TUI FIELD DECOMMISSIONING

Marine Consent and Marine Discharge Consent Application

Prepared for:

Ministry of Business, Innovation and Employment
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SLR

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BASIS OF REPORT

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

The Ministry of Business, Innovation and Employment (**MBIE**) is applying for a marine consent and a marine discharge consent (this combined application is hereafter referred to as the **consent application**) under section 38 of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (**EEZ Act**). This consent application seeks approval for various activities associated with the decommissioning of the Tui oil field (**Tui field**) located within Petroleum Mining Permit 38158 (**PMP 38158**) approximately 50 km off the western coast of Taranaki.

MBIE is proposing to decommission the Tui field which will involve removal of Subsea Infrastructure (**SSI**) and plugging and abandoning (**P&A**) eight wells. The activities associated with the decommissioning of the Tui field include some that are restricted by the EEZ Act.

In November 2019, the operator of the Tui field, Tamarind Taranaki Limited (**TTL**), ceased production from the field and in December 2019 was placed into liquidation. In February 2020, Cabinet decided to fund and undertake the decommissioning of the Tui field in order to protect the Taranaki marine environment. A Project Team was subsequently established in MBIE to plan and manage decommissioning.

Decommissioning of the Tui field is planned to be undertaken in three phases, over a four-year period from 2020:

- Phase 1 – disconnection of the Floating Production Storage and Offloading vessel '*Umuroa*' (**the FPSO**) from the SSI and retrieval of the FPSO's anchors – this phase was completed on 5 May 2021;
- Phase 2 – removal of the SSI; and
- Phase 3 – P&A of wells.

Methods available for completing the decommissioning of subsea oil and gas assets vary based on many factors. In New Zealand, principal considerations when determining the preferred approach include:

- The regulatory regime in force at the time of decommissioning;
- The cultural values and interests of iwi and Māori;
- Feedback from the community and other interested parties;
- The location of the field relative to ports and infrastructure;
- The type of assets that require decommissioning and availability of suitable vessels and equipment;
- The sensitivity of the surrounding marine environment; and
- The metocean conditions and water depth.

Taking these factors into consideration, MBIE used the following criteria to determine the best practicable option for decommissioning the Tui field:

- Compliance with New Zealand law;
- Effects on the environment;
- Cultural values and interests of Treaty of Waitangi partners;
- Effects on health and safety of personnel;

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- Effects on parties with existing interests;
- Good industry practice;
- Likelihood of success; and
- Cost effectiveness.

After considering the options for decommissioning, MBIE has selected an overall approach to leave a 'clear seabed' through recovery of all subsea equipment, and removal of all wellheads to below the seabed surface. This approach is aligned with the Tui Project's intention to ensure protection of the Taranaki marine environment. This approach also allows the field to return to its pre-development condition as soon as possible.

A survey of the seabed will be undertaken at the start of Phase 2 of the decommissioning activities to determine the precise location of the SSI to be recovered. Once these locations have been confirmed, a Construction Support Vessel (**CSV**) will begin its work in the Tui field, disconnecting all of the items of SSI and recovering them from the seabed. This will include the flowlines, risers, umbilicals, jumpers, structures, production skids and hold-back anchors. The SSI will be lifted from the seabed and stored on the CSV until it can be transferred to a support vessel which will periodically transport the recovered SSI back to shore for re-use, recycling or disposal. Phase 2 of the decommissioning activities is expected to occur during summer 2021/22, subject to granting of this consent application, and take approximately 100 days to complete, depending on operational constraints and/or weather delays.

In Phase 3, a Well Intervention Vessel or Mobile Offshore Drilling Unit will enter the four production wells that require plugging downhole (Amokura-2H, Pateke-3H, Pateke-4H, Tui-2H) and will complete the abandonment of them. This will involve pumping cement into the wells to create plugs that seal off the reservoirs. As the plugging of each well is completed, the production casing will be cut below the wellhead and retrieved, the "Christmas Tree" (**Xmas Tree**) retrieved, and wellhead, surface casing and conductor cut approximately 3 m below the seabed and retrieved. The fifth production well (Tui-3H) already has downhole cement plugs in place but will require the seabed infrastructure to be removed in the same way as the other production wells. The three exploration wells in the Tui field (Amokura-1, Tieke-1, Tui-SW2) have already been adequately plugged with cement and are suspended; however, each well still has a wellhead and Xmas Tree installed on it which will be removed to leave a clear seabed.

All equipment recovered during Phase 3 of the decommissioning activities will be transported to shore for re-use, recycling or disposal. Phase 3 is planned to occur in either summer 2021/22 or summer 2022/23, with the exact timing subject to ongoing procurement processes and the granting of this consent application. It is anticipated that Phase 3 of the decommissioning will take up to 150 days to allow for operational constraints, and/or weather downtime.

As part of this consent application, MBIE is proposing to undertake post-decommissioning monitoring in order to monitor the recovery of the benthic environment following the disturbances associated with the decommissioning activities. This recovery will be determined by comparing the state of the environment following decommissioning to that observed prior to the activities taking place. This pre-decommissioning monitoring will be completed under the Exclusive Economic Zone and Continental Shelf (Environmental Effects – Permitted Activities) Regulations 2013.

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An Impact Assessment Area (**IAA**) has been defined, which encapsulates all of the SSI and wells subject to P&A activities, to form the spatial basis of the assessment of effects within the consent application. The IAA enables a detailed and comprehensive understanding of the receiving environment, which is formed by environmental studies to enable a robust Environmental Risk Assessment (**ERA**) process to be completed for the proposed activities.

MBIE has identified persons with an existing interest, as defined by section 4 of the EEZ Act, in this consent application. This process has focused the consultation efforts of MBIE, which has included engaging Te Kāhui o Taranaki, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi to prepare a Cultural Impact Assessment in order to assess the actual and potential effects on their existing interests that may result from the decommissioning of the Tui field. In addition to this, MBIE has obtain the written approval from one further person with existing interest, namely David Ian Ruscoe and Malcolm Russell Moore, being the Liquidators of TTL (in Receivership and in Liquidation), Stewart Petroleum Co Limited (in Receivership and in Liquidation), and W M Petroleum Limited (in Receivership and in Liquidation) as seen in **Appendix I**.

This consent application includes an ERA which has been undertaken to identify and evaluate the potential effects from the decommissioning of the Tui field based on a likelihood and consequence approach. When considering the effects on the environment and persons with existing interests, the following elements were found to influence the overall risk associated with the activity:

- The decommissioning of the Tui field will be conducted to ensure all risks to the environment are managed to as low as reasonably practicable through the adoption of an extensive suite of control measures, design considerations and operational procedures;
- The decommissioning activities will occur over a short period of time, and be temporary in nature, with any potential effects from these activities only occurring during that short timeframe;
- The P&A of the wells within the Tui field will be undertaken in accordance with industry good practice, with the OGUK Well Decommissioning Guidelines (OGUK, 2018) being the most widely accepted guidelines for well abandonments;
- Any discharge of harmful substances from the proposed activities will be intermittent and will stop once sufficient mixing has occurred, which is expected to occur rapidly, so any potential effect would be short-term; and
- Potential effects from the decommissioning of the Tui field will be monitored as per the Environmental Monitoring Plan which will outline the post-decommissioning monitoring required.

Based on the above, the overall risk of adverse effects (including cumulative effects) on the environment and persons with existing interests from the decommissioning of the Tui field is assessed as ***moderate***, with the predicted magnitude of environmental effect being, at worst, ***minor***. That is, while there is a reasonable prospect of some adverse effects occurring, they are likely to be small-scale and temporary.

MBIE has prepared a set of proffered conditions which are included within **Appendix A**. This set of conditions has been based on conditions imposed by the Environmental Protection Authority (**EPA**) on oil and gas operators in New Zealand, where relevant to this consent application, with some additions specific to the context of the consents now sought.

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This consent application has addressed the matters set out in sections 39, 59, 60 and 61 of the EEA Act as summarised in **Table 1** to **Table 4**.

Based on the information presented in this consent application, it is considered that the proposed decommissioning of the Tui field is consistent with the purpose of the EEZ Act (as expressed in section 10) – being the sustainable management of the natural resources of the Exclusive Economic Zone (**EEZ**) and protection of the environment from pollution.

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Table 1 Section 39 legislative requirements

Section 39 of the EEZ Act	How this Requirement is Met
(1) An impact assessment must –	
(1)(a) – describe the activity (or activities) for which consent is sought; and	This consent application seeks the authorisation of various activities associated with the decommissioning of the Tui field, including activities restricted by section 20 and 20B of the EEZ Act. A full description of the activities for which consent is sought is included within **Section 2** of this consent application.
(1)(b) – describe the current state of the area where it is proposed that the activity will be undertaken and the environment surrounding the area; and	The decommissioning of the Tui field will be undertaken within PMP 38158, located ~50 km west off the Taranaki coastline in a water depth of approximately 120 m. An IAA has been defined in order to delineate the study area, and to assess the impacts associated with the decommissioning of the Tui field. This IAA has been developed to encompass the Tui Protected Area specified in the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 and the exploration wells which are subject to P&A activities, with a 1,500 m buffer around all wells associated with the decommissioning activities. **Section 4** contains a detailed description of the current state of the physical environment, biological environment, cultural environment and the socio-economic environment within and surrounding the IAA.
(1)(c) – identify persons whose existing interests are likely to be adversely affected by the activity; and	As assessment has been undertaken to identify any persons whose existing interests who are likely to be adversely affected by this consent application; this assessment is contained within **Section 5**.
(1)(d) – identify the effects of the activity on the environment and existing interests (including cumulative effects and effects that may occur in New Zealand or in the sea above or beyond the continental shelf beyond the outer limits of the Exclusive Economic Zone); and	An ERA has been undertaken in **Section 7** as part of this Impact Assessment (**IA**) to identify the effects of the activities on the environment and existing interests, including cumulative effects and effects that may occur in New Zealand or in the sea above or beyond the continental shelf beyond the outer limits of the EEZ.

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Section 39 of the EEZ Act	How this Requirement is Met
(1)(e) – identify the effects of the activity on the biological diversity and integrity of marine species, ecosystems, and processes; and	In order to identify the effects of the proposed activities on the biological diversity and integrity of marine species, ecosystems, and processes, the ERA contained within **Section 7** of this application has been split into various sections based on the methods in which the activities may result in potential adverse effects, each of which have assessed the potential effects on the relevant receptors in the environment. The overall conclusion of these sections is that the risks to the receptors from the activities proposed as part of the decommissioning of the Tui field are, at worst, ***moderate***, with an associated magnitude of environmental effect of ***minor***.
(1)(f) – identify the effects of the activity on rare and vulnerable ecosystems and habitats of threatened species; and	An assessment of the effects of the proposed decommissioning of the Tui field on rare and vulnerable ecosystems and habitats of threatened species is contained throughout **Section 7**. As outlined above in relation to section 39(1)(e), the overall conclusion of **Section 7** is that the risks to the receptors from the proposed decommissioning activities are, at worst, ***moderate***, with an associated magnitude of environmental effect of ***minor***.
(1)(g) – describe any consultation undertaken with persons described in paragraph (c) and specify those persons who have given written approval to the activity; and	MBIE has engaged with the persons identified as having an existing interest under section 39(1)(c) as outlined within **Section 5**. As part of this engagement, a written approval approval has been provided by David Ian Ruscoe and Malcolm Russell Moore, the Liquidators of TTL (in Receivership and in Liquidation), Stewart Petroleum Co Limited (in Receivership and in Liquidation), and W M Petroleum Limited (in Receivership and in Liquidation). As per section 59(5)(c) of the EEZ Act, the Marine Consent Authority must not have regard to any effects on a person's existing interest if the person has given written approval to the proposed activity.
(1)(h) – include copies of any written approvals to the activity; and	As described above, a written approval has been provided by David Ian Ruscoe and Malcolm Russell Moore, being the Liquidators of TTL, Stewart Petroleum Co Limited, and W M Petroleum Limited. This written approval has been provided within **Appendix I** of this consent application.
(1)(i) – specify any possible alternative locations for, or methods for undertaking, the activity that may avoid, remedy, or mitigate any adverse effects; and	Due to the nature of the proposed activities, that being the decommissioning of the Tui field, there are no alternative locations for undertaking the proposed activities. However, possible alternative methods for undertaking the specific activities associated with the decommissioning of the Tui field have been considered by MBIE, as discussed in detail within **Section 8**.

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Section 39 of the EEZ Act	How this Requirement is Met
(1)(j) – specify the measures that could be taken to avoid, remedy, or mitigate the adverse effects identified (including measures that the applicant intends to take).	Various mitigation measures will be implemented throughout the decommissioning of the Tui field to avoid, remedy, or mitigate potential adverse effects on the environment and existing interests, a summary of which can be seen in **Section 7.9**.
(2) An impact assessment must also, –	
(2)(a) – if it relates to an application for a Marine Discharge Consent, describe the effects of the activity on human health	The pathways for the proposed marine discharge consent activities to affect human health have been assessed within **Section 7.5**.
(2)(b) – if it relates to an application for a Marine Dumping Consent, – (i) describe the effects of the activity on human health; and (ii) specify any practical opportunities to reuse, recycle, or treat the waste or other matter:	As this application is not for a marine dumping consent, section 39(2)(b) is not applicable.
(2)(c) – if it relates to any other application, describe the effects on human health that may arise from the effects of the activity on the environment.	This consent application includes a marine consent, and as such, an assessment of effects on human health that may arise from the effects of the activity on the environment has been undertaken, which is detailed within **Section 7.5**.
(3) – An impact assessment must contain the information required under subsections (1) and (2) in –	
(3)(a) – such detail as corresponds to the scale and significance of the effects that the activity may have on the environment and existing interests; and	This IA has been prepared with consideration given to the scale and significance of the potential effects from the decommissioning of the Tui field on the environment and existing interests, and the detail within this IA addressing the information required under sections 39(1) and (2) has taken this into account.

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Section 39 of the EEZ Act	How this Requirement is Met
(3)(b) – sufficient detail to enable the Environmental Protection Authority and persons whose existing interests are or may be affected to understand the nature of the activity and its effects on the environment and existing interests.	This IA has been prepared to provide sufficient detail, as corresponds to the scale and significance of the potential effects from the decommissioning of the Tui field, to enable the EPA and those persons who have existing interests to understand the nature of the activity (**Section 2**) and its effects on the environment and existing interests (**Section 7**).
(4) – The impact assessment complies with subsections (1)(c) to (f) and (2) if the Environmental Protection Authority is satisfied that the applicant has made a reasonable effort to identify the matters described in those provisions.	MBIE has made all reasonable efforts to provide the information required in sections 39(1)(c) to (f) and 39(2) by utilising the best available information, including the most recent studies aimed at describing the existing environment (**Section 4**) and identifying existing interests (**Section 5**) in order to assess the potential effects from the proposed decommission of the Tui field on these matters (**Section 7**). Therefore, it is considered that the EPA can be satisfied that MBIE has made all reasonable effects to identify the matters described on those provisions.
(5) – The measures that must be specified under subsection (1)(j) include any measures required by another marine management regime and any measures required by or under the Health and Safety at Work Act 2015 that may have the effect of avoiding, remedying, or mitigating the adverse effects of the activity on the environment or existing interests.	An assessment of other marine management regimes has been undertaken within **Section 3.4** to outline any measures that may have the effect of avoiding, remedying or mitigating the adverse effects from the decommissioning of the Tui field on the environment or existing interests.

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Table 2 Section 59 considerations

Section 59 of the EEZ Act	How this Requirement is Met
(2) – If the application relates to a section 20 activity (other than an activity referred to in section 20(2)(ba)), a Marine Consent Authority must take into account –	
(2)(a) – any effects on the environment or existing interests of allowing the activity, including – (i) cumulative effects; and (ii) effects that may occur in New Zealand or in the waters above or beyond the continental shelf beyond the outer limits of the exclusive economic zone; and	As outlined within **Table 1**, an ERA (included within **Section 7**) has been undertaken as part of this application which identifies the effects of the decommissioning of the Tui field on the environment and existing interests, including an assessment on the potential cumulative effects (**Section 7.8**). The overall conclusion of **Section 7** is that the risks to the receptors from the decommissioning of the Tui field are, at worst, ***moderate***, with an associated magnitude of environmental effect of ***minor***.
(2)(b) – the effects on the environment or existing interests of other activities undertaken in the area covered by the application or in its vicinity, including – (i) the effects of activities that are not regulated under this Act; and (ii) effects that may occur in New Zealand or in the waters above or beyond the continental shelf beyond the outer limits of the Exclusive Economic Zone; and	Other users utilise the wider offshore Taranaki area, including for fishing (both commercial and recreational), shipping and other oil and gas activities (as detailed within **Section 4.5**); although, these activities are dispersed over a wide area. The cumulative effects section of this IA (**Section 7.8**) includes an assessment against these activities that are not regulated under the EEZ Act. In addition to the above, **Section 7.6** provides an assessment on the potential effects that may occur outside of the EEZ from the decommissioning of the Tui field as required by section 59(2)(b)(ii). Due to the highly localised area of the proposed activities, the summary of **Section 7.6** is that magnitude of environment effects from the decommissioning of the Tui field occurring outside of the EEZ is predicted to be ***negligible***.
(2)(c) – the effects on human health that may arise from effects on the environment; and	The potential effects on human health that may arise from effects on the environment has been included within the discussion contained in **Section 7.5**.
(2)(d) – the importance of protecting the biological diversity and integrity of marine species, ecosystems, and processes; and	A detailed description of the existing environment within and surrounding the IAA is contained within **Section 4**, and an ERA has been undertaken to determine the potential impacts on this existing environment throughout **Section 7**. Contained within these sections is information relating to the biological diversity and integrity of marine species, ecosystems, and processes within and surrounding the IAA.

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Section 59 of the EEZ Act	How this Requirement is Met
	It is considered that the most direct impact from the decommissioning of the Tui field on biological diversity and integrity of marine species, ecosystems and processes relates to the removal of artificial hard substrate (i.e. the SSI, wellheads and Xmas Trees) which is assessed in detail within **Section 7.2.3.3**. The removal of this artificial hard substrate will directly impact those species which have colonised the infrastructure. A survey by a Remotely Operated Vehicle (**ROV**) was undertaken in December 2020 to determine the 'as-standing' condition of the infrastructure and also to determine whether any biological communities might be present. The 2020 ROV Survey described the SSI as a biodiversity 'hotspot' relative to the surrounding featureless sediments; however, noted that biological assemblages observed were typical to those observed on other offshore Taranaki infrastructure. The 2020 ROV Survey report noted that removal of SSI from the Tui field will result in a net loss of overall biodiversity in the area, relative to its current state which is expected with the removal of artificial hard substrate in an otherwise featureless seabed; however, no sensitive environments or protected species were present on the SSI. Although the removal of artificial hard substrate will impact on the biological diversity associated with the infrastructure, the removal of this infrastructure will effectively return the surrounding environment to its original state prior to the installation of the Tui field. It is considered that returning this area back to its original state, along with the other positive impacts of removing the infrastructure (**Section 7.7**) outweighs the loss of biodiversity associated with the decommissioning of the Tui field. Overall, the environmental risk of adverse impacts has been assessed within **Section 7.2.3.3** as ***moderate***, and the resultant magnitude of environment effects was predicted to be ***minor***.
(2)(e) – the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species; and	Similar to section 59(2)(d) discussed above, any potential rare and vulnerable ecosystems and habitats of threatened species have been identified within the existing environment section (**Section 4**), in particular **Section 4.3.3** identifies potential sensitive environments and protected species located within the IAA. Although the term 'sensitive environments' is not a term used in the provisions of the EEZ Act relevant to this application (i.e. because the Exclusive Economic Zone and Continental Shelf (Environmental Effects—Permitted Activities) Regulations 2013 do not apply here), the term has been used in the past, including by the EPA, to describe rare and vulnerable ecosystems and habitats of threatened species in relation to the benthic environment. An example of this concept can be seen in the conditions of EEZ400011 for the Ports of Auckland Limited Marine Dumping Consent which utilised the meaning given to sensitive environments as a definition of rare and vulnerable ecosystems and habitats of threatened species.

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Section 59 of the EEZ Act	How this Requirement is Met
	An assessment of potential impacts on these environments has been included within the ERA (**Section 7**). The overall conclusion of **Section 7** is that the risks to the receptors from the decommissioning of the Tui field are, at worst, ***moderate***, with an associated magnitude of environmental effect of ***minor***.
(2)(f) – the economic benefit to New Zealand of allowing the application; and	An assessment of the economic benefit of the decommissioning of the Tui field has been provided within **Section 6**.
(2)(g) – the efficient use and development of natural resources; and	As discussed within **Section 2.1**, the Tui field commenced production in July 2007, and ceased in November 2019. During the life of the field, over $NZ400 million had been invested, as detailed within decision for development drilling in the Tui field EEZ100016. While this consent application does not specifically provide for the use and development of natural resources, due to the activity being applied for, it is considered it is an integral aspect of the wider Tui field, which has efficiently used and developed the natural resources.
(2)(h) – the nature and effect of other marine management regimes; and	An assessment of the relevant marine management regimes has been undertaken within **Section 3.4**, including the identification of any provisions within these regimes which will provide additional measures to avoid, remedy or mitigate adverse effects from the activities associated with the decommissioning of the Tui field.
(2)(i) – best practice in relation to an industry or activity; and	MBIE is committed to following industry best practice and will comply with these requirements as appropriate for all operations. An example of this is discussed within **Section 2.4.5**, which details the utilisation of a Blowout Preventor (**BOP**) to prevent the uncontrolled flow of liquids and gases during well operations that is capable of being remotely controlled. The BOP will be compliant with the American Petroleum Institute's Standard 53 "Well Control Equipment Systems for Drilling Wells" which is recognised as industry best practice. In addition, a BOP tethering system, which are now recognised as best practice when intervening on existing facilities, will be utilised which reduces BOP movement and alleviates stress and fatigue on the existing infrastructure

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Section 59 of the EEZ Act	How this Requirement is Met
	It is also necessary to consider not only New Zealand regulatory requirements, but also best practice from overseas countries where subsea oil field decommissioning activities are further advanced (e.g. the United Kingdom and Norway). As outlined within **Section 8.3**, WorkSafe New Zealand's Interpretive Guidelines – Petroleum: Well Operations and Well Examination Schemes (WorkSafe, 2017) do not prescribe specific standards for P&A; however, wells should be abandoned in line with internationally accepted good practice, incorporating continual improvement in practices and technology. Currently, the OGUK Well Decommissioning Guidelines (OGUK, 2018) are the most widely accepted guidelines for well abandonments, and as such, have been chosen for the decommissioning of the Tui field. The well abandonment design must also be approved by an independent well examiner.
(2)(j) – the extent to which imposing conditions under section 63 might avoid, remedy, or mitigate the adverse effects of the activity; and	A set of draft conditions is proffered within **Appendix A** which have been developed in accordance with section 63 of the EEZ Act and will provide further assurances that adverse effects from the activities associated with this consent application will be avoided, remedied or mitigated.
(2)(k) – relevant regulations (other than EEZ policy statements); and	The relevant regulations and applicable laws to this consent application have been discussed within **Section 3.4**.
(2)(l) – any other applicable law (other than EEZ policy statements); and	
(2)(m) – any other matter the Marine Consent Authority considers relevant and reasonably necessary to determine the application.	It is considered there are no other matters relevant to this application that have not already been covered in this IA.
(2A) – If the application is for a Marine Discharge Consent, the EPA must take into account –	
(2A)(a) – the matters described in subsection (2), except paragraph (c); and	The matters within section 59(2) have all been discussed in detail above, and within the relevant sections of the IA
(2A)(b) – the effects on human health of the discharge of harmful substances if consent is granted.	The potential effects on human health of the discharge of harmful substances if consent is granted is discussed within **Section 7.5**.

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Section 59 of the EEZ Act	How this Requirement is Met
(2B) – If the application is for a marine dumping consent or relates to an activity referred to in section 20(2)(ba), the EPA must take into account—	
(2B)(a) – the matters described in subsection (2), except paragraphs (c), (f), (g), and (i); and	Section 59(2B) is not relevant to this consent application.
(2B)(b) – the effects on human health of the dumping of waste or other matter, or the abandonment of the pipeline, if consent is granted; and	
(2B)(c) – any alternative methods of disposal of the waste, other matter, or pipeline that could be used; and	
(2B)(d) – whether there are practical opportunities to reuse, recycle, or treat the waste, other matter, or pipeline.	
(3) – the Marine Consent Authority must have regard to –	
(3)(aa) – EEZ policy statements; and	There are no relevant EEZ policy statements available at the time of drafting this consent application.
(3)(a) – any submissions made and evidence given in relation to the application; and	Section 59(3)(a) is not discussed within this application as the content of any submissions and evidence is not currently known for this application.
(3)(b) – any advice, reports, or information sought under this Part and received in relation to the application; and	Section 59(3)(b) is not discussed within this application as the content of any advice, reports or information sought is not currently known for this application.
(3)(c) – any advice received from the Māori Advisory Committee.	Section 59(3)(c) is not discussed within this application as the content of any advice received from the Māori Advisory Committee is not currently known for this application.

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Section 59 of the EEZ Act	How this Requirement is Met
(4) – When considering an application affected by section 74, the Marine Consent Authority must also have regard to the value of the investment in the activity of the existing consent holder.	Section 59(4) is not relevant to this consent application.
(5) – Despite subsection (3), the marine consent authority must not have regard to -	
(5)(a) – trade competition or the effects of trade competition; or	Trade competition, or the effects of trade competition, and the effects on climate change of discharging greenhouse gases into the air have not been discussed within this application as they are outside the scope of this application and the Marine Consent Authority must not have regard to them. A written approval has been provided by David Ian Ruscoe and Malcolm Russell Moore, being the Liquidators of TTL, Stewart Petroleum Co Limited, and W M Petroleum Limited. This written approval has been provided within **Appendix I** of this consent application.
(5)(b) – the effects on climate change of discharging greenhouse gases into the air; or	
(5)(c) – any effects on a person's existing interest if the person has given written approval to the proposed activity.	
(6) – Subsection (5)(c) does not apply if the person has given written approval by the person withdraws the approval by giving written notice to the Marine Consent Authority -	The written approval provided by David Ian Ruscoe and Malcolm Russell Moore, being the Liquidators of TTL, Stewart Petroleum Co Limited, and W M Petroleum Limited, has not been withdrawn at the time of lodgement.
(6)(a) – before the date of the hearing, if there is one; or	
(6)(b) – if there is no hearing, before the Marine Consent Authority decides the application.	

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Table 3 Section 60 considerations

Section 60 of the EEZ Act	How this Requirement is Met
In considering the effects of an activity on existing interests under section 59(2)(a), a marine consent authority must have regard to –	
(a) – the area that the activity would have in common with the existing interest; and	An assessment of the person(s) that have an existing interest in relation to this application has been undertaken within **Section 5,** which has identified five persons that have an existing interest. One of those parties with an existing interest in the Tui field has provided a written approval (the Liquidators of PMP 38158) and as per section 59(5)(c), the Marine Consent Authority must not have regard to any effects on a person's existing interest if that person has provided a written approval to the proposed activity. For the other parties with existing interests, an assessment of the effects from the proposed activity on these persons with an existing interest is included within **Section 7.4.2** (Taranaki iwi) and **Section 7.4.3** (commercial fishing).
(b) – the degree to which both the activity and the existing interest must be carried out to the exclusion of other activities; and	
(c) – whether the existing interests can be exercised only in the area to which the application relates; and	
(d) – any other relevant matter.	

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Table 4 Section 61 considerations

Section 61 of the EEZ Act	How this Requirement is Met
(1) When considering an application for a marine consent, a marine consent authority must –	
(1)(a) – make full use of its powers to request information from the applicant, obtain advice, and commission a review or a report; and	Should the EPA see the need for any additional information in relation to this application, MBIE will respond in due course.
(1)(b) – base decisions on the best available information; and (1)(c) – take into account any uncertainty or inadequacy in the information available.	MBIE has made all reasonable efforts to provide the information required by utilising the best available information, including the most recent studies aimed at describing the existing environment (**Section 4**) and identifying existing interests (**Section 5**) in order to assess the potential effects from the proposed decommissioning of the Tui field on these matters (**Section 7**). Any uncertainties associated with this consent application do not mean that the assessments and conclusions within this application are uncertain or inadequate. Rather, the approach taken in the preparation of this consent application has enabled the appropriate assessments of potential effects on the environment and existing interests to be made so that the requirement to favour caution does not arise. This approach has involved using worst-case scenario assumptions to account for any possible uncertainty. Further, the information presented in this consent application is the best available information without unreasonable cost, effort or time.
(2) – If, in relation to making a decision under this Act, the information available is uncertain or inadequate, the Marine Consent Authority must favour caution and environmental protection.	As discussed in relation to section 61(1)(b) of the EEZ Act above, it is considered that the information provided within this application is the best information available at the time of submission and provides a robust basis for the EPA to make its decision.
(3) – If favouring caution and environmental protection means that an activity is likely to be refused, the Marine Consent Authority must first consider whether taking an adaptive management approach would allow the activity to be undertaken.	This subsection is not discussed in this application.

EXECUTIVE SUMMARY

Section 61 of the EEZ Act	How this Requirement is Met
(4) – subsection (3) does not -	
(4)(a) – apply to an application for – (i) a Marine Dumping Consent or (ii) a Marine Discharge Consent; or (iii) a Marine Consent in relation to an activity referred to in section 20(2)(ba); or	This subsection is not discussed in this application.
(4)(b) - limit section 63 or 64	This subsection is not discussed in this application.
(5) – in this section, best available information means the best information that, in the particular circumstances, is available without unreasonable cost, effort, or time.	As discussed in relation to section 61(1)(b) of the EEZ Act above, it is considered that the information provided within this application is the best information available at the time of submission.

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APPENDICES

ABBREVIATIONS AND DEFINITIONS

ALARP	As Low as Reasonably Practicable
BOP	Blowout Preventer
BWU	BW Umuroa Pte Limited
CIA	Cultural Impact Assessment
CMA	Coastal Marine Area
CRMS	Craft Risk Management Standard – Biofouling on Vessels Arriving to New Zealand
CSV	Construction Support Vessel
CT	Coil Tubing
D&D Regulations	Exclusive Economic Zone and Continental Shelf (Environmental Effects – Discharge and Dumping) Regulations 2015
Decommissioning Regulations	Draft Exclusive Economic Zone and Continental Shelf (Environmental Effects – Decommissioning) Regulations
DOC	Department of Conservation
DP	Dynamic Positioning
EEZ Act	Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012
EEZ	Exclusive Economic Zone

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EFL	Electrical Flying Lead
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Authority
ERA	Environmental Risk Assessment
FMA	Fisheries Management Area
FNZ	Fisheries New Zealand
GB	Gravity Base
GBA	Gravity Base Anchor
GHS 7	United Nations Globally Harmonised System of Classification and Labelling of Chemicals, 7th revised edition, 2017
GLJ	Gas-lift Jumper
GLM	Gas-lift Manifold
HFL	Hydraulic Flying Lead
IA	Impact Assessment
IAA	Impact Assessment Area
IHS	Import Health Standard: Ballast Water from All Countries
IL	Intervention Lubricator
IMMA	Important Marine Mammal Area
IRS	Intervention Riser System
MACA	Marine and Coastal Area (Takutai Moana) Act 2011
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam Echo Sounder
MBIE	Ministry of Business, Innovation and Employment
MMR	Marine Management Regime
MMPR	Marine Mammal Protection Regulations 1992
MODU	Mobile Offshore Drilling Unit
MPB	Microphytobenthos
MPI	Ministry for Primary Industries
MWA	Mid-Water Arch
NM	Nautical Mile
OSCP	Oil Spill Contingency Plan
P&A	Plugging and Abandoning
PAH	Polycyclic Aromatic Hydrocarbons
Permitted Activities Regulations	Exclusive Economic Zone and Continental Shelf (Environmental Effects – Permitted Activities) Regulations 2013
PMP 38158	Petroleum Mining Permit 38158
ppm	Parts Per Million
PRCP	Proposed Regional Coastal Plan for Taranaki

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PSU	Practical Salinity Units
PTS	Permanent Threshold Shift
QMS	Quota Management System
RMA	Resource Management Act 1991
ROV	Remotely Operated Vehicle
SDU	Subsea Distribution Unit
SSI	Subsea Infrastructure
The CoA Decision	The Court of Appeal Decision
The FPSO	Floating Production Storage and Offloading vessel '*Umuroa*'
The Notice	Hazardous Substances (Hazard Classification) Notice 2020
The Rules	Government Procurement Rules
The Tui field	The Tui Oil Field
TPH	Total Petroleum Hydrocarbon
TRC	Taranaki Regional Council
TTL	Tamarind Taranaki Limited
TTRL	Trans-Tasman Resources Limited
TTS	Temporary Threshold Shift
UTA	Umbilical Termination Assembly
WCNI MMS	West Coast North Island Marine Mammal Sanctuary
WIV	Well Intervention Vessel
Xmas Tree	Christmas Tree – an assembly containing piping and values that is installed on a wellhead to allow flow control and well intervention

1 Introduction

1.1 Purpose of the Application

The Tui oil field (**the Tui field**) is located within New Zealand's Exclusive Economic Zone (**EEZ**), approximately 50 km off the Taranaki coast – its location is shown in **Figure 1**.

Tamarind Taranaki Limited (**TTL**) – permit operator of the Tui field – was placed in receivership and liquidation in December 2019. The liquidators disclaimed the Tui subsea assets to the Crown on 28 April 2020 and the Ministry of Business, Innovation and Employment (**MBIE**), on behalf of the Crown, commenced work to decommission the Tui field.

In January 2020 MBIE sent a letter of intent to Environmental Protection Authority (**EPA**) confirming plans to lodge an application for a marine consent under section 20 of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (**EEZ Act**) for decommissioning of the Tui field.

Decommissioning is planned to be undertaken in three phases:

- Phase 1 – disconnection and demobilisation of the floating production storage and offloading vessel '*Umuroa*' (**the FPSO**) – completed in May 2021;
- Phase 2 – removal of Subsea Infrastructure (**SSI**); and
- Phase 3 – plug and abandonment (**P&A**) of Tui wells.

The proposed activities associated with Phases 2 and 3 include some that are restricted by the EEZ Act, and therefore the reason for this application.

1.2 Structure of the Application

Section 2 presents information on the proposed decommissioning activities which are subject to this application.

Section 3 describes the legislative framework that this Impact Assessment (**IA**) has been prepared in accordance with and explains how all relevant regulatory requirements will be complied with.

Section 4 describes the existing environment in and around the Tui field; including the physical, biological, cultural, and socio-economic environments.

Section 5 presents information on the persons with existing interests in the Tui field as well as the engagement process that MBIE has undertaken.

Section 6 describes the potential economic benefits of allowing the application.

Section 7 details the Environmental Risk Assessment (**ERA**) component of the IA. This section describes the nature of the activities that are the subject of this application and the associated potential effects on the environment and persons with existing interests, taking into account the measures to avoid, remedy, or mitigate effects of the proposed activity.

Section 8 outlines the consideration of alternatives to the activities proposed within this marine consent application.

Section 9 provides a commentary on the conditions proffered by MBIE, which are themselves contained within **Appendix A**.

Section 10 presents the conclusions of the IA.

Section 11 lists the references cited in this document.

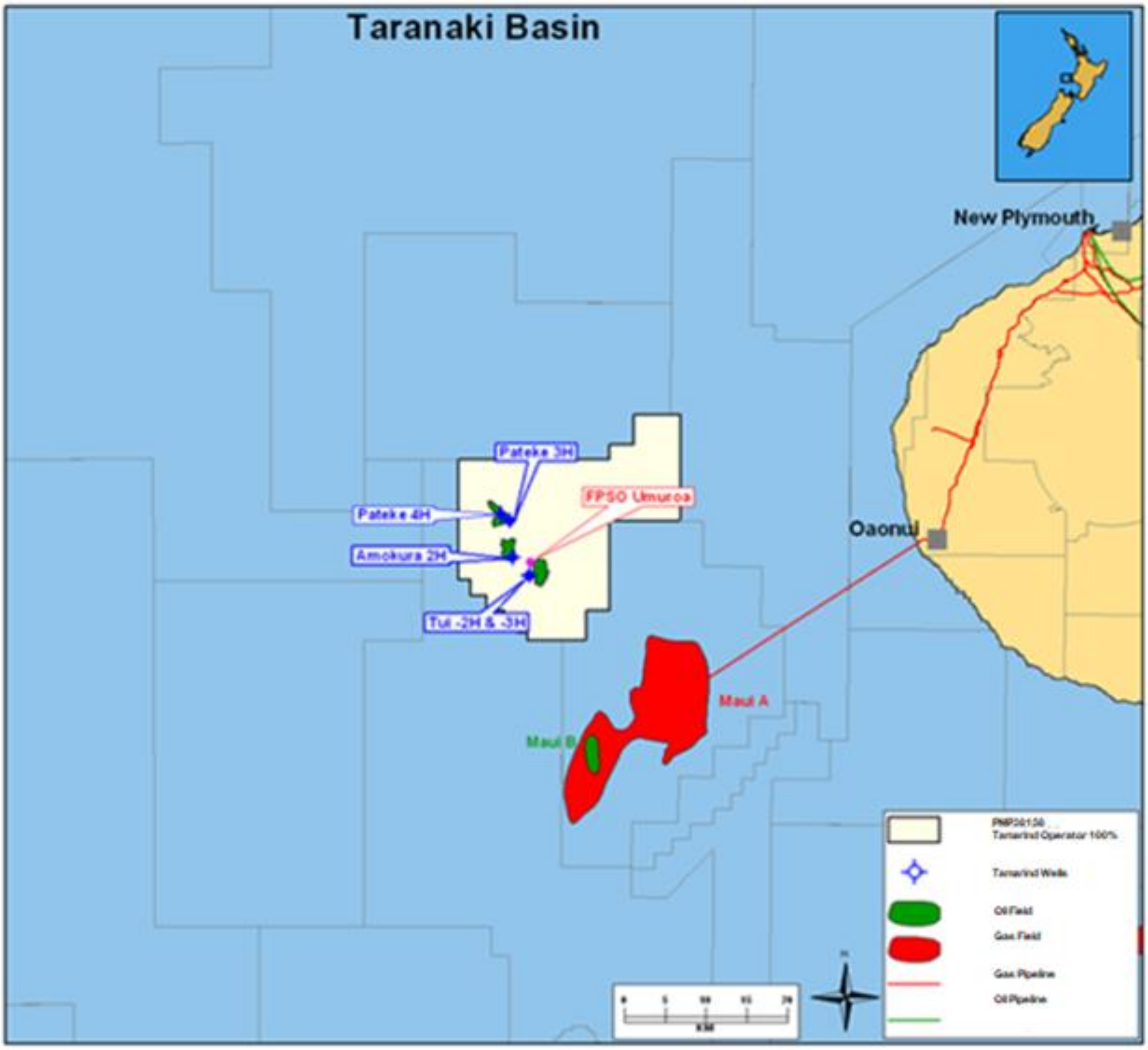
There are several appendices (**Appendix A** to **Appendix J**) which contain reports and information that have been utilised throughout this consent application.

2 Activity Description

2.1 Description of the Tui Field

The Tui field is located within New Zealand's EEZ, ~50 km west off the Taranaki coastline in a water depth of approximately 120 m as seen in **Figure 1**. Three separate oil accumulations have been developed in the Tui field, Tui, Amokura, and Pateke, with production commencing in July 2007.

Figure 1 Tui field location



Production operations ceased in November 2019, and in April 2020 following Tui field operator, TTL, being placed in receivership and liquidation, the New Zealand Crown assumed responsibility for the decommissioning of the Tui field. This responsibility was delegated to MBIE.

Decommissioning of the Tui field is planned to be undertaken in three phases:

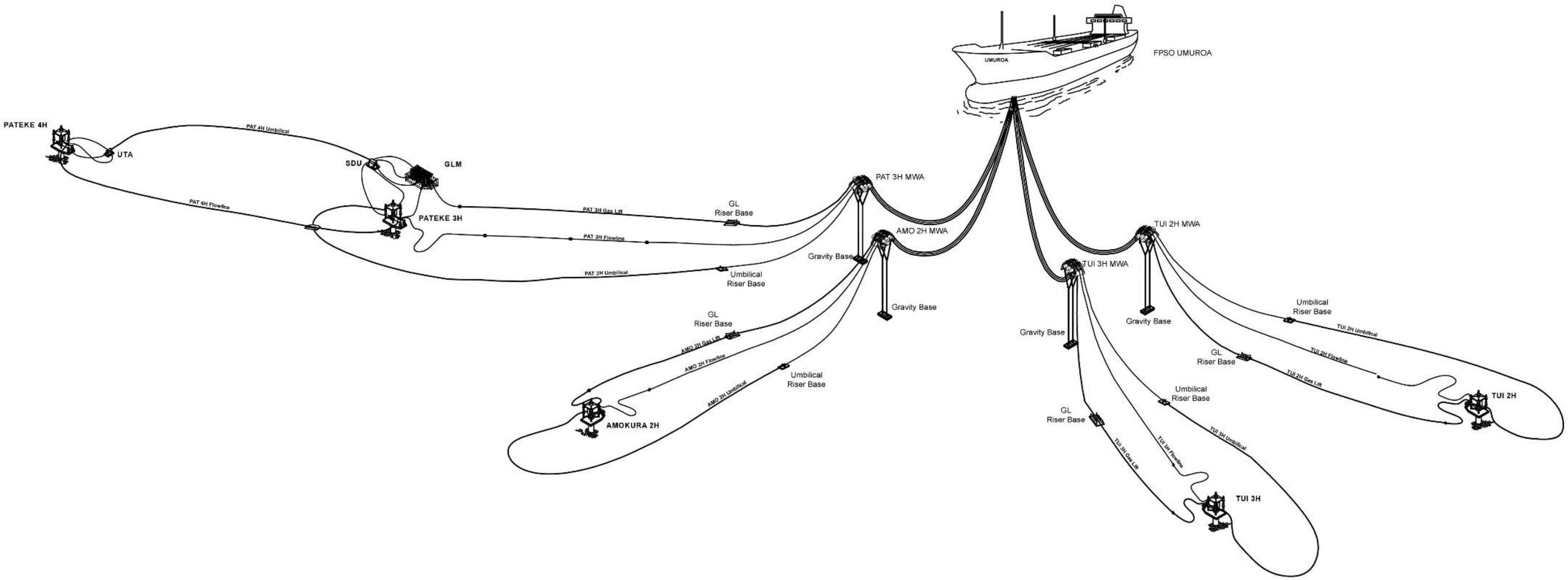
- Phase 1 – disconnection of the FPSO from the SSI and retrieval of the FPSO's anchors – this phase was completed on 5 May 2021;
- Phase 2 – removal of the SSI; and
- Phase 3 – P&A of wells.

The Tui field was a subsea development, utilising five horizontal subsea completions with the wells and SSI tied back via flexible production and gas-lift flowlines to the FPSO (**Figure 2**).

The Tui field SSI (referred to throughout this marine consent) consists of the following:

- Production Flowlines: large diameter (~350 mm) flexible pipeline(s) used to convey production fluids (oil, gas and water) from the wells to the FPSO;
- Umbilicals: smaller diameter (~150 mm) lines which are used to control valves at the subsea Christmas Tree (**Xmas Tree**) (electrically and hydraulically) and to inject chemicals into the well;
- Gas-lift lines (including gas-lift Coil Tubing (**CT**)): smaller diameter (~135 mm) pipeline(s) into which gas was pumped from the FPSO, with this gas entering the well to aid transport of production fluids from the well;
- Risers: those parts of the lines between the seabed and the FPSO, including where they are suspended in the water column and on the Mid-water Arches (**MWA**);
- Umbilical and gas-lift riser bases: these riser bases provide stability to prevent axial movement of these lines;
- MWA: the MWA provides support to the flexible risers and umbilicals that connect to the FPSO in order to absorb the motions of the FPSO. Each MWA is attached to a Gravity Base (**GB**) via two mooring legs (a tether system composed of 56 mm studless chain);
- Gravity Base Anchors (**GBA**): Four gravity base anchors surrounding the Amokura-2H well, which were installed to stabilise the BOP during the 2019 drilling campaign and remain on the seabed;
- Production riser hold-back anchors: these hold-back anchors prevent axial movement of these lines;
- Gas-lift Manifold (**GLM**): the GLM is located near the Pateke-3H Xmas Tree and is designed to distribute lift gas to Pateke-3H and Pateke-4H;
- Umbilical Termination Assembly (**UTA**): the UTA is located at the Pateke-4H wellhead and is the termination that mates with the incoming umbilical and the Pateke-4H Xmas Tree;
- Subsea Distribution Unit (**SDU**): the SDU is located at the Pateke-3H wellhead location and is a connector between the umbilical from the UTA and the GLM and Pateke-3H Xmas Tree. The SDU distributes hydraulic supplies, electrical power supplies and signals to the relevant SSI;
- Gas-lift Jumpers (**GLJ**): the gas-lift jumpers are a connecter/tie-in between the other subsea structures (in this case between the Pateke-3H wellhead, the GLM and the SDU, and between the Pateke-4H wellhead and the UTA); and
- Hydraulic Flying Leads (**HFL**) and Electrical Flying Leads (**EFL**): the HFLs and EFLs are the connecting cables between the other SSI at the Pateke-3H and Pateke-4H wellhead locations, including the SDU, UTA, GLM and the Xmas Trees.

Figure 2 General schematic layout of the Tui field



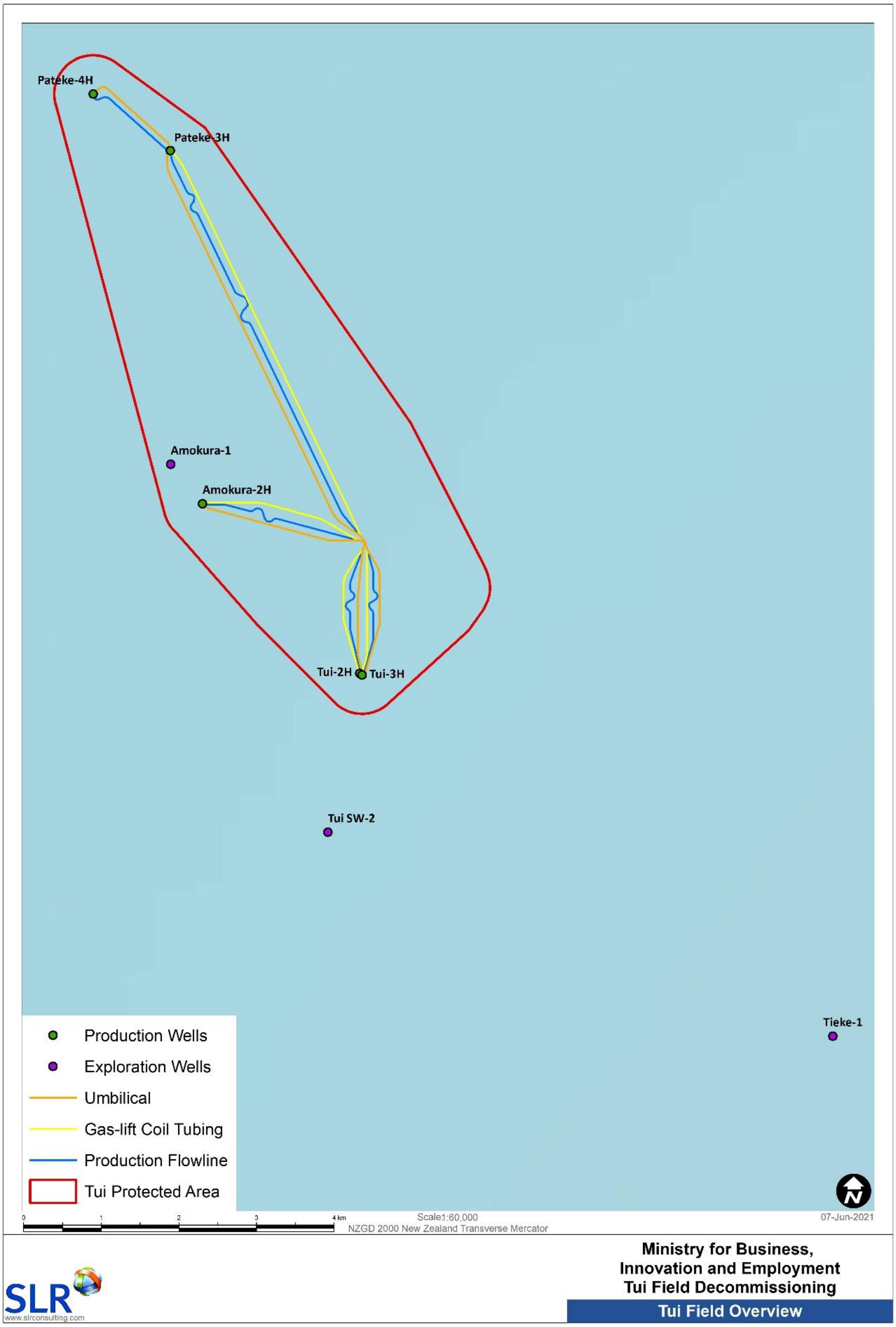
Note: The FPSO is no longer stationed at the Tui field. The risers have been laid on the seabed and will be removed as part of this marine consent application.

The Tui field subsea wells (**Figure 3**), that are subject to this consent application, consist of five production wells (four will be plugged and abandoned and one is already suspended and will be abandoned, i.e. removal of subsea wellhead) plus three suspended exploration wells which will be abandoned. These wells are as follows:

- Production wells:
  - Tui-2H;
  - Tui-3H (already suspended/plugged);
  - Amokura-2H;
  - Pateke-3H;
  - Pateke-4H;
- Exploration wells (all already suspended/plugged):
  - Tui-SW-2;
  - Tieke-1; and
  - Amokura-1

The Tui field also consists of other wells (Kiwi-1, Kahu-1, Tui-1, Pateke-1, Pateke-2, Taranui-1, Oi-1, and Oi-2) which have already been permanently plugged and abandoned, including removal of wellheads, and are therefore not part of the decommissioning of the Tui field.

Figure 3 Overview of the Tui field



2.2 Description of the Project Related Vessels, Drilling Unit and Equipment

The decommissioning of the Tui field will require the use of a variety of vessels, potentially a drilling unit, and the use of Remotely Operated Vehicles (**ROVs**) in order to complete the work in a safe and efficient manner, while reducing potential impacts on the environment as far as practicable. These are outlined below, with further discussions on each in the subsequent sections:

- A Construction Support Vessel (**CSV**) which will primarily be used during the field SSI deconstruction and recovery activities (**Section 2.2.1**);
- Support vessels which will assist in the recovery operations, including the transport of food, water, equipment, and personnel between the shore and the other vessels/units operating in the Tui field (**Section 2.2.2**);
- Either (or both) of the following vessels or unit, dependant on availability, capability and the contracts able to be obtained with MBIE:
  - A Mobile Offshore Drilling Unit (**MODU**) which may be utilised to undertake the P&A operations for the wells within the Tui field (**Section 2.2.3**); or
  - A Well Intervention Vessel (**WIV**) which may be utilised for the P&A operations (**Section 2.2.4**).
- ROVs which will be utilised heavily throughout the decommissioning of the Tui field – both for SSI deconstruction and P&A operations (**Section 2.2.5**).

MBIE has not yet contracted a specific MODU or WIV to undertake the P&A activities associated with the Tui field wells. MBIE will use either, a semi-submersible MODU or a WIV for the P&A activities. A description of both options is outlined in **Sections 2.2.3** and **2.2.4**.

Given the water depths at the well locations (~120 m) it is likely that a MODU will need to be moored, due to the requirement for a high level of position accuracy to be maintained. However, a WIV will not require the same position accuracy and therefore will utilise dynamic positioning (**DP**) to maintain its position. DP is a computer-controlled system that uses multiple independent reference and control systems to maintain a vessel's position by automatically adjusting the vessel's propellers and thrusters.

While a WIV may be used for the P&A activity, MBIE requires the flexibility to be able to use a MODU that maintains its position using a mooring system (an anchoring array consisting of anchors, chains, and wires). The final vessel/unit selection, including whether anchors/moorings will be used or not, will depend on the specific technical requirements and availability at the time when activity is planned to occur.

Use of a mooring system involves disturbance of the seabed by chains and/or anchors, which is restricted by section 20 of the EEZ Act and is therefore included in this marine consent application.

2.2.1 Construction Support Vessel

CSVs are multi-purpose offshore vessels which are utilised in the construction and maintenance of offshore structures, such as oil and gas platforms or marine renewable energy structures (such as wind turbines etc.). These vessels have been designed and built to support the construction (and in this case decommissioning) of offshore and subsea installations. The equipment on board a CSV generally includes a heave-compensated crane, ROVs, A-frames, winches and drums, all of which will be utilised during the retrieval of the SSI.

An example of a CSV that has been utilised in New Zealand waters, and in fact in relation to the demobilisation of the FPSO as part of the overall decommissioning of the Tui field, is the *Skandi Hercules*, shown in **Figure 4**.

Figure 4 Example of a CSV - the Skandi *Hercules*

The use of the CSV itself does not require marine consent as there will be no disturbance of the seabed from the vessel; however, the operations that it will be undertaking require marine consent and are discussed further in **Section 2.3**.

2.2.2 Support Vessels

Support vessels are critical in undertaking the Tui field SSI deconstruction and recovery activities. The support vessels will provide transportation of equipment and materials to and from the CSV, including the infrastructure retrieved from the seabed, to enable the CSV to stay on station as long as possible to reduce the time required to complete the activities.

In addition to the support these vessels provide to the CSV, they are instrumental in completing the decommissioning of the Tui field in a safe and efficient manner and reducing potential effects on the environment and existing interests. Support vessels (and helicopters) are required to transport food, water, equipment, and personnel between the shore and the MODU/WIV.

The use of support vessels (and helicopters) during the decommissioning activities does not necessitate a marine consent under the EEZ Act but has been described for the sake of completeness.

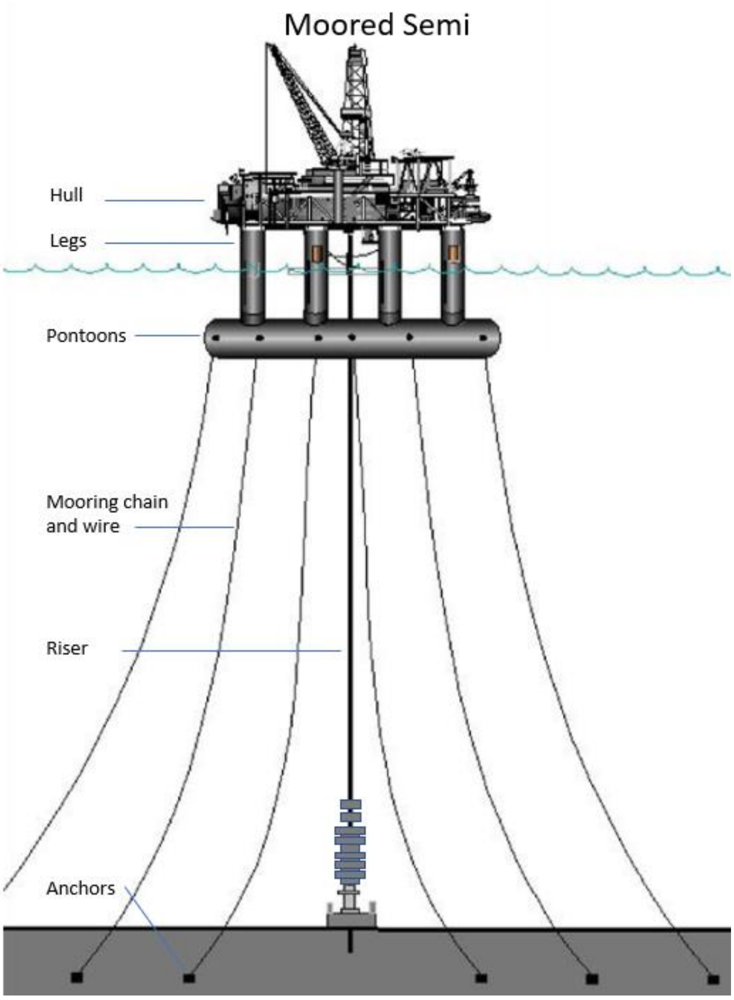
2.2.3 Semi-submersible MODU

A semi-submersible MODU (**Figure 5**) comprises a working deck that is supported by columns attached to pontoons that float in the water and support the hull. A semi-submersible MODU relies on ballasting to raise and lower itself in the water. Ballasting is a process by which sea water is pumped in and out of the pontoons to control the height of the main deck above the sea surface and to maintain MODU stability.

A semi-submersible MODU will be held on station using an anchor array (or DP), with anchoring arrays typically using either an eight, or twelve-point anchoring/mooring system to maintain their position over the well during operations. These are either placed by anchor handling vessels when the MODU arrives on location or pre-laid ahead of time. Once work at the well location is completed, any anchors used are lifted by a support vessel and either returned to the MODU or transported to the next location.

The installation of a semi-submersible MODU that uses an anchoring array involves the disturbance of the seabed which is restricted by section 20 of the EEZ Act and is therefore included in this consent application. The details of the installation and removal of the anchoring array is described further in **Section 2.4.4**.

Figure 5 Simplified diagram of a moored semi-submersible MODU



Source: Adapted from https://en.wikipedia.org/wiki/Semi-submersible_platform

2.2.4 Well Intervention Vessel

A WIV is a CSV that includes a well intervention package, used in well intervention and abandonment activities. WIVs do not require the same level of positioning accuracy as a traditional semi-submersible MODU (**Section 2.2.3**) and therefore do not require to be moored. An example of a WIV is shown in **Figure 6** which is the 'Sapura *Constructor*' that has previously been used in Australasia.

The use of a WIV during the decommissioning activities does not necessitate a marine consent under the EEZ Act as the vessel itself will not disturb the seabed; however, the operations that it will be undertaking require marine consent and are discussed further in **Section 2.3**.

Figure 6 Example of a WIV – the Sapura *Constructor*

2.2.5 Remotely Operated Vehicles

ROVs will be required to support all the decommissioning activities and may include utilisation of sandbags being placed on the seabed for a period of time during operations. These typically occupy an area of 5 m² of the seabed.

To ensure that the ROV does not need to surface every time a new tool or rigging is required, a work basket will be lowered from the vessel(s) and placed on the seabed. This work basket will contain the required equipment and/or rigging for the work at hand, and may range in size; however, it is expected that this work basket will not exceed 12-15 m^2 of disturbance.

If for any reason the ROV had to settle on the seabed, it may leave a small depression on the seabed; being approximately a 6 m^2 footprint based on a typical ROV. In addition, the propulsion jets from the ROV thrusters may disturb fine surficial sediment layers during any activities where the ROV is operating in close proximity to the seabed.

All of the infrastructure that is being removed as part of the decommissioning activities has been in place on the seabed for a number of years, which has likely resulted in sediment building up around, and on, some of the infrastructure. The ROV may be required to utilise a suction dredge or air lift to excavate around the infrastructure and/or wellheads, to provide access for attaching rigging, disconnecting/cutting, or to reduce the potential suction effects associated with lifting this infrastructure from the seabed. This process will not involve taking any sediment as it will just displace the sediment into the vicinity of the infrastructure.

ROVs could be used to complete activities such as inspections, cleaning, valve/control system manipulation, attachment of clamps, rigging and lifting equipment, cutting, flange/connector make-up or disconnection, and to observe activities such as the placement of transponders, observing Blowout Preventer (**BOP**) functions and observing abandonment activities. When not in use, the ROV will either be recovered to the deck of the CSV, WIV, MODU or support vessel or to the tether management system garage located in the water column, typically about mid-water.

The transponders, along with the ROV work baskets, clump weights and sandbags will be relocated on the seabed when moving to the next location in the Tui field.

2.3 Field Asset Deconstruction and Recovery Activities

The following description of the decommissioning of the Tui field are the best estimations at the time of preparing this consent application and represent what is envisaged to be the 'worst-case' scenarios. The exact tooling, sequencing and methodologies used will be subject to contractor selection and detailed engineering that is yet to be undertaken.

2.3.1 Duration of Field Asset Recovery Activities

The duration required to fully recover the SSI within the Tui field will depend on a number of factors; for instance, the degree of operational challenges and any potential adverse weather conditions delaying operations. The best-case scenario (shortest term) for the duration of the recovery of the SSI is estimated at approximately 45 days. However, this could push out to approximately 100 days, due to any operational constraints or weather delays, which has been utilised for assessment purposes.

2.3.2 Production Flowlines/Risers

The following description of the proposed recovery of the flexible production flowlines and risers has assumed that the flowline has been disconnected at the Xmas Tree location, through the ROV cutting/disconnecting the flowline itself.

Prior to the recovery operations, preparatory works will be required to enable safe and efficient recovery of the flowlines and risers. This work will either be done prior to each flowline recovery or done for all flowlines at the same time, and will include:

- Installation of lift rigging to the flowline to assist in lifting onto the CSV;
- Fitting clamps to the flowline riser near the horizontal restraint at the MWA (alternatively, the flowlines may be severed (cut) either side of the MWAs using an ROV);
- Fitting clamps to the flowline near the horizontal restraint at the riser base location; and
- Carrying out inspections of the flowline to check the areas that are buried.

Once the preparatory works have been completed, the recovery of the production flowlines and risers can begin. It is possible that a temporary parking stand could be utilised to accommodate the production flowline end connector during disconnection. If used, this would be temporarily placed on the seabed beside the end fitting during disconnection and be approximately 4 m^2.

There are two main options for recovery of the flowlines – either by recovering the lines and cutting them into short lengths on the deck of the CSV for stacking, or reeling them continuously onto large reels mounted on the deck of the CSV or a carousel on/under the deck. A decision on which methodology will be utilised is yet to be made.

The first of these options will involve the CSV manoeuvring to the end of the flowline and deploying the ROV to attach clamps onto it. The crane onboard the CSV will then be connected to a clamp and raise the line off the seabed until it reaches approximately 20 m below the sea surface. From here, the winch wire on the CSV will be attached to another clamp at the end of the flowline before the crane lifts the flowline the rest of the way out of the water column and over the stern of the CSV.

The flowline will then be recovered onto the deck of the CSV until sufficient length (approximately 20 m) is on the vessel to enable the cutting of the flowline to occur. While the flowline is being held in place by the winch, the other clamp will be detached and moved to behind where the proposed cut is to be and will be held in place with winches onboard the CSV.

Once the 20 m section has been cut, the first clamp will be removed and fitted to the new cut end of the main flowline just in front of the second clamp. Meanwhile, the crane will move the 20 m long cut stalk into a pre-made bundling frame onboard the CSV. During the recovery operation, the bundles of cut flowline will periodically (as the bundling frame reaches capacity) be offloaded onto a support vessel for transport to shore.

The tension of the remaining flowline is taken by the winch and pulled onboard until the next length (approx. 20 m) is ready to cut. The second clamp is then moved to behind of the next cutting point and the above steps are repeated until the pre-installed clamps at the MWA and riser base are reached which will be utilised for further assistance to bring the flowline onto the vessel.

Another option that MBIE may utilise is for the flowline to be recovered onto a reel onboard the CSV and transferred to shore once recovery operations have completed, rather than cutting the flowline as it is recovered to the deck of the CSV. This option will not change the disturbance associated with the recovery.

The approach outlined above will be utilised until all the flowline/riser is recovered onto the deck of the CSV.

The flexible production flowlines/risers at the Tui field range in length and diameter as outlined within **Table 5**. It should be noted that the seabed disturbance is an overestimation as the entire length of the flowline/riser is not currently on the seabed with a portion of it draped over the MWA. However, the full length has been used throughout this consent application to provide a worst-case scenario for seabed disturbance.

In addition to this overestimation outlined above, allowance for disturbance either side of the production flowline/riser has been assumed to cover any resultant sideways movement of the line that will occur as it is being lifted, or for any dredging requirements to unbury the line. This horizontal allowance has assumed the equivalent width of the production flowline/riser on either side of the line will be disturbed (i.e. for a 350 mm diameter line, a total of 1,050 mm width has been used).

Table 5 Production flowlines and risers to be recovered

Equipment	Field	Outside Diameter (mm)	Length (m)	Seabed Disturbance (m^2)
Production riser	Tui-2H, Tui-3H, Amokura-2H, Pateke-3H	356.2	376 each 1,504 total	1,607.17
Production flowline	Tui-2H	343.0	1,612	1,658.75
	Tui-3H	343.0	1,612	1,658.75
	Amokura-2H	343.0	2,046	2,105.33
	Pateke-3H	343.0	5,637	5,800.47
	Pateke-4H	295.7	1,314	1,165.65
		TOTAL:	**13,725**	**13,996.12**

The Tui-2H production flowline has a 12 m long split along its external sheath, located approximately 500 m from the end of the riser. This flowline was pressure tested and flushed along with all other flowlines and as such, the recovery options presented above will be suitable for the Tui-2H flowline.

There are no Naturally Occurring Radioactive Materials either reported or encountered within the Tui field, or anywhere else in the onshore or offshore Taranaki region; therefore, no measures to manage and dispose of Naturally Occurring Radioactive Materials are considered necessary.

2.3.3 Umbilicals

The umbilicals contain hydraulic fluids (with the Pateke-4H umbilical also containing biocide inhibited seawater in its central gas-lift line) and have been disconnected from the FPSO. For this proposed methodology it has been assumed that they have also been disconnected from their respective Xmas Trees (or in the case of the Pateke-4H umbilical from its flanged connections to the SDU and UTA). If the disconnections have not occurred, this will be done - by either releasing the connectors or cutting the connections behind the bend restrictors - prior to recovery.

The fluids within the umbilical chemical/control lines were displaced with hydraulic fluid during disconnection of FPSO. The hydraulic fluid is called 'Transaqua HT2' which is not classified as a harmful substance under the Exclusive Economic Zone and Continental Shelf (Environmental Effects – Discharge and Dumping) Regulations 2015 (the **D&D Regulations**). The gas lift line within the Pateke-4H umbilical was displaced with biocide inhibited seawater, refer **Section 2.5.1**. There are no other harmful substances present within the umbilicals.

The main aspects of the umbilical recovery operation are similar to that used for the production flowline/riser recovery. As with the production flowline, the umbilical will have clamps placed along its length at certain points to assist with recovering the umbilical onto the deck of the vessel. This includes a tether clamp at the riser base, at the buoyancy modules, and the riser clamp at the MWA.

There are two options for the recovery of the umbilical once it reaches the CSV, following similar methodologies as the production flowline recovery, in that the umbilical is either cut into manageable lengths as it is brought onboard the CSV or it is recovered to a drum/reel/carousel which can accommodate the full length of the umbilical first. Once the umbilical is spooled onto the drum/reel/carousel and the drum/reel/carousel is full, the process can either be reversed with the umbilical being unspooled and cut into manageable pieces, or transferred directly to a recycling facility.

There are five umbilicals at the Tui field, with the dimensions outlined in **Table 6**. As with the production flowlines and risers, the seabed disturbance outlined in **Table 6** is an overestimation as the entire length of the umbilical is not currently on the seabed with a portion of it draped over the MWA. However, the full length has been used throughout this consent application to provide a worst-case scenario for seabed disturbance.

As with the production flowlines and risers, a horizontal allowance for disturbance either side of the umbilicals has been assumed to cover any resultant sideways movement of the line that will occur as it is being lifted, or for any dredging requirements to unbury the line.

Table 6 Umbilicals to be recovered

Field	Large Cross Section		Small Cross Section		Total Length (m)	Seabed Disturbance (m^2)
	Outside Diameter (mm)	Length (m)	Outside Diameter (mm)	Length (m)		
Tui-2H	146.9	187	120.9	1,847	2,034	752.32
Tui-3H	146.9	187	120.9	1,781	1,968	728.38
Amokura-2H	146.9	187	120.9	2,192	2,379	877.45
Pateke-3H	146.9	187	120.9	5,661	5,848	2,135.66
Pateke-4H	166.0	1,355	N/A	N/A	1,355	674.79
				Total	**13,584**	**5,168.60**

2.3.4 Gas-Lift Coil Tubing and Risers

The following assumptions have been made for the removal of the gas-lift CT:

- The methodology will be the same for all four lengths of the CT at Tui-2H, Tui-3H, Amokura-2H and Pateke-3H; and
- The anode skid connector clamps have been removed from the CT prior to commencing recovery (as discussed within **Section 2.3.9**).

The CSV will initially locate to the gas-lift riser base and deploy the ROV where it will cut the clamps that hold the CT at the riser base. It should be noted that a clump weight/hold-back rigging (with an approximate disturbance area of 1 m^2) may be required to prevent the gas-lift riser from moving once the clamps have been cut.

Following the disconnection of the clamps at the riser base, the CSV will relocate to the wellhead end of the CT and identify the connection between the CT and the gas-lift jumper. The ROV will be deployed at this location to disconnect the CT from the gas-lift jumper following the installation of two recovery clamps on the FPSO side of the intended cut location. An alternative to the installation of the recovery clamps is the use of a Pipeline Retrieval Tool which would effectively be stabbed into the cut end of the CT before retrieval by winch. This alternative will include similar methodology as the clamp option discussed below.

The CSV crane will be connected to the first recovery clamp and initiate recovery of the CT. Once the CT reaches the stern of the CSV, a hold-back line will be attached to the second recovery clamp to allow disconnection of the crane from the first recovery clamp. A winch work wire will then be connected to the first recovery clamp prior to pulling the CT onboard the CSV. During this time, the ROV will be stationed near the seabed to monitor the touch-down point and the location of the anode skids; when these are reached all recovery operations will stop and the connecting clamps will be removed prior to continuing the recovery of the CT.

Two clamps will be installed at the connection between the CT and the gas-lift riser once the recovery operations reaches this point, the first clamp will be on the CT side of the connection and the second on the gas-lift riser side of the connection. These clamps will be utilised to hold the connection on the deck of the vessel to allow the crew to disassemble the connection between the CT and gas-lift risers, and to then attach the gas-lift riser to a secondary winch onboard the CSV.

The recovery of the gas-lift riser will continue until the catenary (the curve that a hanging chain or cable assumes under its own weight when supported only at its ends) reaches the surface of the MWA at which point the recovery process will stop so that the ROV can monitor the MWA and ensure the gas-lift riser clamp is drawn clear of the MWA. One final stop will occur when the MWA clamp reaches the stern of the CSV to allow it to be removed prior to the full retrieval of the gas-lift riser.

As with the umbilical recovery outlined in **Section 2.3.3**, there are two options for the recovery of the CT and gas-lift risers. These two options relate to the methodology for cutting the CT and gas-lift risers which are either:

1. The CT/gas-lift riser is brought onto the CSV and cut immediately into manageable lengths for bundling and stacking; or
2. The CT/gas-lift riser is recovered to a drum/winch/reel. This can then either be slowly unspooled from the drum/winch/reel once it is full and cut into appropriate lengths to bundle together and transfer to shore or transfer the full drum/reel to shore for unspooling and cutting.

The 'CT' used in this section includes both the gas-lift coil tubing itself and the gas-lift risers (which are those parts that rise from the seabed up to the FPSO (when it was on location)) with the dimensions outlined in **Table 7**. As with the production flowlines/risers and the umbilicals, a horizontal allowance for disturbance either side of the CT/gas-lift riser has been assumed to cover any resultant sideways movement of the line that will occur as it is being lifted, or for any dredging requirements to unbury the line.

Table 7 Coil tubing and gas-lift riser to be recovered

Equipment	Field	Outside Diameter (mm)	Length (m)	Seabed Disturbance (m^2)
Gas-lift riser	Tui-2H, Tui-3H, Amokura-2H, Pateke-3H	144.3	376 each 1,504 total	651.08
Coil tubing	Tui-2H	88.9	1,444	385.11
	Tui-3H	88.9	1,534	409.12
	Amokura-2H	88.9	1,917	511.26
	Pateke-3H	88.9	5,320	1,418.84
		TOTAL:	**11,715**	**3,375.41**

2.3.5 Gas-Lift Jumpers, Hydraulic Flying Leads and Electrical Flying Leads

This group of equipment is made up of the following items:

- Three flexible GLJs for Tui-2H, Tui-3H and Amokura-2H. These GLJs are approximately 35 m in length and have an outside diameter of 145 mm. This equates to approximately 15.2 m^2 of seabed disturbance each, totalling 45.6 m^2 for all three;
- Four 'Unitech' GLJs at Pateke-3H and Pateke-4H. These four GLJs differ in length, between 8.16 m and 18.59 m in length (the largest of which is made up of two GLJs with a mid-line connection); however, they total approximately 48 m, and with an outside diameter of 95 mm the area of seabed disturbance for all four GLJs equates to approximately 14 m^2;
- HFLs at Pateke-3H and Pateke-4H. These HFLs have a female 'alpha plate' on the end of the hose which attaches to a male receptacle on the structure. This female alpha plate will be disengaged from the structure and recovered along with the HFL. The length of the hoses included with all of the HFLs at Pateke-3H and Pateke-4H total approximately 110 m in length, with an outside diameter of 70 mm, totalling approximately 23.1 m^2 of seabed disturbance; and
- EFLs at Pateke-3H and Pateke-4H. These EFLs are made up of a variety of cables and the associated 'cobra head' connectors, totalling approximately 170 m in length with an outside diameter of 29 mm; equating to approximately 14.8 m^2 of seabed disturbance.

When determining the seabed disturbance associated with each of these items, a horizontal allowance has been built in (similar to that detailed in relation to the production flowlines, umbilicals etc.) for any adjacent disturbance that occurs when recovering this equipment.

2.3.5.1 Gas-Lift Jumpers

The recovery of the GLJs differs slightly between those found at Pateke-3H/4H and those at the Tui-2H/Tui-3H/Amokura-2H well locations. The retrieval of the GLJs may involve a work basket being placed at each location, with the GLJs placed inside it prior to recovering the basket to the CSV. Each placement of this work basket will be in the order of a few square metres.

For those GLJs at the Tui-2H/Tui-3H/Amokura-2H well locations it has been assumed that the GLJ at both ends have been cut as part of previous decommissioning activities. The ROV will be deployed to the Xmas Tree end of the GLJ and install a soft sling in a choke configuration at the end of the GLJ (or as an alternative a recovery clamp will be installed). The crane will be deployed and connected to the sling/clamp at the Xmas Tree end of the GLJ and manoeuvre that end to the CT end of the GLJ and lay down the GLJ on the seabed to form a loop. The ROV will then install a sling in a choke configuration on the CT end of the GLJ and connect the crane to both slings/clamps in order to bring the GLJ to the CSV. This process will be repeated for each of the GLJs at these sites.

In terms of the Pateke-3H and Pateke-4H GLJs, the ROV will be required to cut the GLJ connections at the GLM, just prior to the GLJ bend stiffener (located near the connection at the GLM). The ROV will then locate to the Pateke-3H SDU (which is located near the Pateke-3H wellhead) and cut the GLJ near the bend stiffeners connecting to the SDU. From here, the ROV will locate the centre of the cut length of the GLJ and install two soft slings on the GLJ section to be recovered. The crane will be deployed from the CSV and the end of the winch wire connected to the slings by the ROV in order for the GLJs to be recovered onto the deck of the vessel. The same steps will be done for the remaining GLJs at Pateke-3H/Pateke-4H.

2.3.5.2 Hydraulic and Electrical Flying Leads

For both the HFLs and EFLs, the ROV will be deployed to disconnect the alpha plates from the subsea equipment. A crane from the CSV will then be deployed and connected to the handle of the alpha plate for the entire length of the flying lead to be lifted through the water column. The flying leads will be placed into the ROV basket underneath the CSV which will then be recovered to the deck of the vessel once all flying leads are within the basket.

The retrieval of the HFLs and EFLs may also involve a work basket being placed at each location, with the HFLs and EFLs placed inside it prior to recovering the basket to the CSV. Each placement of this work basket will be in the order of a few square metres.

2.3.6 Gas-Lift Manifold

Prior to the removal of the GLM all connections to and from it will be disconnected.

The ROV will be deployed and after the ROV has reached the seabed and located the GLM it will use a jet, suction dredge or air lift to excavate around the GLM in order to reduce suction with the seabed during lifting operations. An inspection will be conducted by the ROV to ensure the lifting pad-eyes are in good condition and that all subsea assets are disconnected.

The 'retrieval rigging' will be deployed from the CSV using the crane onboard and attached to the pad-eyes on the GLM. Should the inspection of the pad-eyes show damage, a chain will be attached to the vertical brace and connected back to the retrieval rigging. From here, the crane will be attached to the retrieval rigging and a constant tension will be maintained. To reduce the suction load, one end of the GLM will be lifted and the ROV will jet under the structure.

Once the GLM has been extracted from the seabed and lifted approximately 10 m above the seabed, it will be slowly lowered back down onto the seabed. From here, the 'retrieval rigging' will be disconnected and switched to the 'lifting rigging' and connected back to the crane. This will enable the GLM to be recovered to the deck of the CSV.

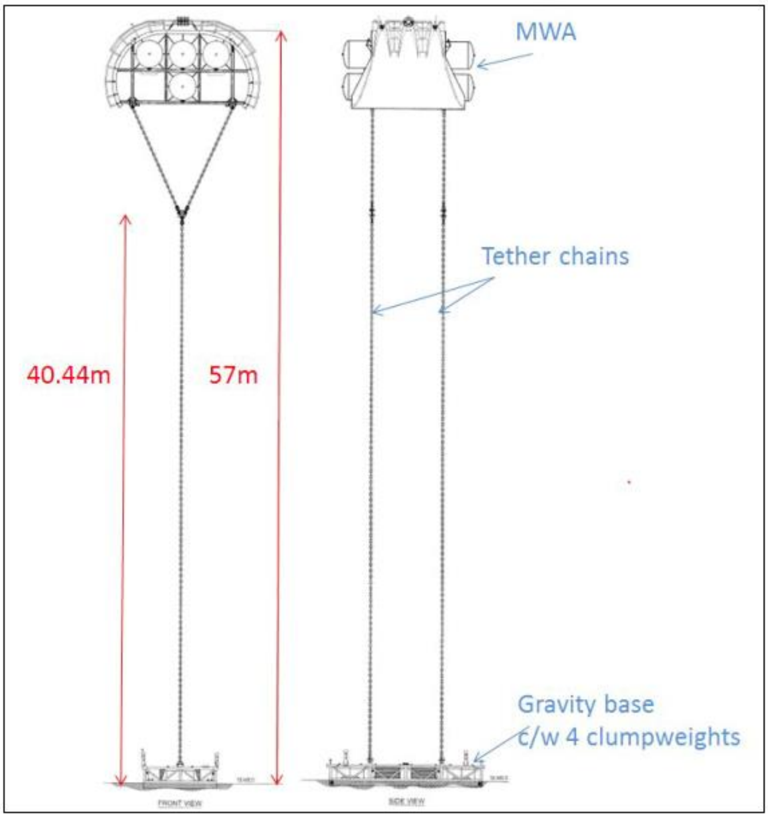
As the GLM will be lifted into the water column and placed back onto the seabed to switch the rigging, the disturbance associated with this activity has been assumed to be double that of the GLM dimensions as it is not known whether this will occur in the same area of disturbance from the initial lifting operations.

The GLM and its associated mud mats are approximately 10 m x 6.4 m (64 m^2). To calculate the total area of disturbance, including any surrounding areas that may need to be excavated, a 2 m buffer around the GLM has been assumed. Therefore, the total seabed disturbance utilised for this marine consent from the recovery of the GLM is 145.6 m^2.

2.3.7 Midwater Arch and Gravity Base

The Tui field consists of four MWAs, each of which is held in place by a tether system, gravity base and associated clump weights. Each MWA tether system has two mooring legs composed of 56 mm studless chain bridle anchored to a GB, which has four clump weights installed on top to provide additional ballast as seen in **Figure 7**.

Figure 7 MWA and GB arrangement



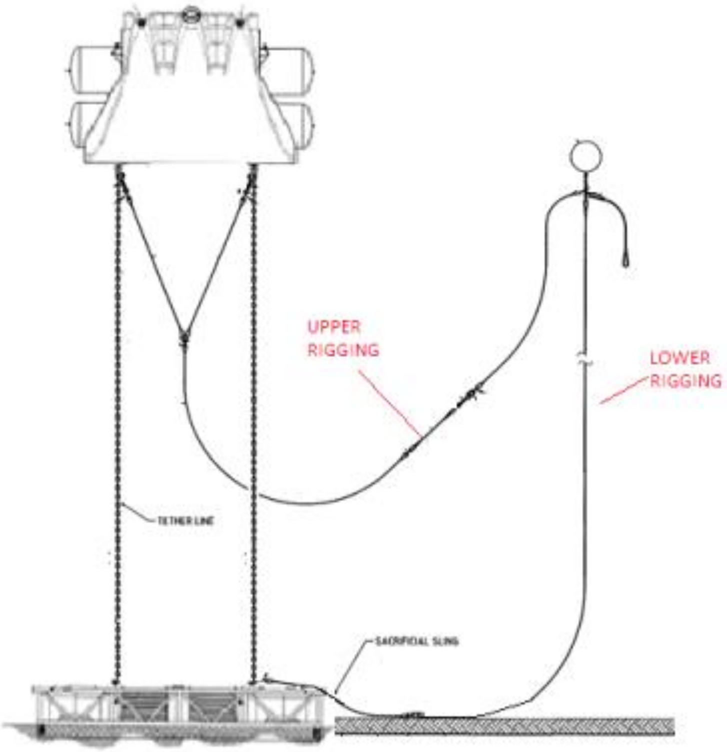
Each MWA will be free from all risers (see **Sections 2.3.2** to **2.3.4**) prior to being recovered and all required rigging and lifting slings will be installed on each structure. There are four options for the recovery of the MWA and GB, each of which has been presented here. The methodology selected will be the same for each of the four MWAs in the Tui field.

2.3.7.1 Option 1A – Use of Hold-back Rigging

Option 1A utilises hold-back rigging which will be attached between the GB and the MWA to allow the tether line to be cut, and the MWA retrieved as per the description below.

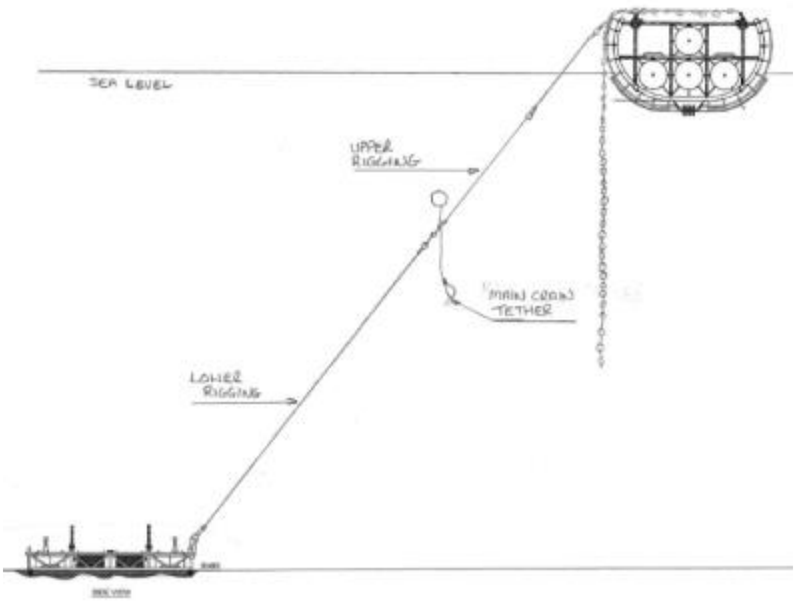
Approximately 140 m of hold-back rigging will be prepared on the deck of the CSV which will be composed of a lower section, and an upper section. The hold-back rigging is required to be longer than the water depth to allow the MWA to float once the tether line is cut. The hold-back rigging will be lowered in separate sections, with the lower section deployed first and attached to the GB. Following this, the upper section will then be deployed and attached to the MWA utilising the ROV and subsequently attached to the lower section as per **Figure 8**.

Figure 8 MWA hold-back rigging



Once the hold-back rigging has been attached, the tether line will be cut, with one tether line carefully cut at a time. Once this has been completed, the MWA will be safe to float to the surface as per **Figure 9**.

Figure 9 MWA recovery



Once the MWA is floating on the sea surface, the CSV will manoeuvre for the onboard crane to be in reach of the main crane tether (seen in **Figure 9**). Once the crane is connected to the main crane tether, the lower section of the hold-back rigging will be cut and fall to the seabed while the MWA is lifted onboard the CSV.

In regard to the GB and its associated rigging, initially the ROV will be deployed to cut the remaining tether chain close to the GB itself, and a wire sling will be sent from the CSV to recover the cut tether chain. The ROV will then use a subsea dredger unit to dredge under the GB in order to decrease the suction when recovery operations begin.

Each of the clump weights will be individually retrieved, first by attaching new rigging to the clump weights and lifting them using the CSV crane. Once all four clump weights have been retrieved, lifting rigging will be attached to the GB and the crane will be attached to this lifting rigging to enable the GB to be retrieved to the CSV. The GB may be lifted on an angle to further reduce suction from the surrounding seabed.

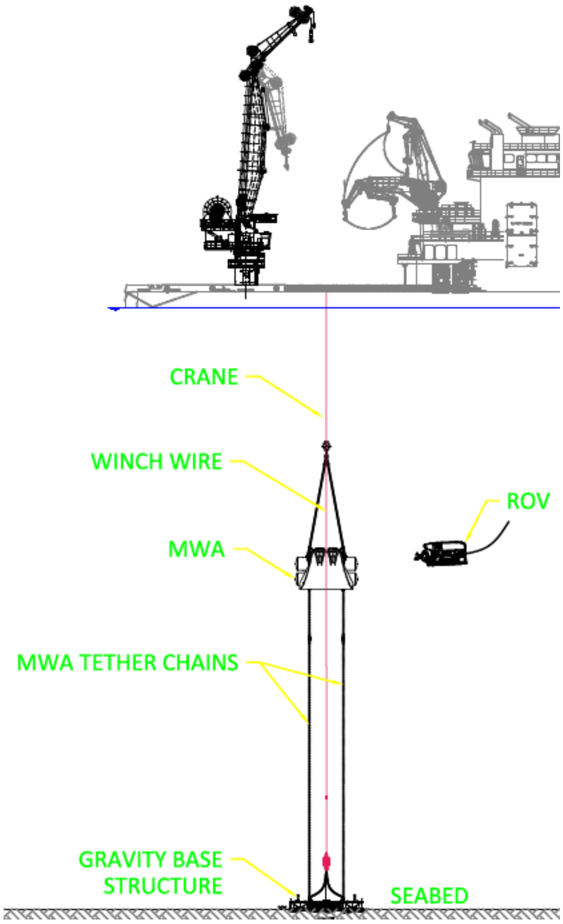
The dimensions of the GB are 11.5 m x 5.5 m, and as with previous disturbance calculations, it is assumed that the seabed surrounding the GB (out to 2 m all around) could be disturbed during recovery operations. Therefore, each GB to be recovered under Option 1 will disturb approximately 147 m^2, totalling 588 m^2 for all four GBs.

2.3.7.2 Option 1B – Direct Lift

Option 1B is similar in nature to Option 1A, in that it creates no additional seabed disturbance beyond that required to lift and remove the MWA and associated GB.

In this option the crane line will be attached to pre-installed rigging on the MWA and another line (either another crane line or a winch line) will be attached to pre-installed rigging on the GB (seen in **Figure 10**). The MWA and GB will then be recovered simultaneously, with lifting continuing until the MWA is at the maximum vertical extent of the crane. The tether chains will then be locked off and the chains cut to release the MWA for laydown. After laying down the MWA on the deck, the crane will be connected to the tether chains and used to lift the GB along with the secondary crane/winch. After lifting to maximum hook height, the tether chains will again be locked off and cut. This process will be repeated until the GB is accessible above the water's surface and the crane can lift it and land it out on the deck.

Figure 10 Recover by direct lift

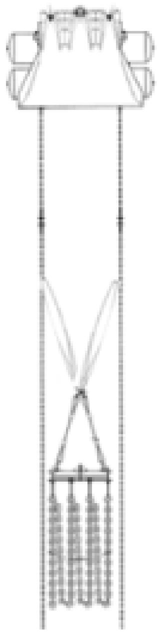


2.3.7.3 Option 2 – Use of Clump Weight

Option 2 utilises a large 80 tonne clump weight rather than the hold-back rigging outlined within Option 1. The clump weight will be utilised to counteract the buoyancy of the MWA and to ensure a safe and controlled disconnection from the GB.

The clump weight will be prepared onboard the CSV with the appropriate rigging and attachment points while the ROV is sent to the tether line attached to the MWA for the required preparation works (attaching grommets etc.). The clump weight will be deployed to the MWA location with the onboard crane. From here the ROV will attach the pre-installed grommets on the tether line (as seen in **Figure 11**) to the rigging on the clump weight and then the crane will slowly lower both the MWA and clump weight to the seabed.

Figure 11 Clump weight attached to MWA



Once the clump weight is on the seabed, the ROV can begin to cut the tether lines attaching the MWA to the GB at a point below where the clump weight is attached. The CSV winch wire is then sent to the seabed and attached to take the load of the clump weight while the load of the MWA is held by the crane. The clump weight and MWA are lifted until the MWA is on the surface. The grommets will then be severed by the ROV while the crane lifts the MWA onboard the CSV. Once the MWA has been successfully recovered, the crane line is sent to the seabed and attached to the clump weight for recovery.

The retrieval of the GB and its associated clump weights under Option 2 is the same as Option 1A and is not repeated here.

The area of disturbance under Option 2 is increased by the placement of the clump weight on the seabed, which is estimated to be approximately an additional 24 m^2 per GB based on the clump weight dimensions of 6 m x 4 m.

2.3.7.4 Option 3 – Sinking of MWA

The third option for recovering the MWA is by cutting large flooding holes into the end of each buoyancy tank with a cutting tool attached to the ROV. From here the buoyancy tanks will slowly fill with seawater and the MWA will land on the nearby seabed. The area of disturbance is estimated to be approximately 113 m^2 for each MWA based on the MWA dimensions of 11.5 m x 9.8m.

Once the MWA is on the seabed, the ROV will be deployed to cut the tether chains and pre-install rigging onto the pad eyes of the MWA to allow recovery by the CSV. The CSV will then deploy the lift rigging at the MWA location and suspend it over the MWA to allow the ROV to connect the rigging to the MWA. Once all of the attachments have been made, the CSV will slowly raise the MWA through the water column to the deck of the vessel; meanwhile the ROV monitors the lifting to ensure the rigging remains untangled and in the correct orientation.

