
 - d) Effects on rare or vulnerable ecosystems, or on the habitats of threatened species. I note that there are no rare or vulnerable ecosystems identified in the AOI, nor any marine protected areas, and that the AOI is unlikely to contain habitat that is of significant importance to threatened species.
38. I consider that the risks of the activities that could result in the greatest adverse effects are those associated with unplanned events - hydrocarbon and chemical spills, and the dropping of small objects (in particular, plastic). Should consent be granted, I suggest that conditions be included to ensure that mitigation measures are developed that will further reduce the risk of adverse effects from these sources to ALARP.