The retrieval of the GB and its associated clump weights under Option 3 is the same as Option 1A and is not repeated here.

2.3.8 Production Riser Hold-back Anchors

The four production risers are moored using hold-back anchors which consists of a 5 tonne MK5 Stevpris anchor along with approximately 30 m of 64 mm studless chain. This same operation will be conducted for all four production riser hold-back anchors.

The ROV will locate the first production riser hold-back anchor and cut the connection utilising the grinder attachment. Meanwhile, the tow wire will be prepared onboard the CSV for anchor recovery and sent to the seabed utilising the crane.

The ROV will connect the CSV winch to the chain link on the seabed and begin the recovery operations. Repositioning may be required to break out the anchor from the seabed with additional help from the motion of the vessel itself. The anchor and chain are then recovered to the deck of the CSV and transferred to the supply vessel for transport to shore.

The anchors each have a surface area of approximately 10.5 m^2 (based on a triangular shape with a base of 4.75 m and a length of 4.4 m). The depth that these anchors are buried into the seabed is not known exactly, which means that when each anchor is pulled up it is likely to result in the disturbance of the seabed not only in the footprint area of the anchor itself but also around it as the sediment depth above the fluke of the anchor is lifted upward and redeposited on the seabed. Assuming this disturbance extends 2 m beyond the physical anchor footprint area, the area of seabed that may be disturbed as a result of lifting each anchor could be in the order of ~37 m^2. In addition to this, each 30 m length of chain may disturb up to 17 m^2 (utilising the same horizontal allowance as previous sections). Therefore, removing all four anchors and chains could result in disturbance of ~216 m^2.

2.3.9 Miscellaneous Equipment

This is a generic task which will be developed further at the engineering stage to accommodate any specifics relevant to the individual structures. However, the general operations for each of these structures will be similar and is expected to be as outlined below (with the exception of the concrete crossing structure which is slightly different).

The miscellaneous equipment consists of the following items:

- One concrete crossing structure located at the Pateke-3H umbilical/Pateke-4H flowline crossing point. This piece of equipment has dimensions of 5.0 m x 3.2 m equating to approximately 16 m^2 of disturbance of seabed. A recovery frame may be utilised to assist in recovery of the structure, which itself could be 5 m x 6 m (30 m^2 in area). This would be placed on the seabed before having the concrete crossing structure lifted on to it and would reduce the risk of the structure breaking during recovery to surface. Any requirement for this will be determined during detailed engineering. Should the concrete crossing structure break apart during recovery operations, the pieces will be recovered individually as far as reasonably practicable (by means such as a crane grab into a basket);
- One SDU which was utilised to connect the Pateke-4H Xmas Tree to the Pateke-3H Xmas Tree (with the UTA discussed below). This unit is 3.9 m x 2.5 m, totalling approximately 10 m^2 of disturbance on the seabed;
- One UTA which was utilised with the SDU to connect the Pateke-4H Xmas Tree to the Pateke-3H Xmas Tree. This assembly is 3.7 m x 2.7 m, equating to approximately 10 m^2 of disturbance on the seabed;

- 16 anode skids, each of which are 1.8 m x 1.8 m, equating to approximately 3.3 m^2 each of disturbance on the seabed, totalling approximately 53 m^2 for all of the skids;
- Four umbilical riser bases which is a guide frame restraining the riser horizontally, each of which are 4.1 m x 2.2 m, equating to approximately 9 m^2 each, totalling 36 m^2 for all four;
- Four gas-lift riser bases which are similar in nature to the umbilical riser base, although each gas-lift riser base are 4.1 m x 2 m, equating to 8.2 m^2 each, totalling approximately 33 m^2 for all four;
- One intermediate skid which was installed as part of the Pateke-4H connection to Pateke-3H to be an intermediate HFL/EFL connection between Pateke-3H Xmas Tree and SDU. The intermediate skid has a base of 3.2 m x 3.2m, disturbing approximately 10.2 m^2 of seabed; and
- Four GBAs which remain on the seabed surrounding Amokura-2H from the 2019 drilling campaign, each of which is 4.0 m x 4.0 m, disturbing approximately 16.0 m^2 each, totalling approximately 64.0 m^2 for all four.

The total footprint from the miscellaneous equipment listed above is approximately 262 m^2. As this equipment has been on the seafloor for a number of years, there may be some excess sediment that is disturbed around the base of the equipment. In addition, during lifting operations additional material around the base of the equipment may be disturbed through any excavation that is required to reduce suction with the seabed when removing the infrastructure. To account for this, it has been assumed that the seabed surrounding the equipment, out to 0.5 m, could be disturbed as part of this marine consent. Therefore, the total area of seabed disturbance has been estimated to be ~376 m^2 to provide for a worst-case scenario of disturbance around this equipment.

In terms of the remaining structures to be lifted, the ROV will locate the remaining structures and excavate around the structure to reduce the suction with seabed during lifting operations. The ROV will also inspect the lifting pad eyes that are attached to the structure and that all subsea assets have been disconnected from each structure. If the pad eyes are damaged, the ROV will find a suitable point to choke a chain around the structure brace and connect the chain back to the lifting rigging. Alternatively, the concrete support recovery frame may be used for lighter structures.

Any existing rigging will be severed utilising the ROV grinder attachment and recovered. The lifting rigging will then be deployed from the crane onboard the CSV and attached to the structure at the seabed. The structure will be slowly lifted from the seabed and recovered to the deck of the vessel and subsequently transferred to shore.

2.4 Well Intervention Abandonment and Wellhead Recovery Activities

2.4.1 Pre-Abandonment Works

Pre-abandonment works at each well site may be undertaken prior to the arrival of the MODU/WIV. There may be an opportunity to prepare the Xmas Trees in conjunction with the field asset deconstruction and recovery work to minimise delays during well plugging and abandonment.

Pre-abandonment operations typically include: ensuring there is no excessive marine growth on the ROV panels, ensuring critical valves are functioning correctly, corrosion caps are able to be efficiently removed, and electrical/hydraulic communications are able to be established with the subsea control modules.

2.4.2 Duration of Well Abandonment Activities

The duration the MODU/WIV is on location at any well location depends on a number of factors. For instance, the total activities required at the well, the degree of operational challenges and adverse weather conditions delaying operations.

The shortest duration the MODU/WIV could be on any one location is approximately 15 days. Most wells that require P&A are likely to be completed within 20 days. However, it is possible that the MODU/WIV could be on a location for longer than 50 days if, for example, due to equipment failure or poor weather. Therefore, for this consent application, a 90-day base case and 150-day worst case has been utilised where required for assessment purposes.

2.4.3 Placement and Retrieval of Transponders

Up to four transponders (each approximately 105 mm in diameter) may also be placed on the seabed by a ROV to mark the well location at each well site. Each transponder is held on the seabed by a 1 m^3 clump weight (1 m x 1 m x 1 m), and the transponder sits about 2.5 m above the seabed. As a result, the four clump weights will occupy a cumulative area of up to 4 m^2 per well, and up to 32 m^2 for all wells in the Tui field.

The transponders will be relocated on the seabed when moving to the next location in the Tui field.

2.4.4 Installation of MODU

The installation of a semi-submersible MODU that utilises an anchoring array involves the disturbance of the seabed and, as such, MBIE is applying for a marine consent for the installation of such a MODU(s).

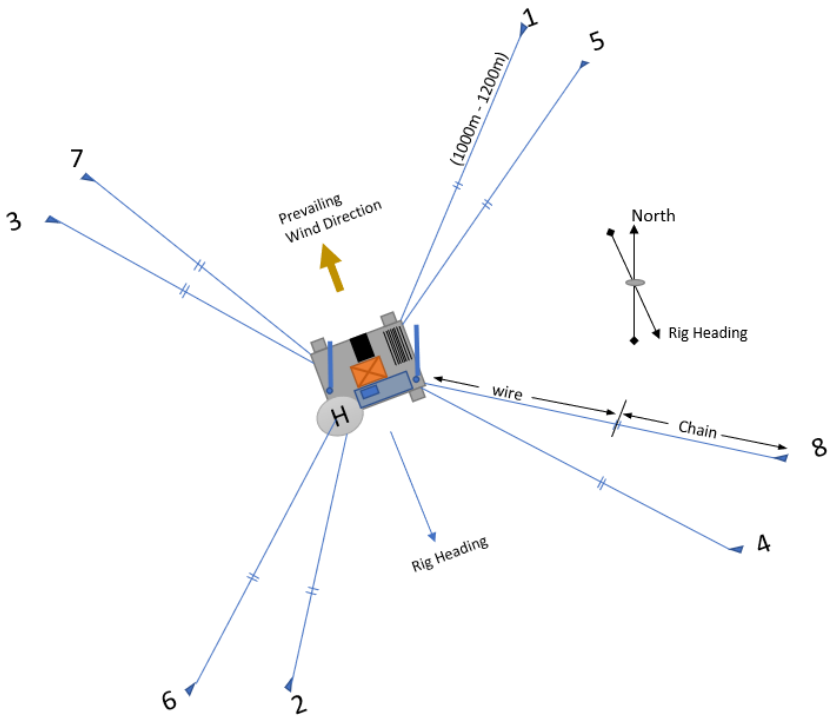
The use of a DP vessel, including a WIV, does not require marine consent as a DP vessel would not result in disturbances of the seabed as part of the installation process.

2.4.4.1 Anchored Semi-submersible MODU

An ‘anchored’ semi-submersible MODU (i.e. one which will utilise an anchoring array to remain on station), if utilised, will utilise eight to twelve anchors, complete with mooring chains and wires, to hold the MODU in place (**Figure 12** and **Figure 13**). The anchors can either be pre-laid on the seabed in advance of the MODU arriving on location or can be deployed once the MODU is in place, meaning that up to 24 anchors could be in place on the seabed at any one time. The placement of these anchors involves support vessel(s) lowering the anchors and mooring chains onto the seabed. Each anchor is then tensioned from the MODU until the anchors have penetrated far enough to reach full holding potential.

Figure 12 Photo of a drag-embedded anchor typically used for a semi-submersible MODU

Figure 13 Eight-anchor mooring setup for a semi-submersible MODU



The extent of the disturbance on the seabed for a semi-submersible MODU is directly correlated with the size and number of anchors and the length of mooring chain in contact with the seabed. Anchors have a maximum surface area of 30 m². For a MODU with twelve anchors this represents a maximum total area of 360 m².

Prior to the final anchor position there is likely to be a drag distance before each anchor penetrates sufficiently to reach full holding potential. A drag distance for a 12-tonne anchor is likely to be between 55 m for medium seabed and 85 m for soft seabed before full penetration and holding capacity is achieved. For an anchor 6 m wide this could result in a maximum disturbance of approximately 510 m² of seabed for each anchor.

Once tensioning is complete, approximately 1,000 m of mooring chain per anchor will rest on the seabed. These chains are typically 0.76 m wide, which equates to approximately 760 m² of seabed disturbance per mooring line. Wire is used to connect the chain to the MODU. The mooring design is such that the wire will not lay on the seabed. The total approximate area of disturbance on the seabed for 8 and 12 anchors is provided in **Table 8**.

Table 8 Approximate area of disturbance for semi-submersible MODU anchor placement

Description	Approximate disturbance of seabed (m²)		
	Per anchor	8 anchors	12 anchors
Anchor placement	30	240	360
Drag during tensioning	510	4,080	6,120
Chain resting on seabed	760	6,080	9,120
Total (m²) per site	**1,300**	**10,400**	**15,600**
Total for Campaign (8 MODU Placements)		**83,200**	**124,800**

The above disturbance will occur over the area for which the anchors are spread. For a MODU with 12 anchors in a water depth of approximately 120 m this equates to an area of approximately 15,600 m² per site.

For each of the wells the anchors would be retrieved with the assistance of support vessels, and then relocated to position the rig above the next location.

All anchors and associated chains and lines would be removed when the MODU is moved to the next location or demobilised. The duration of anchor placement would reflect the overall duration of the activities at each well and the total campaign (see **Section 2.4.2**). It is also possible that a second set of anchors would be pre-laid at the next planned drilling site before the MODU is relocated, meaning that up to 24 anchors could be in place on the seabed at any one time. Once the MODU has relocated to the new site and connected to the pre-laid anchors, the anchors at the previous site would be removed by supporting vessels. It should be noted that although there may be 24 anchors on the seabed at one time there will only be one set of anchors used at any one well location.

The most likely scenario for a MODU would be to anchor at up to four (4) anchor sites based on the following assumptions:

- The three (3) exploration wells may be able to be abandoned without anchoring, but this has not yet been confirmed.
- It is also possible that the MODU may require temporary anchoring, such as in the event of equipment or weather downtime halting operations. If this is the case, then the MODU will be anchored at one of the existing well sites and therefore not require a separate site.
- It is also possible to reach Tui-2H and Tui-3H from a single location as the Xmas Trees are in close proximity.

Irrespective of the above assumptions, consideration has been made for contingency operations and to provide a worst-case scenario in terms of disturbance for this marine consent application. Therefore, MBIE is seeking marine consent for up to a total of eight (8) MODU placements during the decommissioning of the Tui field. Consequently, assessments made in **Section 7** are based on a range of between 41,600 m^2 (four MODU placements with eight anchors) to a maximum total area of 124,800 m^3 (eight MODU placements with 12 anchors).

The seabed character in all parts of the Tui field where anchors will be placed is well understood from previous extensive side-scan sonar imaging, ROV surveys and benthic monitoring studies, with no sensitive environments being present in the area.

The MODU would be transported to New Zealand either by dry-tow where the entire MODU is placed on a specialised vessel and floated off, by wet-tow using specialist towing vessels, or the MODU may transit to location under its own power. In all cases all relevant importation requirements regarding maritime navigation and biosecurity checks and approvals would be applied, such as exchange of ballast water and cleaning of the hull to avoid the introduction of any foreign marine species. In the event that the MODU is dry-towed to New Zealand and is to be offloaded in coastal waters (within 12 Nautical Mile (**NM**) of shore), a Resource Consent would be obtained from the relevant Regional Council for the activity.

2.4.5 Installation and Testing of the BOP (Production Wells Only)

Prior to connecting the BOP (or Intervention Riser System (**IRS**) or Intervention Lubricator (**IL**) depending on the vessel utilised for P&A activities) to the well an ROV is lowered to the top of the existing Xmas Tree and the debris cap removed. The debris cap is a non-pressure containing piece of equipment that protects the top connection of the well from debris or corrosion. At the time of placement, a small stick of biocide is installed inside the cap. This is expected to be fully degraded, however on disconnect from the Xmas Tree any residual quantities of biocide may enter the marine environment.

BOPs will be temporarily connected directly onto the existing Xmas Tree through which the well plugging activities are to occur. BOPs consist of a set of valves that may be closed remotely by the MODU crew in the event that unexpected well pressures are encountered or for any reason there is concern about loss of control of the well fluids. An IRS holds the same purpose however are smaller in size. The BOPs are periodically function tested (weekly) and pressure tested (every two weeks) to ensure they are fit for purpose for each section of the well. Each time a valve is functioned on the BOPs, BOP fluid is released to the environment. This fluid is specifically chosen to be as environmentally friendly as possible. Further discussion on the fluids that are included within this discharge is contained within **Section 2.5.2**.

The BOP is lowered by the MODU on jointed metal tubulars known as a marine riser. The BOPs are suspended at a height above the Xmas Tree and never touches the seabed, being temporarily connected directly onto the existing Xmas Tree through a purpose-built connection on the top of the Xmas Tree. It is through the marine riser, BOP and Xmas Tree that tubulars (or coiled tubing) can be lowered or removed from the well without coming into contact with the seawater. This system also allows fluids to be circulated down into the well via the pipe and back up via the marine riser without coming into contact with the seawater.

The well can also be closed in if weather conditions are such that P&A operations must be suspended. The system allows for the MODU to disconnect the marine riser from the well while leaving the BOP attached to the Xmas Tree and the well closed in preventing any fluids escaping from the well. The marine riser is also displaced with seawater prior to the lower marine riser package being disconnected from the BOP, thus preventing fluids in the marine riser from contaminating the marine environment. The MODU could then move safely a short distance from the Xmas Tree location and wait out any significant weather event. This is explained in more detail in **Section 2.4.8.1**.

At the conclusion of placement of cement plugs and cutting of casing at each site, the BOP will be removed for re-used at the next site.

If a WIV is used for the abandonment operations, then an IL may be used in place of a BOP. These are similar to an IRS, however generally not connected via a riser system.

The BOP will not be placed directly onto the seabed; however, seabed disturbance may occur as a result of ROV activities where turbulence from the ROV propulsion potentially causes small-scale, localised disturbance of nearby sediments (discussed further in **Section 2.2.5**).

The IRS/IL will also not be placed directly on the seabed; however, should one be utilised, an intervention manifold, which will be located on the seabed, will be required to control the functions on the IRS/IL. The area of disturbance from this intervention manifold will be highly dependent on the company contracted to undertake the works, but for the sake of this assessment, an indicative area of 30 m^2 has been assumed.

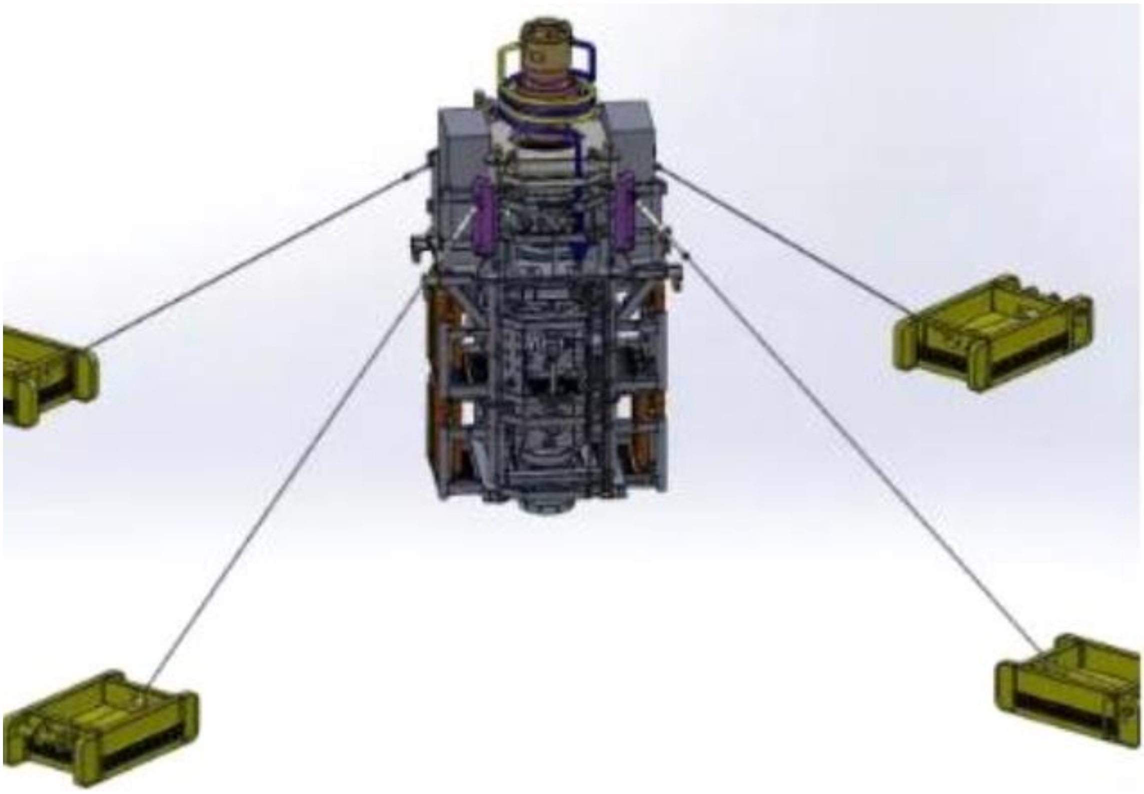
2.4.5.1 BOP Tethering System

If a MODU is utilised as opposed to a WIV then the larger BOP used on a MODU will likely require to be tethered to account for wellhead fatigue (**Figure 14**).

This BOP tethering system will utilise up to four clump weights landed on the seabed approximately 25 m from the well centre. The use of a tethering systems reduces BOP movement and alleviates stress and fatigue on the existing infrastructure. These systems are now recognized as best practice when intervening on existing facilities.

These tethers are connected to the frame of the BOP and provide stability. The tether lines would be in mid water and would not touch the seabed although there is a potential that a line could break, come loose when connecting or dropped by the ROV.

Figure 14 Example of BOP tethering system



A BOP Tethering system would not be required on a WIV as the BOP system is much smaller and lighter.

2.4.6 Plug and Abandonment

As discussed in **Section 2.1**, MBIE is planning to P&A (or in some cases complete the P&A) of five production wells and three exploration wells as part of the decommissioning of the Tui field.

The three exploration wells have previously been plugged and abandoned after drilling and only require the wellheads, casing and conductor to be removed 3 m below the seabed. This work may be completed with the remaining P&A work, or during the retrieval of the SSI.

Similarly, the Tui-3H production well has permanent down hole cement barriers in place which were completed in 2019 during the Tamarind Tui Phase 3 drilling campaign. However, the wellhead and subsea Xmas Tree were left installed which will be removed.

For the remaining four production wells that are shut-in (Pateke-3H, Pateke-4H, Amokura-2H and Tui-2H) the MODU/WIV will enter the wells and establish two abandonment plugs (**Section 2.4.6.1**) which are deep barriers to isolate the reservoir in accordance with the Oil & Gas UK 'Well Decommissioning Guidelines – June 2018' ((OGUK, 2018). After the installation of these abandonment plugs, the Xmas Trees will be retrieved, the well casings and conductors will be cut 3 m below seabed and the wellheads and casing stubs will be recovered. .

All recovered equipment will be transported to shore for scrapping, recycling or re-use.

The following sections will describe in more detail the activities to P&A each the production wells.

2.4.6.1 Installation of Abandonment Cement Plugs

Four of the production wells (Pateke-3H, Pateke-4H, Amokura-2H and Tui-2H) will be required to be plugged, with the fifth (Tui-3H) already plugged with permanent downhole cement barriers in place.

To complete this activity, a mechanical plug is generally placed below the cement plug setting depth with the purpose of holding the cement in place and preventing it from falling down the hole to allow the cement to set. This mechanical plug can be placed either on a wireline or in the end of a pipe.

Once the mechanical plug has been installed, pipe is then transferred into the well to the cement plug setting depth and cement is pumped down the pipe and into the well at the desired depth. The cement will now sit on the mechanical plug that was placed previously. The pipe is them pulled from the well to a depth above the cement plug and suspended for a few hours to allow the cement plug to harden and set.

The final step is to transfer the pipe back in the hole and tag the top of the cement plug to confirm its depth. If the cement is tagged lower than the planned depth, then a further cement plug may be required. Once the cement plug is confirmed in place and at the correct depth, then the cement plug pressure tested to confirm its pressure integrity. Each well may have multiple cement plugs to be placed depending on the final abandonment design. The minimum requirement is two; however, up to four plugs per well may be required.

Each cement plug will be carefully calculated to ensure the minimum volumes remain on the MODU/WIV once the cementing is completed. The total volume of cement slurry required for the cement plugs has been estimated at approximately 240 m^3 for the entire campaign. This volume is an over-estimation and includes a contingency volume to ensure that the plugs are appropriately designed for the wells.

On completion of cementing operations, the system will be washed with up to 3 m^3 of wash-water and discharged overboard. It is estimated that this discharge would be >95% water and the discharge would occur over approximately 30 minutes until the cement unit and topside pipework is cleaned sufficiently. Additionally, very small amounts of dry cement dust may be blown from the deck of the MODU/WIV during handling, resulting in it entering the marine environment where it will ultimately sink and be deposited on the seabed.

2.4.6.1.1 Wireline Logging

Wireline logging involves placing various geophysical and mechanical tools down the well on a cable (the wireline) which will provide a detailed assessment of the rock and fluid types within the wellbore in a stable downhole environment. Wireline logging will be undertaken during the P&A activities and will focus on assessing the cement condition behind the casing, cutting casing, punching casing and other contingency activities.

2.4.6.2 Further Well Abandonment Activities

Cement plugs will be set as per **Section 2.4.6.1** above, and once in place, the following activities will be conducted:

The well above the cement plug is filled with seawater, displacing any well fluids back to the MODU/WIV;

- The internal tubing within the wellbore is then cut below the wellhead and retrieved back through the Xmas Tree and back up to the MODU/WIV;
- The production casing is then cut below the wellhead and pulled back through the Xmas Tree and back to MODU/WIV;
- The BOP, lower marine riser package (the upper section of a two-section subsea BOP) and riser are then retrieved back to the MODU/WIV;
- The Xmas Tree is then disengaged from the wellhead and pulled back to the MODU/WIV;
- The wellhead, surface casing and conductor will then be cut with an internal casing-cutting tool approximately 3 m below the seafloor;
- After the cutting operations are finished, the wellhead is retrieved back up to the deck of the MODU/WIV or one of the support vessels; and
- An ROV will then survey the seabed to confirm removal of all remaining equipment.

2.4.6.3 Workover Fluids

Water-based workover fluids are required to be used during the abandonment process and will be subsequently discharged as part of the Tui decommissioning. The fluids will either be discharged via the riser system when disconnecting, batch discharged either to freshen the fluid system and bring the properties back into specification or the potential batch discharge of fluid at the end of a well abandonment when they cannot be re-used, or part discharged with an interface between fluid types (different weighted brines). There will be no oil-based fluids used, and the environment will not be exposed to oil-based fluids as part of the well abandonment activities.

There are no harmful substances contained within the workover fluids.

2.4.6.4 Other Depositions

During the P&A of the Tui field there will be times when deposition of material occurs on the seabed such as workover fluids (discussed in **Section 2.4.6.3**), cement (discussed in **Section 2.4.8.2**) and milling swarf.

In terms of the milling swarf (metallic waste), if a section of the steel casing needs to be cut and retrieved from the well as part of the abandonment programme, milling swarf is generated. Milling swarf is returned to the MODU/WIV entrained within the workover fluid where it is separated out using magnets located in the cuttings ditch onboard the vessel. However, while most of the milling swarf will be recovered and sent to shore for disposal, a minor amount may be released into the sea. Discharged milling swarf is expected to fall through the water column and onto the seabed following discharge. However, due to the different size, shape and surface area of the milling swarf, swarf materials may settle at a slightly different rate (i.e. quicker and closer to the point of discharge).

2.4.7 Removal of MODU

Following the completion of the P&A operations, the MODU/WIV will demobilise from the well location. During demobilisation, the support vessels will maintain standby operations throughout the process.

If a DP MODU or WIV are used there will be no disturbance to the seabed during the removal process other than removal of positioning beacons.

If a semi-submersible MODU that uses an anchoring array is used, then the seabed will be disturbed through the retrieval of the anchors and mooring chains. The chains that hold the anchors and MODU in place will be relaxed and the support vessel(s) will assist in lifting the anchors and chains from the seabed. Once all of the anchors are on board the MODU or the support vessels, if not self-propelled, the MODU will be towed from the site.

As for the installation of the semi-submersible MODU, the extent of disturbance on the seabed is directly correlated with the size and number of anchors. This is outlined in **Section 2.4.4**, albeit there will be a slight increase in area around the anchor/mooring line that are removed due to the disturbance associated with the extraction of the anchors from under the seabed and/or any horizontal movement of the mooring lines.

Once the MODU has demobilised from the well location, the MODU will be either self-propelled or wet-towed to its next location. If it has finished operations in New Zealand, and is not DP, it may require transportation by a Heavy Lift Vessel, the MODU will be wet-towed to an appropriate location in the Coastal Marine Area (**CMA**) for the float-on operations. If self-propelled, it may depart New Zealand waters under its own power.

2.4.8 Contingent Activities

During the P&A activities it is necessary to have the ability to adapt to the conditions present at the well sites at the time abandoning the wells. While the activity description in **Section 2.4.1** to **2.4.7** provides a degree of flexibility, the following activities may also be required in exceptional circumstances.

Planned and unplanned disconnection of BOPs, additional cement plugs, the use of explosives and faulty cement disposal are not planned as a part of the P&A activities and will only be used as a last resort in response to unavoidable complications relating to the operations on any particular well. These activities are described in more detail in the following sections.

2.4.8.1 Planned and Unplanned Disconnection of BOP

A MODU can maintain its position above a well location within a range of allowable movements or tolerances. A moored MODU will use the anchor spread to maintain position. It can automatically adjust tension on anchor wires to maintain position. The MODU can also quickly pull and release anchor wire to allow it to kedge away from the well if required.

A planned disconnection is not foreseen to be required as the MODU/WIV selected will be designed for operating in adverse weather conditions. An operability study against the metocean conditions predicted within the Tui field area has been conducted which will be a key part of the MODU/WIV selection criteria. However, if adverse weather conditions were forecast, surpassing the station keeping capabilities or mooring capabilities, abandonment operations would cease and a planned disconnect from the well would occur. The well would be shut in at the BOP, forming a pressure-tight seal, the abandonment fluids remaining in the riser would be circulated out back to the MODU and fully displaced with sea water prior to a planned disconnecting of the riser from the BOP. The BOP would be left closed on the seabed. Following the weather system passing through, the MODU is then able to reposition back on the well location and reconnect to the BOP and Xmas Tree.

A MODU also has the ability to disconnect in an emergency. This scenario is highly unlikely to occur; however, under an unplanned emergency disconnect, an automatic system will trigger a sequence that closes the BOP, making the well safe, and then automatically disconnects the riser from the well at the BOP level, with the majority of the BOP remaining on the wellhead to make the well safe. The MODU, along with the riser would then be allowed to move away from the well to a safe zone. Any fluid within the riser, approximately 200 barrels (32 m^3) of brine (water and salt), would be released to the ocean.

If a WIV and IL are used then the vessel will have the ability to stop operations, disconnect any pipes, flowlines and control umbilicals from the IL and recover back to the vessel before moving off location and waiting for the weather to pass before reconnecting.

2.4.8.2 Additional Cement Plugs

Additional cement plugs may be required to be installed in the well to ensure the abandonment objectives are met or due to integrity issues identified in the wells. The following contingency cement barriers may be required:

- Additional secondary cement plugs in the event that the planned cement barriers are not of adequate length, or their integrity is not able to be verified;
- Annulus cementation in the event that the annulus cement installed in the well construction phase is found to be deeper than expected or its integrity is not able to be verified;
- Intermediate or surface cement plugs in the event that the primary barriers cannot be placed as planned, and/or the production casing integrity has been compromised; and/or
- Environmental cement plug in the event that contaminants are found in the well from production operations that are required to be isolated from the marine environment.

2.4.8.3 External Cutting of Wellhead

As outlined within **Section 2.4.6.2**, the wellhead, surface casing and conductor is proposed to be cut with an internal casing-cutting tool. This method is the primary means of cutting the wellheads off. However, as a contingency activity, this may be done using an ROV which will excavate by jetting, suction dredging or air lift around the conductor (out to approximately 9 m in diameter around the well location) at the seabed to make the external cut using a diamond wire saw or similar. The provision for the external cuttings has been included within this consent application in case operational constraints require this to be undertaken.

2.4.8.4 Use of Explosives

Explosives may be used in contingency circumstances, such as:

- To perforate a casing to allow the placement of remedial cement if the cement behind the casing is lost or to allow trapped pressure behind the casing to be bleed off (just above the production packer at approximately 2,600 m below the seabed);
- To sever the work string in the event that it gets stuck and conventional methods cannot free the string (below the production packer at approximately 2,650 m below the seabed); and
- To free the casing/tubing by parting the coupling to allow the pipe thread to be released under tension (just above the production packer at approximately 2,600 m below the seabed).

Of the three scenarios outlined above, the most likely to be used during the decommissioning of the Tui field is the casing perforation for the plugging operations at a depth of approximately 2,600 m below the seabed, just above the production packer. If these perforations are required, the size (power) of the explosion would be designed by a specialist to ensure it is an appropriate solution given the situation. Typically, a wireline will lower a conveyance mechanism which includes shaped charges (or punches) which are spaced by the detonating cord in order to create holes in the casing. Usually there will be between four and six charges of HMX (Cyclotetramethylene Trinitramine), each between 3 and 60 g, to perforate the casing resulting in holes approximately 10-15 mm in diameter. Due to the depth below the seabed at which these explosives are used, it is not anticipated to be felt at the surface of the seabed.

Explosives have been used in the past in the Taranaki region, including during the drilling of the Pateke-4H well in the Tui field. Therefore, the potential to use explosives has been included within this marine consent application out of an abundance of caution.

2.4.8.5 Faulty Cement Disposal

On very rare occasions cement batches may be prepared but are unsuitable for use (e.g. the cement is not weighted or setting correctly) and the full batch of approximately 10 m^3 of cement may need to be discarded. Unused or faulty cement is required to be immediately pumped out of the tanks and sent overboard to prevent it from hardening within tanks, pumps, and pipelines. If the cement is left to harden this would lead to logistical issues, safety concerns, and high costs associated with trying to clean and fix the affected equipment.

While this activity has not been required during any of the Tui drilling campaigns in the past, it is possible that it may occur during P&A.

There are a number of cement jobs associated with abandoning each well (see **Section 2.4.6.1**). There is a possibility that any of these cement jobs could result in a cement batch which is unsuitable for use and needs to be released to the sea, however, this is an extremely rare event. As such, it may not happen at all during the P&A activities, or it may happen more than once. All practicable steps will be implemented to ensure that the cement prepared is appropriate for use and that this release does not occur.

If there is an unsuitable batch requiring disposal, it will be further diluted with water prior to release – this should minimise deposition on the seabed of the heavier components of the cement.

2.5 Discharges Associated with Decommissioning Activities

As part of the decommissioning activities outlined within **Sections 2.3.2**, **2.3.4**, **2.3.4** and **2.4.6.1**, there will be discharges of harmful substances associated with certain activities. The following sections provide an outline of the discharges of harmful substances for which marine discharge consent is sought.

2.5.1 Discharge of Biocide Inhibited Seawater

As part of the demobilisation works for the FPSO, the production flowlines and gas-lift lines were chemically flushed and displaced with biocide inhibited seawater. The production flowlines previously contained produced water with a small percentage of hydrocarbons, this being the reason for flushing in advance of recovery of the flowlines. The biocide inhibited seawater will be discharged as part of the retrieval operations of the production flowlines and gas-lift lines described in **Sections 2.3.2** and **2.3.4** as there is no practicable alternative to the discharge.

The biocide used in the production flowlines and gas-lift lines is 'BE-9' which was dosed at the supplier's recommended rate of 8 L of BE-9 per 31,800 L of seawater. **Table 9** provides specifics of BE-9 based on the information found within the Safety Data Sheet (**SDS**) found in **Appendix B**. This means there is approximately 176 L of BE-9 in the combined volume of approximately 700,000 L of seawater that was left inside the production flowlines and gas-lift lines, at a BE-9 concentration of 251 parts per million (**ppm**). It should be noted that the active component within BE-9, being tributyl tetradecyl phosphonium chloride, constitutes 5-10% of BE-9, meaning the concentration of tributyl tetradecyl phosphonium chloride is, at worst, 25.1 ppm.

Table 9 Harmful substance within the biocide inhibited seawater

Harmful substance	Constituent(s)	CAS No.	GHS 7 Classification	Solubility/ Emulsification	Intended use
BE-9	Tributyl tetradecyl phosphonium chloride	81741-28-8	Chronic Category 1	Miscible with water	Biocide

The discharge of this biocide inhibited seawater will occur during the retrieval process of the production flowlines and gas-lift lines as the lines are brought to the surface, noting they will be severed and cut at various places along their lengths (i.e. either side of the MWAs and at the Xmas Tree). The 'bottom end' of the production flowlines and gas-lift lines will be open to the sea, meaning the biocide inhibited seawater will flow out of the line while the 'top end' of the line is lifted upwards to the CSV. The retrieval process will result in a near continuous discharge of the biocide inhibited seawater to the water column near the seabed. There will be short periods of time between discharges as the CSV manoeuvres to the next line to be retrieved.

The total time period over which this discharge occurs is not known at this stage as the company undertaking the work have yet to be contracted, and the works will be subject to potential delays due to operational and/or weather constraints. However, the most likely worst-case discharge will be during the retrieval of the ~6 km long Pateke-3H production flowline which could be retrieved over a period of one day, resulting in a discharge rate of 3.37 L/s of biocide inhibited seawater.

2.5.2 Discharge of Residual Hydrocarbons

The production flowlines previously contained produced water and varying percentages of hydrocarbons (oil), which were chemically flushed as part of the demobilisation of the FPSO. The flushing was undertaken to remove as much of the hydrocarbons as possible so as to minimise the potential for hydrocarbons to be released from the flowlines during the decommissioning activities.

While the actual quantities of hydrocarbon removed as a result of the flushing are unknown, the removal efficiencies are estimated to be in the order of 75-95%, meaning that somewhere between 5-25% of the hydrocarbons that were present before the flushing may still remain in the flowlines. These remaining residual hydrocarbons may be discharged from the production flowlines as part of their retrieval (described in **Section 2.3.2**) and there is no practicable alternative to the discharge. The definition of 'harmful substance' in the D&D Regulations includes 'oil' and, as such, a marine discharge consent is needed for the discharge of the residual hydrocarbons within the production flowlines. In addition, information is available on the make-up of the residual hydrocarbons and this is presented in **Table 10**, being based on the information contained within the SDS for 'Tui Crude Oil' in **Appendix B**.

Table 10 Harmful substances within residual hydrocarbons

Harmful substance	Constituent(s)	CAS No.	GHS 7 Classification	Solubility/ Emulsification
Residual hydrocarbons (Tui Crude Oil)	Petroleum crude oil (>99%)	8002-05-9	Chronic Category 1	Immiscible
	Benzene (<1%)	71-43-2		

It is important to note that the residual hydrocarbons remaining in the production flowlines are very unlikely to be released during the flowline recovery process. This is because the flushing was undertaken at relatively high flow rates and pressures, meaning that any residual hydrocarbons left in the flowlines are expected to be adhered to the internal walls. It is very unlikely that the surface tension holding the residual hydrocarbons to the internal walls will be overcome as a result of the passive draining of the flowlines during the gradual recovery process. However, for the purposes of this assessment, it has been assumed that 5% of the hydrocarbons adhered to the walls of the flowlines may be dislodged (released) and be discharged during the retrieval process. **Table 11** presents information on the estimated quantity of residual hydrocarbons remaining in each of the production flowlines based on a worst-case (lowest) flushing removal rate of 75%. In addition, **Table 11** presents the worst-case (largest) volume of residual hydrocarbons that is estimated could be discharged from each production flowline (based on 95% adherence factor, or 5% dislodgement factor of the residual hydrocarbons thought to be present in the flowlines). The total estimated volume of residual hydrocarbons that may be discharged from all the production flowlines is ~171 L (1.1 bbl), the majority of which (~68%) would be from the Pateke-3H flowline, this being because it is the longest flowline and had the highest percentage of hydrocarbons (3.2%) prior to flushing.

Table 11 Estimated volume of residual hydrocarbons from production flowlines that may be discharged

Production Flowline	Total Internal Volume of Production Flowline (including riser)	Estimated Percentage Hydrocarbons Before Flushing	Estimated Volume of Hydrocarbons Before Flushing	Estimated Range of Volumes of Hydrocarbons Remaining After Flushing (75% removal)	Estimated Volume of Hydrocarbons that may be discharged (5% of remaining hydrocarbons after flushing)
Tui-2H	95,918 L	0.7%	671 L	168 L	8 L
Tui-3H	95,918 L	1%	959 L	240 L	12 L
Amokura—2H	116,945 L	1.1%	1,286 L	322 L	16 L
Pateke-3H	290,929 L	3.2%	9,310 L	2,327 L	116 L
Pateke-4H	45,110 L	3.2%	1,444 L	361 L	18 L
Total					**171 L (1.1 bbl)**

The discharge of the residual hydrocarbons may occur during the retrieval process of the production flowlines as the lines are brought to the surface, noting they will be severed and cut at various places along their lengths (i.e. either side of the MWAs and at the Xmas Tree). The 'bottom end' of the production flowlines will be open to the sea, meaning the contents (including any residual hydrocarbons) will flow out of the line while the 'top end' of the line is lifted upwards to the CSV. The retrieval process will result in a near continuous discharge of the contents to the water column near the seabed. There will be short periods of time between discharges as the CSV manoeuvres to the next line to be retrieved.

The total time period over which this discharge occurs is not known at this stage as the company undertaking the work has yet to be contracted, and the works may be subject to potential delays due to operational and/or weather constraints. Estimations of the worst-case discharge are based on the retrieval of the ~5.6 km long Pateke-3H production flowline which could be retrieved over a period of one day, resulting in a discharge rate of 3.37 L/s of the contents of the flow line, with a discharge rate of 0.0013 L/s of residual hydrocarbons.

2.5.3 Discharge of BOP Fluid

A BOP is a safety device that is used to prevent the uncontrolled flow of liquids and gases during well operations, that is capable of being remotely controlled. When the BOP is closed, a pressure-tight seal is formed at the top of the well, preventing the fluids from escaping. The BOP will be compliant with the American Petroleum Institute's Standard 53 "Well Control Equipment Systems for Drilling Wells" which is recognised as industry best practice.

As part of the BOP operation a small amount of BOP control system fluid is discharged every time a component of the BOP is functioned, with function tests (approximately weekly) and BOP tests (at least every 21 days) involving functioning a large number of components.

The discharge of harmful substances within the BOP fluid will occur from the BOP located approximately 15 m above the seafloor.

As the MODU/WIV is yet to be contracted to undertake the P&A work, the exact harmful substance(s), if any, to be discharged from the BOP is not certain. However, MBIE is applying to discharge Erifon HD 603 HP No Dye (**Erifon HD**) which is diluted in water to a 50:1 ratio (50 parts water, 1 part Erifon HD) as it was used by the COSL *Prospector* (a MODU recently used in New Zealand waters). **Table 12** provides specifics of Erifon HD based on the information found within the SDS found in **Appendix B**.

Table 12 Harmful substances within the BOP fluid

Harmful substance	Constituent(s)	CAS No.	GHS 7 Classification	Solubility/ Emulsification	Intended use
Erifon HD 603 HP No Dye	Ethylene glycol (25 – 35%)	107-21-1	Chronic Category 1	Not available	BOP fluid
	Amides, tall-oil fatty, N,N-bis(hydroexyethyl) (10-20%)	68155-20-4			
	Decanoic acid (5-10%)	334-48-5			
	Diathanolamine (5-7%)	111-42-2			
	N,N'-methylene-bis [5-methyloxazolidine] (1-3%)	66204-44-2			
	Ingredients determined not to be hazardous, including water (balance)	-			

The larger of the two tests, the BOP test, will take approximately four hours to complete, and will involve multiple valves/rams on the BOP being tested (some at the same time). Over this testing period, it is estimated that approximately 2,000 L of BOP fluid will be discharged. However, Erifon HD only contributes a small percentage of the BOP fluid, with Erifon HD constituting approximately 40 L (at a dilution rate of 50:1 water).

Over the course of the P&A activities, it is anticipated that the BOP will be on each well for 7 to 14 days (i.e. the BOP will not be located on the well for the full time it takes to P&A that well). As the function testing of the BOP will result in a smaller volume of discharge, the BOP test has been utilised for assessment purposes, with each of these tests resulting in a small amount of intermittent discharge (up to four hours at a time), with the vast majority of the time the BOP not discharging anything.

Over the course of the entire P&A phase of the decommissioning activities, it has been estimated that a total of ~36,000 L of BOP fluid will be discharged (this includes a 50% contingency to account for operational/weather downtime). Of this ~36,000 L of BOP fluid, approximately 720 L of Erifon HD will be discharged.

2.5.4 Discharge of Cement Additives

As outlined within **Section 2.4.6.1**, installing the cement plugs for the decommissioning of all of the wells in the Tui field will involve approximately 240 m^3 of cement slurry. Cement additives are included in the cement slurry and some of these are harmful substances. The proposed recipe of the cement slurry (for all of the cementing operations required for all of the P&A works) includes approximately 250 L of a substance called 'NF-6' (**Table 13**) which is a harmful substance under the D&D Regulations (albeit, this is only a very small proportion of the total 240 m^3 of cement slurry). NF-6 is added to cement mixes to reduce foaming which can affect the performance of the cement and affect the efficacy of pumping the cement into the wellbore. It is worth noting that as cement plugs are located downhole, this volume of cement is not discharged directly to the surrounding marine environment. **Table 13** provides specifics of NF-6 based on the information found within the SDS found in **Appendix B**.

Table 13 Harmful substances within the cement slurry

Harmful substance	Constituent(s)	CAS No.	GHS 7 Classification	Solubility/ Emulsification	Intended use
NF-6	Vegetable oil	Proprietary	Chronic Category 2	Dispersible	Cement defoamer

Unlike the cementing operations in exploration drilling which can lead to diffuse discharge of substances while the cement sets, the cement plugs associated with the P&A operations are undertaken within the wellbore themselves. The plugs are proposed to be completed at the reservoir level, and near the surface. However, the surface plug is unlikely to contact the seawater in the surrounding environment as it is still below the seabed and as such, any diffuse discharge of harmful substances from the setting of the cement will be very minor.

Once cementing operations are complete, the system/machinery will be washed, with up to 3 m^3 of wash-water per cement plug; this wash-water is discharged overboard from the MODU/WIV. It is estimated that this discharge would be >95% water (thereby diluting the small percentage of harmful substance even further) and the discharge would occur over approximately 30 minutes until the cement unit and topside pipework is cleaned sufficiently and could occur up to two times per well. The volume of cement within this wash water will be minimised as far as practicable by carefully calculating the amount of cement required for each cement plug; however, any excess cement that remains in the tank is required to be pumped overboard to avoid that cement from hardening within the machinery.

In addition to that above, there is a potential that, in some exceptional situations, an entire cement batch may be required to be discarded overboard due to an error in the cement mixing process, or when there is a mechanical failure during the pumping of the cement. The discharge of this excess cement is a contingent activity and will be avoided as much as possible but is included within this application out of an abundance of caution. If this situation occurs, up to 10 m^3 of cement will need to be pumped out of the tanks and discharged overboard to prevent it from hardening within the tanks, pumps, and pipework. All practicable steps i.e. trained, qualified and competent cementers will be employed, and project specific cement recipes developed and followed to ensure that the cement prepared is appropriate for use and that this release is not required.

2.6 Environmental Monitoring

As part of the decommissioning activities in the Tui field, MBIE is proposing to undertake environmental monitoring prior to and after retrieval of the SSI and P&A of the wells. The purpose of the proposed environmental monitoring is to assess the extent of the seabed disturbance and to monitor the recovery of the benthic marine environment and determine any changes in the sediment physico-chemical properties and biological communities.

The proposed environmental monitoring is divided into two phases: 1) pre-decommissioning; and 2) post-decommissioning. Due to the tight timeframes associated with the decommissioning of the Tui field, including the time between obtaining this marine consent and beginning the decommissioning works, the pre-decommissioning monitoring will be undertaken in the summer period (December 2021 to March 2022). Therefore, this will be undertaken under the Exclusive Economic Zone and Continental Shelf (Environmental Effects – Permitted Activities) Regulations 2013 (**Permitted Activities Regulations**). As such, the following discussion and the associated assessment within **Section 7.2.3** has focused on the disturbances associated with the post-decommissioning monitoring.

The activities included within environmental monitoring involve the disturbance of the seabed and the removal of non-living material through the use of benthic survey equipment such as Van-Veen grab samplers. The use of benthic survey equipment can disturb the seabed in a way that will adversely affect those individual marine species that are removed as part of the captured seabed sample. No sampling equipment will be permanently deployed on the seabed.

An Environmental Monitoring Plan (**EMP**) will be prepared as a requirement of the proffered conditions with this marine consent (**Appendix A**). The EMP will provide the specific sampling methodology to be conducted at the Tui field pre- and post-decommissioning and consist of two elements: 1) imagery; and 2) sediment analysis. These are discussed in further detail below.

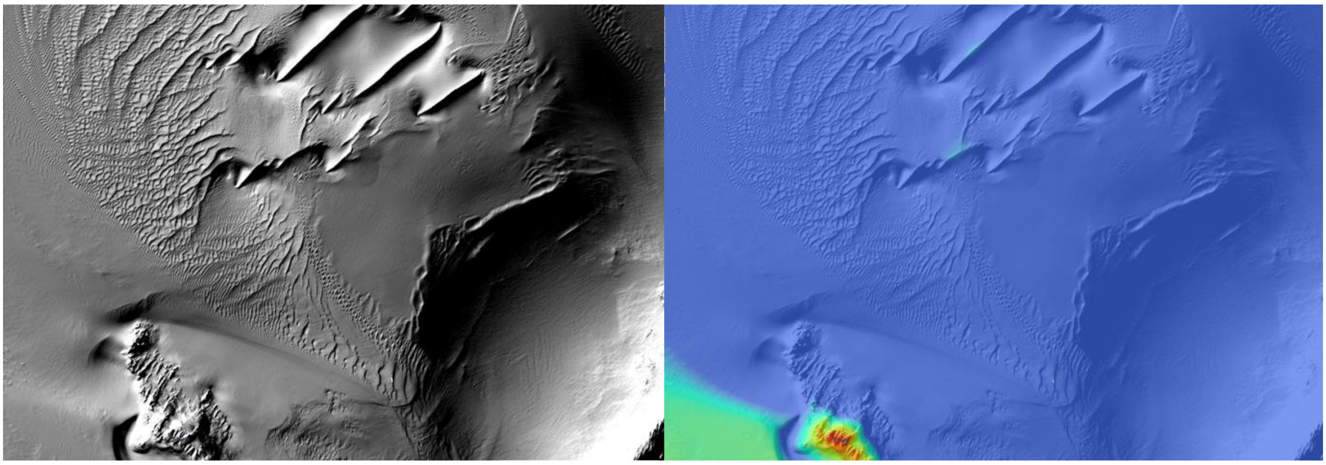
2.6.1 Imagery

2.6.1.1 Multibeam Echo Sounder

A Multibeam Echo Sounder (**MBES**) survey is proposed to be undertaken pre-decommissioning and following removal of the SSI. The MBES survey area will include all the Tui field SSI and wells plus a buffer area, and will be undertaken prior to any physical works taking place.

The outputs of the MBES survey will be a high-resolution bathymetric image of the seabed such as the examples provided in **Figure 15** (the same area is presented in both images, one version as hillshade and the other coloured)[1].

Figure 15 Example output of MBES survey



The pre-decommissioning MBES survey will create a ‘baseline’ against which the post-decommissioning MBES survey can be compared. The outputs of the post-decommissioning MBES survey will be compared to the outputs of the pre-decommissioning MBES, and this comparison assessment will serve two purposes: 1) it will confirm, or otherwise, that all the SSI has been removed; and 2) the scale and locations of seabed disturbance associated with the decommissioning activities will be able to be determined. The results of the latter will be used to identify the locations where post-decommissioning benthic imagery surveys will be undertaken and refine the positions of the seabed sediments sampling stations (both discussed below).

2.6.1.2 Benthic Imagery Transects

A seabed imaging platform, towed by a survey vessel, will be utilised to obtain semi-quantitative epibenthic data through interpretation of video and/or still imagery that will be collected.

[1] These images are from the Marlborough District Council’s Smart Maps and show an area to the north of Arapawa Island in the Marlborough Sounds.

The locations of the post-decommissioning benthic imagery will be determined by analysing the outputs of the post-decommissioning MBES survey and will target the areas where the greatest disturbance has occurred. Additional existing imagery is available from benthic imagery gathered as part of the monitoring of marine consent EEZ300006 and a 2020 ROV Survey (**Appendix C**) which included visual assessment of the epibenthic and fouling communities.

The total number and length of the transects utilising a seabed imaging platform will be detailed within the EMP. However, it is anticipated that ~35 transects, each being ~250 m in length, will be conducted across the areas of greatest disturbance. This indicative number and length of transects has been utilised for assessment purposes in this marine consent application; however, this number may change depending on the development and subsequent approval of the EMP.

An example of the type of seabed imaging platform is a video sled which has been used in previous environmental monitoring in the Tui field. If a similar platform is utilised for the benthic imagery transects associated with this environmental monitoring, the disturbance associated with this seabed imaging platform corresponds to the skids/runners along its base which may result in shallow indentations (usually less than 10 mm deep) in the soft mud sediments at the Tui field when the platform touches the seabed. The total disturbance of the seabed from this seabed imaging platform is difficult to determine as it will depend on the final arrangement of the video imagery proposed in the EMP. However, utilising the example outlined above, each of the 250 m long transects would equate to approximately 20 m^2 of seabed disturbance (based on the runners being 40 mm wide each), totalling 700 m^2 for approximately 35 transects. It should be reiterated that this area of disturbance is only indicative and will be subject to the number and placement of the video transects and the seabed imaging platform utilised.

In addition to the benthic imagery transects, footage from ROVs used during the decommissioning activities will be analysed to determine and document seabed disturbance to supplement the pre- and post-decommissioning imagery.

2.6.2 Sediment Analysis

Post-decommissioning physical seabed sampling (grab/core sampling) is proposed to be undertaken at and around the locations of greatest physical disturbance, with focus areas being where larger scale disturbance of the seabed has occurred and/or where the decommissioning activities may result in the discharge of materials to seabed and/or water column. Sediment samples collected by a grab sampler are proposed to be analysed for the following:

- Infauna macrofauna species;
- Chemical analyses for:
  - Polycyclic aromatic hydrocarbons (**PAHs**);
  - Total petroleum hydrocarbons (**TPH**);
  - Benzene, toluene, ethylbenzene, and xylene;
  - The following metals and metalloids: As, Ba, Cd, Cr, Cu, Pb, Ni, Mg, Mn, Fe, Zn, Hg;
  - Total organic carbon; and
- Particle grainsize distribution.

It is not proposed to undertake monitoring associated with the potential impacts on microphytobenthos from the decommissioning of the Tui field. This is due to the fact that the environmental monitoring undertaken in the South Taranaki Bight over the last ~10 years, including within the Tui field, has not resulted in any observations of conspicuous microphytobenthos. Therefore, this type of monitoring is not proposed or considered necessary.

An indicative design (**Figure 16**) of a possible sampling station layout for benthic sample collection has been developed to provide an estimation of the seabed disturbance associated with this activity for assessment purposes in this consent application. The specific number and location of these sampling stations may change, with the final sampling design proposed to be completed as part of the development of the EMP which would be a condition of the consent. Nevertheless, the following discussion outlines the rationale for the locations shown in **Figure 16**.

Twelve disturbance locations have been identified for focused sampling effort, these being the eight wells subject to P&A activities, two representative MWAs (of the four total) and two representative production riser hold-back anchors (of the four total). In addition, two far-field control stations have been included that have similar depth and benthic habitat characteristics for comparing the results with those of the disturbed areas and allowing some measure of the wider scale temporal changes that may be occurring region-wide over the decommissioning period. These far-field control stations align with the previous annual ecological effects monitoring undertaken in the Tui field focussed on effects of discharges from the FPSO.

The sampling focused on the eight wells (an example of which is shown in the top-left inset of **Figure 16**) has been initially designed based on the predominant current direction in the Tui field (**Section 4.2.3**), with two main depositional axes being to the north and south-southwest which should highlight the greatest impacts from the proposed activities. In addition, a minor depositional axis that is likely to be less impacted by deposition, has been utilised to the east for comparative purposes, except where an easterly axis intersected with disturbance activities in which case a westerly minor axis is used. A sampling station has been located at the disturbance site itself, along with two sampling stations along each identified axes, one at 50 m to determine close proximity impacts from the disturbance activities, and one ‘near-field control’ station at 250 m.

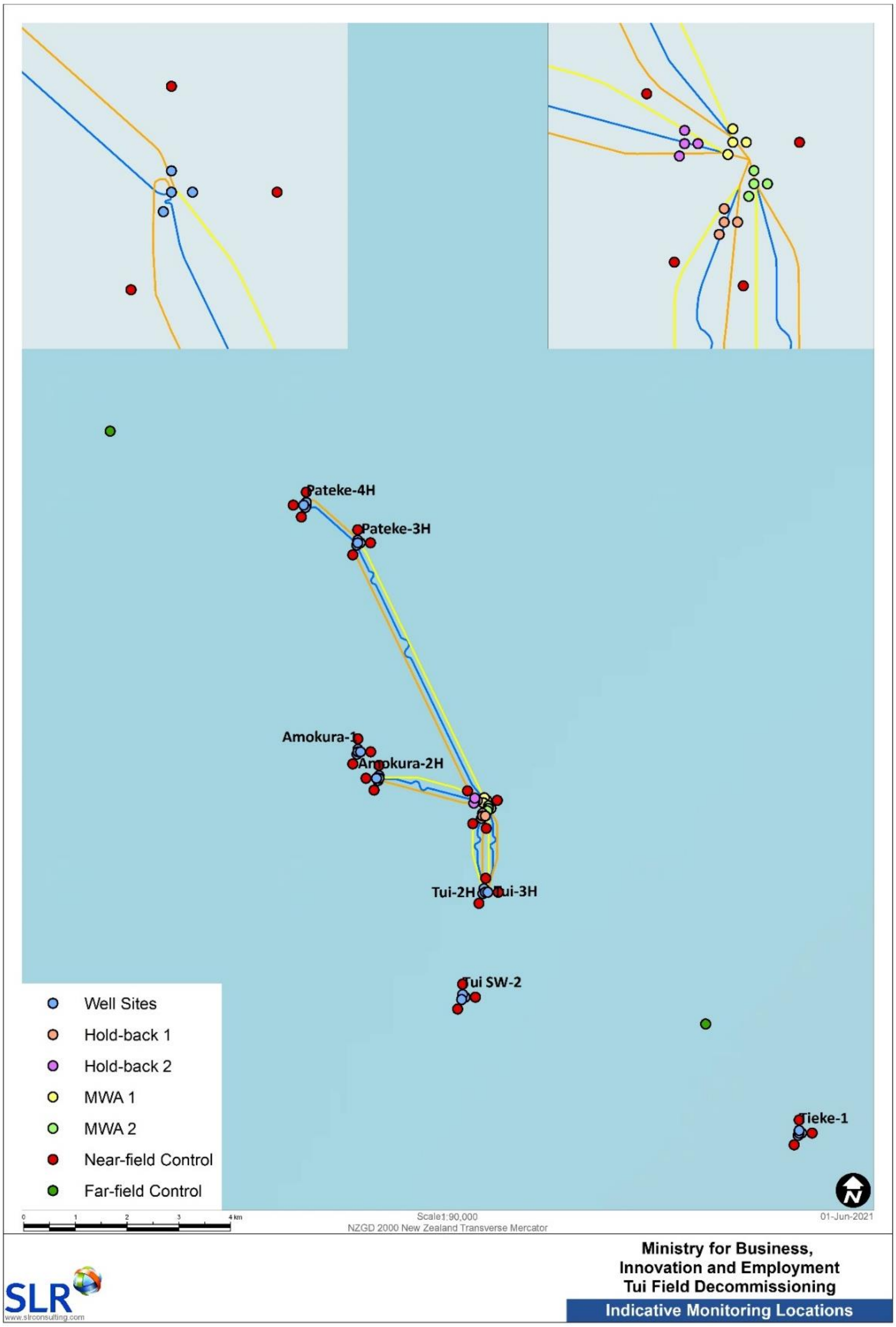
The sampling centred around the MWAs and production riser hold-back anchors is aligned with the description outlined above. However, as this area is a focal point for removal of several pieces of SSI, each of the four disturbance locations has not been able to include near-field controls along each axis as they would incur some sort of deposition/impact from SSI removal activities. Therefore, this whole area has essentially been treated as a single disturbance site with four near-field controls located around the SSI removal area, approximately 250 m from the highly disturbed areas as can be seen in the top-right inset of **Figure 16**.

The seabed sampling will be undertaken using a double Van-Veen grab sampler (or similar). It is anticipated that triplicate grab samples will be taken at ~72 stations in and around where there has been the greatest disturbance (as outlined above). As an example, each deployment of the double Van-Veen grab sampler currently utilised for these types of surveys in the offshore Taranaki region disturbs an area of seabed of approximately 0.21 m^2 (0.32 m x 0.64 m) and removes approximately 0.026 m^3 of sediment[2]. The total area of disturbance is difficult to determine as the final total number of sampling stations will be determined during the development of the EMP; however, assuming the indicative 72 triplicate grab sampling stations are collected, this equates to approximately 45.4 m^2 of seabed disturbance.

[2] Only a small proportion (<10%) of the total sediment volume collected would be physically retained for chemical/biological analyses and the remainder of the sediment is deposited back into the environment at/very-near the point of collection.

As with the video transects, this sampling design, and associated area of disturbance is only indicative and will be subject to the number and placement of the grab sample stations identified during the development of the EMP.

Figure 16 Indicative sediment sampling locations



2.6.3 Environmental Monitoring Frequency and Duration

As outlined in **Section 2.6**, the pre-decommissioning monitoring will occur prior to obtaining the marine consent for decommissioning activities under the Permitted Activities Regulations and will be timed for the summer period (December 2021 to March 2022) when previous benthic surveys in the Tui field have taken place. While MBIE aims to remove the SSI and P&A the wells as part of a single decommissioning campaign, it may be that there is a time delay between the two phases. The post-decommissioning MBES survey will occur as soon as practicable following the P&A works if both phases are completed together. In the event that there is, or is likely to be, a time delay between removal of the SSI and the P&A then the MBES survey will be undertaken as soon as practicable following removal of the SSI. As discussed earlier, the outputs of the post-decommissioning MBES survey will be used to confirm the locations of the sampling stations for benthic imagery and sediment sample collection and it is therefore important to identify these sites within a short timeframe of the physical disturbance having occurred.

MBIE proposes to undertake the initial post-decommissioning benthic imagery and collection of sediment samples in the first summer season (December to March) following completion of the P&A of the wells, irrespective of whether there has been a time delay between removal of the SSI and the P&A. The summer season has been selected because weather and sea-state conditions at this time of year are usually more settled and suited for the type of fieldwork necessary to complete the monitoring. Undertaking the benthic survey in the summer season also allows the most relevant comparisons with existing historical physico-chemical, biological, and imagery data collected in the Tui field as part of the routine benthic monitoring that was undertaken as a requirement of marine consent EEZ300006. Previous comparative work in the offshore Taranaki area has shown that significant temporal differences in biological communities can occur at similar locations between different seasons. Comparing results from a post-decommissioning environmental survey to the results of the previous monitoring surveys undertaken in a different season could result in differences being observed that are falsely attributed to the effects of the decommissioning activities when they are, in fact, partly or wholly, as a result of natural temporal (seasonal) variability.

The results from each monitoring station will be compared to the results obtained from the same stations during the pre-decommissioning survey (where possible) as well as those from the near- and far-field control stations. Following the initial post-decommissioning survey, MBIE is proposing to undertake a second post-decommissioning survey five years after the P&A works have been completed to assess the recovery of the benthic communities.

MBIE proposes to prepare a report following the completion of each monitoring event and a final report which summarises the monitoring results and include an assessment of the level of recovery that has occurred at each station.

No additional MBES survey work is proposed, or considered necessary, as part of this further annual environmental monitoring (should it be undertaken).

2.7 Activity Triggers and Consenting Requirements

Many of the activities proposed to be undertaken and described in the preceding sections of this IA are restricted by sections 20 or 20B of the EEZ Act. **Table 14** identifies which of the various activities trigger a marine consent or marine discharge consent requirement under sections 20 or 20B of the EEZ Act – the table also cross-references the sections of this IA which present a detailed description of the activities.

Table 14 Activity triggers and consenting requirements under the EEZ Act

Relevant section 20 and 20B restricted activities of the EEZ Act	Retrieval of production flowlines, umbilicals, and gas-lift CT from the seabed	Retrieval of MWA and GB	Retrieval of miscellaneous subsea equipment, hold-back anchors, GLJs, HFLs, EFLs, and GLM	Installation and subsequent removal of MODU/WIV	P&A of wells	Post-decommissioning monitoring
Section of IA where activity is described in detail	**Section 2.2.5** **Section 2.3.2** **Section 2.3.3** **Section 2.3.4** **Section 2.5.1**	**Section 2.2.5** **Section 2.3.7**	**Section 2.2.5** **Section 2.3.5** **Section 2.3.6** **Section 2.3.8** **Section 2.3.9**	**Section 2.2.5** **Section 2.4.3** **Section 2.4.4** **Section 2.4.7**	**Section 2.2.5** **Section 2.4.5** **Section 2.4.6** **Section 2.4.8** **Section 2.5.2** **Section 2.5.4**	**Section 2.6.1** **Section 2.6.2**
20(2)(a) the construction, placement, alteration, extension, removal, or demolition of a structure on or under the seabed	Triggered by the placement of a temporary parking stand on the seabed and its subsequent removal (an option being considered). Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal. Note: the removal of the production flowlines, gas-lift CT and umbilicals is considered more appropriately covered under the next two sub-sections as they are pipelines and cables, rather than structures.	Triggered by the alteration, demolition, and removal of the MWAs and their GBs (and associated clump weights). Triggered by the temporary placement of clump weights on the seabed and their subsequent removal (one of the options being considered). Triggered by the temporary placement of the MWAs on the seabed and their subsequent removal (one of the options being considered). Triggered by the temporary placement of hold-back rigging on the seabed and their subsequent removal (one of the options being considered). Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the alteration and removal of miscellaneous subsea equipment, hold-back anchors, GLJs, HFLs, EFLs, and GLM. Triggered by the temporary placement of recovery frame and its subsequent removal. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the temporary placement of MODU anchors and mooring lines on the seabed and their subsequent removal (if anchored MODU option is chosen). Triggered by the temporary placement of transponders and associated clump weights on the seabed and their subsequent removal. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the alteration of the wells and removal of wellhead infrastructure. Triggered by the temporary placement of a BOP on wellheads and its subsequent removal. Triggered by the temporary placement of BOP clump weights and their subsequent removal. Triggered by the temporary placement of the intervention manifold on the seabed and its subsequent removal. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the temporary placement of environmental monitoring equipment on the seabed and its subsequent removal.
20(2)(b) the construction, placement, alteration, extension, removal, or demolition of a submarine pipeline on or under the seabed	Triggered by the alteration and removal of the production flowlines and gas-lift CT (production flowlines and gas-lift CT are 'pipelines' under the EEZ Act as they are used for the conveyance of gas, petroleum, oil, water, any other mineral, liquid or substance as per the Submarine Cables and Pipelines Protection Act 1996).		Triggered by the alteration and removal of the GLJs and HFLs (GLJs and HFLs are 'pipelines' under the EEZ Act as they are used for the conveyance of gas, petroleum, oil, water, any other mineral, liquid or substance as per the Submarine Cables and Pipelines Protection Act 1996).			
20(2)(c) the placement, alteration, extension, or removal of a submarine cable on or from the seabed	Triggered by the alteration and removal of the umbilicals (umbilicals are 'cables' under the EEZ Act as they contain electrical cables).		Triggered by the alteration and removal of the EFLs (EFLs are 'cables' under the EEZ Act as they contain electrical cables).			
20(2)(d) the removal of non-living natural material from the seabed or subsoil						Triggered by collection of grab samples.
20(2)(e) the disturbance of the seabed or subsoil in a manner that is likely to have an adverse effect on the seabed or subsoil	Triggered by the removal of production flowlines and gas-lift CT off the seabed. Triggered by the placement of a temporary parking stand on the seabed (an option being considered).	Triggered by the removal of the MWAs and GBs off the seabed, including excavation by jetting, suction dredging, or air lift to reduce suction effects. Triggered by the temporary placement of clump weights on the seabed and their subsequent removal (one of the options being considered).	Triggered by the removal of the miscellaneous subsea equipment, hold-back anchors, GLJs, HFLs, EFLs, and GLM off the seabed, including excavation by jetting, suction dredging, or air lift to reduce suction effects. Triggered by the temporary placement of recovery frame and its subsequent removal.	Triggered by the temporary placement of MODU anchors and mooring lines on the seabed and their subsequent removal (if anchored MODU option is chosen). Triggered by the temporary placement of transponders and associated clump weights on the seabed and their subsequent removal.	Triggered by the temporary placement of BOP clump weights. Triggered by excess cement and/or milling swarf which may be discharged and land on the seabed (contingency activity). Triggered by the temporary placement of the intervention manifold on the seabed and its subsequent removal.	Triggered by the collection of grab samples and benthic imagery equipment disturbance of the seabed.

Relevant section 20 and 20B restricted activities of the EEZ Act	Retrieval of production flowlines, umbilicals, and gas-lift CT from the seabed	Retrieval of MWA and GB	Retrieval of miscellaneous subsea equipment, hold-back anchors, GLJs, HFLs, EFLs, and GLM	Installation and subsequent removal of MODU/WIV	P&A of wells	Post-decommissioning monitoring
	Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the temporary placement of the MWAs on the seabed and their subsequent removal (one of the options being considered). Triggered by the temporary placement of hold-back rigging on the seabed and their subsequent removal (one of the options being considered). Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	
20(2)(f) the deposit of any thing or organism in, on, or under the seabed	Triggered by the placement of a temporary parking stand on the seabed (an option being considered). Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed.	Triggered by the temporary placement of a clump weight on the seabed (one of the options being considered). Triggered by the temporary placement of the MWAs on the seabed (one of the options being considered). Triggered by the temporary placement of the hold-back rigging on the seabed (one of the options being considered). Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed.	Triggered by the temporary placement of recovery frame. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed.	Triggered by the placement of MODU anchors and mooring lines on the seabed (if anchored MODU option is chosen). Triggered by the temporary placement of transponders and associated clump weights on the seabed. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed.	Triggered by the temporary placement of BOP clump weights. Triggered by excess cement and/or milling swarf that may be deposited on the seabed (contingency activity). Triggered by the temporary placement of the intervention manifold on the seabed. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed.	Triggered by the temporary placement of environmental monitoring equipment on the seabed. Triggered by the deposition of sediment released from the monitoring vessel to the sea after preliminary processing onboard.
20(2)(g) the 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	Triggered by the removal of production flowlines and gas-lift CT off the seabed. Triggered by the placement of a temporary parking stand on the seabed (an option being considered). Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the removal of the MWAs and GBs off the seabed, including excavation by jetting, suction dredging, or air lift to reduce suction effects. Triggered by the temporary placement of clump weights on the seabed and their subsequent removal (one of the options being considered). Triggered by the temporary placement of the MWAs on the seabed and their subsequent removal (one of the options being considered). Triggered by the temporary placement of hold-back rigging on the seabed and their subsequent removal (one of the options being considered). Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the removal of the miscellaneous subsea equipment, hold-back anchors, GLJs, HFLs, EFLs, and GLM off the seabed, including excavation by jetting, suction dredging, or air lift to reduce suction effects. Triggered by the temporary placement of recovery frame and its subsequent removal. Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the temporary placement of MODU anchors and mooring lines on the seabed and their subsequent removal (if anchored MODU option is chosen). Triggered by the temporary placement of transponders and associated clump weights on the seabed and their subsequent removal. Triggered by the use of ROV near seabed, including the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the temporary placement of BOP clump weights and their subsequent removal. Triggered by excess cement and/or milling swarf that may be discharged and land on the seabed (contingency activity). Triggered by the temporary placement of the intervention manifold on the seabed and its subsequent removal. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the collection of grab samples and benthic imagery equipment disturbance of the seabed. Triggered by the deposition of sediment released from the monitoring vessel to the sea after preliminary processing onboard.

Relevant section 20 and 20B restricted activities of the EEZ Act	Retrieval of production flowlines, umbilicals, and gas-lift CT from the seabed	Retrieval of MWA and GB	Retrieval of miscellaneous subsea equipment, hold-back anchors, GLJs, HFLs, EFLs, and GLM	Installation and subsequent removal of MODU/WIV	P&A of wells	Post-decommissioning monitoring
20(4)(a) the construction, mooring or anchoring long-term, placement, alteration, extension, removal, or demolition of a structure, part of a structure, or a ship used in connection with a structure	Triggered by the placement of a temporary parking stand and its subsequent removal (an option being considered). Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the alteration, demolition, and removal of the MWAs and their GBs (and associated clump weights). Triggered by the temporary placement of clump weights and their subsequent removal (one of the options being considered). Triggered by the temporary placement of the MWAs and their subsequent removal (one of the options being considered). Triggered by the temporary placement of hold-back rigging and their subsequent removal (one of the options being considered). Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the alteration and removal of miscellaneous subsea equipment, hold-back anchors, GLJs, HFLs, EFLs, and GLM. Triggered by the temporary placement of recovery frame and its subsequent removal. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the temporary placement of MODU anchors and mooring lines on the seabed and their subsequent removal (if anchored MODU option is chosen). Triggered by the temporary placement of transponders and associated clump weights on the seabed and their subsequent removal. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the alteration the wells and removal of wellhead infrastructure. Triggered by the temporary placement of a BOP on the wellhead and its subsequent removal. Triggered by the temporary placement of BOP clump weights and their subsequent removal. Triggered by the temporary placement of the intervention manifold on the seabed and its subsequent removal. Triggered by the temporary placement of the ROV's work basket/toolbox on the seabed, and its subsequent removal.	Triggered by the temporary placement of environmental monitoring equipment on the seabed and its subsequent removal.
20(4)(b) the causing of 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	Triggered by the use of ROV operations and cutting activities.	Triggered by the use of ROV operations and cutting activities.	Triggered by the use of ROV operations and cutting activities.	Triggered by the use of ROV operations.	Triggered by the use of ROV operations and cutting activities. May be triggered by the rotation of work string.	Triggered if self-propelled underwater imaging system is used.
20(4)(c) the causing of an explosion					Triggered by the use of explosives.	
20B(1) the discharge of a harmful substance from a structure into the sea or into or onto the seabed	Triggered by the discharge of the contents of the production flowlines and gas-lift CT, which contain BE-9 biocide and any residual hydrocarbons (both harmful substances).				Triggered by the discharge of BOP fluid (a harmful substance) as part of regular testing of the BOP functionality. Triggered by the discharge of washwater from cement tanks and cement if required to be disposed of overboard.	

3 Legislative Framework

This is a combined application for a marine consent and a marine discharge consent to undertake activities associated with the decommissioning of the Tui field restricted by sections 20 and 20B of the EEZ Act, respectively. The following sections describe the requirements within the EEZ Act and the D&D Regulations. In addition, information is presented on relevant marine management regimes (**MMRs**) which assist in avoiding, remedying, or mitigating adverse effects on the environment or existing interests associated with the proposed activities.

3.1 Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012

3.1.1 Purpose

The EEZ Act came into force in 2013 to provide a comprehensive environmental consenting regime for activities within New Zealand's EEZ and continental shelf. Section 10 of the EEZ Act outlines its purpose and states:

(1) The purpose of this Act is –

(a) to promote the sustainable management of the natural resources of the exclusive economic zone and the continental shelf; and

(b) in relation to the exclusive economic zone, the continental shelf, and the waters above the continental shelf beyond the outer limits of the exclusive economic zone, to protect the environment from pollution by regulating or prohibiting the discharge of harmful substances and the dumping or incineration of waste or other matter.

*(2) In this Act, **sustainable management** means managing the use, development, and protection of natural resources in a way, or at a rate, that enables people to provide for their economic well-being while –*

(a) sustaining the potential of natural resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) safeguarding the life-supporting capacity of the environment; and

(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.

3.1.2 Section 20 Restrictions

Section 20 of the EEZ Act lists a number of activities that cannot be undertaken within the EEZ or in, or on, the continental shelf unless the activity is a permitted activity or authorised by a marine consent or sections 21, 22 or 23 of the EEZ Act.

A number of the proposed activities are restricted by section 20 of the EEZ Act and are not classified as permitted or authorised by a marine consent. The specific proposed activities restricted by section 20 of the EEZ Act are described in detail in **Section 2** and **Table 14** identifies how the activities fit within the relevant restriction(s) under section 20 of the EEZ Act for which marine consent is being sought.

3.1.3 Section 20B Restrictions

Section 20B of the EEZ Act restricts the discharge of harmful substances from structures and submarine pipelines into the sea or into or onto the seabed of the EEZ unless the discharge is a permitted activity or authorised by a marine (discharge) consent or sections 21, 22, or 23 of the EEZ Act.

The decommissioning of the Tui field will involve the discharge of harmful substances from a structure and from a submarine pipeline (the production flowlines and gas-lift CTs) – these discharges being restricted by section 20B of the EEZ Act as they are not a permitted activity or authorised by sections 21, 22, or 23 of the EEZ Act.

The specific activities which are included within the marine discharge consent component of this consent application are outlined in **Section 2.4** and **Table 14**, with the classification of these activities being detailed under the D&D Regulations (**Section 3.3**).

3.1.4 Information Requirements

As required by section 38 of the EEZ Act, an application for a marine consent or marine discharge consent must include an IA prepared in accordance with section 39 of the EEZ Act. Section 39 of the EEZ Act sets out what information must be included within an IA. **Table 1** summarises how these requirements are met in this document.

Sections 59, 60, and 61 of the EEZ Act set out matters the marine consent authority must take into consideration and principles it must apply when making a decision on an application for a marine consent or marine discharge consent. **Table 2**, **Table 3,** and **Table 4** summarise how these requirements are met in this document.

Importantly, section 61(1)(b) of the EEZ Act states that a marine consent authority must base its decisions on the 'best available information', being the best information that, in the particular circumstances, is available without unreasonable cost, effort, or time. The information presented in this consent application comprises the best available information.

3.2 Proposed Exclusive Economic Zone and Continental Shelf (Environmental Effects – Decommissioning) Regulations

The Government is in the process of developing regulations under the EEZ Act which would apply to decommissioning activities; however, they have not been finalised or come into force and therefore have no legal status or direct relevance in the consideration of this application[3]. These regulations are referred to as the Exclusive Economic Zone and Continental Shelf (Environmental Effects – Decommissioning) Regulations (**Decommissioning Regulations**) and the Government has released exposure drafts of the regulations for targeted consultation. Despite the fact the Decommissioning Regulations currently have no legal effect, it is considered appropriate to provide a brief discussion on them.

Sections 100A to 100D of the EEZ Act set out a process for an owner or operator of an offshore installation used in connection with petroleum production (among other things) to submit a decommissioning plan to the EPA for acceptance. The Decommissioning Regulations will inform this process, including in respect of the information that must be included in a decommissioning plan, and the criteria against which the plan must be assessed.

Section 100D of the EEZ Act requires a public consultation process in relation to a decommissioning plan that has been submitted for acceptance. The Applicant in such a process would need to consider each submission and either amend the plan in response to the submission or explain why it does not propose to amend the plan in response to the submission. If the EPA is satisfied that the plan meets the criteria set out in the Decommissioning Regulations, it must accept the plan. Once the owner or operator has an accepted decommissioning plan, they would need to apply for the required marine consents for undertaking the activities – these marine consents fall to be 'non-notified' by virtue of the definition of 'non-notified activity' in section 4 of the EEZ Act.

Section 38(3) of the EEZ Act states that any application for marine consent that relates to an activity that is to be undertaken in connection with the decommissioning of an offshore installation used in connection with petroleum production, or a structure, submarine pipeline, or submarine cable associated with such an installation must include an 'accepted decommissioning plan' that covers the activity, and the proposed carrying out of the activity must be in accordance with that plan.

Although not a regulatory requirement, MBIE has prepared a Decommissioning Plan (**Appendix D**) in parallel with this marine consent application (reflecting the policy intent of the draft decommissioning regulations) in order to mitigate the risk of the new regulations coming into force prior to MBIE's application being lodged, and to assist with project planning and stakeholder engagement.

[3] If the regulations come into force before a decision is made on the current application, they will still not have any direct relevance to this application. Clause 2 of Schedule 1 to the EEZ Act specifies that section 38(3) and Subpart 4 (consisting of sections 100A to 100D) of the EEZ Act do not apply in relation to an application made before the Decommissioning Regulations come into force. Where the Decommissioning Regulations are in force, section 38(3) requires that an application for an activity that is to be undertaken in connection with the decommissioning of an offshore installation (among other things) must include an accepted decommissioning plan that covers the activity; and the proposed carrying out of the activity must be in accordance with that plan.

3.3 Exclusive Economic Zone and Continental Shelf (Environmental Effects—Discharge and Dumping) Regulations 2015

The D&D Regulations set out the provisions for the discharge of harmful substances, including from offshore structures. The D&D Regulations provide classifications for different types of discharges of harmful substances, including activity statuses for some activities (i.e. permitted or prohibited) and processing pathway (i.e. non-notified).

Regulation 4 of the D&D Regulations provides the meaning of a 'harmful substance' as:

(a) a substance that is ecotoxic to aquatic organisms and is hazardous for the purposes of the Hazardous Substances (Minimum Degrees of Hazard) Notice 2017;

(b) oil;

(c) garbage;

(d) sediments from mining activities other than petroleum extraction.

Although regulation 4(a) of the D&D Regulations states that a harmful substance is one that 'is hazardous for the purposes of the Hazardous Substances (Minimum Degrees of Hazard) Notice 2017', this 2017 notice has been revoked and replaced by the Hazardous Substances (Hazard Classification) Notice 2020 (**the Notice**) which came into force on 30 April 2021[4]. Part D of the Notice requires that any enactment that refers to the 2017 notice must be treated as referring to the Notice.

The purpose of the Notice is to establish a hazard classification system for hazardous substances and gases under pressure by reference to the United Nations Globally Harmonised System of Classification and Labelling of Chemicals, 7th revised edition, 2017 (**GHS 7**), and by adopting classification categories for certain substances that are ecotoxic to the terrestrial environment.

If a substance is ecotoxic to aquatic organisms under the categories for aquatic ecotoxicity that New Zealand has adopted under GHS 7, then it is a harmful substance for the purpose of regulation 4 of the D&D Regulations. These categories under GHS 7 are:

- Hazardous to the aquatic environment acute (Category 1)
- Hazardous to the aquatic environment chronic (Category 1)
- Hazardous to the aquatic environment chronic (Category 2)
- Hazardous to the aquatic environment chronic (Category 3)
- Hazardous to the aquatic environment chronic (Category 4)

New Zealand has elected not to adopt the GHS categories 'hazardous to the aquatic environment - acute Category 2' and '- acute Category 3'. As such, substances that are currently classed as hazardous under GHS only by virtue of being in these categories (as a result of the characteristics and ecotoxicity) are not 'harmful substances' for the purpose of regulation 4 of the D&D Regulations.

4 https://www.epa.govt.nz/industry-areas/hazardous-substances/rules-for-hazardous-substances/epa-notices-for-hazardous-substances/epa-notices-no-longer-in-force/

As discussed in **Section 2.5.2**, residual hydrocarbons may be discharged from the production flowlines during their retrieval. These hydrocarbons meet the definition of being a harmful substance under the D&D Regulations under clause (b) as they are 'oil'.

This consent application seeks a marine discharge consent for discharges associated with the decommissioning of the Tui field classified as harmful substances under regulations within the D&D Regulations, noting the change in relation to the Notice, as discussed in the following paragraphs.

Regulation 20 of the D&D Regulations classifies the discharge of harmful substances described in regulation 4(a) from mining activities as a non-notified activity under the EEZ Act. The EEZ Act defines a 'mining activity' as:

> *"an activity carried out for, or in connection with, -*
>
> *(a) the identification of areas of the seabed likely to contain mineral deposits; or*
>
> *(b) the identification of mineral deposits; or*
>
> *(c) the taking or extraction of minerals from the sea or seabed, and associated processing of those minerals."*

This consent application relates to the decommissioning of the Tui field which was, until recently, in the process of extracting minerals from the seabed, and the associated processing of these minerals. It is considered that the activities associated with the decommissioning works align with this definition as they are being undertaken 'in connection with' the original mining activities. As such, any discharges from activities associated with the decommissioning are covered by regulation 20 of the D&D Regulations.

Based on the above, the discharges of cement, BOP fluid, and biocide inhibited seawater, all of which may contain a harmful substance(s), as well as the discharge of residual hydrocarbons, are covered by regulation 20 of the D&D Regulations – that is, they are classified as being a non-notified activity under the EEZ Act. A detailed description of these discharges is contained within **Section 2.5**.

3.4 Other Marine Management Regimes

Section 39 of the EEZ Act states that an IA must specify any measures required by another MMR and any measures required by or under the Health and Safety at Work Act 2015 that may have the effect of avoiding, remedying, or mitigating the adverse effects of the activity on the environment or existing interests. Further, section 59(2)(h) of the EEZ Act states that the EPA must take into account the nature and effect of other marine management regimes when considering applications.

Section 7 of the EEZ Act specifies what an MMR means and includes a list of MMRs that may be relevant to any particular activity. The MMRs that may be relevant to this marine consent (i.e. those that may include measures required by, or under, them which may have the effect of avoiding, remedying, or mitigating the adverse effects of the decommissioning activities on the environment or existing interests) are the:

- Biosecurity Act 1993;
- Crown Minerals Act 1991;
- Marine Mammals Protection Act 1978
- Maritime Transport Act 1994;
- Submarine Cables and Pipelines Protection Act 1996; and
- Wildlife Act 1953.

These MMRs are discussed in the following sections, along with the Health and Safety at Work Act 2015.

The consideration of the provisions within the Resource Management Act 1991, and the New Zealand Coastal Policy Statement 2010, comes down to the potential effects that an activity may have within the CMA waters. Due to the separation distance between the IAA and the CMA/EEZ boundary (with the IAA approximately 18 km from the boundary) and the spatial extent of the effects from the activities for which consent is sought, it is considered that the Resource Management Act 1991 and New Zealand Coastal Policy Statement 2010 are not relevant MMRs to this consent application, and that no weighting should be given to the provisions within them.

3.4.1 Biosecurity Act 1993

The Biosecurity Act 1993 provides the legal framework for the Ministry for Primary Industries (**MPI**), and others, to help keep harmful organisms out of New Zealand. This is achieved through pre-border entry risk management and standard setting, border management, readiness and response, and long-term pest management.

The Craft Risk Management Standard – Biofouling on Vessels Arriving to New Zealand (**CRMS**) has been issued under the Biosecurity Act 1993. The CRMS requires a vessel that arrives in New Zealand waters to have a 'clean hull' which is when no biofouling of live organisms is present other than that within the thresholds provided in the CRMS.

The owner/operator of the WIV/MODU will need to provide evidence to MPI to confirm the biofouling requirements of the CRMS have been met or, if the CRMS requirements cannot be met, a vessel-specific Craft Risk Management Plan may be developed. The Craft Risk Management Plan will need to be approved by MPI before the vessel enters New Zealand waters.

In addition to the CRMS, MPI has developed the Import Health Standard: Ballast Water from All Countries (**IHS**) which sets out the minimum requirements that must be met for vessel ballast water loaded within the territorial waters of a county other than New Zealand that are intended to be discharged into New Zealand waters (noting that this applies only to coastal waters within 12 NM of the New Zealand coastline). Compliance with the IHS requirements is intended to minimise the introduction of harmful aquatic species to New Zealand.

Before any vessel arrives in New Zealand, it must send a biofouling and ballast water declaration to MPI. This can be sent with the vessel's 'Advance notice of arrival form'. Parts 1 and 2 of the biofouling and ballast declaration need to be completed if the vessel has ballast water and if it proposes to discharge ballast water in New Zealand waters (i.e. within 12 NM of the coast), the owner/operator of the vessel must request permission by completing part 3 of the form.

This MMR is important for the decommissioning of the Tui field as it requires measures to be put in place prior to the vessels entering New Zealand waters. However, it is considered that the Biosecurity Act 1993 does not provide measures to avoid, remedy, or mitigate effects of the specific activities for which marine consent is being sought.

3.4.2 Crown Minerals Act 1991

Section 101B of the Crown Minerals Act 1991 relates to committing offences in relation to the interference with structures or operations in offshore areas; specifically, section 101B(2) relates to committing an offence in relation to entering a specific non-interference zone. A non-interference zone relates to a permitted prospecting, exploration, or mining activity. Although the specific activities associated with this consent application are not specified within the definition of 'mining' under the Crown Minerals Act 1991, it is considered that the decommissioning of the Tui field is an integral part of the wider mining operations within Petroleum Mining Permit 38158 (**PMP 38158**). Therefore, an application may be made to the Chief Executive of MBIE to establish a 500 m "non-interference zone" around any MODU/WIV utilised for the decommissioning activities. This would reduce the potential introduction of additional health and safety risks by unauthorised persons during the proposed operations.

3.4.3 Marine Mammals Protection Act 1978

The Marine Mammals Protection Act 1978 provides for the protection, conservation, and management of marine mammals. This Act provides for the establishment of marine mammal sanctuaries, within which activities known to harm particular marine mammal species can be restricted and strictly controlled by the Minister of Conservation. The closest marine mammal sanctuary to the IAA is the West Coast North Island Marine Mammal Sanctuary which was established to protect the nationally critical Māui's dolphins and is bounded by the CMA/EEZ boundary located approximately 18 km to the east of the IAA. The West Coast North Island Marine Mammal Sanctuary places restrictions on commercial and recreational set net fishing, seismic surveying, and seabed mining; however it is silent on all other activities that could potentially occur in these coastal waters, such as the transiting of vessels such as those proposed to be used in association with the decommissioning of the Tui field.

Under this Act, the Marine Mammal Protection Regulations 1992 (**MMPR**) give rules and guidelines to boat users on how they should interact with marine mammals at sea in order to minimise the threats from boat strike, noise pollution, harassment, displacement and separation of mothers and their young. Compliance with the MMPR during the decommissioning of the Tui field will serve to reduce the likelihood of marine mammal ship strike, thereby assisting in the avoidance of potential effects on the environment.

3.4.4 Maritime Transport Act 1994

The Maritime Transport Act 1994 regulates the maritime activities within New Zealand waters to enable the implementation of New Zealand's obligations under international maritime agreements and conventions. This is achieved through various maritime rules and marine protection rules which are administered by Maritime New Zealand (**MNZ**). These rules cover a wide range of activities, including, but not limited to:

- Procedures relating to ship operations;
- Health and safety of ship's personnel;
- Navigation safety;
- The management of operational waste from vessels and offshore platforms; and
- Oil pollution prevention and responding to oil spills.

Of particular relevance to the decommissioning activities is the requirement for an Oil Spill Contingency Plan (**OSCP**). Marine Protection Rules: Part 131 requires offshore installations (i.e. a MODU) to not be operated without an approved OSCP. The OSCP supports an efficient and effective response to an oil spill at sea and also ensures certain pollution prevention equipment and arrangements on board the MODU meet international performance standards and maintenance requirements.

Further, Marine Protection Rules: Part 103A (which gives effect to Regulation 26 of Annex I of the International Convention for the Prevention of Pollution from Ships (**MARPOL**)) requires ships to have shipboard oil pollution emergency plans / oil spill contingency plans. These plans are designed to assist personnel in dealing with an unexpected or probable discharge or escape of oil and to mitigate its effects.

3.4.5 Submarine Cables and Pipelines Protection Act 1996

In 2007 the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 came into force. This order was made pursuant to section 12(1) of the Submarine Cables and Pipelines Protection Act 1996 and defines a 'Protected Area' around the Tui field which encompasses all five production wells as well as the (now departed) FPSO. The extent of the Protected Area is shown in **Figure 17**.

The effect of this Protected Area is that no ships, except ships being used for research by the Ministry of Fisheries (provided the research is carried out without directly or indirectly attaching any of the ship to the seabed) or ships being used for oil field operation or maintenance purposes, may enter the area. Other vessels may transit through the Protected Area, but no fishing may occur nor can any vessel anchor within the area.

3.4.6 Wildlife Act 1953

The Wildlife Act 1953 deals with the protection and control of wild animals and birds, as well as the management of game with a requirement for permits to deal with certain wildlife. Part 1 of this Act provides protection of most species of wildlife (including mammals, birds, reptiles and amphibians), native or introduced where no one may kill or have in their possession of any such bird or animal unless they have a permit. This part of the act also provides protection to a small number of terrestrial invertebrates and marine species which are listed in Schedules 7 or 7A of the Act (if they are not listed, they are unprotected).

The protection of those marine species declared to be animals (Schedule 7A of the Wildlife Act 1953) provides a mechanism for avoiding adverse effects of the decommissioning of the Tui field on the environment. An assessment of the likelihood of encountering these protected marine species is contained within **Section 4.3.3.2**. The protection of animals under the Wildlife Act 1953 has been considered when determining potential adverse effects, including the development of the proffered conditions.

3.4.7 Health and Safety at Work Act 2015

The Health and Safety at Work Act 2015 is the principal legislation for managing health and safety at work in New Zealand. The primary set of regulations under this Act relevant to this consent application is the Health and Safety at Work (Petroleum Exploration and Extraction) Regulations 2016 (**HSWPEE Regulations**).

These regulations contain a number of measures that can have an effect of avoiding, remedying, or mitigating adverse effects on the environment or existing interests, including:

- The requirement for a 'Safety Case' to be submitted to, and approved by, WorkSafe. A Safety Case must identify hazards that have the potential to cause multiple fatalities on or near the MODU, describe how the hazards are controlled, and describe the safety management system in place to ensure the controls are effectively and consistently applied;
- The requirement to ensure wells are designed, constructed, operated, maintained, suspended, and abandoned in a way that risks from the wells are reduced to a level that is "As Low As Reasonably Practicable" (**ALARP**);
- The requirement for a well examination scheme that requires an independent and competent person to examine all wells; and
- The requirement for reporting of all notifiable incidents.

A Safety Case will be required under the HSWPEE Regulations for a MODU (if used) as it meets the definition of a 'non-production installation'.

If a MODU is to be used for the P&A works then Part 5 of HSWPEE Regulations states that it will need to either have a current certificate of fitness or a recognised verification scheme. A certificate of fitness demonstrates that the MODU, and all equipment necessary for its safe operation, are appropriately designed, in good working order, and in a good state of repair. A recognised verification scheme can apply to a MODU and is an alternative to a certificate of fitness. A verification scheme demonstrates that all safety-critical elements of the MODU are documented, suitable, in good working order, and in a good state of repair.

Regulation 72 of the HSWPEE Regulations requires a drilling contractor to prepare an emergency response plan and submit a copy to WorkSafe for a non-production installation (i.e. a MODU).

4 Existing Environment

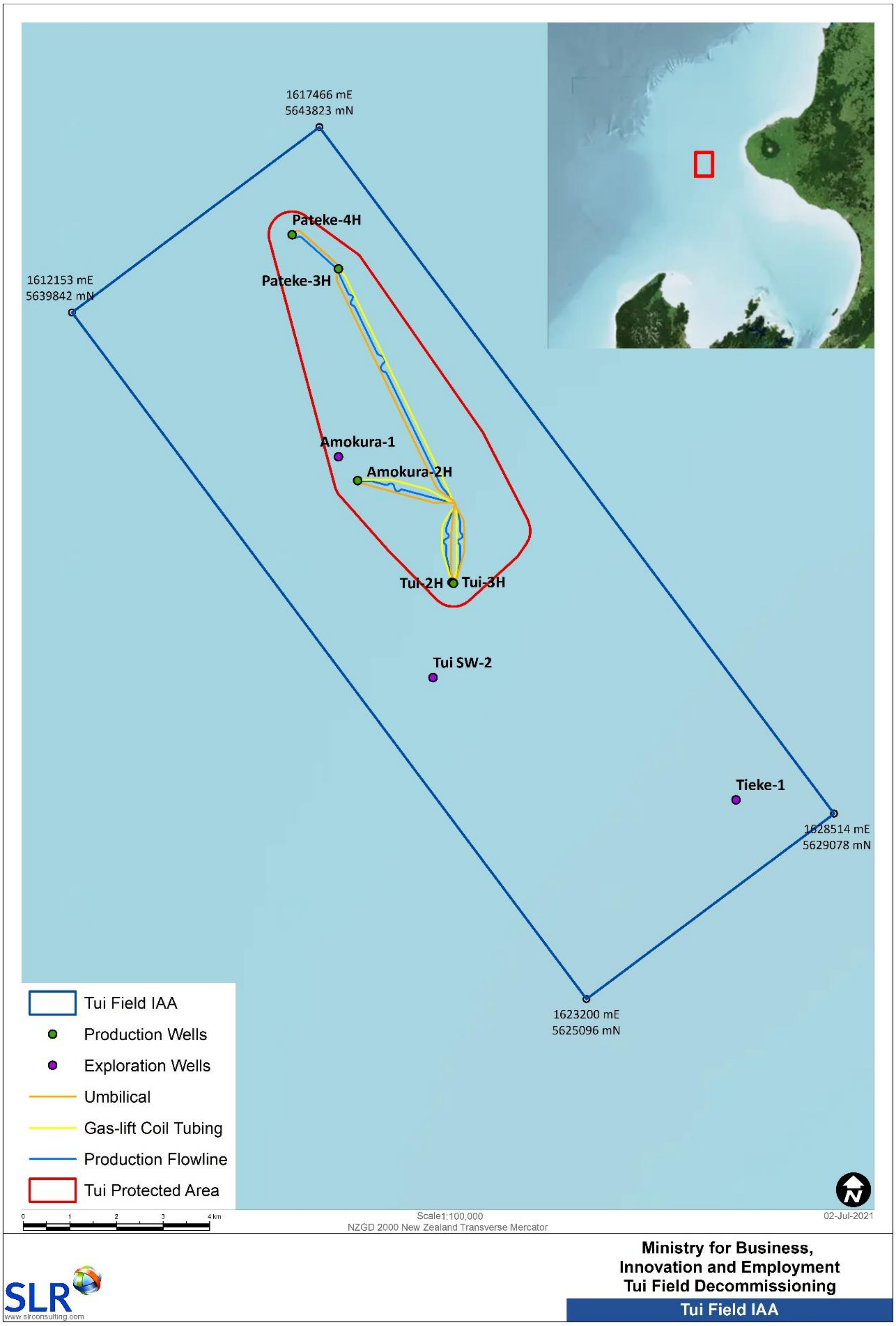
4.1 Introduction

Section 39(1)(b) of the EEZ Act requires an IA to describe the current state of the area where it is proposed that the activity will be undertaken and the environment surrounding the area. This is commonly referred to as the 'existing environment' and, for the purposes of this consent application, an Impact Assessment Area (**IAA**) has been defined.

The IAA has been developed to encompass the Protected Area specified in the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 and the wells which are subject to the proposed activities in this consent application. A buffer of 1,500 m has been placed around all eight wells that require P&A activities to allow for the potential anchor spread associated with the placement of a semi-submersible MODU, with the IAA covering all of the buffer areas. The IAA, shown in **Figure 17**, covers the area in which potential effects may result and encompasses an area of approximately 122 km^2.

The following sections describe the existing environment both in terms of the physical and biological environment.

Figure 17 IAA for this consent application



4.2 Physical Environment

4.2.1 Te Ao Māori

It is recognised that the description of the physical environment below is largely based on a western science perspective. As described in the Cultural Impact Assessment (**CIA**) (attached as **Appendix E**), Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi have a holistic view of the environment based around whakapapa (genealogy) and whanaungatanga (relationships), connecting Mana Whenua and all physical and spiritual things in the world.

The CIA states:

> *"Our relationship with the environment stems from our whakapapa to Papatūānuku (Earth Mother) and Ranginui (Sky Father) who gave rise to many children, also known as the Atua (guardians) of the domains of the natural world. Therefore, it is important to understand that potential impacts of any proposed activity would be conceptualised holistically."*

The Te Ao Māori perspective of the physical environment is described further in **Section 4.4** below and in the CIA.

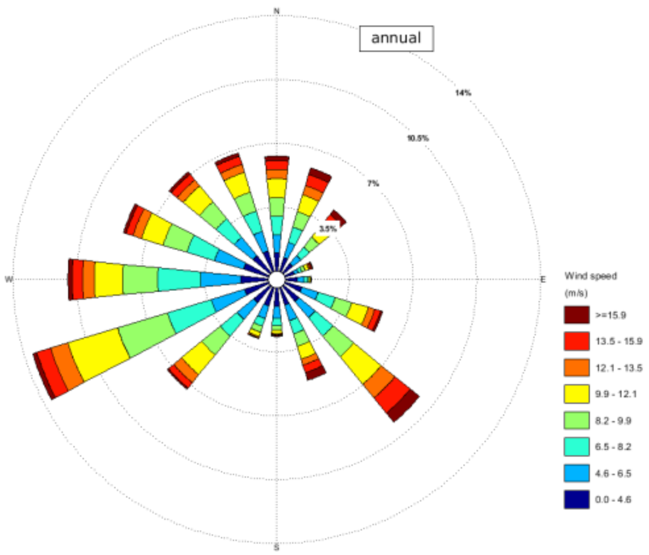
4.2.2 Meteorology

New Zealand's climate varies from the warm subtropical upper North Island to cool temperate in the lower South Island (NIWA, 2021). Three key features determine New Zealand's climate: prevailing winds, the ocean, and the mountain ranges (Te Ara, 2021a). Due to its location within the Southern Hemisphere temperate zone and the roughly south-west to north-east orientation of the country, New Zealand's weather systems mainly arise from its exposure to prevailing westerly airflows (Macara, 2018), known as the roaring forties and furious fifties (Te Ara, 2021a). Low-pressure systems usually separate two high pressure systems, which, as they move east across the country, usually bring a regular weather sequence for approximately a week before the low-pressure system develops bringing unstable wet and windy weather (Macara, 2018).

Taranaki is considered one of the windiest regions in New Zealand (Chappell, 2014). Within this climatic zone the most settled weather occurs in summer and early autumn, with winter months the most unsettled time of the year (NIWA, 2021).

TTL commissioned a summary report of the metocean conditions in the Tui field to provide an initial characterisation of the environment. As part of this modelling report, the summary statistics of the wind at the Tui field were provided based on a 38-year hindcast dataset. **Figure 18** provides the annual wind rose at 10 m elevation at the Tui field, from hindcast data between 1979 and 2016.

Figure 18 Annual wind rose at 10 m elevation at the Tui field



Source: MetOcean Solutions, 2018

Note: Wind directions are reported in the 'coming from' convention.

Periods of high rainfall occur in Taranaki when a slow-moving anticyclone lies to the east of New Zealand, allowing warmer moist northerly air from the tropics to flow over the country. Heavy rain can occur if these conditions are associated with slow-moving fronts lying north-south near Taranaki, or when depressions move across the region. When the airflow over New Zealand is from the northeast, rainfall in Taranaki tends to be scattered and light until the next frontal zone crosses the region. In Taranaki, westerly airstreams are associated with periods of unsettled showery weather. In these situations, a belt of high pressure lies to the north of the country, while to the south migratory depressions move steadily eastwards. The westerly airstream frequently contains rapidly moving cold fronts bringing periods of heavier showers to western New Zealand. Rain frequency and intensity increases inland towards Mount Taranaki (Chappell, 2014).

There is currently no rainfall monitoring and recording equipment at any of the offshore installations in and around the Tui field. Rainfall records for onshore sites across the Taranaki region are recorded by the Taranaki Regional Council (**TRC**). Rainfall statistics were accessed from TRC for its '*Kapoaiaia at Cape Egmont*' site, located on the coast approximately 43 km north-east of the IAA. The mean annual rainfall at this site for the period 2016-2021 is 1,417 mm, with the mean monthly totals ranging from 69 mm (in March) to 166 mm (in July).

4.2.3 Currents and Waves

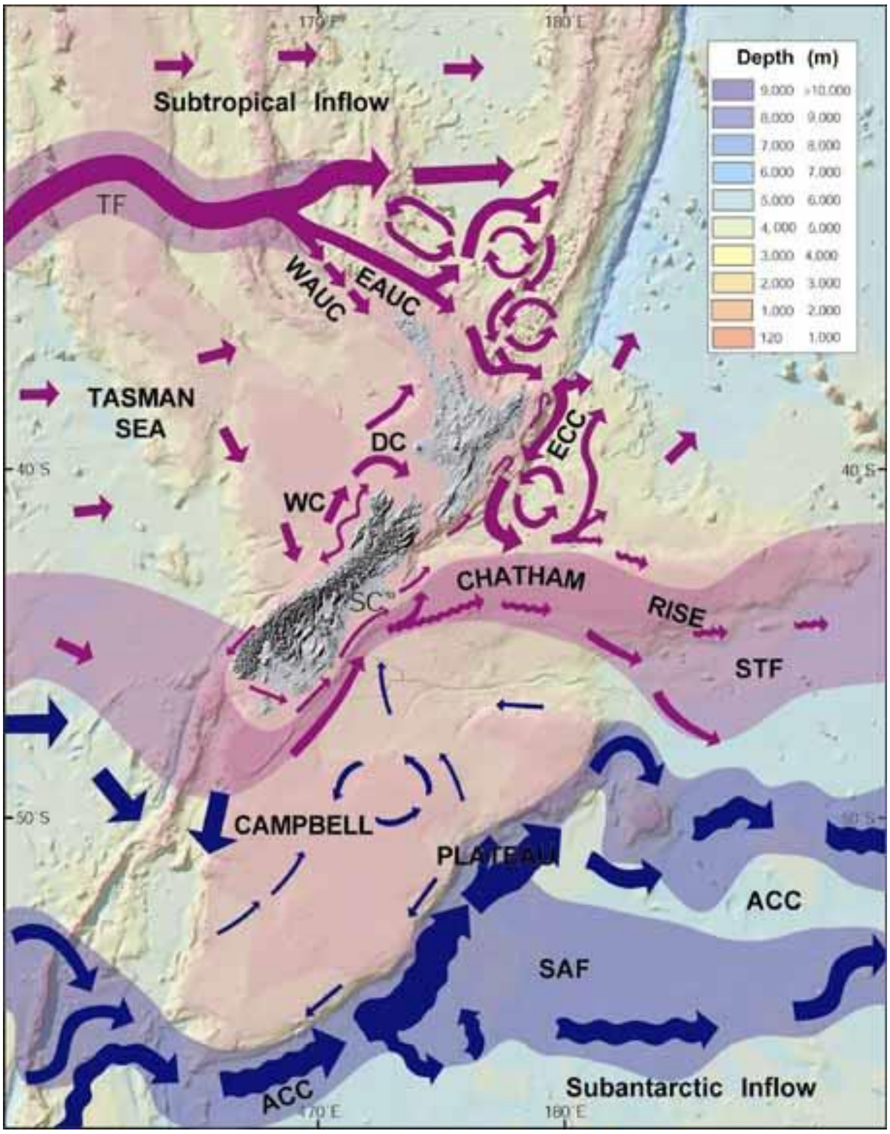
New Zealand's coastal current regime is dominated by three components: wind-driven flows, low-frequency flows and tidal currents. The net current flow is a combination of all of these components, which is often further influenced by the local bathymetry.

New Zealand lies in the pathway of eastward-flowing currents driven by winds that blow across the South Pacific Ocean (Brodie, 1960; Te Ara, 2021a). As a result, New Zealand is exposed to the southern branch of the South Pacific subtropical gyre driven by the southeast trade winds to the north and the Roaring Forties westerly winds to the south (Gorman *et al.*, 2005; Te Ara, 2021a).

The main ocean currents around New Zealand are illustrated in **Figure 19**. The eastward flow out of the Tasman Sea splits into two currents across the top of the North Island: the West Auckland Current flowing from Cape Reinga towards Kaipara, and the East Auckland Current flowing from North Cape towards the Bay of Plenty (Brodie, 1960; Heath, 1985; Stanton, 1973). As the West Auckland Current travels south, it is met in the North Taranaki Bight by the north-flowing Westland Current. The Westland Current flows from the west coast of the South Island up to the west coast of the North Island where it weakens and becomes subject to seasonal variability. As a result of local weather conditions and seasonality, the convergence zone of the two currents is highly variable (i.e. the northern limit of the Westland Current and the southern limit of the West Auckland Current) (Brodie, 1960; Ridgway, 1980; Stanton, 1973).

Seasonal variation in the West Auckland Current and Westland Current results in varying temperatures and salinity off the Taranaki coastline. During winter, the West Auckland Current extends further south, bringing warmer waters. In contrast, the West Auckland Current is weaker in the summer months and the Westland Current dominates, bringing colder waters (Ridgway, 1980; Stanton, 1973).

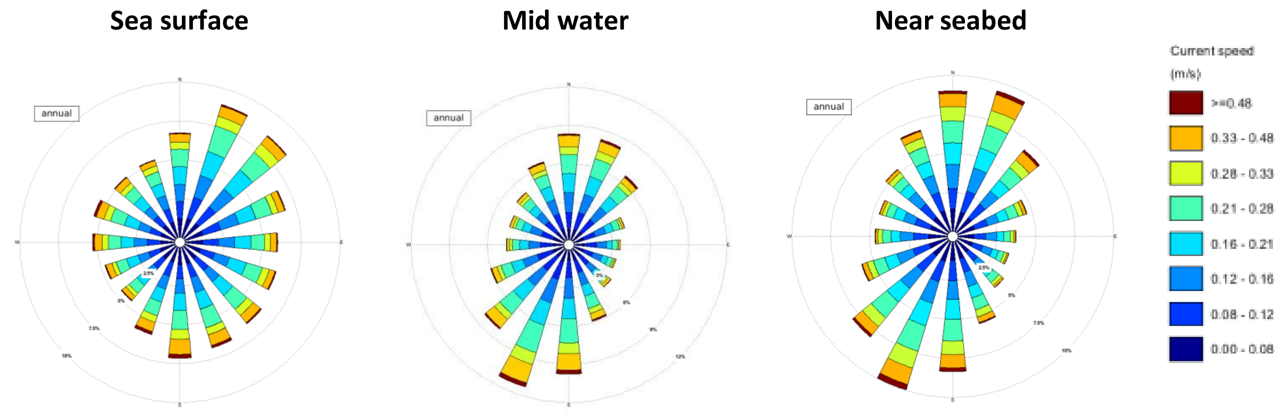
Figure 19 Ocean circulation around the New Zealand coastline



Source: Te Ara, 2021a

The currents within the IAA have been modelled by MetOcean Solutions (2018) based on a 16-year hindcast (2001 – 2016) for the sea surface, midwater and near seabed levels. The annual current roses for these three levels are illustrated in **Figure 20**. The current statistics for the sea surface, midwater and near seabed levels in the Tui field, based on the hindcast modelling, for each month and annual mean is presented in **Table 15**.

Figure 20 Annual current roses for the sea surface, midwater and near seabed



Source: MetOcean Solutions, 2018

Note: Current directions are reported in the 'going to' convention.

Table 15 Modelled mean current statistics for sea surface, midwater and near seabed

Time Period	Sea surface (m/s)	Midwater (m/s)	Near seabed (m/s)
January	0.21	0.08	0.08
February	0.23	0.08	0.09
March	0.20	0.09	0.09
April	0.18	0.09	0.09
May	0.16	0.09	0.10
June	0.16	0.08	0.10
July	0.16	0.08	0.08
August	0.14	0.06	0.07
September	0.16	0.06	0.07
October	0.17	0.07	0.08
November	0.19	0.07	0.08
December	0.22	0.08	0.08
Annual	0.18	0.08	0.09

Source: MetOcean Solutions, 2018

4.2.3.1 Waves

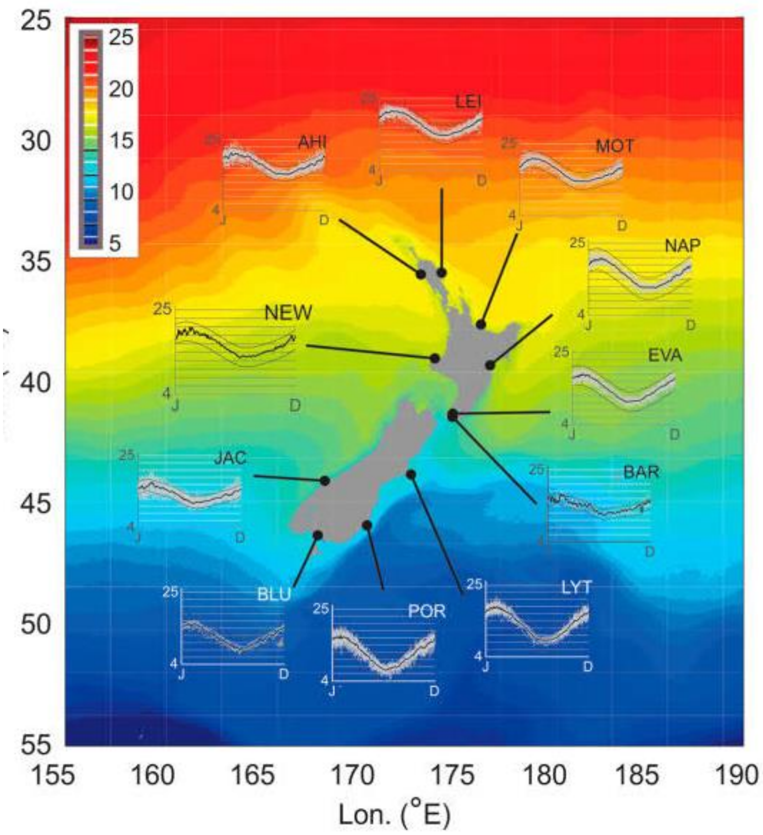
The offshore Taranaki region is considered to have a high-energy wave climate due to its exposure to long-period swells originating from the Southern Ocean and locally generated seas (Hume *et al.*, 2015). The majority of the wave energy arrives from the west and southwest, with southerly waves able to rapidly rise. In general, wave height in the Taranaki Bight shows a seasonal cycle, with mean significant wave heights peaking in late winter (August and September) and lowest in late summer (MacDiarmid *et al.*, 2015a), although large-wave conditions can arise at any time of the year. The largest waves are found off the western end of Cape Egmont, with wave height decreasing further south as a result of the north-western tip of the South Island providing shelter from the prevailing south-westerly swells (MacDiarmid *et al.*, 2015a). Significant wave heights in excess of 8 m can occur during stormy conditions, particularly in the winter and early spring (MacDiarmid *et al.*, 2015a).

4.2.4 Thermoclines and Sea Surface Temperature

Sea surface temperatures in New Zealand waters generally show a north-to-south gradient, with warmer waters being found in the north, cooling towards the south (Te Ara, 2021b).

The sea surface temperature in the offshore region typically ranges from approximately 15 °C in winter through to 22 °C in summer (Stevens *et al.*, 2019). The average sea surface temperature of the Taranaki Bight is approximately 15 °C as seen in **Figure 21**. The inshore surface temperatures are more highly variable, depending on location, with New Plymouth ranging from 18-20 °C in summer and 12-14 °C in winter

Figure 21 Regional sea surface temperatures averaged over 2003 – 2015



Source: Stevens *et al*., 2019

RPS (2018) collated data from World Ocean Atlas 2013 database produced by the National Oceanographic Data Centre and its co-located World Data Center for Oceanography and is summarised in **Table 16**. Monthly average sea-surface temperatures near the release site were found to vary over the course of the year from a minimum of 13.0 °C (August) to a maximum of 19.1 °C (March). Monthly average salinity of the upper water column varied only slightly throughout the year from a minimum of 35.0 Practical Salinity Units (**PSU**) (January and March) to a maximum of 35.3 PSU (July).

Table 16 Seasonal average sea-surface temperature and salinity in/near the IAA

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)	17.8	19.1	19.1	17.6	16.2	14.9	14.4	13.0	13.6	13.9	14.9	16.1
Salinity (PSU)	35.0	35.1	35.0	35.2	35.2	35.2	35.3	35.2	35.1	35.1	35.1	35.2

Source: RPS, 2018

4.2.5 Water Quality

The following general assumptions regarding the water quality within the IAA can be made based on knowledge of the offshore Taranaki region:

- Due to the offshore nature of the IAA, it is away from any major influence from riverine inputs (i.e. dilution and sedimentation);
- The IAA has fresh seawater inputs derived from the Tasman Sea; and
- Nutrient levels are expected to be highest towards the south of the IAA due to the influence of the Kahurangi Upwelling.

Receiving water chemical composition testing was undertaken as part of routine monitoring in the Tui field in February 2021, down-current of the FPSO *Umuroa*. The results of this testing showed that the water quality at the Tui field is in line with what is expected in a dynamic well-mixed offshore marine environment. Specifically, the PAH/TPH and Volatile Organic Compounds were all below analytical detection limits; in addition, most metals/metalloids were below analytical detection limits, and those that weren't were still below the default guideline values under ANZECC[5].

4.2.6 Ambient Noise

Hildebrand (2009) defines ambient noise in the ocean as the sound field against which signals must be detected. In the marine environment, ambient noise is generated by numerous sources, including:

- Biological – marine organisms (e.g. cetacean vocalisations, echolocations, drumming of the swim bladder by fish, snapping shrimp feeding behaviours);
- Physical – meteorological, oceanographic processes and natural seismic events (e.g. breaking waves, rain, lighting strikes, earthquakes); and
- Anthropogenic – shipping traffic, marine construction, seismic surveys, drilling.

[5] Australian and New Zealand Environment and Conservation Council for Fresh and Marine Water Quality Guidelines

Noise from ships (e.g. from propellers, machinery, and the passage of the hull through water) is the dominant anthropogenic sound in marine waters (Gordon & Moscrop, 1996) and adds to the constant natural ambient noise level in the marine environment (Parsons *et al.*, 2004). In general, older vessels produce more noise than more modern vessels, and larger vessels produce more noise than smaller vessels (Gordon & Moscrop, 1996).

Fish utilise sound for navigation and selection of habitat, mating and communication; marine mammals use sound as a primary means of underwater communication and navigation, and toothed whales in particular use echolocation to locate and track the presence of prey (Hildebrand, 2009).

Noise levels from various anthropogenic sources in the marine environment are provided in **Table 17**. All size classes of vessels presented in **Table 17** transit New Zealand waters, including some vessels larger than those reported below. Anthropogenic noises that overlap in space, time and frequency with marine fauna can represent potential stressors to individuals and populations (Warren *et al*., 2021).

Table 17 Examples of anthropogenic noise sources in the marine environment

Source	Frequency (kHz)	Source level	Reference
Fishing trawler	0.1	158 dB re 1 µPa	Malme *et al.*, 1989
Tanker (135 m length)	0.43	169 dB re 1 µPa	Buck & Chalfant, 1972
Tanker (179 m length)	0.06	180 dB re 1 µPa	Ross, 1976
Super tanker (266 m length)	0.008	187 dB re 1 µPa	Thiele & Ødegaard. 1982
Super tanker (337 m length)	0.007	185 dB re 1 µPa	Thiele & Ødegaard. 1982
Super tanker (340 m length)	0.007	190 dB re 1 µPa	Thiele & Ødegaard. 1982
Containership (219 m length)	0.033	181 dB re 1 µPa	Buck & Chalfant, 1972
Containership (274 m length)	0.008	181 dB re 1 µPa	Ross, 1976
Freighter (135 m length)	0.041	172 dB re 1 µPa	Thiele & Ødegaard. 1982
Semi-sub MODU	0.001 to 4	154 dB re 1 µPa	University of Maryland, 2000
Drillship	0.6	185 dB re 1 µPa	University of Maryland, 2000
Jack-up drilling rig	0.002 to 1.4	120 dB re 1 µPa	Todd *et al.* 2020

Two studies are of interest with regard to ambient noise in Taranaki waters; Warren *et al.* (2021) characterised the soundscape of central New Zealand including the waters of the South Taranaki Bight via the deployment of four hydrophones (South Taranaki, Cook Strait, Kaikoura and Wairarapa) from June to December 2016, and McPherson *et al.* (2019) modelled anthropogenic noise on the west coast of the North Island from July 2014 to June 2015. Key findings from these two studies are summarised below:
Warren *et al.* (2021) found that:

a. In the South Taranaki Bight sound levels were highest below 100 Hz, ranging from 75 to 97 dB re $1\mu Pa^2 Hz^{-1}$;

b. Noise from wind, rain, tidal activity and wave activity (across a broad range of frequencies) consistently increased ambient sound levels - where increasing sound levels correlated to an increase in condition intensity (e.g. high winds caused higher sound levels than light winds etc);

c. Earthquake noise was frequently detected in central New Zealand;

d. Pygmy blue whale calls were abundant in the South Taranaki Bight especially in autumn;

e. Calls from humpback whales, Antarctic blue whales and Antarctic minke whales were recorded from the Bight during migration periods in winter and spring;

f. An unidentified biological 'chorus' with seasonal and daily patterns was detected at all hydrophone locations possibly representing sounds produced by planktivorous fish; and

g. Shipping noise (persistent tonal sound) was constantly present and seismic survey noise was detected during survey periods, both overlapped in frequency with baleen whale calls.

McPherson *et al.* (2019) found that:

a. Noise propagates further in winter, as winter conditions support longer range propagation and lower attenuation rates;

b. New Plymouth had the highest vessel traffic levels along the entire west coast, and these high levels of broad-band frequencies extend south from New Plymouth into the South Taranaki Bight. The overall vessel traffic levels and associated sound level is lowest in winter. However, seasonal differences are less apparent for commercial shipping categories, i.e. bulk carriers, container ships, tankers and vehicle carriers, compared to fishing vessels;

c. Noise contributions from the FPSOs 'Umuroa' and 'Raroa' were prominent in the Taranaki soundscape, particularly during operation - and that noise contributions of platforms (Māui A, Māui B, and Kupe) were less prominent;

d. Seismic survey design has a significant effect on soundscape effects, with sparse line spacing being advantageous with regard to lowering the soundscape influence; and

e. Modelling results showed that for March, at 12 NM offshore of New Plymouth (the receiver of most relevance to the Tui field) the broad-band sound level is predicted to be above the 'baseline quiet noise level' on average 96.8% of the time, i.e. the soundscape is driven by anthropogenic noise for 96.8% of the time. The predicted sound levels at New Plymouth and Cape Egmont always exceed the baseline quiet noise level, based on these locations being subject to the greatest vessel traffic densities.

4.2.7 Bathymetry and Geology

New Zealand is surrounded by a gently sloping continental shelf, extending from the coast out to a water depth of 100 – 160 m. Beyond this, the gradient of the seabed steepens as the sea floor transitions into the continental slope. The continental slope descends relatively rapidly from the edge of the shelf down to depths of more than 4,000 m. At the foot of the slope, the seaward gradient flattens out into ocean basins – wide, undulating but relatively flat zones lying at depths of 4,000 – 5,000 m (Te Ara, 2021c).

The surface of the continental shelf is predominantly flat although punctuated by local banks and reefs, whereas the slope is irregular with large marine valleys called submarine canyons. These canyons occur where the slope is relatively steep (e.g. off Kaikoura) and generally run from the edge of the continental shelf to the foot of the continental slope (Te Ara, 2021c). There are no submarine canyons located near the IAA.

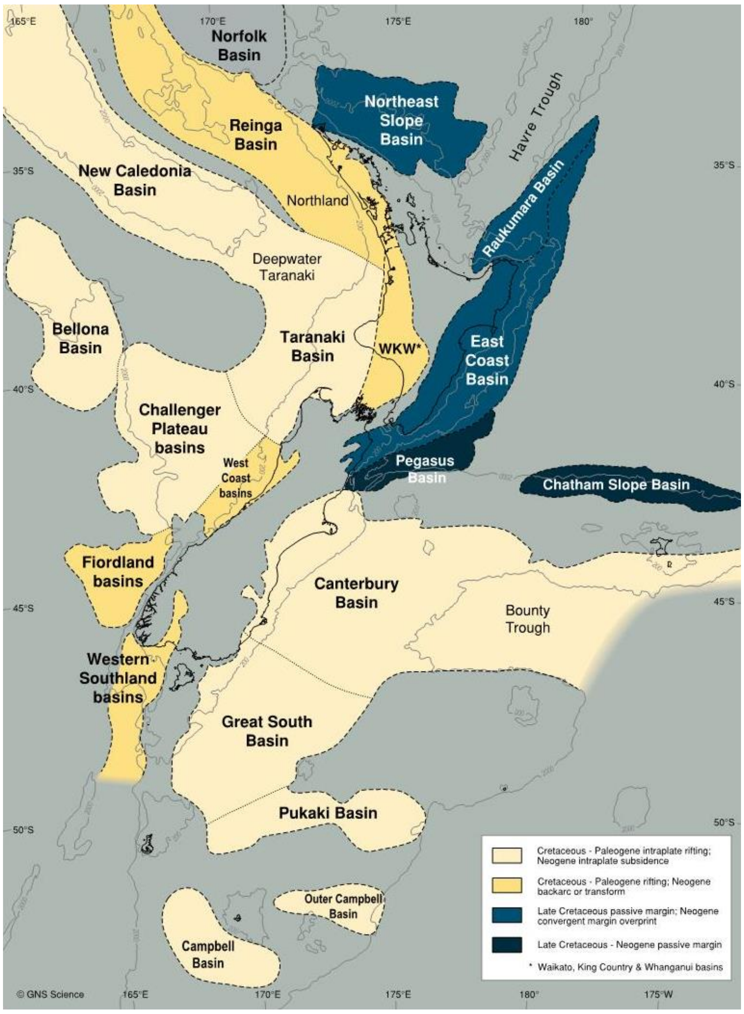
The width of New Zealand's continental shelf varies. In the North Taranaki Bight the shelf is broad, narrowing around Cape Egmont before widening again across the South Taranaki Bight (MacDiarmid *et al.*, 2015a). The Taranaki continental shelf has a 150 km wide opening to the Tasman Sea, occupying approximately 30,000 km², and slopes gently towards the west with an overall gradient of <0.1° (up to 0.5° locally) (Nodder, 1995). Water depths within the IAA ranges from 100 – 130 m.

There are eight sedimentary basins underlying New Zealand's continental shelf with known or potential hydrocarbons present (**Figure 22**). To date, commercial quantities of oil and gas have only been produced from the Taranaki Basin; however, non-commercial hydrocarbon discoveries have been made in the offshore East Coast, Canterbury, and Great South basins (NZP&M, 2014).

The IAA traverses the Taranaki Basin which lies at the southern end of a rift that developed sub-parallel to the Tasman Sea rift that now separates Australia from New Zealand. The Taranaki Basin occupies the site of a late Mesozoic extension on the landward side of the Gondwana margin and covers approximately 330,000 km². The structure of the basin is controlled by movements along the Taranaki, Cape Egmont and Turi fault zones (NZP&M, 2014).

Basement rocks in the Taranaki Basin originate from a number of different terranes. Crustal slabs can comprise sedimentary, plutonic, and volcanic rocks. The terranes around New Zealand are grouped into the Paleozoic (540 – 300 million years ago) Western Province, and the Permian to early Cretaceous (300 – 100 million years ago) Eastern Province. At the boundary between these two provinces is a zone of volcanic arc rocks which form the western section of the Taranaki Peninsula. The Waikato coastline to the north-east is greywacke Eastern Province terrane (Morton & Miller, 1968).

Figure 22 New Zealand's sedimentary basins



Source: NZP&M, 2014

4.2.8 Seafloor Sediments and Substrate

TTL (and previously AWE Taranaki Limited) monitored sediment quality within the IAA to understand the effects, if any, of the FPSO discharges on the environment. Twenty locations, ranging from 300 m to 6,000 m from the FPSO, were routinely monitored from 2012, with sampling being undertaken to assess the sediment grain size, organic content, and TPH concentrations. The most recent round of monitoring (conducted in February 2021 by MBIE) found similar results to all previous monitoring occasions.

Annual benthic monitoring characterised the physical and chemical nature of the seabed and benthic communities in the Tui field, and in particular around the vicinity of the FPSO. Particle size distribution and organic content analysis showed sediment within the IAA being dominated by silt and clay fractions and sediment texture becoming coarser with proximity to the FPSO. Slight overall coarsening in sediment texture was observed across the years monitored; although these changes do not appear to be related to the discharges that occurred from the FPSO.

The monitoring routinely returned results that showed all concentrations of metals being below the relevant Australian and New Zealand Environment and Conservation Council (**ANZECC**) guideline values. In addition, PAH were detected at some of the monitoring locations, albeit below ANZECC thresholds. No detectable concentrations of TPH were found in any sediment samples in the most recent monitoring (2021) which is consistent with previous surveys in the Tui field.

4.3 Biological Environment

4.3.1 Microphytobenthos

Microphytobenthos (**MPB**) is the term given to a diverse range of unicellular eukaryotic algae, diatoms, cyanobacteria and flagellates that live in/on the uppermost few millimetres of seabed sediments within the photic zones of the ocean where they are able to photosynthesise.

Benthic algal species are generally limited to the sufficiently well-lit parts of the ocean (photic zone) in order to receive the required amounts of light for photosynthesis to occur. However, some species of algae have been found to have the ability to survive in deeper, more poorly illuminated areas (Markager & Sand-Jensen 1992). In very clear waters some species of Foliose macroalgae have been found in depths as deep as 157 m (with just 0.06% surface light levels) and other species such as crustose algae have been found as deep as 268 m (just 0.0005% of surface light) (Littler *et al.*, 1985; Markager & Sand-Jensen 1992). Benthic MPB (particularly diatoms) have been recorded to occur as deep as 191-222 m off the coast of the USA (Cahoon *et al.*, 1992; McGee *et al.*, 2008). Thus, the water depths at the Tui field ~120 m could be within the plausible range of benthic MPB, although this will be dependent on the level of useable radiation that reaches the seabed in this area, which is a factor of water clarity.

The Tui field is situated offshore and away from major riverine sources of sediment, or coastal resuspension and as such, water clarity is generally high. However, other biological factors such as presence of photo- and zooplankton, as well as environmental factors like storm events, can reduce light penetration to the seabed in these offshore areas.

The presence of MPB is often visually revealed by the presence of a blue/green/brown film or colouration to the surface of the seabed sediments. Benthic monitoring has been undertaken at the Tui field, and nearby Māui and Maari fields, as well as control stations elsewhere in the offshore Taranaki area, for almost 10 years (at water depths ranging from 105 to 130 m). Even with this extensive amount of monitoring being undertaken, observations of conspicuous MPB such as blue/green/brown films (or obvious diatom mats) have not been made. However, monitoring surveys undertaken over this period, have not specifically sampled and tested for MPB, which might reveal the presence of very low abundances of MPB taxa, so the presence and relative importance of this to primary productivity in the area cannot be directly estimated.

Modelling undertaken of the South Taranaki Bight used 0.1% of surface irradiation as a conservative estimate of the light-limited extent of MPB production (Cahoon *et al.*, 2015; Cahoon, 2016). Based on the light extinction equation used in this modelling (a negative exponential), the 0.1% light level as a limit for MPB, and a light extinction coefficient of 0.1, the depth limit for MPB in the modelled area came out as 69 m (Cahoon, *pers. comm.*, 2021). Therefore, based on the water depth the Tui field (~120 m), it is likely to be too deep for there to be significant MPB that might be impacted by the decommissioning of the Tui field.

4.3.2 Benthic Invertebrates

To gain an understanding of the benthic invertebrate communities within the IAA, a summary of the most recent annual benthic monitoring undertaken at the Tui field is presented (SLR, 2021a) which is also contained within **Appendix F**.

Overall, 126 benthic macrofaunal taxa were found within the samples collected within the Tui field. Benthic crustaceans belonging to the order Cumacea were the most prevalent taxa followed by three polychaete taxa: Maldanidae, Cirratulidae, and *Spiophanes* spp. **Table 18** shows the general classification and trophic group of each taxon reported.

Table 18 Macrofaunal taxa found at the greatest abundance overall within samples collected in 2021

Taxa	General Classification	General Trophic Group
Cumacea	Malacostraca: Cumacea	Filter feeder, deposit feeder
Maldanidae	Polychaeta: Maldanidae	Deposit feeder
Cirratulidae	Polychaeta: Cirratulidae	Deposit feeder
Spiophanes spp.	Polychaeta: Spionidae	Deposit feeder
Aglaophamus sp.	Polychaeta: Nephtyidae	Carnivore
Ampharetidae	Polychaeta: Ampharetidae	Deposit feeder
*Neilonella wrighti**	Bivalvia: Neilonellidae	Filter feeder
Paraonidae	Polychaeta: Paraonidae	Deposit feeder
Amphipoda	Malacostraca: Amphipoda	Deposit feeder
Onuphis aucklandensis	Polychaeta: Onuphidae	Deposit feeder

Note: * Previously known as *Austrotindaria wright* (unaccepted).

The high relative abundance of Cumacea at all sites in 2021 is positive overall, indicating sediment conditions which can support taxa sensitive to chemical stressors in the marine environment. Macrofaunal communities were relatively similar across sampling stations (>70% similarity). Univariate results showed that evenness and species diversity were largely uniform across all stations and relatively typical of moderately diverse infauna.

Statistical analyses found no clear differences between the communities along different transects within the Tui field in 2021. However, due to the differing lengths and number of stations along each transect it is difficult to confidently assess the heterogeneity of the macrofaunal community among transects overall.

There was a significant effect of distance on macrofauna community composition in 2021. Pairwise comparisons revealed that this was driven by differences occurring between communities at 300 m and 750 m, 300 m and 2,000 m; 300 m and 4,000 m; 1,000 m and 4,000 m; and 2,000 m and 4,000 m.

4.3.3 Sensitive Environments and Protected Species

Although the term 'sensitive environments' is not a term used in the provisions of the EEZ Act relevant to this application (i.e. because the Exclusive Economic Zone and Continental Shelf (Environmental Effects—Permitted Activities) Regulations 2013 do not apply here), the term has been used in the past, including by the EPA, to describe rare and vulnerable ecosystems and habitats of threatened species in relation to the benthic environment. An example of this concept can be seen in the conditions of EEZ400011 for the Ports of Auckland Limited Marine Dumping Consent which utilised the meaning given to sensitive environments as a definition of rare and vulnerable ecosystems and habitats of threatened species.

The Wildlife Act 1953 also provides useful context when determining potentially rare and vulnerable ecosystems and habitats of threatened species in its protection of certain species, including those marine species declared to be animals under Schedule 7A of that Act.

Based on the above, the following sections outline sensitive environments and protected species, which in turn can be read as being rare and vulnerable ecosystems and habitats of threatened species.

4.3.3.1 Sensitive Environments

Schedule 6 of the Exclusive Economic Zone and Continental Shelf (Environmental Effects—Permitted Activities) Regulations 2013 describes 13 sensitive biogenic environments. These environments were identified by the Ministry for the Environment in consultation with National Institute of Water and Atmospheric Research and include:

- Stony coral thickets or reefs
- Xenophyophore beds;
- Bryozoan thickets;
- Calcareous tube worm thickets;
- Chaetopteridae worm fields;
- Sea pen fields;
- Rhodolith (maerl) beds;
- Sponge gardens;
- Beds of large bivalve molluscs;
- Macro-algae beds;
- Brachiopods;
- Deep-sea hydrothermal vents; and
- Methane or cold seeps

The 'sensitivity' of an environment is defined as the tolerance of a species or habitat to damage from an external factor combined with the time taken for its subsequent recovery from damage sustained as a result of the external factor. The rarity of a particular habitat was also taken into account when considering its tolerance; an external factor is more likely to damage a higher proportion of a population or habitat as rarity increases; therefore, a rare habitat has a lower tolerance rating (MacDiarmid *et al.*, 2013).

Analysis of the macrofauna samples and observations from the video imagery undertaken during the 2021 annual benthic monitoring within the Tui field indicated that no 'sensitive environments', were encountered. However, small numbers of individuals representing some of the '*characteristic species of sensitive environments*' were found in macrofauna samples (e.g. chaetopteridae worms and sea pens) and observed in video imagery (e.g. sea pens) at low densities.

These results were the same as that found during the 2020 ROV Survey in the Tui field (**Appendix C**) where some species characteristic of sensitive environments were observed (e.g. sea pens and calcareous tubeworms), however not at the densities required to reach the threshold criteria to qualify as a 'sensitive environment'.

Therefore, it is considered that no sensitive environments as defined in Schedule 6 of the Exclusive Economic Zone and Continental Shelf (Environmental Effects—Permitted Activities) Regulations 2013 are likely to exist within the area where the activities are proposed or within the wider IAA.

4.3.3.2 Protected Species

Eight species of fish are listed as protected under Schedule 7A of the Wildlife Act 1953: basking shark, deepwater nurse shark, great white shark, manta ray, oceanic white-tip shark, spiny-tailed devil ray, spotted black grouper, and whale shark. In addition to the protection offered under the Wildlife Act 1953, great white sharks, basking sharks, and oceanic white-tip sharks are also protected under the Fisheries Act 1996, prohibiting New Zealand flagged vessels from taking these species from all waters, including beyond New Zealand's EEZ. Of these protected species, the great white shark and basking shark have the greatest potential to occur in the IAA. Deepwater nurse sharks, manta rays, oceanic white-tip sharks, spiny-tailed devil rays, and spotted black grouper all prefer warmer waters found in the upper North Island.

The 2020 ROV Survey in the Tui field (**Appendix C**) did not observe any fish species or coral taxa that are covered by Schedule 7 of the Wildlife Act 1953.

4.3.4 Fish

Fish populations within the IAA are represented by various demersal and pelagic species, most of which are widely distributed from north to south, and from shallow coastal water to beyond the continental shelf edge. A large proportion of New Zealand's fish are categorised as 'widespread' (approximately 30% of described species), in that they occur across all three major oceans or in the Pacific and Atlantic oceans; however, there is also a large proportion of fish that are classified as endemic (approximately 22% of described species) (Roberts *et al.*, 2015).

The IAA lies within the neritic zone of the ocean - the relatively shallow part of the ocean that extends from the intertidal zone out to the shelf break (approximately 200 m water depth). This zone is an area of high primary productivity and supports a number of commercially and recreationally important fish species. The fish found within the neritic zone generally are highly mobile, do not have fixed territories, and often school (Roberts *et al.*, 2015).

Over the summer months when warmer currents move down from the north, a number of larger pelagic species visit the waters of the IAA. The most common of these seasonal species are sunfish, flying fish, marlin, albacore tuna, skipjack tuna, mako sharks, and blue sharks.

The fish species potentially present in the IAA, based on a water depth of approximately 150 m or less, are presented in **Table 19**. This information was collated from the MPI New Zealand fish guides (McMillan *et al.*, 2011a; 2011b) and more than 35 years of trawl surveys as reported in Anderson *et al.* (1998), Bagley *et al.* (2000), Hurst *et al.* (2000a, 2000b), and O'Driscoll *et al.* (2003). The present total (as of 2013) for the number of fish species identified within New Zealand's EEZ is 1,262 (Roberts *et al.*, 2015), therefore, the table below is not intended to provide an exhaustive list of all species present in the IAA, but instead lists the main species.

Table 19 Fish species present offshore and inshore of the IAA

Species – Common Name		
Anchovy [1]	Hapuku[1,2]	Rough skate[1,2]
Albacore tuna[2]	Hoki[1,2]	Rubyfish[1,2]
Banded tripplefin[3]	Jack mackerel (*T. novaezelandiae*)[1,2,]	Rough skate[1,2]
Banded wrasse[3]	Jack mackerel (*Trachurus declivis*)[1,2,]	Rubyfish[1,2]
Barracouta[1,2,]	Jock stewart[1]	Scaly gurnard[1,2]
Bass grouper[2]	John dory[1,2]	Scaly-headed triplefin [2]
Black angelfish[3]	Kahawai[1,2]	Scarlet wrasse [2]
Blue cod[1,2]	Kingfish[1,2]	School shark[1,2]
Blue dot tripplefin[3]	Leatherjacket[1,2]	Sea perch[1,2]
Blue mackerel[1,2,]	Lemon sole [1]	Shorttail stingray[1,2]
Blue moki [1]	Ling[1,2]	Silver dory[1,2]
Blue shark[1,2]	Long-tailed stingray [1]	Silver warehou[1,2]
Blue warehou[1,2]	Mako shark[1,2]	Silverside[1,2]
Blue-eyed tripplefin[3]	Marblefish[3]	Skipjack tuna[2]
Brill [1]	Murphy's mackerel[1,2]	Slender roughy[3]
Broadnose sevengill shark[2]	New Zealand bigeye	Smooth skate[1,2]
Brown stargazer[1, 2]	New Zealand rock lobster	Snapper[1,2]
Butterfish[3]	New Zealand sole [1]	Southern bastard cod[3]
Butterfly perch[1,2, 3]	Northern spiny dogfish[1,2]	Spectacled triplefin
Carpet shark[1,2]	Oblique-swimming triplefin	Spiny dogfish[1,2]
Common conger eel [3]	Orange perch[1]	Spotted gurnard[1,2]
Common roughy[1,2]	Parore[3]	Spotted stargazer[1,2]
Common tripplefin[3]	Pigfish [1,2,3]	Spotty [1,2, 3]
Conger eels[1]	Pilchard[1,2,4]	Sprats (*Sprattus antipodum*) [1]
Crested blenny[3]	Porae[3]	Sprats (*S. muelleri*) [1]
Cucumberfish[1,2]	Porbeagle shark[1,2]	Sweep[3]
Dark ghost shark[1,2]	Porcupine fish[1,2]	Tarakihi[1,2]
Dwarf scorpionfish[3]	Pufferfish [1]	Thresher shark[1,2,4]
Eagle ray[1,2]	Ray's bream[2]	Trevally[1,2]
Electric ray[1,2]	Red cod[1,2]	Turbot [1]
Frostfish[1,2,4]	Red moki[3]	Variable triplefin[3]

Gemfish[1,2]	Red mullet [1]	White trevally[2]
Giant stargazer[1,2]	Redbait[1,2]	Witch [1,2]
Girdled wrasse [2]	Red-banded perch[3]	Yaldwyn's triplefin[3]
Goatfish [2]	Rig[1,2]	Yellow-belly flounder [1]
Greenback flounder [1]	Robust tripplefin[3]	Yellow-black triplefin[3]
Gurnard[1,2]	Rock cod [2]	Yelloweyed mullet [1]

1 Trawl surveys (Anderson *et al.*, 1998; Bagley *et al.*, 2000; Hurst *et al.*, 2000a, 2000b; O'Driscoll *et al.*, 2003)

2 McMillan *et al.,* 2011a, 2011b

3 Smith *et al.*, 2013 and MacDiarmid *et al.*, 2015b

The 2020 ROV Survey observed a variety of fish species within the Tui field which were largely concentrated in hotspots around the larger infrastructure on the seabed (Xmas Tree, UTA etc.) and those in the water column (MWA, mooring lines and risers) (**Appendix C**). Example images of the fish species observed can be seen in **Figure 23**.

Sea perch were ubiquitous across all areas surveyed, likely taking advantage of the shelter/cover provided by the physical infrastructure and the increased abundance of suitable prey items such as smaller fish and crustaceans. Other common finfish taxa around the larger infrastructure objects were bastard red cod (*Pseudophycis* sp.) and New Zealand bigeye (*Pempheris adspersa*). Tarakihi (*Nemadactylus macropterus*) and john dory (*Zues faber*) were encountered occasionally around the larger infrastructure as well as along the more open sections of the production flow lines and/or umbilicals. Conger eels were observed utilising the cryptic habitats provided by most of the larger structures like the Xmas Trees, UTA, gravity bases etc. Occasional juvenile gurnard (*Chelidonichthys kumu*), rough skate (*Zearaja nasuta*) and short-tailed stingray (*Dasyatis brevicaudata*) were observed on the seabed near the longer stretches of production flow lines.

Across all larger seabed structures small (~80 mm) egg-cases were observed. While it was not possible to directly identify what species the egg cases belonged to, they were most likely an elasmobranch – possibly carpet sharks (*Cephaloscyllium isabellum*).

Small New Zealand rock lobster (*Jasus edwardsii*) were present within two of the MWAs which, while not common, is not altogether unexpected as this species requires suitable cryptic habitat to hide safely within and structures like these are the only option in what is a relatively featureless seabed area in the Taranaki Basin. It is likely that the observed individuals were not the only crayfish present and most likely would have settled out of the water column during their puerulus phase and then remained in these areas as they could find sufficient food and suitable protection from predators.

Several pipefish (possibly *Stigmatophora longirostris*) and seahorses (*Hippocampus* sp.) were occasionally observed near SSI, but not consistently around any particular piece of infrastructure.

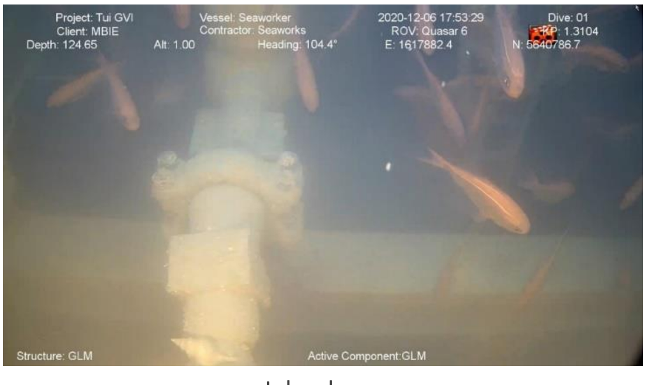
Pelagic species such as kingfish (*Seriola lalandii*) were regularly observed higher in the water column, mainly around the MWAs and in shallower depths in close proximity to the FPSO around the dynamic sections of the lines and the mooring line structures.

Figure 23 Example images of fish species observed in the Tui field during the 2020 ROV Survey

Sea perch

Red cod

New Zealand bigeye



Tarakihi

John dory

New Zealand rock lobster

Seahorse

Conger eel

Rough skate (left) and Shorttail stingray (right)

Egg-cases

4.3.5 Cephalopods

New Zealand cephalopods include the cuttlefish, squid, and octopus (Te Ara, 2021d). All cephalopods consist of a mantle, head, and eight arms (and two long tentacles in the case of some squid).

In New Zealand there are 42 species of octopus, of which 68% are endemic (O'Shea, 2013), and over 85 species of squid and other related groups of which most are open-ocean animals. Octopuses mainly live on the seafloor and are the largest predators on reefs. Cephalopods are also an important prey for marine mammals, fish and birds (Te Ara, 2021d). For example, pilot whales feed mainly on arrow squid and common octopuses (Beatson *et al.*, 2007).

Due to their affiliation with reef habitats, the IAA is not considered to be important habitat for octopuses; however, benthic surveys for offshore monitoring surrounding the Taranaki oil and gas fields have occasionally caught small octopuses, more specifically the species *Macroctopus maorum* (SLR, pers. obs.).

The New Zealand squid fishery appears amongst the top five fisheries in New Zealand and focusses on two species of arrow squid; Gould's arrow squid (*Nototodarus gouldi*) and Sloan's arrow squid (*Nototodarus sloanii*) (Fisheries NZ, 2021). These species are found across the continental shelf in water depths up to 500 m but are most commonly caught in waters less than 300 m (Fisheries NZ, 2021). *N. sloanii* is primarily found along New Zealand's south-east coast and has been reported on the west coast of the North Island as far north as Cape Egmont; where it forms less than 10% of the arrow squid catch. In comparison, *N. gouldi* is found off the west and east coasts of the North Island, and the central, north-west, and north-east coasts of the South Island as far south as Banks Peninsula (Smith *et al.*, 1987).

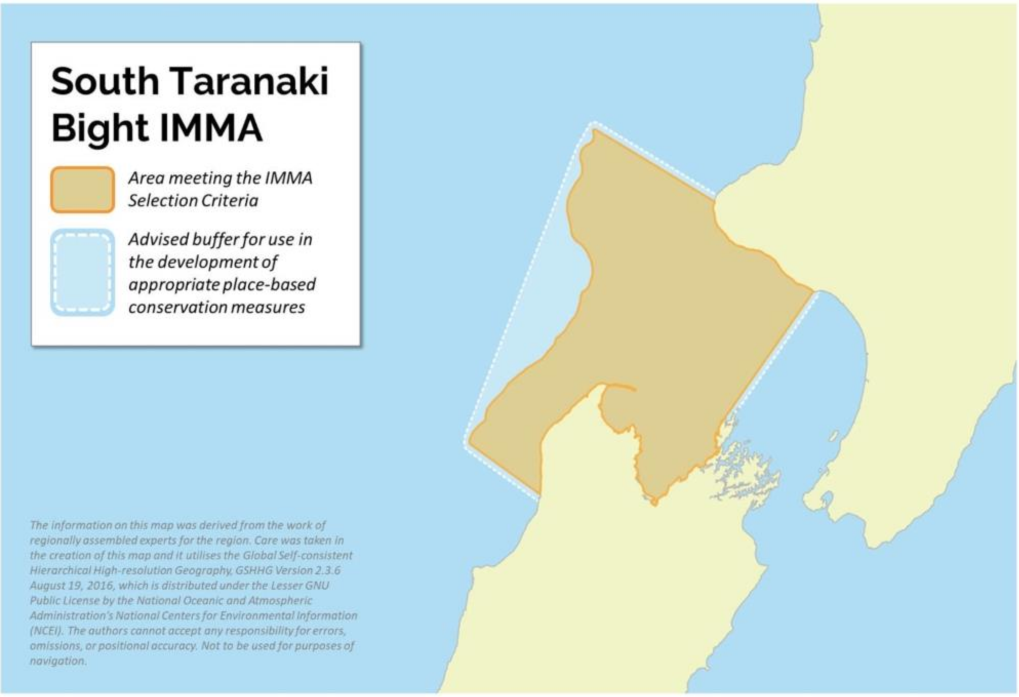
Squid have a rapid growth rate and are thought to live only for a year (Fisheries NZ, 2021). The majority of fishing activity for squid takes place in summer months from January through to May. Arrow squid have been caught within the Taranaki Bight during research trawl surveys (Bagley *et al.*, 2000); however, they are not commercially targeted within the bight as 95% of New Zealand's squid catch is taken by deep-water trawls from southern and sub-Antarctic fishing grounds, while coastal jigging vessels catch the rest in calmer, more northern waters (Deepwater Group, 2021).

4.3.6 Marine Mammals

The IAA overlaps the South Taranaki Bight Important Marine Mammal Area (**IMMA**) as depicted in **Figure 24.** The summary of the IMMA as presented by the Marine Mammal Protected Areas Taskforce is quoted below:

> *"The South Taranaki Bight mostly comprises shallow shelf waters (~100-120m) and is strongly influenced by a nutrient-rich upwelling system. Over 35 different marine mammal species have been documented within the region including at least eight species or subspecies with IUCN threatened or vulnerable status (e.g. Māui dolphins, Antarctic blue whale – both 'critical' Hector's dolphin, pygmy blue whale, Oceania sub-population humpback whale, sei whale – all four 'endangered', fin whale, sperm whale – both 'vulnerable'). New Zealand pygmy blue whales are a genetically distinct and isolated population with year-round presence in the region, which is a critical foraging ground. Hector's dolphins and Māui dolphin occur in the coastal waters of the South Taranaki Bight. The IMMA which is used as a migratory corridor for humpback, blue, and southern right whales, and includes colonies of New Zealand fur seals. The South Taranaki Bight region has relatively high levels of anthropogenic activities."*

Figure 24 South Taranaki Bight IMMA



Source: https://www.marinemammalhabitat.org/portfolio-item/south-taranaki-bight/

IMMA's are defined as discrete portions of habitat, important to marine mammal species, that have the potential to be delineated and managed for conservation. It is important to note that IMMA's are areas identified as important for a marine mammal population and do not offer protection of a population such as would be provided by a Marine Mammal Sanctuary or Marine Reserve.

In addition, PMP 38158 sits just outside the boundary of the West Coast North Island Marine Mammal Sanctuary (**WCNI MMS**). The aim of the sanctuary is to protect the threatened Māui's dolphin, primarily from fishing impacts. The WCNI MMS currently extends from Maunganui Bluff in Northland to Taputeranga Marine Reserve on the south coast of Wellington and out to 12 NM.

4.3.6.1 Cetacean Species that could be Present in and around the Tui Field

Knowledge of cetacean distribution is typically amassed over long temporal periods utilising a combination of data collection techniques (e.g. stranding data, opportunistic sightings, systematic survey data, etc.). It is therefore important to assess multiple data sources when considering cetacean distribution. The following data sources were used to predict which cetacean species may be present within the IAA during decommissioning activities:

- Sightings data (received from H. Hendricks, Department of Conservation (**DOC**) 09/09/2020):
  - From previous seismic surveys that have been undertaken in the Taranaki region (obtained from DOC marine mammals sightings database);
  - From opportunistic sightings (obtained from DOC marine mammals sightings database);
  - From operator work vessels (obtained from the DOC marine mammal sightings database);
- Stranding data (obtained from the DOC marine mammals stranding database as received from H. Hendricks, DOC 23/09/2019);
- Habitat modelling and distribution descriptions (Stephenson *et al.,* 2020; Torres, 2015); and
- Knowledge of seasonal migration patterns, general ecology, and habitat preferences for each species (obtained from published literature).

Because of the highly mobile nature of most marine mammal species it is also important to assess species occurrence over an area that is larger than the IAA in order to predict species presence within the IAA. **Figure 25** provides a summary of all sightings recorded in the DOC marine mammal sightings database in the vicinity of the IAA (including a 20 km buffer).

While the above data sources represent the best possible information, it is important to note:

- Data gaps in sightings data do not necessarily indicate an absence of cetaceans, but typically reflect a lack of observation effort;
- While stranding data gives a broad indication of species occurrence, dead animals can wash ashore well away from where they died; and sick or diseased animals may be outside of their normal range prior to death;
- Each point within **Figure 25** represents a sighting entry within the DOC database. Each entry can be either a single animal or a group of animals; and
- Entries in the sightings and stranding data that do not identify cetaceans to species level were excluded from the analysis.

After reviewing all the data sources, the likelihood of each marine mammal species being present in and around the Tui field during decommissioning activities was determined as 'likely', 'possible' or 'unlikely'. A full summary of the assessment findings is presented in **Appendix G**, and **Table 20** provides a summary of those species that are likely to be present and those that could possibly be present. In addition, the following subsections provide a brief discussion of those species that are most likely to occur in the vicinity of decommissioning activities.

Figure 25 Marine mammal sightings within 20 km of the IAA

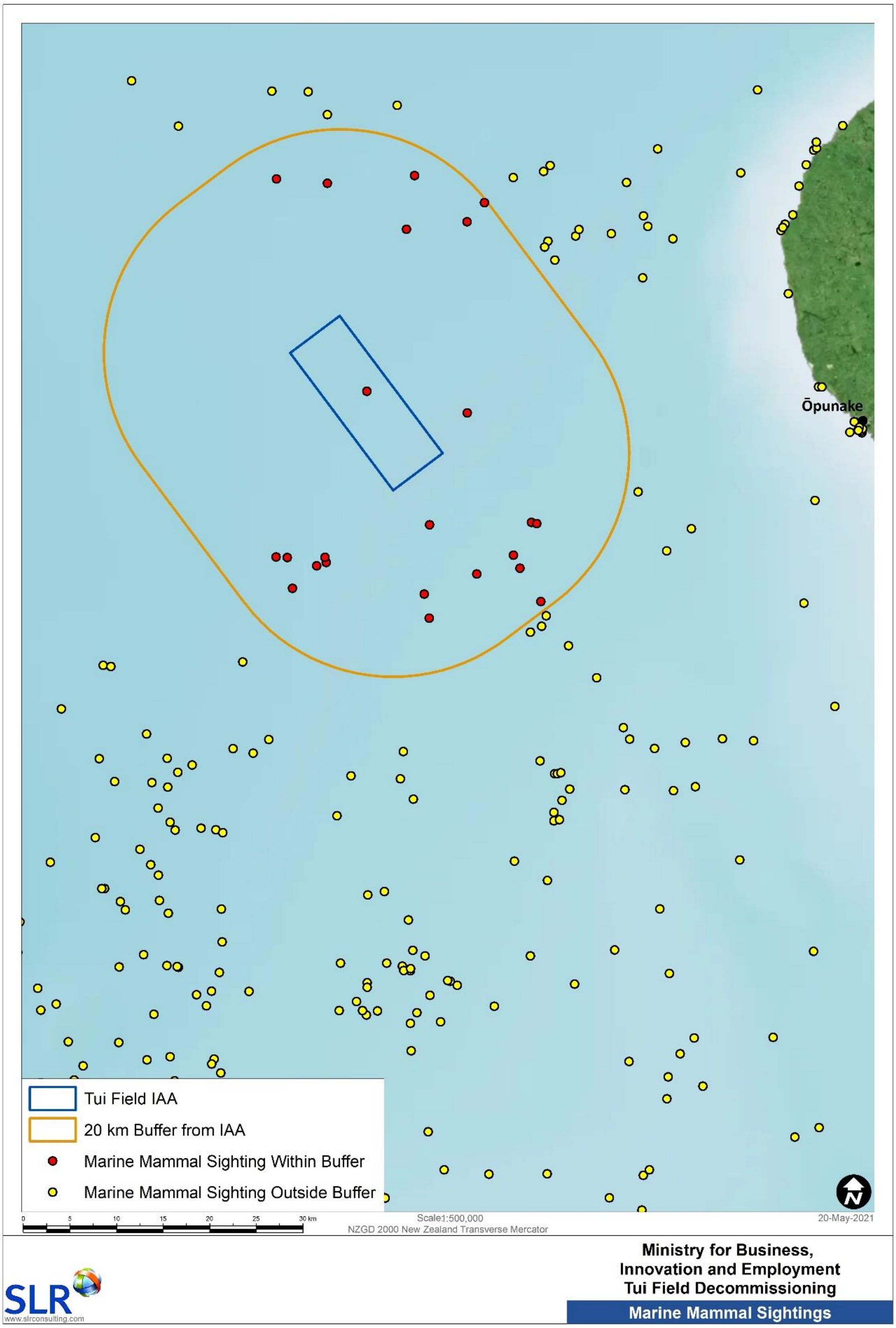


Table 20 Cetacean species that are 'likely' to or could 'possibly' be present in the IAA

Likely	Blue whales	Two subspecies of blue whale occur in NZ waters. Both subspecies known to occur in the STB. Feeding and breeding of resident pygmy blue whales has been confirmed and migrating Antarctic blue whales pass through (Barlow *et al.*, 2018). Feeding distribution is driven by concentrations of *Nyctiphanes australis* prey (Torres & Klinck, 2016). A reasonable number of sightings have been recorded in the vicinity and modelling suggests a moderate to high probability of occurrence; hence it is **likely** that blue whales could be present.
	Common dolphins	This species is commonly seen in Taranaki waters (Torres *et al.*, 2012; Stephenson *et al.*, 2020); hence common dolphins are **likely** to be present.
	Killer whales	Small groups of killer whales are typically seen around New Zealand where they travel an average of 100 – 150 km per day (Visser, 2000). Killer whales are thought to feed predominantly on rays which can bring them into very shallow coastal waters (Visser, 2000). Sightings are not uncommon in Taranaki waters (Torres, 2012). On this basis, it is **likely** that this species will pass through the area on a sporadic basis.
	Long-finned pilot whales	Pilot whale sightings occur in NZ waters year-round (Berkenbusch *et al.*, 2013). Long-finned pilot whales commonly strand on New Zealand coasts; with the stranding rate peaking in spring and summer (O'Callaghan *et al.*, 2001). Pilot whales forage at depth (i.e. several hundred metres; Berkenbusch *et al.*, 2013). But given their presence in the sighting record and the modelling results it is **likely** they will be present.
Possible	Bottlenose dolphin	The Marlborough Sounds supports a resident population of inshore bottlenose dolphins (Constantine, 2002). Offshore sightings are less common and typically occur in waters beyond the 100 m depth contour (Torres, 2012); hence an occasional presence is **possible**.
	Fin whale	Fin whales undertake long seasonal migrations and are usually found in deep offshore waters (Shirahai and Jarrett, 2006). They are occasionally seen in deep waters of the STB (Torres 2012) and habitat here is moderately suitable (Stephenson *et al.*, 2020); hence occasional sightings are **possible.**
	Minke whale	The Antarctic minke is very abundant in Antarctic waters in summer, but outside of the summer months their distribution is less well-known (Cooke *et al.*, 2018). Southern Hemisphere Dwarf minke whales also feed in Antarctic waters in summer and have a broad latitudinal distribution in other seasons (Cooke, 2018). Most minke whale sightings around New Zealand occur in spring; aligning with the southern migration towards the Antarctic feeding grounds (Berkenbusch *et al.*, 2013). Based on the information presented here, occasional presence is **possible** in spring.
	Cuvier's beaked whale	Found in deep waters (> 200 m) and is thought to prefer steep bathymetry near the continental slope in water depths greater than 1,000 m (Taylor *et al.*, 2008). Despite the predicted habitat suitability being low (Stephenson *et al.*, 2020), a reasonable number of strandings have occurred in the vicinity and acoustic recordings of this species have been made in Cook Strait (Goetz, 2017); therefore, it is **possible** that Cuvier's beaked whales will be occasionally present.
	Gray's beaked whale	This species has a circumpolar distribution south of 30° and occurs in deep waters beyond the shelf edge (Taylor *et al.*, 2008a). Based on acoustic detections (Goetz, 2017) and reasonable number of strandings, it is **possible** that they could have an occasional presence, particularly in nearby deep waters of Cook Strait.
	Strap-toothed whale	This species occurs between 35-60°S in cold temperate waters and prefers deep waters beyond the shelf edge (Taylor *et al.*, 2008b). Acoustic recordings of this species have been made in Cook Strait (Goetz, 2017) and explain the presence of this species in the stranding record. Despite the lack of sightings, it is **possible** that this species will occasionally be present, particularly in nearby deep waters.

	Humpback whale	Humpback whales migrate northwards along coastal NZ from May to Aug (Gibbs & Childerhouse, 2000), and southward from Sep to Dec (Dawbin, 1956). During migrations they typically use continental shelf waters (Jefferson *et al*., 2008) and can approach closely to shore when passing headlands or moving through confined waters (e.g. Gibbs *et al.,* 2017). A well-established northward migration route passes through Cook Strait and on through the STB in winter. Hence it is **possible** that this species will be present on a seasonal basis.
	Hector's/Maui's dolphins	There are two subspecies: Maui's dolphins are present on the west coast of the North Island, and South Island Hector's dolphins are present around the South Island. Māui's and Hector's cannot be readily differentiated at sea; however, both subspecies have coastal distributions thought to be largely constrained within the 100 m isobath (Slooten *et al.,* 2006; Du Fresne, 2010). Maui's dolphins have a population stronghold between Manukau Harbour and Port Waikato (Slooten *et al*., 2005), but their total distribution is wider; from Maunganui Bluff (Currey *et al*., 2012) to Taranaki (DOC, 2020). The Tui field occurs offshore of the typical species distribution, but occasional offshore sightings have been made. Based on this information, it is **possible** that Hector's/Maui's dolphins will occasionally be present.
	Pygmy right whale	Pygmy right whales are the smallest, most cryptic and least known of the baleen whales (Fordyce & Marx, 2012). In New Zealand, sightings typically occur near Stewart Island and Cook Strait (Kemper, 2002). Therefore, it is **possible** that this species could be present given their apparent association with nearby Cook Strait, but ecological information is very scant for this species.
	Pygmy sperm whale	Pygmy sperm whales are seldom seen at sea on account of their low profile in the water and lack of a visible blow; for this reason, little information is available on this species. They are known to be a deep-water species (Taylor *et al.,* 2012) and this is reflected by habitat modelling (Stephenson *et al.,* 2020). Despite this, a reasonable number of strandings occur nearby and given that ecological information is relatively scant for this species it would be appropriate to conclude that it is **possible** that this species could be occasionally present.
	Sei whale	This species is generally found in offshore, deep waters beyond the continental slope (Horwood, 2009). They are occasionally seen in deep waters of the STB (Torres 2012) and habitat modelling suggests moderate habitat suitability (Stephenson *et al.,* 2020); therefore, occasional sightings are **possible.**
	Short-finned pilot whale	The short-finned pilot whale is less frequently encountered than the long-finned pilot whale in New Zealand waters on account of its preference for warmer sub-tropical habitat in deep offshore waters (Berkenbusch *et al*., 2013). Based on habitat modelling (Stephenson *et al*., 2020) it is **possible** that this species will occasionally be present.
	Sperm whale	Sperm whales have a wide global distribution but are predominantly found in deep waters (> 1,000 m) in the open ocean over the continental slope (Berkenbusch *et al.,* 2013). However, the occurrence of a reasonable number of strandings nearby and sightings in the wider STB it is **possible** that sperm whales will occasionally be present.
	Southern right whale	Coastal waters around mainland New Zealand represent a historic calving ground for this species, with recent evidence suggesting a slow recolonization of this breeding range (Carroll *et al.,* 2014). Southern right whales utilise shallow coastal waters as their winter calving and nursery grounds (Patenaude, 2003). Three sightings have been reported from the vicinity. On this basis it is **possible** that southern right whales could have a seasonal presence, although winter sightings are expected closer inshore.

4.3.6.1.1 Blue Whale

Two subspecies of blue whale occur in New Zealand waters: Antarctic and pygmy blue whales. Antarctic blue whales are migratory through New Zealand (particularly the South Taranaki Bight; Warren *et al.,* 2021), while New Zealand waters support a population of pygmy blue whales that are thought to be largely resident to the region (Barlow *et al*., 2018).

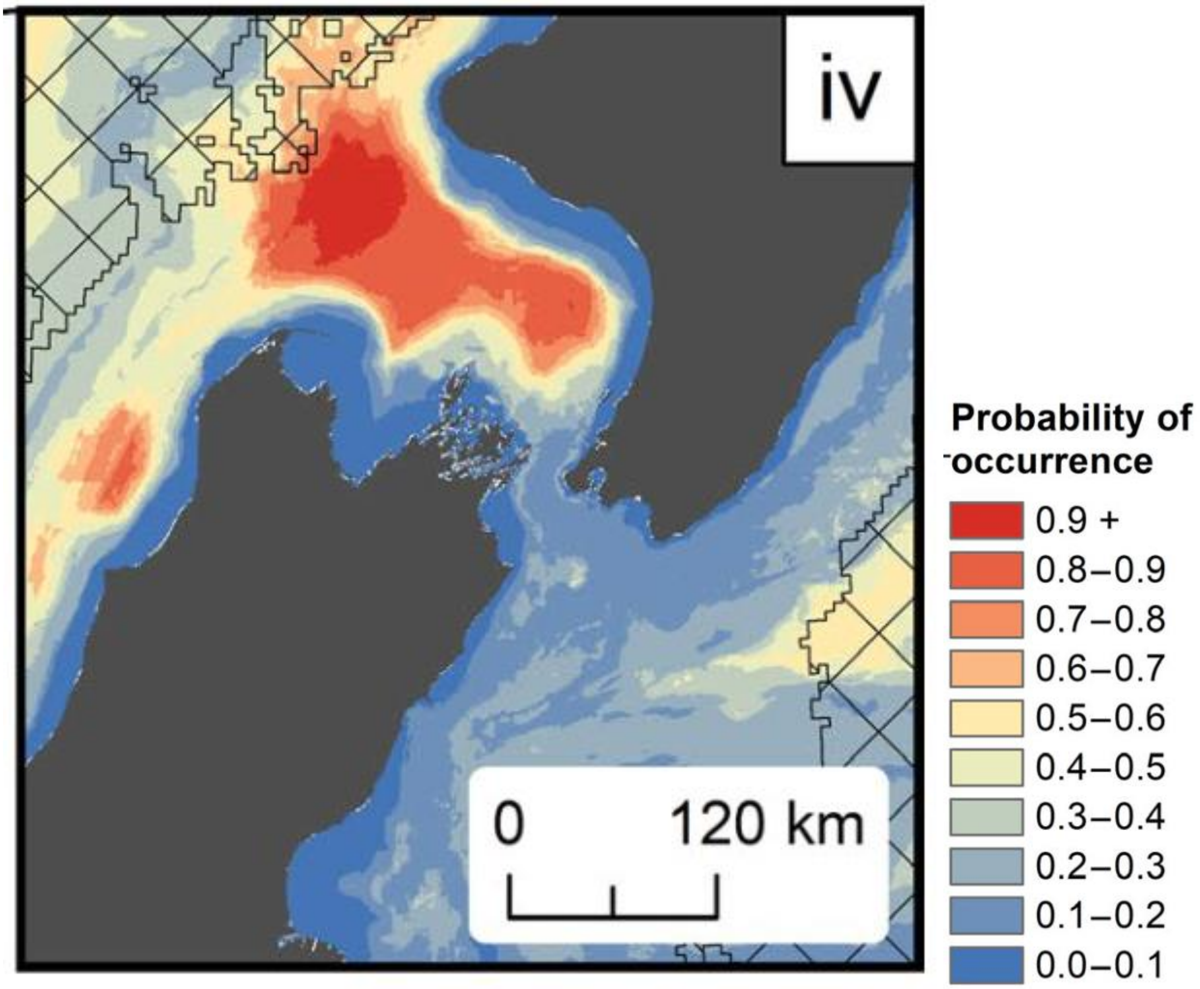
Sightings reports for blue whales occur across many regions of New Zealand, however sightings are concentrated in the South Taranaki Bight (see Figure 3 of Barlow *et al*. 2018), leading researchers to conclude that this is as "an important area for blue whales within the New Zealand EEZ, particularly for foraging" (Barlow *et al*., 2018). Visual sightings records and acoustic detections reveal that blue whales are present here in every month of the year (Torres *et al.*, 2017; Barlow *et al*. 2018) with a concentration of acoustic detections occurring particularly between March and May (Warren *et al*., 2021). This consistency of presence, coupled with genetic data that suggests a high degree of genetic isolation and a lack of international photo-identification matches, indicates that the New Zealand population has a high degree of residency. Using mark-recapture data Barlow *et al*. (2018) produced a conservative abundance estimate for the New Zealand population of pygmy blue whales of 718 (SD = 433) individuals.

Data collected since 2012 has identified the South Taranaki Bight as a blue whale foraging ground, with data suggesting whales target the krill *Nyctiphanes australis*. The absolute distribution of blue whales in the region varies with oceanographic patterns and the subsequent distribution of prey. In El Nino conditions whales tend to be located west of the Bight, but inside the Bight during more typical weather patterns (Torres & Klinck 2016). A recent paper by Barlow *et al.* (2021) found that on average there is a two-week lag time between upwelling inducing wind events and blue whale aggregations. Most sightings records of blue whales around Taranaki occur beyond the 12 NM CMA boundary (see Figure 16 in Torres *et al.,* 2017). In February 2016, a field survey gathered the first evidence of breeding behaviour in the waters within and to the west of the South Taranaki Bight. High densities of mother/calf pairs were observed, and documentation included the first aerial footage of blue whale nursing behaviour (Torres & Klinck 2016).

The IUCN Red List of Threatened Species currently lists the pygmy blue whale as 'Data Deficient'. In the latest DOC threat assessment for marine mammals, the threat classifications for pygmy blue whales was changed from 'Migrant' to 'Data Deficient' (Baker *et al*., 2019) given the recent evidence of population residency around New Zealand. Due to the lack of availability of population trend data, a 'Data Deficient' classification was considered the most appropriate for this subspecies (Baker *et al*., 2019).

While in general there have been a high number of blue whale sightings reports from Taranaki waters, the majority of these occur in the South Taranaki Bight in waters beyond the CMA. Eighteen blue whale sightings have been reported in the vicinity of the Tui field, and nine stranding events have been documented along the coastline. Habitat modelling for blue whales has been undertaken by Stephenson *et al*. (2020) and is presented in **Figure 26** where moderate to high probabilities of occurrence are predicted for the Tui field. Based on this information, it is **likely** that blue whales will be present at times during decommissioning activities.

Figure 26 Probability of occurrence of blue whales



Note: The predicted probability of occurrence of blue whale (*Balaenoptera musculus musculus* and *B. m. brevicauda*) in the New Zealand EEZ modelled using bootstrapped BRTs and areas of low predicted environmental coverage depicting the lower confidence that can be placed in the predicted probability occurrence (criss-cross black line).

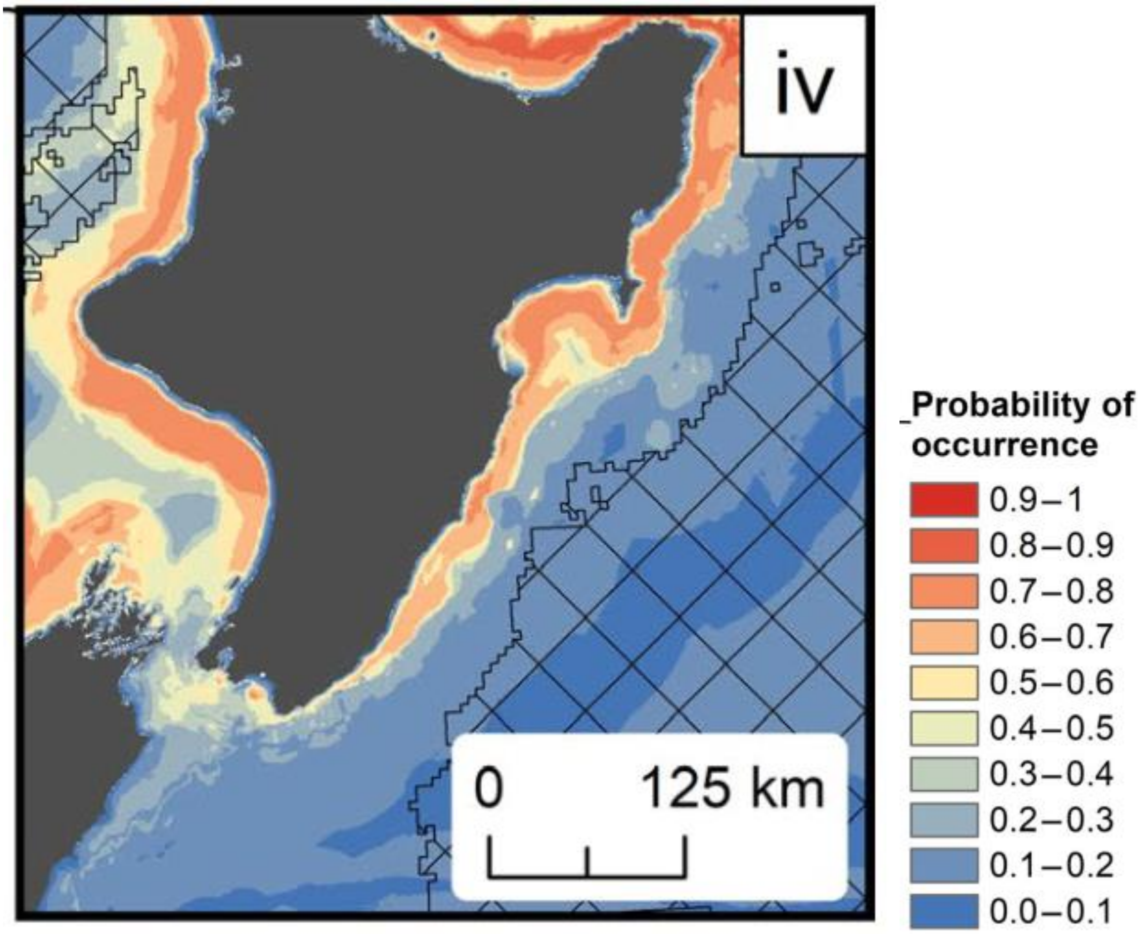
Source: Reproduced from Stephenson *et al* (2020).

4.3.6.1.2 Common Dolphin

Common dolphins are abundant and widespread throughout tropical and temperate oceans (Berkenbusch *et al.*, 2013). They occur around most of the New Zealand coastline, where they are generally observed in coastal waters during spring and summer, moving further offshore in autumn (Stockin *et al.*, 2008). Common dolphins are a highly social species that sometimes forms large groups consisting of thousands of individuals within which co-operative foraging is common (Stockin *et al.,* 2008).

Common dolphins are the most frequently encountered cetacean species in the South Taranaki Bight (Torres, 2012). Most sightings occur over summer months, but this seasonality could simply reflect an observational bias (Torres, 2012). Three sightings of common dolphins have been reported in the vicinity of the Tui field, with the single largest sighting estimated at 200 individuals. Seventy-one stranding events have also been reported along the nearby coastline. Based on these records and their known presence in coastal waters, common dolphins are **likely** to have a frequent presence in the Tui field. Habitat modelling for common dolphins has been undertaken by Stephenson *et al.* (2020) and gives a moderate to high likelihood of occurrence for this species in the IAA (**Figure 27**). Common dolphins are considered 'not threatened' by the New Zealand Threat Classification Scheme.

Figure 27 Probability of occurrence of common dolphins



Note: The predicted probability of common dolphin (*Delphinus delphis*) occurrence in the New Zealand EEZ modelled using bootstrapped BRTs and areas of low predicted environmental coverage depicting the lower confidence that can be placed in the predicted probability occurrence (criss-cross black line).

Source: Reproduced from Stephenson *et al* (2020).

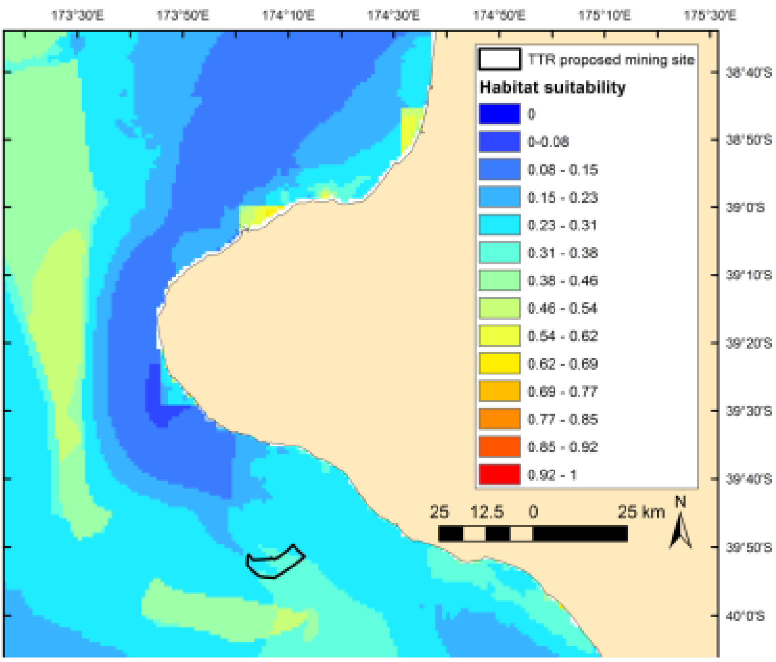
4.3.6.1.3 Killer Whale

Killer whales are found in all marine regions, from the equator to polar waters (Reeves *et al*., 2017). There are four morphological 'ecotypes' of killer whales described in the southern hemisphere (Types A – D: Pitman *et al*., 2011), with New Zealand being the only place where three out of the four ecotypes have been reported (Pitman *et al*., 2011; Foote *et al*., 2013). New Zealand's coastal ecotype killer whale population is small (65 – 167 individuals: Visser, 2006) and is made up of at least three possible sub-populations based on geographic distribution; a North Island only subpopulation, South Island only subpopulation, and a North and South Island sub-population (Visser, 2000). The abundance of other ecotypes utilising New Zealand waters is unknown.

Killer whales are wide-ranging, with some New Zealand whales estimated to travel an average of 100 – 150 km per day (Visser, 2007). High re-sighting rates of some identifiable individuals suggest killer whales live permanently or at least semi-permanently around New Zealand's coast (Visser, 2007); however, the mobility of this species and their opportunistic foraging behaviour (Visser, 2000) indicates that this species can readily move between areas to maximise foraging opportunities and avoid disturbances.

While no killer whale sightings have been recorded in the vicinity of the Tui field, sightings of this species are not uncommon around Taranaki, occurring from coastal waters to deeper offshore waters (Torres, 2012). Strandings for this species are rare, with three reported for nearby coastlines. Torres (2015) undertook habitat modelling to predict habitat suitability for killer whales around Taranaki (as part of the TTR Marine Consent Application), results from this study found that sea surface temperature is a strong driver of killer whale distribution and that the Tui field represents habitat of moderate suitability (**Figure 28**). Based on the habitat modelling results and the wide-ranging nature of this species, it is considered that killer whales are **likely** to visit waters of the Tui field. Killer whales are considered 'nationally critical' by the New Zealand Threat Classification Scheme.

Figure 28 Habitat suitability for killer whales



Note: Habitat suitability predictions for killer whales in the North and South Taranaki Bights derived from the habitat use model with bias correction. TTR's proposed project area is outlined in black. The habitat suitability index is a logistic output from the Maxent model (warm colours showing the highest habitat suitability).

Source: Reproduced from Torres (2015).

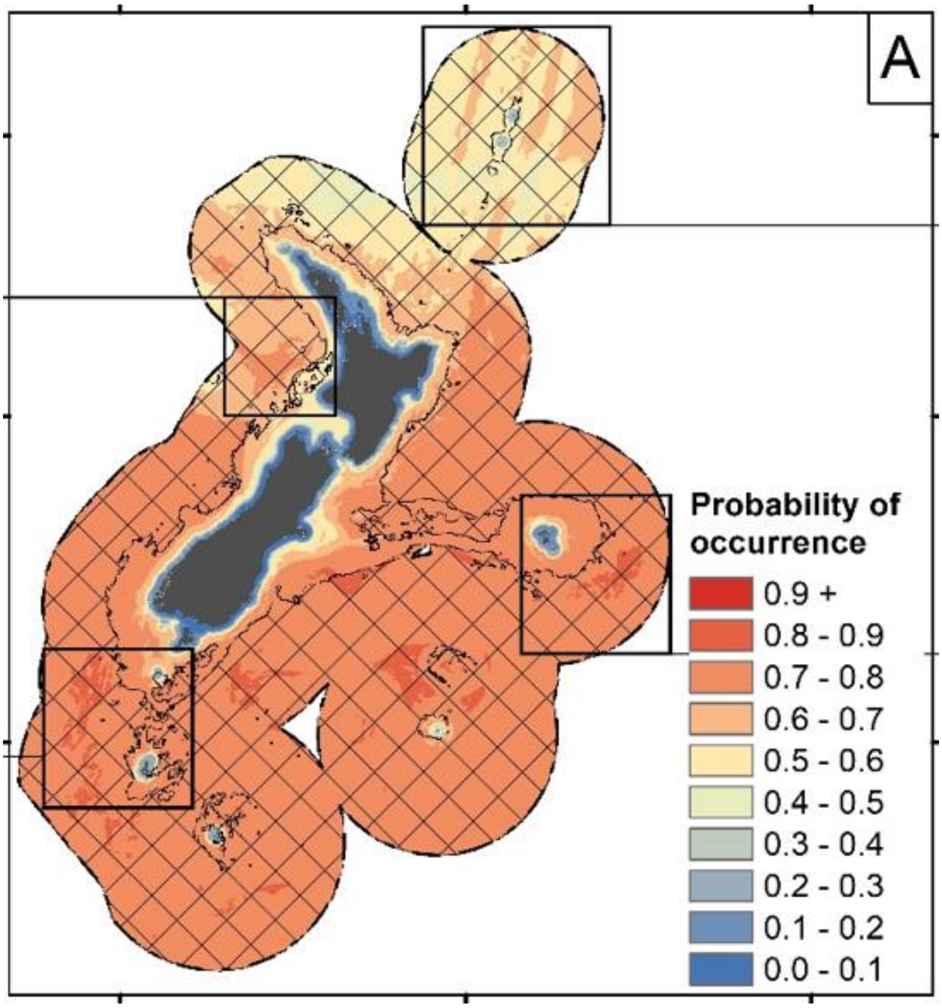
4.3.6.1.4 Long-finned Pilot Whale

Pilot whale sightings occur in New Zealand waters during all seasons (Berkenbusch *et al.*, 2013), with sightings of pilot whales in Taranaki waters reasonably common, particularly in summer (Torres, 2012).

Pilot whales are highly social, often travelling in large groups of over 100 individuals (DOC, 2020a). These whales commonly strand on New Zealand coasts, with the stranding rate peaking in spring and summer (O'Callaghan *et al.*, 2001). Farewell Spit is a recognised hotspot for pilot whale mass-stranding incidents; and November, December and January are the most common months in which mass stranding events occur (DOC marine mammal stranding data).

Ten sightings records for this species have been reported from the vicinity of the Tui field and 76 recorded stranding events. Habitat modelling for pilot whales has been undertaken by Stephenson *et al.* (2020) and is presented in **Figure 29** where moderate to high probabilities of occurrence are predicted in the Tui field. Hence, it is **likely** that long-finned pilot whales will be present at times during decommissioning activities.

Figure 29 Probability of occurrence of pilot whales



Note: The predicted probability of occurrence of pilot whales (*Globicephala melas & Globicephala macrorhynchus)* in the New Zealand EEZ modelled using bootstrapped BRTs and areas of low predicted environmental coverage depicting the lower confidence that can be placed in the predicted probability occurrence (criss-cross black line).

Source: Reproduced from Stephenson *et al.* (2020).

4.3.6.2 Pinniped Species that could be Present in and around the Tui Field

New Zealand fur seals are the only pinniped species that is expected to have a routine presence in and around the Tui field. However, rare visits by leopard seals could potentially occur (see Hupman *et al.,* 2019), but in general this species is unlikely to be present in the Tui field.

4.3.6.2.1 New Zealand Fur Seal

New Zealand fur seals are widespread around rocky coastlines on the mainland and offshore islands. There are six breeding colonies of relevance to the Tui field:

- Ngā Motu/Sugar Loaf Islands, New Plymouth;
- Stephens Island, outer Marlborough Sounds;
- Tonga Island, Tasman Bay;
- Separation Point, Golden Bay;
- Pillar Point, just south of Farewell Spit; and
- Archway Islands, just south of Farewell Spit.

The closest colony is at Ngā Motu/the Sugar Loaf Islands, approx. 85 km to the north (around the coastline of Cape Egmont); smaller haul-out sites are present throughout the Taranaki coast, although these do not meet the definition of a colony/rookery (Miller & Williams, 2003). Population numbers within the Ngā Motu area appear to be stable, with a lack of suitable habitat for hauling out and breeding likely limiting population growth (Miller & Williams, 2003).

New Zealand fur seals are opportunistic feeders that forage on a range of species, with the relative importance of each prey item varying seasonally and geographically (Baird, 1994). Foraging habitats vary with season and sex although inshore and deeper offshore foraging habitat is used throughout the year (Harcourt *et al.*, 2002). Females tend to forage over continental shelf waters, with males using deeper continental shelf breaks and pelagic waters (Page *et al.*, 2005). Foraging trips often last for several days (Page *et al.*, 2005) and GPS tagged animals have shown females to forage up to 78 km from breeding colonies (Harcourt *et al.*, 1995), foraging further offshore in winter (Harcourt *et al.*, 2002). The Tui field falls within the foraging range of the Ngā Motu breeding colony.

The breeding season for New Zealand fur seals occurs from mid-November to mid-January, with peak pupping in mid-December (Crawley & Wilson, 1976; Miller & Williams, 2003). Pups are suckled for approximately 300 days, during which adult females alternate between foraging at sea and returning to shore to feed their young (Boren, 2005).

At sea sightings of fur seals in the South Taranaki Bight are common (see Cawthorn (2015) and DOC marine mammal sighting database). It is particularly noteworthy that the Tui field falls within the foraging range of the Ngā Motu breeding colony hence, this species is **likely** to be present.

4.3.7 Seabirds

4.3.7.1 Species Potentially Present

The term 'seabirds' represents the bird species that spend some or part of their life-cycle feeding over open marine waters (Taylor, 2000). The Taranaki region is visited by several seabird species that either pass through the region during migrations of foraging voyages or are permanent residents. Approximately 60% of New Zealand's seabirds regularly forage more than 50 km from shore, while the remaining species are only occasionally sighted away from land (Taylor, 2000).

Systematic and quantitative studies of seabird distributions and abundances in the South Taranaki Bight have not been carried out (Thompson, 2015); at-sea abundance and distribution surveys for seabirds are generally lacking throughout New Zealand waters. Knowledge of the at-sea distributions of New Zealand's seabirds is generally restricted to targeted studies and observations from commercial fishing vessels (e.g. Richard *et al*., 2020[6]). As a result, sightings typically favour species that are attracted to fishing vessels and small/cryptic species may be missed and/or underestimated.

A summary of the seabird species identified as potentially present within the Tui field (and wider South Taranaki Bight) is provided in **Table 21**, including relevant threat classifications (IUCN Red List and New Zealand Threat Status). Presence of species was determined based on references such as Scofield & Stephenson (2013), Thompson (2015), Richard *et al*. (2020), eBird (2021), and NZBirdsOnline (2021).

Within the Proposed Regional Coastal Plan for Taranaki, Taranaki Regional Council has listed several birds as being regionally significant on account of their coastal indigenous biodiversity values (TRC, 2018). These species are identified in **Table 21** with an *. Grey-faced petrel have also been listed within the Proposed Regional Coastal Plan for Taranaki as 'regionally distinctive'.

[6] Since 2004, independent fisheries observers working off commercial fishing vessels have been making regular counts of the number of seabirds surrounding fishing vessels. This data is coordinated by the Department of Conservation and collated by Dragonfly Science. The correct reference for this is Richard *et al*. (2020).

Table 21 Seabirds species potentially present within the Tui field and wider South Taranaki Bight

Common Name	Scientific Name	IUCN Threat Status [1]	NZ Threat Status [2]
Antipodean albatross*	*Diomedea antipodensis antipodensis*	Endangered	Nationally critical
Gibson's albatross	*Diomedea antipodensis gibsoni*	Endangered [4]	Nationally critical
Salvin's mollymawk	*Thalassarche salvini*	Vulnerable	Nationally critical
Black petrel*	*Procellaria parkinsoni*	Vulnerable	Nationally vulnerable
Campbell Island mollymawk	*Thalassarche impavida*	Vulnerable	Nationally vulnerable
Flesh-footed shearwater*	*Puffinus carneipes*	Near threatened	Nationally vulnerable
Grey-headed mollymawk*	*Thalassarche chrysostoma*	Endangered	Nationally vulnerable
Hutton's shearwater	*Puffinus huttoni*	Endangered	Nationally vulnerable
Little blue penguin*	*Eudyptula minor*	Least concern	At risk - Declining
Sooty shearwater/Muttonbird*	*Puffinus griseus*	Near threatened [4]	At risk - Declining
White-capped/shy mollymawk	*Thalassarche cauta steadi*	Near threatened [4]	At risk - Declining
Little shearwater	*Puffinus assimilis haurakiensis* [5]	Least concern	At risk - Recovering
Northern giant petrel*	*Macronectes halli*	Least concern	At risk - Recovering
Sooty tern*	*Onychoprion fuscata serratus*	Least concern [4]	At risk - Recovering
Broad-billed prion*	*Pachyptila vittata*	Least concern	Relict
Cook's petrel	*Pterodroma cookii*	Vulnerable	Relict
Fairy prion*	*Pachyptila turtur*	Least concern	Relict
Fluttering shearwater*	*Puffinus gavia*	Least concern	Relict
Grey-backed storm petrel	*Garrodia nereis*	Least concern	Relict
Mottled petrel	*Pterodroma inexpectata*	Near threatened	Relict
Northern diving petrel*	*Pelecanoides urinatrix urinatrix*	Least concern [4]	Relict
White-faced storm petrel*	*Pelagodroma marina maoriana*	Least concern [4]	Relict
Antarctic prion*	*Pachyptila desolata*	Least concern	Naturally uncommon
Brown skua/southern skua	*Catharacta antarctica lonnbergi*	Least concern	Naturally uncommon
Buller's mollymawk	*Thalassarche bulleri bulleri*	Near threatened	Naturally uncommon
Buller's shearwater*	*Puffinus bulleri*	Vulnerable	Naturally uncommon
Grey petrel	*Procellaria cinerea*	Near threatened	Naturally uncommon
Northern royal albatross*	*Diomedea sanfordi*	Endangered	Naturally uncommon
Snare's petrel	*Daption capense australe*	Least concern [4]	Naturally uncommon
Southern royal albatross*	*Diomedea epomophora*	Vulnerable	Naturally uncommon
Westland petrel	*Procellaria westlandica*	Endangered	Naturally uncommon
Arctic skua	*Stercorarius parasiticus*	Least concern	Migrant
Blue petrel	*Halobaena caerulea*	Least concern	Migrant

Common Name	Scientific Name	IUCN Threat Status [1]	NZ Threat Status [2]
Cape pigeon/petrel	*Daption capense capense*	Least concern [4]	Migrant
Kerguelen petrel	*Lugensa brevirostris*	Least concern	Migrant
Medium-billed/Salvin's prion	*Pachyptila salvini*	Least concern	Migrant
Narrow-billed prion	*Pachyptila belcheri*	Least concern	Migrant
Pomarine skua	*Coprotheres pomarinus* [6]	Least concern [4]	Migrant
Short-tailed shearwater	*Puffinus tenuirostris*	Least concern	Migrant
Snowy albatross	*Diomedea exulans*	Vulnerable	Migrant
Southern giant petrel	*Macronectes giganteus*	Least concern	Migrant
Wilson's storm petrel	*Oceanites oceanicus exasperatus*	Least concern [4]	Migrant
Wedge-tailed shearwater	*Puffinus pacificus chlororhynchus*	Least concern [4]	Vagrant
Black-browed mollymawk	*Thalassarche melanophris*	Least concern	Coloniser
Indian ocean yellow-nosed mollymawk	*Thalassarche carteri*	Endangered	Coloniser
Australasian gannet	*Morus serrator*	Least concern	Not threatened
Grey-faced petrel*	*Pterodroma macroptera gouldi*	Least concern [4]	Not threatened
White-chinned petrel	*Procellaria aequinoctialis*	Vulnerable	Not threatened
White-headed petrel	*Pterodroma lessonii*	Least concern	Not threatened

1 IUCN Red List https://www.iucnredlist.org/

2 Robertson *et al*., 2017

3 New Zealand Birds Online, 2021

4 Scientific names are based on those provided in the New Zealand Threat Classification System (Roberston *et al*., 2017) and differ to those listed on the IUCN Red List. The IUCN Red List is generally at species level while Robertson *et al*. (2017) goes further to sub-species level.

5 Identified within Thompson (2015) as '*P. assimilis*'; however, the New Zealand Threat Classification System identifies three sub-species of little shearwater; *P. assimilis haurakiensis, P. assimilis kermadecensis, P. assimilis assimilis*. For this analysis it has been assumed that *P. assimilis haurakiensis* (North Island little shearwater) has been assumed.

6 *Coprotheres pomarinus* is the scientific name for Pomarine skua within Robertson *et al*., 2017; however, this bird is also referred to as the Pomarine jaeger (*Stercorarius pomarinus*).

4.3.7.2 Breeding Areas

Approximately 84 species of seabird breed throughout New Zealand (Taylor 2000); however, the South Taranaki Bight lacks suitable predator-free breeding habitat for many species. There are no seabird breeding areas of relevance to the Tui field; however, large colonies are found off the coast of New Plymouth at Ngā Motu/the Sugar Loaf Islands, and smaller colonies occur at various locations along the coast.

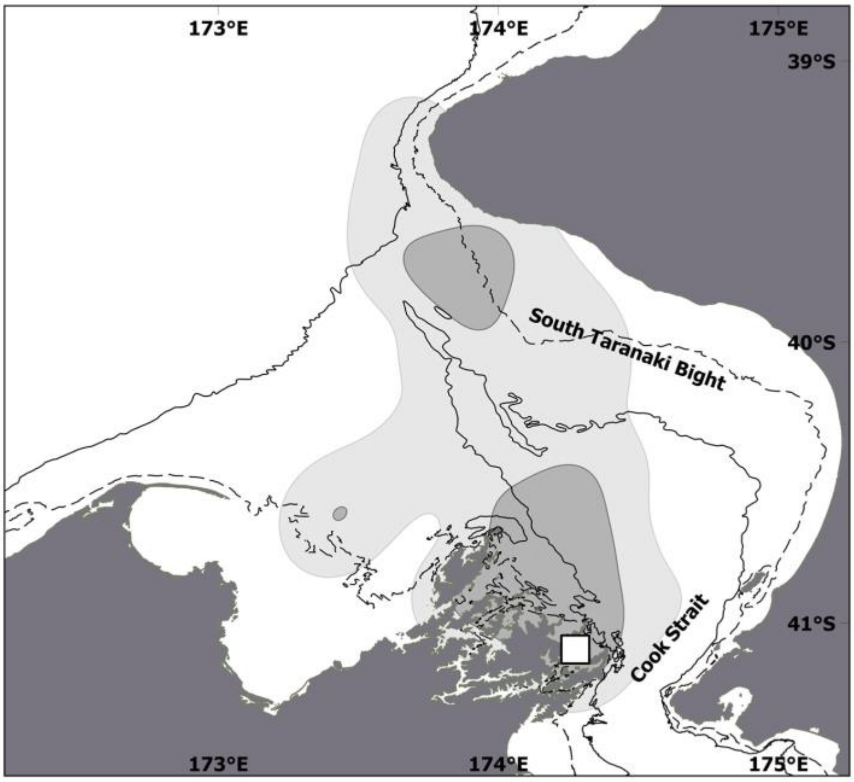
4.3.7.3 Little Blue Penguin/Kororā

Little penguins (also commonly known as little blue penguins) are the world's smallest species of penguin, with a wide distribution throughout coastal New Zealand (Scofield & Stephenson, 2013). They are considered a taonga species by iwi and concerns are regularly raised with regard to any potential effects of activities on foraging and nesting of these birds.

Except for within the Taranaki region, there are few colonies along the North Island's west coast (Wilson & Mattern, 2018). These penguins forage at sea during the day, returning at night to their burrows (NZBirdsOnline, 2021). They generally return to their natal colony for breeding and retain pair bonds and often the same burrow year after year (Wilson & Mattern, 2018).

Little penguins were historically thought to forage within 30 km of nest sites during the chick-rearing stage (Hoskins *et al*., 2008; Agnew, 2014; Pelletier *et al*., 2014) and unusually long foraging trips (of up to 118 km) had only been recorded in the closely related Australian little blue penguin (*E. novaehollandiae*) when foraging in the Great Australian Bight (Wiebkin *et al*., 2005). However, based on GPS tracking data, Poupart *et al* (2017) revealed that little penguins are capable of, and routinely carry out, extended foraging trips of up to 214 km from breeding colonies, with penguins from Marlborough Sounds colonies frequently utilising South Taranaki Bight water as foraging grounds (**Figure 30**). Such long-distance trips were found to be particularly important during the egg-incubation stage (Poupart *et al*., 2017); eggs are typically laid from July to November, with incubation lasting up to 36 days (NZBirdsOnline, 2021). Following hatching, the chicks are fed by both parents who carry out foraging trips closer to the nest site (Poupart *et al*., 2017).

Figure 30 Foraging areas of Motuara Island, Marlborough Sounds, penguins during incubation stage



Source: Poupart *et al*., 2017

Light grey area represents the home range (95% UD) and the dark grey the focal area (50% UD). The study colony is shown by the white square. The 50 m bathymetry contour is represented by a dashed line and the 100 m contour by the solid line.

4.3.7.4 Important Bird Areas

Royal Forest & Bird Protection Society of New Zealand Incorporated, Birdlife International, and Birds New Zealand have identified several areas throughout New Zealand as 'Important Bird Areas'. These areas have been identified as internationally important for bird conservation and are known to support key species and other biodiversity and provide input into the international Important Bird Area Programme.

Important Bird Areas are not officially protected under legislation; their function is to help focus and facilitate conservation action for a network of sites that are significant for the long-term viability of naturally occurring populations (Forest & Bird, 2014). However, the Important Bird Area has been included within Proposed Regional Coastal Plan (**PRCP**) for Taranaki, with a respective policy requiring avoiding, remedying or mitigating adverse effects of activities in this area.

Important Bird Areas are broken down by 'coastal sites and islands', 'rivers, estuaries, coastal lagoons and harbours', and 'seaward extensions, pelagic areas' (Forest & Bird, 2014); only seaward extensions and pelagic areas are of relevance to activities associated with the decommissioning of the Tui field.

Seaward extensions are areas that extend out from the land-confines of breeding colonies and which are used by the colony for feeding, maintenance behaviours and social interactions. The boundaries of these areas are typically limited to the foraging range, depth, and/or habitat preferences of the species concerned, but may also cover the passage of birds in and out of their colonies (Forest & Bird, 2014).

Although the Tui field lies north of the boundaries of the Cook Strait Important Bird Area it provides a useful gauge on the bird species that may be utilising the South Taranaki Bight. Cook Strait is a major passage or flyway for pelagic seabirds breeding outside the region, including birds from northern islands (e.g. Buller's shearwater, grey-faced petrel), the South Island's West Coast (e.g. Westland petrel), and Subantarctic islands (e.g. Salvin's mollymawk, Antipodean albatross) (Forest & Bird, 2014). This area meets the following criteria:

- A1: Regular presence of threatened species – i.e. more than threshold numbers of one of more globally threatened species; and
- A4: More than one percent of the world population of one or more congregatory species:
    - A4ii: 1% global population.
    - A4iii: 10,000 pairs seabirds or 20,000 individual seabirds.

Trigger species and their qualifying Important Bird Area criteria (based on the above criteria) for the Cook Strait Important Bird Area are listed in **Table 22**.

Table 22 Cook Strait Important Bird Area trigger species

Trigger species	Activity	IBA Criteria
Fairy prion, fluttering shearwater, Australasian gannet	Foraging	A4ii
Sooty shearwater	Foraging, passage	A1, (A4iii)
Black-billed gull, black-fronted tern	Post-breeding foraging	A1
Antipodean albatross, Northern royal albatross, white-capped albatross, Salvin's mollymawk, white-chinned petrel, Buller's shearwater	Passage	A1
Westland petrel, Hutton's shearwater	Passage	A1, A4ii
Species group (multiple species including a number not listed above)		A4iii

Source: Forest & Bird, 2014.

Note: Some species listed in **Table 22** as trigger species have not been included in **Table 21** due to their more coastal distribution (e.g. black-billed gull).

4.4 Cultural Environment

Aotearoa's marine environment is highly valued by Māori and plays an important role in historic and present-day culture. The values placed on the marine environment stem from a wide range of elements including the provision of kaimoana (seafood), a sacred pathway which provides a means of historic and contemporary transport and communication, and the habitat of numerous taonga (treasured) species.

There are eight recognised iwi within the Taranaki Region, all of which have traditions that demonstrate an ancestral, cultural, historical and spiritual connection to the coastal environment (TRC, 2018). The IAA lies within the rohe of Taranaki Iwi, who exercise mana whenua and mana moana from Paritūtū (North Taranaki), around the western coast of Taranaki Maunga, south to Rawa o Turi Stream (South Taranaki), and seaward to the outer extent of the EEZ. All other iwi in the region have historical and contemporary associations with the coastline around Taranaki.

Because Taranaki Iwi exercise kaitiakitanga for the area surrounding the Tui field, they have been engaged to prepare a CIA in relation to the IAA and the anticipated impacts to cultural values. On this basis, the CIA (found in **Appendix E**) should be consulted as the primary point of cultural information. The CIA has identified the potential receptors or environmental features and/or species of cultural significance to Taranaki Iwi, and has outlined the state of the mouri for each of them. This determination was made through hui. The information presented in the CIA includes a 'baseline' of the mouri, based on the absence of the Tui field (i.e. prior to the instalment of the Tui field in 2007) and the current state of the mouri (factoring in the past Tui field activities, and the historical trends for resources that have contributed to this state). The cultural values of specific concern are set out in the CIA, and are as follows:

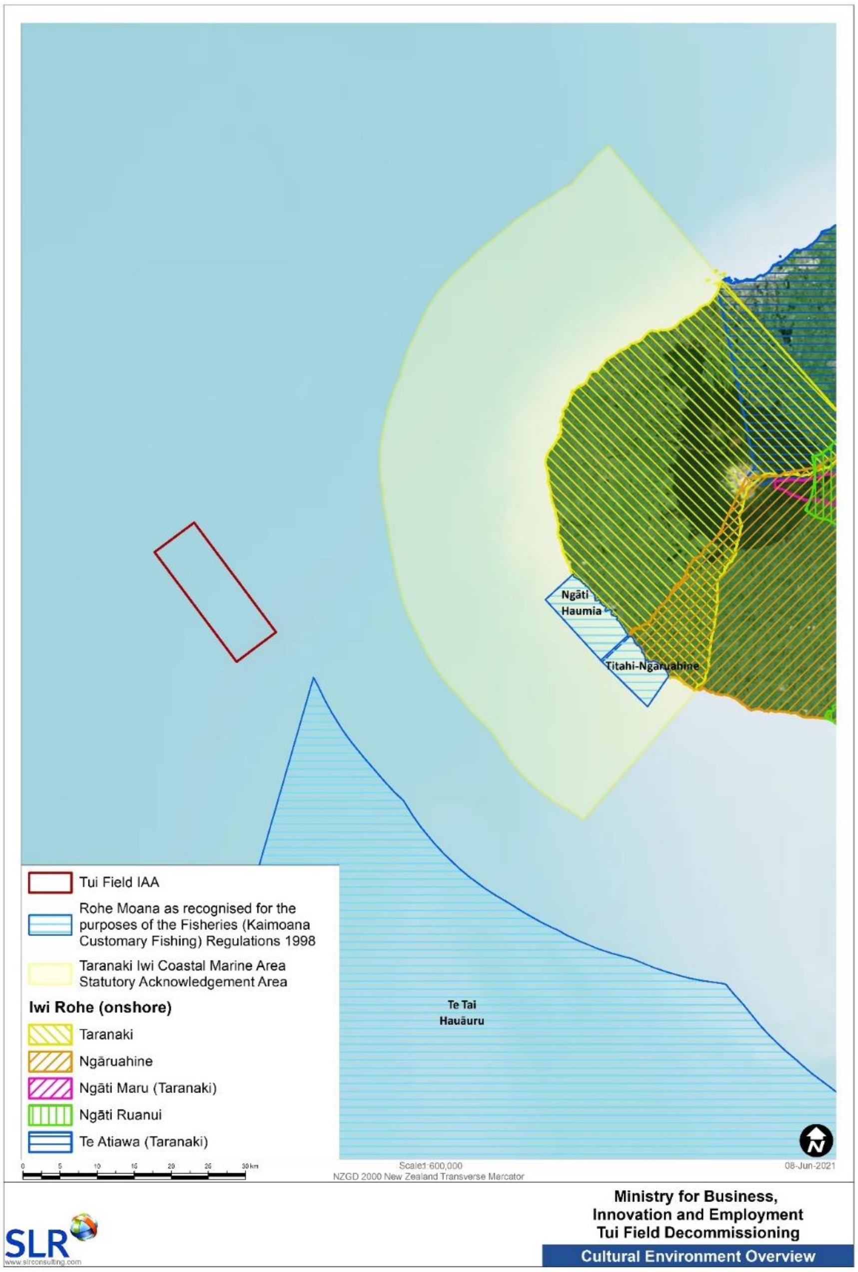
- Ngā Taonga Koiora (native flora and fauna) – the mouri of these taonga species, those being marine mammals, fish and benthic species;
- Ngā Tangata (people) - in te ao Māori, the inclusion of the wairua (spiritual health), the role of the whānau (family) and the balance of the hinengaro (mind) are as important as the physical manifestations (body). Should one of the four dimensions be missing or in some way damaged, a person, or a collective may become 'unbalanced' and subsequently unwell. These four dimensions are:
  - Taha wairua (spiritual health) - spiritual health and well-being obtained through the maintenance of a balance with nature and the protection of mouri;
  - Taha whānau (family health) - the responsibility and capacity to belong, care for and share in the collective, including relationships and social cohesion;
  - Taha hinengaro (mental health) – mental health and well-being and the capacity to communicate, think and feel; and
  - Taha tinana (physical health) – physical health and well-being;
- Ngā Taonga Tuku Iho (valued flora and fauna) - the mouri of species valued by tangata whenua in Fisheries Management Area 8 including snapper, kahawai, blue cod, flatfish, small sharks, eels kina, mussels, toheroa, pipi, cockles and tuatua; and the inability to fish these species due to fishing exclusions in the Tui field;
- Ngā Moana (coastal and offshore waters) – the mouri of this element;
- Te Hau (air) – the mouri of this element and its ability (or not) to sustain all forms of life;
- Ngā Taonga Tuku Iho (traditional Māori values and practices) - the ability to undertake kaitiakitanga to sustain ourselves and our tikanga; and

- Whaioranga (economic development and sustainability) - The interests that tangata whenua have in minerals (and resulting royalties) and commercial fisheries.

In addition to the mouri described in the CIA, the following sub-sections provide a brief description of the cultural environment in relation to the IAA.

The onshore rohe (geographic boundaries) of iwi that occur in the vicinity of the IAA, according to Taranaki Regional Council records, are illustrated in **Figure 31** and include: Ngāti Tama, Ngāti Mutunga, Te Atiawa, Ngāti Maru, Taranaki, Ngāruahine, Ngāti Ruanui, and Ngaa Rauru. **Figure 31** also provides the location of the Taranaki Iwi Coastal Marine Area Statutory Acknowledgement Area outlined within the PRCP as detailed within the deed plan OTS-053-55.

Figure 31 Cultural environment overview in relation to the IAA



4.4.1 Customary Fishing and Iwi Fisheries Interests

The fishing rights of tangata whenua are referred to as 'customary fisheries'. Te Tiriti o Waitangi – The Treaty of Waitangi guarantees customary fishing rights to tangata whenua, and these rights have been adopted into numerous pieces of legislation. Customary fisheries take place in rohe moana which are defined customary fishing areas recognised for the purposes of the Fisheries (Kaimoana Customary Fishing) Regulations 1998. The rohe moana of relevance to the IAA are illustrated in **Figure 31** and listed below:

- Ngāti Haumia Rohe Moana;
- Titahi-Ngaruahine Rohe Moana; and
- Te Tai Hauāuru.

Iwi hold customary fishing rights under the Fisheries (Kaimoana Customary Fishing) Regulations 1998. These regulations stem from the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 and provide for the customary harvesting of kaimoana for special occasions. Under these regulations iwi may issue permits to harvest kaimoana in a way that exceeds those levels typically permitted in order to provide for hui (a gathering or meeting), tangi (funeral) or as koha (a gift, donation or contribution). The sale of any kaimoana harvested under a customary permit is prohibited. Only iwi may authorise a permit within their rohe moana, although the applicant/holder of a customary permit does not have to be affiliated to any iwi.

The allocation of customary fishing rights is undertaken by Tangata Kaitiaki/Tiaki in accordance with tikanga Māori (meaning culturally proper, i.e. aligned with the customary system of values and practices that have been developed over time and are deeply embedded in the social context). Tangata Kaitiaki/Tiaki are individuals or groups that have been appointed by local Tangata Whenua and confirmed by the Minister of Fisheries and whose role is to authorise customary fishing within their rohe moana. Under the regulations, customary fishing rights can be caught by commercial fishing vessels on behalf of the holder of the customary fishing right.

Customary fisheries can be managed by the establishment of one of the following customary management areas:

- Mātaitai reserves – recognise and provide for traditional fishing through local management. These areas are closed to commercial fishing, that may have bylaws affecting recreational and customary fishing;
- Taiāpure – estuarine or coastal areas that are significant for food, spiritual, or cultural reasons. These local fisheries of special significance allow all types of fishing but may have additional fishing rules and are managed by local communities;
- Temporary closures – areas that are temporarily closed to fishing or certain fishing methods. These are issued under sections 186A or 186B of the Fisheries Act 1996; and
- Customary bylaw areas – changes to fisheries management rules made by tangata whenua or Tangata Kaitiaki/Tiaki (guardians) for their Crown settlement area or mātaitai reserve.

As of the time of writing this marine consent application, none of the above customary management areas have been gazetted for the Taranaki region.

Customary fishing rights are in addition to recreational fishing rights and do not remove the right of tangata whenua to catch their recreational limits under the amateur fishing regulations. The Fisheries (Amateur Fishing) Regulations 2013 impose restrictions on the taking fish, aquatic life, or seaweed, unless they are taken for the purposes of a hui or tangi and are in accordance with an authorisation issued under regulation 51 of the Fisheries (Amateur Fishing) Regulations 2013.

In addition to customary fishing rights, recognised iwi were allocated fisheries assets via commercial quota under the Māori Fisheries Act 2004. Each iwi was also assigned income shares in Aotearoa Fisheries Limited, which is managed and overseen by Te Ohu Kaimoana (the Māori Fisheries Commission). Te Ohu Kaimoana harvest, procure, farm, process, and market kaimoana in New Zealand and internationally. For quota associated with fisheries that are classified as 'deepwater', all iwi were assigned quota based on population size and relative length of coastline within their rohe. Quota for fisheries considered to be 'inshore' was allocated only to iwi whose rohe overlapped with the management area of the stock.

Also of relevance to the IAA, is the Te Taihauāuru Iwi Forum which was established to collaborate on fisheries management issues (commercial and non-commercial) in Fisheries Management Area (**FMA**) 8 (see **Section 4.5.1**) which is an area known to iwi as the 'rohe of Te Taihauāuru' (from Mokau River to Waikanae). Members of the forum include the Te Atiawa (Taranaki) Settlements Trust, Te Rūnanga o Ngāti Mutunga, Te Kaahui o Ruru, Te Rūnanga o Ngāi Apa, Te Whiringa Muka Trust, Ati Awa Ki Whaarongotai Charitable Trust, Muaupoko Tribal Authority Inc., Te Rūnanga o Raukawa/Raukawa Ki Te Tonga Trust, Te Pātiki Trust – Ngāti Hauiti, and Te Ohu Tiaki o Rangitaane Te Ika a Māui Trust. A fisheries plan, 'Te Taihauāuru Iwi Forum Fisheries Plan 2012 – 2017', was developed by Te Taihauāuru which outlines the collective agreements of the iwi involved, with a secondary purpose of identifying how government and private organisations can work with Te Taihauāuru to assist in achieving their objectives (Te Taihauāuru, 2012).

4.4.2 Statutory Acknowledgement Areas

Statutory Acknowledgements are acknowledgements made by the Crown of an iwi or hapū's particular cultural, spiritual, historical or traditional association with specified areas. These acknowledgements are made in each Deed of Settlement that is negotiated between an iwi group and the Crown during the process of a Treaty of Waitangi claim and once settlement is complete are legally recognised by each settlement act. They include areas of land, geographic features, lakes, rivers, wetlands and the CMA that are part of Crown-owned land (MfE, 1999).

A Statutory Acknowledgement generally requires councils to:

- Forward summaries of all relevant resource consent applications to the relevant claimant group governance entity, and to provide the governance entity with the opportunity to waive its right to receive summaries;
- Have regard to a statutory acknowledgement in forming an opinion as to whether the relevant claimant group may be adversely affected in relation to resource consent applications concerning the relevant statutory area; and
- Within the claim areas, attach for public information a record to all regional policy statements, district plans, and regional plans of all areas affected by statutory acknowledgements.

For the most part, the statutory acknowledgement areas in the Taranaki region are located onshore; however, there are three relevant areas in the coastal and marine areas. Two of the CMA statutory acknowledgement areas, Ngāruahine Coastal Marine Area - Ngāruahine (Ngāruahine Claims Settlement Act 2016) and Te Atiawa Coastal Marine Area - Te Atiawa (Te Atiawa Claims Settlement Act 2016), do not encompass the area of the coast to the east of the IAA.

However, the third CMA statutory acknowledgement area, the Taranaki Iwi Coastal Marine Area statutory acknowledgement area, is located east of the IAA, as shown in **Figure 31**. Further discussion on the statement of association of Taranaki Iwi as relevant to the Taranaki Iwi Coastal Marine Area statutory acknowledgement area is outlined within **Section 5.1.1.2** when determining potential existing interests.

4.4.3 Interests under the Marine & Coastal Area (Takutai Moana) Act 2011

The Marine and Coastal Area (Takutai Moana) Act 2011 (**MACA**) acknowledges the importance of the marine and coastal area to all New Zealanders while providing for the recognition of the customary rights of iwi, hapū and whānau in the CMA. Iwi, hapū or whānau groups may be granted recognition of two types of customary interest under the MACA: Customary Marine Title and Protected Customary Rights. The recognition that these two types of customary interest were summarised by Te Arawhiti – the Office for Māori Crown Relations (Te Arawhiti, 2021), as outlined below.

Customary Marine Title recognises the relationship of an iwi, hapū or whānau with a part of the common marine and coastal area[7]. Public access, fishing and other recreational activities are allowed to continue in Customary Marine Title areas; however, the group that holds Customary Marine Title maintains the following rights:

- A Resource Management Act permission right which lets the group say yes or no to activities that need resource consents or permits in the area;
- A conservation permission right which lets the group say yes or no to certain conservation activities in the area;
- The right to be notified and consulted when other groups apply for marine mammal watching permits in the area;
- The right to be consulted about changes to Coastal Policy Statements;
- A wāhi tapu protection right which lets the group seek recognition of a wāhi tapu and restrict access to the area if this is needed to protect the wāhi tapu;
- The ownership of minerals other than petroleum, gold, silver and uranium which are found in the area;
- The interim ownership of taonga tūturu found in the area; and
- The ability to prepare a planning document which sets out the group's objectives and policies for the management of resources in the area.

Protected Customary Rights may be granted within the common marine and coastal area to allow for customary activities such as the collection of hāngi stones or launching of waka. If a group has a Protected Customary Right recognised, they do not need a resource consent to carry out that activity and local authorities cannot grant resource consents for other activities that would have an adverse effect on the Protected Customary Right.

[7] The marine and coastal area is the area between the mean high-water springs and the outer limits of the territorial sea (12 NM from shore). The common marine and coastal area are the parts of the marine and coastal area that aren't in private ownership or part of a conservation area.

Table 23 lists the Customary Marine Title and Protected Customary Rights applications that have been received and are of relevance to the IAA. These applications are still being progressed and no official approval has been released, as such, the applications themselves do not found "existing interests" in terms of paragraph (f) of the definition in section 4 of the EEZ Act.

Nonetheless, the customary rights, interests, and activities underpinning those applications – which include the elements identified in the CIA and other interests summarised above – are equally relevant to consider in assessing this application for marine consents in terms of paragraph (a) of the definition of "existing interests". **Table 23** highlights the application by Taranaki Iwi as the only application that relates to the area of the coast to the east of the IAA; however, it is worth noting the further applications around Taranaki also outlined in **Table 23**.

Table 23 Applications under MACA in the vicinity of the IAA

Applicant	High Court Reference	Recognition Sought	Application Area
Application relating to the area of the coastline inshore of the IAA			
Taranaki iwi	CIV-2017-485-000212	Customary Marine Title and Protected Customary Rights	Paritūtū to Rawa-o-Turi Stream and out to 12 NM offshore between these points – the area of coast to the east of the IAA.
Further applications relating to other areas of the coastline around Taranaki			
Ngāti Ruanui	CIV-2017-485-000282	Customary Marine Title and Protected Customary Rights	Northern boundary is Waingongoro River, southern boundary is Whenuakura River and out to 12 NM offshore between these points.
Ngāti Hāua Hapū of Ngāruahinerangi iwi	CIV-2017-485-000293	Customary Marine Title and Protected Customary Rights	Between the mouth of the Raoa (Rawa) Stream to the mouth of the Ōtakeho Stream and out to 12 NM offshore between these points.
Ngāti Tamaahuroa and Tītahi Hapū	CIV-2017-485-000300	Customary Marine Title and Protected Customary Rights	12 NM out from the mouth of Taungātara Stream to the northwest and the mouth of Rāroa/Rawa Stream to the southeast.
Te Korowai o Ngāruahine	CIV-2017-485-000243	Customary Marine Title and Protected Customary Rights	12 NM out from the mouth of Taungātara Stream to the northwest and from the mouth of Waihi Stream to the southeast.
Robinson & Anor (Ngati Manuhiakai)	CIV-2011-485-000797	Protected Customary Rights	Foreshore and seabed within the tribal takiwa of Ngati Manuhiakai: from Waingongoro River in the south to the Wahamoko Stream in the north west.

Applicant	High Court Reference	Recognition Sought	Application Area
Okahu Inuawai Hapū	CIV-2011-485-000803	Protected Customary Rights	12 nautical miles out from the mouth of Inaha Stream to the northwest, and from the mouth of Waihi Stream to the southeast.
Kanihi-Umutahi Hapū	CIV-2011-485-000814	Protected Customary Rights	12 nautical miles out from the mouth of Inaha Stream to the northwest, and from the mouth of Waihi Stream to the southeast.
Araukuuku Hapū	CIV-2017-485-000210	Customary Marine Title and Protected Customary Rights	From Taungatara Stream in the north, south to Waihi Stream and out to 12 NM.
Ngati Tū Hapū	CIV-2017-485-000213	Customary Marine Title and Protected Customary Rights	From Taungatara Stream in the north, south to Waihi Stream and out to 12 NM.
Te Atiawa (Taranaki)	CIV-2017-485-000310	Customary Marine Title and Protected Customary Rights	From Paritutu in the south to Waiau Stream in the north out to 12 NM.

Source: https://www.courtsofnz.govt.nz/the-courts/high-court/high-court-lists/marine-and-coastal-list-applications/

4.4.4 Coastal Taonga Species

Schedule 5 of the PRCP has identified a number of taonga species with special cultural, spiritual, historical and traditional associations located within the Taranaki CMA and as identified in the deeds of settlement for iwi of Taranaki. These taonga species are listed in **Table 24** and may be found within the IAA.

Table 24 Coastal taonga species Identified within the PRCP

Māori Name	Common Name	Scientific Name	Present in the IAA?
Marine fish			
Tuna	Long-finned eel	*Anguilla dieffenbachia*	*Possible* – However, a freshwater species but spends part of its life stages at sea but not known to specifically frequent the IAA.
Tuna	Short-finned eel	*Anguilla australis*	*Possible* – However, a freshwater species but spends part of its life stages at sea but not known to specifically frequent the IAA.
	Australian long-finned eel	*Anguilla rheinhartii*	*Possible* – However, a freshwater species but spends part of its life stages at sea but not known to specifically frequent the IAA.
Piharau	Lamprey	*Geotria australis*	*Possible* – However, a freshwater species but spends part of its life stages at sea but not known to specifically frequent the IAA.
Hāpuka	Groper	*Polyprion oxygeneios*	*Possible*

Māori Name	Common Name	Scientific Name	Present in the IAA?
Kahawai	Sea trout	*Arripis trutta*	*Likely*
Kanae	Grey mullet	*Mugil cephalus*	*Possible but unlikely* – generally inshore species, mainly around harbours and estuaries.
Mararī	Butterfish	*Odax pullus*	*Very unlikely* – mainly a coastal species where algae beds are present on hard substrate.
Moki	Blue Moki	*Latridopsis ciliaris*	*Possible* – generally a more inshore species
Paraki/Ngaore/Pōrohe	Common smelt	*Retropinna retropinna*	*Very unlikely*- generally freshwater, estuarine or close coastal dweller.
Pāra	Frostfish	*Lepidopus caudatus*	*Possible* –more common in deeper waters
Pātiki mahoao	Black flounder	*Rhombosolea retiaria*	*Very unlikely* – shallow estuarine and freshwater flounder species.
Pātiki rore	New Zealand Sole	*Peltorhamphus novaezeelandiae*	*Possible* –generally found in shallower areas <100 m
Pātiki tore	Lemon Sole	*Pelotretis flavilatus*	*Possible* – however, generally found in shallower areas (<40 m)
Pātiki totara	Yellow-belly flounder	*Rhombosolea leporina*	*Possible* – however, generally found in shallower areas (<40 m)
Pātiki	Sand flounder	*Rhombosolea plebeia*	*Possible* – however, generally found in shallower areas (<40 m)
Pātukituki/Rāwaru	Blue cod/Rock cod	*Parapercis colias*	*Possible*
Pioke, Tope, Mangō	School shark/rig	*Galeorhinus galeus*	*Likely*
Reperepe	Elephant fish	*Callorhynchus millii*	*Possible*
Koiro, ngoiro, totoke, hao, ngoio, ngoingoi, putu	Conger eel	*Conger verreauxi*	*Likely*
Marine Invertebrates			
Pūpū	Cat's eye snail	*Lunella smaragdus/Diloma sp*	*Unlikely* – generally intertidal/shallow subtidal
Kōtoretore, Kotore, humenga	Sea anemone	*Order Actiniaria*	*Likely*
Rori, rore	Sea cucumber	*Australostichopus mollis*	*Likely*
Rori (which includes ngutungutukaka)	Shield Shell/Seasnail	*Scutus breviculus*	*Possible* but *unlikely* – generally limited to shallower subtidal areas.
Hihiwa	Yellowfoot paua	*Haliotis australis*	*Not present* – requires hard substrate in shallow subtidal areas.
Paua	Blackfoot paua	*Haliotis iris*	*Not present* – requires hard substrate in shallow subtidal areas.

Māori Name	Common Name	Scientific Name	Present in the IAA?
Kutai/Kuku	Blue mussel	*Mytilus edulis*	*Possible* – Were present on upper sections of production flowlines, gas-lift lines and umbilical risers. However, may no longer be viable as risers have been laid down on seabed.
Kutai/Kuku	Green lipped mussel	*Perna canaliculus*	*Possible* – Were present on upper sections of production flowlines, gas-lift lines and umbilical risers. However, may no longer be viable as risers have been laid down on seabed.
Pipi/Kakahi	Pipi	*Paphies australis*	*Very Unlikely* – generally limited to intertidal and shallow subtidal areas
Tītiko/Karehu	Mud snail	*Amphibola crenata, Lunella smaragdus, Diloma sp.*	*Unlikely* – generally intertidal/shallow subtidal taxa.
Kina	Sea urchin	*Evechinus chloroticus*	*Present*
Kōura	Rock lobster/crayfish	*Jasus edwardsii*	*Present* – several observed on the MWA's during 2020 ROV Survey.
Kaeo	Sea tulip	*Pyura pachydermatina*	*Possible* - more generally in shallow waters
Koeke	Common Shrimp	*Palaemon affinis*	*Possible*
Wheke	Octopus	*Macroctopus maorum*	*Present*
Kaunga	Hermit crab	*Pagurus novizealandiae*	*Present*
Pāpaka parupatu	Mud crab	*Austrohelice crassa*	*Very Unlikely* – estuarine/ intertidal/shallow subtidal species.
Pāpaka parupatu	Paddlecrab	*Ovalipes catharus*	*Possible* – more commonly in shallower areas (generally <30 m) but could be swimming near the surface.
Patangatanga, patangaroa, pekapeka	Starfish	*Class Asteroidea*	*Present*
Purimu	Surfclam	*Dosinia anus, Paphies donacina, Spisula discors, Spisula murchisoni, Crassula aequilatera, Bassina yatei, or Dosinia subrosea*	*Very Unlikely* – generally limited to shallow subtidal areas near surf zone
Tuangi	Cockle	*Austrovenus stutchburyi*	*Very Unlikely* – generally limited to intertidal and shallow subtidal areas
Tuatua	Tuatua	*Paphies subtriangulata, P. donacina*	*Very Unlikely* – generally limited to intertidal and shallow subtidal areas
Waharoa	Horse mussel	*Atrina zelandica*	*Unlikely* – generally limited to shallowed than 30-40 m
Karauria, ngakihi, tio, repe	New Zealand rock oyster	*Saccostrea glomerata*	*Unlikely* – generally intertidal or shallow fouling.

Māori Name	Common Name	Scientific Name	Present in the IAA?
Kuakua, pure, tipa, tipai, kopa	Scallop	*Pecten novaezelandiae*	*Possible* – has been seen/found in benthic surveys in offshore Taranaki
Marine plants			
Karengo	Nori	*Porphyra/Pyropia sp.*	*Unlikely* - requires hard substrate in photic zone
Marine mammals – all species but specifically:			
Tohorā	Beaked whales	Family *Ziphiidae*	For likelihood of marine mammals within the IAA refer to **Table 20** within **Section 4.3.6** and **Appendix G**.
Tohorā	Melon-headed whale	*Peponocephala electra*	
Tohorā	Pygmy killer whale	*Feresa attenuata*	
Tohorā	False killer whale	*Pseudorca crassidens*	
Tohorā	Killer whale	*Orcinus orca*	
Tohorā	Long-finned pilot whale	*Globicephala melas*	
Tohorā	Short finned pilot whale	*Globicephala macrorhynchus*	
Parāoa	Sperm whale	*Physeter macrocephalus*	
	Pygmy sperm whale	*Kogia breviceps*	
	Dwarf sperm whale	*Kogia sima*	
	Common bottlenose dolphin	*Tursiops truncatus*	
Aihe	Short-beaked common dolphin	*Delphinus delphis*	
	Hector's dolphin (South Island Hectors dolphin and Māui dolphin)	*Cephalorhynchus hectori (C. hectori hectori* and *C. hectori maui)*	
	Dusky dolphin	*Lagenorhynchus obscurus*	
	Risso's dolphin	*Grampus griseus*	
	Spotted dolphin	*Stenella attenuata*	
	Striped dolphin	*Stenella coeruleoalba*	
	Rough-toothed dolphin	*Steno bredanensis*	
	Southern right whale dolphin	*Lissodelphis peronii*	
	Spectacled porpoise	*Phocoena dioptrica*	

4.4.5 Sites of Significance to Māori

Schedule 6B of the PRCP for Taranaki identifies various known Sites of Significance to Māori due a variety of values including kaitiakitanga and mouri. The sites identified within Schedule 6B, particularly those near Cape Egmont being the closest to the Tui field, extend out approximately 500 m from the shoreline, and are therefore located approximately 45 km away from the Tui field. Due to this significant separation distance and the fact that the proposed decommissioning activities will not have any adverse effects beyond the IAA, as discussed later in this IA, a full list and map of the Sites of Significance to Māori has not been reproduced here.

4.5 Socio-Economic Environment

This section outlines the socio-economic environment within and in proximity to the IAA. This section covers fisheries, shipping and oil and gas activities.

4.5.1 Fisheries

There are ten FMAs implemented within New Zealand waters in order to manage the Quota Management System (**QMS**). The QMS is currently regulated by Fisheries New Zealand (**FNZ**) and is the primary management tool to allow commercial utilisation of New Zealand's fisheries resources and ensure their sustainability for the future; the QMS and Annual Catch Entitlements provide for the commercial utilisation and sustainable catch of 96 species.

The IAA lies within FMA 8 (Central) which extends along the Taranaki and Whanganui coastline, where the exposed coastline is subject to westerly winds and southwest swells, which can often result in rough seas and limit the number of fishable days. Despite the exposed nature of the coastline, the area is considered to have a valuable recreational, customary and inshore commercial and offshore trawler fishery.

4.5.1.1 Commercial Fishing

FMAs are further subdivided into Statistical Areas which form the basis of the spatial reporting requirements to FNZ, of which the IAA is located within Statistical Area 040. For the purposes of this consent application and to determine the use of the IAA by commercial fishers, catch data was requested from FNZ under the Official Information Act 1982.

FNZ reviewed data from the last five complete calendar years (2016 – 2020) and provided information on fishing events that were reported to Statistical Area 040. However, it is worth noting that some fishers did not have to report a precise location (i.e. latitude and longitude) for each fishing event, these were only required to report events to a Statistical Area due to the requirement to report electronically being phased in through the 2019 calendar year. Nevertheless, FNZ provided summary information relevant to the IAA, with a total of 6,061 fishing events were reported within Statistical Area 040, of these:

- Three fishing events were reported, by latitude and longitude, that were within the boundary of the IAA;
- 3,351 fishing events were reported by latitude and longitude outside of the IAA; and
- 2,707 records were reported to Statistical Area 040 and FNZ cannot determine with certainty that these reported fishing events occurred outside of the IAA.

Although only three fishing events over the five-year period were reported within the IAA (by specific coordinates) there is a possibility that some of the remaining 2,707 reported events could have occurred within the IAA. However, it is considered unlikely[8] that many of these were within the IAA due to the Tui Protected Area and the close proximity of oil and gas assets in the area. If the number of fishing events were to be prorated based on the known number of fishing events inside and outside the IAA, it could be expected that approximately another three fishing events occurred within this five-year period (based on ~0.1% of 2,707 events).

FNZ was unable to provide information on the species caught during the three fishing events known to be within the IAA due to commercial and privacy considerations as this catch was from a small number of commercial operators (less than three).

4.5.1.2 Recreational Fishing

Wynne-Jones *et al*. (2019) reported the results of the National Panel Survey of Recreational Fishers; the most comprehensive survey undertaken on recreational fishing catch and effort, based on FMAs which involved year-long contact with approximately 7,000 recreational fishers. The most common finfish species caught within the wider FMA 8 (within which the IAA is located) are snapper, kahawai, red gurnard, blue cod and tarakihi, while pipi, paua, kina, tutaua, and rock lobster are the most commonly fished invertebrates. November to January represents the months with the highest number of fishing days. More than half of recreational fishing events in FMA 8 occur from land, followed by trailer/motorboat, with rod/line and long-line/kontiki the most popular fishing methods (Wynne-Jones *et al*., 2019).

Boat fishing activities are mainly centred around the main boat launching locations, particularly between Patea and Whanganui, and around New Plymouth, with the area from Patea north to Cape Egmont relatively lightly fished (Rob Greenaway & Associates, 2015). Launching at many of these locations is limited by sea conditions, for example, boat access at Ohawe is only suitable for one in five days, while the Patea Bar is usable for approximately 80 days a year (Rob Greenaway & Associates, 2015).

Hartill *et al*. (2011) undertook aerial surveys of fishing effort and boat-ramp interviews of fishers to investigate the snapper fishery along the Taranaki coast. Interviewed fishers estimated the majority of fishing occurred within a few kilometres of the shore, from trailer motorboats (compared to launches, charter boats, yachts, or kayaks). Recreational fishing effort was generally highest in summer months and on weekends and public holidays, with daily effort peaking mid-morning or early-afternoon. Common target species were blue cod, red gurnard, kahawai, snapper, red cod, tarakihi and trevally (Hartill *et al*., 2011). Summer months also see pelagic fish species such as striped marlin, tuna (albacore and skipjack), dorado and mako shark present in the offshore Taranaki waters, which are targeted by larger vessels capable of travelling further offshore.

Most productive fishing areas are inshore of the 12 NM limit, although hapuku, rig, and shark are targeted outside of 12 NM when sea conditions allow (these offshore trips usually involve two or more boats for safety reasons).

Shellfish gathering occurs within the South Taranaki Bight, and although the level that occurs is unknown, it is thought to be locally important (Rob Greenaway & Associates, 2015). Target species for shellfish gathering include mussels (plentiful south from Manaia), paua (particularly around Oeo and Opunake), and kina. The coastline north of Ohawe is considered a prime regional shellfish gathering area.

[8] This is the opinion of the author of this consent application.

There are several recreational fishing and boating clubs throughout the Taranaki, Manawatū-Whanganui and Waikato regions, and many host and administer fishing competitions throughout the year, with anglers fishing over wide areas of the coastline and further out to sea. For example, the New Plymouth Sport Fishing and Underwater Club runs several major competitions over its season and the summer game fishing tournaments attract large numbers of vessels that head offshore to target striped marlin and tuna.

4.5.2 Shipping

MNZ recommends that commercial vessels should stay a minimum of 5 NM off the mainland, any charted points of danger, or any offshore islands. There are no dedicated shipping lanes around New Zealand, and as a result, vessels travelling to/from or between ports will generally take the most direct or shortest route possible, providing it is safe to do so.

The presence of a MODU/WIV and support vessel(s) at any of the P&A locations will be visually obvious and well notified through 'Notices to Mariners', which are updated fortnightly by Land Information New Zealand (**LINZ**). Guidance within the New Zealand Nautical Almanac recommends that vessels operating in the vicinity of production platforms and exploration rigs maintain an adequate safe margin of distance, and where there is sufficient sea room, vessels should keep at least 5 NM clear of any MODU and/or installation.

A precautionary area was established in the offshore Taranaki area by the International Maritime Organisation in 2007. All ships passing through this area must navigate with particular caution in order to reduce the risk of a maritime casualty and the possible resulting marine pollution, given the high level of offshore petroleum activity within this area. The precautionary area is a standing notice in the Notice to Mariners issued by LINZ each year in the New Zealand Nautical Almanac. The almanac lists the navigation hazards within this precautionary area as the Pohokura, Māui, Maari, Tui and Kupe fields. The entire IAA is within the Taranaki Offshore Precautionary Area. Maritime Chart NZ48 – 'Western Approaches to Cook Strait' states '*All ships should navigate with particular caution in order to reduce the risk of marine pollution in the precautionary area*'.

4.5.3 Oil and Gas Activities

Exploration and production activities for oil, gas and associated products have occurred along and off the coast of Taranaki since the 1960s, with an increase in activity since the early 2000s, particularly in relation to exploration and further expansion of existing fields. The Taranaki region is the centre of New Zealand's oil, gas and petrochemical industries, and with the significant economic input the industry and associated support industries contribute, oil and gas is of major importance to the New Zealand economy. Oil and gas facilities in the Taranaki region produce crude oil, condensate, naphtha, natural gas, liquefied petroleum gas and compressed natural gas, as well as the petrochemical products methanol and urea.

Current producing fields in the offshore Taranaki area include the Maari, Māui, Kupe and Pohokura fields. Under the Submarine Cables and Pipelines Protection Act 1996 various protected areas have been established around New Zealand by Order in Council. These areas typically ban all anchoring and most types of fishing to prevent cable and pipeline damage. The Tui Area Development under the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 is of relevance to the IAA (discussed further in **Section 3.4.2**).

5 Existing Interests and Engagement

5.1 Introduction

Section 39(1)(c) of the EEZ Act requires an IA to identify persons whose existing interests are likely to be adversely affected by the activities.

Section 4 of the EEZ Act defines existing interests, in relation to New Zealand, the EEZ, or the continental shelf as the interest a person has in:

(a) any lawfully established existing activity, whether or not authorised by or under any Act or regulations, including rights of access, navigation, and fishing:

(b) any activity that may be undertaken under the authority of an existing marine consent granted under section 62:

(c) any activity that may be undertaken under the authority of an existing resource consent granted under the Resource Management Act 1991:

(d) the settlement of a historical claim under the Treaty of Waitangi Act 1975:

(e) the settlement of a contemporary claim under the Treaty of Waitangi as provided for in an Act, including the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992:

(f) a protected customary right or customary marine title recognised under the Marine and Coastal Area (Takutai Moana) Act 2011.

The extent of the IAA was used to identify persons with existing interests which may be adversely affected by the proposed decommissioning activities. Any interest within, or in close proximity to the IAA which could foreseeably be adversely affected by the activities which are the subject of this marine consent application and satisfy one or more of the above criteria is discussed in the following sections.

5.1.1 Lawfully Established Existing Activities

Under part (a) of the definition of existing interest, the interest a person has in any lawfully established existing activity, whether or not authorised by or under any Act or regulations, is considered an existing interest. For the IAA, which is the subject to this application, the lawfully established existing activities are: 1) existing PMP 38158; 2) kaitiakitanga; 3) commercial and recreational fishing (including Māori customary and commercial fishing); and 4) maritime traffic. These are discussed separately in the following subsections.

5.1.1.1 Existing PMP 38158

Production within PMP 38158 ceased in November 2019, however the permit still has legal effect. The holders of PMP 38158 were Stewart Petroleum Company Limited, TTL, and WM Petroleum Limited. All three companies are in receivership and liquidation. The liquidators for all three companies are David Ian Ruscoe and Malcolm Russell Moore (both of Grant Thornton New Zealand Limited). While the liquidators have disclaimed the Tui assets within PMP 38158, they are still the legal holders of the PMP. Until such time as PMP 38158 is surrendered the two liquidators are persons with an existing interest for the purposes of the EEZ Act.

5.1.1.2 Rights and Interests Recognised under the Treaty of Waitangi

The Court of Appeal decision (**the CoA decision**) in *Trans- Tasman Resources Ltd v Taranaki-Whanganui Conservation Board*)[9] made findings on existing interests that are relevant to this application. The CoA decision traverses a large number of matters relating to the Decision-making Committee's decision to grant various marine consents and marine discharge consents for a proposed iron-sand mining proposal within the South Taranaki Bight.[10] While many of the matters and findings presented in the CoA decision relate specifically to Trans-Tasman Resources Limited's (**TTRL**) proposal, the decision is the most up to date case law on a number of matters relating to the interpretation and application of certain sections of the EEZ Act. It is noted that TTRL has appealed the CoA decision to the Supreme Court; however, until such time as that Court makes its judgment the CoA decision represents the current legal position on the matters in that judgment.

The CoA decision found that, *inter alia*, in order to ensure that section 12 of the EEZ Act (Treaty of Waitangi) achieves the outcomes it expressly identifies (recognising and respecting the Crown's responsibility to give effect to the principles of the Treaty of Waitangi), the references to '*existing interests*' in section 59 of the EEZ Act must be read as including the interests of Māori in relation to all the taonga referred to in the Treaty of Waitangi.[11] The CoA records that the second article of the Treaty of Waitangi contains an unqualified guarantee to the rangatira and hapū of New Zealand of full exclusive undisturbed possession in relation to their, *inter alia*, '*taonga katoa*' – the CoA decision found that those guaranteed rights and interests are a '*lawfully established existing activity*' under paragraph (a) of the of the section 4 definition of '*existing interest*' in the EEZ Act.[12] The CoA decision confirmed kaitiakitanga was an integral component of the customary rights and interests of Māori in relation to the taonga referred to in the Treaty of Waitangi.[13] The CoA decision found that whanaungatanga and kaitiakitanga relationships between affected iwi and the marine environment and its resources are relevant 'existing interests' and impacts on those relationships need to be considered.[14] The CoA decision notes that the sea and other significant features are not to be viewed as just physical resources but as entities in their own right – as ancestors, gods, whanau – that iwi have an obligation to care for and protect.[15]

Ngā Kaihautū Tikanga Taiao, the statutory Māori Advisory Committee of the EPA, has published a protocol entitled '*Incorporating Māori Perspectives into Decision Making*'[16]. This protocol includes a description of key Māori concepts and practices to guide decision makers in considering Māori perspectives as they relate to EPA matters. The protocol provides the following useful description of the principle of kaitiakitanga (noting the protocol states that various iwi and hapū groups may have different interpretations):

> *Kaitiakitanga is a guiding principle for decision makers and a valuable navigational tool for the EPA in making sound judgements and decisions when taking into account mātauranga Māori. Kaitiakitanga is defined in the Resource Management Act 1991 as guardianship or stewardship, though it was used by Māori to define conservation customs and traditions. It is intimately linked to rangatiratanga, the power and authority of tangata whenua to control and manage the resources within their territory, as guaranteed in the preamble and Article II of Te Tiriti o Waitangi (The Treaty of Waitangi).*

[9] CA573/2018 [2020] NZCA 86
[10] From [133].
[11] At [166], [168] and [171].
[12] At [166] and [169].
[13] At [170].
[14] At [172] – [173].
[15] At [174].
[16] https://www.epa.govt.nz/assets/Uploads/Documents/Te-Hautu/293bdc5edc/EPA-Maori-Perspectives.pdf

All resources and forms of life were birthed from Papatūānuku, the earth mother who is the personification of the Whenua (Earth). Through her union with Ranginui (sky father), all things were created – meaning that all animate and inanimate things are related through whakapapa.

According to Māori tradition, the resources or children of Papatūānuku do not belong to tangata (people), but rather tangata are one of the many children who belong to Papatūānuku. People, animals, birds and fish all harvest the bounties of Papatūānuku but do not own them.

Kaitiakitanga is therefore the undertaking of duties and obligations inherited from the atua (spiritual guardians and first children of Papatūānuku) over the realms of those atua. They include but are not limited to:

- *Tāne Mahuta – kaitiaki of the resources of the forests*
- *Tangaroa – kaitiaki of the resources of the oceans*
- *Rongo-mā-tāne – kaitiaki of the resources of cultivated foods*
- *Haumietiketike – kaitiaki of uncultivated foods*
- *Tūmatauenga – kaitiaki of people and tribal conflicts*
- *Tāwhirimātea – kaitiaki of the elements*
- *Rūaumoko – kaitiaki of volcanoes and earthquakes*

It is the responsibility of people as kaitiaki to ensure the protection of the cultural and spiritual health and well-being both of themselves and of the resources which it is their duty to protect. This is achieved by performing kawa or ceremonial rituals according to the tikanga or laws/rules of those rituals. There are three key spiritual elements (taha wairua) of kaitiakitanga which define health and well-being for Māori. They are mauri, mana and tapu.

Taranaki Iwi are the kaitiaki of the coastal waters in and around the IAA. The interests of Taranaki Iwi in the IAA are recognised in the Taranaki Iwi Deed of Settlement between Taranaki Iwi and the Crown. The Taranaki Iwi Claims Settlement Act 2016 gives effect to Taranaki Iwi Deed of Settlement and includes a list of Statutory Acknowledgement areas, one of which is the 'Taranaki Iwi coastal marine area'.

The CIA (**Appendix E**) describes in detail the existing interests of Taranaki Iwi, and describes how customary interests were preserved by the Treaty, in the following terms:

Article 2 of the Treaty contains an unqualified guarantee to the rangatira and hapū of New Zealand of "rangatiratanga" (in te reo Māori) and "full exclusive and undisturbed possession" (in English) in relation to their lands, estates, forests, fisheries and "taonga katoa". The exercise of these guaranteed rights and interests is a lawfully established existing activity for the purposes of the EEZ Act. The exercise of these rights and interests can be described as the most long-standing lawfully established existing class of activities in New Zealand. Those rights were not affected by the acquisition of sovereignty by the British Crown in 1840. Article 2 of the Treaty recognises the continued existence of these rights and interests.

The following statement of association by Taranaki Iwi included in the Taranaki Deed of Settlement supporting documents[17] applies to the Taranaki Iwi coastal marine statutory area (emphasis added):

> *Taranaki Iwi exercise mana whenua and mana moana from Paritutu in the north around the western coast of Taranaki Maunga to Rāwa o Turi stream in the south and from these boundary points out to the outer extent of the exclusive economic zone.*
>
> *The traditions of Taranaki Iwi illustrate the ancestral, cultural, historical and spiritual association of Taranaki Iwi to the coastal marine area within the Taranaki Iwi rohe ("Coastal Marine Area"). The seas that bound the Coastal Marine Area are known by Taranaki Iwi as Ngā Tai a Kupe (the shores and tides of Kupe). The coastal lands that incline into the sea are of high importance to Taranaki Iwi and contain kāinga (villages), pā (fortified villages), pūkāwa (reefs) for the gathering of mātaitai (seafood), tauranga waka or awa waka (boat channels), tauranga ika (fishing grounds) and mouri kōhatu (stone imbued with spiritual significance). The importance of these areas reinforces the Taranaki Iwi tribal identity and provides a continuous connection between those Taranaki Iwi ancestors that occupied and utilised these areas.*

While the legal area covered by the statutory acknowledgement area consists of the CMA, as defined by the Resource Management Act 1991 (**RMA**) as being from the coast out to 12 NM, the above statement of association clearly identifies Taranaki Iwi's mana moana as extending over the EEZ.

In relation to kaitiakitanga, the CIA states the following:

> *Kaitiakitanga is recognised as an aspect of the existing interest of Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi. Hapū experts advise that it is important to note that kaitiakitanga includes the practise of use, development, restoration and protection of resources and relationships, not just the stewardship of resources as commonly misconceived. It is also necessary to understand the inextricably linked concepts of whanaungatanga and kaitiakitanga; a system that enabled human exploitation of the environment, but through the kinship value (known in Te Ao Māori as whanaungatanga) they also emphasised human responsibility to nurture and care for it (known in Te Ao Māori as kaitiakitanga). These give context to the existing interest that Taranaki Iwi has in the Tui Oilfield, and the lands, estates, forests, fisheries and "taonga katoa" therein.*
>
> *Previous approvals that have facilitated the exploitation of resources from the Tui Oilfield have largely excluded Taranaki Iwi from exercising their rangatiratanga or kaitiakitanga in any meaningful way. Regarding the resource use aspect of kaitiakitanga this has contributed to there being limited demonstrable positive impacts on the social or cultural well-being of Taranaki Iwi resulting from the exploitation of resources in the Tui Oil Field since operations began in 2005. Those factors which improve social and cultural wellbeing such as education, employment or the maintenance/development of cultural infrastructure such as marae/pā, whare wānanga and the like have not benefited from the exploitation of the Tui Oil Field as would be expected if the existing rangatira interests of Taranaki Iwi had been taken into account through those decisions. The cumulative adverse effects on Taranaki Iwi resulting from this is significant.*

[17] https://www.govt.nz/assets/Documents/OTS/Taranaki-iwi/Taranaki-Iwi-Documents-Schedule-5-Sep-2015.pdf

This application is for what will be the last two phases of operations on the Tui Oil Field. Recently MBIE released a paper Supporting the Māori Economy and Achieving Economic and Social Outcomes through Te Kupenga Hao Pāuaua recognising that increasing the proportion of relevant contracts awarded to Māori businesses will assist in improving social and cultural outcomes for Māori. It is considered that the approach recommended in that paper be applied to this application, noting that the Crown is the applicant in this instance.

In respect to the resource protection or management aspects of kaitiakitanga it is considered that specific conditions are required to ensure that Taranaki Iwi are able to exercise that interest through the implementation of the programme of works. Fundamental to kaitiakitanga are requirements on tangata whenua to nurture relationships between people, and people and place. At a practical level this requires access into a kaupapa, to information, and to an area. It requires opportunities for Tangata Whenua to contribute to the decisions towards better health and well-being (cultural, social, economic and environmental). It is a continuous and ongoing process. It is reliant on a willingness of all parties to engage in that process and relationship to be successful.

In large projects such as the proposal it is common that iterative changes in delivery to respond to changes in context will be made. Conditions which require the on-going engagement of Taranaki Iwi in those changes and certifying the management plans which are proposed to avoid, remedy and/or mitigate the adverse effects of the operation. As articulated in the assessment below with respect to mouri, there are a number of potential adverse effects which require management across the implementation of this consent. For this reason, a Kaitiaki Forum (or similar) that enables the consent holder to access cultural expertise in making operational decisions which affect those aspects of mouri is recommended.

Healthy marine and coastal resources are central to Taranaki Iwi's cultural identity and wellbeing. Access to kaimoana, treasured places, and mahinga kai[18] are all intricately linked to cultural identity.

Based on this, MBIE acknowledges and respects the fact that Taranaki Iwi are persons with a broad range of existing interests for the purposes of the EEZ Act.

MBIE and Te Kāhui o Taranaki Trust, being the Post-Settlement Governance Entity of Taranaki Iwi, have been working closely together since early 2020 to understand and reflect Taranaki Iwi's cultural values and interests in the Tui field decommissioning.

In March 2021 MBIE and Taranaki Iwi entered into a partnership agreement, the purpose of which is to support engagement between MBIE and Taranaki Iwi to increase understanding of, and participation in, the decommissioning process. Taranaki Iwi are represented by a dedicated engagement lead and a wider Ohu group that provides both technical expertise and cultural knowledge.

[18] the customary gathering of food and natural materials and the places where those resources are gathered.

5.1.1.3 Commercial and Recreational Fishing

Fishing activity, both commercial and recreational, is limited within the IAA due to the Protected Area around the Tui field (discussed in **Section 3.4.2**) covering around 17% of the IAA (no fishing may occur within the Protected Area). This Protected Area will remain in force until such time as the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 is formally revoked, which is not expected to occur until after the decommissioning activities are completed.

The majority of the works associated with the decommissioning activities will be undertaken within the Protected Area around the oil field. However, two of the exploration wells (Tieke-1 and Tui SW-2P) that require abandonment (removal of subsea trees) are located outside of this Protected Area which will require a temporary exclusive occupation of space to enable the MODU/LWIV to complete the activities. In addition, if an anchored MODU is used, the anchoring array may extend beyond the Protected Area for those wells located in close proximity to the edge of the Protected Area. Because some of the activities will occur outside the Protected Area it is considered that commercial fishing interests may be potentially adversely affected by the proposed activities.

The Deepwater Group is a non-profit organisation that works in partnership with the MPI and involves more than 50 seafood companies. The Deepwater Group represents participants in New Zealand's major deepwater commercial fisheries, including hake, hoki, jack mackerel, ling, orange roughy, oreo, scampi, southern blue whiting and squid. Shareholders of the Deepwater Group hold over 90% of all deepwater quotas in New Zealand. For these reasons, the Deepwater Group is considered to have an existing interest in this consent application.

Māori have customary and commercial fishing interests and these are discussed in **Sections 5.1.5.1** and **5.1.5.2**.

It is noted that, once decommissioning activities have concluded, both commercial and recreational fishers will be positively affected by the proposed activities because they will be able to fish within the Protected Area after the decommissioning activities are completed and the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 is revoked and any structures located on the seabed associated with the Tui field have been removed.

5.1.1.4 Marine Traffic

With regard to maritime traffic (which includes commercial shipping), there are no dedicated shipping lanes around New Zealand. As a result, vessels travelling in the waters around New Zealand (including the IAA) generally take the most direct or shortest route possible, provided it is safe to do so. The majority of the activities associated with this marine consent application will take place within the established Protected Area around the Tui field (discussed in **Section 3.4.2**) and, while ships are lawfully able to transit through this area, commercial marine traffic tends to avoid this area.

Further to transient and temporary nature of marine traffic, the IAA is located within a Precautionary Area which was established in the offshore Taranaki area (discussed in **Section 3.4.5**) which requires all ships passing through the area to navigate with particular caution to reduce the risk of a maritime casualty or possible marine pollution. In addition, the New Zealand Nautical Almanac states that where there is sufficient sea room, vessels should keep at least 5 NM clear of oil and gas installations, and that due allowance should always be given to prevailing weather conditions and the possibility of engine steering or other mechanical failure.

Given the transient and temporary nature of maritime traffic, and the ability of ships to move to avoid conflicting activities, they are not considered to be an existing interest adversely affected by the proposed activities.

5.1.2 Existing Marine Consents

Under part (b) of the definition of existing interest, the interest a person has in any activity that may be undertaken under the authority of an existing marine consent granted under section 62 of the EEZ Act is considered an existing interest.

Based on a review of the publicly available marine consent decision reports on the EPA website[19] there are no current marine consents within the IAA, other than those in favour of MBIE (formerly TTL, whose consent was transferred to MBIE on 19 June 2020). The nearest location for a marine consent is the Māui field, located approximately 15 km to the southeast of the Tieke-1 exploration well.

Although not a marine consent granted under section 62 of the EEZ Act, on 31 October 2017 the EPA provided TTL (now in favour of MBIE) with a ruling for activities associated with the disconnection of the FPSO *Umuroa* from its subsea risers and mooring lines (and their subsequent placement on the seabed). The activities associated with this ruling have been completed in 2021 and form the first phase of the full demobilisation and decommissioning of the Tui field.

Based on the above, there are no parties who hold interest in a granted marine consent which would be considered existing interests adversely affected by the proposed activities.

5.1.3 Existing Resource Consents

Under part (c) of the definition of existing interest, the interest a person has in any activity that may be undertaken under the authority of an existing resource consent granted under the RMA is considered an existing interest. The RMA has jurisdiction out to 12 NM (22.2 km) from the coastline of New Zealand, being the CMA. Given that the IAA is approximately a further 18 km offshore from the CMA/EEZ boundary, there are no parties who hold an existing resource consent, who would be considered an existing interest affected by the proposed activities.

5.1.4 Historical Claim under the Treaty of Waitangi Act 1975

Under part (d) of the definition of existing interest, the interest a person has in any settlement of a historical claim under the Treaty of Waitangi Act 1975 is considered an existing interest.

The Taranaki Iwi Claims Settlement Act 2016 gives effect to the Taranaki Iwi Deed of Settlement and includes a number of statutory acknowledgement areas, one of which is the Taranaki Iwi Coastal Marine Area. These statutory acknowledgement areas are recognised under the RMA, including the Proposed Taranaki Regional Coastal Plan, and the Heritage New Zealand Pouhere Taonga Act 2014.

As discussed in **Section 4.4.2**, the legal area covered by the Taranaki Iwi Coastal Marine Area statutory acknowledgement covers the CMA. However, as outlined within **Section 5.1.1.2**, the statement of association by Taranaki Iwi clearly identifies Taranaki Iwi's mana moana as extending over the EEZ. Therefore, the broad range of interests of Taranaki Iwi in the IAA (and the coastal marine area more generally) are relevant to decision-making, and as such Taranaki Iwi are considered to be persons with existing interests under part (d) of the definition.

[19] https://www.epa.govt.nz/

5.1.5 Contemporary Claim under the Treaty of Waitangi Act 1975

Under part (e) of the definition of existing interest, the interest a person has in any settlement of a contemporary claim under the Treaty of Waitangi as provided for in an Act, including the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, is an existing interest. Potential existing interests fall into two categories: customary fishing rights and fishing quota holders which are discussed in the subsections below.

It is noted that fishers will be positively affected by the proposed activities because they will be able to fish within the Protected Area after the decommissioning activities are completed and the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 is revoked.

5.1.5.1 Customary Fishing Rights

Iwi hold customary fishing rights under the Fisheries (Kaimoana Customary Fishing) Regulations 1998. These regulations stem from the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992 and provide for the customary harvesting of kaimoana for special occasions. This enables iwi to issue permits to harvest kaimoana in a way that exceeds levels permitted in standard practice to provide for a hui, tangi or as koha.

There are three types of customary fishing areas recognised under the legislation: rohe moana, mātaitai, and Taiāpure as discussed within **Section 4.4.1**.

The closest customary fishing area to the IAA is the Te Tai Hauāuru (**Figure 31**) which is located approximately 8 km to the southeast of the IAA.

Māori customary fishing interests are sometimes exercised using commercial fishing vessels. If this occurs in the vicinity of the Tui field, Māori customary interests will be affected in the same manner as commercial fishing interests, in addition to any cultural values associated with customary fishing.

It is understood that Taranaki Iwi operate a pātaka system for customary fishing using commercial fishing vessels. This pātaka system includes iwi and hapū managing a customary permit system which will allow commercial fishers to harvest fish. Any fish harvested under this system are kept separate from the commercial harvest, processed and then stored in a factory. Iwi or hapū keep track of the fish harvested under this pātaka system which can then be distributed to marae in order to provide seafood for tangi. It is understood that to date, pātaka have operated using inshore commercial fishing vessels; however, iwi have recently been working together to develop a pātaka system for deep water fishers that could be harvested using a commercial fishing vessel.

Taranaki Iwi are therefore considered to be persons with existing interests due to customary fishing that is undertaken by commercial fishing vessels.

5.1.5.2 Fishing Quota Holders

In addition to the Treaty of Waitangi (Fisheries Claims) Settlement Act 1992, the Maori Fisheries Act 2004 establishes the regime for allocating fisheries settlement assets, including income shares in Aotearoa Fisheries Limited (now trading as Moana New Zealand) and quota to iwi recognised under that Act. The Act also establishes Te Ohu Kaimoana whose role is to advance the interest of iwi individually and collectively, primarily in the development of fisheries, fishing, and fisheries-related activities, in order to:

- Ultimately benefit the members of iwi and Māori generally;
- Further the agreements made in the Deed of Settlement;

- Assist the Crown to discharge its obligations under the Deed of Settlement and the Treaty of Waitangi; and
- Contribute to the achievement of an enduring settlement of the claims and grievances referred to in the Deed of Settlement (s 32).

Its duties and functions include: allocating and transferring settlement assets to mandated iwi organisations, appointing the directors of Aotearoa Fisheries Limited and protecting and enhancing the interests of iwi and Māori in relation to fisheries, fishing and fisheries-related activities. Aotearoa Fisheries Limited/Moana New Zealand harvests, procures, farms, processes and markets kaimoana in New Zealand and internationally. The company owns 50% of Sealord, which harvests primarily in deep-water fisheries, including areas within the offshore Taranaki region.

Because Te Ohu Kaimoana and Aotearoa Fisheries Limited/Moana New Zealand oversees quota holders within the IAA, they have been treated as an existing interest which could potentially be adversely affected by this application.

It is noted that commercial fishers will be positively affected by the proposed activities because they will be able to fish within the Protected Area after the decommissioning activities are completed and the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 is revoked.

5.1.6 Protected Customary Right or Customary Marine Title

Under paragraph (f) of the definition of existing interest, the interest a person has in any protected customary right or customary marine title recognised under MACA is an existing interest. There are no such areas within or in proximity to the IAA. However, there are a number of applications for customary right or customary marine title that are yet to be determined (albeit all located within the CMA, approximately 18 km from the IAA). As such, there are no protected customary rights or customary marine titles (strictly speaking, in terms of paragraph (f) of the definition) which are considered existing interests that would be adversely affected by the proposed activities.

Again, however, the customary interests and activities that underpin those claims, which extend beyond the CMA (refer **Section 5.1.1.2**), are existing interests in terms of paragraph (a) of the definition. These are essentially the same activities and interests described in the CIA and summarised above.

5.1.7 Summary of Existing Interests

Based on the definition of existing interests in section 4 of the EEZ Act, those parties that are considered to have existing interests for the purposes of this marine consent application are:

- The liquidators of the legal holders of PMP 38158;
- Taranaki Iwi;
- The Deepwater Group;
- Te Ohu Kaimoana; and
- Aotearoa Fisheries Limited/Moana New Zealand.

5.2 Summary of Engagement Undertaken

MBIE has engaged with a variety of groups during the development of this marine consent application, including iwi, parties that have an existing interest in relation to this application, local and central government, government departments and other interested groups. The extent of this engagement and the feedback received is summarised in **Appendix H**. MBIE is committed to working in partnership with iwi and to ongoing engagement with other holders of existing interests and interested groups throughout the decommissioning of the Tui field.

As a result of the consultation MBIE has undertaken with the liquidators of the legal holders of PMP 38158, a written approval has been provided from the liquidators, as seen in **Appendix I**.

As discussed in **Section 5.1.1** MBIE has been working with Taranaki Iwi throughout the development of this marine consent application, with Taranaki Iwi preparing a CIA which assesses the actual and potential effects of the Tui decommissioning on the existing interests of Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi, that may result from phases 2 and 3 of the Tui field decommissioning to inform requisite marine consents. As can been seen in **Appendix H**, MBIE has been involved in regular communications and face-to-face meetings with Taranaki iwi.

Attempts at consultation with Aotearoa Fisheries Limited/Moana New Zealand have been undertaken on a number of occasions with no response as seen in **Appendix H**.

An information sheet was provided to both the Deepwater Group and Te Ohu Kaimoana that had a summary of what was proposed, indicative timing and a location map, as well as stipulating that after the activities had ceased, the seabed would be left clear, and the restricted area for fishing would be ultimately removed. This information sheet was distributed to all members of both Deepwater Group and Te Ohu Kaimoana. In addition, Te Ohu Kaimoana requested a copy of this application once submitted to EPA.

6 Economic Benefits

In February 2020, Cabinet decided to fund the decommissioning of the Tui field following the liquidation of TTL. In May 2020, MBIE commenced work to manage the Tui field assets and plan for decommissioning.

This is New Zealand's first offshore oil field decommissioning project and a new role for the Crown and MBIE. It is expected that decommissioning will be completed by 2024.

MBIE intends to procure suppliers to complete decommissioning, for Phase 2 – removal of SSI and Phase 3 – P&A of the wells. A procurement process is currently underway, which has been designed in accordance with the Government Procurement Rules (**the Rules**). The Rules help to support good market engagement, which leads to better outcomes for agencies, suppliers and New Zealand taxpayers. A key focus of the Rules is the importance of open competition – giving all businesses the chance to participate, and enough time to respond to opportunities properly. The rules also acknowledge that procurement can be leveraged to achieve broader outcomes. Broader outcomes are the secondary benefits that are generated by the way a good, service or works is produced or delivered. These outcomes can be social, environmental, cultural or economic benefits, and will deliver long-term public value for New Zealand. As such, broader outcomes form a part of MBIE's tender evaluation criteria established for decommissioning procurement.

In relation to the local impact/access to New Zealand businesses being realised through the completed FPSO demobilisation phase, MBIE signed an agreement in November 2020 with BW Umuroa Pte Limited (**BWU**) to disconnect and demobilise the FPSO from the Tui field - the first phase in Tui field decommissioning.

Demobilisation work took place from December 2020 to April 2021 with local impact as follows:

- BWU sub-contracted 27 different companies registered in New Zealand to provide goods and services to undertake demobilisation of FPSO;
- Some 170 New Zealanders were directly employed to undertake offshore demobilisation activities. Additionally, a further 15-20 New Zealanders were employed onshore by MBIE and its partners to perform functions related to project management and oversight; and
- It is estimated that a further 100 New Zealanders were employed in onshore activities to support the FPSO demobilisation. This includes those employed in firms that supplied goods and other onshore services to BWU as well as direct contracts to MBIE.

Based on the local impact/broader outcomes realised from the FPSO disconnection, it is estimated the next two phases of Tui field decommissioning will be approximately 70 percent of the figures quoted above.

7 Impact Assessment – Potential Environmental Effects

7.1 Introduction

This section presents an assessment of the actual and potential effects on the environment and existing interests that may arise from the proposed activities which are the subject of this application. This section has been split between those activities under the marine consent and marine discharge consent due to the differing Environmental Risk Assessment (**ERA**) methodologies used in each.

The adverse effects on existing interests, effects on human health, effects outside the EEZ and any potential cumulative impacts, are assessed in a holistic manner which includes all activities associated with this consent application (i.e. both marine consent and marine discharge consent aspects).

The important positive effects of decommissioning the Tui field, which are relevant to most of the categories of adverse effects, are summarised in **Section 7.7**.

In relation to the seasonality of potential receptors found in the marine environment around the Tui field, it is difficult to determine specific seasonal trends based on the available information. However, the assessment included within this consent application has been undertaken on the basis that those species identified in **Section 4** will be present during the decommissioning activities to account for this uncertainty – this results in a 'worst-case' assessment because it is very unlikely that all these species (receptors) will be present at the time the decommissioning activities will occur.

7.2 Marine Consent Activities

7.2.1 Environmental Risk Assessment Methodology

This assessment is based on a qualitative ERA which considers the likelihood of an effect occurring and its potential consequence. The ERA process focuses on those activities for which consent is being applied for; that is, those activities restricted by section 20 the EEZ Act. The ERA results consider the different receptors in the marine environment that could potentially be affected by the activities which are the subject of this consent application.

The joint Australian & New Zealand International Standard Risk Management – Guidelines, (AS NZS ISO 31000:2018) (ISO, 2018) have been used to develop the ERA. In particular, the ERA methodology used in this consent application has been adapted from MacDiarmid *et al.* (2012) which sets out a risk assessment framework for activities in New Zealand's EEZ and extended continental shelf. Guidance from Clark *et al.* (2017) has also been used to refine the ERA methodology so that it is specific and relevant to this consent application.

Table 25 has been adapted from MacDiarmid *et al.* (2012); specifically, the consequence levels within Table 2-2 within MacDiarmid *et al.* (2012) have been used with some modifications to the descriptions so that the matrix and criteria are relevant to this consent application, albeit with the same intent as the original descriptions. An example of this is in relation to the "Proportion of Habitat Affected" being the equivalent to "Scale". MacDiarmid *et al.* (2012) used a percentage of habitat for the proportion of habitat affected; however, scale of effect is deemed to be more appropriate here on account of the small IAA.

The ERA was completed using all available literature, reports, experience, and expert judgement. To summarise, the main steps undertaken for this ERA process were:

- Identify the potential sources of environmental risk (e.g. magnitude, scale, frequency, and intensity);
- Assess the potential consequences for each risk across all potential environmental receptors (with the operational procedures and proposed mitigation measures in place) - based on the criteria in **Table 25**;
- Assess the likelihood of a consequence occurring for each receptor - based on the criteria in **Table 26**;
- Assign an overall classification of risk for any residual impacts, being the consequence score multiplied by the likelihood score – the resultant risk categories are presented in **Table 27** and the respective rank descriptions described in **Table 28**; and
- Assign a predicted magnitude of environmental effect as described in the right-hand column of **Table 28** – note that, for the purposes of this ERA, the 'Negligible' effect category incorporates all effects that are less than negligible, which includes 'no effects' and '*de minimis*'[20] effects.

[20] *De minimis* is a shorthand way of expressing the full Latin maxim "de minimis non curat lex", which is usually translated as "the law is not concerned with trifles." In the present context, it means that an adverse effect or consequence that is so trifling that the law should regard it as of no consequence.

Table 25 Criteria for assessing potential consequence levels

Consequence level	Scale	Duration and Recovery	Populations and Protected Species	Habitat and Ecosystem Function	Socio-Economic
0 – Negligible	Highly localised effect (<1 km^2).	Temporary duration (days-weeks). No recovery period necessary	No predicted adverse effects to populations. Almost no protected species impacted.	Undetectable, affecting <1% of original habitat area. Ecosystem function unaffected outside of natural variation.	No disruptions to normal activities.
1 - Minor	Localised effect (1-5 km^2).	Short term duration (weeks-months). Rapid recovery would occur once activity stops (within weeks).	Possible adverse effect to populations, but not sufficient to be detectable. Some individuals of protected species may be impacted but no impact on their population.	Measurable but localised, affecting 1-5% of original habitat area. Minor changes to ecosystem function.	Short term disruptions to normal activities (weeks to months).
2 - Moderate	Medium scale effect (5-100 km^2).	Medium term duration (months). Short term recovery period required once activity stops (within months).	Detectable impacts to populations. Could affect seasonal recruitment but does not threaten long-term viability. Some population level effects may become apparent for protected species.	Potential impacts more widespread, affecting 5-20% or original habitat area. Moderate changes to ecosystem function.	Medium term disruptions to normal activities (months).
3 - Severe	Large scale effect (100-500 km^2).	Long term duration (years). Substantial recovery period required once activity stops (within years).	Impacts to populations are clearly detectable and may limit capacity for population increase. Population level impacts are clearly detectable for protected species.	Widespread impacts, affecting 20-60% of original habitat area. Severe changes to ecosystem function.	Long term disruptions to normal activities (years).
4 - Major	Very large-scale effect (500-1,000 km^2).	Extensive duration (years-decades). Substantial recovery period required once activity stops (years to decades).	Long-term viability of populations is clearly affected. Local extinctions are a real possibility if activity continues. Serious conservation concerns for protected species.	Activity may result in major changes to ecosystem or region, affecting 60-90% of original habitat area. Major changes to ecosystem function.	Extensive disruptions to normal activities (years-decades).
5 - Catastrophic	Regional effect (>1,000 km^2).	Very extensive duration (decades). Extremely long recovery period (> decades) or no recovery predicted.	Local extinctions are expected in the short-term. Very serious conservation concerns for protected species.	Activity will result in critical changes to ecosystem or region, affecting virtually all original habitat. Total collapse of ecosystem.	Very extensive disruptions to normal activities (decades).

Table 26 Criteria for assessing consequence likelihood

Level/Score	Description	Likelihood of exposure
1	Remote	Extremely unlikely but theoretically possible.
2	Rare	May occur, but only in exceptional circumstances.
3	Unlikely	Not likely to occur in normal circumstances.
4	Possible	Could occur at some time.
5	Likely	Will probably occur in normal circumstances.
6	Certain	Is expected to occur in most circumstances and has a history of occurrence.

* Where 'likelihood' = the likelihood of a consequence occurring from the activity

Table 27 Overall risk of residual impacts

		Consequence Level					
		0 Negligible	1 Minor	2 Moderate	3 Severe	4 Major	5 Catastrophic
Likelihood of Consequence	1 – Remote	Negligible (0)	Very Low (1)	Very Low (2)	Low (3)	Low (4)	Low (5)
	2 – Rare	Negligible (0)	Very Low (2)	Low (4)	Moderate (6)	Moderate (8)	Moderate (10)
	3 – Unlikely	Negligible (0)	Low (3)	Moderate (6)	Moderate (9)	High (12)	High (15)
	4 – Possible	Negligible (0)	Low (4)	Moderate (8)	High (12)	High (16)	Extreme (20)
	5 – Likely	Negligible (0)	Low (5)	Moderate (10)	High (15)	Extreme (20)	Extreme (25)
	6 – Certain	Negligible (0)	Moderate (6)	High (12)	Extreme (18)	Extreme (24)	Extreme (30)

Table 28 Risk ranking description

Risk Ranking		Potential Impact	Predicted Magnitude of Environmental Effect
	Extreme (18-30)	Extreme Risk – unacceptable for project to continue under existing circumstances. Requires immediate action. Equipment could be destroyed with large environmental impact as a result of the activity.	Very Significant.
	High (12-16)	High Risk (intolerable risk) – where the level of risk is not acceptable and control measures are required to move the risk to lower the risk categories. Medium environmental impact from the activity.	Significant.
	Moderate (6-10)	Moderate Risk – requires additional control measures where possible or management/communication to maintain risk at less than significant levels. Small environmental impact from the activity. Where risk cannot be reduced to 'Low' control measures must be applied to reduce the risk as far as reasonably practicable. Requires continued tracking and recorded action plans.	Minor.
	Low (3-5)	Low Risk – where the level of risk is broadly acceptable and generic control measures are already assumed in the design process but require continuous monitoring and improvement.	Less than Minor.
	Very Low (1-2)	Very Low Risk – where the level of risk is acceptable and no specific control measures are required.	Almost Negligible.
	Negligible (0)	Negligible Risk – no intervention or further monitoring is required. Negligible (at worst) environmental impact.	Negligible.

7.2.2 Outline of Actual and Potential Adverse Effects

The sources of potential effects on environmental receptors (physical environment, biological environment) from the marine consent activities associated with the decommissioning of the Tui field can be summarised as:

- Temporary presence of objects in the water column (**Section 7.2.3.1**):

  For planned activities these include: the MODU/WIV, CSV, support vessels, anchor lines, ROVs, crane and winch wires, and the various pieces of SSI and well equipment (including equipment associated with the retrieval operation, i.e. rigging, recovery aids, temporary clamps, baskets, clump weights etc) as they are lifted through the water column to the surface, as well as the BOP riser during P&A activities.

  No additional objects will be placed in the water column during contingent activities.

- Seabed disturbance (**Section 7.2.3.2**):

  Sources of disturbance from planned activities include: ROV use (including disturbance from thrusters, work baskets, jet/suction dredge, high-pressure water jet and airlift capabilities), line lifting (including production flowlines, umbilicals, gas-lift CT and associated risers, GLJs, HFLs, EFLs), use of rigging, clump weights and sandbags, removal of GLM/UTA/SDU/intermediate skids and riser bases (including mud mats), removal of MWA and GB structures (including lifting/placement of clump weights and sinking of MWA), removal of production riser hold-back anchors (including anchor chain), removal of miscellaneous SSI equipment as described in **Section 2.3.9** (including the use of a recovery frame), MODU anchor lifting/placement, BOP tethering (including use of clump weights), removal of wellheads and Xmas trees and grab sampling and benthic imagery use during environmental monitoring.

  For contingent activities sources of disturbance also includes: planned and unplanned disconnection of BOP and faulty cement disposal.

- Removal of artificial hard substrate (**Section 7.2.3.3**):

  For planned activities this includes the removal of all SSI, wellheads and Xmas trees in place within the Tui field. For a full list of SSI components and Tui field subsea wells see **Section 2**.

  No additional artificial hard substrate will be removed as part of contingent activities.

- Noise and vibrations (**Section 7.2.3.4**):

  For planned activities sources include: MODU/WIV operations, CSV, support vessels, ROV operations, helicopter operations, other underwater activities (including rigging, winching, cutting, pumping etc.) and use of a MBES survey during environmental monitoring;

  For contingent activities noise sources also include: the use of downhole explosives, if necessary.

Each of these potential effects and their associated risk, in relation to the various receptors, are discussed in the sub-sections below. As part of the following assessments, the measures that MBIE will implement to avoid, remedy or mitigate environmental effects to ALARP are considered.

7.2.3 Actual and Potential Adverse Effects from Marine Consent Activities

7.2.3.1 Temporary Presence of Objects in the Water Column

7.2.3.1.1 Overview

For planned activities the following objects will have a temporary presence in the water column: the MODU/WIV, CSV, support vessels, anchor lines, ROV, winch wires, buoyancy modules, and the various pieces of SSI (including equipment associated with retrieval, i.e. rigging, clump weights etc) as they are lifted through the water column to the surface, and BOP riser.

7.2.3.1.2 Measures to Avoid, Remedy or Mitigate

The following measures will be implemented to avoid, remedy or mitigate the effects of the temporary presence of objects in the water column, including on the sea surface, during the decommissioning of the Tui field:

- Activities associated with decommissioning will be temporary and of short-term duration;
- Decommissioning activities will be undertaken in the shortest amount of time possible, to minimise the duration for which objects occur in the water column, subject to health, safety and operational constraints;
- Decommissioning activities will occur in a highly localised area as defined by the IAA, and the marine space occupied by objects in the water column will be miniscule compared to the available marine habitat in the region;
- Mooring lines/chains associated with the MODU will be heavy gauge and will typically be maintained under tension;
- All items placed in the water column will be removed once decommissioning activities are complete;
- The transit speed of support vessels will be relatively low (approximately 11 knots) compared to inshore recreational vessels;
- Vessel crews will be vigilant for marine mammals and will comply with the MMPR;
- All food waste will be comminuted before being discharged overboard to avoid attracting seabirds;
- Deck light use (at night and during fog) will be limited to the minimum required for safe navigation and operation of vessels;
- Deck lights will be directed downwards onto work areas and shielded to reduce peripheral light emissions and reduce the potential for bird strike;
- Vessel crews will be required to record any marine mammal observations and record them on the DOC Marine Mammal Observation forms; and
- Vessel crews will record any seabird vessel collisions or interactions.

Despite the above-mentioned measures, marine mammals and seabirds could potentially be impacted by the temporary presence of objects in the water column and a discussion of the potential effects is provided in the subsections below.

The temporary physical presence of objects in the water column is not expected to have any significant adverse effects on plankton and primary productivity, benthic invertebrates, fish and cephalopod populations, the nearshore coastal environment and associated marine communities, or existing interests, and as such they are not considered further below.

7.2.3.1.3 Marine Mammals

Displacement or Entanglement

Marine mammals are typically highly aware of their surroundings and possess exceptional abilities to detect and avoid obstacles in the water column. Sound plays an important role in navigation for marine mammals and can be used in several ways. Many species are believed to avoid coastlines and reefs by using the acoustic cue of breaking waves, while others can also emit sounds and interpret the reflected signal (echo-locating) as a way of mapping their local underwater environment (DOSITS, 2021).

Despite these abilities, obstacles in the marine environment represent a potential risk of displacement or entanglement to marine mammals. The level of risk varies according to the factors listed in **Table 29** (following Wilson *et al.*, 2007).

Table 29 Risk factors for marine mammal collision or entanglement

Risk Factor	Notes
Species	Of the large whales, right whales have limited ability to control their buoyancy which increases their susceptibility to collision. Seals and dolphins are typically highly manoeuvrable and capable of rapid turns to avoid obstacles.
Size	Generally, it is assumed that the larger the animal, the less able it is to manoeuvre through spatially restricted areas. Also, most large marine mammals are accustomed to deeper offshore environments where exposure to obstacles is relatively infrequent.
Sensory Perception	Dolphins and toothed whales navigate by echolocation. The mechanism for navigation in baleen whales is not well understood; however, the use of low frequency sounds is a possibility and navigation abilities are highly refined.
Age	Young animals may not recognise an obstacle as a threat, whilst old animals may have compromised abilities to detect the threat or escape from it once perceived.
Health	As with old animals, diseased animals may have compromised abilities to detect and/or escape from threats.
Behaviour	Marine mammals can be curious, and seals and dolphins in particular often approach unfamiliar objects.
Population Density	Probability dictates that the greater the density of animals in an area, the greater the chance of collision.
Oceanic Conditions	Turbidity may affect the ability of some marine mammals to visually detect obstacles, and high current flow rates can increase collision rates. Anthropogenic sounds may also affect echo-locating abilities.
Nature of Obstacle	Solid, stationary obstacles are more easily detected by echolocating marine mammals as they have higher acoustic reflectivity. Proximity and relative orientation to other objects can affect escape options.

During the P&A activities associated with the decommissioning of the Tui field, the constant physical presence of a MODU/WIV in the IAA could result in marine mammals being displaced from a small portion of the water column. While minor displacement could affect some large cetaceans, Gales (1982) states that whales can either ignore or easily avoid MODUs without appreciable change in their behaviour, and the movement of small cetaceans and pinnipeds will be virtually unimpeded. For the decommissioning of the Tui field, any displacement effects are predicted to be insignificant as 1) the area of potential displacement is miniscule compared to the home ranges of marine mammals; 2) alternative pelagic habitat is plentiful; and 3) any displacement effects would be temporary.

Physical structures in the marine environment can also increase the potential risk of collision or entanglement for marine mammals; however, entanglements of New Zealand marine mammals are typically associated with unattended fishing gear (Laverick *et al.*, 2017) and collisions are typically associated with ships as discussed in the following section. Regarding mooring lines, the entanglement of humpback whales in lobster pot mooring lines (Rowe, 2007) does however provide evidence to suggest that lines do pose some risk to marine mammals. However, this risk can be appropriately reduced though the use of thick, high tension mooring lines (Boehlert *et al.*, 2007). The mooring lines that will be used to hold the MODU on station will be thick, heavy gauge lines or chains that are maintained under tension; hence the risk of marine mammal entanglement associated with MODU anchoring is low.

It is noteworthy that the physical presence of the MODU/WIV could provide temporary habitat enhancement to some species. New Zealand fur seals are frequent visitors to oil platforms and installations in offshore Taranaki waters. There are three possible reasons for this association, the first being that physical structures in the water column can act as 'fish aggregating devices' which may attract marine predators on account of increased prey availability. Physical structures may also provide pinnipeds with haul-out opportunities (depending on hull design etc.) or simply represent a source of curiosity. It is therefore possible that New Zealand fur seals may be attracted to the MODU/WIV.

Consequence – Any potential impacts associated with the displacement or entanglement of marine mammals from the presence of the MODU/WIV would be highly localised within the IAA and would only occur for a relatively short period of time. As soon as the decommissioning activities conclude, any potential impacts would cease immediately. Therefore, based on **Table 25**, it is considered that the consequence of the temporary presence of objects in the water column on marine mammals is *minor*.

Likelihood – The likelihood of the temporary presence of objects in the water column displacing or entangling marine mammals is considered extremely unlikely based on the discussions above, albeit theoretically possible. Therefore, based on **Table 25**, it is considered that the likelihood is *remote*.

As the consequence of the impacts from the temporary presence of objects in the water column is *minor*, and it is considered a *remote* likelihood of occurring, the environmental risk of adverse impacts is assessed as ***very low***, and the resultant magnitude of environmental effects predicted to be ***almost negligible***.

Planned Activity	Consequence	Likelihood	Residual Risk	Predicted Magnitude of Environmental Effects
Temporary presence of objects in the water column – displacement or entanglement effects on marine mammals	1 – Minor	1 – Remote	1 – Very low	Almost Negligible

Ship Strike

The term 'ship strike' refers to the collision of a marine mammal with a vessel, and as ship strike events can result in death or life-threatening injuries to whales and dolphins, they are of global conservation concern (IWC, 2014). A number of factors influence the likelihood of collisions, these are:

- Vessel size – larger vessels (> 80 m) are more frequently involved in collisions with marine mammals than smaller vessels (Laist *et al.*, 2001; Jensen & Silber, 2003). Large vessels usually have deeper drafts, hence a larger strike area (Schoemann *et al.*, 2020);
- Vessel speed – most lethal marine mammal collisions involve vessels travelling at faster speeds (> 12 knots) (Laist *et al.*, 2001; Vanderlaan & Taggart, 2007) because higher speeds increase the risk of blunt force trauma (Wang *et al.*, 2007);
- Species – large whales are the most common victims of collisions (e.g. fin whales, right whales, humpback whales, minke whales and sperm whales) (Laist *et al.*, 2001; Jensen & Silber, 2003; Van Waerebeek *et al.*, 2007). However, a recent global review of ship strike incidents by Schoemann *et al.* (2020) found a total of 61 marine mammal species are affected by vessel collisions and incidents involving smaller species often go unreported; and
- Behaviour – species that remain at or near the sea surface for extended periods are particularly vulnerable to collisions (Laist *et al.*, 2001; Constantine *et al.*, 2012), as are species that are attracted to vessels (Bejder *et al.*, 1999; Wursig *et al.*, 1998).

All marine mammal species potentially present in the IAA are potentially at risk of collision with operational vessels. However, data indicates that large whales are at greater risk than smaller marine mammal species (Laist *et al.*, 2001; Jensen & Silber, 2003); where the size and agility of dolphins and seals means that these groups are more successful at avoiding potential collisions (Schoemann *et al.*, 2020). On account of the potential presence of blue whales in the Tui field, it is noteworthy that evidence suggests that this species is limited in their ability to avoid collisions, particularly with fast ships, as they tend to respond to a ships approach by a slow descent without lateral movement out of the path of the vessel (McKenna *et al.*, 2015).

Jensen and Silber (2003) reported that fin whales, humpback whales, minke whales, southern right whales and sperm whales were the most likely to be involved in ship-strike incidents. These species could potentially be present in the Tui field (see **Section 4.3.6.1**).

One of the primary factors affecting the severity of each ship-strike incident is vessel speed (Jensen & Silber, 2003) where the likelihood of mortality increases with increasing speed. The mean vessel speed that results in mortality following a ship strike is 18.6 knots (Jensen & Silber, 2003) and Laist *et al.* (2001) found that most lethal ship strike incidents involved vessels travelling at 14 knots or faster. Vanderlaan and Taggart (2007) reported that the probability of a lethal injury drops below 0.5 at speeds of 11.8 knots or less. The normal transit speed for support vessels to and from the IAA will be approximately 11 knots, somewhat reducing the probability of lethal ship strike events.

The MMPR stipulate the requirements for operating vessels around marine mammals including:

- Avoid sudden or repeated changes in speed and direction near marine mammals;
- There should be no more than three vessels within 300 m of any marine mammal;
- Vessels should travel no faster than idle or 'no wake' speed within 300 m of any marine mammal;
- Do not circle whales and dolphins, and do not obstruct their path or cut through any group; and

- Keep at least 50 m from whales (or 200 m from any large whale mother and calf/calves).

Compliance with these regulations during the decommissioning of the Tui field will serve to reduce the likelihood of marine mammal ship strike, as will the slow operation speed of vessels and the short-term duration of the programme. In addition, the movements of support vessels outside of the IAA will confer no greater environmental risk than other marine users in the area.

Consequence – The potential for any collisions between marine mammals and operational vessels would be highly localised and temporary in nature. However, based on the likely marine mammal species to be within the IAA at the time of the proposed decommissioning activities, some protected marine mammal species could be at risk if in the vicinity of the decommissioning activities; although as soon as the decommissioning activities concludes, any potential impacts would cease immediately. As outlined above, a potential ship strike could result in death or life-threatening injuries to whales and dolphins which could be severe to those individuals. However, at a population level, this potential consequence is not considered especially significant noting the infinitesimally small chance of this occurring given the small populations and vast habitat range. Therefore, based on **Table 25**, it is considered that the consequence of the physical presence of objects resulting in ship strike on marine mammals is *minor*.

Likelihood – Based on the discussions above, including the provision of the mitigation measures and operational procedures (such as complying with the MMPR), it is considered that the likelihood of the physical presence of objects resulting in ship strike is theoretically possible. Therefore, based on **Table 25**, it is considered that the likelihood is *remote*.

As the consequence of the impacts from the physical presence of objects resulting in ship strike on marine mammals is *minor*, and it is considered a *remote* likelihood of occurring, the environmental risk of adverse impacts is assessed as ***very low***, and the resultant magnitude of environmental effects predicted to be ***almost negligible***.

Planned Activity	Consequence	Likelihood	Residual Risk	Predicted Magnitude of Environmental Effects
Temporary presence of objects in the water column – ship strike effects on marine mammals	1 – Minor	1 – Remote	1 – Very low	Almost Negligible

7.2.3.1.4 Seabirds

Seabirds use the sea surface for resting and the upper water column for feeding. Hence, the presence of the MODU/WIV and other vessels could displace seabirds from a small area of habitat. This effect was documented for shearwaters, storm petrels and northern fulmar that occurred in lower densities within 10 km of oil platforms on the Scotian Shelf compared with regions 10 – 50 km away (AMEC, 2011). While this effect is theoretically possible, the effects of displacement during the decommissioning of the Tui field are considered to be insignificant on account of 1) the extremely small area of potential displacement compared to the wider surrounding habitat, 2) the temporary nature of the displacement, and 3) the plentiful amount of alternative habitat in which there are no obstructions.

In addition to the above, the presence of the MODU/WIV and other vessels may result in interactions with seabirds through bird strike or disorientation at night on account of the use of operational lighting on vessel decks. Seabirds are highly visual animals (Merkel, 2010), and are known to be attracted to offshore structures on account of structural stimuli, increased food concentrations, oceanographic processes, and lights (Wiese *et al.*, 2001). Authors have recorded densities from seven times (e.g. Tasker *et al.*, 1986; Baird, 1990) to 38 times greater around platforms than surrounding waters (Wiese & Montevecchi, 2000 as cited in Wiese *et al.*, 2001).

The MODU/WIV that will be used during the decommissioning of the Tui field will be large, stationary, highly visible structures with the visibility at night being further enhanced by onboard lighting. Seabirds that forage at night on bioluminescent prey, such as storm petrels and other birds from the order procellariforms, are naturally attracted to light sources, with attraction further enhanced by fog, haze or drizzle (Wiese *et al.*, 2001). Attracted and disoriented seabirds may collide with the MODU/WIV leading to injury or death. Documented mortalities of this kind are typically higher when birds are migrating through inclement weather as this is when large numbers of seabirds fly at lower altitudes close to the sea surface (Crawford, 1981). Seabird mortality as a result of a collision may be under-reported as it is unknown how many birds are killed but not recovered.

Merkel (2010) reported on bird strikes in coastal and offshore waters off Southwest Greenland, an area of international importance to wintering seabirds, and found 76% of events to occur within 4 km from land, so proximity to shore may lead to a higher collision rate in some areas. It is not clear whether the extended distance from shore of the Tui field will be of benefit in reducing the potential risk of bird strike. However, oil and gas operators off Taranaki have recorded a low level of interactions with seabirds; for example, since 2015, OMV New Zealand Limited (once Shell Todd Oil Services Limited) reported one unidentified dead petrel on the Māui-B platform (Thompson, 2017). Based on this, the likelihood of bird strike with the MODU/WIV is expected to be very low.

While the potential effects listed above are detrimental, some effects associated with the presence of the MODU/WIV may be beneficial as structures can serve to attract and concentrate prey or provide roosting opportunities at sea (Wiese *et al.*, 2001).

Consequence – Any potential for the physical presence of objects on seabirds will be highly localised, specifically around those objects (MODU/WIV) and be temporary in nature. The implementation of the mitigation measures proposed in **Section 7.2.3.1.2** will reduce any potential consequences to seabirds as far as practicable, and as outlined in **Section 7.2.1**, the determination of the consequence takes into account the operational procedures and proposed mitigation measures being in place. If any impacts do occur, they are not anticipated at a detectable population level. Therefore, based on **Table 25**, it is considered that the consequence of the physical presence of objects impacting seabirds is *minor*.

Likelihood – It is considered that the physical presence of objects impacting seabirds may occur, but only in exceptional circumstances. Therefore, based on **Table 25**, it is considered that the likelihood is *rare*.

As the consequence of the impacts from the physical presence of objects impacting seabirds is *minor*, and it is considered a *rare* likelihood of occurring, the environmental risk of adverse impacts is assessed as ***very low***, and the resultant magnitude of environmental effects predicted to be ***almost negligible***.

Planned Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Effects
Temporary presence of objects – effects on seabirds	1 – Minor	2 – Rare	2 – Very low	Almost Negligible

7.2.3.2 Seabed Disturbance

7.2.3.2.1 Overview

For planned activities the sources of seabed disturbance include: MODU anchor lifting/placement, ROV use (including disturbance from thrusters, work baskets, jet/suction dredge and airlift capabilities), line lifting (including production flowlines, umbilicals, gas-lift CT and associated risers, GLJs, HFLs, EFLs), use of rigging, clump weights and sandbags, lifting/placement of GLM (including mud mats), removal of MWA and GB structure (including lifting/placement of clump weights and sinking of MWA), removal of production riser hold-back anchors (including anchor chain), removal of miscellaneous SSI equipment as described in **Section 2.3.9** (including the use of a recovery frame), BOP tethering (including use of clump weights), and grab sampling and benthic imagery gathered during environmental monitoring. In addition, contingent activities sources of disturbance includes: planned and unplanned disconnection of BOP and faulty cement disposal.

7.2.3.2.2 Measures to Avoid, Remedy or Mitigate

The following measures will be implemented to avoid remedy or mitigate the effects of seabed disturbance during the Tui Decommissioning Programme:

- Activities associated with decommissioning will be temporary and of short-term duration;
- Decommissioning activities will be undertaken in the shortest amount of time possible, to minimise the duration for which seabed disturbance will occur;
- Decommissioning activities will occur in highly localised area as defined by the IAA and the area of seabed disturbance will be smaller still (~0.12% of the IAA);
- The spatial extent of disturbance to the seabed will be limited to the minimum required in order to complete the operations;
- All items placed on the seabed will be removed once decommissioning activities are complete;
- ROVs will attempt to operate at a suitable distance above the seabed to minimise sediment disturbance, except for when seabed contact or disturbance is planned and necessary;
- All ROV works will be undertaken by appropriately trained and experienced ROV operators;
- Post-decommissioning environmental monitoring will be undertaken to assess the extent of the seabed disturbance and to monitor the recovery of the benthic marine environment and determine any changes in the sediment physico-chemical properties within the IAA;
- Experienced personnel in deep-water sampling with quality control procedures in place will be carrying out the environmental monitoring programme;
- All equipment utilised for the environmental monitoring programme will be appropriately inspected, tested, and maintained to ensure its integrity;
- Deployment of the sampling equipment used during the environmental monitoring programme will be undertaken in a controlled manner to avoid any deployment wakes and to allow mobile species time to avoid the descending sampling equipment; and
- Seabed imaging equipment used during the environmental monitoring programme will be deployed in a manner that avoids contact with the seabed as far as practicable.

Despite the above-mentioned measures, benthic communities (including benthic demersal fish and octopus) and marine mammals could potentially be impacted by seabed disturbance and a discussion of the potential effects is provided in the subsections below.

Seabed disturbance is not expected to have any adverse effects on plankton and primary productivity, sensitive environments, pelagic fish, seabirds, or the nearshore coastal environment and associated marine communities, and as such they are not considered further below.

7.2.3.2.3 Benthic Communities

Benthic infauna communities and epifauna communities (including invertebrates, demersal fish and octopuses) are most likely to be affected by seabed disturbance during the decommissioning of the Tui field. The benthic invertebrate communities within the Tui field are described in **Section 4.3.1** as being dominated by polychaetes and no sensitive environments or protected coral species have been identified in the IAA (**Section 4.3.3**). While some demersal fish and octopus could occur in the IAA (see **Sections 4.3.4 and 4.3.5**), no protected fish species have been identified in the IAA (**Section 4.3.3.2**).

The most severe effects on benthic communities from seabed disturbance during the decommissioning of the Tui field will be via direct mortality of individuals from crushing by the placement of equipment on the seabed (e.g. anchors, clump weights, chains, etc). Mortality risk is highest for sessile species. In comparison, mobile species (including demersal fish and octopus) are likely to be temporarily displaced from the areas affected by seabed disturbance.

Sediment suspension and deposition is a certain effect of seabed disturbance in the silty clay substrate (see **Section 4.2.8**) of the IAA during decommissioning activities and will be a common consequence of placing, moving or removing equipment and SSI from the seabed. Occasionally sediment suspension will be intentional, for example the use of ROV jet propulsion to scour sediment from around an existing SSI component to assist with its retrieval. Once suspended, the subsequent deposition of sediments that have been disturbed can affect benthic biota by clogging feeding apparatus, influence respiration rates, burying individuals and modifying sediment size characteristics which can influence the habitability of an area for some species (Hewitt and Pilditch, 2004; Trannum *et al*., 2010, 2011; Tjensvoll *et al*., 2013). These impacts can reduce the fitness and condition of biota, modify community structure and in some cases may result in mortality (Norkko *et al*., 2006; Trannum *et al*., 2010, 2011).

Table 30 summarises the predicted areas of seabed disturbance for each activity that will or may form part of the decommissioning of the Tui field. The maximum total (cumulative) area of seabed disturbance predicted is 150,763 m^2 or 0.151 km^2. In comparison, the area of the IAA is 122 km^2. On this basis the area of predicted disturbance accounts for approximately 0.12% of the IAA. MODU placement represents by far the largest cause of potential seabed disturbance (up to 124,800 m^2), although if a WIV is used as the primary platform from which P&A decommissioning activities will occur this disturbance will not transpire, and the overall footprint of seabed disturbance will be even smaller.

Table 30 Predicted areas of seabed disturbance during decommissioning activities

Specific Decommissioning Activity	Predicted Area of Seabed Disturbance	Maximum Total Seabed Disturbance (m^2)
ROV works and placement of transponders (**Section 2.2.5**)	Sandbags typically occupy an area of 5 m^2. The work basket will not exceed 12-15 m^2 of disturbance. The four clump weights will occupy a cumulative area of up to 4 m^2 per well, and up to 32 m^2 for all wells. A typical ROV has a 6 m^2 footprint.	58
Removal of production flowlines/risers (**Section 2.3.2**)	Maximum total of 13,996.12 m^2 seabed disturbance.	13,996.12
Removal of umbilicals (**Section 2.3.3**)	Maximum total of 5,168.60 m^2 seabed disturbance.	5,168.60
Removal of gas-lift CT (**Section 2.3.4**)	Maximum total of 3,375.41 m^2 seabed disturbance.	3,375.41
Removal of GLJs, HFLs and EFLs (**Section 2.3.5**)	Total for all three flexible GLJs is 45.6 m^2, and 14 m^2 for all four 'Unitech' GLJs. Total for all HFLs is 23.1 m^2. Total for all EFLs is 14.8 m^2.	97.50
Removal of GLM (**Section 2.3.6**)	Total for GLM recovery is 145.6 m^2	145.60
Removal of MWA and GB (**Section 2.3.7**)	Options 1A & 1B: total of 588 m^2 for all four GBs Option 2: total of 684 m^2 for all four GBs and the associated clump weights Option 3: total of 1,038.8 m^2 for all four GBs and the associated disturbance from the sunken MWAs	1,038.80
Removal of production riser hold-back anchors (**Section 2.3.8**)	Total of 216 m^2 for all four anchors and chains	216
Removal of miscellaneous equipment (**Section 2.3.9**)	Up to 376 m^2	376
MODU installation (if necessary) (**Section 2.4.4**)	Up to 124,800 m^2 for eight placements of a 12 anchor MODU	124,800
Environmental monitoring (**Section 2.6**)	Up to 700 m^2 for each annual video sled survey (assuming 35 transects). This equates up to 1,400 m^2 for two years of post-decommissioning surveys. Up to 45.4 m^2 for each annual round of grab sampling (assuming 72 triplicate stations). This equates up to 90.8 m^2 for two years of post-decommissioning surveys.	1,490.80
Total		**150,762.83** **(0.151 km^2)**

It should be noted that the number of times that the ROV works will result in disturbance over the course of the decommissioning of the Tui field is unknown (i.e. how often the ROV will settle on the seabed). However, the values are overshadowed by the remaining disturbances from the other activities identified in **Table 30** and as such, are not considered to be overly critical in estimating the area of disturbances.

An additional impact from the seabed disturbance on benthic communities will result from the suspension of sediments during the retrieval of SSI and the associated operations (such as jetting or from ROV thrusters), and the subsequent settlement of that sediment on the seabed. The quantity of sediment that is suspended in the water column and the distance at which it will settle out is difficult to determine. However, it is anticipated that this sedimentation will be spatially restricted in the near vicinity of the SSI. As an extreme example, deposition modelling undertaken for EEZ100016 for the development drilling in the Tui field modelled the near-surface release of approximately 100 m^3 of drill cuttings and associated muds (for a single well) resulting in deposition above background sedimentation levels (10 $g/m^2/day$) extending out to approximately 200 m. The decommissioning of the Tui field is anticipated to liberate much less fine sediment that would suspend in the water column, and would mainly do so from the seabed, resulting in a much smaller lateral spread with the majority of the sediment expected to settle near the disturbance site as larger clumps of sediment.

The sediments in and around the SSI may include traces of substances (some potentially harmful when they were first used and likely degraded over time) from previous drilling campaigns and installation of the Tui field. The quantity of any relic substances is anticipated to be small as it is understood that most of the wells within the Tui field, at least the production wells post 2007, had their drill cuttings collected and shipped ashore. Any such suspension and settlement of these relic substances will be in a highly discrete and spatially restricted area around the SSI. Environmental monitoring undertaken in 2021 associated with the production activities in the Tui field did not find levels of contaminants (both metals/metalloids and PAH/TPH) from production activities in the sediment in exceedance of applicable guideline levels, including at stations within 200 m of the SSI.

Following the removal of SSI and well abandonment, it is anticipated that several depressions will remain in the seabed for some time. For components that are relatively light these depressions are expected to be shallow and some infill is expected over time from the resuspension of surrounding sediments during storm events, currents and biological activity. However, for SSI components that are large and heavy (e.g. the GB of the MWA or the wellheads themselves), these depressions are expected to be deep and will most likely become permanent features of the seabed of the IAA. Evidence of this type of disturbance has been reported from Admiralty Bay where historically MODU's have been soft-pinned prior to float-on operations. Here depressions up to 5 m in depth that have been colonised by epifauna have been observed by benthic survey technologies even after 10 years of the causative activity taking place (SLR, 2019). Despite some long-term/permanent changes to the seabed being possible from the decommissioning of the Tui field, all disturbed substrate will start to be recolonised by species immediately following the cessation of disturbance; hence retains some ecological value even after being altered.

Recolonisation Following Disturbance

Surveys of seabeds in the offshore Taranaki area before and following major physical disturbance (such as MODU anchor placements and exploration drilling), have shown that benthic recolonisation of the disturbed seabeds begins to occur rapidly, with more mobile taxa such as fishes moving back into the areas within days of disturbances occurring (*pers. comm.* Toby Harvey), and other mobile taxa such crustaceans and gastropods on the scales of weeks. Less mobile/sedentary taxa such as polychaete worms, small bivalves, asteroids, etc. take longer to recolonise but are usually present again within 6-12 months depending on the level of disturbance and the changes to seabed physical and chemical characteristics, tending to rely on larval recruitment and settlement from the water column.

Imagery of the seabed obtained during recent benthic surveys associated with exploration wells showed that between seven and ten months following the completion of the exploration drilling epifauna including gastropods and starfish, as well as mobile fish species were present at the sites of disturbance (including large physical disturbances from MODU anchors as well as removal of wellheads and discharge of materials), along with evidence of infauna including burrows and worm-casts (SLR, 2021b and c).

The depressions left at the location of exploration drilling wellheads following their removal are often observed in initial post-drill surveys undertaken within 12 months of completion of drilling. However, based on four exploration wells where three post-drill surveys have been completed (Ruru-2/3, Whio-1, Manaia-2, Matuku-1), this depression was not visible (filled in) by the second post-drill survey (i.e. after two years).

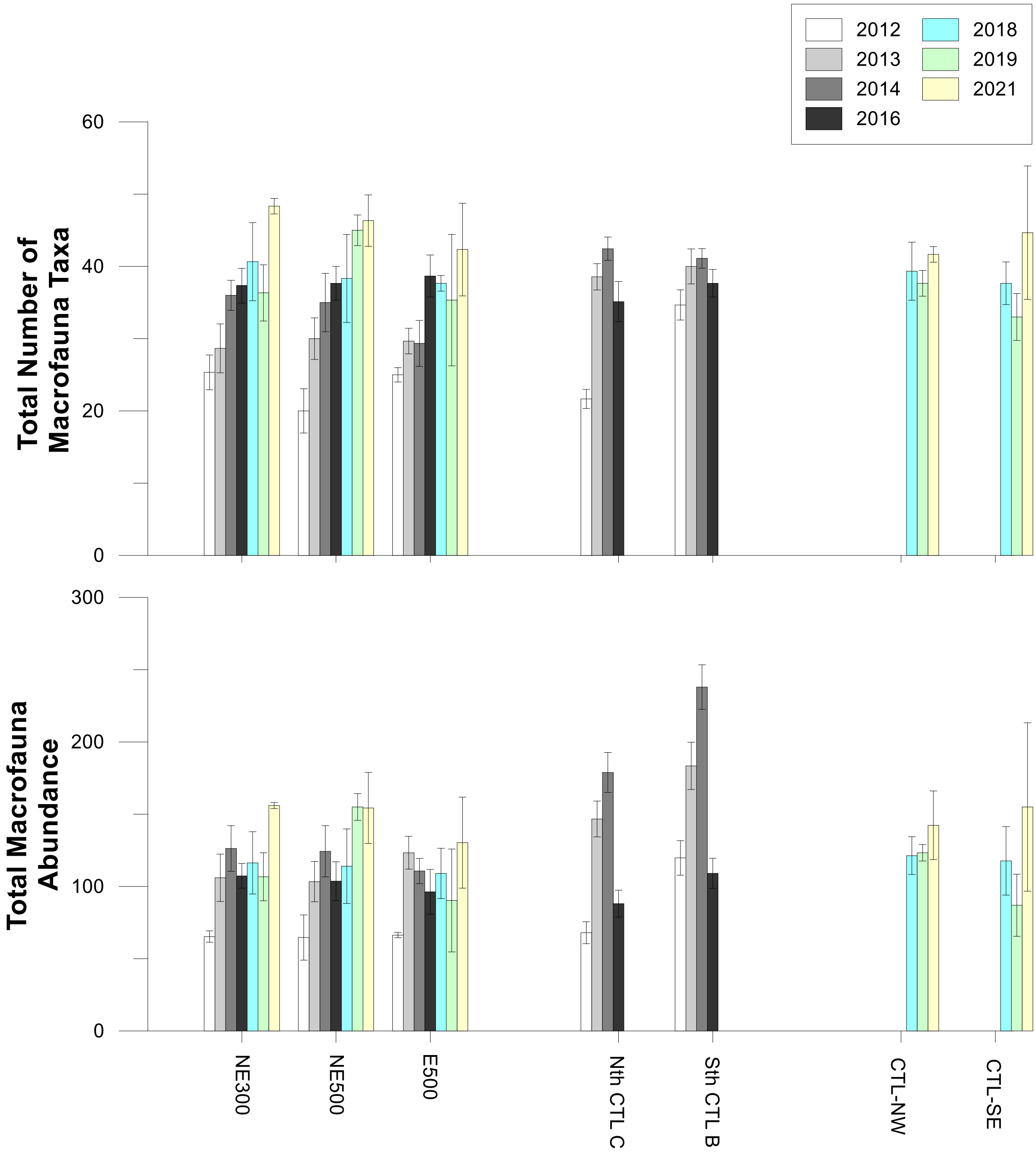
Monitoring surveys have largely occurred over summer periods due to favourable weather and sea conditions. As a result, observations of seabed and associated biological recovery of offshore Taranaki areas following impacts (or ongoing production activities), have been largely summer based. However, the Whio-1 exploration well was monitored pre-and post-drilling over the spring period (October/November) and rates of infauna and epifauna recovery were observed to be similar to that seen during summer monitoring surveys in other similar offshore Taranaki areas.

Previous monitoring carried out in the offshore Taranaki area, including at the Tui field, has revealed that there has been significant variability in macrofauna community characteristics and composition at both field sites (or exploration well sites) and at theoretically ‘unimpacted’ control sites between survey events, indicating natural temporal ‘noise’ in the area.

Benthic monitoring has been occurring at the Tui field since 2012, although the location of monitoring stations changed somewhat (including new control sites) in 2018 with the implementation of a new monitoring programme for the Tui field. A subset of the macrofauna abundance and diversity results is displayed in **Figure 32** and shows that over this time the macrofauna is highly variable between years, both at sampling stations close to the areas of greatest impact, and at the control stations. Data from the control stations shows large changes in abundance, in particular over the period 2012-2016, which has been attributed by the taxonomists undertaking the analysis to a recruitment event between 2012 and 2013 with large numbers of juvenile macrofauna present in a number of taxa. Between 2014 and 2016 such recruitment events did not appear to have occurred and there was a notable absence of smaller individuals within the collected samples.

Therefore, although monitoring will be occurring within the same season, there is considerable natural temporal variation occurring across the offshore Taranaki area and in the Tui field. The amplitude of this variability can be considerable and create a significant amount of ‘noise’ when attempting to distinguish the magnitude of effects of anthropogenic disturbances such as the removal of the SSI and P&A works on the biological communities.

Figure 32 Number of macrofauna taxa and total abundance at Tui field monitoring stations close to the FPSO and at control sites between 2012 and 2021



Consequence – Although the disturbance on benthic communities is highly localised (i.e. < 1 km^2), the decommissioning work, and therefore the associated disturbance, will take months to complete. In addition, although the physical disturbance of the seabed may result in permanent depression features in the seabed, these areas are anticipated to recolonise quickly. The benthic communities found in and around the Tui field are typical of the wider Taranaki region, with no sensitive environments or protected species present (**Section 4.3.3**). Therefore, based on **Table 25**, it is considered that the consequence of the seabed disturbance on benthic communities is *minor*.

Likelihood – The seabed disturbance from the decommissioning of the Tui field is a certainty of occurring as the proposal is not able to be completed without causing these impacts, and as such, the resultant impacts on the benthic environment are certain to occur. Therefore, based on **Table 25**, it is considered that the likelihood is *certain*.

As the consequence of the impacts from seabed disturbance on benthic communities is *minor*, and it is *certain* that it will occur, the environmental risk of adverse impacts is assessed as ***moderate***, and the resultant magnitude of environmental effects predicted to be ***minor***.

Planned Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Effects
Seabed disturbance – effects on the benthic communities	1 – Minor	6 – Certain	6 – Moderate	Minor

7.2.3.2.4 Marine Mammals

Reduced Visibility – Direct Effect of Seabed Disturbance

Any disturbance to the seabed as part of the decommissioning of the Tui field has the potential to increase turbidity in the surrounding water column. However, turbidity effects are predicted to be of little ecological relevance to marine mammals for the following reasons:

- The area of turbidity caused by seabed disturbance from the decommissioning of the Tui field will be discrete and spatially restricted to small areas within the IAA;
- Marine mammals are highly mobile and have ample opportunity to avoid discrete areas of turbidity;
- Marine mammals are well adapted to forage and navigate at depth where natural light is limited or in turbid coastal waters where visibility is restricted; and
- Instead of vision, toothed whales and dolphins use echolocation to navigate and detect prey and baleen whales and pinnipeds feel for prey with their sensitive whiskers (Peyensen *et al.*, 2012; Denhardt *et al.*, 1998).

Changes to Prey Availability

The seabed is an important habitat for those species that rely directly on benthic organisms as a primary source of food. For these species, disturbance to the seabed has the potential to affect the quality and availability of benthic prey which ultimately can affect the health of individuals and resilience of the populations that they belong to.

Target prey species for marine mammals on the seabed are most likely to be large mobile epifauna (for example larger species of crabs and bivalves) that will be relatively tolerant of low levels of disturbance (Lohrer *et al.*, 2004) or demersal fish that would most likely move out of the area of disturbance. In addition, marine mammals are highly mobile and can readily avoid the small affected areas in favour of alternative benthic foraging habitat.

Of the marine mammal species that are likely or possibly to be present in the IAA, common dolphins, killer whales, long-finned pilot whales, bottlenose dolphins, Cuvier's beaked whale, Māui's dolphins, sperm whales and New Zealand fur seals are known to exploit benthic prey in offshore waters (see **Table 31**); however, none of these species rely solely on benthic prey.

Table 31 Foraging ecology of marine mammals that could occur in the IAA

Species	Foraging Ecology	Benthic Prey?
	Likely within IAA	
Blue whales	Feed on krill and other zooplankton by lunge feeding in mid- or surface-waters (Acevedo-Gutierrez *et al.*, 2002). Diet does not include benthic prey.	No
Common dolphins	Diverse diet of fish and cephalopod species. The primary prey species in New Zealand are pelagic, including arrow squid, jack mackerel and anchovy, but the overall diet does include some benthic prey (Meynier *et al.*, 2008). Diet changes with body size, sex and season (Peters *et al.*, 2020).	Yes
Killer whales	Orca present around the North Island are generalist foragers that opportunistically take advantage of prey (Visser, 2007). Benthic foraging for rays is common around New Zealand's coast (Visser, 1999). Diet does include some benthic prey.	Yes
Long-finned pilot whales	Diet information is limited for this species in New Zealand, but stomach content analysis of five stranded individuals suggests a cephalopod diet of both pelagic squid and benthic octopus (Beatson *et al.*, 2007). Diet does include some benthic prey.	Yes
New Zealand fur seal	New Zealand fur seals forage on a range of species, with the relative importance of each prey item varying by season. Arrow squid are important prey items in summer and autumn, lanternfish are taken year-round, barracouta and jack mackerel are major contributors to the summer diet, while red cod, ahuru, and octopus are important winter prey species (Harcourt *et al.*, 2002). Diet does include benthic prey.	Yes
	Possibly within IAA	
Bottlenose dolphin	Varied diet of fish and squid (Blanco *et al.*, 2001; Gowans *et al.*, 2008, Constantine & Baker, 1997) and carry out foraging dives in both shallow and deep habitats (to depths of over 500 m) (Wells & Scott, 2009). Diet does include some benthic prey.	Yes
Fin whale	Diet is dominated by krill in the southern hemisphere (Miyashita *et al.*, 1995; Shirahai & Jarrett, 2006). Lunge feed in mid- or surface-waters. Diet does not include benthic prey.	No
Minke whale	Feed on krill and a variety of other small schooling fish by lunge feeding in mid- or surface-waters (Cooke *et al.*, 2018). Diet does not include benthic prey.	No
Cuvier's beaked whale	Feed mostly on deep-sea squid, but also sometimes take fish and crustaceans. They apparently feed both near the bottom and in the water column (Baird *et al.*, 2020). Diet does include some benthic prey.	Yes
Gray's beaked whale	Diet appears to vary with location but includes meso-pelagic fish and squid (Pitman *et al.*, 2020). Diet does not include benthic prey.	No
Strap-toothed whale	Diet is comprised almost entirely of oceanic squid (Sekiguchi *et al.*, 1996). Diet does not include benthic prey.	No
Humpback whale	Feed on krill and small pelagic schooling fish by lunge feeding in mid- or surface-waters (Murase *et al.*, 2002). Diet does not include benthic prey.	No
Hector's/Maui's dolphins	Diet consists of a variety of fish species, with red cod, ahuru, arrow squid, sprat, sole, and stargazer contributing the majority (77%) of the total diet (Miller *et al.*, 2013). Diet does include some benthic prey.	Yes

Species	Foraging Ecology	Benthic Prey?
Pygmy right whale	Diet thought to consist of meso-zooplankton, particularly calanoid copepods (Cooke, 2018a). Diet does not include benthic prey.	No
Pygmy sperm whale	Diet consists primarily of oceanic cephalopods, but includes fish, shrimp and swimming crabs (Beatson, 2007). Diet does not include benthic prey.	No
Sei whale	Feed on zooplankton, pelagic schooling fish and squid (Cooke, 2018b). Diet does not include benthic prey.	No
Short-finned pilot whale	Primarily adapted to feed on squid, but diet also includes some oceanic fish species (Minton *et al.*, 2018). Diet does not include benthic prey.	No
Sperm whale	In New Zealand, this species feeds mainly on squid and fish, the presence of groper and ling in the diet is clear evidence of bottom feeding (Gaskin and Cawthorn, 1967). Diet does include some benthic prey.	Yes
Southern right whale	Utilises offshore summer feeding grounds in Antarctic waters to feed on krill by lunge feeding in mid- or surface-waters. Do not typically feed during coastal winter presence in New Zealand (Carroll *et al.*, 2011). Diet does not include benthic prey.	No

In addition to potential changes in abundance and distribution of benthic prey from seabed disturbance, it is also noteworthy that SSI associated with oil and gas facilities globally can provide predictable foraging opportunities to marine mammals (Todd *et al.*, 2020). These authors documented food-related behaviours (searching and foraging) mainly for phocid seals (Gray and common seals) around anthropogenic structures in the northeast Atlantic and highlighted the possibility that decommissioning may reduce foraging opportunities for at least some individuals in some locations. Of greater relevance to New Zealand are the findings of Arnould *et al.* (2015) who noted that, of 36 tagged Australian fur seals, 25% exhibited foraging behaviour near SSI, with evidence suggesting that individual seals targeted oil and gas pipelines and undersea cables. While quantitative knowledge of the role of oil and gas SSI for New Zealand fur seals is lacking, it is known that seals have a consistent presence around oil and gas platforms in Taranaki and take advantage of haul-out opportunities that some types of infrastructure (e.g. jackets of platform legs) present (McConnell, 2015). Therefore, it is reasonable to assume that they also take advantage of foraging opportunities associated with SSI (which can support higher densities and diversities of fauna on an otherwise homogenous sedimentary seabed) throughout the region.

In summary, changes to prey availability for marine mammals might occur either through a) demersal fish or mobile epifauna avoiding areas of increased turbidity caused by decommissioning activities; or b) the reduction of productive benthic foraging habitat through the removal of SSI. While these potential effects are noted, they are unlikely to be of ecological relevance to marine mammals as:

- No marine mammal species is entirely reliant on the IAA seabed for foraging habitat, and any marine mammal species that do forage on the seabed here can access nearby alternative foraging habitat of similar quality;
- While some marine mammals do have a benthic component to their diets, none are solely reliant on benthic prey (consuming a mixture of benthic and pelagic prey species); and
- Any area of reduced abundance of fish (on account of fish avoiding areas of disturbance) will be highly localised to the area in which seabed disturbance is occurring.

Consequence – Any potential impacts on marine mammals, either directly through increased turbidity, or from the reduction in prey species, from seabed disturbance would be highly localised around the decommissioning activities and would only occur for a relatively short period of time, with these impacts ceasing as soon as the works conclude. Therefore, based on **Table 25**, it is considered that the consequence of the seabed disturbance on marine mammals is *minor*.

Likelihood – The seabed disturbance from the decommissioning of the Tui field is a certainty of occurring as the proposal is not able to be completed without causing these impacts. However, the likelihood of a consequence occurring from this on marine mammals is not likely to occur in normal circumstances as no marine mammal species is entirely reliant on the IAA for benthic habitat foraging. Therefore, based on **Table 25**, it is considered that the likelihood is *unlikely*.

As the consequence of the impacts from seabed disturbance on marine mammals is *minor*, and it is considered an *unlikely* occurrence, the environmental risk of adverse impacts is assessed as ***low***, and the resultant magnitude of environmental effects predicted to be ***less than minor***.

Planned Activity	Consequence	Likelihood	Residual Risk	Predicted Magnitude of Environmental Effects
Seabed disturbance –effects on marine mammals	1 – Minor	3 – Unlikely	3 – Low	Less than minor

7.2.3.3 Removal of Artificial Hard Substrate

7.2.3.3.1 Overview

The primary purpose of the decommissioning of the Tui field is the removal of anthropogenic structures from the seabed. A full description of the structures to be removed is given in **Section 2**, but the main components that are subject to retrieval include: production flowlines/risers, umbilicals, gas-lift CT, GLJs, HFLs, EFLs, gas-lift manifold, MWA and GB, and production riser holdback anchors. In addition, there are eight subsea wellheads and Xmas trees.

7.2.3.3.2 Measures to Avoid, Remedy or Mitigate

No measures will be implemented to avoid, remedy or mitigate the effects of removal of the artificial hard substrate that has been provided by the SSI within the Tui field, as this effect is intrinsically linked to the purpose of the decommissioning. The following receptors could potentially be impacted by artificial hard substrate removal and a discussion of the potential effects is provided in the subsections below:

- Artificial reef invertebrate assemblages;
- Fish and cephalopods; and
- Marine mammals.

Removal of artificial hard substrate is not expected to have any adverse effects on seabirds, nearshore coastal environments and associated marine communities and as such they are not considered further below.

7.2.3.3.3 Artificial Reef Invertebrate Assemblages

Long-term or permanent anthropogenic structures associated with oil and gas activities act as artificial reefs, by the provision of hard substrate for the attachment and colonisation of sessile invertebrates which in turn attract motile invertebrates and other fauna (Macreadie *et al.*, 2011; Todd *et al.*, 2018). These artificial reefs can provide important refuges for a variety of marine fauna (Claisse *et al.*, 2014; Todd *et al.*, 2016) particularly as commercial fishing is typically excluded from the vicinity of offshore oil and gas infrastructure (van Elden *et al.*, 2019). On this basis, it is increasingly recognised that oil and gas platforms may provide significant ecological services during their active lifespan (van Elden *et al.*, 2019), with complex reef-type habitats emerging within 5-6 years (Driessen, 1986). Of particular note is the role that offshore infrastructure plays in the provision of hard substrate to which sessile invertebrates can attach in an environment where hard substrate is otherwise limited (Macreadie *et al.*, 2011, van Elden *et al.*, 2019). This colonisation forms the basis of, and supports, a broader reef assemblage to establish through time.

The 2020 ROV Survey (**Appendix C**) of the SSI of the Tui field confirmed that sessile assemblages were present at low to moderate levels on all SSI components, but that densities of organisms were greater on structures that were lifted above the seabed (i.e. the risers) and that densities increased with decreasing depth, particularly at water depths less than ~60 m (SLR, 2021d). Assemblages observed were predominantly of tubeworms, small tuft hydroids, encrusting sponges, tunicates, barnacles (including larger goose barnacles), and anemones (predominantly jewel anemones), with occasional other taxa including whelks/small gastropods, hermit crabs, ball and finger sponges, starfish and cushion stars, wandering anemones and New Zealand rock lobster. The 2020 ROV Survey described the SSI as a biodiversity 'hotspot' relative to the surrounding featureless sediments; however, noted that biological assemblages observed were typical to those observed on other offshore Taranaki infrastructure. The 2020 ROV Survey report noted that removal of SSI from the Tui field will result in a net loss of overall biodiversity in the area, relative to its current state which is expected with the removal of artificial hard substrate in an otherwise featureless seabed; however, no sensitive environments or protected species were present on the SSI.

Consequence – Any removal of artificial hard substrate will impact those species that use it to survive. While this effect will be highly localised, it is considered that it will cause detectable changes to ecosystem function with the loss of assemblages that have colonised the SSI, wellheads and Xmas trees. However, there are no sensitive environments or protected species impacted by the removal of artificial hard substrates in the Tui field, and the species that have colonised the artificial hard substrate are widespread through the wider Taranaki region. In addition, the removal of the SSI will effectively return the surrounding environment to its original state prior to the installation of the Tui field. Therefore, based on **Table 25**, it is considered that the overall consequence from the removal of artificial hard substrate on artificial reef assemblages is *minor*.

Likelihood – The removal of the artificial hard substrate is a certainty of occurring as the proposal is not able to be completed without causing these impacts, and as such, the resultant impacts on the artificial reef invertebrate assemblages are certain to occur. Therefore, based on **Table 25**, it is considered that the likelihood is *certain*.

As the consequence of the impacts from the removal of the artificial hard substrate on artificial reef invertebrate assemblages is *minor*, and it is *certain* that it will occur, the environmental risk of adverse impacts is assessed as ***moderate***, and the resultant magnitude of environmental effects predicted to be ***minor***.

Planned Activity	Consequence	Likelihood	Residual Risk	Predicted Magnitude of Environmental Impact
Removal of artificial hard substrate –effects on artificial reef invertebrate assemblages	1 – Minor	6 – Certain	6 – Moderate	Minor

7.2.3.3.4 Fish and Cephalopods

The presence of the artificial reef invertebrate assemblage encourages ecosystem complexity and through time can come to support fish populations by provision of foraging habitat (Cowan and Rose, 2016), refuge from predators (Todd *et al.*, 2016) and refuge from fishing pressure (van Elden *et al.*, 2019).

It appears that some long-term oil and gas structures can enhance fish production (Fowler and Booth, 2012), but typically fish are attracted to structures from surrounding habitat (Macreadie et al., 2011). Several studies have described oil and gas infrastructure around the world as de facto marine protected areas on account of exclusion of fishing pressure that results from the establishment of safety zones around platforms (Friedlander *et al.*, 2014). In exceptional circumstances, these refuges can provide important conservation benefits. For example, eight platforms off California collectively support 20% of the annual number of surviving juveniles for a critically endangered rockfish species (*Sebastes paucispinis*).

Fish were reportedly concentrated around the larger SSI features both on the seabed and in the water column during the 2020 ROV Survey of the Tui field SSI (SLR, 2021d) (**Appendix C**). These structures provided cryptic habitat for fish that would otherwise be absent from, or present at much lower densities, in the offshore environment. The fish species with the highest observed occurrence were sea perch, bastard red cod and bigeye (see **Section 4.3.4** for a full list of fish species encountered), with kingfish regularly observed higher in the water column (SLR, 2021d). Most fish species observed during the 2020 ROV Survey were mobile species that could readily move into alternative habitat (albeit of lesser quality) once SSI is removed. However, this is not the case for pipe fish and seahorses that were observed during the 2020 ROV Survey, these species are typically associated with macroalgae in coastal environments in which they have a high degree of site fidelity and habitat complexity (Baker, 2006). It is questionable as to whether the individuals of these species that occur in association with the Tui field SSI would survive to find alternative suitable habitat in the offshore Taranaki environment.

No protected fish species were seen during the 2020 ROV Survey. Cephalopods were absent from survey observations and while this may indicate an absence from the area, the highly cryptic nature of benthic octopus in particular may simply have precluded any observations.

Consequence – Any removal of artificial hard substrate will impact those species that use it to survive, albeit in a highly localised area. The adverse impacts from the removal of artificial hard substrate will not result in impacts at a population level, with affected individual fish largely expected to relocate to alternative habitat. In addition, there are no protected species that will be impacted by this activity. Therefore, based on **Table 25**, it is considered that the overall consequence from the removal of artificial hard substrate on fish and cephalopods is *minor*.

Likelihood – The removal of the artificial hard substrate is a certainty of occurring as the proposal is not able to be completed without causing these impacts; however, the impacts from this activity on the fish and cephalopods are not considered to be a certainty due to their ability to move into alternative habitat. Therefore, based on **Table 25**, it is considered that the likelihood is *likely*.

As the consequence of the impacts from the removal of the artificial hard substrate on fish and cephalopods is *minor*, and it is *likely* that it will occur, the environmental risk of adverse impacts is assessed as ***low***, and the resultant magnitude of environmental effects predicted to be ***less than minor***.

Planned Activity	Consequence	Likelihood	Residual Risk	Predicted Magnitude of Environmental Impact
Removal of artificial hard substrate –effects on fish and cephalopods	1 – Minor	5 – Likely	5 - Low	Less than minor

7.2.3.3.5 Marine Mammals

As described in **Sections 7.2.3.3.3** and **7.2.3.3.4**, offshore oil and gas infrastructure acts as an artificial reef; being colonised by sessile invertebrates and attracting fish over time. In turn, fish-eating marine mammals can be attracted to these locations for foraging opportunities that are predictable through space and time (McLean *et al.*, 2019).

While only a few studies have quantified the use of offshore infrastructure by marine mammals, these studies clearly indicate an association between several marine mammal species and anthropogenic structures around the world. Cetacean examples include harbour porpoises that are frequently present near installations in the North Sea (Todd *et al.*, 2009; Todd *et al.*, 2016; Delefosse *et al.*, 2018) and bottlenose dolphin presence around platforms in the Adriatic Sea (Troissi *et al.*, 2013). Pinniped examples include common and gray seals that target wind farm turbine piles to feed in the North Sea (Russell *et al.*, 2014), Californian sea lions that regularly haul out and nurse pups on oil and gas installations in the Pacific US (Orr *et al.*, 2017), and Australian fur seals forage near offshore structures off the coast of Victoria in Australia (Arnould *et al.*, 2015). In addition, Todd *et al.*, (2020) recently undertook a global analysis of incidentally collected ROV and commercial diver video imagery and reported 67 individual marine megafauna sightings including three sightings of whales, one sighting of dolphins and 16 sightings of seals near subsea anthropogenic structures. This work demonstrated presence and foraging of marine mammals in these man-made settings and provided visual verification of seals following subsea pipelines.

During the 2020 ROV Survey staff onboard the survey vessel recorded the following marine mammal sightings:

- New Zealand fur seals were frequently observed during the survey, both at the sea surface nearby the FPSO and also at the seabed in ~125 m of water (SLR, 2021d);
- Pilot whales were observed on several occasions during the survey, both within the Tui field itself and to the east and south of the field while the survey vessel was in transit or on weather standby (SLR, 2021d); and
- A larger whale was also observed on the sea surface to the south of the Tui field and, although rough sea conditions at the time made for difficult identification the size, shape, coloration, and the shape of the animals blow most closely resembled a pygmy blue whale (SLR, 2021d).

While several marine mammal species could potentially be present in the IAA, New Zealand fur seals are the only species known to have a frequent presence around Tui field SSI. On this basis, removal of structures during the process of the decommissioning of the Tui field is likely to have the greatest impact on this species which has had an ongoing presence here since field establishment in 2007.

While information about the number of individual New Zealand fur seals that actively use the Tui field SSI as foraging habitat is unavailable, tagging studies of fur seals in Australia confirm that in some circumstances a reasonable proportion of individuals from a population (25% of 36 tagged seals) can come to rely on anthropogenic structures as a foraging destination (Arnould et al., 2015). **Table 31** summarises New Zealand fur seal foraging ecology as including a range of prey species that vary seasonally; where arrow squid are important prey in summer/autumn, lanternfish are taken year-round, barracouta and jack mackerel are major contributors to the summer diet, while red cod, ahuru, and octopus are important winter prey species (Harcourt *et al.*, 2002). Foraging occurs both through the water column and on the seabed. While some individuals may source some prey items consistently from around Tui field SSI, New Zealand fur seals are considered opportunistic foragers with diets that exhibit a high degree of plasticity over a range of prey items and habitats to suggest that affected individuals will quickly adapt to new foraging strategies following the removal of the SSI.

While other species of marine mammals also probably feed within the IAA on occasion, the impacts of removing the artificial hard substrate are unlikely to be of ecological relevance as no marine mammal species is entirely reliant on the IAA for foraging habitat, and any marine mammal species that do occasionally forage here have vast home-ranges and uninhibited access to alternative foraging habitat.

Consequence – The removal of the artificial hard substrate will have a highly localised effect on marine mammals, specifically those that utilise the SSI for foraging. However, there are no predicted adverse impacts at a population level, with any impact New Zealand fur seals easily expected to adapt to alternative habitat. Therefore, based on **Table 25**, it is considered that the overall consequence from the removal of artificial hard substrate on marine mammals is *minor*.

Likelihood – The removal of the artificial hard substrate is a certainty of occurring as the proposal is not able to be completed without causing these impacts; however, the impacts from this activity on the marine mammals are not considered to be a certainty due to their ability to move to, and forage within, an alternative habitat. Therefore, based on **Table 25**, it is considered that the likelihood is *likely*.

As the consequence of the impacts from the removal of the artificial hard substrate on marine mammals is *minor*, and it is *likely* that it will occur, the environmental risk of adverse impacts is assessed as ***low***, and the resultant magnitude of environmental effects predicted to be ***less than minor***.

Planned Activity	Consequence	Likelihood	Residual Risk	Predicted Magnitude of Environmental Impact
Removal of artificial hard substrate – effects on marine mammals	1 – Minor	5 – Likely	5 - Low	Less than minor

7.2.3.4 Noise and Vibrations

7.2.3.4.1 Overview

Sources of underwater noise include: MODU/WIV operations, CSV, support vessels, ROV operations, helicopter operations and other underwater activities (including rigging, winching, cutting, pumping etc).

7.2.3.4.2 Measures to Avoid, Remedy or Mitigate

The following measures will be implemented to avoid remedy or mitigate the effects of noise and vibrations during the decommissioning of the Tui field:

- Activities associated with decommissioning will be temporary and of short-term duration;
- Decommissioning activities will be undertaken in the shortest amount of time possible to minimise the duration of underwater noise disturbance;
- Decommissioning activities will occur in highly localised area as defined by the IAA; although underwater noise may propagate beyond the IAA boundaries;
- Helicopter use will comply with the MMPR and flight paths will avoid seabird breeding colonies and fur seal haul-out locations where possible.

Despite the above-mentioned measures to avoid, remedy or mitigate the predicted adverse effects, the following receptors could potentially be impacted by noise and vibrations from the decommissioning of the Tui field, and a discussion of the potential effects is provided in the subsections below:

- Marine mammals;
- Fish and cephalopods;
- Seabirds; and
- Plankton.

Noise and vibrations are not expected to have any adverse effects on benthic invertebrate communities, nearshore coastal environments and associated marine communities, and as such they are not considered further below.

7.2.3.4.3 Marine Mammals

Underwater Noise

Marine mammals produce sound not only for communication with conspecifics (e.g. Quick & Janik, 2012), but also for foraging, navigation, reproduction, parental care, avoidance of predators, and to gain an overall awareness of the surrounding environment (Thomas *et al.*, 1992; Johnson *et al.*, 2009). Toothed whales and dolphins use echolocation to forage and navigate, whilst all marine mammals are believed to use passive listening to gather useful navigational cues (e.g. the sound of waves breaking on coastline etc.). On this basis underwater noise generated by human activity (e.g. construction/decommissioning of facilities, shipping, seismic surveys, drilling, coastal development etc.) has the potential to have effects on marine mammals. Effects are typically perceptual, behavioural or physical as discussed below.

The main perceptual effect is auditory 'masking' of important biological sounds (i.e. the reduced ability of marine fauna to perceive natural acoustic signals used by conspecifics for communication, navigation, predator avoidance, foraging etc.) (e.g. Erbe & Farmer, 2000). Marine mammals must be able to perceive and effectively respond to biologically important sounds. Anthropogenic noise can interfere with the perception of these sounds. Such interference is referred to as 'masking'. The likelihood of masking is determined by how much overlap occurs between the frequency of animal vocalisations and the frequency of anthropogenic sounds (Richardson *et al.*, 1995). Low frequency noises (e.g. engine noise from large ships) are more likely to lead to masking as these noises travel more readily through water than high frequency noises. These low frequency noises typically impact baleen whales that predominantly use low frequency sounds to communicate (Simmonds *et al.*, 2004).

Even activities that emit relatively low intensity underwater noise can cause masking, but the biological significance of any effect will largely depend on the significance of the habitat affected and the duration of the effect, where ongoing masking in habitat that is of high importance will have the greatest ecological significance.

It is also worth considering that some species are known to counter effects of masking by changing their vocalisation behaviour to compensate. For example, with increasing ambient noise right whales increased the frequency of their vocalisations (Parks *et al*., 2007), bottlenose dolphins increased calling rate (Buckstaff, 2004) and killer whales increased call durations (Foote *et al.,* 2004).

The main potential behavioural effects observed in response to underwater noise are the interruption of behavioural patterns (e.g. feeding, breeding, migrating or resting) (e.g. Finneran *et al*., 2000) and the displacement from habitat (e.g. Thompson *et al*., 2013). Temporary avoidance is the most commonly reported behavioural response by marine mammals in the vicinity of high intensity acoustic disturbance (Stone & Tasker, 2006); however, some species appear to be attracted to low/medium intensity disturbance (e.g. Wursig *et al.*, 1998; Simmonds *et al.*, 2004; Lalas & McConnell, 2016). Avoidance behaviours may culminate in marine fauna being displaced from habitat and detrimental effects could be expected if this displacement occurs from optimal habitat in the long-term.

New Zealand fur seals are likely to be attracted to any MODU used during the decommissioning of the Tui field. However, pinnipeds are not as sensitive to underwater noise as whales and dolphins as they are an otariid and have small ear flaps, which have muscles and a cartilage valve along the external ear canal function to close the ear canal to water (Southall *et al.,* 2007); hence they are expected to tolerate and habituate to anthropogenic noise more readily.

Potential physical effects to marine mammals from underwater noise include physiological stress responses (e.g. Romano *et al*., 2004), organ damage (Cox *et al.*, 2006) and permanent or temporary hearing loss (DOC, 2013; Lucke *et al*., 2009). However, the sound intensity (energy levels, frequencies and duration) required to produce these physical effects is unknown for most marine fauna (Richardson *et al.*, 1995), but NMFS (2018) provide recent estimates of noise thresholds required to elicit permanent hearing damage: permanent threshold shift (**PTS**). Physical damage to date has only been associated with very high intensity underwater noise such as military sonar (Cox *et al.*, 2006; Ketten, 2014). Most mobile species, if given the opportunity, are thought to avoid the range in which physical effects occur.

Whether or not any perceptual, behavioural or physical effect will occur, and the magnitude of any effect depends on a suite of factors, including: noise characteristics (frequency, volume, intensity, duration etc.), bathymetry (water depth, seabed gradient etc.), and species and life history stage (Simmonds *et al*., 2004). Detrimental impacts are generally greatest for marine mammals when:

- The frequency of the anthropogenic noise overlaps with the frequency of animal vocalisations resulting in masking (Erbe *et al*., 2016);
- The volume and intensity of the anthropogenic noise is high, and the duration is long (McGregor *et al*., 2013);
- The noise occurs in shallow or confined waters that provides habitat to resident animal populations with small home ranges (Forney *et al*., 2013);
- The marine mammal population is already of conservation concern (Weilgart, 2007); or
- Animals are subject to noise during periods of critical life history (e.g. breeding, feeding, resting, migrating etc.) (Dunlop *et al.,* 2017).

In order to assess the potential impacts of the noise generated by decommissioning activities on marine mammals it is necessary to have an understanding of both the likely characteristics of the anthropogenic noise and the distribution of marine mammals in the IAA and the relative importance of this area to them (see **Section 4.3.6**). In general, marine mammal species that could be present in the IAA (see **Table 20**) are those that utilise open water habitat and have large home ranges.

The most intense noise to occur at the seabed during the decommissioning of the Tui field is anticipated to be during well abandonment, where the cutting of the conductor and casing will result in vibrations. However, these effects will be highly localised as the conductor is cemented in place which will assist in attenuating or damping any vibrations. In addition, these activities will occur at least 3 m below the seabed, hence the surrounding seabed will assist with muffling the noise/vibrations generated. On this basis, the noise and vibrations associated with planned activities occurring on the seabed are not anticipated to cause significant adverse effects to marine mammals. Some minor behavioural effects (e.g. avoidance or attraction) could occur. Of greater significance to this marine consent application is the noise associated with vessel operation within the water column as discussed below.

Whilst shipping noise has been associated with a number of detrimental effects on marine mammals (e.g. masking (Erbe, 2002), physiological stress (Wright *et al*., 2007), changes in behaviour (Nowacek *et al*., 2007), and changes in vocalisations (Parks *et al*., 2007)), in the most part, the movement of support vessels during the decommissioning of the Tui field constitutes no greater threat than fishing vessels or commercial shipping that might also use the region. The noise outputs from the passage of support vessels will be transient at any one location en-route to and from the Tui field and will only persist for the duration of the project. The exception to this is the use of dynamic positioning thrusters either during the positioning/relocation of the MODU or during WIV operations which is discussed further below.

McCauley (1998) measured the noise emissions from a semi-submersible MODU off the coast of Australia and characterised the noise emissions during periods of drilling and non-drilling. Even when the MODU was not actively drilling (as would be the case for the decommissioning of the Tui field), noise was emitted from structure-borne vibrations, machinery noise, pumps, valves, discharges and miscellaneous banging as gear was moved about the deck. For this study, the MODU was stationed in a water depth of 110 m. During the non-drilling period, the highest noise level measured from the MODU was 117 dB re 1µPa at 125 m from the wellhead location at which it was positioned, and in calm conditions the MODU noise was audible for 1 – 2 km. The results of the McCauley (1998) study are relevant to this consent application as these measurements come from a semi-submersible MODU (which is a possible option for decommissioning activities) stationed at a similar water depth to that of the Tui field.

Interestingly, Todd *et al.* (2020a) measured the near-field sound pressure levels associated with a jack-up MODU in the North Sea and concluded that noise levels measured during the operation of support vessels were higher than any MODU operations in the 25 Hz to 1 kHz frequency band. At these frequencies' vessel noise was generally 20 dB greater than MODU operations (even when the MODU was drilling). Todd *et al.* (2020a) also noted that sound levels of large distributed sources, such as MODU hulls, are generally lower than would be measured from point sources e.g. a single airgun from a seismic survey (Todd *et al.*, 2020a). While the sound profile from the jack-up MODU is of less relevance to this consent application, this study highlights the fact that vessel noise typically represents the most pervasive auditory component associated with MODU operations.

In keeping with this finding, Merchant *et al.* (2014) investigated the baseline soundscape and the contribution of shipping noise to the Moray Firth in northeast Scotland. During the recording period of this study, measurements were opportunistically made of vessels using DP to tow and position MODUs in the area. These vessels produced sustained, high-amplitude broadband noise concentrated below ~1 kHz, and the authors concluded that DP use produces sound levels significantly higher than generic shipping noise (Merchant *et al.*, 2014), where peak frequencies of commercial shipping are typically <100 Hz (e.g. Arveson and Vendittis, 2000; McKenna *et al.*, 2012).

These studies allow the following predictions for the decommissioning of the Tui field to be made: a) MODU noise may be audible to marine mammals out to 2 km (following McCauley *et al.*, 1998), b) support vessel operation will produce higher noise levels that will be audible beyond this range, and c) DP operations will be responsible for the loudest underwater noise component of the decommissioning of the Tui field.

Section 2.2 outlines how activities associated with the decommissioning of the Tui field will occur from either a semi-submersible MODU or a WIV. The use of DP would be fundamental to both scenarios for a) positioning/repositioning a MODU or b) maintaining the position of a WIV. Broadband sound levels for DP thruster noise were recorded by MacGillivray (2006; as cited by MacPherson *et al.*, 2016) for the Dive Support Vessel '*Fu Lai*' as 182.4 dB re 1 µPa at 1 m. It is reasonable to assume that DP use during the decommissioning of the Tui field will approximate this level. However, without specific knowledge of the sound levels of the actual MODU/WIV that will be used and further sound transmission loss modelling it is not possible to predict the range over which this noise will be audible to marine mammals.

However, it is possible to make some inferences against the published thresholds for PTS as shown in **Table 32**. The onset thresholds provided here represent the sound level that marine mammals would need to be exposed to over a 24-hr period for PTS to occur. All but one of the PTS onset thresholds are lower than the predicted sound level from the DP thrusters; meaning that even if a marine mammal was to remain 1 m from the thrusters for 24 hours no PTS would be expected. High frequency cetaceans are the only group for which this statement is untrue; where the only species potentially present in the IAA belonging to this group are Māui/Hector's dolphins, pygmy sperm whales and dwarf sperm whales (following NMFS, 2018). The likelihood of these species being present continuously for extended periods in such close proximity to the DP thrusters is nil.

Table 32 Non-impulsive noise event PTS thresholds for marine mammals

Marine mammal hearing group	PTS onset threshold Weighted SEL_{24hr} dB re 1µPa^2·S
Low-frequency (LF) cetaceans	199
Mid-frequency (MF) cetaceans	198
High-frequency (HF) cetaceans	173
Phocid Pinnipeds in water (PW)	201
Otariid Pinnipeds in water (OW)	219

Source: NMFS, 2018

While hearing damage to marine mammals is not anticipated during the decommissioning of the Tui field, it is possible that some marine mammals in the immediate vicinity of the MODU/WIV may be subject to masking, and minor behavioural changes (e.g. temporary displacement or attraction) as a result of noise emitted from the DP system; however, these effects are unlikely to be of ecological relevance to marine mammals as:

- The open water nature of the IAA which provides animals with ample opportunity to move away from the noise source into alternative habitat in the wider Taranaki region;
- The IAA does not represent critical habitat for any marine mammal species; and
- The short-term nature of the decommissioning activities, and hence any associated effects will also be short-term in nature.

Consequence – The effects of underwater noise on marine mammals will be localised and any noise in the water column would stop as soon as the decommissioning activity stops. Noise levels will be greatest when DP is in use and masking and minor behavioural changes could occur. Some individuals of protected species may be impacted but no impact on their populations is predicted. Therefore, based on **Table 25**, it is considered that the overall consequence from the generation of underwater noise on marine mammals is *minor*.

Likelihood – Although the generation of underwater noise is considered to be a certainty due to the fact that vessels (including MODU/WIV, CSV, support vessels, ROVs etc.) will be utilised, and rigging, winching, cutting, pumping operations are required to complete the decommissioning. However, it is considered that the potential impacts outlined above from this activity on the marine mammals are not considered to be a certainty due to their ability to move to, and forage within, an alternative habitat. Therefore, based on **Table 25**, it is considered that the likelihood is *likely*.

As the consequence of the impacts from the generation of underwater noise on marine mammals is *minor*, and it is *likely* that it will occur, the environmental risk of adverse impacts is assessed as ***low***, and the resultant magnitude of environmental effects predicted to be ***less than minor***.

Planned Activity	Consequence	Likelihood	Residual Risk	Predicted Magnitude of Environmental Impact
Noise and Vibrations – effects on marine mammals from underwater noise	1 – Minor	5 – Likely	5 – Low	Less than minor

Helicopter Noise

The effect of helicopter presence on marine mammal behaviour was reviewed by Richardson *et al.* (1995). In general, reactions vary with species, time of year, and helicopter altitude, type and behaviour. For New Zealand fur seals, helicopters flying over haul-out sites at altitudes greater than 305 m elicited few responses, but below this altitude responses were noted (i.e. increased alertness, rapid water entry) and increased in magnitude as flight altitude decreased; however, habituation to frequent helicopter activity tended to decrease the level of response for some species through time. Whale response to helicopter presence varied from no response to avoidance dives and abrupt changes in direction (Richardson *et al.,* 1995). Patenaude *et al.* (2002) states that noise is likely to be a primary driver for observed behavioural changes, but the shadow of the aircraft passing over the whale is also likely to contribute to avoidance.

Aircraft overflights at low altitude can cause some toothed and baleen whales to dive or turn away, with sensitivity depending on animal activity. For cetaceans, effects seem transient and occasional overflights have no identified long-term consequences.

The closest terrestrial breeding colony of New Zealand fur seals to the Tui field occurs within the group of islands collectively referred to as the Sugar Loaf Islands. Pupping occurs on the islands in December/January (Baird, 2011). Specific breeding locations include Waikaranga (Seal Rock), Moturoa, and Whareumu (Lion Rock), and non-breeding fur seal haul-outs do occur along most coastlines of the Sugar Loaf Islands (*pers. comm.* C. Lilley, Ngā Motu Office, DOC).

When departing and arriving into New Plymouth, helicopter operations are sometimes directed to fly over the Sugar Loaf Islands airspace by Air Traffic Control. However, flight altitude here is typically well above the altitude at which a disturbance response would be expected from fur seals. Based on this, the helicopter operations that will support decommissioning activities are not anticipated to cause any disturbance to fur seals at the Sugar Loaf Islands.

In New Zealand, the MMPR stipulate the requirements for helicopter use around marine mammals, including restrictions on altitude and lateral approach distances. With regard to helicopter use around marine mammals, regulation 18 of the MMPR stipulates that:

- When flying around marine mammals no aircraft shall be flown below 150 m unless taking off of landing; and
- When flying at altitudes lower than 600 m, no aircraft shall be closer than 150 m horizontally from a point directly above any marine mammal.

Restrictions on altitude and lateral approach distances are thought to decrease the likelihood of whales reacting and being displaced from important habitat (Patenaude *et al.*, 2002). The above MMPR restrictions will be implemented during the decommissioning of the Tui field and are considered appropriate to mitigate against disturbance to marine mammals from helicopter use during decommissioning activities.

Consequence – The effects of helicopter noise on marine mammals will be highly localised (less than 1 km^2) and temporary; however, some protected marine mammal species could be subject to short-term disturbance impacts. Therefore, based on **Table 25**, it is considered that the overall consequence from helicopter noise on marine mammals is *minor*.

Likelihood – Based on the mitigation measures, including meeting the MMPR, it is considered that the likelihood of an impact occurring from the use of helicopters during the decommissioning of the Tui field could occur at some time. Therefore, based on **Table 25**, it is considered that the likelihood is *possible*.

As the consequence of the impacts from helicopter noise on marine mammals is *minor*, and it is *possible* that it will occur, the environmental risk of adverse impacts is assessed as ***low***, and the resultant magnitude of environmental effects predicted to be ***less than minor***.

Planned Activity	Consequence	Likelihood	Residual Risk	Predicted Magnitude of Environmental Impact
Noise and Vibrations – effects on marine mammals from helicopter noise	1 – Minor	4 – Possible	4 – Low	Less than minor

7.2.3.4.4 Fish and Cephalopods

Fish

Fish utilise sound for navigation and selection of habitat, mating, and communication (Bass & McKibben, 2003), and although fish lack an inner ear like mammals and birds, they have dedicated sound-detection organs or otoliths (Popper & Fay, 1993).

Sound affects fish physiology in several ways depending on the source level and species. Effects of noise include increased stress levels (Santulli *et al.*, 1999; Smith, 2004; Buscaino *et al.*, 2010), temporary hearing damage or permanent hearing damage (i.e. PTS) (Smith, 2004; Popper *et al.*, 2005), damage to sensory organs (McCauley *et al.*, 2003), attraction, disruption to underwater acoustic cues, changes in behaviour, localised avoidance, and abandonment of a region (McCauley, 1998).

Fish will typically move away from a loud acoustic source that is above its comfort threshold, minimising their exposure and the potential for any hearing damage. Fish avoidance behaviours include vertical or horizontal movements away from the noise source, the breaking up of schooling groups (with a possible simultaneous increase of depth) and increases in swimming speed (Vabø *et al*., 2002; Handegard *et al*., 2003). Such avoidance responses have been demonstrated in a range of demersal and pelagic fish species, with reactions usually occurring when noise levels exceed fish threshold hearing by 30 dB or more (see Mitson, 1995).

The response of fish to acoustic disturbance varies with species, with the presence or absence of a swim bladder playing an important role (Popper *et al.,* 2014). Where species that do not have swim bladders or gas-filled chambers (e.g. sharks, skates, rays, jawless fishes, some flatfish, some gobies, some tuna and others) are less sensitive to sound and less likely to experience adverse effects; these species detect particle motion rather than sound pressure. In contrast, species with a swim bladder (or other gas-filled chamber) are generally more sensitive to sound exposure and more likely to suffer adverse effects.

While avoidance behaviour is possible, it is noteworthy that fish may also be attracted to offshore oil and gas structures; for instance, schooling pelagic fish are commonly observed around the existing well head platforms and FPSOs in the Taranaki Basin, indicating that noise and vibrations involved with the running of these facilities do not displace fish permanently from the area.

As outlined in relation to the potential effects on marine mammals above, the broadband sound levels for DP thruster noise during the decommissioning of the Tui field are expected to be approximately 182.4 dB re 1 µPa at 1 m (MacGillivray, 2006; as cited by MacPherson *et al.*, 2016). Popper *et al.* (2014) noted that there is no evidence of mortality or 'potential mortal injury' to fish from shipping noise and on this basis provide onset threshold guidelines only for recoverable injury (at sound pressure levels of 170 dB rms for 48 hours) and temporary threshold shift (**TTS**) (at 158 dB rms for 12 hours) and only for fish species that rely on their swim bladder for hearing (i.e. pressure detection). Using this information, the following conclusions can be made about the potential effects of underwater noise on fish from the decommissioning of the Tui field:

- Fish mortality or serious injury is not expected; and
- The risk of recoverable injury or TTS, while theoretically possible, is low as fish species which could be present in the IAA are highly mobile (see **Section 4.3.4**) and, given their pelagic nature, are unlikely to remain in close proximity to the noise source for hours at a time.

Consequence – The effects of noise and vibration on fish will be a highly localised, short-term effect with rapid recovery occurring once activity ceases. No mortality or serious injury predicted, and TTS effects are unlikely given the transient nature of pelagic fish in the IAA. Therefore, based on **Table 25**, it is considered that the consequence from noise and vibration generation on fish is *minor*.

Likelihood – It is considered that the likelihood of an impact occurring from the generation of noise and vibrations on fish during the decommissioning of the Tui field is not likely to occur in normal circumstances. Therefore, based on **Table 25**, it is considered that the likelihood is *unlikely*.

As the consequence of the impacts from the generation of noise and vibrations on fish is *minor*, and it is *unlikely* that it will occur, the environmental risk of adverse impacts is assessed as ***low***, and the resultant magnitude of environmental effects predicted to be ***less than minor***.

Planned Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Noise and Vibrations – effects on fish	1 – Minor	3 - Unlikely	3 – Low	Less than minor

Cephalopods

Squid hear sounds by way of statocysts; sensory hair cells responsible for balance. Responses of squid to anthropogenic sounds include statocyst damage (Andre *et al.*, 2011) and alarm responses such as firing of ink sacks, avoidance behaviours, increases in swimming speed, and shifts in metabolic rates (Weilgart, 2018). However, these responses have typically been recorded in studies focusing on seismic surveys, which emit much more intense and explosive sounds compared to those expected from DP use during the decommissioning of the Tui field.

Hearing in octopuses is not well studied, although Kaifu *et al.* (2007) demonstrated responses of octopuses (*Octopus ocellatus*) exposed to sound pressures of 120 dB re 1 µPa. Octopuses responded at frequencies of 50 – 150 Hz in the form of respiratory suppression (i.e. a reduction in mantle muscle movements) and a retraction of their eyes. No response was observed at frequencies of 200 – 1,000 Hz (Kaifu *et al*., 2007).

The response of octopuses and squid to sound stimulus differs on account of their differing lifestyle; as squid are pelagic species, they respond by exhibiting avoidance behaviours, while octopuses have a generally benthic lifestyle and respond to threats by freezing in place (Packard *et al.*, 1990).

Consequence – The effects of noise and vibration on cephalopods will be a highly localised, short-term effect with rapid recovery occurring once activity ceases and there are no predicted adverse effects to populations. Therefore, based on **Table 25**, it is considered that the overall consequence from noise and vibration generation on cephalopods is *negligible*.

Likelihood – It is considered that the likelihood of an impact occurring from the generation of noise and vibrations on cephalopods during the decommissioning of the Tui field is not likely to occur in normal circumstances. Therefore, based on **Table 25**, it is considered that the likelihood is *unlikely*.

As the consequence of the impacts from the generation of noise and vibrations on cephalopods is *negligible*, and it is *unlikely* that it will occur, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Planned Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Noise and vibrations – effects on cephalopods	0 – Negligible	3 – Unlikely	0 – Negligible	Negligible

7.2.3.4.5 Seabirds

Very little information exists about the effects of underwater noise on seabirds (Braun, 2016); with no information available on the potential effects of DP noise on birds. Seabirds have been shown to respond to vessel traffic by avoidance of heavily used areas and disruption of feeding behaviours (Schwemmer *et al.*, 2011; Velando & Munilla, 2011). It is possible that these effects could occur during the decommissioning of the Tui field.

Little blue penguins could be somewhat more vulnerable on account of their restriction to within the water column while at sea. Based on the findings of Pichegru *et al.* (2017), where African penguins avoided foraging near seismic surveys, little blue penguins could avoid foraging in the immediate vicinity of the decommissioning activities on account of noise disturbance from DP thrusters.

In addition, noise generated by helicopters can disturb seabirds during the breeding season when birds are nesting and courting (e.g. Wilson *et al*., 1991). However, there are no seabird colonies within the IAA, and helicopters will not carry out low-altitude flights/take-offs or landing over sensitive onshore areas.

Consequence – The effects of noise and vibration on seabirds will be a highly localised, short-term effect with rapid recovery occurring once activity ceases. Some protected seabird species could be subject to short-term disturbance impacts. Therefore, based on **Table 25**, it is considered that the overall consequence from noise and vibration generation on seabirds is *minor*.

Likelihood – The potential for impacts on seabirds from the decommissioning activities will probably occur in normal circumstances, based on the discussions above. Therefore, based on **Table 25**, it is considered that the likelihood is *likely*.

As the consequence of the impacts from the generation of noise and vibrations on seabirds is *minor*, and it is *likely* that it will occur, the environmental risk of adverse impacts is assessed as ***low***, and the resultant magnitude of environmental effects predicted to be ***less than minor***.

Planned Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Noise and vibrations – effects on seabirds	1 - Minor	*5 – Likely*	5 - Low	Less than minor

7.2.3.4.6 Plankton

Whilst zooplankton do not have hearing structures, they are able to detect changes in surrounding pressure (Richardson *et al*., 2017), hence underwater acoustic disturbance has recently emerged as a topic of discussion within scientific communities. Until recently it was believed that exposure to high intensity acoustic emissions (e.g. seismic surveys) had no significant effects on zooplankton abundance or mortality (e.g. Pearson *et al.,* 1994; Parry *et al.,* 2002; Dalen, 1994; Payne *et al*., 2009), with physiological effects only occurring within metres of the sound source (Payne *et al,* 2009). In contrast, recent work by McCauley *et al.* (2017) has suggested that seismic surveys in particular may cause significant mortality to zooplankton populations out to 650 m from the source. Subsequent studies contradict the findings of McCauley *et al.* (2017) and are more in line with earlier suggestions that the mortality effects of intense underwater noise on zooplankton is limited to approximately 10 m from the source (Fields *et al.*, 2019). In general, it is agreed that this is an area that requires more investigation.

In regard to the decommissioning of the Tui field, the effects of underwater noise on zooplankton is unlikely to be of ecological relevance as:

- The use of DP thrusters has been identified as the most intense source of planned underwater noise (see **Section 7.2.3.4.3**) and sound levels expected from DP use are significantly lower than those associated with seismic surveys (which possibly affect zooplankton abundance nearby). Where the predicted sound exposure level of DP use during the decommissioning of the Tui field is 182.4 dB re 1 µPa at 1 m compared to 260 dB re 1 µPa at 1 m (Hildebrand, 2009) for contemporary seismic surveys; and
- The IAA is in the distal reaches of the Kahurangi upwelling (see **Section 4.2.5**) which is the basis of the primary productivity hotspot for the Taranaki Bight; for this reason, productivity levels within the IAA will be somewhat depleted after traversing the Taranaki Bight. Therefore, although the potential for mortality of zooplankton during the decommissioning of the Tui field cannot be entirely discounted, wide-ranging or population-level effects on zooplankton are unlikely. In addition, movements of water masses from outside the area of disturbance will rapidly replenish any zooplankton populations that may have been depleted by DP use during decommissioning activities.

Consequence – Based on the discussions above, the effects of noise and vibration on plankton will be a highly localised, short-term effect with rapid recovery occurring once activity ceases. Therefore, based on **Table 25**, it is considered that the overall consequence from noise and vibration generation on plankton is *negligible*.

Likelihood – Impacts on plankton from noise generated during the decommissioning activities is not likely to occur in normal circumstances, based on the discussions above. Therefore, based on **Table 25**, it is considered that the likelihood is *unlikely*.

As the consequence of the impacts from the generation of noise and vibrations on plankton is *negligible*, and it is *unlikely* that it will occur, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Planned Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Noise and vibrations – effects on zooplankton	0 - Negligible	*3 – Unlikely*	0 - Negligible	Negligible

7.2.3.5 Use of Explosives

7.2.3.5.1 Overview

Explosives would only be used as a contingency activity (as described in **Section 2.4.8.2**) and within the well itself (i.e. far below the seabed). The location of the explosives placement will depend on the requirements for their use; however, the magnitude of the detonation will be such that it is highly unlikely to be felt at the surface (i.e. seabed) or through the water column.

7.2.3.5.2 Measures to Avoid, Remedy or Mitigate

The following measures will be implemented to avoid remedy or mitigate the effects of the use of explosives during the decommissioning of the Tui field:

- All efforts will be made to undertake decommissioning activities without the use of explosives in the first instance; and
- If explosives are required, their use will be planned, designed and supervised by a team of experts who will ensure that the size of the charge will be minimised whilst still being strong enough to complete the desired task.

Despite the above-mentioned measures to avoid, remedy or mitigate the predicted adverse effects, the following receptors could potentially be impacted by using explosives during contingency activities and a discussion of the potential effects is provided in the subsections below:

- Benthic communities;
- Marine mammals; and
- Fish and cephalopods.

The use of explosives is not expected to have any adverse effects on plankton and primary productivity, seabirds, or the nearshore coastal environment and associated marine communities, and as such they are not considered further below.

7.2.3.5.3 Benthic Communities

As any explosives required will be used down-hole, utilising charges specifically designed for the task at hand, it is considered that most of the noise generated from the explosive charge would emanate out through the walls of the well into the surrounding strata. The sediments at each well location will likely absorb and muffle any sound waves before they reach the seabed.

Invertebrates on the seabed and within the substrate are generally not expected be affected by the detonation of explosives, although minor behavioural changes may occur such as retraction of feeding structures or bodies into shells in response to vibrations. Consequently, if explosives are required, there should be no significant effect on the benthic fauna.

Consequence – Based on the discussions above, the effects from the use of explosives on benthic communities will be a highly localised, short-term effect with rapid recovery occurring once activity ceases. Therefore, based on **Table 25**, it is considered that the overall consequence from the use of explosives on benthic communities is *negligible*.

Likelihood – Impacts on benthic communities from the use of explosives during the decommissioning activities is not likely to occur in normal circumstances due to the depth at which the explosives will be used, and the magnitude of the explosives which would not be felt at the seabed. Therefore, based on **Table 25**, it is considered that the likelihood is *unlikely*.

As the consequence of the impacts from use of explosives on benthic communities is *negligible*, and it is *unlikely* that it will occur, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Contingent Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Contingent activities – effects from explosives on benthic communities	0 – Negligible	3 – Unlikely	0 – Negligible	Negligible

7.2.3.5.4 Marine Mammals

The detonation of explosives results in the release of intense sound pressures which are classed as impulsive and are typically short-lived and characterised by rapid rise times (Simmonds *et al*., 2004). Explosions generally have high source levels, with the exact characteristics of the produced sound varying with the weight of the charge and depth of the detonation (Hildebrand, 2009). The resulting noise and vibrations from the detonation of explosives have the potential for several effects on marine mammals, including mortality, injury, permanent or temporary hearing impairment, and/or behavioural responses. Blast damage to marine mammals would be greatest at close ranges to the detonation (i.e. mortality, injury, PTS) and severity of impact would decrease with increasing distance from the blast as the effects of the shock wave reduce (i.e. TTS, behavioural response).

For planned explosions in the marine environment, specific information (weight of the charge, blast depth and detonation pattern) is typically used to estimate the zone of impact within which permanent hearing damage of marine mammals is expected. However, such assessments are not possible in the case of contingent activities as the type of explosion, depth etc. are unknown until the situation unfolds. It is possible however, to make inferences about potential zones of impact from other projects for which planned underwater explosions have occurred. For instance, drill and blast technology proposed to be used during the construction of the subsea Menai Strait Tunnel in Wales was modelled, with the following maximum injury ranges for the detonation of a single charge at a depth of 10 m below the seabed: 67 m for low frequency cetaceans, 28 m for mid-frequency cetaceans, 109 m for high frequency cetaceans, 42 m for phocids and 14 m for fish (RPS, 2018a). While the Menai Strait Tunnel project is useful to give an indication of the potential impacts on marine mammals from the use of explosives below the seabed, the magnitude of explosives modelled in RPS (2018a), at 3 to 6 kg per charge, was significantly higher than the most likely scenario for the decommissioning of the Tui field at between 3 and 60 g (which will be conducted at a great depth, ~2,600 m below the seabed).

Behavioural responses which could occur beyond the range predicted to cause injury include: no reaction, startle reaction, displacement, attraction, diving, surfacing, schooling, increased respiration, or swimming away from the noise (Nowacek et al. 2007). The intensity of the animal's response can be impacted by several factors such as the intensity of the stimulus, and the individual's species, gender, reproductive status, health and age. Given the one-off nature of any contingent explosive use during the decommissioning of the Tui field, behavioural responses are not expected to cause anything more than a minor disruption to marine mammals, if any response at all.

Consequence – Based on the discussions above, the effects from the use of explosives, if there are any effects at all due to the likely depth (approximately 2,600 m below seabed) at which the explosives may be used, on marine mammals will be a highly localised, short-term effect with rapid recovery occurring once activity ceases. Therefore, based on **Table 25**, it is considered that the overall consequence from the use of explosives on marine mammals is *negligible*.

Likelihood – Impacts on marine mammals from the use of explosives during the decommissioning activities is not likely to occur in normal circumstances due to the depth at which the explosives will be used, and the magnitude of the explosives which would not be felt at the seabed. Therefore, based on **Table 25**, it is considered that the likelihood is *unlikely*.

As the consequence of the impacts from use of explosives on marine mammals is *negligible*, and it is *unlikely* that it will occur, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Contingent Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Contingent activities – effects of explosives on marine mammals	0 – Negligible	3 – Unlikely	0 – Negligible	Negligible

7.2.3.5.5 Fish and Cephalopods

As with marine mammals, any fish near a detonation may be exposed to a pressure wave and could theoretically cause injuries, hearing damage or a behavioural response, where the severity of effects would decrease with increasing distance from the charge. However, the sound modelling results from the Menai Strait Tunnel project (discussed in **Section 7.2.3.5.4** above) suggest the maximum zone of injury for fish would be very small (< 20 m) from explosions occurring below the seabed, so the potential for significant levels of fish mortality or injury are very low, and the consequences of any behavioural responses would be ecologically insignificant.

Consequence – Based on the discussions above, and that in relation to marine mammals, the effects from the use of explosives on fish and cephalopods will be a highly localised, short-term effect with rapid recovery occurring once activity ceases. Therefore, based on **Table 25**, it is considered that the overall consequence from the use of explosives on fish and cephalopods is *negligible*.

Likelihood – Impacts on fish and cephalopods from the use of explosives during the decommissioning activities is not likely to occur in normal circumstances due to the depth at which the explosives will be used, and the magnitude of the explosives which would not be felt at the seabed. Therefore, based on **Table 25**, it is considered that the likelihood is *unlikely*.

As the consequence of the impacts from use of explosives on fish and cephalopods is *negligible*, and it is *unlikely* that it will occur, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Contingent Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Contingent activities – effects of explosives on fish	0 – Negligible	3 – Unlikely	0 – Negligible	Negligible

7.3 Marine Discharge Consent Activities

The environmental risk, and commensurate level of environmental effect on the marine environment associated with the proposed discharge of harmful substances from the decommissioning of the Tui field was assessed following the European Oilfield Speciality Chemicals Association Chemical Hazard and Risk Management (**CHARM**) model and non-CHARM approach where applicable (See **Section 7.3.1.2** for the details on the assessment approach).

The assessment for this consent application has been modelled on the EPA's ERA approach that has been used in the assessment of marine discharge consents applications and relevant variations to existing marine discharge consents, including, but not limited to, the following (all of which have been granted by the EPA):

- OMV New Zealand Limited's Taranaki EAD Programme (EEZ300011);
- OMV GSB Limited's Great South Basin EAD Programme (EEZ200009-2); and
- OMV Taranaki Limited's Māui Field EAD Programme (EEZ200011-2).

This harmful substance ERA has adopted the same information standards as the EPA and is based on ecotoxic and environmental fate data for the most ecotoxic component of each harmful substance (the **active component**). These data were sourced from the:

- SDS for each product (**Appendix B**);
- EPA substance database (Chemical Classification and Information Database (**CCID**));
- European Chemicals Agency registered substance dossier;
- Organisation for Economic Cooperation and Development's website[21] 'eChemPortal';
- Canadian Chemicals website[22]; and
- EPA's ERA for EEZ200009-2.

In addition to the above sources, extra information was provided in confidence to MBIE by a chemical supplier and has been redacted from this consent application and appendices. MBIE understands that the EPA has access to this proprietary information; however, MBIE can provide it on a confidential basis if required.

Appendix J is an important point of reference for this harmful substance ERA as it contains:

- The information on the ecotoxicity and environmental fate of the components of each substance (collated from the information sources listed above) that underpins this assessment;
- The calculations that underpin the hazardous classification of each substance; and
- The non-CHARM assessment calculations.

[21] https://www.echemportal.org/echemportal/substance-search
[22] https://canadachemicals.oecd.org/

This ERA is based on worst-case discharge assumptions which produces worst-case estimates of risk and environmental effects for each discharge scenario, which aligns with the EPA approach used in its previous ERAs. Utilising these worst-case scenarios ensures that there is no underestimation of potential effects, but also deals with the uncertainty around the exact volume, concentration, and frequency of the discharge of each harmful substance. By over-estimating the potential environmental effects using worst-case assumptions, the variability in discharge characterisations that will occur during decommissioning activities is accounted for and removes the risk of the activity being carried out in a way that results in environmental effects greater than predicted.

The results presented in this ERA have been calculated using quantities of harmful substances (and their diluents where applicable) that would be discharged at the worst-case scenario for each activity type where harmful substances may be present and discharged, e.g., the longest production flowline (Pateke-3H) has been utilised for the discharge of biocide inhibited seawater and residual hydrocarbons. Using this methodology allows the results from the assessment to be applicable across the remaining relevant SSI to be recovered.

7.3.1 Environmental Risk Assessment Methodology

7.3.1.1 Harmful Substance Classification

As detailed within **Section 3.3** New Zealand is currently in the process of changing how it identifies and classifies 'harmful substances' in the context of the EEZ Act, from the previous system where substances ecotoxic aquatic organisms/environments were classified as 9.1A, B, C or D, to the GHS 7 system of classification and labelling of chemicals. It is understood that there is a four-year transition period (ending April 2025) between the two systems for suppliers to update to the relevant SDS and labelling.

At the time of preparing this ERA, the suppliers of the chemical substances which are currently classified as harmful under the previous classification system which are proposed to be utilised during the decommissioning of the Tui field, have not yet created and distributed GHS 7 compliant SDSs. Therefore, in order to complete this ERA, the interpretation of whether a chemical is a harmful substance and its associated effects has been based upon the GHS 7 mixture rules.

In addition, the D&D Regulations' definition of harmful substances includes 'oil', which includes residual hydrocarbons that may be discharged from the production flowlines.

7.3.1.2 Overview of CHARM and Non-CHARM Assessments

The CHARM model is limited in the kinds of substances that it can be applied to. Whether the CHARM or non-CHARM approach is to be followed when assessing the risk of a substance depends on various factors. In summary, the CHARM model is not suitable for use with substances that are:

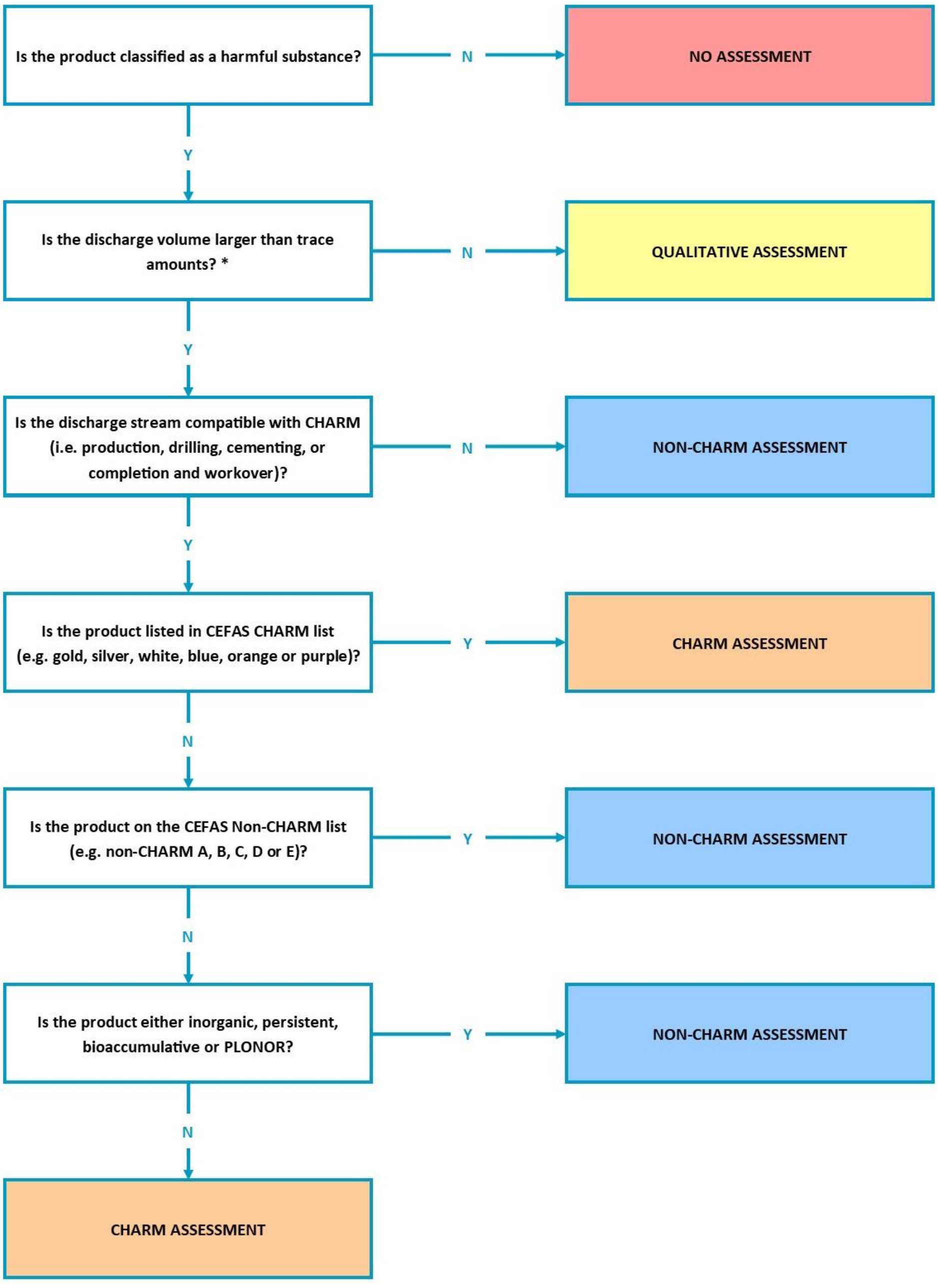
- Surfactants[23];
- Inorganic substances;
- Both bioaccumulative and persistent; or

[23] The CHARM user guide states that the CHARM model is imperfect when used to assess surfactants because of their complex behaviour in the environment. Several calculations in the model are based upon the Log Pow (measure of a substances solubility/ miscibility in fats and water – a proxy measure for a substances bioaccumulative potential), a non-existent parameter for surfactants.

- That are on the List of Substances/Preparations Used and Discharged Offshore which are Considered to Pose Little or No Risk to the Environment (**PLONOR list**)[24].

In the instance that the CHARM model cannot be used the non-CHARM approach is adopted. **Figure 33** provides a flow chart that outlines the steps to determining the appropriate assessment approach for a substance that is hazardous to the aquatic environment.

Figure 33 Decision making flowchart for the CHARM or non-CHARM assessment



* In some instances, very small quantities of substances that are harmful to the aquatic environment (Chronic Category 4) can be qualitatively assessed.

[24] As determined by the OSPAR Commission.

7.3.1.2.1 Calculation of Risk Quotients

Central to both the CHARM and non-CHARM approaches is the calculation of a Risk Quotient (**RQ**) value, which requires dividing the Predicted Environmental Concentration (**PEC**) of a substance by the Predicted No Effect Concentration (**PNEC**) for that substance. The non-CHARM assessment used in this consent application follows the same principles as the CHARM model to generate RQs. However, a further step in the non-CHARM assessment requires consideration of a component's potential to bioaccumulate and persist in the environment.

Both the CHARM and non-CHARM approaches calculate RQs based on the concentration of the active component of a substance (substances are often mixtures of multiple components). For this consent application, unless otherwise specified, when the term 'substance' is used in relation to either assessment approach it is referring to the active component of that substance. The results of the assessment of the active component of a substance are then used to represent the estimated level of risk for the discharge of the entire substance (in the instance that the substance is a mixture).

A PNEC is calculated by applying extrapolation factors to available ecotoxicity data for the active component of a substance[25]. The process for applying extrapolation factors is outlined in Table 2 of the CHARM user guide[26]. Extrapolation factors are selected to account for uncertainties with respect to the relevance of the available data to the situation in the field, and relate to the following variables:

- Extrapolating to a no effect level if the test endpoint does not represent 'no effect' (for example when an LC_{50} or EC_{50} value is available rather than a No Observed Effect Concentration (**NOEC**));
- Extrapolating to chronic exposures when acute data are used to calculate the PNEC;
- Accounting for untested biota groups when data are not available for all three groups of organisms (algae, crustacea and fish); and
- Extrapolating from laboratory to field conditions.

A calculated RQ value greater than 1 indicates that the PEC is greater than the PNEC and environmental effects *may* result from a discharge of the substance. The higher the RQ value, the greater the potential for an adverse effect will be. RQ values greater than 1,000 are generally considered to indicate a very high risk of adverse environmental effects (see **Table 33** for information on the level of risk associated with RQ bands).

Table 33 RQ bands and level of risk ascribed to each band by the EPA in its previous ERAs

Risk Quotient Band	EPA Overall Risk
< 1	Negligible
1 – 30	Very Low
30 – 100	Low
100 – 300	Moderate
300 – 1,000	High
> 1,000	Very High

[25] Active component means the component(s) in a substance that drives the harmful substance classification.
[26] CHARM User Guide V1.5: https://eosca.eu/wp-content/uploads/2018/08/CHARM-User-Guide-Version-1-5.pdf

7.3.1.2.2 Dilution Factors

The CHARM model deals with either continuous or batchwise discharges. According to the CHARM user guide a default dilution factor of 1,000 at 500 m (radius of a circle with an area of 0.785 km^2) from the point of discharge must be applied to continuous discharges.

For batchwise discharges the CHARM model uses dilution factors that are selected from the tables in Appendix III of the CHARM user guide which cater for different discharge rates and discharge volumes for substances with different densities to specify a dilution factor calculated at 1,784 m (radius of a circle with an area of 10 km^2) from the point of discharge.

The dilution characteristics of batchwise discharges differ significantly from those of continuous discharges; hence, a different dilution factor is applied, and different equations are used to calculate the PEC for batchwise discharges (**PEC_{batch}**).

7.3.1.2.3 Extrapolation of Risk Quotients

The CHARM and non-CHARM approaches to extrapolating RQs across uniform areas assume that environmental effects will occur in a linear manner over the entire area within a circle of 0.78 km^2 for continuous discharges, and within a circle of 10 km^2 for batchwise discharges. When in fact any environmental effects will occur along a variable gradient in less uniform areas that are determined by prevailing wind and current conditions.

RQs calculated using ecotoxicity data for pelagic species represent a risk or level of effect of the active component of the substance at a set distance – 500 m for continuous discharges and 1,784 m for batchwise discharges. This means that the concentration of the substance, and therefore the associated risk levels, can be expected to rise with proximity to the point of discharge.

RQs calculated using ecotoxicity data for sediment reworkers[27] represent the average concentration of the substance component in the sediment in an area. Where sediment reworker data are not available, the CHARM model can calculate a PEC for the benthic environment using pelagic data and information on the substances octonol-water partition coefficient (measure of a substances solubility/ miscibility in fats and water- termed Log P_{ow} or Log K_{ow}).

The non-CHARM approach only calculates RQs using data on pelagic species and it is assumed that this RQ produced is also representative of the benthic effects of a discharge. This is a safe assumption as invariably the RQ for the pelagic species is higher than the RQ calculated for the benthic environment. It is understood that this assumption has previously also made by the EPA when carrying out non-CHARM assessments in its ERAs.

[27] Sediment reworker refers to benthic fauna that that carry out bioturbation (the act of aerating sediments by introducing oxygenated water into the sediment via movement through the sediment). This is a key mechanism involved in the aerobic degradation of organic matter in surficial sediments. The CHARM model assumes that a substance in sediment is only exposed to oxygen 10% of the time, and so applies an extrapolation factor of 1,000 to the lowest EC_{50}/LC_{50}.

7.3.1.2.4 Harmful Substance Additives

Once the harmful substances are added to the fluids within their respective discharge routes (biocide inhibited seawater, BOP fluid and cement) they cannot be separated. This means that every time a discharge of an additive (i.e. the harmful substance) is referred to, it is important to note that the discharge includes the specific harmful substance itself, and the larger overall fluid that it is diluted within.

The CHARM model calculates RQs for benthic and pelagic species for the discharge of an additive, including for the continuous discharge of additives and batchwise discharge of additives. The non-CHARM approach also calculates the RQ for continuous and batchwise discharges of additives; however, this approach only calculates RQs using data on pelagic species.

7.3.1.2.5 Assumptions Made in CHARM and Non-CHARM Assessments

The following are assumptions that have been made for the CHARM and non-CHARM assessments:

- In relation to the discharge of the biocide inhibited seawater, the time (T) taken to sever and retrieve the longest production flowline (Pateke 3H) is assumed to be 24 hours. This value has been utilised when determining the discharge rate for biocide inhibited seawater from all of the production flowlines and gas-lift lines. Whereas, in reality, the rates will likely be similar or lower, particularly on the gas-lift CT where the internal diameter of the line is much smaller compared to that of the production flow lines;
- In relation to the discharge of the BOP fluid, the time taken to undertake a BOP test (T) is assumed to be 4 hours, or 0.167 days, as outlined within **Section 2.5.3**. This value has been utilised to determine the discharge rate of the BOP fluid for each time a BOP test is undertaken, rather than the discharge across the entire time it takes to P&A a well as the BOP will spend the majority of its time not discharging any harmful substances and only intermittently discharge during testing operations;
- The residual current speed at the Tui field is assumed to be 0.07 ms^{-1} (MetOcean Solutions, 2018) based on the values provided for in **Table 15**. This value is the lowest modelled near seabed current speed at the Tui field. The near seabed current speed has been utilised due to the location of dominant discharges associated with this consent application. To ensure a worst-case, site specific scenario, the lowest current speed modelled has been utilised rather than the default setting within CHARM of 0.01 m/s;
- Water depth is assumed to be 120 m which is based on the average depth of the seabed sampled during benthic sampling completed in the Tui field in February 2021 as well as from the 2020 ROV Survey;
- Platform density is assumed to be 0.1 MODU per 10 km^2 which is a default value in the CHARM model;
- When determining the batchwise dilution factors for the non-CHARM calculations, the values for density and/or, discharge volume and/or, discharge rate were always rounded up to the next highest value in relevant table in Appendix III of the CHARM user guide;
- The PNEC used in each assessment is calculated following the approach outlined in Table 2 of the CHARM user guide; and
- The RQ in each assessment is always calculated by dividing the PEC by the PNEC.

The CHARM procedure sets out that the highest RQ calculated (based on the active component of the substance) is to be used to describe the overall environmental risks and effects of the discharge of a substance. In practice, this means that if more than one RQ is calculated for a substance (e.g. a benthic and pelagic RQ) it is the highest of these that would be used to describe the overall effects of the discharge of that substance.

7.3.1.3 Differences between MBIE's and EPA's ERA Approach

The ERA approach for the marine discharge consent component of this application aligns closely to the approach that the EPA has used for previous marine discharge consent applications. However, there are two main differences between this ERA and the EPA's which are discussed in the following sections.

7.3.1.3.1 Non-CHARM Calculations

There is no available information on the EPA's non-CHARM calculation method used in previous assessments ERAs to allow for exact replication for this consent application. Therefore, the non-CHARM calculations used in this assessment are outlined below as it is possible that there will be some slight differences between this non-CHARM approach and that followed by the EPA. The non-CHARM calculations carried out for this assessment are provided in the '*Non-CHARM Batchwise*' and the '*Non-CHARM Continuous*' tabs in **Appendix J**. The following sections outline the different calculations used for each non-CHARM assessment.

Non-CHARM Batchwise Calculations

The '*Non-CHARM Batchwise*' tab in **Appendix J** outlines the calculations used to assess the risk of non-CHARM substances. The standard calculations follow a straightforward procedure whereby the concentration of a substance in the discharge is converted to parts per million (**ppm**). The PEC is then calculated by dividing the concentration of the substance in ppm by its corresponding batchwise dilution factor (e.g. X ppm/D_{batch}).

The PNEC is calculated following the procedure outlined in Table 2 of the CHARM user guide, which gives specific instruction on how to apply extrapolation factors to the lowest EC_{50}/LC_{50}/NOEC value, as applicable depending on the available ecotoxicity data for the specific substance.

The RQ is then calculated by dividing the PEC by the PNEC.

Non-CHARM Continuous Calculations

The '*Non-CHARM Continuous*' tab in **Appendix J** outlines calculations carried out to assess the continuous discharge of non-CHARM additives. "Continuous" discharge is in fact a misnomer, as the discharges tend to be intermittent, with the rate of discharge usually being small and the material almost immediately being dispersed and diluted. Due to this, the assessments for BE-9, Erifon HD and residual hydrocarbons have utilised the continuous pathway when the volume of discharge and the discharge rate is known, especially when those volumes/rates fall outside the application dilution factors identified within Appendix III of the CHARM User Guide.

The PEC was calculated by using Equation 17 of the CHARM model (**Figure 34**). This equation uses a number of variables (some of which are outlined in **Section 7.3.1.2.5** and all of which are set out in Table 2 in the '*Non-CHARM Continuous*' tab in **Appendix J**) with some being default values provided by the CHARM model that can be used in the absence of site-specific values and others which must be calculated using other equations outlined in the CHARM user guide.

In each calculation *M* equals the maximum estimated mass (kg) of the particular additive required for the activity being undertaken. The volume of water passing by the installation each day (*Vt*: measured in m^3) was calculated using Equation 16 of the CHARM user guide. The time taken to undertake the specific activity (*T*) was assumed to be one day in relation to the discharge of BE-9 and residual hydrocarbons within the Pateke-3H production flowline, and 0.167 days (or 4 hours) for the discharge of BOP fluid as outlined in **Section 7.3.1.2.5**.

Figure 34 Equation 17 of the CHARM model

$$PEC_{water,cont} = \frac{M}{T \times V_t} \times 10^3$$

7.3.1.3.2 Deriving Effect Levels from RQs

Table 34 outlines the EPA's approach to converting calculated RQs to environmental risk rankings and MBIE's approach to converting the EPA's ERA environmental risk rankings to risks and environmental effect to align with those in **Table 27** and **Table 28**.

It should be noted that the conversion of the EPA's overall ERA risk ranking system to one that aligns with this IA does not down-weight or underestimate any effect levels. The conversion is purely for the purpose of ensuring consistency between the reporting on environmental effects.

Table 34 Comparison of the EPA's ERA overall risk rankings to MBIE's risk ranking and environmental effect magnitude

Risk Quotient Band	EPA Overall ERA Risk	MBIE's Risk Ranking	MBIE's Predicted Magnitude of Environmental Effect
< 1	Negligible	Negligible	Negligible
1 – 30	Very Low	Very Low	Almost Negligible
30 – 100	Low	Low	Less than Minor
100 – 300	Moderate	Moderate	Minor
300 – 1,000	High	High	Significant
> 1,000	Very High	Extreme	Very Significant

7.3.2 Actual and Potential Adverse Effects from Planned Marine Discharge Consent Activities

7.3.2.1 Discharge of Biocide Inhibited Seawater

7.3.2.1.1 Description of Discharge and ERA Pathway

As discussed in **Section 2.5.1**, the production flowlines and gas-lift lines were flushed and displaced with biocide inhibited seawater which will be discharged as part of the retrieval operations of the production flowlines and gas-lift lines. The biocide used in the production flowlines and gas-lift lines was 'BE-9' which is used to retard microbial growth.

BE-9 is classified as being hazardous to the aquatic environment chronic Category 1. Up to a total of 175 L of BE-9 (equivalent to 175 kg with a specific gravity of 1) has been utilised to flush and displace the production flow lines and gas-lift lines, at a dose rate of 8 L of BE-9 per 31,800 L of seawater.

As outlined within **Sections 2.3.2** and **2.3.4**, the retrieval of the production flowlines and gas-lift lines will involve an ROV making several cuts along the length of the lines to aid in the retrieval process. Once these cuts have been made, the CSV will begin retrieving the lines from the seabed which will result in a relatively intermittent discharge from the end of the pipeline resting on the seabed as the head pressure pushes water downwards when the lines come clear of the sea surface. As the final section of the line is retrieved, the CSV would be located directly above the end of the line, at which time the discharge point will slowly get shallower until the end of the line reaches the sea surface.

Although the discharge point will slowly change at the end of the retrieval process as outlined above, a worst-case scenario has been assumed where the entire contents of the longest flowline (the Pateke 3H production flowline with a total quantity of biocide inhibited seawater approximately 290.93 m^3 which includes approximately 73.2 kg of BE-9) at a continuous rate. Retrieval of Pateke-3H production flowline is expected to take 24 hours to complete. Based on this, a discharge rate over the 24-hour recovery period for the Pateke 3H production flowline is calculated as being 12.12 m^3/hr (i.e. 290.93 m^3/24 hr). It is considered that this value is appropriate to utilise for the assessment of this discharge stream as it is based on a realistic retrieval speed of the flowline which equates to a realistic discharge rate. This discharge rate has been based on the longest of the production flowlines, and therefore equates to the highest total volume of BE-9 discharged at any one location. This value has been utilised when determining the discharge rate for biocide inhibited seawater from all of the production flowlines and gas-lift lines. Whereas, in reality, the rates will likely be similar or lower, particularly on the gas-lift CT where the internal diameter of the line is much smaller compared to that of the production flow lines.

7.3.2.1.2 ERA Results

The discharge of the biocide inhibited seawater within Pateke-3H production flowline fluid was assessed using the non-CHARM model, in a continuous discharge method as outlined in **Section 7.3.1.3.1**. The result of this assessment is summarised in **Table 35**.

Table 35 Results of the non-CHARM assessment for biocide inhibited seawater from the Pateke-3H production flowline

Harmful Substance	Assessment Pathway	Maximum Quantity	Volume of Diluent (m^3)	RQ	Magnitude of Effect
BE-9	Non-CHARM continuous	73.2 kg	290.93	0.014	Negligible

As outlined within **Section 2.5.1**, the above results are only based upon the discharge of BE-9 within the Pateke-3H production flowline as this is the largest of the flowlines to be recovered and each of the recovery operations are temporally separate. However, the above results provide an appropriate approximation of the resultant effects from each of the recovery operations. The total volume over the entire decommissioning process is 176 L (176 kg) of BE-9.

7.3.2.1.3 Discussion

Given the fact the end of the lines will be resting on the seabed initially and only rise through the water column in the very last part of the retrieval, any discharge of the biocide inhibited seawater within the lines (either continuous) will primarily affect the benthic species rather than pelagic species.

In this discharge scenario, the specific gravity of the discharge in relation to the receiving environment is important to consider. Due to the dosage rate of the biocide (251 ppm) within the discharge stream, the vast majority of the discharged fluid is seawater at a specific gravity of 1.025. The specific gravity of the combined biocide inhibited seawater can be calculated; however, due to the dilution rate of BE-9 within the biocide inhibited seawater, the specific gravity of the resultant discharge is only slightly less than that of seawater (1.02499). This means that the discharge from the flowlines will be readily mixed with the surrounding seawater and is not expected to sink and settle on the seabed.

In general, substances take up to 10 times longer to breakdown and disperse in the benthic environment than in the water column[28]. The rate of substance breakdown and dispersal in the benthic environment is strongly linked to rate of the successional recolonization and the resulting bioturbation of the sediment (Johnson, 1971, 1972; Nilsson & Rosenberg, 2000).

A key consideration when interpreting the findings is that these results are relevant to the estimated risk level and associated potential ecotoxic effects of the discharge of harmful substances only and not the combined effects of any physical disturbance and associated deposition from the decommissioning activities. Any ecotoxic effects that may occur will likely be outlasted by the physical disturbance resulting from the removal of infrastructure.

It is important to note that the calculated RQ is based on pelagic species but given that the end of the production and gas-lift lines where the fluids are expected to be discharge from are likely to be resting on the seabed for most of the discharge, there is the potential for the discharge of BE-9 to enter the sediment at ecotoxic concentrations.

As covered in **Section 7.3.2.1.2** the calculated RQ for BE-9 in this situation is based on pelagic species and has been assumed to also be representative of the benthic effects of discharging this harmful substance at the seabed. Typically, calculated RQs for pelagic are higher than those for the benthic and thus it is expected that effects to benthic taxa would also be *negligible*. The RQ assumes that the active component of BE-9 is 100% active in the biocide inhibited seawater upon its release into the water column near the seabed. Biocides can stay active for approximately 6 months, or up to 12 months at the outside, and therefore given that a minimum of nine months is likely to have elapsed between the flushing of the lines and their severing and removal (and therefore release of the substance) it is likely that the bulk of the active component will have become inactive by the time it is released.

[28] Section 3.2.1 of the CHARM user guide

Organic substances generally take up to 10 times longer to biodegrade in sediments compared to the water column. Rates of substance biodegradation in sediments, as for dissolution, are also linked with the successional recolonization of sediments by benthic communities. The process of biodegradation is driven by microbial communities which are directly associated with benthic meio- and macrofaunal communities (Kröncke *et al*., 2004). The microbial communities that will drive biodegradation of organic substances in the benthic environment are likely to recover at similar rates to the meio- and macrofaunal communities (Kröncke *et al*., 2004). The dispersal of BE-9 in sediment will be contingent on mechanisms other than biodegradation such as dissolution which increases with bioturbation. Dissolution in sediments is strongly linked with rates of bioturbation because the movement of benthic animals over and through the sediment introduces water into the sediment matrix (Nilsson & Rosenberg, 2000). Rates of bioturbation in areas affected by the discharge of harmful substances will increase with time and space as the concentration of harmful substances and associated level of effect decrease, and the benthic communities begin to return to ambient, undisturbed conditions. The rate of recovery in benthic communities in the marine environment varies significantly with the deeper habitats generally taking longer to recover (Harris, 2014). However, full recovery is not required for rates of bioturbation to increase (Schaanning *et al*., 2008) and subsequently disperse any harmful substances to below ecotoxic concentrations.

The rate of biodegradation of the active component in BE-9 in water is stated to be 0% in 28 days ('persistent[29]' according to the SDS). As the rate of biodegradation in sediment is up to ten times slower than the water column and linked with the recovery of the benthic environment and bioturbation, it is reasonable to expect that where any ecotoxic effects occur in the benthic environment they could last for a number of months. However, BE-9 is not bioaccumulative and as such does not have the potential to concentrate or biomagnify through the food chain.

Any effects that do occur from the discharge of BE-9 could result in some lethal effects on marine species, including on fish/plankton within the water column. The majority of effects will be non-lethal, including the displacement of species and/or ecotoxic reactions in some species and are expected to dissipate to undetectable levels over time, with most of the effects ceasing directly after discharge.

In conclusion, the magnitude of worst-case potential effects of the discharge of BE-9 directly at the seafloor will, at worst, be *negligible* at 500 m from the point of discharge. The majority of these *negligible* effects which will affect benthic species (and/or pelagic taxa in the lowest portion of the water column) and will be patchily distributed along a spatial gradient from the point of discharge. Any effects (if they occur) could persist in the sediment for months until the active component biodegrades or is dispersed via dissolution or bioturbation, with the effects occurring most adjacent to the point(s) of discharge persisting for the longest period of time.

It should be noted here that the calculation of the RQ for continuous discharge of BE-9 from the production/gas-lift lines utilised the lowest monthly mean current speed for the near-seabed strata (0.07 m/s) rather than the default CHARM value (0.01 m/s). Although even at the much slower default current setting the RQ value (0.1) would still indicate a *negligible* level of effect at 500 m.

[29] A given volume of a persistent substance breaks-down at a rate of <70% in 28 days.

7.3.2.2 Discharge of Residual Hydrocarbons

7.3.2.2.1 Description of Discharge and ERA Pathway

As discussed in **Section 2.5.2**, the production flowlines were flushed prior to the disconnection of the FPSO but may contain residual hydrocarbons that could be discharged as part of the retrieval operations of the production flowlines.

The residual hydrocarbons are classified as being hazardous to the aquatic environment chronic Category 1. Up to a total of 171 L of residual hydrocarbons may be discharged from all the production flowlines, with the majority potentially discharged from the Pateke-3H flowline.

The retrieval of the production flowlines will result in a relatively intermittent discharge from the end of the flowline resting on the seabed as the head pressure pushes water downwards when the lines come clear of the sea surface. As the final section of the production flowline is retrieved, the CSV would be located directly above the end of the line, at which time the discharge point will slowly get shallower until the end of the line reaches the sea surface.

Although the discharge point will slowly change at the end of the retrieval process as outlined above, a worst-case scenario has been assumed where the entire contents of the longest flowline (the Pateke 3H production flowline contains 290.93 m^3 of seawater, of which may include 116 L, or 93 kg of residual hydrocarbons) at a continuous rate. Retrieval of Pateke-3H production flowline is expected to take 24 hours to complete. Based on this, a discharge rate over the 24-hour recovery period for the Pateke 3H production flowline is calculated as being 12.12 m^3/hr (i.e. 290.93 m^3/24 hr). It is considered that this value is appropriate to utilise for the assessment of this discharge stream as it is based on a realistic retrieval speed of the flowline which equates to a realistic discharge rate. This discharge rate has been based on the longest of the production flowlines, and therefore equates to the highest total volume of residual hydrocarbons that may be discharged at any one location.

7.3.2.2.2 ERA Results

The discharge of the residual hydrocarbons within Pateke-3H production flowline fluid was assessed using the non-CHARM model, in a continuous discharge method as outlined in **Section 7.3.1.3.1**. The result of this assessment is summarised in **Table 35**.

Table 36 Results of the non-CHARM assessment for residual hydrocarbons from the Pateke-3H production flowline

Harmful Substance	Assessment Pathway	Maximum Quantity	Volume of Diluent (m^3)	RQ	Magnitude of Effect
Residual hydrocarbons	Non-CHARM continuous	93.0 kg[30]	290.93	6.1	Almost negligible

As outlined within **Section 2.5.2**, the above results are only based upon the discharge of residual hydrocarbons within the Pateke-3H production flowline as this is the largest of the flowlines to be recovered and each of the recovery operations are temporally separate. However, the above results provide an appropriate approximation of the resultant effects from each of the recovery operations. The total volume over the entire decommissioning process is 171 L (139 kg) of residual hydrocarbons.

[30] Equivalent to 116 L of residual hydrocarbons.

7.3.2.2.3 Discussion

The results presented in **Table 11** show that the volume, and rates, of residual hydrocarbons that may be discharged from the production flowlines during their retrieval are very small. Under a worst-case scenario, that being the discharge from the Pateke-3H flowline, the rate of residual hydrocarbon discharge would be in the order of 0.0013 L/s, or 116 L/d (noting that it is estimated that it will only take one day to retrieve this flowline) with a hydrocarbon concentration of up to 400 ppm.

Once hydrocarbons are released, they can undergo a wide variety of physical, chemical, and biological changes, referred to as 'weathering'. The rate of weathering depends on the nature of the oil, water temperature, and wave action. As hydrocarbons are less dense than seawater, they will typically migrate upwards to the sea surface where they can evaporate, disperse, and oxidise.

Hydrocarbons within the marine environment can result in potential effects on a variety of receptors. They can destroy the insulating ability of fur-bearing mammals and the water repellent properties of bird's feathers, both of which can cause hypothermia in affected individuals. Mammals and birds may also experience chronic or acute effects if hydrocarbon water is ingested. Fish and benthic biota can come into contact with hydrocarbons if it is mixed into the water column or adhered to seabed sediments. When exposed to hydrocarbons, adult fish may experience reduced growth, enlarged livers, changes in heart and respiration rates, fin erosion, and reproduction impairment. Fish eggs and larvae can be especially sensitive to lethal and sublethal impacts. In a discharge to the marine environment such as that which might occur in the Tui field, the majority of the discharged oil will likely be in the water column. Larger more motile taxa such as fishes would be able to move away from areas where discharged hydrocarbons might be present.

The calculated RQ for residual hydrocarbons in this situation is based on pelagic species and has been assumed to also be representative of the benthic effects of discharging this harmful substance at the seabed. Typically, calculated RQs for pelagic are higher than those for the benthic and thus it is expected that effects to benthic taxa would also be *almost negligible*. Given that the density of the residual hydrocarbons ('Tui Crude Oil') is lower than the surrounding seawater some proportion is likely to begin to float upwards following discharge. This will likely decrease the chances of effects occurring to benthic species and will move the discharged residual hydrocarbons to the more dynamic, high-energy environment at the sea surface which will increase the speed of the substances breakdown compared to remaining on/near the seabed.

MBIE notes that the EPA, in its decision on BWO's second ruling request (EEZ500029), considered the risks associated with spilling 490,000 L of pre-flushed production water within all of the production flow lines within the oil field containing 3% oil in water (i.e. 30,000 ppm), equivalent to 14,700 L of hydrocarbons, to have a 'minor' effect. The EPA noted "*…the majority of effects localised to the water column and surface waters above the compromised flowline"* and *"I do not consider the effects to have population effects on any organisms due the relatively short duration of any spill and relatively rapid recovery time (months) for affected organisms*". The scale of effects of discharging, at most, 171 L of residual hydrocarbons will be significantly lower than the scenario considered by the EPA in EEZ500029.

In conclusion, the magnitude of worst-case potential effects of the discharge of residual hydrocarbons directly at the seafloor will, at worst, be *almost negligible* at 500 m from the point of discharge. The majority of these effects will likely be to pelagic taxa and will be patchily distributed along a spatial gradient from the point of discharge. Some effects (if they occur) could persist in the sediment for months until the active component biodegrades or is dispersed via dissolution or bioturbation, with the effects occurring most adjacent to the point(s) of discharge persisting for the longest period of time. However, given the lesser specific gravity of the residual hydrocarbons compared to the surrounding seawater some proportions of the discharged hydrocarbons may float and result in effects to pelagic taxa within the water column at the point of discharge and higher.

7.3.2.3 Discharge of BOP Fluid

7.3.2.3.1 Description of Discharge and ERA Pathway

As outlined in **Section 2.5.2**, during the P&A operations the BOP is periodically tested as part of its integral safety procedures to ensure all hydraulic valve systems are functioning properly. During each test, or in the unlikely event that the BOP is triggered outside of testing, BOP hydraulic fluids are discharged into the water column approximately 15 m above the seabed. The CHARM model is not designed to assess the discharges from BOPs and therefore the non-CHARM approach was used.

As discussed within **Section 2.5.3**, the harmful substance within the BOP fluid discharge is Erifon HD, which is diluted in water to a 50:1 ratio (i.e. 50 parts water to 1 part Erifon HD). This assessment has been based on a single BOP test which is undertaken over a 4 hour period, however, over the course of the decommissioning of the Tui field, it is estimated that a total of ~36,000 L of BOP fluid will be discharged (this volume includes a 50% contingency to allow for operational/weather downtime). This ~36,000 L of BOP fluid will contain approximately 720 L of Erifon HD.

The harmful substance in the BOP fluid associated with this consent application outlined above was utilised onboard the COSL *Prospector* MODU during recent drilling operations conducted in New Zealand waters, including at the Tui field. In order to cover the possibility that this, or a similar MODU, is used to undertake the P&A in the Tui field, this chemical has been assessed in this ERA. It is worth noting that other BOP fluids could be utilised by different WIV/MODU that contain no harmful substances, in which case there would be no discharges from the BOP that would trigger requirement for marine consent.

Based on the above, a continuous discharge of the BOP fluid has been assessed over the course of a BOP test which takes approximately 4 hours to complete. A continuous discharge is considered appropriate to use in this case as the discharges tend to be intermittent, with the rate of discharge usually being small and the material almost immediately being dispersed and diluted – a point noted in the CHARM User Guide as being a descriptor of 'continuous' discharge (which is really a misnomer).

Further justification of the use of a continuous discharge pathway assessment is the fact that the non-CHARM batchwise model utilises dilution factors obtained from Appendix III of the CHARM User Guide which is bounded by very specific parameters, with discharge volumes of between 3 m^3 and 120 m^3, at discharge rates ranging between 60 m^3/hr and 180 m^3/hr. That is, a 'batchwise' discharge is a short duration, high volume, discharge and 'one-off', rather than regular intermittent discharges such as those that occur from the BOP.

As the discharge of BOP fluid associated with a BOP test will result in up to 2 m^3 of fluid discharged at a rate of 0.5 m^3/hr, this volume and rate doesn't fall within the values specific in Appendix III of the CHARM User Guide. In addition, as the discharge volume and the rate at which it is discharged is known in this instance, a continuous discharge pathway is considered more appropriate and has been utilised for this application.

The calculations for the assessment of Erifon HD are set out in the '*Non-CHARM Continuous*' tab in **Appendix J**. The results are summarised in **Section 7.3.2.3.2**.

Erifon HD is classified as hazardous to the aquatic environment chronic Category 1.

7.3.2.3.2 ERA Results

The discharge of the BOP fluid was assessed using the non-CHARM model in a batchwise as outlined in **Section 7.3.2.3.1**. The result of this assessment is summarised in **Table 37**.

Table 37 Results of the non-CHARM assessment for BOP fluid from a single BOP test

Harmful Substance	Assessment Pathway	Maximum Quantity	Volume of Diluent (m^3)	RQ	Magnitude of Effect
Erifon HD 603 HP No Dye (NZ)	Non-CHARM continuous	40 L	2,000 - Diluted 50:1	0.068	Negligible

As outlined in **Section 2.5.3**, the above results are only based upon the discharge of Erifon HD within a single BOP test activity as this is the largest volume of the substance to be discharged in any single 'function' or 'test' situation. This is considered to be an appropriate approximately of the resultant effects from each of the potential 'function' or 'test'. The total volume of Erifon HD to be discharged over the entire decommissioning process is estimated at 720 L within ~36,000 L of BOP fluid.

7.3.2.3.3 Discussion

The results of this ERA show that the continuous discharge of Erifon HD over the course of a BOP test as having a *negligible* effect (RQ = 0.068) on the marine environment at 500 m from the point of discharge (**Table 37**). It is possible that Erifon HD will not disperse 500 m from the discharge point given that it is denser than seawater (specific gravity of 1.06) and that it will be discharged from the BOP at approximately 15 m above the seabed.

It is likely that most of the potential effects associated with the discharge of Erifon HD will occur well within 500 m and that it will predominantly affect the benthic environment given the near-seabed discharge and specific gravity being greater than seawater. Erifon HD is soluble in water, which means that any discharge will undergo mixing and dilution in the water column before sinking to the seabed. However, given that the active component in in Erifon HD is assumed (due to lack of data) to be persistent (i.e. not rapidly biodegradable), any potential effects could persist in the benthic environment for a period of months. This estimation of the temporal aspects of effects on benthic species is made on the basis that a given volume of a persistent organic substance biodegrades at a rate of < 70% in 28 days and that rates of biodegradation are linked with benthic recovery and bioturbation as discussed in **Section 7.3.2.1.3**.

The active component in Erifon HD is assumed (due to lack of data) to be bioaccumulative. The risk of bioaccumulation and biomagnification through the food-web is extremely low given the low volumes of Erifon HD that will be discharged per BOP test (approximately 40 L), and the fact that for biomagnification in the food-web to occur a continuous source of Erifon HD would need to be available to organisms to ingest over long periods of time. As outlined in **Section 2.5.3**, the BOP will not be discharging for the majority of the time that a BOP is located on a well.

Any effects that do occur from the discharge of Erifon HD could result in some lethal effects on marine species. Small species of fish will likely be the most affected in the water column, and sessile benthic invertebrates being the most affected on the seabed. The majority of effects from the discharge of Erifon HD will be non-lethal, including the displacement of species and/or ecotoxic reactions in some species. These effects will dissipate to undetectable levels over time, with most of the effects ceasing directly after discharges.

7.3.2.4 Discharge of Cement Additives

7.3.2.4.1 Description of Discharge and ERA Pathway

The largest quantity of cement additives that are discharged into the marine environment from the decommissioning activities are discharged in batches (in this case assumed to be up to 10 m^3) from the WIV/MODU in situations where there are excess amounts of cement remaining after cementing activities or if the cement batch characteristics are/become unsuitable for the task at hand.

Unlike the cementing operations in an exploration drilling campaign which can lead to diffuse discharge of substances while the cement sets, the cement plugs associated with the P&A operations are undertaken within the wellbore themselves. The plugs are proposed to be completed at the reservoir level, and at the seabed surface. However, the seabed surface plug is unlikely to contact the seawater in the surrounding environment as at the point the plugged well was cut-off (3 m below seabed surface) the cement within the wellbore would have largely dried/hardened and it would still be below the seabed and buried by the infilling of sediment. As such, and diffuse discharge of harmful substances from the setting of the cement will be very minor.

In addition to the above, there will be very minor trace amounts of harmful substances within the wash water that is discharged following cement operations. As outlined in **Section 2.5.4**, it is expected up to 3 m^3 of wash-water per cement plug will be discharged, or which over 95% will be water, further diluting the volume of harmful substance within the slurry.

As the largest volume of harmful substances discharged as part of cementing operations is associated with the contingent discharge of excess cement, this has been utilised in the following assessment as the worst-case scenario.

The harmful substance within the cement mixture is called 'NF-6' and is a cement defoamer which is added to cement mixes to reduce foaming which can affect the performance of the cement and affect the efficacy of pumping the cement into the wellbore.

Up to 250.4 L of NF-6 could be used and potentially discharged during the P&A of all the wells within the Tui field and has been utilised for this assessment. However, the maximum volume that would be used at any one well is 57 L based on the volume of cement required to safely plug the largest wells (Tui-2H, Amokura-2H and Pateke-3H). This volume of NF-6 is highly conservative as it takes into account a 10% excess in addition to a 50% contingency. Further to this conservative volume, it is highly unlikely that the full volume of NF-6 would be discharged directly into the marine environment from the WIV/MODU as part of a single batch of concrete.

NF-6 is on the OCNS list has a HQ band of Gold and is assessed using the CHARM model. A batch discharge of the full volume of NF-6 for a single well (assumed to be 57 L in this instance) in a 10 m^3 cement batch was assessed using the CHARM model. This assessment also follows worst-case principles as it is unlikely that this full volume of NF-6 would be added to a single cement batch and subsequently discharged in one event.

The SDS for NF-6 does not provide a CAS number for its active component (60% -100% of the product) as it is considered as proprietary information. Information on the ecotoxicity of the active component in Section 12 of the SDS indicates that the active component is not ecotoxic to aquatic organisms. However, an investigation into the ecotoxicity of this substance was undertaken with the chemical supplier who provided further details in confidence which has been redacted in the '*Harmful Substance Ecotox Data*' tab of **Appendix J**[31]. The chemical supplier provided the CAS number for the active component of NF-6 and provided a link to the EPA's webpage that includes ecotoxicity data that suggests the active component in NF-6 is classified as a Chronic Category 2 substance under the GHS 7 classification system. The chemical provider does not consider the active component to be ecotoxic based on its own testing but has adopted the EPAs classification. This is the reason that the Chronic Category 2 classification is inconsistent with the information provided in section 12 of the SDS.

7.3.2.4.2 ERA Results

The discharge of the cementing additives was assessed using the CHARM model in a batchwise method as outlined in **Section 7.3.2.4.1**. The result of this assessment is summarised in **Table 38**.

Table 38 Results of the non-CHARM assessment for cement additives

Harmful Substance	Assessment Pathway	Maximum Quantity	Volume of Diluent (m^3)	RQ	Magnitude of Effect
NF-6	Non-CHARM batchwise	57 L	10	0.21	Negligible

7.3.2.4.3 Discussion

The potential effects of the discharge of NF-6 were assessed as *negligible* (RQ= 0.21) at 1,784 m from the point of discharge (**Table 38**), which indicates that the marine environment beyond 1,784 m of the discharge could be affected in a small but measurable way.

If NF-6 is discharged in a cement batch then the density of that cement batch will result in some ecotoxic concentrations of NF-6 reaching the seabed. The active component in NF-6 is assumed (due to lack of data) to be bioaccumulative but is known to be readily biodegradable. The risk of bioaccumulation and biomagnification through the food-web is extremely low given the low volumes of NF-6 that will be discharged per well (a maximum of 57 L – including excess and contingency), and the fact that for biomagnification in the food-web to occur a constant source of NF-6 would need to be available to organisms to ingest over long periods of time. Any small volumes of NF-6 that remain in the water column at 1,784 m from the MODU will quickly disperse to below ecotoxic concentrations, but any ecotoxic concentrations that reach the seabed could persist for a period of weeks to possibly months. This estimation of the temporal aspects of benthic effects is made on the basis that a given volume of NF-6 is readily biodegradable (at a rate of 67% in 21 days[32]) and that rates of biodegradation and dispersion are linked with benthic recovery and bioturbation as discussed in **Section 7.3.2.1.3**.

[31] This proprietary information has been redacted from this consent application and appendices as it is considered sensitive information. MBIE understands that the EPA has access to this proprietary information; however, MBIE can provide it on a confidential basis if required.
[32] according to Centre for Environment, Fisheries and Aquaculture Science certificate provided by the supplier.

7.4 Potential Adverse Effects on Existing Interests

7.4.1 Liquidators

As per section 59(5)(c) of the EEZ Act, the Marine Consent Authority must not have regard to any effects on a person's existing interest if the person has given written approval to the proposed activity. A written approval has been provided by David Ian Ruscoe and Malcolm Russell Moore, being the Liquidators of TTL (in Receivership and in Liquidation), Stewart Petroleum Co Limited (in Receivership and in Liquidation), and W M Petroleum Limited (in Receivership and in Liquidation) as seen in **Appendix I**. As such, any potential effects on these parties are not considered further.

7.4.2 Taranaki Iwi

MBIE is grateful to Taranaki Iwi for the partnership being built in the context of the decommissioning activities, and for advice that has been (and will continue to be) provided by Taranaki Iwi as to how best to undertake those activities in a way that is respectful of the values that the Iwi hold in the IAA and the coastal marine area more broadly.

As outlined within **Section 4.4**, MBIE engaged Taranaki Iwi to prepare a CIA (included within **Appendix E**) to assess the actual and potential effects on the existing interests of Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi that may result from the decommissioning of the Tui field.

The assessment in the CIA speaks for itself, but key findings and recommendations are summarised in this section. The CIA includes the following overall conclusion:

> *The assessment has been articulated to* He Whetū Mārama *outlining how the cultural values of Taranaki Iwi are able to be expressed through the project. Whilst the proposal is to completely remove all of the remnant infrastructure and plug and abandon the wells the adverse effects of the exploitation of natural resources in the Tui Oilfield on the existing interests of Taranaki Iwi will remain until such time as the mouri of the area is able to rebalance itself. Taranaki Iwi support the expediated removal of infrastructure from Tangaroa and commend MBIE for their commitment towards the outcome. This is balanced with the need to ensure time is provided to ensure cultural expertise is utilised in designing the project and methods to avoid, remedy or mitigate adverse effects that may result from the programme.*

The CIA also included a number of recommendations which were designed to recognise the relationship of Taranaki Iwi to both the environment and area through whakapapa; and the practice of tikanga and kawa, and the application of mātauranga Māori by Taranaki Iwi kaitiaki, to ensure the mouri of the ecosystem and environment. **Table 39** provides a summary of the conclusions and recommendations detailed within the CIA, with MBIE’s response.

Table 39 CIA recommendations and MBIE response

CIA Recommendation	MBIE Response
1. Update the Existing Interests section of the application to provide the greater depth regarding the existing interests of Taranaki Iwi with respect to rangatiratanga and kaitiakitanga.	Actioned - updated Existing Interests section (**Section 5**).
2. Update the Existing Environment section of the application to ensure the description of the current natural environment notes the interconnection between those elements described and tangata whenua through whakapapa.	Actioned - updated Existing Environment section (**Section 4**).
3. Take into account those existing rangatira and kaitiaki interests by structuring whanaungatanga and kaitiakitanga into the programme of works by:	
a. Resourcing consultation with nga iwi o Taranaki.	Actioned and ongoing through partnership/funding agreement including resourcing an Iwi Engagement Lead role, Ohu group and consultation programme.
b. Engaging cultural expertise to develop the proposal.	Actioned and ongoing through engagement of Taranaki Iwi to prepare a CIA and adoption of outcomes for the programme such as complete removal of all subsea infrastructure. Also, the conditions require that the environmental monitoring plan be prepared in consultation with Te Kāhui o Taranaki Trust.
c. Implementing the MBIE recommendations regarding procurement and Māori business.	MBIE is currently undertaking a procurement process to secure suppliers to complete the final two phases of decommissioning. This procurement is being undertaken in accordance with the Government Procurement Rules (https://www.procurement.govt.nz/procurement/principles-charter-and-rules/government-procurement-rules/), including Rule 17 on increasing access for New Zealand businesses, including Māori (https://www.procurement.govt.nz/procurement/principles-charter-and-rules/government-procurement-rules/planning-your-procurement/increase-access-for-new-zealand-businesses/).
d. Monitor the performance of the Tui Decommissioning Project against the targets set in that MBIE advice with respect to Māori businesses.	The procurement process for decommissioning will be undertaken in accordance with the Government Procurement Rules, including evaluation of tenders against Broader Outcomes, developed specific to the Tui Project. The progressive procurement target for MBIE, as a mandated government agency, is that 5% of the total number of procurement contracts are awarded to Māori businesses. MBIE will facilitate formal introductions between selected suppliers and Taranaki Iwi.

CIA Recommendation	MBIE Response
e. Require that any sub-contractor to the project (including current contractors) are operating to the values of the MBIE and Te Kahui O Taranaki partnership. This may require cultural induction of contractors to understand the world view of Taranaki Iwi.	MBIE will facilitate cultural inductions (if required) as part of the partnership agreement with Taranaki Iwi.
4. Take into account those existing rangatira and kaitiaki interests through the Impact Assessment and proffered conditions by:	
a. Implementing a Kaitiaki Forum secured by way of condition of consent.	MBIE and Taranaki Iwi are discussing this recommendation further in context of the existing partnership agreement and exploring options such as whether it is the wider eight Iwi at these forums or expansion of existing Ohu group (which meets regularly) with the addition of two environmental colleagues. The proffered existing interest and reporting consent conditions (conditions 18, 20 and 21) emphasise MBIE's intention to provide up-to-date information on the decommissioning activities to Te Kāhui o Taranaki Trust, as well as provision of monitoring logs and reports throughout Tui field decommissioning. This is aligned with the partnership agreement and is likely to exceed what would usually be achieved solely by a Kaitiaki Forum which might only meet quarterly. MBIE considers this is a more appropriate approach, given the likely short timeframe over which the consented activities would occur.
b. Committing to the co-development of Environmental Monitoring Plan(s) (EMP) for the project with Taranaki Iwi, ensuring our matauranga has the opportunity to inform the data relied upon for the performance of the Consent Holder. Secure this requirement by way of condition of consent.	This recommendation is reflected in proffered consent conditions 7 and 8 which were updated following engagement with Taranaki Iwi on the CIA. The EMP required by Condition 7 will be prepared in consultation with Taranaki Iwi.
c. Consider the length of time consent is applied for to ensure sufficient time is available for the area to re-balance with respect to mouri, this being informed by the EMP, and an adaptive co-management approach.	MBIE has taken this into consideration in determining the duration of consent applied for. Proffered conditions including consent duration are based on other marine consents and marine discharge consents that the EPA has granted under the EEZ Act, namely those for oil and gas exploration activities. For the marine consent, expiry of 31 December 2030 is proposed. The marine consent covers not only the decommissioning activities but also the post-decommissioning monitoring, which includes a seabed sampling event five years after the P&A is completed. A further two years has been sought should there be delays in the decommissioning programme.

The measures by which effects on Taranaki Iwi and commercial and recreational fishing interests (discussed below) will be addressed will also ensure that the decommissioning activities will have no adverse effect on any people exercising other customary activities in the area.

7.4.3 Commercial Fishing

An analysis of the commercial fishing events within the IAA has been provided by FNZ (**Section 4.5.1.1**) which showed that the IAA is not currently of particular importance for commercial fishers with approximately six fishing events over a five-year period (based on a prorated amount), likely due to the Tui Protected Area and the close proximity to oil and gas infrastructure.

The primary adverse effect from the decommissioning of the Tui field on commercial fishing interests is due to the presence of the MODU/WIV when undertaking the P&A activities. Although this may result in some restrictions in the area in which commercial fishers can obtain their quota, this small area is considered to be negligible in comparison to the remaining offshore area in which commercial fishers can operate within. This can be seen in the current situation where, over a five-year period, approximately six commercial fishing events occurred over a 122 km^2 area (being the IAA), compared to the wider Statistical Area 040 including over 6,000 fishing events, even though part of the IAA is fishable (being outside the Tui Protected Area).

Any restrictions associated with the decommissioning of the Tui field will be temporary in nature and will immediately be removed once the work is completed. In addition, once the decommissioning works have been completed, the commercial fishing industry will have additional area to conduct fishing operations once the Tui Protected Area is officially revoked. Therefore, any short-term temporary restrictions will be outweighed by the removal of the current restrictions resulting in positive impacts.

Experience has shown that commercial fishers consider the best mitigation measure that can be implemented is early communication of proposed activities, and as long as the fishers are aware in advance and are kept well informed then they will be able to plan their fishing activities around this.

Consequence – Based on the above discussion, the impacts from the temporary restrictions associated with the decommissioning of the Tui field on the commercial fishing industry will be of a short-term duration, which will immediately recover once operations cease. In addition, due to the small number of fishing events over a five-year period, it is considered that the restrictions placed on the commercial fishing industry will not result in disruption to normal operations. Therefore, based on **Table 25**, it is considered that the consequence of the temporary restrictions to commercial fishers is *negligible*.

Likelihood – The predicted effects from the decommissioning of the Tui field on commercial fishers is *certain* as they are expected to occur. The MODU/WIV will only be on the well locations for the period it takes to P&A the well, once that is complete it will be removed and will not return.

As the consequence of the impacts from the temporary restrictions associated with the decommissioning of the Tui field on the commercial fishing industry is *negligible*, and it is considered the likelihood of occurring is *certain*, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Planned Activities	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Effects
Effects on Existing Interests - commercial fishing	0 – Negligible	6 – Certain	0 – Negligible	Negligible

7.5 Effects on Human Health

The main pathway for potential effects on human health is associated with the discharge of harmful substances. The pathways for effects on human health from the discharge of harmful substances relate to either direct exposure to the discharge or from the consumption of fish caught (either commercially or recreationally) that have been exposed and contaminated by the discharge. Due to the distance offshore, combined with the high-energy and exposed marine environment, the potential interactions between the general public and the activities proposed as part of the decommissioning of the Tui field are significantly reduced.

Any pelagic fish species entering the discharge plume would only experience low-level exposure to a harmful substance within the discharge due to the rapid dilution and dispersion of the harmful substances upon entering the marine environment. The only potential for some form of impact would be if the fish species were located right next to the point of discharge for extended periods of time. The PNECs that were determined for the various harmful substances to be discharged (**Section 7.3.2**) have been based on ecotoxic data which required subjecting the test species to the contaminant for long periods of time (from 48 hours up to 21 days); given the offshore location of the decommissioning activities (and hence any potential discharges), any fish that did show up would be highly mobile, so this constant period of exposure would not occur. Therefore, this means that the risk of bioaccumulation of any harmful substances to offshore fish species around the discharge point is extremely low.

Any potential effects from a harmful substance discharge will be intermittent and timed around removal of production flowlines and gas-lift lines and P&A activities. Any environmental effects will reduce and/or stop once sufficient dilution and dispersion has occurred, which is expected to occur rapidly in the high-energy offshore Taranaki Basin marine environment.

Consequence – Any discharge of harmful substances is not anticipated to impact any commercial fish species. Given the significant distance offshore in the remote exposed location, there is likely to be limited interaction with the general public. As a result, the consequences from the decommissioning activities and discharge of harmful substances on human health would be *negligible*.

Likelihood – The likelihood of any effects on human health from the decommissioning of the Tui field, and associated discharge of harmful substance, is assessed as being *remote* due to the distance offshore, combined with the rapid dilution and dispersion anticipated in the high-energy offshore Taranaki Basin marine environment.

As the consequence of effects from the decommissioning of the Tui field on human health is *negligible*, and it is considered a *remote* likelihood of occurrence, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Planned Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Human health	0 – Negligible	1 – Remote	0 – Negligible	Negligible

7.6 Effects outside the EEZ

The activities involved in the decommissioning of the Tui field will be highly localised, being confined around the locations of the SSI to be recovered and the wells subject to P&A.

The effects from the decommissioning of the Tui field are highly localised, with the maximum extent of the effects from this proposal relating to the seabed disturbance as discussed within **Section 7.2.3.2**. These effects will occur within the delineated IAA which is itself located a significant distance from the boundaries of the EEZ. The closest point of the IAA to the inshore boundary of the EEZ (i.e. the CMA boundary) is over 17 km away. Due to this significant distance offshore, there will be no adverse effects on the marine environment (including existing interests) within the CMA.

Similarly, the planned activities associated with the decommissioning of the Tui field will have no adverse effects beyond the waters of the EEZ and Continental Shelf.

Consequence – Due to the significant distance from the boundaries of the EEZ, the resultant consequence has been assessed as *negligible*.

Likelihood – It is considered that the likelihood of any effects occurring outside of the EEZ is *remote* due to the significant separation distance between the activities and the boundary of the EEZ.

As the consequence of effects from the decommissioning of the Tui field occurring outside of the EEZ is *negligible*, and it is considered a *remote* likelihood of occurrence, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Planned Activity	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Effects outside the EEZ	0 – Negligible	1 – Remote	0 – Negligible	Negligible

7.7 Positive Effects

The decommissioning of the Tui field will result in the following significant positive effects, discussed further below:

- The reduced restrictions on fishing activity in the region, resulting in an increased area for commercial fishers to undertake their activity;
- Economic benefits from the decommissioning activities itself, such as jobs and increase spending on services/equipment;
- Returning the environment within the IAA to a pre-disturbed time once recovery has occurred; and
- Mitigated any risk of hydrocarbon releases from the wells within the IAA due to the appropriate P&A operations.

These positive effects are relevant to most of the sources of adverse effects on the environment and existing interests, listed above, and provide a compelling environmental, cultural, and economic rationale for MBIE to undertake the proposed decommissioning activities.

As discussed within **Section 3.4.5**, the ability for fishing to be undertaken within the Tui field is restricted by the Tui Protected Area. However, once decommissioning of the Tui field has been completed, including any structures located on the seabed associated with the Tui field being removed, the Tui Protected Area (**Figure 17**) afforded by the Submarine Cables and Pipelines Protection (Tui Area Development) Order 2007 will be revoked.. After this has occurred, both commercial and recreational fishers will be positively affected by the proposed activities because they will be able to fish within the Protected Area.

The economic benefits associated with the decommissioning of the Tui field are discussed within **Section 6** and are not repeated here.

Following completion of the decommissioning activities, the surrounding environment will begin to recover, with near seabed currents beginning to smooth out the depressions and disturbance associated with the decommissioning. In addition, the surrounding benthic habitat will begin to recolonise those areas which are currently occupied by the SSI. This recovery will begin once the decommissioning activities cease and will eventually progress towards returning the seabed to a pre-disturbed state.

The decommissioning of the Tui field includes P&A of the Tui wells in accordance with internationally accepted good practice, i.e. in line with the OGUK Well Decommissioning Guidelines (OGUK, 2018) as outlined within **Section 8.3**. These guidelines are the most widely accepted for well abandonments, are the basis of the Tui Project Well Examination Scheme, and as such, have been chosen for the P&A of wells. Once P&A has been completed, the wells will be permanently inoperative and as so far as is reasonably practicable, that fluids cannot escape from the wells or connected strata.

7.8 Potential Cumulative Effects

The potential for cumulative effects is considered with regards to two groups of activities, which are listed as follows, and addressed in the following sections:

- The various planned activities which are subject of this consent application; and
- Other activities occurring within (e.g. fishing and marine traffic) and outside the IAA (e.g. land use, coastal discharges).

7.8.1 Potential Cumulative Effects from Planned Activities

Sections 7.2 and **7.3** assesses the actual and potential impacts of each of the various planned activities on different environmental receptors. **Table 40** presents a summary of the risks and predicted magnitude of environmental effects of each of the planned activities on various environmental receptors. The majority of the effects of individual activities on the environmental receptors range from 'negligible' through to 'less than minor' and, in two instances, 'minor'. There will be additive (cumulative) effects of the various individual planned activities on each environmental receptor; however, it is those proposed activities that result in the greatest, or most likely, potential effect on each environmental receptor which will 'drive' the overall cumulative effects. This is particularly the case when adding those effects which are considered to be 'negligible' as those effects will not increase the likelihood or consequence to any meaningful degree.

For the purpose of this cumulative assessment, the environmental receptors that have been considered are listed below. In addition, a brief description of the 'driver' activity for each has been outlined with a description as to why this activity has been utilised for this assessment.

- Benthic communities – the key 'driver' activity for potential effects on the benthic communities is the direct seabed disturbance associated with the various activities as described in **Section 7.2.3.2**. This activity has been utilised as it is a certainty to occur and will result in the greatest magnitude of potential environmental effects out of all of the activities proposed. It is worth noting that this activity already includes a cumulative assessment of the disturbance activities, i.e. the total area of the disturbance is assessed rather than individual components of the SSI.
- Artificial reef invertebrate assemblages – the key 'driver' activity for potential effects on artificial reef invertebrate assemblages is the removal of the artificial hard substrate that they rely on as described in **Section 7.2.3.3**. This activity has been utilised as it is a certainty to occur and will result in the greatest magnitude of potential environmental effects out of all of the activities proposed. As with the benthic communities, **Section 7.2.3.3** has assessed the removal of the entire artificial hard substrate rather than individual components of the SSI.
- Pelagic environs (including plankton, fish, cephalopods) – the key 'driver' activity for the potential effects on the pelagic environs is the removal of the artificial hard substrate that they rely on, both as shelter and for prey as discussed in **Section 7.2.3.3**. This activity has been utilised as it has the greatest risk and associated predicted magnitude of effect, primarily due to the likelihood of impacts occurring from the removal of artificial hard substrate. As with the benthic communities and artificial reef invertebrate assemblages above, **Section 7.2.3.3** has assessed the removal of the entire artificial hard substrate rather than individual components of the SSI.

- Seabirds – seabirds are affected by the lighting arrangement onboard the vessels (**Section 7.2.3.1.4**); however, due to the mitigation measures in place to reduce this effect (down to an *almost negligible* effect), the key 'driver' activity for the potential effects on birds relates to noise and vibrations, primarily caused by the use of helicopters during the decommissioning of the Tui field as outlined within **Section 7.2.3.4**. This activity has been utilised as it has the greatest risk and associated predicted magnitude of environmental impact of the activities which may impact on birds.
- Marine mammals – The key 'driver' activity for the potential effects on marine mammals is the causing of underwater noise and vibration discussed in **Section 7.2.3.4**. As can be seen in the summary in **Table 40**, there are a number of activities which may result in impacts on marine mammals, such as reduction in prey from seabed disturbance and removal of artificial hard substrate, or from the temporary presence of objects in the water column causing displacement, entanglement or potential ship strikes. However, the cause of underwater noise and vibrations is considered the driver as this activity has the greatest likelihood of occurring, and the resultant risk. In addition, the other activities are not considered to be additive to this impact as the causing of noise and vibrations will effectively reduce the likelihood of other impacts occurring by acting as a deterrent to marine mammals.

The cumulative effects on the various environmental receptors associated with the planned activities are as follows:

Environmental Receptor	'Driver' Activity of Environmental Risk/Effect (i.e. activity with most significant effect on receptor)	Cumulative Effects of Proposed Activities			
		Consequence	Likelihood	Cumulative Risk	Predicted Magnitude of Cumulative Environmental Impact
Benthic communities	Effects associated with seabed disturbance	1 – Minor	6 – Certain	6 – Moderate	Minor
Artificial reef invertebrate assemblages	Effects associated with the removal of artificial hard substrate	1 – Minor	6 – Certain	6 – Moderate	Minor
Marine mammals	Effects associated with noise and vibrations	1 – Minor	5 – Likely	5 – Low	Less than minor
Seabirds	Effects associated with noise and vibrations	1 – Minor	5 – Likely	5 – Low	Less than minor
Pelagic environs	Effects associated with the removal of artificial hard substrate	1 – Minor	5 – Likely	5 – Low	Less than Minor

The following sections provide an assessment of the cumulative impacts of other activities in combination with the planned marine consent activities assessed above. These other activities include other activities associated with this marine consent application (i.e. the discharges associated with the decommissioning of the Tui field) and those that may occur within and outside of the IAA (i.e. marine traffic/fishing vessels causing noise and vibrations).

7.8.1.1 Cumulative Effect of Harmful Substance Discharge

The potential for cumulative effects from the discharge of harmful substances may occur in combination with the other discharges, and/or in combination with the other marine consent activities.

There is a potential for cumulative effects to arise from the proposed discharge of harmful substances if, either simultaneously, or within a short time of one another, and the spatial scale of effects overlap. The CHARM User Guide states "*the toxicity of the individual chemicals can be regarded as independent, and additive or synergistic effects are assumed to be cancelled out by the antagonistic effects. Adding the individual RQs will therefore lead to an overestimation of the environmental risk of the package, especially for large packages*".

The potential for cumulative effects from the discharge of harmful substances is limited due to the type of activities proposed as part of the decommissioning of the Tui field, particularly due to the temporal differences in the proposed activities. The activities subject to this application can be split between the SSI retrieval activities (**Section 2.3**) and the P&A activities (**Section 2.4**). This is also the case with the discharge of harmful substances as they are specifically linked to certain activities, with the discharge of BE-9 and residual hydrocarbons being linked to the SSI retrieval (from the production flowlines and gas-lift lines) and the discharge of BOP fluid/cementing associated with the P&A activities. As these two activities are distinct on a temporal scale, and because the harmful substances that are the subject of this application are not anticipated to persist in the benthic environment (**Sections 7.3.2.1.3**, **7.3.2.3.3**, **7.3.2.4.3**), they are considered separately.

In order to assess the cumulative effects from the discharges associated with the P&A activities (BOP fluid and cement additives), and to continue using the worst-case scenario (bearing in mind the CHARM User Guide statement above) the sum of the RQs for these substances is assumed to be additive. The sum of the RQs for these harmful substances is 0.278 which equates to a predicted magnitude of environment effect of *negligible* as per **Table 34**. The CHARM User Guide utilises a radius of 1,784 m from the discharge for batchwise discharges and 500 m for continuous discharges. It is also assumed that the level of cumulative effect that could theoretically be experienced is also at 500 m from the point of discharge, with those effects from the batchwise discharge of cement additives (NF-6) being more concentrated in that 500 m radius than expressed in the RQ calculated for that substance. However, the cumulative magnitude of environmental effect of *negligible* is considered to still represent the overall effect on the ecosystem around each well that requires P&A activities.

The retrieval of the SSI will potentially result in both BE-9 and residual hydrocarbons being discharged at the same time. The cumulative effects of these discharges using the worst-case scenario (bearing in mind the CHARM User Guide statement above) is assessed as being the sum of the RQs. The sum of the RQs for BE-9 and residual hydrocarbons from the Pateke-3H production flowline is 6.1 which equates to a predicted magnitude of environment effect of *almost negligible* as per **Table 34.**

Due to the timing differences in recovering the production flowlines and gas-lift lines (i.e. all of the lines wouldn't be retrieved at the same time), cumulative effects from the discharge of BE-9 and residual hydrocarbons would only result due to the potential spatial overlap of these discharges. The discharge point from each of these lines will be in the vicinity of the MWAs due to the methodology of recovering the lines (**Sections 2.3.3** and **2.3.4**). These MWAs, and therefore the discharge points, are located between 50 m and 175 m apart, which means that some spatial overlap may occur based on the radius of impacts associated with the non-CHARM model (i.e. 500 m). However, this spatial overlap will be reduced due to the refresh rate at which the area will receive over the timeframe it the discharge of biocide inhibited seawater occurs. The potential for cumulative effects from the discharge of BE-9/residual hydrocarbons and seabed disturbance from the retrieval of the SSI is reduced due to:

- The specific gravity of the residual hydrocarbons discharged is less than seawater, meaning it will likely rise within the water column;
- The bulk of the ingredient of BE-9 is likely to have become inactive by the time the lines are retrieved (**Section 7.3.2.3**);
- BE-9 is not bioaccumulative (Log Pow = <3) as per the SDS; and
- The specific gravity of the discharge of biocide inhibited seawater will likely readily mix in the water column once discharged.

Although there is unlikely to be a temporal overlap in the discharges of BE-9 and residual hydrocarbons, to determine the worst-case potential cumulative effects it has been assumed that each of the lines are retrieved at once. As per the discussion above regarding the discharges from the P&A activities, even if these discharges occurred from the same point, utilising the additive approach, the resultant RQ would still only be 24.6 (based on four production lines each with a RQ of 6.1, being the RQ calculated for residual hydrocarbon discharges from the Pateke-3H production flowlines, plus eight lines (four production flowlines and four gas-lift lines) each with an RQ of 0.014, being the RQ calculated for BE-9 discharges from the Pateke-3H production flowline). This overall RQ is an extreme over exaggeration as the RQs used are based on the discharge from the largest production flowline with the highest concentration of residual hydrocarbons (i.e. Pateke 3H). Nevertheless, the cumulative magnitude of environmental effect is *almost negligible*.

7.8.2 Potential Cumulative Effects from Other Activities within the IAA

Cumulative effects may occur between activities associated with the decommissioning of the Tui field and other marine activities that occur inside and outside of the IAA. The other activities that may occur within the IAA include marine traffic and commercial fishing and are discussed in the following section.

Terrestrial activities which have the potential to give rise to cumulative effects on the marine environment are those associated with land use, such as farming, industrial activities, and the discharge of storm water and wastewater. However, given the IAA is a significant distance offshore and there is a large body of high-energy coastal water between the IAA and any terrestrial activities that may introduce harmful substances into the marine environment, any contribution to cumulative effects is very unlikely due to the spatially restricted discharges associated with this consent application and are not considered further.

7.8.2.1 Marine Traffic and Commercial Fishing

7.8.2.1.1 Noise and Vibration

Marine traffic and commercial fishing are responsible for significant noise input into the marine environment. Vessel noise is low frequency and propagates effectively over long distances. However, as explained in **Section 7.2.3.4**, there are no dedicated shipping lanes around New Zealand which results in vessels generally travelling to/from or between ports utilising the most direct and shortest route possible, provided it is safe to do so, and the IAA is not heavily utilised by the commercial fishing industry (**Section 4.5.1.1**). Due to the IAA being located a significant distance offshore and, for the most part, contained within the Tui Protected Area, it is likely that marine traffic avoids this particular area. In addition, the precautionary around that was established in the offshore Taranaki area requires all ships passing through this area navigate with particular caution.

The 'background' noise levels associated with busy shipping areas is known to affect the communication calls between marine mammals due to 'masking', whereby calls are not as easily heard above the noisy background. Masking is a complex phenomenon and masking levels are difficult to predict for any particular combination of sender, environment, and receiver characteristics (Erbe *et al*., 2016). In the presence of constant noise, marine mammals sometimes adapt their vocalisations in order to overcome the effects of masking (e.g. McGregor *et al*., 2013).

The cumulative effects of exposure to multiple sound sources may be more relevant at the population level on a chronic basis than at the individual level on an acute basis (Ellison *et al*., 2016), and therefore introducing short-term (acute) vessel noise to an area that has existing background noise from operational activities is unlikely to impact marine species at the population level.

Marine environments differ in their resilience to anthropogenic stressors (Ban *et al.*, 2010), and the potential for cumulative effects is likely to be related to physical features such as water depth, seabed characteristics and coastline shape. A higher risk from noise is evident in shallow waters and enclosed bays where the attenuation potential is lower, whereas open-water areas, as in the IAAs, allow sound to dissipate more rapidly and therefore the risk is lower.

Consequence – Potential cumulative effects are associated with noise and vibration from activities associated with the decommissioning of the Tui field and marine traffic/commercial fishing would be short-term in nature and would cease once the vessel has passed by. As such, any overlap in noise is not expected to have any adverse effects to marine mammal or fish populations in the area. As a result, the consequences would be *negligible*.

Likelihood – The likelihood of any cumulative effects from marine traffic/commercial fishing and the activities associated with the decommissioning of the Tui field has been assessed as *remote* as the proposed decommissioning activities are temporary, marine traffic/commercial fishing will be very limited throughout the IAA, and if it does occur, it will be transient and only within the noise and vibration envelope of the decommissioning activities for a short period of time.

As the consequence associated with the effects of marine traffic/commercial fishing and noise and vibration having a cumulative effect is *negligible*, and it is considered a *remote* likelihood of occurrence, the environmental risk of adverse impacts is assessed as ***negligible***, and the resultant magnitude of environmental effects predicted to be ***negligible***.

Cumulative Effect	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Maritime traffic and commercial fishing - noise and vibration	0 – Negligible	1 – Remote	0 – Negligible	Negligible

7.8.3 Potential Cumulative Effects on Environmental Receptors from Planned Activities and Other Activities

Section 7.8.1.1 identifies the cumulative effects associated with other activities associated with the decommissioning of the Tui field (being the discharge of harmful substances) and **Section 7.8.2** identifies the cumulative effects of other activities occurring within and outside the IAA not associated with the decommissioning of the Tui field.

The risks and magnitude of these effects have been assessed as 'almost negligible' but, despite this, these activities do contribute additional effects on the various environmental receptors that are already predicted to be affected by the planned activities (**Section 7.8.1**)

These additional effects are almost negligible and do not increase the overall magnitude of effect determined for the 'driver' activity – that is, they do not result in the overall magnitude of effects to increase to a higher category. The following table presents the overall cumulative effects assessment on the various environmental receptors, this being the combined effects of the proposed activities plus the discharge of harmful substances, plus other activities not associated with the decommissioning of the Tui field.

Environmental Receptor (including 'Driver' of effect of proposed activities)	Cumulative Effect of the Planned Activities on Receptor	Cumulative Effects of Other Activities		Overall Cumulative Effect on Receptor
		Effect of Discharge of Harmful Substances	Effect of Marine Traffic – Noise/Vibration	
Benthic communities (effects associated with seabed disturbance)	Minor	Almost negligible	N/A	Minor
Artificial reef invertebrate assemblages (effects associated with the removal of artificial hard substrate)	Minor	Almost negligible	N/A	Minor
Marine mammals (effects associated with noise and vibrations)	Less than minor	Almost negligible	Negligible	Less than minor
Seabirds (effects associated with noise and vibrations)	Less than minor	Almost negligible	Negligible	Less than minor
Pelagic environs (effects associated with the removal of artificial hard substrate)	Less than Minor	Almost negligible	Negligible	Less than Minor

7.9 Unplanned Events

7.9.1 Introduction

Unplanned activities are those that are unintended and do not constitute activities for which marine consent or marine discharge consent is sought. Unplanned activities include:

- Dropped objects (from vessels or a MODU);
- Vessel strikes with marine mammals; and
- Release of hydrocarbons from a well due to P&A failure or blowout.

An IA needs to assess the potential effects associated with unplanned events, but only if the unplanned event results in a 'high potential impact'. This requirement comes from the definition of 'effect' in section 6 of the EEZ Act which includes 'any potential effect of low probability that has a high potential impact'. Of the unplanned events listed above, only vessel strikes with marine mammals has the potential to result in a high impact and these effects have been assessed in **Section 7.2.3.1.3**. The following sections discuss the two other unplanned events that could occur which may results in potential impacts and explains why these impacts are not considered to be 'high' (meaning they do not fall under the definition of an 'effect' under the EEZ Act).

7.9.2 Dropped Objects

There is a remote possibility that an object, such as an item of equipment being recovered from the seabed, is accidently dropped and falls back to the seabed during the decommissioning activities. This could potentially occur due to failure of the lifting equipment, rigging, or the item being recovered.

There are many processes in place to reduce the likelihood of this occurring, including certification of equipment, lifting plans and procedures, safe lifting zones (away from assets such as wellheads), and safe operating thresholds (weather conditions). In the unlikely event of a dropped object, every effort will be made to identify the cause of the failure and safely recover the object.

The primary potential effect of dropped objects on the seabed relate to disturbance and would most likely be crushing of benthic organisms. However, the area affected would not be large, resulting in a 'negligible' adverse effect (and would certainly not constitute a 'high' impact to the environment).

7.9.3 Discharge of Hydrocarbons from a Well

This section discusses the potential of a release of hydrocarbons from any of the wells, including as a result of a P&A failure or a blowout. There is essentially an extremely low risk of such a release of hydrocarbons from the wells because:

- Multiple well barriers are in place;
- There is no sustained pressure in the Xmas Trees;
- There are no hydrocarbons presently in any tubing;
- The surface-controlled subsurface safety valves have been tested and are in place;
- When wells were producing there was a 97% - 98% water cut, meaning that the hydrocarbon content is very low at only between 2-3%; and

- The wells have been producing for over 12 years and are now under pressured, therefore they are not able to flow without the use of gas lift. If there was a leak of oil from a well, the well would be killed by sea level hydrostatic pressure.

The first four listed items were recently executed and verified as part of preparation for FPSO disconnection and demobilisation. Based on this information, and findings from a general visual inspection of the Tui field during the 2020 ROV survey, annual well examination certificates have been issued for each well by an independent well examiner.

A loss of well control during P&A activities has been determined as extremely unlikely. The highest exposure in terms of a release of hydrocarbons would be during well intervention activities; however, there is essentially an extremely low risk of any such releases for the same reasons as bulleted above, plus:

- There is no 'drilling' proposed and this eliminates any risks of drilling into a new (pressurised) reservoir;
- The P&A programme involves intervention on existing wells, meaning that the BOP, Xmas Tree, wellhead, and casing strings are already in place prior to entering the well, with known barriers;
- A conservative approach will be taken when intervention on wells occurs to further reduce the likelihood of a loss of well control, namely:
    - Fluid densities will be maintained above the maximum expected reservoir pressure;
    - There are significant redundancies in the BOP (seven potential barriers in the BOP);
    - All critical personnel must hold valid Well Control Certificates; and
    - Well control training drills and exercises will be carried out regularly (including regularly function testing of the BOP).
- The P&A programme includes development of a well control plan; and
- A well control insurance policy will be in place.

Further, the mitigation measures for a P&A failure, in addition to the wells being unable to flow without the use of gas lift, include following international best practice (i.e. OGUK standards which are widely accepted guidelines for well abandonments), verification of cement plugs (discussed in **Section 2.4.6.1**), compliance with a well control plan (prepared in conjunction with the successful tenderer along with MBIE) and use of appropriately skilled and competent suppliers to design the P&A programme and execute the work.

Based on the above MBIE contends that no hydrocarbons could be released from any of the wells, and there is certainly no chance of a 'high potential impact' occurring as a result of hydrocarbon releases from any well.

7.10 Summary of Mitigation Measures

Again, the proposed decommissioning activities will have significant benefits for the environment and existing interests, summarised in **Section 7.7**.

In terms of managing adverse effects, operations associated with the decommissioning of the Tui field will be conducted to ensure that all risks to the environment are managed to a level that is ALARP through the adoption of an extensive suite of control measures, design considerations and operational procedures. The measures to avoid, remedy or mitigate each specific potential environmental effect have been listed throughout this section and are summarised below:

<u>Mitigations relating to the temporary presence of objects in the water column:</u>

- Activities associated with decommissioning will be temporary and of short-term duration;
- Decommissioning activities will be undertaken in the shortest amount of time possible, to minimise the duration for which objects occur in the water column;
- Decommissioning activities will occur in highly localised area as defined by the IAA, and the marine space occupied by objects in the water column will be miniscule compared to the available marine habitat in the region;
- Mooring lines/chains associated with the MODU will be heavy gauge and will typically be maintained under tension;
- All items placed in the water column will be removed once decommissioning activities are complete;
- The transit speed of support vessels will be relatively low (approximately 11 knots);
- Vessel crews will be vigilant for marine mammals and will comply with the MMPR;
- All food waste will be comminuted before being discharged overboard to avoid attracting seabirds;
- Deck light use (at night and during fog) will be limited to the minimum required for safe navigation and operation of vessels;
- Deck lights will be directed downwards onto work areas and shielded to reduce peripheral light emissions and reduce the potential for bird strike;
- Vessel crews will be required to record any marine mammal observations and record them on the DOC Marine Mammal Observation forms; and
- Vessel crews will record any seabird vessel collisions or interactions.

<u>Mitigations relating to seabed disturbance:</u>

- Activities associated with decommissioning will be temporary and of short-term duration;
- Decommissioning activities will be undertaken in the shortest amount of time possible, to minimise the duration for which seabed disturbance will occur;
- Decommissioning activities will occur in highly localised area as defined by the IAA and the area of seabed disturbance will be smaller still (~0.12% of the IAA);
- The spatial extent of disturbance to the seabed will be limited to the minimum required in order to complete the operations;
- All items placed on the seabed will be removed once decommissioning activities are complete;

- ROVs will attempt to operate at a suitable distance above the seabed to minimise sediment disturbance, except for when seabed contact or disturbance is planned and necessary;
- All ROV works will be undertaken by appropriately trained and experienced ROV operators;
- Pre- and Post-decommissioning environmental monitoring will be undertaken to assess the extent of the seabed disturbance and to monitor the recovery of the benthic marine environment and determine any changes in the sediment physico-chemical properties within the IAA;
- Experienced personnel in deep-water sampling with quality control procedures in place will be carrying out the environmental monitoring programme;
- All equipment utilised for the environmental monitoring programme will be appropriately inspected, tested, and maintained to ensure its integrity;
- Deployment of the sampling equipment used during the environmental monitoring programme will be undertaken in a controlled manner to avoid any deployment wakes and to allow mobile species time to avoid the descending sampling equipment; and
- Seabed imaging equipment used during the environmental monitoring programme will be deployed in a manner that avoids contact with the seabed as far as practicable.

Mitigations relating to removal of artificial hard substrate:

No measures will be implemented to avoid, remedy or mitigate the effects of removal of the artificial hard substrate that has been provided by the SSI within the Tui field, as this effect is intrinsically linked to the purpose of the decommissioning.

Mitigations relating to noise and vibrations:

- Activities associated with decommissioning will be temporary and of short-term duration;
- Decommissioning activities will be undertaken in the shortest amount of time possible to minimise the duration of underwater noise disturbance;
- Decommissioning activities will occur in highly localised area as defined by the IAA; although underwater noise may propagate beyond the IAA boundaries; and
- Helicopter use will comply with the MMPR and flight paths will avoid seabird breeding colonies and New Zealand fur seal haul-out locations where possible.

Mitigations relating to the contingent use of explosives:

- All efforts will be made to undertake decommissioning activities without the use of explosives in the first instance; and
- If explosives are required, their use will be planned, designed and supervised by a team of experts who will ensure that the size of the charge will be minimised whilst still being strong enough to complete the desired task.

Mitigations relating to planned discharges:

- The flushing of the production flowlines and gas-lift CT was undertaken to remove as much of the hydrocarbons as possible so as to minimise the hydrocarbons to be released from the flowlines during the decommissioning activities;
- Cement volumes will be specifically calculated to minimise excess cement remaining; and

- Cement will be specifically formulated to ensure it is suitable for the plugging operations which reducing harmful substances as far as practicable.

In addition to these specific mitigation measures a large number of additional measures will also be implemented to reduce health and safety risks and to further reduce potential environmental risks associated with the decommissioning of the Tui field. These measures are listed below:

<u>Compliance with relevant marine management regimes:</u>

- MARPOL and Marine Protection Rules Part 130A and 123A requiring all vessels (including the MODU) involved in the decommissioning of the Tui field to have an approved and certified Shipboard Marine Pollution Emergency Plan and an IOPP Certificate;
- Maritime Protection Rules Part 131 requirement for offshore installations, e.g. a MODU, to not be operated without an approved OSCP;
- HSWPEE Regulations (regulation 72) requires a drilling contractor to prepare an emergency response plan and submit a copy to WorkSafe New Zealand for a non-production installation, i.e. a MODU;
- A rig/unit specific Safety Case will be prepared by the MODU operator and submitted to WorkSafe New Zealand for approval prior to the commencement of operations of the MODU (if necessary);
- All vessels entering New Zealand waters (if not already in the country) as part of the decommissioning of the Tui field will adhere to CRMS and the IHS;
- All vessels associated with the decommissioning of the Tui field (including MODU and any support vessels) will be subjected to a hull inspection. If required, a Craft Risk Management Plan will be prepared and submitted to Biosecurity New Zealand for approval; and
- If transportation of the MODU via a heavy-lift vessel is required, the time in transit to New Zealand and the fact that the MODU will be exposed to air on the back of the heavy lift vessel, will likely result in the removal/killing of any non-invasive marine species that might have been present on the hull or structures.

<u>Compliance with relevant best practice or standard operating procedures:</u>

- All personnel using equipment will have the appropriate training and qualifications (where appropriate);
- All equipment used for the decommissioning of the Tui field will be inspected, tested and maintained as per the relevant maintenance system requirements and in accordance with applicable industry standards to ensure its integrity;
- Lifting and bulk transfer operations will be undertaken following Standard Operating Procedures;
- All lifting equipment will be tested and certified, and inspected prior to use, including checking the lifting capabilities of any machinery being use (e.g. cranes) and all loads will be checked for correct size, weight, packaging and item security before any lift commences;
- Lifting/landing areas and routes will be kept clear of personnel, so no one is placed under a suspended load;
- All objects (where practicable) that are dropped/fall into the sea will be located by the ROV and retrieved if safely feasible. Any significant objects unable to be recovered must be reported to the EPA and if they remain floating other notifications may be needed (e.g. MNZ); and

- Engagement with iwi will be ongoing throughout the decommissioning of the Tui field.

Navigational safety:

- The Tui Protected Area is currently in place around the SSI and the majority of the wells associated with this consent application;
- A Notice to Mariners will be broadcast on maritime radio and emailed to all registered recipients every two weeks to advise of the presence of the MODU/WIV;
- At all times the support vessel(s) are on location they will be adhering to the COLREGS, maintaining a visual watch and undertaking a full radar scanning watch for the presence of any other vessels in close proximity or any vessel on a course heading towards the MODU/LWIV;
- The vessel(s) will scan VHF and SSB radio on the local working channel as well as monitoring emergency Channel 16 and SSB 2182 for contact with any other vessels in the vicinity;
- Appropriate day shapes (such as 'Restricted in its Ability to Manoeuvre' for vessels carrying out refuelling operations) and lights will be displayed;
- The CSV, MODU/WIV and support vessels will have AIS. The AIS will transmit key information from the MODU and support vessels (i.e. vessel position, type, identity, speed, course etc.); and
- Commercial fishing interests will continue to be consulted with in regard to the decommissioning of the Tui field and will be notified of the timings of operations (commencing and completing).

Oil spill prevention and response:

- Refuelling (applicable to MODU only) will only be undertaken during daylight hours and in appropriate weather conditions (as determined by vessel masters);
- Transfer hoses will be fitted with 'dry-break' couplings (or similar) and only certified hoses will be used. This equipment will be routinely checked for integrity;
- In the event that a spill occurs during refuelling, a spill response will initially be undertaken in accordance with the relevant Shipboard Marine Pollution Emergency Plan, and notifications will be provided to MNZ and the EPA via MNZ's Response Coordination Centre, and relevant regional councils as required;
- Spill response kits will be located and maintained on-board the MODU in close proximity to hydrocarbon bunkering areas; and
- MNZ's spill-response equipment and personnel will be mobilised if required.

Appendix A outlines the conditions proposed to ensure that the effects associated with the decommissioning of the Tui field on the environment and existing interests are mitigated to the extent that they are temporary and no more than minor.

7.11 Summary of ERA Results

The assessment of potential environmental effects and the significance of their effects has drawn on reported literature for potential environmental effects in combination with and benthic sampling results related to the IAA where applicable, and in accordance with the EEZ Act and other relevant legislation. Based on this, an ERA was completed as described in **Sections 7.2.1** and **7.3.1**, with the outcome being summarised in **Table 40** below.

Table 40 Summary assessment of risks and associated magnitude of environmental impacts from the marine consent activities

	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Temporary presence of objects in the water column – displacement or entanglement effects on marine mammals	1 – Minor	1 – Remote	1 – Very low	Almost Negligible
Temporary presence of objects in the water column – ship strike effects on marine mammals	1 – Minor	1 – Remote	1 – Very low	Almost Negligible
Temporary presence of objects – effects on seabirds	1 – Minor	2 – Rare	2 – Very low	Almost Negligible
Seabed disturbance – effects on the benthic communities	1 – Minor	6 – Certain	6 – Moderate	Minor
Seabed disturbance –effects on marine mammals	1 – Minor	3 – Unlikely	3 – Low	Less than minor
Removal of artificial hard substrate –effects on artificial reef invertebrate assemblages	1 – Minor	6 – Certain	6 – Moderate	Minor
Removal of artificial hard substrate –effects on fish and cephalopods	1 – Minor	5 – Likely	5 - Low	Less than minor
Removal of artificial hard substrate – effects on marine mammals	1 – Minor	5 – Likely	5 - Low	Less than minor
Noise and Vibrations – effects on marine mammals from underwater noise	1 – Minor	5 – Likely	5 – Low	Less than minor
Noise and Vibrations – effects on marine mammals from helicopter noise	1 – Minor	4 – Possible	4 – Low	Less than minor
Noise and Vibrations – effects on fish	1 – Minor	3 - Unlikely	3 – Low	Less than minor
Noise and vibrations – effects on cephalopods	0 – Negligible	3 – Unlikely	0 – Negligible	Negligible
Noise and vibrations – effects on seabirds	1 - Minor	5 – Likely	5 - Low	Less than minor
Noise and vibrations – effects on zooplankton	0 - Negligible	3 – Unlikely	0 - Negligible	Negligible
Contingent activities – effects from explosives on benthic communities	0 – Negligible	3 – Unlikely	0 – Negligible	Negligible

	Consequence	Likelihood	Risk	Predicted Magnitude of Environmental Impact
Contingent activities – effects of explosives on marine mammals	0 – Negligible	3 – Unlikely	0 – Negligible	Negligible
Contingent activities – effects of explosives on fish	0 – Negligible	3 – Unlikely	0 – Negligible	Negligible
Other				
Effects on Existing Interests - commercial fishing	0 – Negligible	6 – Certain	0 – Negligible	Negligible
Human health	0 – Negligible	1 – Remote	0 – Negligible	Negligible
Effects outside the EEZ	0 – Negligible	1 – Remote	0 – Negligible	Negligible
Cumulative effects				
Discharge of harmful substances	0 – Negligible	1 – Remote	0 – Negligible	Negligible
Maritime Traffic - Noise and Vibration	0 – Negligible	1 – Remote	0 – Negligible	Negligible

This ERA uses the best available information and deals with the uncertainty in specific details on discharge characteristics by adopting worst-case assumptions which produces worst-case results for each discharge that is assessed. The worst-case potential effect out of all the discharge scenarios is *almost negligible* based on the discharge of residual hydrocarbons (**Section 7.3.2.2**). The remaining discharges of harmful substances have all resulted in a *negligible* effect.

All predicted potential ecotoxic effects will be temporary and at worst, could last for a number of months in the marine environment. Any effects that do arise will be patchily distributed along a spatial and temporal gradient from the WIV/MODU, flowline end and wellhead. Once decommissioning operations stop, the gradient of effects in the water column quickly disperse as discharges will no longer be occurring. The gradient of effects that will exist in the benthic environment will take longer to disperse and will be linked with the rate of recolonization of the sediment around the wellhead. A summary of the ERA results is included within **Table 41**.

Table 41 Summary assessment of RQs and associated magnitude of environmental impacts associated with the discharge of harmful substances

Planned Marine Discharge Consent Activities		
Discharge of Biocide Inhibited Seawater	RQ = 0.014	Negligible
Discharge of Residual Hydrocarbons	RW = 6.1	Almost Negligible
Discharge of BOP Fluids	RQ = 0.068	Negligible
Discharge of Cement Additive	RQ = 0.21	Negligible

8 Consideration of Alternatives

8.1 Introduction

Section 39(1)(i) of the EEZ Act requires an applicant to specify any possible alternative locations for, or methods for undertaking, the activity that may avoid, remedy, or mitigate any adverse effects. These considerations are discussed within this section.

Methods available for completing the decommissioning of subsea oil and gas assets vary based on many factors. In New Zealand, principal considerations when determining the preferred approach include:

- The regulatory regime in force at the time of decommissioning;
- The cultural values and interests of iwi and Māori;
- Feedback from the community and other interested parties;
- The location of the field relative to ports and infrastructure;
- The type of assets that require decommissioning and availability of suitable vessels and equipment;
- The sensitivity of the surrounding marine environment; and
- The metocean conditions and water depth.

This assessment of alternatives has focused on the methods for undertaking the proposed decommissioning of the Tui field as there are no 'alternative locations' to undertake the activity.

The main factors that were considered when evaluating decommissioning options are shown in **Figure 35**.

Figure 35 Key factors during evaluation of decommissioning options

It is also necessary to consider not only New Zealand regulatory requirements, but also best practice from overseas countries where subsea oil field decommissioning activities are further advanced (e.g. the United Kingdom and Norway).

8.2 Subsea Infrastructure

There are several approaches that can be taken when decommissioning the SSI. The three main options are to:

1. Abandon the assets in-place;
2. Remove the assets that can be most easily recovered and leave others in place; or
3. Remove all assets to leave a 'clear seabed'.

Past operators of the Tui field had commenced work on identifying options for how best to decommission the Tui field prior to it becoming the responsibility of the Crown. This work was able to be leveraged to accelerate the planning process.

Fields that include fixed platforms and rigid subsea pipelines present particular challenges when it comes to decommissioning. The decommissioning of the Tui field is somewhat simplified by the nature of the field and the fact that it utilised a FPSO with flowlines and structures on the seabed, rather than being anchored, piled, trenched, or buried. This assists the decommissioning in two ways:

1. The use of a floating vessel (FPSO) to process and store the oil, rather than a fixed production platform, removes any need to dismantle, deconstruct or leave in place platform topsides, jacket or piles; and
2. The use of flexible flowlines and gas lift lines, as well as skid-mounted subsea equipment – and the absence of any rigid steel pipelines on or under the seabed – means it is a feasible option to recover these items of equipment from the field without causing significant disturbance to the seabed.

After considering the three options, MBIE has chosen to pursue a 'clear seabed' approach and remove all the SSI from the Tui field allowing the field to return to its pre-development condition as soon as possible

8.3 Wells

The only aspect of well P&A where there is some flexibility in approach relates to the subsea wellheads, and whether they are recovered or left/abandoned in place. Removal of the wellheads needs to be balanced against the technical and economic viability of completing the removal.

MBIE has chosen (like it has for the SSI) to pursue a 'clear seabed' approach. That is, all the wells will be plugged with cement and abandoned, with their wellheads and Xmas trees removed and the well casings cut below the seabed and recovered. As for removal of the SSI, this approach allows the field to return to its pre-development condition as soon as possible.

WorkSafe – Petroleum and Geothermal High Hazards Unit is the regulatory body that oversees well operations in New Zealand, including the P&A of subsea wells. The Interpretive Guidelines – Petroleum: Well Operations and Well Examination Schemes (WorkSafe, 2017) do not prescribe specific standards for P&A, however wells should be abandoned in line with internationally accepted good practice, incorporating continual improvement in practices and technology. Currently, the OGUK Well Decommissioning Guidelines (OGUK, 2018) are the most widely accepted guidelines for well abandonments, and as such, have been chosen for this project. The well abandonment design must also be approved by an independent well examiner.

8.4 Vessels & Drilling Unit Selection

As outlined within **Section 2.2**, the decommissioning of the Tui field will require a variety of vessels, and potentially a drilling unit (MODU), in order to complete the work in a safe and efficient manner.

The main potential adverse effect from the consent application arises if a MODU (drilling unit) is used to undertake the P&A operations on the wells in the Tui field.

The vessels under consideration for use during decommissioning (such as support vessels/CSVs/WIVs) may have alternatives in respect to the vessel themselves, but the potential adverse effects between these will be similar.

8.5 Retrieval of Midwater Arches and associated Gravity Bases

As outlined within **Section 2.3.7**, there are four potential options for retrieving the MWAs and GBs, which are as follows:

- Option 1A – use of hold-back rigging;
- Option 1B – direct lifting;
- Option 2 – use of clump weight(s); and
- Option 3 – sinking of the MWA.

Each of these four options has a potential disturbance related impact on the seabed, depending on the equipment used. The area of seabed disturbance from these four options ranges from approximately 590 m^2 for Options 1A & 1B through to approximately 1,040 m^2 for Option 3 (**Table 30**). The assessment of the seabed disturbance associated with the decommissioning of the Tui field is included within **Section 7.2.3.2** and has utilised a worst-case scenario for the retrieval of the MWAs and GBs, utilising the largest of the seabed disturbances (approximately 1,040 m^2) associated with Option 3.

The alternative options for this activity could potentially reduce the area of seabed disturbance by up to 450 m^2; however, it is considered that this reduction would not reduce the ***minor*** magnitude of environmental effects (as assessed within **Section 7.2.3.2**) by any measurable amount as the driving activity resulting in the scale of seabed disturbance in that assessment relates to other activities (such as the installation and removal of an anchored MODU and the retrieval of production flowlines, umbilicals and gas-lift CT).

8.6 Discharge of Biocide Inhibited Seawater and Residual Hydrocarbons

During the demobilisation of the FPSO the production flowlines and gas-lift lines were chemically flushed to remove hydrocarbons present in readiness for decommissioning. After flushing, the lines were displaced with biocide inhibited seawater, capped and laid on the seabed.

The recovery of these lines from the seabed will ultimately result in the discharge of the biocide inhibited seawater and potentially some residual hydrocarbons. It is considered that there are no practicable alternatives to this discharge, as the volumes of biocide inhibited seawater and any residual hydrocarbons expected to be discharged does not lend itself to containment and subsequent disposal ashore. In addition, the anticipated level of impact from these discharges are ***almost negligible***; therefore, any additional cost and health and safety implications of any alternatives are not considered necessary to mitigate this almost negligible effect.

8.7 Discharge of Blowout Preventer Fluid

The BOP is a safety device where large high-pressure valves are used to prevent the uncontrolled flow of liquids and gases during well operations. BOP hydraulic fluid will periodically be discharged as part of standard operations and testing procedures. All products within the BOP fluid are used sparingly, and testing operations are only carried out as frequently as industry standards deem necessary to minimise the discharge of harmful substances to the marine environment.

Based on the above, there are no alternatives to discharging the BOP fluid to the marine environment.

The BOP fluid utilised for the assessment in **Section 2.5.2** is an example of BOP fluid that has been used as part of previous drilling operations in New Zealand in the past. There is a chance that the BOP fluid utilised on the final contracted MODU/WIV may not be harmful; however, this is subject to contractual negotiations and the availability of vessels/drilling units able to conduct the P&A activities.

Nevertheless, the assessed magnitude of environmental effect associated with the discharge of harmful substances in the BOP fluid is ***negligible*** (**Section 7.3.2.2**); therefore, it is considered that no alternatives are required.

8.8 Discharge of Excess Cement

The cement recipe used for the P&A operations will be specifically designed by the cementing contractor and will use the least amount of harmful substances, whilst still being able to meet the performance requirements.

There is a potential for excess cement (up to 10 m^3) to be discharged overboard as a contingency (discussed in **Section 2.4.8.5**) in situations during P&A where an error in the cement mixing process or from a mechanical failure during the pumping of the cement. There is a possibility that this discharge will contain a harmful substance (NF-6), likely in small volumes. Nevertheless, as a worst-case scenario, the assessment of this discharge (see **Section 7.3.2.4**) shows that even if the full volume is within the discharge, the resultant magnitude of environment effect is ***negligible***. Therefore, it is considered that no alternatives are required.

9 Proffered Conditions

9.1 Introduction

MBIE has prepared proffered conditions which are included in **Appendix A**. The proffered conditions have been split into two sets, the first is for the marine consent and the second is for the marine discharge consent. The conditions are generally based on other marine consents and marine discharge consents that the EPA has granted under the EEZ Act, namely those for oil and gas exploration activities. This section presents a summary of the key proffered conditions and the rationale behind their drafting.

MBIE considers that the proffered conditions, both singularly and in total, appropriately avoid, remedy, or mitigate potential adverse effects identified by this IA.

9.2 Consent Duration and Reviews

Proffered Condition 2 of the marine consent seeks an expiry date of 31 December 2030. While MBIE's intention is to complete SSI removal and P&A works as part of a single decommissioning campaign (i.e. in summer of 2021/22), there may be a time delay between the two phases and the P&A would be completed in summer of 2022/23. The marine consent covers not only the decommissioning activities but also the post-decommissioning monitoring, which includes a sampling event five years after the P&A is completed. The five-year post-decommissioning sampling would therefore occur in 2028; however, an additional two years is sought should there be delays in the decommissioning programme, meaning an expiry date of 31 December 2030 is appropriate.

Proffered Condition 2 of the marine discharge consent seeks an expiry date of 31 December 2025. This is a shorter duration than the marine consent because the discharges of harmful substances will only occur up to the end of the P&A. However, as with the marine consent, an additional two years has been provided for should there be delays in completing the works.

Both sets of conditions include standard advice notes regarding the EPA's ability to review the duration and/or conditions of the consents under sections 76 and 77 of the EEZ Act. The ability to review the duration and/or conditions do not need to be imposed as formal conditions as the ability to instigate such reviews are codified in the EEZ Act and is not a condition that a consent holder can or must comply with.

9.3 Marine Consent Conditions

Proffered conditions 1 to 6 are administrative conditions.

Proffered conditions 7 and 8 requires MBIE to prepare an EMP and provide a copy to the EPA and Te Kāhui o Taranaki Trust prior to undertaking the decommissioning activities. The EMP will outline the proposed monitoring that will be undertaken following the decommissioning activities (the pre-decommissioning monitoring having been undertaken under the Permitted Activities Regulations). The EMP will be consistent with the indicative monitoring programme as discussed in **Section 2.6** of this consent application.

Proffered condition 9 requires MBIE to undertake monitoring in accordance with the EMP and specifies the timeframes when monitoring must be undertaken. The monitoring must be undertaken within 15 months of the completion of the P&A of all wells and repeated approximately five years after the completion of the P&A of all wells. Condition 9 also requires the monitoring to be undertaken at the same time of year as the pre-decommissioning monitoring and the condition defines the "same time of year" as meaning within six (6) weeks (either before or after) of the end date of the pre-decommissioning monitoring, unless otherwise agreed to in writing by the EPA.

Proffered conditions 10 to 15 relate to mitigating potential impacts to seabirds and marine mammals in accordance with similar conditions on existing marine consents as a result of recommendations by DOC. It is considered that these same conditions are relevant for the decommissioning of the Tui field.

Proffered conditions 16 and 17 require MBIE to remove all the SSI and to P&A all the wells within the Tui field. These conditions also require MBIE to provide confirmation that the SSI has been removed by way of the results of the post-decommissioning MBES survey and confirmation that the wells have been P&A. Proffered condition 18 requires MBIE to keep the persons with existing interests identified in this IA, including Te Kāhui o Taranaki Trust, informed on decommissioning activities, including the scheduling and location of any MODU or WIV.

Proffered condition 19 requires MBIE to notify the EPA, in writing, of: a) the intended date of the commencement of the removal of the SSI; b) the intended date of the commencement of the P&A of the first well; c) the date(s) that any MODU, WIV, and CSV is on site at each well location (including its position); and d) the date decommissioning of the Tui field has ended.

Proffered condition 20 requires MBIE to provide a digital copy of the logs that record seabird collisions and marine mammal sightings following the decommissioning of the Tui field to the EPA, DOC, and Te Kāhui o Taranaki Trust.

Proffered conditions 21 and 22 require MBIE to prepare a Monitoring Report for each of the two post-decommissioning monitoring events and provide the report to the EPA and Te Kāhui o Taranaki Trust. Each Monitoring Report must be prepared by a suitably qualified and experienced person and must include a description, analysis, evaluation and discussion on all of the environmental monitoring results. The Monitoring Reports must also include a comparison of the environmental monitoring results against the preceding pre- and post-decommissioning monitoring results. Proffered condition 22 also stipulates that Monitoring Report must include all the raw data obtained from the environmental monitoring in an electronic format agreed to by the EPA.

A general advice note is included which reminds MBIE of its potential obligations under other MMRs, including the possible requirement for an Emergency Spill Response Plan under the D&D Regulations, an Oil Spill Contingency Plan under Marine Protection Rules: Part 131, its obligations under the Biosecurity Act 1993 (for ballast water and biofouling on vessels), Marine Mammals Protection Act 1978 (for marine mammals), and the Wildlife Act 1953 (for seabirds and marine mammals).

9.4 Marine Discharge Consent Conditions

Proffered conditions 1 to 6 are administrative conditions.

Proffered condition 7 limits the discharge of harmful substances to those identified in Table 1 which is attached to the marine discharge consent (at the end). These four substances are those which have been assessed in the IA.

Proffered condition 8 requires MBIE to keep a written record of the number of cement batch discharges and the volume of cement discharged during each cement batch discharge, including the date on which each cement batch discharge occurred.

Specific monitoring for effects associated with the discharge of harmful substances is not proposed or considered necessary. Collection and analysis of water column samples to measure the effects of the discharges is impracticable given the temporary, intermittent nature of the discharges. However, any effects associated with the discharges on the benthic communities and sediment chemistry would be detected by the proposed environmental monitoring under the marine consent.

Lastly, an advice note is included which reminds MBIE of possible additional obligations under other MMRs, including possibly under the D&D Regulations.

10 Conclusion

MBIE is applying for a marine consent and a marine discharge consent under section 38 of the EEZ Act. This consent application is to permit activities associated with the decommissioning of the Tui field which is scheduled to begin in the summer of 2021-22. The decommissioning of the Tui field will involve removal of SSI and P&A of eight well.

An ERA has been undertaken to identify the actual and potential effects on the environment and existing interests that may arise from the activities associated with the decommissioning of the Tui field. The ERA is a qualitative assessment which takes into account the potential consequences of an effect occurring as well as the likelihood of such an effect occurring and focuses on the activities for which consent is being sought; that is, those activities restricted by section 20 and 20B of the EEZ Act.

Key considerations when assessing the actual and potential effects on the environment and existing interests from those activities associated with the decommissioning of the Tui field are as follows:

- The activities and their consequential impacts are spatially restricted, with the majority of the works being undertaken within the Tui Protected Area;
- The activities will be temporary in nature, with impacts ceasing once the decommissioning works have completed, and colonisation of disturbed areas beginning quickly after the retrieval of the SSI;
- The potential impacts from the discharge of harmful substances will be intermittent during decommissioning activities, and will stop once sufficient mixing has occurred which is expected to occur rapidly in the high-energy offshore environment; and
- Potential effects associated with the decommissioning of the Tui field will be monitored as per the EMP (set out in the conditions proffered in **Appendix A**) which will outline the pre- and post-decommissioning monitoring required for the Tui field.

The end result of the decommissioning of the Tui field will be the removal of the infrastructure to leave a clear seabed to allow recolonisation of the area by marine species, and for the removal of the restrictions placed by the Tui Protected Area. Therefore, the proposed activities will have significant positive effects on the environment and existing interests. The activities will also be significantly beneficial in terms of ‘broader outcomes’ – employment and other economic benefits.

Given the above points, in combination with the full suite of mitigation measures outlined in **Section 7.9**, and the proffered conditions contained in **Appendix A**, the overall environmental risk of adverse effects occurring from the decommissioning of the Tui field is, at worst, ***moderate***, with the predicted magnitude of effects being ***less than minor***.

Based on the information presented in this consent application, granting consents for the proposed decommissioning of the Tui field will strongly promote the purpose of the EEZ Act – being the sustainable management of the natural resources of the EEZ and protection of the environment from pollution.

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APPENDIX A

Proffered Conditions

MARINE CONSENT CONDITIONS

DEFINITIONS:

Terms used in this Schedule of Conditions have the following meanings:

CSV means a Construction Support Vessel.

Decommissioning means the removal of all SSI, P&A of all the wells, including removal of wellheads within the Tui field.

EEZ Act means the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012.

EMP means Environmental Monitoring Plan.

EPA means the Environmental Protection Authority or any equivalent Authority having an equivalent role under the EEZ Act.

Existing Interest has the same meaning given in section 4 of the EEZ Act.

MBES means a Multibeam Echo Sounder.

MODU means a Mobile Offshore Drilling Unit.

P&A means plug and abandon (or plugging and abandoning).

SSI means the Subsea Infrastructure within the Tui field, including the production flowlines, umbilicals, gas-lift lines (including coil tubing), anode skids, umbilical and gas-lift riser bases, mid-water arches and their gravity bases, production riser hold-back anchors, gas-lift manifold, umbilical termination assembly, subsea distribution unit, gas-lift jumpers, hydraulic flying leads, and electrical flying leads.

Suitably qualified and experienced person means a person who:

(a) holds a degree qualification in the relevant subject matter, or holds relevant professional certification from a relevant professional body; and

(b) has at least eight years' relevant experience.

Tui field means the area located in Petroleum Mining Permit 38158.

WIV means a Well Intervention Vessel.

Well(s) means any or all of the wells located within the Tui field being those referred to as Tui-2H, Tui-3H, Amokura-2H, Pateke-3H, Pateke-4H, Tui-SW-2, Tieke-1, and Amokura-1 wells.

Working day has the same meaning given in section 4 of the EEZ Act.

CONDITIONS:

Administrative –

1 Subject to compliance with these consent conditions, the activities authorised by this marine consent must be undertaken in general accordance with the application document entitled "Tui Field Decommissioning" (dated July 2021) prepared by SLR Consulting NZ Limited. Where there is any conflict between these documents, and any of the conditions of this marine consent, the conditions of this marine consent prevail.

2 This marine consent expires on 31 December 2030.

3 The consent holder must ensure that a copy of this marine consent, and any variations of it, is available for inspection by the EPA at the consent holder's head office in New Zealand, and on any MODU, WIV, or CSV undertaking activities authorised by this marine consent.

4 The consent holder must ensure that all personnel, including any contractors, involved in undertaking any of the activities authorised by this marine consent are fully informed of their obligations and responsibilities in exercising this marine consent.

5 The consent holder must keep a record to show that the personnel, including contractors, referred to in Condition 4, have been informed of their obligations under this marine consent. The consent holder must provide a copy of this record to the EPA upon request.

6 The consent holder must, prior to first commencing the activities authorised by this marine consent, provide to the EPA, in writing, the name and contact details of the person(s) who has responsibility for compliance management, collating information, and reporting in accordance with the requirements of this marine consent. In the event that the responsible person changes, the consent holder must advise the EPA, in writing, of the name and contact details of the new person within 20 working days of the change.

Environmental Monitoring Plan –

7 Prior to undertaking any activities authorised by this marine consent the consent holder must submit an submit an EMP to the EPA and Te Kāhui o Taranaki Trust. The purpose of the EMP is to specify:

a) the frequency and duration of sampling following completion of the decommissioning of the Tui field as specified in Condition 9;

b) the parameters to be monitored;

c) the sampling methodologies to be employed;

d) reporting requirements and reporting frequencies; and

e) the monitoring methodology to be employed that will ensure that any effects of monitoring on marine mammals, fish, and benthic communities are no more than has been described in the application referred to in Condition 1. The EMP shall include identification of the phases of the project where a qualified marine mammal observer will be present on any of the vessels or MODU.

8 The EMP required by Condition 7 must be prepared by a suitably qualified and experienced person(s) in consultation with Te Kāhui o Taranaki Trust. In the event that consent holder does not accept any of Te Kāhui o Taranaki Trust's recommendations in respect of the contents of the EMP then the consent holder shall provide a copy of these recommendations (including any supporting comments from Te Kāhui o Taranaki Trust regarding the basis of the recommendations) and an explanation why the recommendation(s) has not been accepted, to the EPA with the EMP.

9 The consent holder must undertake post-decommissioning monitoring and this must:

a) be in accordance with the EMP submitted to the EPA in accordance with Condition 7;

b) be undertaken within 15 months of the completion of the P&A of all wells within the Tui field;

c) be repeated approximately five years after the completion of the P&A of all wells within the Tui field; and

d) be undertaken at the same time of year as the pre-decommissioning monitoring. For the purposes of this condition, the "same time of year" means within six (6) weeks (either before or after) of the end date of the pre-decommissioning monitoring, unless otherwise agreed to in writing by the EPA.

Advice Note 1:

Condition 9d) refers to pre-decommissioning monitoring, which has already been undertaken as a permitted activity under the Exclusive Economic Zone and Continental Shelf (Environmental Effects—Permitted Activities) Regulations 2013.

Marine mammal and seabird conditions –

10 The consent holder must make available to the personnel working on the MODU, WIV, and CSV a New Zealand marine mammal and seabird species identification guide(s) to assist in the accurate identification of species.

11 To minimise potential adverse effects on seabirds, the consent holder must ensure that all nocturnal (night-time) lighting utilised on any MODU, WIV, CSV, or any support vessel associated with activities authorised by this marine consent is minimised to the greatest practicable extent while still meeting operational and safety requirements.

12 The consent holder must maintain a log of any seabird collisions with any MODU, WIV, CSV, or any support vessels associated with activities authorised by this marine consent, including the following information where available:

a) date and time of collision;

b) weather conditions;

c) species (where known);

d) condition of the bird (dead, released alive and unharmed or injured); and

e) photographs (where practicable).

13 Where a live injured seabird is found on any MODU, WIV, CSV, or support vessel associated with activities authorised by this marine consent, the consent holder must notify the Department of Conservation and Te Kāhui o Taranaki Trust as soon as reasonably practicable by the fastest possible means in the circumstances. In the event that seabird injuries are observed to occur due to the effects of vessel lighting then the consent holder shall review that vessel's lighting setup to ensure condition 11 is appropriately complied with.

14 All employees and contractors of the consent holder undertaking watch-keeping duties must be informed of their obligations under the Marine Mammals Protection Act 1978 and the Marine Mammals Protection Regulations 1992 or any subsequent regulations.

15 The consent holder must maintain a log, using the Department of Conservation's marine mammal sighting form, of all marine mammal sightings from any MODU, WIV, CSV, and support vessels associated with activities authorised by this marine consent, including the following information, where available:

a) the date and location of all marine mammal sightings;

b) the species of marine mammal(s) (where known) and the number of individuals (including the presence of juveniles) associated with each sighting;

c) the behaviour of marine mammal(s) sighted including their direction of travel;

d) any marine mammal injuries or mortalities observed;

e) the approximate size in metres of each marine mammal; and

f) any physical interaction between any marine mammals and any equipment, vessels, or other inanimate objects (including but not limited to vessel strike or entanglement).

Existing interest conditions –

16 All SSI within the Tui field must be removed. To confirm that all structures have been removed, a MBES survey must be undertaken prior to, and following completion of the removal of the SSI within the Tui field and the results included in the first Monitoring Report required by Condition 21.

17 All wells within the Tui field must be P&A and all wellheads, casings and conductors must be removed three (3) metres below the seabed. The consent holder must provide confirmation of compliance with this condition to the EPA and Te Kāhui o Taranaki Trust as soon as reasonably practicable after all the P&A works are completed.

18 The consent holder must provide all persons with existing interests identified in the application referred to in Condition 1, including Te Kāhui o Taranaki Trust, with up-to-date information on the activities authorised by this marine consent, including the scheduling and location of any CSV, MODU or WIV, and environmental monitoring undertaken in accordance with the conditions of this marine consent. The consent holder must make this information available through standard communications channel(s). Evidence of this communication must be provided to the EPA upon request.

Reporting conditions –

19 The consent holder must notify the EPA, in writing, of:

a) the intended date of the commencement of the removal of the SSI, at least 48 hours before that date;

b) the intended date of the commencement of the P&A of the first well, at least 48 hours before that date;

c) the date that any MODU, WIV, or CSV is on site at each well location, including its latitude and longitude, within five (5) working days after the MODU or WIV is on site; and

d) the date that decommissioning of the Tui field has ended, within five (5) working days of that date.

20 The consent holder must provide a digital copy of the logs required by Conditions 12 and 15 to the EPA, the Department of Conservation, and Te Kāhui o Taranaki Trust as follows:

a) If the P&A is completed immediately following the removal of the SSI then the digital copy of the logs must be provided within three (3) months of the P&A of the last well within the Tui field; or

b) If the P&A is not completed immediately following the removal of the SSI then a digital copy of the logs must be provided within three (3) months of the removal of the SSI and also within three (3) months of the P&A of the last well within the Tui field.

21 The consent holder must, within nine (9) months after each stage of monitoring required under Conditions 9b) and 9c), provide a Monitoring Report to the EPA and Te Kāhui o Taranaki Trust.

22 Each Monitoring Report required under Condition 21 must be prepared by a suitably qualified and experienced person(s) and must include, but not necessarily be limited to, the following:

a) a description, analysis, evaluation and discussion of all the environmental monitoring results, including that obtained in accordance with Conditions 9;

b) a comparison of the environmental monitoring results against the preceding pre- and post-decommissioning monitoring results; and

c) a complete copy of all raw data obtained from the environmental monitoring, including all data obtained under Condition 9, in an electronic format agreed to by the EPA.

Advice Note 2: Review of conditions

The EPA may serve notice on the consent holder, in accordance with sections 76 and 77 of the EEZ Act, of its intention to review the duration or conditions of this marine consent for any of the reasons set out in section 76(1).

General advice notes –

The consent holder is reminded that it has obligations under other marine management regimes, including, but not necessarily limited to, the following:

a) Regulation 24 of the Exclusive Economic Zone and Continental Shelf (Environmental Effects—Discharge and Dumping) Regulations 2015 requires that the consent holder may not operate an offshore installation without an Emergency Spill Response Plan approved by the EPA.

b) Marine Protection Rules: Part 131 under the Maritime Transport Act 1994 requires offshore installations (i.e. a MODU) to not be operated without an approved Oil Spill Contingency Plan.

c) The Biosecurity Act 1993 requires that the consent holder complies with the Import Health Standard – Ballast Water from All Countries and the Craft Risk Management Standard – Biofouling on Vessels Arriving to New Zealand prepared under that Act.

d) The Marine Mammals Protection Act 1978 requires that the consent holder complies with sections 16(2) to (5), which require:

(2) Any person (not being a person to whom subsection (1) applies) who, by any means whatsoever, accidentally or incidentally kills or injures any marine mammal shall report the event to an officer or a fishery officer (as defined in section 2(1) of the Fisheries Act 1996) as soon as practicable.

(3) Every report under subsection (1) or subsection (2) shall include—

(a) the location of the area where the event took place; and

(b) the species (if known) of the marine mammal killed or injured, or a general description of the mammal; and

(c) a description of conditions and the circumstances of the event.

(3A) In addition to providing the particulars required by subsection (1) or subsection (2), a person required to report an event to which that subsection applies shall provide to the Director-General such other particulars relating to the event as the Director-General may require for the purposes of this Act.

(4) Every person commits an offence against this Act who contravenes subsection (1) or subsection (2).

(5) Every person commits an offence against this Act who refuses or fails to furnish any information or particulars required by the Director-General under subsection (3A).

e) The Wildlife Act 1953, which applies to seabirds and marine mammals, requires the consent holder to comply with sections 63B(2) to (4), which require:

(2) Any person (other than a person to whom subsection (1) applies) who, by any means whatever, accidentally or incidentally kills or injures any marine wildlife, shall, as soon as practicable, report the event to a ranger or a fishery officer (as defined in section 2(1) of the Fisheries Act 1996).

(3) Every report under subsection (1) or subsection (2) shall include—

(a) the location of the area where the event took place; and

(b) the species (if known) of the marine wildlife killed or injured, or a general description of the wildlife; and

(c) a description of the conditions and the circumstances of the event.

(4) In addition to providing the particulars required by subsection (1) or subsection (2), a person required to report an event to which that subsection applies shall provide to the Director-General such other particulars relating to the event as the Director-General may require for the purposes of this Act.

MARINE DISCHARGE CONSENT CONDITIONS

DEFINITIONS:

Terms used in this Schedule of Conditions have the following meanings:

CSV means a Construction Support Vessel.

EEZ Act means the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012.

EPA means the Environmental Protection Authority or any equivalent Authority having an equivalent role under the EEZ Act.

MODU means a Mobile Offshore Drilling Unit.

P&A means plug and abandon (or plugging and abandoning).

Well(s) means any or all of the wells located within Petroleum Mining Permit 38158 being those referred to as Tui-2H, Tui-3H, Amokura-2H, Pateke-3H, Pateke-4H, Tui-SW-2, Tieke-1, and Amokura-1 wells.

WIV means a Well Intervention Vessel.

Working day has the same meaning given in section 4 of the EEZ Act.

CONDITIONS:

Administrative –

1 Subject to compliance with these consent conditions, the activities authorised by this marine discharge consent must be undertaken in general accordance with the application document entitled "Tui Field Decommissioning" (dated July 2021) prepared by SLR Consulting NZ Limited. Where there is any actual or apparent conflict between these documents, and any of the conditions of this marine discharge consent, these conditions prevail.

2 This marine discharge consent expires on 31 December 2025.

3 The consent holder must ensure that a copy of this marine discharge consent, and any variations of it, is available for inspection by the EPA at the consent holder's head office in New Zealand, and on any MODU, WIV, or CSV undertaking activities authorised by this marine discharge consent.

4 The consent holder must ensure that all personnel, including any contractors, involved in undertaking any of the activities authorised by this marine discharge consent are fully informed of their obligations and responsibilities in exercising this marine discharge consent.

5 The consent holder must keep a record to show that the personnel, including contractors, referred to in Condition 4, have been informed of their obligations under this marine discharge consent. The consent holder must provide a copy of this record to the EPA upon request.

6 The consent holder must, prior to first commencing the activities authorised by this marine discharge consent, provide to the EPA, in writing, the name and contact details of the person(s) who has responsibility for compliance management, collating information, and reporting in accordance with the requirements of this marine discharge consent. In the event that the responsible person changes, the consent holder must advise the EPA, in writing, of the name and contact details of the new person within 20 working days of the change.

Harmful substances –

7 This marine discharge consent authorises the discharge of up to four harmful substances as identified within Table 1 attached to these conditions.

Record keeping –

8 The consent holder must keep a written record of the number of cement batch discharges and the volume of cement discharged during each cement batch discharge, including the date on which each cement batch discharge occurred. The consent holder must provide a copy of this record to the EPA on request and also within six months of the completion of the P&A of the final well.

Advice Note 1: Review of conditions

The EPA may serve notice on the consent holder, in accordance with sections 76 and 77 of the EEZ Act, of its intention to review the duration or conditions of this marine discharge consent for any of the reasons set out in section 76(1).

Advice Note 2: Other Obligations

The consent holder is reminded that it may have obligations under other marine management regimes, including, but not necessarily limited to, regulation 24 of the Exclusive Economic Zone and Continental Shelf (Environmental Effects—Discharge and Dumping) Regulations 2015.

Table 1: Harmful Substances Authorised to be Discharged

Discharge Stream	Harmful Substance	Use
Contents of production flowlines and gas-lift lines	BE-9	Biocide
	Residual hydrocarbons	No use
Blow Out Preventer	Erifon HD 603 HP No Dye	BOP fluid
Cement	NF-6	Cement defoamer

APPENDIX B

Safety Data Sheets

HALLIBURTON

SAFETY DATA SHEET

BE-9

Revision Date: 13-Oct-2017 **Revision Number:** 1

1. Product and Company Identification

Product Name
Product Trade Name: BE-9

Other Names
Synonyms None
Hazardous Material Number: HB006583

Recommended Use
Recommended Use Biocide
Uses advised against No information available

Company Name, Address and Contact Details
Manufacturer/Supplier Halliburton New Zealand
1 Paraite Rd,
Bell Block, New Plymouth
New Zealand Registration No.: 824207

E-mail Address fdunexchem@halliburton.com

Emergency Telephone Number +64 800 451719
Global Incident Response Access Code: 334305
Contract Number: 14012

New Zealand National Poisons Centre 0800 764 766 (24 hours)

2. Hazards Identification

Statement of Hazardous Nature
Classified as hazardous according to criteria in the Hazardous Substances (Minimum Degrees of Hazard) Regulation 2001;
Classified as dangerous good according to NZS 5433:2012, UN, IMDG or IATA

Classification
8.2C Corrosive to dermal tissue if exposed for greater than 1 hour
8.3A Corrosive to ocular tissue

Hazard and Precautionary Statements

Hazard Pictograms

Signal Word Danger

Hazard Statements H314 - Causes severe skin burns and eye damage
H318 - Causes serious eye damage

Precautionary Statements

Prevention P101 - If medical advice is needed, have product container or label at hand

	P102 - Keep out of reach of children P103 - Read label before use P104 - Read Safety Data Sheet before use. P260 - Do not breathe dust/fume/gas/mist/vapors/spray P264 - Wash face, hands and any exposed skin thoroughly after handling P280 - Wear protective gloves/eye protection/face protection
Response	P301 + P330 + P331 - IF SWALLOWED: rinse mouth. Do NOT induce vomiting P303 + P361 + P353 - IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water [or shower]. P363 - Wash contaminated clothing before reuse P304 + P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing. P310 - Immediately call a POISON CENTER or doctor/physician P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing
Storage	P405 - Store locked up
Disposal	P501 - Dispose of contents/container to an approved incineration plant

Contains

Substances	CAS Number	Substance HSNO Classification
Tributyl tetradecyl phosphonium chloride	81741-28-8	8.2C 8.3A

2.3. Other Hazards

None known

3. Composition and Information on Ingredients

Substances	CAS Number	PERCENT (w/w)
Tributyl tetradecyl phosphonium chloride	81741-28-8	5 - 10%

4. First Aid Measures

Requirements for First Aid or Medical Care

Inhalation	If inhaled, move victim to fresh air and seek medical attention.
Eyes	Immediately flush eyes with large amounts of water for at least 30 minutes. Seek prompt medical attention.
Skin	In case of contact, immediately flush skin with plenty of soap and water for at least 30 minutes and remove contaminated clothing, shoes and leather goods immediately. Get medical attention immediately.
Ingestion	Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

Workplace Facilities Required

None

Relation to Health Effect

Most Important Symptoms/Effects

Causes severe eye irritation which may damage tissue. Causes severe skin irritation with tissue destruction.

Medical Attention and Special Treatment

Notes to Physician

Treat symptomatically

5. Fire-fighting measures

Type of Hazard

Flammability Hazard

Non-flammable

5.1. Extinguishing media

Suitable Extinguishing Media

Water fog, carbon dioxide, foam, dry chemical.

Extinguishing media which must not be used for safety reasons

None known.

HAZCHEM Code

Hazchem Code: 2X

Special Protective Equipment and Precautions for Fire Fighters

Special protective equipment for firefighters

Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.

Special exposure hazards in a fire

Decomposition in fire may produce harmful gases. Do not allow runoff to enter waterways. Use water spray to cool fire exposed surfaces.

6. Spillage, Accidental Release Measures

6.1. Personal precautions, protective equipment and emergency procedures

Use appropriate protective equipment.
See Section 8 for additional information

6.2. Environmental precautions

Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

6.4. Reference to other sections

See Section 8 and 13 for additional information.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions

Avoid contact with eyes, skin, or clothing. Wash hands after use. Launder contaminated clothing before reuse. Do NOT consume food, drink, or tobacco in contaminated areas.

Handling Practices

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

Approved Handlers

This product does NOT require an approved handler.

7.2. Conditions for safe storage, including any incompatibilities

Store in a cool well ventilated area. Keep container closed when not in use. Store away from direct sunlight. Store in a dry location. Store in a manner to prevent commingling with incompatible materials. Store away from alkalis. Store away from reducing agents. Store locked up.

Store Site Requirements

No special controls required

Packaging

No special packaging required

8. Exposure Controls and Personal Protection

Workplace Exposure Standards

Exposure Limits

Substances	CAS Number	New Zealand WES	ACGIH TLV-TWA
Tributyl tetradecyl phosphonium chloride	81741-28-8	Not applicable	Not applicable

Engineering Controls

Engineering Controls Use in a well ventilated area. Local exhaust ventilation should be used in areas without good cross ventilation.

Personal Protective Equipment (PPE)

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard

	EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Dust/mist respirator. (N95, P2/P3)
Hand Protection	Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Neoprene gloves. (>= 0.75 mm thickness) This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.
Skin Protection	Wear impervious protective clothing, including boots, gloves, lab coat, apron, rain jacket, pants or coverall, as appropriate, to prevent skin contact.
Eye Protection	Chemical goggles; also wear a face shield if splashing hazard exists.
Other Precautions	Eyewash fountains and safety showers must be easily accessible.
Hygiene Measures	Handle in accordance with good industrial hygiene and safety practice.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State:	Liquid	**Color**	Clear colorless
Odor:	Slight	**Odor Threshold:**	No information available

Property Remarks/ - Method	Values
pH:	6-8
Freezing Point / Range	-8 - -10 °C
Melting Point / Range	No data available
Boiling Point / Range	100 °C / 212 °F
Flash Point	No data available
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.95 - 1.0
Water Solubility	Miscible with water
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	No data available
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%)	No data available

10. Stability and Reactivity

10.2. Chemical stability

Stable

10.4. Conditions to avoid

None anticipated

10.5. Incompatible materials

Reducing agents. Strong alkalis.

10.6. Hazardous decomposition products

Chlorine. Phosphorus acids. Carbon monoxide and carbon dioxide.

Hazardous Reactions

Hazardous Polymerization: Will Not Occur

11. Toxicological Information

Health Effect from Likely Routes of Exposure

Acute Toxicity

Inhalation	May cause respiratory irritation.
Eye Contact	Causes severe eye irritation which may damage tissue. May cause eye burns.
Skin Contact	Causes severe skin irritation with tissue destruction.
Ingestion	Irritation of the mouth, throat, and stomach. May cause abdominal pain, vomiting, nausea, and diarrhea.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

Toxicity Data

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Tributyl tetradecyl phosphonium chloride	81741-28-8	= 611 mg/kg (rat)	No data of sufficient quality are available	> 0.908 mg/L (rat, 4hr, mist)

Substances	CAS Number	Skin corrosion/irritation
Tributyl tetradecyl phosphonium chloride	81741-28-8	Causes burns (Rabbit)

Substances	CAS Number	Serious eye damage/irritation
Tributyl tetradecyl phosphonium chloride	81741-28-8	Causes severe eye irritation which may damage tissue. (Rabbit)

Substances	CAS Number	Skin Sensitization
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	Respiratory Sensitization
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	Mutagenic Effects
Tributyl tetradecyl phosphonium chloride	81741-28-8	No data of sufficient quality are available.

Substances	CAS Number	Carcinogenic Effects
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	Reproductive toxicity
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	STOT - single exposure
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Substances	CAS Number	STOT - repeated exposure
Tributyl tetradecyl phosphonium chloride	81741-28-8	No data of sufficient quality are available.

Substances	CAS Number	Aspiration hazard

Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

12. Ecological Information

12.1. Toxicity

Product Ecotoxicity Data
No data available

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available	LC50 (96 h) 0.46 mg/L (Oncorhynchus mykiss) LC50 (96 h) 0.06 mg/L (Lepomis macrochirus)	No information available	EC50 (48 h) 0.025 mg/L (Daphnia sp.)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Tributyl tetradecyl phosphonium chloride	81741-28-8	(0% @ 28d)

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Tributyl tetradecyl phosphonium chloride	81741-28-8	< 3

12.4. Mobility in soil

Substances	CAS Number	Mobility
Tributyl tetradecyl phosphonium chloride	81741-28-8	No information available

Ecotoxicity Hazard Statements
None known

12.6. Other adverse effects

Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

13.1. Waste treatment methods

Disposal methods Disposal should be made in accordance with federal, state, and local regulations. Incineration recommended in approved incinerator according to federal, state, and local regulations. Substance should NOT be deposited into a sewage facility.

Contaminated Packaging Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

14. Transport Information

IMDG/IMO

UN Number UN2922
UN proper shipping name: Corrosive Liquid, Toxic, N.O.S. (contains Tributyl Tetradecyl Phosphonium Chloride)
Transport Hazard Class(es): 8, (6.1)
Packing Group: II
Environmental Hazards: Marine Pollutant
EMS: EmS F-A, S-B

NZ 5433.1999

UN Number UN2922
UN proper shipping name: Corrosive Liquid, Toxic, N.O.S. (contains Tributyl Tetradecyl Phosphonium Chloride)
Transport Hazard Class(es): 8, (6.1)

Packing Group: II

IATA/ICAO

UN Number UN2922
UN proper shipping name: Corrosive Liquid, Toxic, N.O.S. (contains Tributyl Tetradecyl Phosphonium Chloride)
Transport Hazard Class(es): 8, (6.1)
Packing Group: II

Special Precautions for User None
Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable

15. Regulatory Information

New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
HSNO Approval Number	HSR002491
Group Name	Additives, Process Chemicals and Raw Materials (Corrosive HSR002491)
HSNO Controls	Refer to the NZ EPA website for more information: http://www.epa.govt.nz
Approved Handlers	Not Applicable
Poisons Schedule:	None Allocated

16. Other information

The following sections have been revised since the last issue of this SDS
Section 15. Regulatory Information

Additional information For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key or legend to abbreviations and acronyms used in the safety data sheet
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
MARPOL – International Convention for the Prevention of Pollution from Ships
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
ppm – parts per million
TWA – Time-Weighted Average
VOC – Volatile Organic Carbon
C - Celsius
IATA/ICAO - International Air Transport Association / International Civil Aviation Organization
IMDG/IMO - International Maritime Dangerous Goods / International Maritime Organization
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/
NZ CCID

Revision Date: 01-Jul-2016

Revision Note
SDS sections updated:
2

Disclaimer Statement
This information is furnished without warranty, expressed or implied, as to accuracy or completeness. The information is obtained from various sources including the manufacturer and other third party sources. The information may not be valid under all conditions nor if this material is used in combination with other materials or in any process. Final determination of suitability of any material is the sole responsibility of the user.

End of Safety Data Sheet

Powered by Chemwatch

Tui Crude Oil

Tamarind Taranaki Limited

Chemwatch Hazard Alert Code: **4**

Chemwatch: **4847-03**
Version No: **2.1.1.1**
Safety Data Sheet according to WHS and ADG requirements

Issue Date: **01/01/2013**
Print Date: **05/22/2017**
L.GHS.AUS.EN

SECTION 1 IDENTIFICATION OF THE SUBSTANCE / MIXTURE AND OF THE COMPANY / UNDERTAKING

Product Identifier

Product name	Tui Crude Oil
Synonyms	Not Available
Proper shipping name	PETROLEUM CRUDE OIL
Other means of identification	Not Available

Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses	Feedstock.

Details of the supplier of the safety data sheet

Registered company name	Tamarind Taranaki Limited
Address	PO Box 8156 New Plymouth 4342 New Zealand
Telephone	06 7592173
Fax	06 7592175
Website	www.tamarindenergy.com
Email	info@tamarindresources.com

Emergency telephone number

Association / Organisation	Not Available
Emergency telephone numbers	021308150 (24 hrs)
Other emergency telephone numbers	Not Available

SECTION 2 HAZARDS IDENTIFICATION

Classification of the substance or mixture

Poisons Schedule	S5
Classification [1]	Flammable Liquid Category 3, Germ cell mutagenicity Category 1B, Carcinogenicity Category 1A, Specific target organ toxicity - single exposure Category 3 (narcotic effects), Aspiration Hazard Category 1, Acute Aquatic Hazard Category 1, Chronic Aquatic Hazard Category 1
Legend:	*1. Classified by Chemwatch; 2. Classification drawn from HSIS ; 3. Classification drawn from EC Directive 1272/2008 - Annex VI*

Label elements

Hazard pictogram(s)	

Continued...

SIGNAL WORD	DANGER

Hazard statement(s)

H226	Flammable liquid and vapour.
H340	May cause genetic defects.
H350	May cause cancer.
H336	May cause drowsiness or dizziness.
H304	May be fatal if swallowed and enters airways.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s) Prevention

P201	Obtain special instructions before use.
P210	Keep away from heat/sparks/open flames/hot surfaces. - No smoking.
P271	Use only outdoors or in a well-ventilated area.
P281	Use personal protective equipment as required.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ventilating/lighting/intrinsically safe equipment.
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P261	Avoid breathing mist/vapours/spray.
P273	Avoid release to the environment.
P280	Wear protective gloves/protective clothing/eye protection/face protection.

Precautionary statement(s) Response

P301+P310	IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician.
P308+P313	IF exposed or concerned: Get medical advice/attention.
P331	Do NOT induce vomiting.
P370+P378	In case of fire: Use alcohol resistant foam or normal protein foam for extinction.
P312	Call a POISON CENTER or doctor/physician if you feel unwell.
P391	Collect spillage.
P303+P361+P353	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304+P340	IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.

Precautionary statement(s) Storage

P403+P235	Store in a well-ventilated place. Keep cool.
P405	Store locked up.

Precautionary statement(s) Disposal

P501	Dispose of contents/container in accordance with local regulations.

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Substances

See section below for composition of Mixtures

Mixtures

CAS No	%[weight]	Name
8002-05-9	>99	petroleum crude oil
		A complex mixture containing
		paraffinic and cycloparaffinic hydrocarbons
71-43-2	<1	benzene

SECTION 4 FIRST AID MEASURES

Continued...

Description of first aid measures

Eye Contact	If this product comes in contact with the eyes: ▸ Wash out immediately with fresh running water. ▸ Ensure complete irrigation of the eye by keeping eyelids apart and away from eye and moving the eyelids by occasionally lifting the upper and lower lids. ▸ Seek medical attention without delay; if pain persists or recurs seek medical attention. ▸ Removal of contact lenses after an eye injury should only be undertaken by skilled personnel.
Skin Contact	If skin contact occurs: ▸ Immediately remove all contaminated clothing, including footwear. ▸ Flush skin and hair with running water (and soap if available). ▸ Seek medical attention in event of irritation.
Inhalation	▸ If fumes or combustion products are inhaled remove from contaminated area. ▸ Lay patient down. Keep warm and rested. ▸ Prostheses such as false teeth, which may block airway, should be removed, where possible, prior to initiating first aid procedures. ▸ Apply artificial respiration if not breathing, preferably with a demand valve resuscitator, bag-valve mask device, or pocket mask as trained. Perform CPR if necessary. ▸ Transport to hospital, or doctor.
Ingestion	▸ For advice, contact a Poisons Information Centre or a doctor at once. ▸ Urgent hospital treatment is likely to be needed. ▸ If swallowed do **NOT** induce vomiting. ▸ If vomiting occurs, lean patient forward or place on left side (head-down position, if possible) to maintain open airway and prevent aspiration. ▸ Observe the patient carefully. ▸ Never give liquid to a person showing signs of being sleepy or with reduced awareness; i.e. becoming unconscious. ▸ Give water to rinse out mouth, then provide liquid slowly and as much as casualty can comfortably drink. ▸ Transport to hospital or doctor without delay.

Indication of any immediate medical attention and special treatment needed

For acute or short term repeated exposures to petroleum distillates or related hydrocarbons:

- Primary threat to life, from pure petroleum distillate ingestion and/or inhalation, is respiratory failure.
- Patients should be quickly evaluated for signs of respiratory distress (e.g. cyanosis, tachypnoea, intercostal retraction, obtundation) and given oxygen. Patients with inadequate tidal volumes or poor arterial blood gases (pO2 50 mm Hg) should be intubated.
- Arrhythmias complicate some hydrocarbon ingestion and/or inhalation and electrocardiographic evidence of myocardial injury has been reported; intravenous lines and cardiac monitors should be established in obviously symptomatic patients. The lungs excrete inhaled solvents, so that hyperventilation improves clearance.
- A chest x-ray should be taken immediately after stabilisation of breathing and circulation to document aspiration and detect the presence of pneumothorax.
- Epinephrine (adrenalin) is not recommended for treatment of bronchospasm because of potential myocardial sensitisation to catecholamines. Inhaled cardioselective bronchodilators (e.g. Alupent, Salbutamol) are the preferred agents, with aminophylline a second choice.
- Lavage is indicated in patients who require decontamination; ensure use of cuffed endotracheal tube in adult patients. [Ellenhorn and Barceloux: Medical Toxicology]

SECTION 5 FIREFIGHTING MEASURES

Extinguishing media

- Foam.
- Dry chemical powder.
- BCF (where regulations permit).
- Carbon dioxide.
- Water spray or fog - Large fires only.

Special hazards arising from the substrate or mixture

Fire Incompatibility	▸ Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result

Advice for firefighters

Fire Fighting	▸ Alert Fire Brigade and tell them location and nature of hazard. ▸ May be violently or explosively reactive. ▸ Wear breathing apparatus plus protective gloves. ▸ Prevent, by any means available, spillage from entering drains or water course. ▸ If safe, switch off electrical equipment until vapour fire hazard removed. ▸ Use water delivered as a fine spray to control fire and cool adjacent area. ▸ Avoid spraying water onto liquid pools. ▸ **DO NOT** approach containers suspected to be hot. ▸ Cool fire exposed containers with water spray from a protected location. ▸ If safe to do so, remove containers from path of fire.

Continued...

Fire/Explosion Hazard	▸ Liquid and vapour are flammable. ▸ Moderate fire hazard when exposed to heat or flame. ▸ Vapour forms an explosive mixture with air. ▸ Moderate explosion hazard when exposed to heat or flame. ▸ Vapour may travel a considerable distance to source of ignition. ▸ Heating may cause expansion or decomposition leading to violent rupture of containers. ▸ On combustion, may emit toxic fumes of carbon monoxide (CO). Combustion products include: , carbon dioxide (CO_2) , other pyrolysis products typical of burning organic material.
HAZCHEM	3W

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

Minor Spills

- Remove all ignition sources.
- Clean up all spills immediately.
- Avoid breathing vapours and contact with skin and eyes.
- Control personal contact with the substance, by using protective equipment.
- Contain and absorb small quantities with vermiculite or other absorbent material.
- Wipe up.
- Collect residues in a flammable waste container.

Major Spills

Chemical Class: aromatic hydrocarbons
For release onto land: recommended sorbents listed in order of priority.

SORBENT TYPE	RANK	APPLICATION	COLLECTION	LIMITATIONS
LAND SPILL - SMALL				
Feathers - pillow	1	throw	pitchfork	DGC, RT
cross-linked polymer - particulate	2	shovel	shovel	R,W,SS
cross-linked polymer- pillow	2	throw	pitchfork	R, DGC, RT
sorbent clay - particulate	3	shovel	shovel	R, I, P,
treated clay/ treated natural organic - particulate	3	shovel	shovel	R, I
wood fibre - pillow	4	throw	pitchfork	R, P, DGC, RT
LAND SPILL - MEDIUM				
cross-linked polymer -particulate	1	blower	skiploader	R, W, SS
treated clay/ treated natural organic - particulate	2	blower	skiploader	R, I
sorbent clay - particulate	3	blower	skiploader	R, I, P
polypropylene - particulate	3	blower	skiploader	W, SS, DGC
feathers - pillow	3	throw	skiploader	DGC, RT
expanded mineral - particulate	4	blower	skiploader	R, I, W, P, DGC

Legend
DGC: Not effective where ground cover is dense
R; Not reusable
I: Not incinerable
P: Effectiveness reduced when rainy
RT:Not effective where terrain is rugged
SS: Not for use within environmentally sensitive sites
W: Effectiveness reduced when windy
Reference: Sorbents for Liquid Hazardous Substance Cleanup and Control;
R.W Melvold et al: Pollution Technology Review No. 150: Noyes Data Corporation 1988

- Clear area of personnel and move upwind.
- Alert Fire Brigade and tell them location and nature of hazard.

	- May be violently or explosively reactive. - Wear breathing apparatus plus protective gloves. - Prevent, by any means available, spillage from entering drains or water course. - No smoking, naked lights or ignition sources. - Increase ventilation. - Stop leak if safe to do so. - Water spray or fog may be used to disperse / absorb vapour. - Contain spill with sand, earth or vermiculite. - Use only spark-free shovels and explosion proof equipment. - Collect recoverable product into labelled containers for recycling. - Absorb remaining product with sand, earth or vermiculite. - Collect solid residues and seal in labelled drums for disposal. - Wash area and prevent runoff into drains. - If contamination of drains or waterways occurs, advise emergency services.

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

Precautions for safe handling

Safe handling	- Containers, even those that have been emptied, may contain explosive vapours. - Do NOT cut, drill, grind, weld or perform similar operations on or near containers. - **DO NOT** allow clothing wet with material to stay in contact with skin - Electrostatic discharge may be generated during pumping - this may result in fire. - Ensure electrical continuity by bonding and grounding (earthing) all equipment. - Restrict line velocity during pumping in order to avoid generation of electrostatic discharge (<=1 m/sec until fill pipe submerged to twice its diameter, then <= 7 m/sec). - Avoid splash filling. - Do NOT use compressed air for filling discharging or handling operations. - Avoid all personal contact, including inhalation. - Wear protective clothing when risk of overexposure occurs. - Use in a well-ventilated area. - Prevent concentration in hollows and sumps. - **DO NOT** enter confined spaces until atmosphere has been checked. - Avoid smoking, naked lights or ignition sources. - Avoid generation of static electricity. - **DO NOT** use plastic buckets. - Earth all lines and equipment. - Use spark-free tools when handling. - Avoid contact with incompatible materials. - When handling, **DO NOT** eat, drink or smoke. - Keep containers securely sealed when not in use. - Avoid physical damage to containers. - Always wash hands with soap and water after handling. - Work clothes should be laundered separately. - Use good occupational work practice. - Observe manufacturer's storage and handling recommendations contained within this SDS. - Atmosphere should be regularly checked against established exposure standards to ensure safe working conditions.
Other information	- Store in original containers in approved flammable liquid storage area. - Store away from incompatible materials in a cool, dry, well-ventilated area. - **DO NOT** store in pits, depressions, basements or areas where vapours may be trapped. - No smoking, naked lights, heat or ignition sources. - Storage areas should be clearly identified, well illuminated, clear of obstruction and accessible only to trained and authorised personnel - adequate security must be provided so that unauthorised personnel do not have access. - Store according to applicable regulations for flammable materials for storage tanks, containers, piping, buildings, rooms, cabinets, allowable quantities and minimum storage distances. - Use non-sparking ventilation systems, approved explosion proof equipment and intrinsically safe electrical systems. - Have appropriate extinguishing capability in storage area (e.g. portable fire extinguishers - dry chemical, foam or carbon dioxide) and flammable gas detectors. - Keep adsorbents for leaks and spills readily available. - Protect containers against physical damage and check regularly for leaks. - Observe manufacturer's storage and handling recommendations contained within this SDS. In addition, for tank storages (where appropriate): - Store in grounded, properly designed and approved vessels and away from incompatible materials. - For bulk storages, consider use of floating roof or nitrogen blanketed vessels; where venting to atmosphere is possible, equip storage tank vents with flame arrestors; inspect tank vents during winter conditions for vapour/ ice build-up. - Storage tanks should be above ground and diked to hold entire contents.

Conditions for safe storage, including any incompatibilities

Continued...

Suitable container	▸ Packing as supplied by manufacturer. ▸ Plastic containers may only be used if approved for flammable liquid. ▸ Check that containers are clearly labelled and free from leaks. ▸ For low viscosity materials (i) : Drums and jerry cans must be of the non-removable head type. (ii) : Where a can is to be used as an inner package, the can must have a screwed enclosure. ▸ For materials with a viscosity of at least 2680 cSt. (23 deg. C) ▸ For manufactured product having a viscosity of at least 250 cSt. (23 deg. C) ▸ Manufactured product that requires stirring before use and having a viscosity of at least 20 cSt (25 deg. C): (i) Removable head packaging; (ii) Cans with friction closures and (iii) low pressure tubes and cartridges may be used. ▸ Where combination packages are used, and the inner packages are of glass, there must be sufficient inert cushioning material in contact with inner and outer packages ▸ In addition, where inner packagings are glass and contain liquids of packing group I there must be sufficient inert absorbent to absorb any spillage, unless the outer packaging is a close fitting moulded plastic box and the substances are not incompatible with the plastic.
Storage incompatibility	Avoid storage with oxidisers

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

OCCUPATIONAL EXPOSURE LIMITS (OEL)

INGREDIENT DATA

Source	Ingredient	Material name	TWA	STEL	Peak	Notes
Australia Exposure Standards	benzene	Benzene	3.2 mg/m3 / 1 ppm	Not Available	Not Available	Not Available

EMERGENCY LIMITS

Ingredient	Material name	TEEL-1	TEEL-2	TEEL-3
petroleum crude oil	Petroleum distillates; petroleum ether; includes clay-treated light naphthenic [64742-45-6]; low boiling [68477-31-6]; petroleum extracts [64742-06-9]; petroleum base oil [64742-46-7]; petroleum 50 thinner, petroleum spirits [64475-85-0], Soltrol, VM&P naphtha [8032-32-4]; Ligroine, and paint solvent; petroleum paraffins C5-C20 [64771-72-8]; hydrotreated light naphthenic [64742-53-6]; solvent refined light naphthenic [64741-97-5]; and machine coolant 1	1,100 mg/m3	1,800 mg/m3	40,000 mg/m3
benzene	Benzene	Not Available	Not Available	Not Available

Ingredient	Original IDLH	Revised IDLH
petroleum crude oil	10,000 ppm	1,100 [LEL] ppm
benzene	3,000 ppm	500 ppm

MATERIAL DATA

NOTE E: Substances with specific effects on human health that are classified as carcinogenic, mutagenic and/ or toxic for reproduction in categories 1 or 2 are ascribed Note E if they are classified as very toxic (T+), toxic (T) or harmful (Xn). For these substances the risk phrases R20 ,R21, R22, R23, R24,R25, R26, R27, R28, R39, R68, R48 and R65 and all combinations of these risk phrases shall be proceeded by the word "Also".
R45-23: May cause cancer. Also toxic by inhalation
This note applies only to certain complex oil-derived substances in Annex VI.
European Union (EU) List of harmonised classification and labelling hazardous substances, Table 3.1, Annex VI, Regulation (EC) No 1272/2008 (CLP) - up to the latest ATP
NOTE M: The classification as a carcinogen need not apply if it can be shown that the substance contains less than 0.005% w/w benzo[a]pyrene (EINECS No 200-028-5). This note applies only to certain complex oil-derived substances in Annex IV.
European Union (EU) List of harmonised classification and labelling hazardous substances, Table 3.1, Annex VI, Regulation (EC) No 1272/2008 (CLP) - up to the latest ATP

Exposure controls

Appropriate engineering controls	Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection. The basic types of engineering controls are: Process controls which involve changing the way a job activity or process is done to reduce the risk. Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment. Ventilation can remove or dilute an air contaminant if designed properly. The design of a ventilation system must match the particular process and chemical or contaminant in use. Employers may need to use multiple types of controls to prevent employee overexposure.

Continued...

General exhaust is adequate under normal operating conditions. Local exhaust ventilation may be required in specific circumstances. If risk of overexposure exists, wear approved respirator. Correct fit is essential to obtain adequate protection. Provide adequate ventilation in warehouse or closed storage areas. Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

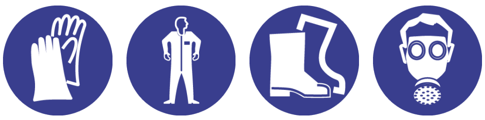
Type of Contaminant:	Air Speed:
solvent, vapours, degreasing etc., evaporating from tank (in still air).	0.25-0.5 m/s (50-100 f/min)
aerosols, fumes from pouring operations, intermittent container filling, low speed conveyer transfers, welding, spray drift, plating acid fumes, pickling (released at low velocity into zone of active generation)	0.5-1 m/s (100-200 f/min.)
direct spray, spray painting in shallow booths, drum filling, conveyer loading, crusher dusts, gas discharge (active generation into zone of rapid air motion)	1-2.5 m/s (200-500 f/min.)
grinding, abrasive blasting, tumbling, high speed wheel generated dusts (released at high initial velocity into zone of very high rapid air motion).	2.5-10 m/s (500-2000 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favourable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2 m/s (200-400 f/min) for extraction of solvents generated in a tank 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Personal protection



Eye and face protection

- Safety glasses with side shields.
- Chemical goggles.
- Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lenses or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59], [AS/NZS 1336 or national equivalent]

Skin protection

See Hand protection below

Hands/feet protection

- Wear chemical protective gloves, e.g. PVC.
- Wear safety footwear or safety gumboots, e.g. Rubber

The selection of suitable gloves does not only depend on the material, but also on further marks of quality which vary from manufacturer to manufacturer. Where the chemical is a preparation of several substances, the resistance of the glove material can not be calculated in advance and has therefore to be checked prior to the application.
The exact break through time for substances has to be obtained from the manufacturer of the protective gloves and has to be observed when making a final choice.
Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended.
Suitability and durability of glove type is dependent on usage. Important factors in the selection of gloves include:

- frequency and duration of contact,
- chemical resistance of glove material,
- glove thickness and
- dexterity

Select gloves tested to a relevant standard (e.g. Europe EN 374, US F739, AS/NZS 2161.1 or national equivalent).

- When prolonged or frequently repeated contact may occur, a glove with a protection class of 5 or higher (breakthrough time greater than 240 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended.
- When only brief contact is expected, a glove with a protection class of 3 or higher (breakthrough time greater

Continued...

	than 60 minutes according to EN 374, AS/NZS 2161.10.1 or national equivalent) is recommended. · Some glove polymer types are less affected by movement and this should be taken into account when considering gloves for long-term use. · Contaminated gloves should be replaced. For general applications, gloves with a thickness typically greater than 0.35 mm, are recommended. It should be emphasised that glove thickness is not necessarily a good predictor of glove resistance to a specific chemical, as the permeation efficiency of the glove will be dependent on the exact composition of the glove material. Therefore, glove selection should also be based on consideration of the task requirements and knowledge of breakthrough times. Glove thickness may also vary depending on the glove manufacturer, the glove type and the glove model. Therefore, the manufacturers' technical data should always be taken into account to ensure selection of the most appropriate glove for the task. Note: Depending on the activity being conducted, gloves of varying thickness may be required for specific tasks. For example: · Thinner gloves (down to 0.1 mm or less) may be required where a high degree of manual dexterity is needed. However, these gloves are only likely to give short duration protection and would normally be just for single use applications, then disposed of. · Thicker gloves (up to 3 mm or more) may be required where there is a mechanical (as well as a chemical) risk i.e. where there is abrasion or puncture potential Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturiser is recommended.
Body protection	See Other protection below
Other protection	▸ Overalls. ▸ PVC Apron. ▸ PVC protective suit may be required if exposure severe. ▸ Eyewash unit. ▸ Ensure there is ready access to a safety shower.
Thermal hazards	Not Available

Recommended material(s)

GLOVE SELECTION INDEX

Glove selection is based on a modified presentation of the:
"Forsberg Clothing Performance Index".
The effect(s) of the following substance(s) are taken into account in the ***computer-generated*** selection:
Tui Crude Oil

Material	CPI
PE/EVAL/PE	A
PVA	A
TEFLON	A
VITON	A
VITON/NEOPRENE	A
BUTYL	C
BUTYL/NEOPRENE	C
NATURAL RUBBER	C
NEOPRENE	C
NITRILE	C
NITRILE+PVC	C
PVC	C

* CPI - Chemwatch Performance Index
A: Best Selection
B: Satisfactory; may degrade after 4 hours continuous immersion
C: Poor to Dangerous Choice for other than short term immersion
NOTE: As a series of factors will influence the actual performance of the glove, a final selection must be based on detailed observation. -
* Where the glove is to be used on a short term, casual or infrequent basis, factors such as "feel" or convenience (e.g. disposability), may dictate a choice of gloves which might otherwise be unsuitable following long-term or frequent use. A qualified practitioner should be consulted.

Respiratory protection

Type AB-P Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

Where the concentration of gas/particulates in the breathing zone, approaches or exceeds the "Exposure Standard" (or ES), respiratory protection is required.
Degree of protection varies with both face-piece and Class of filter; the nature of protection varies with Type of filter.

Required Minimum Protection Factor	Half-Face Respirator	Full-Face Respirator	Powered Air Respirator
up to 10 x ES	AB-AUS P2	-	AB-PAPR-AUS / Class 1 P2
up to 50 x ES	-	AB-AUS / Class 1 P2	-
up to 100 x ES	-	AB-2 P2	AB-PAPR-2 P2 ^

^ - Full-face
A(All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 = Acid gas or hydrogen cyanide(HCN), B3 = Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO2), G = Agricultural chemicals, K = Ammonia(NH3), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 degC)

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Appearance	Oily flammable liquid with hydrocarbon odour; floats on water.

Physical state	Liquid	**Relative density (Water = 1)**	0.81
Odour	Not Available	**Partition coefficient n-octanol / water**	Not Available
Odour threshold	Not Available	**Auto-ignition temperature (°C)**	Not available.
pH (as supplied)	Not Applicable	**Decomposition temperature**	Not Available
Melting point / freezing point (°C)	Not Available	**Viscosity (cSt)**	3.136
Initial boiling point and boiling range (°C)	70	**Molecular weight (g/mol)**	Not Applicable
Flash point (°C)	42.5	**Taste**	Not Available
Evaporation rate	Not Available	**Explosive properties**	Not Available
Flammability	Flammable.	**Oxidising properties**	Not Available
Upper Explosive Limit (%)	Not available.	**Surface Tension (dyn/cm or mN/m)**	Not Available
Lower Explosive Limit (%)	Not available.	**Volatile Component (%vol)**	Not Available
Vapour pressure (kPa)	26.0	**Gas group**	Not Available
Solubility in water (g/L)	Immiscible	**pH as a solution (1%)**	Not Applicable
Vapour density (Air = 1)	>1	**VOC g/L**	7.91

SECTION 10 STABILITY AND REACTIVITY

Reactivity	See section 7
Chemical stability	‣ Unstable in the presence of incompatible materials. ‣ Product is considered stable. ‣ Hazardous polymerisation will not occur.
Possibility of hazardous reactions	See section 7
Conditions to avoid	See section 7
Incompatible materials	See section 7
Hazardous decomposition products	See section 5

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects

Inhaled	Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by narcosis, reduced alertness, loss of reflexes, lack of coordination and vertigo. High inhaled concentrations of mixed hydrocarbons may produce narcosis characterised by nausea, vomiting and lightheadedness. Inhalation of aerosols may produce severe pulmonary oedema, pneumonitis and pulmonary haemorrhage. Inhalation of petroleum hydrocarbons consisting substantially of low molecular weight species (typically C2-C12) may produce irritation of mucous membranes, incoordination, giddiness, nausea, vertigo, confusion, headache, appetite loss, drowsiness, tremors and anaesthetic stupor. Massive exposures may produce central nervous system depression with sudden collapse and deep coma; fatalities have been recorded. Irritation of the brain and/or apnoeic anoxia may produce convulsions. Although recovery following overexposure is generally complete, cerebral micro-haemorrhage of focal post-inflammatory scarring may produce epileptiform seizures some months after the exposure. Pulmonary episodes may include chemical pneumonitis with oedema and haemorrhage. The lighter hydrocarbons may produce kidney and neurotoxic effects. Pulmonary irritancy increases with carbon chain length for paraffins and olefins. Alkenes produce pulmonary oedema at high concentrations. Liquid paraffins may produce anaesthesia and depressant actions leading to weakness, dizziness, slow and shallow respiration, unconsciousness, convulsions and death. C5-7 paraffins may also produce polyneuropathy. Aromatic hydrocarbons accumulate in lipid rich tissues (typically the brain, spinal cord and peripheral nerves) and may produce functional impairment manifested by nonspecific symptoms such as nausea, weakness, fatigue and vertigo; severe exposures may produce inebriation or unconsciousness. Many of the petroleum hydrocarbons are cardiac

Continued...

	sensitisers and may cause ventricular fibrillations.
Ingestion	Accidental ingestion of the material may be damaging to the health of the individual. Ingestion of petroleum hydrocarbons may produce irritation of the pharynx, oesophagus, stomach and small intestine with oedema and mucosal ulceration resulting; symptoms include a burning sensation in the mouth and throat. Large amounts may produce narcosis with nausea and vomiting, weakness or dizziness, slow and shallow respiration, swelling of the abdomen, unconsciousness and convulsions. Myocardial injury may produce arrhythmias, ventricular fibrillation and electrocardiographic changes. Central nervous system depression may also occur. Light aromatic hydrocarbons produce a warm, sharp, tingling sensation on contact with taste buds and may anaesthetise the tongue. Aspiration into the lungs may produce coughing, gagging and a chemical pneumonitis with pulmonary oedema and haemorrhage.
Skin Contact	Repeated exposure may cause skin cracking, flaking or drying following normal handling and use. Skin contact with the material may damage the health of the individual; systemic effects may result following absorption. Limited evidence exists, or practical experience predicts, that the material either produces inflammation of the skin in a substantial number of individuals following direct contact, and/or produces significant inflammation when applied to the healthy intact skin of animals, for up to four hours, such inflammation being present twenty-four hours or more after the end of the exposure period. Skin irritation may also be present after prolonged or repeated exposure; this may result in a form of contact dermatitis (nonallergic). The dermatitis is often characterised by skin redness (erythema) and swelling (oedema) which may progress to blistering (vesiculation), scaling and thickening of the epidermis. At the microscopic level there may be intercellular oedema of the spongy layer of the skin (spongiosis) and intracellular oedema of the epidermis. The material may accentuate any pre-existing skin condition
Eye	Limited evidence exists, or practical experience suggests, that the material may cause eye irritation in a substantial number of individuals and/or is expected to produce significant ocular lesions which are present twenty-four hours or more after instillation into the eye(s) of experimental animals. Repeated or prolonged eye contact may cause inflammation characterised by temporary redness (similar to windburn) of the conjunctiva (conjunctivitis); temporary impairment of vision and/or other transient eye damage/ulceration may occur. Petroleum hydrocarbons may produce pain after direct contact with the eyes. Slight, but transient disturbances of the corneal epithelium may also result. The aromatic fraction may produce irritation and lachrymation.
Chronic	On the basis, primarily, of animal experiments, the material may be regarded as carcinogenic to humans. There is sufficient evidence to provide a strong presumption that human exposure to the material may result in cancer on the basis of: - appropriate long-term animal studies - other relevant information There is sufficient evidence to provide a strong presumption that human exposure to the material may result in the development of heritable genetic damage, generally on the basis of - appropriate animal studies, - other relevant information Repeated or prolonged exposure to mixed hydrocarbons may produce narcosis with dizziness, weakness, irritability, concentration and/or memory loss, tremor in the fingers and tongue, vertigo, olfactory disorders, constriction of visual field, paraesthesias of the extremities, weight loss and anaemia and degenerative changes in the liver and kidney. Chronic exposure by petroleum workers, to the lighter hydrocarbons, has been associated with visual disturbances, damage to the central nervous system, peripheral neuropathies (including numbness and paraesthesias), psychological and neurophysiological deficits, bone marrow toxicities (including hypoplasia possibly due to benzene) and hepatic and renal involvement. Chronic dermal exposure to petroleum hydrocarbons may result in defatting which produces localised dermatoses. Surface cracking and erosion may also increase susceptibility to infection by microorganisms. One epidemiological study of petroleum refinery workers has reported elevations in standard mortality ratios for skin cancer along with a dose-response relationship indicating an association between routine workplace exposure to petroleum or one of its constituents and skin cancer, particularly melanoma. Other studies have been unable to confirm this finding. Chronic exposure to benzene may cause headache, fatigue, loss of appetite and lassitude with incipient blood effects including anaemia and blood changes. Benzene is a myelotoxicant known to suppress bone- marrow cell proliferation and to induce haematologic disorders in humans and animals. Signs of benzene-induced aplastic anaemia include suppression of leukocytes (leukopenia), red cells (anaemia), platelets (thrombocytopenia) or all three cell types (pancytopenia). Classic symptoms include weakness, purpura, and haemorrhage. The most significant toxic effect is insidious and often reversible injury to the blood forming tissue. Leukaemia may develop. Occupational exposures have shown a relationship between exposure to benzene and production of myelogenous leukaemia. There may also be a relationship between benzene exposure and the production of lymphoma and multiple myeloma. In chronic exposure, workers exhibit signs of central nervous system lesions and impairment of hearing. Benzene haemotoxicity and leukaemogenicity involve metabolism, growth factor regulation, oxidative stress, DNA damage, cell regulation, and apoptosis. (Yoon et al Environmental Health Perspectives, 111, pp 1411-1420, 2003)

	TOXICITY	IRRITATION
Tui Crude Oil	Not Available	Not Available
petroleum crude oil	**TOXICITY**	**IRRITATION**
	Oral (rat) LD50: >4300 mg/kgd[2]	Eye (rabbit): 100 mg mild
		Skin (rabbit): 500 mg/24H Mild

Continued...

	TOXICITY	IRRITATION
benzene	dermal (mouse) LD50: 48 mg/kg[2]	Eye (rabbit): 2 mg/24h - SEVERE
	Inhalation (rat) LC50: 17500 ppm/7hr[2]	SKIN (rabbit):20 mg/24h - moderate
	Oral (rat) LD50: 690-1230 mg/kg[1]	
Legend:	*1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2.* Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances*	

PETROLEUM CRUDE OIL

The materials included in the Lubricating Base Oils category are related from both process and physical-chemical perspectives;
The potential toxicity of a specific distillate base oil is inversely related to the severity or extent of processing the oil has undergone, since:

- The adverse effects of these materials are associated with undesirable components, and
- The levels of the undesirable components are inversely related to the degree of processing;
- Distillate base oils receiving the same degree or extent of processing will have similar toxicities;
- The potential toxicity of *residual base oils* is independent of the degree of processing the oil receives.
- The reproductive and developmental toxicity of the distillate base oils is inversely related to the degree of processing.

Unrefined & mildly refined distillate base oils contain the highest levels of undesirable components, have the largest variation of hydrocarbon molecules and have shown the highest potential carcinogenic and mutagenic activities. Highly and severely refined distillate base oils are produced from unrefined and mildly refined oils by removing or transforming undesirable components. In comparison to unrefined and mildly refined base oils, the highly and severely refined distillate base oils have a smaller range of hydrocarbon molecules and have demonstrated very low mammalian toxicity. Mutagenicity and carcinogenicity testing of residual oils has been negative, supporting the belief that these materials lack biologically active components or the components are largely non-bioavailable due to their molecular size.
Toxicity testing has consistently shown that lubricating base oils have low acute toxicities. Numerous tests have shown that a lubricating base oil's mutagenic and carcinogenic potential correlates with its 3-7 ring polycyclic aromatic compound (PAC) content, and the level of DMSO extractables (e.g. IP346 assay), both characteristics that are directly related to the degree/conditions of processing
for Unrefined and Mildly Refined Distillate Base Oils
Acute toxicity: LD50s of >5000 mg/kg (bw) and >2g/kg (bw) for the oral and dermal routes of exposure, respectively, have been observed in rats dosed with an unrefined light paraffinic distillate The same material was also reported to be "moderately irritating" to the skin of rabbits. When tested for eye irritation in rabbits, the material produced Draize scores of 3.0 and 4.0 (unwashed/washed eyes) at 24 hours, with the scores returning to zero by 48 hours. The material was reported to be "not sensitising" when tested in guinea pigs
Repeat dose toxicity: 200, 1000 and 2000 mg/kg (bw)/day of an unrefined base oil has been applied undiluted to the skin of male and female rabbit.. The test material was applied to the rabbits' skins 3 times/week for 4 weeks. To ensure maximum exposure, the applied material was covered with an occlusive dressing for 6 hours. In the high dose group, body weight gains were affected by treatment. These effects were largely due to effects on growth rate during the first week of the study. There were no significant differences between treated and control groups for any of the recorded haematological and clinical chemistry values. Gross and microscopic pathology findings relating to the treated skin were seen in all rabbits in the highest dose group. The findings consisted of "slight" to "moderate" proliferative changes in the treated skin.
Reproductive/ developmental toxicity No reproductive or developmental toxicity studies have been reported for unrefined & mildly refined distillate base oils. However, a developmental toxicity screening study has been reported for heavy vacuum gas oil, a material with a process history similar to the unrefined distillate base oils.. As an unrefined vacuum distillate material, heavy vacuum gas oil contains the broadest spectrum of chemical components and highest concentration of bioavailable and/or biologically active components Because of their lack of or low level of processing, in comparison to other refined base oils. the unrefined lubricating base oils will also have higher concentrations of bioavailable and/or biologically active components.
Heavy vacuum gas oil was applied daily to the skin of pregnant rats on days 0-19 of gestation. Dose levels administered included: 30, 125, 500 and 1000 mg/kg (bw)/day. All animals were euthanised on day 20. In the dams, the only dose-related finding at gross necropsy was pale colored lungs in four animals in the highest dose group and in one animal in the 500 mg/kg (bw)/day group. Mean thymus weights of the dams in the highest dose group were approximately half those of the control groups. Although absolute liver weights were unaffected by exposure to the gas oil, mean relative liver weights were increased (approximately 15%) in groups exposed to doses greater than 125 mg/kg (bw)/day. Maternal and foetal body weights were reduced at 500 and 1000 mg/kg (bw)/day. Significant increases in resorptions were also seen in these two dose groups. Soft tissue variations and malformations, and skeletal malformations were also increased at 500 and 1000 mg/kg
Genotoxicity: Modified Ames assays have been carried out on a number of base oils that were either unrefined or poorly refined. The oils were found to be mutagenic, with a strong correlation between mutagenicity and 3-7 ring PAC content.
Carcinogenicity: The general conclusions that can drawn from the animal carcinogenicity studies are potential skin carcinogens. When applied repeatedly to the skin, carcinogenic base oils are associated only with skin tumours and not with an increase in systemic tumours
No significant acute toxicological data identified in literature search.
for petroleum:
This product contains benzene which is known to cause acute myeloid leukaemia and n-hexane which has been shown to metabolize to compounds which are neuropathic.
This product contains toluene. There are indications from animal studies that prolonged exposure to high concentrations of toluene may lead to hearing loss.
This product contains ethyl benzene and naphthalene from which there is evidence of tumours in rodents
Carcinogenicity: Inhalation exposure to mice causes liver tumours, which are not considered relevant to humans. Inhalation

Continued...

	exposure to rats causes kidney tumours which are not considered relevant to humans. **Mutagenicity:** There is a large database of mutagenicity studies on gasoline and gasoline blending streams, which use a wide variety of endpoints and give predominantly negative results. All in vivo studies in animals and recent studies in exposed humans (e.g. petrol service station attendants) have shown negative results in mutagenicity assays. **Reproductive Toxicity:** Repeated exposure of pregnant rats to high concentrations of toluene (around or exceeding 1000 ppm) can cause developmental effects, such as lower birth weight and developmental neurotoxicity, on the foetus. However, in a two-generation reproductive study in rats exposed to gasoline vapour condensate, no adverse effects on the foetus were observed. **Human Effects:** Prolonged/ repeated contact may cause defatting of the skin which can lead to dermatitis and may make the skin more susceptible to irritation and penetration by other materials. Lifetime exposure of rodents to gasoline produces carcinogenicity although the relevance to humans has been questioned. Gasoline induces kidney cancer in male rats as a consequence of accumulation of the alpha2-microglobulin protein in hyaline droplets in the male (but not female) rat kidney. Such abnormal accumulation represents lysosomal overload and leads to chronic renal tubular cell degeneration, accumulation of cell debris, mineralisation of renal medullary tubules and necrosis. A sustained regenerative proliferation occurs in epithelial cells with subsequent neoplastic transformation with continued exposure. The alpha2-microglobulin is produced under the influence of hormonal controls in male rats but not in females and, more importantly, not in humans. The material may be irritating to the eye, with prolonged contact causing inflammation. Repeated or prolonged exposure to irritants may produce conjunctivitis. The substance is classified by IARC as Group 3: **NOT** classifiable as to its carcinogenicity to humans. Evidence of carcinogenicity may be inadequate or limited in animal testing. Tumorigenic - Carcinogenic by RTECS criteria.
BENZENE	**WARNING:** This substance has been classified by the IARC as Group 1: **CARCINOGENIC TO HUMANS**. Inhalation (man) TCLo: 150 ppm/1y - I
PETROLEUM CRUDE OIL & BENZENE	The material may cause skin irritation after prolonged or repeated exposure and may produce a contact dermatitis (nonallergic). This form of dermatitis is often characterised by skin redness (erythema) and swelling the epidermis. Histologically there may be intercellular oedema of the spongy layer (spongiosis) and intracellular oedema of the epidermis.

Acute Toxicity	⃠	**Carcinogenicity**	✔
Skin Irritation/Corrosion	⃠	**Reproductivity**	⃠
Serious Eye Damage/Irritation	⃠	**STOT - Single Exposure**	✔
Respiratory or Skin sensitisation	⃠	**STOT - Repeated Exposure**	⃠
Mutagenicity	✔	**Aspiration Hazard**	✔

Legend: ✘ *– Data available but does not fill the criteria for classification*
✔ *– Data available to make classification*
⃠ *– Data Not Available to make classification*

SECTION 12 ECOLOGICAL INFORMATION

Toxicity

Tui Crude Oil

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable

petroleum crude oil

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.00746mg/L	4
EC50	48	Crustacea	0.058mg/L	4
BCF	96	Fish	0.2mg/L	4
EC20	168	Crustacea	0.11mg/L	4
NOEC	168	Crustacea	<=0.05mg/L	4

benzene

ENDPOINT	TEST DURATION (HR)	SPECIES	VALUE	SOURCE
LC50	96	Fish	0.00528mg/L	4
EC50	48	Crustacea	9.23mg/L	4
EC50	72	Algae or other aquatic plants	29mg/L	4
BCF	24	Algae or other aquatic plants	10mg/L	4

Continued...

	EC50	24	Crustacea	1.59mg/L	5
	NOEC	480	Crustacea	ca.0.17mg/L	1
Legend:	*Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 (QSAR) - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data*				

Very toxic to aquatic organisms.
for crude petroleum oil:
Environmental fate:
The processes determining the fate of oil in seawater are reasonably well understood.
Initially, the oil spreads out as a film on the sea surface as a result of wind and wave action. The more volatile, lower molecular weight hydrocarbons are lost by evaporation. Polar compounds and the mono-aromatic hydrocarbons have an appreciable water solubility and are taken into solution. A key ancillary process is that of emulsification, since crude oil has a natural tendency to form emulsions in sea water. Such emulsions are usually of the oil-in-water type, but may also be of the water-in-oil type.
The latter are often of the intractable 'chocolate mousse' type. Significant amounts of crude oil, particularly the higher molecular weight compounds, sink naturally, rolling along the ocean bottom picking up sand and shells and forming tarry balls which are resistant to degradation by any method.
Hydrocarbons may also reach the bottom sediments by sorption onto suspended particles which ultimately settle on the sea floor. Spilt oil also undergoes chemical changes, particularly oxidation by free radical mechanisms initiated by sunlight.
The initial products of such reactions are hydroperoxides, and these in turn form compounds such as alcohols, acids and aldehydes, many of which have an appreciable water solubility. Polymerization also occurs to yield intractable tarry materials.
The bulk of spilt crude oil is biodegraded by the micro-organisms present in sea water. Emulsification to form oil-in-water emulsions yields small particles of crude oil that are biodegraded by bacteria, yeasts, fungi and actinomycetes. Many factors influence the rate of biodegradation, in particular temperature, dissolved oxygen concentration and the availability of nitrogen and phosphorus nutrients. Adapted micro-organisms are often found in ocean areas where crude oil spills are common. It has calculated that where an adapted microbial population is available in well-aerated sea water at 20 to 30 °C, the rate of crude oil oxidation ranges from 0.02 to 0.2 g of oil oxidized/m2/day. Experimentally it has been determined that complete oxidation of 1.0 mg of hydrocarbon requires between 3 and 4 g of oxygen, i.e. it has a BOD of 3 to 4 mg oxygen/mg. Since the oxygen content of sea water is between 6 and 11 mg/liter, depending on salinity and temperature, this means that about 320 000 litres of sea water is required to oxidise one liter of crude oil. Crude oil contains hydrocarbons of well-defined generic types that are biodegraded at different rates. n-Alkanes are readily degraded in sea water, since many micro-organisms can utilize them. Branched-chain or iso-alkanes are less readily biodegraded but they do ultimately biodegrade. The degradation of cycloalkanes has not been extensively studied, but the ring structure is resistant to biodegradation. Aromatic hydrocarbons are also resistant to biodegradation, but a few micro-organisms are able to utilize them. High molecular weight compounds, the tars and asphaltenes, degrade very slowly..
Ecotoxicity:
The effects of crude and refined oils on organisms found in fresh and sea water ha been extensively reviewed.
sea water. Where spillages occur the non-mobile species suffer the greatest mortality, whereas fish species can often escape from the affected region. The extent of the initial mortality depends on the chemical nature of the oil, the location, and the physical conditions, particularly the temperature and wind velocity. Most affected freshwater and marine communities recover from the effects of an oil spill within a year. The occurrence of biogenic hydrocarbons in the world's oceans is well recorded. They have the characteristic isoprenoid structure, and measurements made in water columns indicate a background concentration of 1.0 to 10 ul/l. The higher molecular weight materials are dispersed as particles, with the highest concentrations of about 20 ul/l occurring in the top 3 mm layer of water.
A wide variation in the response of organisms to oil exposures has been noted. The larvae of fish and crustaceans appear to be most susceptible to the water-soluble fraction of crude oil. Exposures of plankton and algae have indicated that certain species of diatoms and green algae are inhibited, whereas microflagellates are not.
For the most part, molluscs and most intertidal worm species appear to be tolerant of oil contamination.
for lubricating oil base stocks:
Vapor Pressure Vapor pressures of lubricating base oils are reported to be negligible. In one study, the experimentally measured vapour pressure of a solvent-dewaxed heavy paraffinic distillate base oil was 1.7 x 10exp-4 Pa . Since base oils are mixtures of C15 to C50 paraffinic, naphthenic, and aromatic hydrocarbon isomers, representative components of those structures were selected to calculate a range of vapor pressures. The estimated vapor pressure values for these selected components of base oils ranged from 4.5 x 10exp-1 Pa to 2 x 10exp-13Pa. Based on Dalton's Law the expected total vapour pressure for base oils would fall well below minimum levels (10exp-5 Pa) of recommended experimental procedures.
Partition Coefficient (log Kow): In mixtures such as the base oils, the percent distribution of the hydrocarbon groups (i.e., paraffins, naphthenes, and aromatics) and the carbon chain lengths determines in-part the partitioning characteristics of the mixture. Generally, hydrocarbon chains with fewer carbon atoms tend to have lower partition coefficients than those with higher carbon numbers .However, due to their complex composition, unequivocal determination of the log Kow of these hydrocarbon mixtures cannot be made. Rather, partition coefficients of selected C15 chain-length hydrocarbon structures representing paraffinic, naphthenic, and aromatic constituents in base oil lubricants were modelled . Results showed typical log Kow values from 4.9 to 7.7, which were consistent with values of >4 for lubricating oil basestocks
Water Solubility: When released to water, base oils will float and spread at a rate that is viscosity dependent. While water solubility of base oils is typically very low, individual hydrocarbons exhibit a wide range of solubility depending on molecular weight and degree of unsaturation. Decreasing molecular weight (i.e., carbon number) and increasing levels of unsaturation increases the water solubility of these materials. As noted for partition coefficient, the water solubility of lubricating base oils cannot be determined due to their complex mixture characteristics. Therefore, the water solubility of individual C15 hydrocarbons representing the different groups making up base oils (i.e., linear and branched paraffins, naphthenes, and aromatics) was modelled. Based on water solubility modelling of those groups, aqueous solubilities are typically much less than 1 ppm. (0.003-0.63 mg/l)
Environmental Fate:
Photodegradation: Chemicals having potential to photolyse have UV/visible absorption maxima in the range of 290 to 800 nm. Some chemicals have absorption maxima significantly below 290 nm and consequently cannot undergo direct photolysis in sunlight (e.g. chemicals such as alkanes, alkenes, alkynes, saturated alcohols, and saturated acids). Most hydrocarbon constituents of the materials in this category are not expected to photolyse since they do not show absorbance within the 290-800 nm range. However, photodegradation of polyaromatic hydrocarbons (PAHs) can occur and may be a significant degradation pathway for these constituents of lubricating base oils. The degree and rate at which PAHs may photodegrade depend upon whether conditions allow penetration of light with sufficient energy to effect a change. For example,polycyclic aromatic compounds (PAC) compounds bound to sediments may persist due to a lack of sufficient light penetration
Atmospheric gas-phase reactions can occur between organic chemicals and reactive molecules such as photochemically produced hydroxyl radicals,

Continued...

ozone and nitrogen oxides. Atmospheric oxidation as a result of radical attack is not direct photochemical degradation, but indirect degradation. In general, lubricating base oils have low vapour pressures and volatilisation is not expected to be a significant removal mechanism for the majority of the hydrocarbon components. However, some components (e.g., C15 branched paraffins and naphthenes) appear to have the potential to volatilise Atmospheric half-lives of 0.10 to 0.66 days have been calculated for representative C15 hydrocarbon components of lubricating base oils
Stability in Water: Chemicals that have a potential to hydrolyze include alkyl halides, amides, carbamates, carboxylic acid esters and lactones, epoxides, phosphate esters, and sulfonic acid esters. Because lubricating base oils do not contain significant levels of these functional groups, materials in the lubricating base oils category are not subject to hydrolysis
Chemical Transport and Distribution in the Environment : Based on the physical-chemical characteristics of component hydrocarbons in lubricating base oils, the lower molecular weight components are expected to have the highest vapour pressures and water solubilities, and the lowest partition coefficients. These factors enhance the potential for widespread distribution in the environment. To gain an understanding of the potential transport and distribution of lubricating base oil components, the EQC (Equilibrium Criterion) model was used to characterize the environmental distribution of different C15 compounds representing different structures found in lube oils (e.g., paraffins, naphthenes, and aromatics). The modelling found partitioning to soil or air is the ultimate fate of these C15 compounds. Aromatic compounds partition principally to soil. Linear paraffins partition mostly to soil, while branching appears to allow greater distribution to air. Naphthenes distribute to both soil and air, with increasing proportions in soil for components with the greater number of ring structures. Because the modelling does not take into account degradation factors, levels modelled in the atmosphere are likely overstated in light of the tendency for indirect photodegradation to occur.
Biodegradation: The extent of biodegradation measured for a particular lubricating oil basestock is dependent not only on the procedure used but also on how the sample is presented in the biodegradation test. Lubricant base oils typically are not readily biodegradable in standard 28-day tests. However, since the oils consist primarily of hydrocarbons that are ultimately assimilated by microorganisms, and therefore inherently biodegradable. Twenty-eight biodegradability studies have been reported for a variety of lubricating base oils. Based on the results of ultimate biodegradability tests using modified Sturm and manometric respirometry testing the base oils are expected to be, for the most part, inherently biodegradable. Biodegradation rates found using the modified Sturm procedure ranged from 1.5 to 29%. Results from the manometric respirometry tests on similar materials showed biodegradation rates from 31 to 50%. Biodegradation rates measured in 21-day CEC tests for similar materials ranged from 13 to 79%.
Ecotoxicity:
Numerous acute studies covering fish, invertebrates, and algae have been conducted to assess the ecotoxicity of various lubricating base oils. None of these studies have shown evidence of acute toxicity to aquatic organisms. Eight, 7-day exposure studies using rainbow trout failed to demonstrate toxicity when tested up to the maximum concentration of 1000 mg/L applied as dispersions. Three, 96-hour tests with rainbow trout also failed to show any toxic effects when tested up to 1000 mg/L applied as dispersions. Similarly, three 96-hour tests with fathead minnows at a maximum test concentration of 100 mg/L water accommodated fractions (WAF) showed no adverse effects. Two species of aquatic invertebrates (Daphnia magna and Gammarus sp.) were exposed to WAF solutions up to 10,000 mg/L for 48 and 96-hours, respectively, with no adverse effects being observed. Four-day exposures of the freshwater green alga (Scenedesmus subspicatus) to 500 mg/L WAF solutions failed to show adverse effects on growth rate and algal cell densities in four studies
Multiple chronic ecotoxicity studies have shown no adverse effects to daphnid survival or reproduction. In 10 of 11 chronic studies, daphnids were exposed for 21 days to WAF preparations of lubricating base oils with no ill effects on survival or reproduction at the maximum concentration of 1000 mg/L. One test detected a reduction in reproduction at 1000 mg/L. Additional data support findings of no chronic toxicity to aquatic invertebrates and fish. No observed effect levels ranged from 550 to 5,000 mg/L when tested as either dispersions or WAFs.
The data described above are supported by studies on a homologous series of alkanes. The author concluded that the water solubility of carbon chains .C10 is too limited to elicit acute toxicity. This also was shown for alkylbenzene compounds having carbon numbers .C15. Since base oils consist of carbon compounds of C15 to C50, component hydrocarbons that are of acute toxicological concern are, for the most part, absent in these materials. Similarly, due to their low solubility, the alkylated two to three ring polyaromatic components in base oils are not expected to cause acute or chronic toxicity. This lack of toxicity is borne out in the results of the reported studies.
The effects of crude and refined oils on organisms found in fresh and sea water ha been extensively reviewed.
sea water. Where spillages occur the non-mobile species suffer the greatest mortality, whereas fish species can often escape from the affected region. The extent of the initial mortality depends on the chemical nature of the oil, the location, and the physical conditions, particularly the temperature and wind velocity. Most affected freshwater and marine communities recover from the effects of an oil spill within a year. The occurrence of biogenic hydrocarbons in the world's oceans is well recorded. They have the characteristic isoprenoid structure, and measurements made in water columns indicate a background concentration of 1.0 to 10 ul/l. The higher molecular weight materials are dispersed as particles, with the highest concentrations of about 20 ul/l occurring in the top 3 mm layer of water.
A wide variation in the response of organisms to oil exposures has been noted. The larvae of fish and crustaceans appear to be most susceptible to the water-soluble fraction of crude oil. Exposures of plankton and algae have indicated that certain species of diatoms and green algae are inhibited, whereas microflagellates are not.
For the most part, molluscs and most intertidal worm species appear to be tolerant of oil contamination.
DO NOT discharge into sewer or waterways.

Persistence and degradability

Ingredient	Persistence: Water/Soil	Persistence: Air
benzene	HIGH (Half-life = 720 days)	LOW (Half-life = 20.88 days)

Bioaccumulative potential

Ingredient	Bioaccumulation
benzene	HIGH (BCF = 4360)

Mobility in soil

Ingredient	Mobility
benzene	LOW (KOC = 165.5)

Continued...

SECTION 13 DISPOSAL CONSIDERATIONS

Waste treatment methods

Product / Packaging disposal	▸ Recycle wherever possible or consult manufacturer for recycling options. ▸ Consult State Land Waste Authority for disposal. ▸ Bury or incinerate residue at an approved site. ▸ Recycle containers if possible, or dispose of in an authorised landfill.

SECTION 14 TRANSPORT INFORMATION

Labels Required

	
Marine Pollutant	
HAZCHEM	3W

Land transport (ADG)

UN number	1267
UN proper shipping name	PETROLEUM CRUDE OIL
Transport hazard class(es)	Class: 3 Subrisk: Not Applicable
Packing group	III
Environmental hazard	Not Applicable
Special precautions for user	Special provisions: 223 357 Limited quantity: 5 L

Air transport (ICAO-IATA / DGR)

UN number	1267
UN proper shipping name	PETROLEUM CRUDE OIL
Transport hazard class(es)	ICAO/IATA Class: 3 ICAO / IATA Subrisk: Not Applicable ERG Code: 3L
Packing group	III
Environmental hazard	Not Applicable
Special precautions for user	Special provisions: A3A177 Cargo Only Packing Instructions: 366 Cargo Only Maximum Qty / Pack: 220 L Passenger and Cargo Packing Instructions: 355 Passenger and Cargo Maximum Qty / Pack: 60 L Passenger and Cargo Limited Quantity Packing Instructions: Y344 Passenger and Cargo Limited Maximum Qty / Pack: 10 L

Sea transport (IMDG-Code / GGVSee)

UN number	1267

UN proper shipping name	Petroleum crude oil
Transport hazard class(es)	IMDG Class: 3 IMDG Subrisk: Not Applicable
Packing group	III
Environmental hazard	Marine Pollutant
Special precautions for user	EMS Number: F-E, S-E Special provisions: 223 357 Limited Quantities: 5 L

Transport in bulk according to Annex II of MARPOL and the IBC code

Not Applicable

SECTION 15 REGULATORY INFORMATION

Safety, health and environmental regulations / legislation specific for the substance or mixture

PETROLEUM CRUDE OIL(8002-05-9) IS FOUND ON THE FOLLOWING REGULATORY LISTS

Australia Exposure Standards
Australia Hazardous Substances Information System - Consolidated Lists
Australia Inventory of Chemical Substances (AICS)
International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs

BENZENE(71-43-2) IS FOUND ON THE FOLLOWING REGULATORY LISTS

Australia - New South Wales Work Health and Safety Regulation 2011 Restricted carcinogens
Australia - Northern Territories Work Health and Safety National Uniform Legislation Regulations- Restricted carcinogens
Australia - Queensland Work Health and Safety Regulation - Restricted Carcinogens
Australia - South Australia - Work Health and Safety Regulations 2012 - Restricted carcinogens
Australia - Tasmania - Work Health and Safety Regulations 2012 - Restricted carcinogens
Australia - Western Australia Carcinogenic substances to be used only for purposes approved by the Commissioner
Australia Exposure Standards
Australia Hazardous Substances Information System - Consolidated Lists
Australia Inventory of Chemical Substances (AICS)
Australia Work Health and Safety Regulations 2016 - Hazardous chemicals (other than lead) requiring health monitoring
Australia Work Health and Safety Regulations 2016 - Restricted carcinogens
International Agency for Research on Cancer (IARC) - Agents Classified by the IARC Monographs

National Inventory	Status
Australia - AICS	Y
Canada - DSL	Y
Canada - NDSL	N (benzene; petroleum crude oil)
China - IECSC	N (petroleum crude oil)
Europe - EINEC / ELINCS / NLP	Y
Japan - ENCS	N (petroleum crude oil)
Korea - KECI	Y
New Zealand - NZIoC	Y
Philippines - PICCS	Y
USA - TSCA	Y
Legend:	*Y = All ingredients are on the inventory* *N = Not determined or one or more ingredients are not on the inventory and are not exempt from listing(see specific ingredients in brackets)*

SECTION 16 OTHER INFORMATION

Other information

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

Continued...

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

Definitions and abbreviations

PC－TWA: Permissible Concentration-Time Weighted Average
PC－STEL: Permissible Concentration-Short Term Exposure Limit
IARC: International Agency for Research on Cancer
ACGIH: American Conference of Governmental Industrial Hygienists
STEL: Short Term Exposure Limit
TEEL: Temporary Emergency Exposure Limit。
IDLH: Immediately Dangerous to Life or Health Concentrations
OSF: Odour Safety Factor
NOAEL :No Observed Adverse Effect Level
LOAEL: Lowest Observed Adverse Effect Level
TLV: Threshold Limit Value
LOD: Limit Of Detection
OTV: Odour Threshold Value
BCF: BioConcentration Factors
BEI: Biological Exposure Index

SAFETY DATA SHEET

ERIFON HD 603 HP NO DYE (NZ)

Infosafe No.: LQ92A
ISSUED Date : 19/09/2018
ISSUED by: MACDERMID OFFSHORE SOLUTIONS

1. IDENTIFICATION

GHS Product Identifier
ERIFON HD 603 HP NO DYE (NZ)

Company Name
MACDERMID OFFSHORE SOLUTIONS (ABN 84 133 834 812)

Address
29 Dennis Street Campbellfield,
VIC 3061 Australia

Telephone/Fax Number
Tel: +61 3 9303 5150

Emergency phone number
+61 3 9303 5150 (9-5pm)

Recommended use of the chemical and restrictions on use
Open loop BOP fluid.

Disclaimer
MacDermid Offshore Solutions is the trading name of MacDermid Canning Limited.

2. HAZARD IDENTIFICATION

GHS classification of the substance/mixture
Classified as Hazardous according to the Hazardous Substances (Minimum Degrees of Hazard) Regulations 2001, New Zealand.
Not classified as Dangerous Goods for transport according to the New Zealand Standard NZS 5433:2012 Transport of Dangerous Goods on Land.
6.1D (Oral) - Substance that is acutely toxic
6.3A Substance that is irritating to the skin
6.9A (Single exposure) - Substance that is toxic to human target organs or systems
6.9A (Repeated exposure) - Substance that is toxic to human target organs or systems
8.3A Substance that is corrosive to ocular tissue
9.1C Substance that is harmful in the aquatic environment
9.3C Substance that is harmful to terrestrial vertebrates

Signal Word (s)
DANGER

Hazard Statement (s)
H302 Harmful if swallowed.
H315 Causes skin irritation.
H318 Causes serious eye damage.
H370 Causes damage to organs (kidney, nervous system) by ingestion.
H372 Causes damage to organs (kidney) through prolonged or repeated exposure by ingestion.
H412 Harmful to aquatic life with long lasting effects.
H433 Harmful to terrestrial vertebrates.

Pictogram (s)
Exclamation mark,Health hazard,Corrosion

Precautionary statement – Prevention
P102 Keep out of reach of children.
P103 Read label before use.
P260 Do not breathe dust/fume/gas/mist/vapours/spray.
P264 Wash contaminated skin thoroughly after handling.
P270 Do not eat, drink or smoke when using this product.
P273 Avoid release to the environment.
P280 Wear protective gloves/protective clothing/eye protection/face protection.

Precautionary statement – Response
P101 If medical advice is needed, have product container or label at hand.
P301+P312 IF SWALLOWED: Call a POISON CENTER or doctor/physician if you feel unwell.
P330 Rinse mouth.
P302+P352 IF ON SKIN: Wash with plenty of soap and water.
P332+P313 If skin irritation occurs: Get medical advice/attention.
P362 Take off contaminated clothing and wash before reuse.
P305+P351+P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P310 Immediately call a POISON CENTER or doctor/physician.
P314 Get medical advice/attention if you feel unwell.

Precautionary statement – Disposal
P501 In the case of a substance that is in compliance with a HSNO approval other than a Part 6A (Group Standards) approval, a label must provide a description of one or more appropriate and achievable methods for the disposal of a substance in accordance with the Hazardous Substances (Disposal) Regulations 2001. This may also include any method of disposal that must be avoided. See Section 13 for disposal details.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredients

Name	CAS	Proportion
Ethylene glycol	107-21-1	25-<35 %
Amides, tall-oil fatty, N,N-bis(hydroxyethyl)	68155-20-4	10-<20 %
Decanoic Acid	334-48-5	5-<10 %
Diethanolamine	111-42-2	5-<7 %
N,N'-methylene-bis [5-methyloxazolidine]	66204-44-2	1-<3 %
Ingredients determined not to be hazardous, including water.		Balance

4. FIRST-AID MEASURES

Inhalation
If inhaled, remove affected person from contaminated area. Keep at rest until recovered. If symptoms develop and/or persist seek medical attention.

Ingestion
Do not induce vomiting. Wash out mouth thoroughly with water. Seek immediate medical attention.

Skin
Remove all contaminated clothing immediately. Wash affected area thoroughly with soap and water. Wash contaminated clothing before reuse or discard. Seek medical attention.

Eye contact
If in eyes, hold eyelids apart and flush the eyes continuously with running water. Remove contact lenses. Continue flushing until advised to stop by the Poisons Information Centre or a doctor, or for at least 15 minutes. Seek immediate medical attention.

First Aid Facilities
Eyewash, safety shower and normal washroom facilities.

Advice to Doctor
Treat symptomatically.

Other Information
For advice in an emergency, contact a Poisons Information Centre or a doctor at once. (0800 764 766)

5. FIRE-FIGHTING MEASURES

Suitable Extinguishing Media
Use appropriate fire extinguisher for surrounding environment.

Hazards from Combustion Products
Under fire conditions this product may emit toxic and/or irritating fumes, smoke and gases including carbon monoxide, carbon dioxide and oxides of nitrogen.

Specific Hazards Arising From The Chemical
Following evaporation of the aqueous component under fire conditions, the non-aqueous component may decompose and/or burn.

Decomposition Temperature
Not available

Precautions in connection with Fire
Fire fighters should wear full protective clothing and self-contained breathing apparatus (SCBA) operated in positive pressure mode. Fight fire from safe location.

6. ACCIDENTAL RELEASE MEASURES

Emergency Procedures
Wear appropriate personal protective equipment and clothing to prevent exposure. If possible contain the spill. Place inert absorbent material onto spillage. Collect the material and place into a suitable labelled container. Do not dilute material but contain. Dispose of waste according to the applicable local and national regulations. If contamination of sewers or waterways occurs inform the local water and waste management authorities in accordance with local regulations.

7. HANDLING AND STORAGE

Precautions for Safe Handling
Avoid inhalation of vapours and mists, and skin or eye contact. Use only in a well ventilated area. Keep containers sealed when not in use. Prevent the build up of mists or vapours in the work atmosphere. Maintain high standards of personal hygiene i.e. Washing hands prior to eating, drinking, smoking or using toilet facilities.

Conditions for safe storage, including any incompatibilities
Store in a cool, dry, well-ventilated area, out of direct sunlight. Protect from freezing. Store in suitable, labelled containers. Keep containers tightly closed. Store away from incompatible materials. Ensure that storage conditions comply with applicable local and national regulations.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Occupational exposure limit values
No exposure value assigned for this material. However, the available exposure limits for ingredients are listed below:

Ethylene glycol

TWA: 50 ppm, 127 mg/m³ (Vapour and mist)
Notices: Ceiling.

Diethanolamine
TWA: 3 ppm, 13 mg/m³

TWA (Time Weighted Average): The average airborne concentration of a particular substance when calculated over a normal eight-hour working day, for a five-day week.
Ceiling: A concentration that should not be exceeded during any part of the working day.

Source: Workplace Exposure Standards and Biological Exposure Indices.

Biological Limit Values
No biological limits allocated.

Appropriate Engineering Controls
This substance is hazardous and should be used with a local exhaust ventilation system, drawing vapours away from workers' breathing zone. If the engineering controls are not sufficient to maintain concentrations of vapours/mists below the exposure standards, suitable respiratory protection must be worn.

Respiratory Protection
If engineering controls are not effective in controlling airborne exposure then an approved respirator with a replaceable vapor/mist filter should be used. Refer to relevant regulations for further information concerning respiratory protective requirements.
Reference should be made to Australian Standards AS/NZS 1715 (2009), Selection, Use and Maintenance of Respiratory Protective Devices; and AS/NZS 1716 (2012), Respiratory Protective Devices, in order to make any necessary changes for individual circumstances.

Eye Protection
Safety glasses with full face shield should be used. Eye protection devices should conform to relevant regulations.
Eye protection should conform with Australian/New Zealand Standard AS/NZS 1337 2 & 6 (2012) - Eye Protectors for Industrial Applications.

Hand Protection
Wear gloves of impervious material such as nitrile, latex rubber or neoprene (>8 hours breakthrough time). Final choice of appropriate gloves will vary according to individual circumstances. i.e. methods of handling or according to risk assessments undertaken. Occupational protective gloves should conform to relevant regulations.
Reference should be made to AS/NZS 2161.1 (2016): Occupational protective gloves - Selection, use and maintenance.

Body Protection
Suitable protective work wear, e.g. cotton overalls buttoned at neck and wrist is recommended. Chemical resistant apron is recommended where large quantities are handled.

9. PHYSICAL AND CHEMICAL PROPERTIES

Properties	Description	Properties	Description
Form	Liquid	**Appearance**	Liquid
Colour	Amber	**Odour**	Amine-like
Decomposition Temperature	Not available	**Melting Point**	Not available
Boiling Point	100 °C	**Solubility in Water**	Not available
pH	10	**Vapour Pressure**	Not available
Vapour Density (Air=1)	Not available	**Evaporation Rate**	Not available
Odour Threshold	Not available	**Viscosity**	20 cSt (20 °C)
Partition Coefficient: n-octanol/water	Not available	**Density**	1.06 g/cm³ (20 °C)
Flash Point	Not available	**Flammability**	Non flammable
Auto-Ignition Temperature	Not applicable	**Flammable Limits - Lower**	Not available
Flammable Limits - Upper	Not available		

10. STABILITY AND REACTIVITY

Chemical Stability
Stable under normal conditions of storage and handling.

Reactivity and Stability
Reacts with incompatible materials.

Conditions to Avoid
Extremes of temperature and direct sunlight.

Incompatible materials
Not available

Hazardous Decomposition Products
Thermal decomposition may result in the release of toxic and/or irritating fumes, smoke and gases including: carbon monoxide, carbon dioxide and oxides of nitrogen.

Possibility of hazardous reactions
Under normal conditions of storage and use, hazardous reactions will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicology Information
The available toxicity data for product and ingredients is given below.

Acute Toxicity - Oral
Acute toxicity estimates (ATE): 1287.7 mg/kg

Acute Toxicity - Inhalation
Acute toxicity estimates (ATE value)
Inhalation (vapours): 440 mg/l
Inhalation (dusts and mists): 44.44 mg/l

Acute Toxicity - Dermal
Ethylene glycol
LD50(mouse - male, female): 3500 mg/kg

Ingestion
Harmful if swallowed. Ingestion of this product may cause irritation to the mouth, throat, oesophagus and stomach with symptoms of nausea, abdominal discomfort, vomiting and diarrhoea.

Inhalation
Inhalation of product vapours may cause irritation of the nose, throat and respiratory system.

Skin
Causes skin irritation. Skin contact will cause redness, itching and swelling. Repeated exposure may cause skin dryness and cracking and may lead to dermatitis.

Diethanolamine
Species: rabbit
Exposure: 500mg (24h)
Result: Mild irritant

Decanoic Acid
Species: rabbit
Exposure: 50mg
Result: Mild irritant

Eye
Causes eye damage. Eye contact will cause stinging, blurring, tearing, severe pain and possible burns, necrosis, permanent damage and blindness.

Diethanolamine
Species: rabbit

Exposure: 750 mg (24h)
Result: Severe irritant

Exposure: 5500 mg (24h)
Result: Severe irritant

Decanoic Acid
Species: rabbit
Exposure: 72h
Score: >2
Result: Cornea opacity

Respiratory sensitisation
Not expected to be a respiratory sensitiser.

Skin Sensitisation
Not expected to be a skin sensitiser.

Decanoic Acid
Species: Guinea pig
Result: Not sensitizing

Germ cell mutagenicity
Not considered to be a mutagenic hazard.

Carcinogenicity
Not considered to be a carcinogenic hazard.

Diethanolamine is listed as a Group 2B: Possibly carcinogenic to humans according to International Agency for Research on Cancer (IARC).

Reproductive Toxicity
Not considered to be toxic to reproduction.

STOT-single exposure
Causes damage to organs (kidney, nervous system) by ingestion.

STOT-repeated exposure
Causes damage to organs (kidney) through prolonged or repeated exposure by ingestion.

Aspiration Hazard
Not expected to be an aspiration hazard.

12. ECOLOGICAL INFORMATION

Ecotoxicity
Harmful to aquatic life with long lasting effects. Harmful to terrestrial vertebrates.

Persistence and degradability
Diethanolamine
Degradability: 93 % - Readily - 28 days

Decanoic Acid
Degradability: >60 % - Readily - 30 days (OECD 301D)

Mobility
Not available

Bioaccumulative Potential
Ethylene glycol
LogPow: -1.36, low bioaccumulative potential

Diethanolamine
LogPow: -1.43, low bioaccumulative potential

Other Adverse Effects
Not available

Environmental Protection
Prevent this material entering waterways, drains and sewers.

Acute Toxicity - Fish
Ethylene glycol
LC50(Pimephales promelas): 72,860 mg/l/96h (fresh water)
LC50(Pimephales promelas): 8050 mg/l/96h (fresh water)

Diethanolamine
LC50(Pimephales promelas - Juvenile): 100 mg/l/96h (fresh water)(fledgling, hatchling, weanling)

Decanoic Acid
LC50(fish): 275 mg/l/96h

Acute Toxicity - Daphnia
Ethylene glycol
EC50(Daphnia magna): >100 mg/l/48h (fresh water)
LC50(Daphnia magna - Neonate): 41,000 mg/l/48h (fresh water)

Diethanolamine
LC50(Daphnia magna): 55,000 mìcrog/l/48h (fresh water)

Decanoic Acid
EC50(Daphnia): >20 mg/l/48h

Acute Toxicity - Algae
Ethylene glycol
EC50(Pseudokirchneriella subcapitata): >6500 mg/l/96h (fresh water)

Diethanolamine
EC50(Pseudokirchneriella subcapitata): 12 mg/l/96h (fresh water)

Acute Toxicity - Other Organisms
Ethylene glycol
LC50(Crangon crangon - Adult): 100 mg/l/48h (marine water)
EC50(Micro-organism): >1995 mg/l/30min (fresh water)

Diethanolamine
LC50(Ceriodaphnia dubia - Neonate): 28,800 mìcrog/l/48h (fresh water)

13. DISPOSAL CONSIDERATIONS

Disposal considerations
Product Disposal:
Product wastes are controlled wastes and should be disposed of in accordance with all applicable local and national regulations. This product can be disposed through a licensed commercial waste collection service. In this specific case the product is water-based/water-soluble and therefore can be sent through a Waste Water Treatment Plant and after treatment can be discharged into environment through the sewerage or drainage systems as authorized.

Personal protective clothing and equipment as specified in Section 8 of this SDS must be worn during handling and disposal of this product. The ventilation requirements as specified in the same section must also be followed, and the precautions given in Section 7 of this SDS regarding handling must also be followed. Do not dispose into the sewerage system. Do not discharge into drains or watercourses or dispose where ground or surface waters may be affected.

In New Zealand, the disposal agency or contractor must comply with the New Zealand Hazardous Substances (Disposal) Regulations 2001. Further details regarding disposal can be obtained on the EPA New Zealand website under specific group standards.

Container Disposal:
The container or packaging must be cleaned and rendered incapable of holding any substance. It can then be disposed of in a manner consistent with that of the substance it contained. In this instance the packaging can be disposed through a commercial waste collection service.

Alternatively, the container or packaging can be recycled if the hazardous residues have been thoroughly cleaned or rendered non-hazardous.

In New Zealand, the packaging (that may or may not hold any residual substance) that is lawfully disposed of by householders or other consumers through a public or commercial waste collection service is a means of compliance with regulations.

14. TRANSPORT INFORMATION

Transport Information
Not classified as Dangerous Goods for transport according to the New Zealand Standard NZS 5433:2012 Transport of Dangerous Goods on Land.
Not classified as Dangerous Goods by the criteria of the International Air Transport Association (IATA) Dangerous Goods Regulations for transport by air.
Not classified as Dangerous Goods by the criteria of the International Maritime Dangerous Goods Code (IMDG Code) for transport by sea.

U.N. Number
None Allocated

UN proper shipping name
None Allocated

Transport hazard class(es)
None Allocated

IMDG Marine pollutant
No

Transport in Bulk
Not available

Special Precautions for User
Not available

15. REGULATORY INFORMATION

Regulatory information
Classified as Hazardous according to the Hazardous Substances (Minimum Degrees of Hazard) Regulations 2001, New Zealand.
All components of this product are listed on the New Zealand Inventory of Chemicals (NZIoC) or exempted.

Group Standard: Lubricants, Lubricant Additives, Coolants and Anti-freeze Agents (Subsidiary Hazard) Group Standard 2006

HSNO Approval Number
HSR002606

16. OTHER INFORMATION

Date of preparation or last revision of SDS
SDS created: September 2018

References
Workplace Exposure Standards and Biological Exposure Indices.
Transport of Dangerous goods on land NZS 5433.
Preparation of Safety Data Sheets - Approved Code of Practice Under the HSNO Act 1996 (HSNO CoP 8-1 09-06).
Assigning a hazardous substance to a group standard.
Adopted biological exposure determinants, American Conference of Industrial Hygienists (ACGIH).

Contact Person/Point
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The data included herein presented according to MacDermid Offshore Solutions practices current at the time of preparation hereof, is made available solely for the consideration, investigation and verification of the original recipients hereof and does not constitute a representation or warranty for which MacDermid Offshore Solutions assumes legal responsibility. It is the responsibility of a recipient for this data to remain currently informed on chemical hazard information, to design and update its own safety program and to comply with all Federal, State and Local laws and regulations applicable to safety, occupational health, right to know and environmental protection.

END OF SDS

HALLIBURTON

SAFETY DATA SHEET

NF-6

Revision Date: 01-Jun-2018 **Revision Number:** 30

1. Identification

Product Name

Product Trade Name: NF-6

Other Names

Synonyms None

Hazardous Material Number: HM001971

Recommended Use

Recommended Use Defoamer

Uses advised against No information available

Company Name, Address and Contact Details

Manufacturer/Supplier Halliburton New Zealand
1 Paraite Rd,
Bell Block, New Plymouth
New Zealand Registration No.: 824207

E-mail Address fdunexchem@halliburton.com

Emergency Telephone Number +64 800 451719
Global Incident Response Access Code: 334305
Contract Number: 14012

New Zealand National Poisons Centre 0800 764 766 (24 hours)

2. Hazards Identification

Statement of Hazardous Nature

Classified as hazardous according to criteria in the Hazardous Substances (Minimum Degrees of Hazard) Regulation 2001; Not Classified as dangerous good according to NZS 5433:2012, UN, IMDG or IATA

Classification

9.1D Slightly harmful in the aquatic environment

Hazard and Precautionary Statements

Hazard Pictograms

Signal Word None

Hazard Statements H413 - May cause long lasting harmful effects to aquatic life

Precautionary Statements

Prevention P103 - Read label before use
P104 - Read Safety Data Sheet before use.

Response None

Storage None

Disposal P501 - Dispose of contents/container to an approved incineration plant

Contains

Substances	CAS Number	Substance HSNO Classification
Vegetable oil	Proprietary	9.1D (fish) 9.1D (Crustacean)

2.3. Other Hazards
This mixture contains no substance considered to be persistent, bioaccumulating nor toxic (PBT).
This mixture contains no substance considered to be very persistent nor very bioaccumulating (vPvB).

3. Composition/Information on Ingredients

Substances	CAS Number	PERCENT (w/w)
Vegetable oil	Proprietary	60 - 100%

4. First Aid Measures

Requirements for First Aid or Medical Care

Inhalation If inhaled, remove from area to fresh air. Get medical attention if respiratory irritation develops or if breathing becomes difficult.
Eyes In case of contact, immediately flush eyes with plenty of water for at least 15 minutes and get medical attention if irritation persists.
Skin Wash with soap and water. Get medical attention if irritation persists.
Ingestion Do NOT induce vomiting. Give nothing by mouth. Obtain immediate medical attention.

Workplace Facilities Required
None

Relation to Health Effect
Most Important Symptoms/Effects
No significant hazards expected.

Medical Attention and Special Treatment
Notes to Physician
Treat symptomatically

5. Fire-fighting measures

Type of Hazard
Flammability Hazard
Non-flammable

5.1. Extinguishing media
Suitable Extinguishing Media
Carbon dioxide, dry chemical, foam.
Extinguishing media which must not be used for safety reasons
None known.

HAZCHEM Code
Hazchem Code: None Allocated

Special Protective Equipment and Precautions for Fire Fighters
Special protective equipment for firefighters
Full protective clothing and approved self-contained breathing apparatus required for fire fighting personnel.
Special exposure hazards in a fire
Use water spray to cool fire exposed surfaces. Decomposition in fire may produce harmful gases.

6. Accidental Release Measures

6.1. Personal precautions, protective equipment and emergency procedures
Use appropriate protective equipment. Avoid contact with skin, eyes and clothing. Avoid breathing vapors. Ensure adequate ventilation.
See Section 8 for additional information

6.2. Environmental precautions
Prevent from entering sewers, waterways, or low areas.

6.3. Methods and material for containment and cleaning up

Isolate spill and stop leak where safe. Contain spill with sand or other inert materials. Scoop up and remove.

6.4. Reference to other sections

See Section 8 and 13 for additional information.

7. Handling and storage

7.1. Precautions for safe handling

Handling Precautions

Avoid contact with eyes, skin, or clothing. Avoid breathing vapors. Ensure adequate ventilation. Wash hands after use. Launder contaminated clothing before reuse. Use appropriate protective equipment.

Handling Practices

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice.

Approved Handlers

This product does NOT require an approved handler.

7.2. Conditions for safe storage, including any incompatibilities

Store away from oxidizers. Keep container closed when not in use.

Store Site Requirements

No special controls required

Packaging

No special packaging required

8. Exposure Controls/Personal Protection

Workplace Exposure Standards

Exposure Limits

Substances	CAS Number	New Zealand WES	ACGIH TLV-TWA
Vegetable oil	Proprietary	Not applicable	Not applicable

Engineering Controls

Engineering Controls A well ventilated area to control dust levels. Local exhaust ventilation should be used in areas without good cross ventilation.

Personal Protective Equipment (PPE)

Personal Protective Equipment If engineering controls and work practices cannot prevent excessive exposures, the selection and proper use of personal protective equipment should be determined by an industrial hygienist or other qualified professional based on the specific application of this product.

Respiratory Protection If engineering controls and work practices cannot keep exposure below occupational exposure limits or if exposure is unknown, wear a NIOSH certified, European Standard EN 149, AS/NZS 1715:2009, or equivalent respirator when using this product. Selection of and instruction on using all personal protective equipment, including respirators, should be performed by an Industrial Hygienist or other qualified professional. Organic vapor respirator with a dust/mist filter. (A2P2/P3)

Hand Protection Chemical-resistant protective gloves (EN 374) Suitable materials for longer, direct contact (recommended: protection index 6, corresponding to > 480 minutes permeation time as per EN 374): Polyvinylchloride gloves. (>= 0.7 mm thickness) This information is based on literature references and on information provided by glove manufacturers, or is derived by analogy with similar substances. Please note that in practice the working life of chemical-resistant protective gloves may be considerably shorter than the permeation time determined in accordance with EN 374 as a result of the many influencing factors (e.g. temperature). If signs of wear and tear are noticed then the gloves should be replaced. Manufacturer's directions for use should be observed because of great diversity of types.

Skin Protection Normal work coveralls.

Eye Protection Chemical goggles; also wear a face shield if splashing hazard exists.

Other Precautions None known.

Hygiene Measures Handle in accordance with good industrial hygiene and safety practice.

9. Physical and Chemical Properties

9.1. Information on basic physical and chemical properties

Physical State:	Liquid	**Color**	Yellow
Odor:	Mild	**Odor Threshold:**	No information available

Property Remarks/ - Method	Values
pH:	No data available
Freezing Point / Range	No data available
Melting Point / Range	No data available
Boiling Point / Range	182 °C / 360 °F
Flash Point	> 170 °C / > 340 °F
Evaporation rate	No data available
Vapor Pressure	No data available
Vapor Density	No data available
Specific Gravity	0.93
Water Solubility	Dispersible
Solubility in other solvents	No data available
Partition coefficient: n-octanol/water	No data available
Autoignition Temperature	385 °C / 725 °F
Decomposition Temperature	No data available
Viscosity	No data available
Explosive Properties	No information available
Oxidizing Properties	No information available

9.2. Other information

VOC Content (%)	No data available
Liquid Density	7.70 lbs/gal

10. Stability and Reactivity

10.2. Chemical stability

Stable

10.4. Conditions to avoid

None anticipated

10.5. Incompatible materials

Strong oxidizers.

10.6. Hazardous decomposition products

Hydrocarbons. Carbon monoxide and carbon dioxide.

Hazardous Reactions

Hazardous Polymerization: Will Not Occur

11. Toxicological Information

Health Effect from Likely Routes of Exposure

Acute Toxicity

Product Information Under certain conditions of use, some of the product ingredients may cause the following:

Inhalation	May cause mild respiratory irritation.
Eye Contact	None known.
Skin Contact	None known.
Ingestion	May cause abdominal pain, vomiting, nausea, and diarrhea.

Chronic Effects/Carcinogenicity No data available to indicate product or components present at greater than 0.1% are chronic health hazards.

Toxicity Data

Toxicology data for the components

Substances	CAS Number	LD50 Oral	LD50 Dermal	LC50 Inhalation
Vegetable oil	Proprietary	No data available	No data available	No data available

12. Ecological Information

12.1. Toxicity

Product Ecotoxicity Data

Substance Ecotoxicity Data

Substances	CAS Number	Toxicity to Algae	Toxicity to Fish	Toxicity to Microorganisms	Toxicity to Invertebrates
Vegetable oil	Proprietary	EC50 (72h) >3200 mg/L (Skeletonema costatum)	LC50 (96h) >5600 mg/L (Scopthalmus maximus)	No information available	LC50 > 10000 mg/L (Acartia tonsa)

12.2. Persistence and degradability

Substances	CAS Number	Persistence and Degradability
Vegetable oil	Proprietary	

12.3. Bioaccumulative potential

Substances	CAS Number	Log Pow
Vegetable oil	Proprietary	No data available

12.4. Mobility in soil

Substances	CAS Number	Mobility
Vegetable oil	Proprietary	No information available

Ecotoxicity Hazard Statements
May cause long lasting harmful effects to aquatic life

12.6. Other adverse effects
Endocrine Disruptor Information
This product does not contain any known or suspected endocrine disruptors

13. Disposal Considerations

13.1. Waste treatment methods

Disposal methods Incineration recommended in approved incinerator according to federal, state, and local regulations. Substance should NOT be deposited into a sewage facility.

Contaminated Packaging Follow all applicable national or local regulations. Contaminated packaging may be disposed of by: rendering packaging incapable of containing any substance, or treating packaging to remove residual contents, or treating packaging to make sure the residual contents are no longer hazardous, or by disposing of packaging into commercial waste collection.

14. Transport Information

NZ 5433.1999

UN Number Not restricted
UN proper shipping name: Not restricted
Transport Hazard Class(es): Not applicable
Packing Group: Not applicable

Environmental Hazards: Not applicable

IMDG/IMO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

IATA/ICAO

UN Number	Not restricted
UN proper shipping name:	Not restricted
Transport Hazard Class(es):	Not applicable
Packing Group:	Not applicable
Environmental Hazards:	Not applicable

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code Not applicable
Special Precautions for User None

15. Regulatory Information

New Zealand Inventory of Chemicals	All components are listed on the NZIoC or are subject to a relevant exemption, permit, or assessment certificate.
HSNO Approval Number	HSR002503
Group Name	Additives, Process Chemicals and Raw Materials (Subsidiary hazard HSR002503)
HSNO Controls	Refer to the NZ EPA website for more information: http://www.epa.govt.nz
Approved Handlers	Not Applicable
Poisons Schedule:	None Allocated

16. Other information

Additional information

For additional information on the use of this product, contact your local Halliburton representative.

For questions about the Safety Data Sheet for this or other Halliburton products, contact Chemical Stewardship at 1-580-251-4335.

Key or legend to abbreviations and acronyms used in the safety data sheet
bw – body weight
CAS – Chemical Abstracts Service
EC50 – Effective Concentration 50%
LC50 – Lethal Concentration 50%
LD50 – Lethal Dose 50%
LL50 – Lethal Loading 50%
MARPOL – International Convention for the Prevention of Pollution from Ships
mg/kg – milligram/kilogram
mg/L – milligram/liter
NOEC – No Observed Effect Concentration
OEL – Occupational Exposure Limit
ppm – parts per million
TWA – Time-Weighted Average
VOC – Volatile Organic Carbon
C - Celsius
IATA/ICAO - International Air Transport Association / International Civil Aviation Organization
IMDG/IMO - International Maritime Dangerous Goods / International Maritime Organization
mg/m^3 - milligram/cubic meter
mm - millimeter
mmHg - millimeter mercury
w/w - weight/weight
d - day

Key literature references and sources for data
www.ChemADVISOR.com/
NZ CCID
Cosmetic Ingredient Review

Revision Date: 01-Jun-2018
Revision Note
SDS sections updated:
1

Disclaimer Statement
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End of Safety Data Sheet

APPENDIX C

Tui Field ROV Survey – Assessment of Biological Communities

TUI FIELD ROV SURVEY

Assessment of Biological Communities

Prepared for:

Ministry of Business, Innovation and Employment
15 Stout Street
PO Box 1473
WELLINGTON

SLR Ref: 740.30000.00000-R01
Version No: -v1.0
January 2021

PREPARED BY

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BASIS OF REPORT

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
740.30000.00000-R01-v1.0	21 January 2021	Reid Forrest	Rob Lieffering	Dan Govier
740.30000.00000-R01-v0.1	21 January 2021	Reid Forrest	Rob Lieffering	Dan Govier

EXECUTIVE SUMMARY

In November 2020, Ministry of Business, Innovation and Employment (**MBIE**) commissioned a Remotely Operated Underwater Vehicle (**ROV**) of the subsea infrastructure associated with the Tui oil field ~50 km off the Taranaki coast (**Figure 1**). The field was taken on by MBIE following the receivership and liquidation of Tamarind Taranaki Limited (**TTL**) in November 2019, and being at the end of its productive life, the field is proposed to be decommissioned. The decommissioning process will involve plugging and abandonment of all eight wells within the Tui field, as well as the removal of all subsea infrastructure and the Floating Production Storage and Offloading (**FPSO**) vessel Umuroa and its mooring equipment. MBIE are currently in the process of preparing a decommissioning plan for these activities and to best inform this process, an up to date inspection report on all subsea assets was required. Seaworks Ltd were contracted by MBIE to undertake a survey of the subsea assets utilising an ROV. MBIE was also interested to determine whether any biological communities might be present in the areas surrounding, or had established on the subsea infrastructure, that could present issues for the decommissioning/demobilisation activities (i.e. Sensitive Environments). To assist with this assessment, SLR Consulting NZ Limited (**SLR**) provided an experienced benthic ecologist to be present onboard the ROV survey vessel and observe and assist with the capture of benthic imagery.

The ROV survey was completed in December 2020, utilising an SMD Quasar work class ROV fitted with High Definition (**HD**) video imagery equipment and covered five main areas:

- Pateke 3H and 4H and associated lines and Mid-Water Arch (**MWA**);
- Amokura-2H and associated lines and MWA;
- Tui-2H and associated lines and MWA;
- Tui-3H and associated lines and MWA; and
- FPSO moorings 8 and 9.

Seabed environments were dominated by relatively flat, muddy-sands and sandy mud sediments, with epifauna and infauna consistent with previous seabed surveys conducted in the Tui field. The findings were also very similar to other areas off offshore Taranaki in comparable water depths. The pipelines, originally laid on the seabed (including flowlines, gas-lift and umbilical's) were observed to be in various states of entrenchment, open-span and burial across their lengths, sometimes creating trenches up to 0.5m in depth, or deeper in the case of trenches left by the movement of mooring chains holding the FPSO. Sediment grainsize was found to become coarser closer to the MWA's and FPSO, with sandy sediments and increased proportions of shell hash material.

Subsea infrastructure positioned on the seabed was observed to be covered with low-moderate levels of fouling comprised predominantly of tubeworms, small tuft hydroids, encrusting sponges, tunicates, barnacles (including larger goose barnacles), and anemones (predominantly jewel anemones), with occasional other taxa including whelks/small gastropods, hermit crabs, ball and finger sponges, starfish and cushion stars and wandering anemones. Fouling communities were notably greater on lines that lifted above the seabed through dynamic and catenary sections, particularly tubeworms and jewel anemones, and in shallower waters from ~60 m depth anemones, crustose coralline algae, small algae and mussels were present. The subsea structures also aggregated and provided cryptic habitats for increased abundances of mobile fish species which would either not be present or at much sparser densities in these offshore environments, which included sea perch, red cod , Big-eye, tarakihi, john dory, conger eels, juvenile gurnard, rough skate, short-tailed stingray, New Zealand rock lobster, pipefish and seahorses, kingfish and sharks.

EXECUTIVE SUMMARY

The infrastructure present within the Tui field is a biodiversity 'hotspot' relative to the wider offshore Taranaki area. The presence of the infrastructure creates artificial habitats that are not normally present within the relatively flat and featureless muddy-sand/sandy-mud sediment habitats present across much of the offshore Taranaki area. However, biological communities observed on and around the subsea infrastructure present in the Tui field were relatively typical of those observed on other similar artificial structures in the offshore Taranaki area. No taxa were observed that would be considered particularly unique or highly localised to this area. No sensitive environments or species protected under the Wildlife Act (1953) were observed on the seabed or subsea infrastructure during the survey, although low abundances of some taxa characteristic of sensitive environments were present, as has been previously observed in the Tui field and other offshore Taranaki areas.

While removal of all subsea infrastructure from the Tui field will result in returning the area to a more 'natural' state in terms of the biological communities and habitats present, it will likely result in a net loss of overall biodiversity in the area, relative to the current state.

It is recommended that during the 2021 annual benthic monitoring survey, additional benthic imagery should be collected specifically looking to cover areas of the Tui field not previously assessed in the ROV survey and earlier annual monitoring surveys.

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DOCUMENT REFERENCES

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ABBREVIATIONS

BWO	BW Offshore Limited
EEZ	Exclusive Economic Zone
FPSO	Floating Production, Storage and Offload Vessel
HD	High-definition
MBIE	Ministry of Business, Innovation and Employment
MLC	Mid-line Connection
MWA	Midwater Arch
P&A	Plugging and Abandonment
ROV	Remotely Operated Vehicle
SDU	Subsurface Distribution Unit
Seaworks	Seaworks Limited
SLR	SLR Consulting NZ Limited
SST	Subsurface Tree
TTL	Tamarind Taranaki Limited
Tui Field	The Tui oil field
UTA	Umbilical Termination Assembly

1 Introduction

The Tui oil field (**Tui field**) is located within New Zealand's Exclusive Economic Zone (**EEZ**), ~50 km off the Taranaki coast (**Figure 1**). The Tui field, located within Petroleum Mining Permit 38158 (**PMP 38158**), was previously operated by Tamarind Taranaki Limited (**TTL**) until November 2019 when the company went into receivership and liquidation. The Ministry of Business, Innovation and Employment (**MBIE**), on behalf of the Crown, has taken on the responsibility of TTL's assets within PMP 38158, which include the wells and associated infrastructure.

Five subsea wells are connected to the anchored floating production storage and offloading vessel '*Umuroa*' (**the FPSO**) (**Figure 2**) which is owned by BW Offshore Limited (**BWO**). In addition, there are three other wells, referenced as the Tui SW-2P, Amokura-1, and Tieke-1 wells, within the Tui field which have been suspended but these are not connected to the FPSO.

The Tui field is at the end of its productive life and MBIE is proposing to decommission the Tui field which is likely to involve plugging and abandoning (**P&A**) the eight wells and removal of all the subsea equipment/infrastructure. The first part of the overall decommissioning project involves suspending (shutting in) four of the eight wells (those that have not already been suspended) and demobilisation of the FPSO which, once demobilised, would leave New Zealand waters. MBIE is also in the process of developing a decommissioning plan that will result in all the subsea equipment/infrastructure of the Tui field being removed and P&A of all eight wells.

The Tui field decommissioning activities will involve the disturbance of the seabed which may affect benthic communities that are present in and around the disturbance activities. There are a number of different types of seabed disturbance that are likely to occur during the decommissioning activities:

1. The use of Remotely Operated Underwater Vehicles (**ROVs**) near the seabed;
2. The laying down of the production flow lines, the gas lift lines, and the umbilicals on the seabed;
3. The removal of the anchor chain and anchors (moorings);
4. The drilling, plugging and abandoning (including cementing) of existing wells; and
5. The removal of subsea infrastructures such as wellhead, Christmas trees, pipelines, umbilicals, compressors and pumps etc.

As an initial step in the demobilisation of the FPSO and decommissioning of the field and, MBIE wishes to assess the current "as-standing" condition of the subsea infrastructure and the associated mooring lines and flow-lines to better understand what risks may actually be present. MBIE is also interested to determine whether any biological communities might be present in the areas surrounding, or had established on the subsea infrastructure, that could present issues for the decommissioning activities, such as impacting upon sensitive environments or protected species.

In November 2020, MBIE contracted SLR Consulting NZ Limited (**SLR**) to provide a suitably trained and experienced benthic ecologist to be present onboard the Seaworks Limited (**Seaworks**) ROV survey vessel and observe the capture of benthic imagery and, where applicable, direct ROV pilots to capture best possible imagery of seabed habitats and species. This report outlines the results of SLR's observations.

Figure 1 Location of the Tui Field in the Taranaki Basin

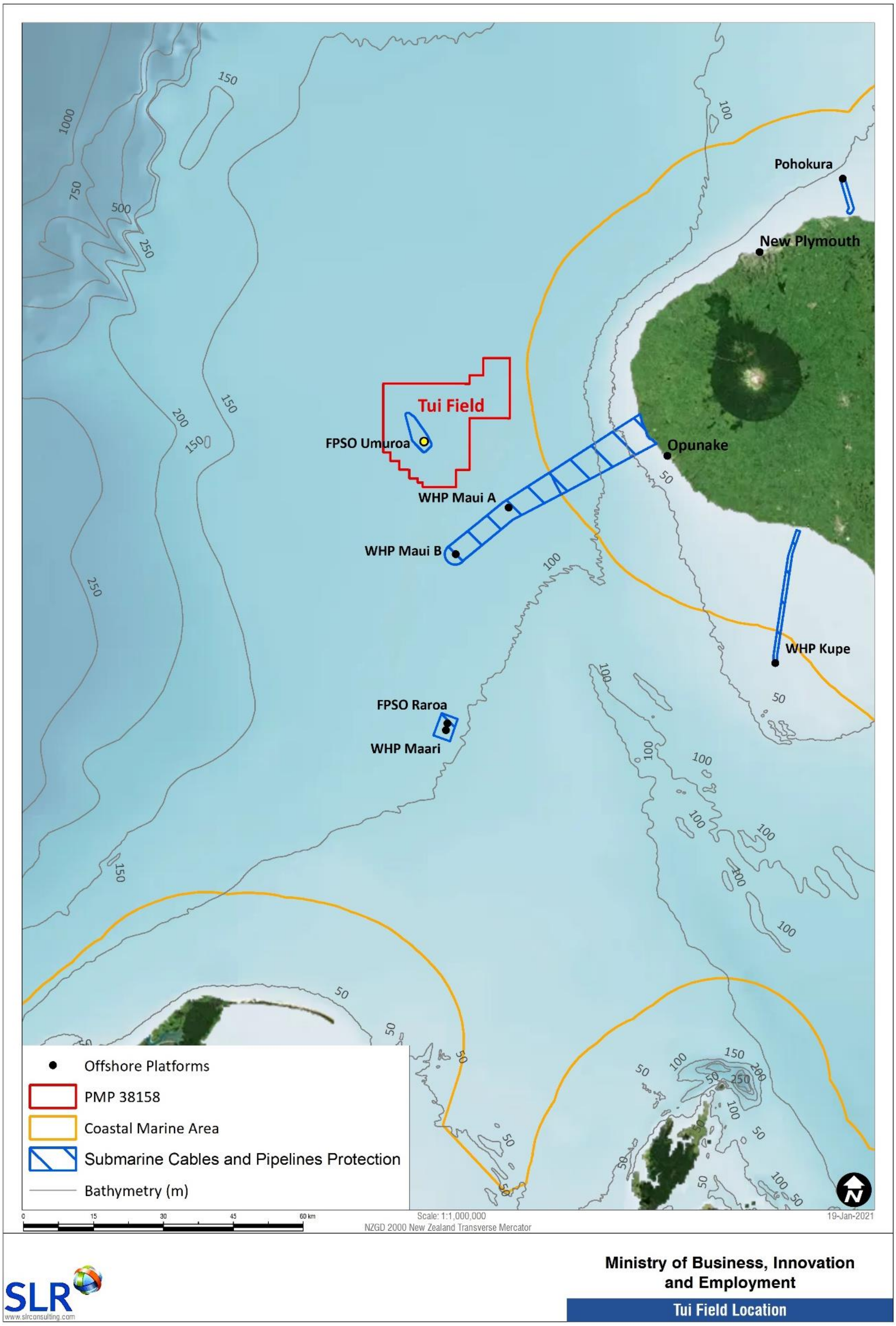
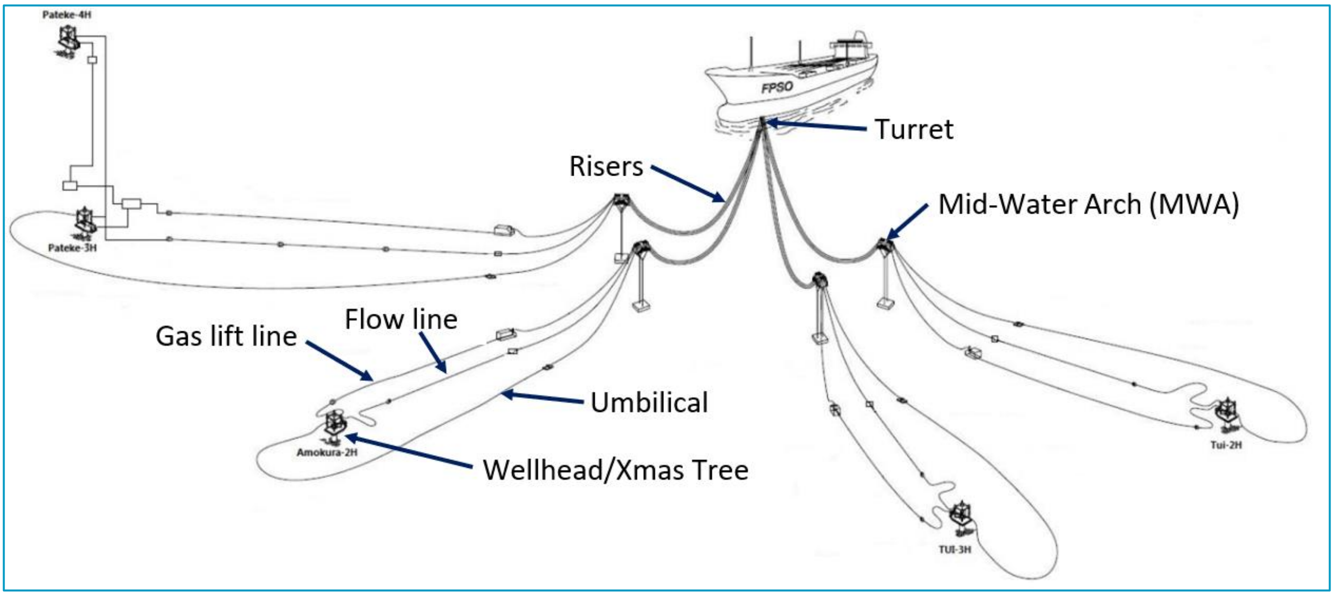


Figure 2 General Schematic Layout of the Tui Oil Field



2 Methodology

The ROV survey was conducted from the vessel Seaworker between the 2nd and 19th of December 2020, utilising the SMD Quasar work class ROV (**Figure 3**) fitted with a 1080P HD video camera system linked to Digital Edge recording systems.

Figure 3 SMD Quasar ROV Utilised for the 2020 Tui Field ROV Survey

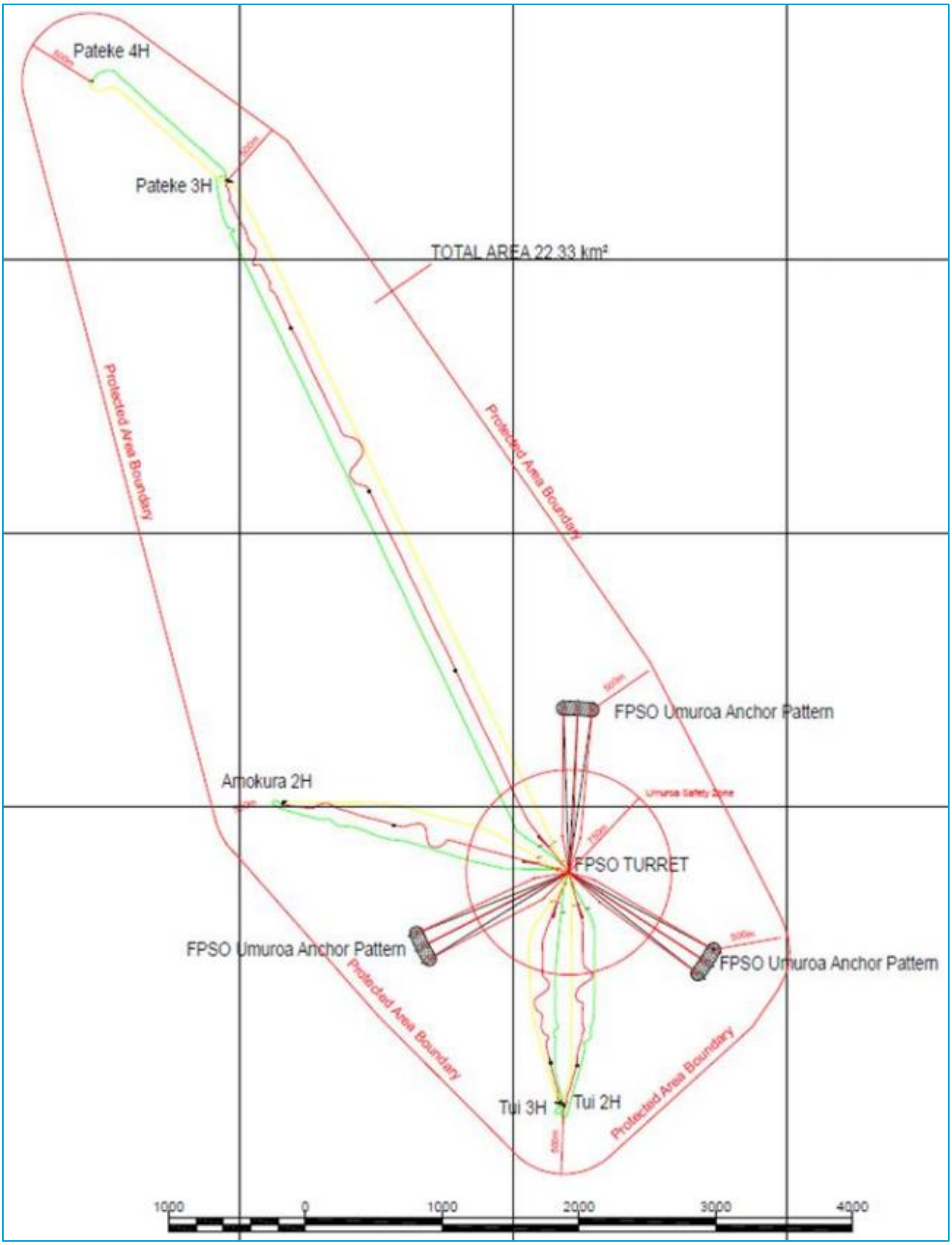
During ROV deployments, a team made up of ROV Supervisor, Pilot, and Technician operated the ROV, while incoming video imagery from several onboard cameras was also viewed by the trained and experienced marine ecologist provided by SLR. Imagery was recorded onboard the survey vessel and the ROV Supervisor provided narrated commentary to overlay the incoming imagery.

2.1 Tui Field Infrastructure

The ROV survey covered five main areas (**Figure 2** and **Figure 4**) during the survey, being:

- Pateke 3H and 4H and associated lines and Mid-Water Arch (**MWA**);
- Amokura-2H and associated lines and MWA;
- Tui-2H and associated lines and MWA;
- Tui-3H and associated lines and MWA; and
- FPSO moorings 8 and 9.

Figure 4 Plan view of the Tui Field Layout Including the Producing Wells, the Gas-lift, Production and Umbilical Lines, and the FPSO Umuroa Mooring Array



The FPSO has mooring array consisting of three groups of three 20 t 'Stevpris' anchors. Each anchor has ~1,065 m of 114 mm diameter bottom anchor chain attached to it. Each bottom anchor chain is connected to ~110 m of 111.5 mm wire rope and then onto a 117 mm diameter top anchor chain section. A general schematic of each mooring line/and anchor is presented in **Figure 5** and the layout of the mooring array is shown in **Figure 6**. Under predicted loadings, around 800 m of the total ~1,065 m length of each bottom anchor chain is located on/under the seabed.

Figure 5 General Schematic of FPSO Mooring and Anchor Layout (note – schematic is not to scale)

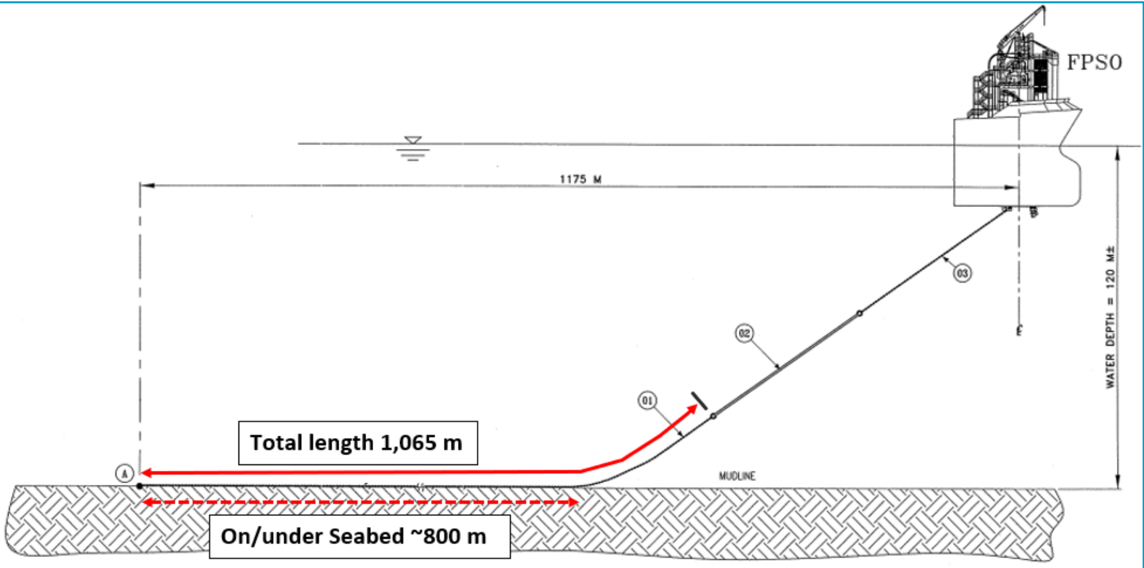
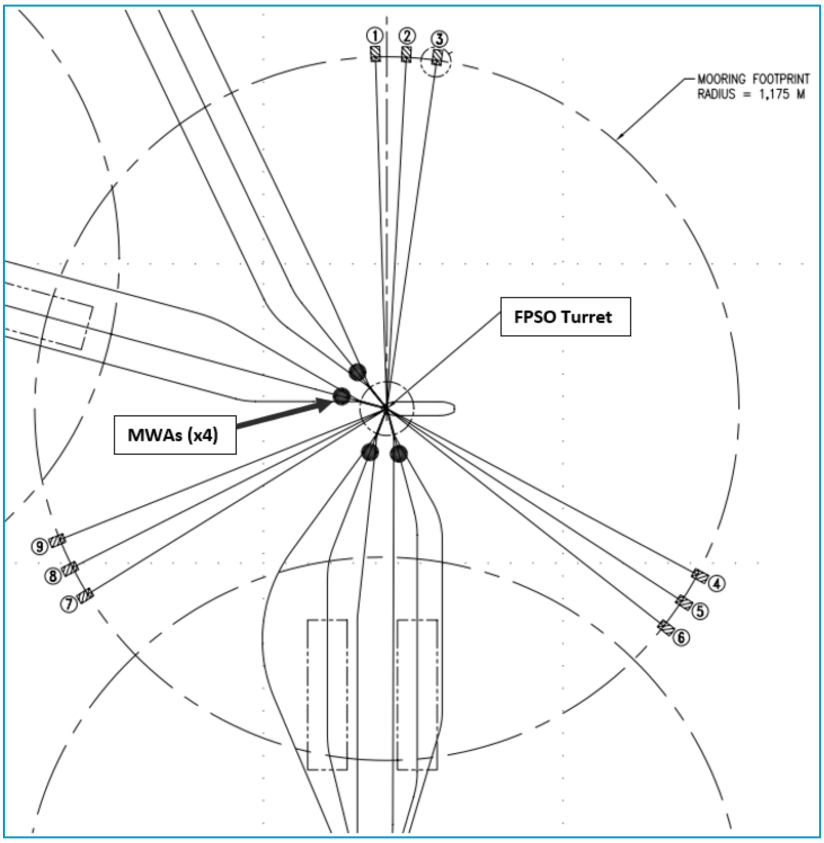


Figure 6 Plan View of FPSO Umuroa Mooring Array



Full details of the structural inspection of the physical infrastructure completed during the survey is contained within the Seaworks 2021 Survey report, whereas this report solely focuses on the biological and ecological observations. A full list of features that were visited, and videoed/photographed during the survey are provided in **Table 1**.

Table 1 Physical Structures Within the Tui Field Visited and Observed with the ROV During the December 2020 Survey.

Survey Area	Structure Surveyed
Pateke-4H	Subsurface Tree (SST)
	Umbilical Termination Assembly (**UTA**)
	Production Flowline
	Integrated Gas Lift Umbilical
Pateke-3H	Subsurface Distribution Unit (**SDU**)
	SST
	Gas Lift Manifold
	Intermediate Skid
	Production Flowline
	Mid-Line connection and associated anode-skid
	MWA
	MWA tethers and gravity base
	Dynamic Catenary Sections
Tui-2H	SST
	Production Flowline
	Mid-Line connection and associated anode-skid
	Holdback clamp
	Holdback chain
	Production Flowline Dynamic Section
	MWA
	MWA tethers and gravity base
	Gas lift line Dynamic Section and riser base
	Gas lift line
	Dynamic Catenary Sections
Tui-3H	SST
	Production Flowline
	Mid-Line connection and associated anode-skid
	Holdback clamp
	Holdback chain
	Production Flowline Dynamic Section

Survey Area	Structure Surveyed
	MWA
	MWA tethers and gravity base
	Gas lift line Dynamic Section
	Gas lift line and Riser base
	Dynamic Catenary Sections
Amokura-2H	SST and anode skid
	Production Flowline
	Mid-Line connection and associated anode-skid
	Holdback clamp
	Holdback chain
	Production Flowline Dynamic Section
	MWA
	Mid-water Arch tethers and gravity base
	Gas lift line Dynamic Section
	Gas lift line and riser base
	Dynamic Catenary Sections
FPSO Mooring Lines	Mooring Line 8
	Mooring Line 9
Gravity Bases	Bases left nearby Amokura-2H during preparation for the abandoned drilling programme in early 2020

2.2 Sensitive Environments

The Ministry for the Environment (in consultation with NIWA) has defined a number of marine biogenic and geological environments as 'sensitive' in order to provide guidance for operators planning to conduct permitted activities within the EEZ (MacDiarmid *et al*., 2013) under the Exclusive Economic Zone and Continental Shelf (Environmental Effects—Permitted Activities) Regulations 2013. Although the MacDiarmid *et al.* (2013) report was initially prepared for permitted activities, it is currently the most robust definition for a marine 'sensitive environment'.

The 'sensitivity' of an environment is defined as the tolerance of a species or habitat to damage from an external factor combined with the time taken for its subsequent recovery from damage sustained as a result of the external factor. The rarity of a particular habitat was also taken into account when considering its tolerance; an external factor is more likely to damage a higher proportion of a population of habitat as rarity increases; therefore, a rare habitat has a lower tolerance rating (MacDiarmid *et al.*, 2013).

Table 2 in **Appendix A** provides details on the environments considered sensitive under the MacDiarmid *et al*. (2013) classifications and the indicators used to identify their presence. It is believed that the development of the sensitive environment definitions were intended to apply to 'natural occurring' habitats and communities and not necessarily to habitats that may have developed upon (or nearby as a result of the presence of) anthropogenic structures in the marine environment. They were specifically developed to protect existing sensitive environments that may be impacted by permitted activities that were proposed to be undertaken within the EEZ. Despite these limitations, reference to 'sensitive environments' and comparisons to the criteria used to define their existence in an area, have been used within this report, but only in a more general context where applicable species/communities were observed to be present.

2.3 Protected Species

Nine species of fish (bony and cartilaginous) are listed as protected under Schedule 7A of the Wildlife Act 1953: basking shark, deepwater nurse shark, great white shark, manta ray, oceanic white-tip shark, spiny-tailed devil ray, giant grouper, spotted black grouper, and whale shark. In addition to the protection offered under the Wildlife Act 1953, great white sharks, basking sharks, and oceanic white-tip sharks are also protected under the Fisheries Act 1996, prohibiting New Zealand flagged vessels from taking these species from all waters, including beyond New Zealand's EEZ.

In addition to fish species discussed in the previous paragraph, four groups of cnidarians are also afforded protection under Schedule 7A of the Wildlife Act 1953 – Antipatharia (Black corals), Gorgonacea (Gorgonian corals), Scleractinia (Stony corals), and Stylasteridae (Hydrocorals).

3 Findings

3.1 Observed Physical Seabed Habitats

The majority of the seabed throughout the survey areas was relatively homogenous, being flat sandy-mud/muddy-sand (**Figure 7**) occasionally interrupted by small mounds and hollows created by worms/shrimps and the feeding activities of some fish species. Lines laid onto the seabed (including gas-lift, production flowlines and umbilicals) were in various states of exposure from fully exposed in span above the seabed, to resting on top, partially buried, buried on one side only or fully buried. In some areas the lines had become partially entrenched and formed trenches up to 0.5 m deep and 0.8 m wide.

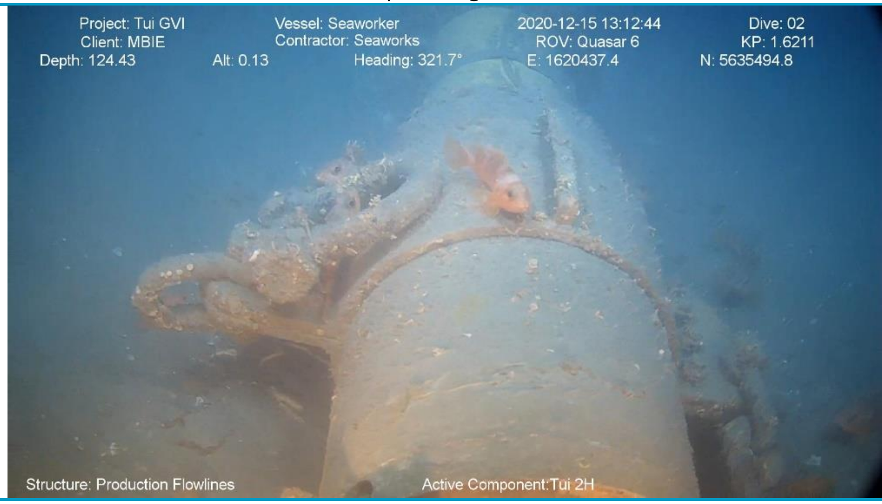
As observed in previous benthic samplings surveys in the Tui field, sediment grainsize became coarser, comprising of 'muddy-sand' dominated by fine- and medium-grained sands in close-proximity to the FPSO, with higher proportions of broken shell materials. Observations revealed these coarser sediments to have a somewhat darker colouration and were typically observed most commonly in the area between the hold-back clamps and the dynamic sections of the lines where they left the seabed, as well as around the MWA gravity-bases.

Along the two mooring lines surveyed the touchdown locations showed extended areas of significant trenching (**Figure 7**) where expected movement in the mooring chains had resulted in trenches up to 1 m deep and 1.5 m width at the top. Moving from the touchdown point towards the anchor the trenches decreased in width and depth with chains eventually disappearing back into burial well before reaching the locations of the fully buried anchors.

Figure 7 Physical Seabed Habitats Around and Beneath Tui Field Subsea Infrastructure

Production Flowline entrenched into seabed sediments

Production Flowline holdback clamp resting on seabed sediments



Pateke-3H Production Flowline in partial burial

FPSO Umuroa Mooring Chain entrenched in Seabed Sediments

3.2 Observed Biological Taxa

3.2.1 Benthic Communities

Most of the surveyed subsea infrastructure resting on the seabed showed low to moderate levels of marine growth coverage, mainly comprised of tubeworms, small tuft hydroids, encrusting sponges, tunicates, barnacles (including larger goose barnacles), and anemones (predominantly jewel anemones) (**Figure 8**).

Epifauna and infauna communities on and around the subsea infrastructure were observed to be relatively similar across all areas surveyed. However, as would be expected, marine growth was observed to be heaviest on infrastructure that had been in place for the longest continuous period (e.g. Tui-2H and lines), while newer installations such as Pateke-4H showed slightly (but noticeable) less marine growth. Other common taxa encountered on and around the surveyed structures included whelks/small gastropods, hermit crabs, ball and finger sponges, starfish and cushion stars with occasional wandering anemones.

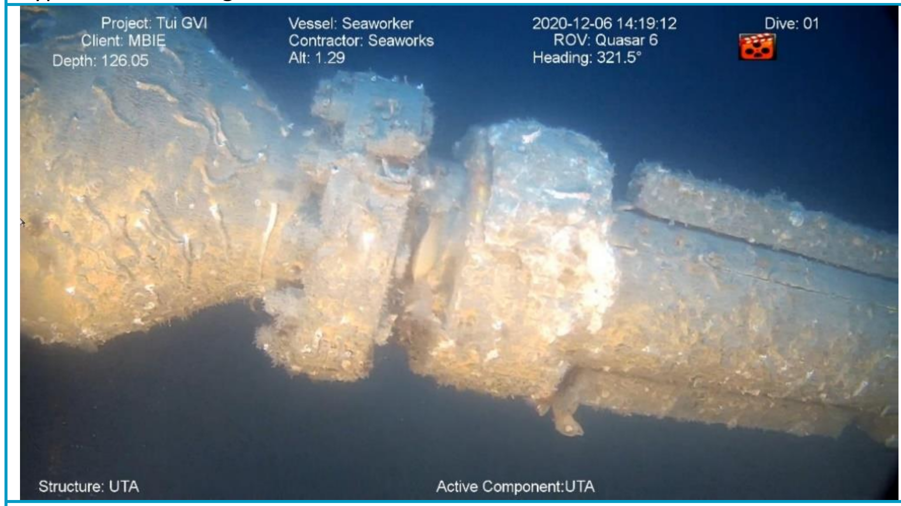
On the seabed surrounding the subsea infrastructure the epifauna, infauna, and lebensspuren observed during the survey were similar to that observed in benthic video sled tows undertaken within the Tui field in previous years, as well as in other offshore Taranaki fields. The soft muddy seabed was often pockmarked with animal burrows (shrimps, worms, and fishes) as well as small mounds, and hermit crabs and whelks were frequently seen along with their tracks left in the sediments. Small worm tubes and seapens occurred occasionally on/in the seabed, along with tusk shells, small empty bivalve shells and sponges (finger and ball species).

The greatest levels of marine growth and most diverse encrusting communities were observed on the dynamic sections of the lines and moorings, and increased with decreasing depth (**Figure 9**, **Figure 10**, **Figure 11**). In the shallowest surveyed areas the lines and moorings were thickly coated in small algae, mussels (particularly greenshell mussel), sponges, and anemones (**Figure 10**). Near the lower end of the dynamic sections of the lines (just above where they lifted from the seabed) thick tubeworm growth was present, particularly thickest on the floatation collars installed on the umbilical lines (**Figure 11**). Moving upwards from this point and also along the mooring lines, jewel anemones became the dominant marine growth, often with bright purple and pink colouration. Bands of encrusting sponges in yellows and grey occasionally broke up the near solid coverage of anemone growth, and in shallower areas above the mid water arches (<60 m depth) crustose coralline algae patches were also occasionally observed (**Figure 10**). These types of communities are commonly encountered on other anthropogenic structures deployed in the offshore Taranaki marine environment, with jewel anemones often one of the first and thickest growths to develop.

Lines lying on the seabed (including umbilical, production flowline and gas lifts) showed noticeably less marine growth than the same lines when they were in dynamic sections held above the seabed, and less than other subsea infrastructure in the same areas – such as mid line connections, hold back clamps and chains, floatation buoys, SST etc. The exact reasons for this are not definitively known but it may be that the polypropylene casing around the lines provides a more difficult substrate for organisms to colonise when there are greater amounts of fine sediment present. Alternatively, it may be that shifting seabed sediments and movements in the lines against the seabed removes and/or smothers some amount of the growth before it can fully establish and multiply widely.

Figure 8 Marine Growth Observed on and Around Seabed Mounted Subsea Infrastructure

Typical tubeworm growth on seabed mounted infrastructure



Small tubeworms attached to producton flowline

Small sponge growth on sides of production flowline

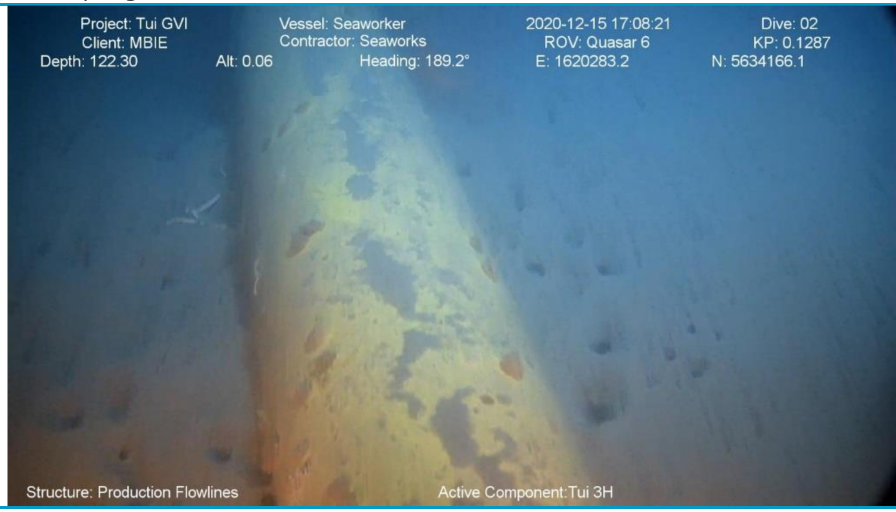
Typical marine growth

Close-in view of small tubeworms on the production flowline

Calcareous tubeworms fallen onto seabed beside flowline

Small gastropods on production flowline

Small sponges

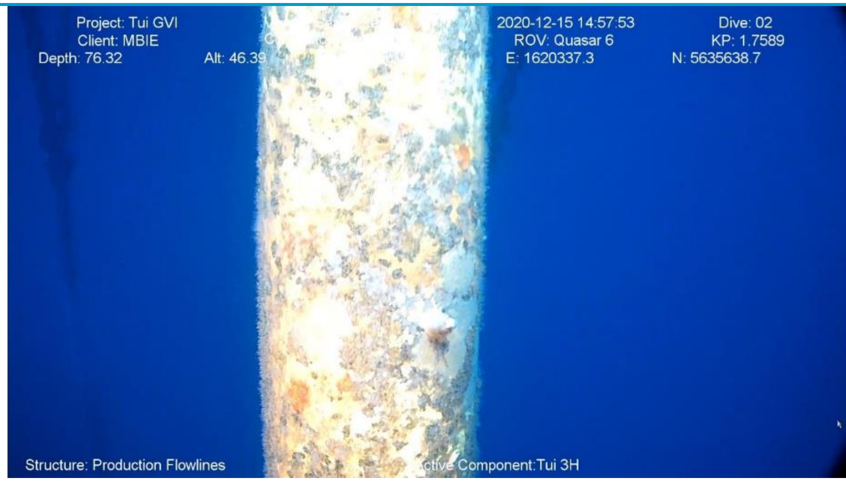


Goose barnacles attached to a line securing a float on an umbilical line	
	

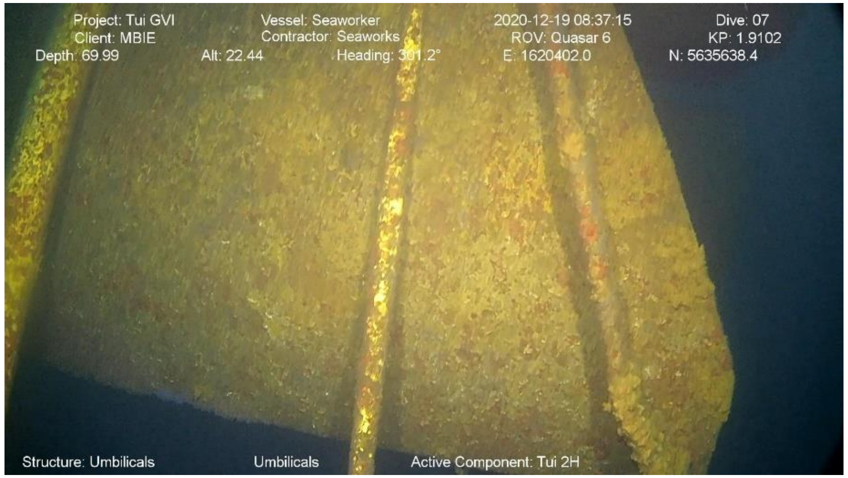
Figure 9 Communities Observed on Mid Water Arches and the Ascending Limbs/Catenary Sections of lines

Marine growth on Amokura-2H MWA

Sponges, anemones and coralline algae on production flowline



Marine growth on lower gutter edge on Tui-2H MWA



Marine growth on Tui-3H MWA

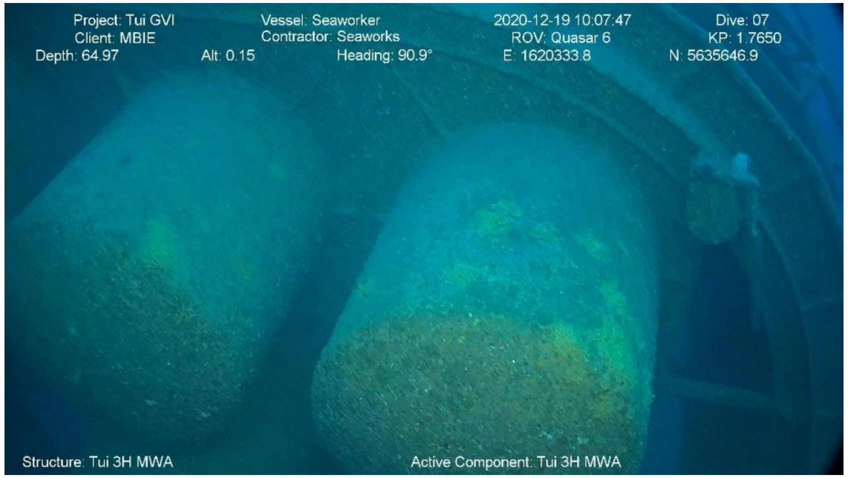


Figure 10 Shallow water fouling communities observed on production flowline, gas-lift, umbilical and Mooring Lines Below the FPSO Umuroa Turret.

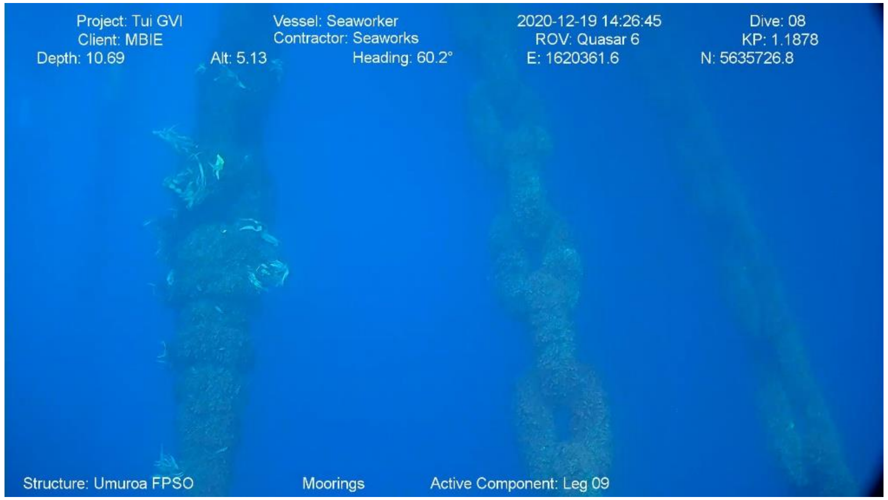
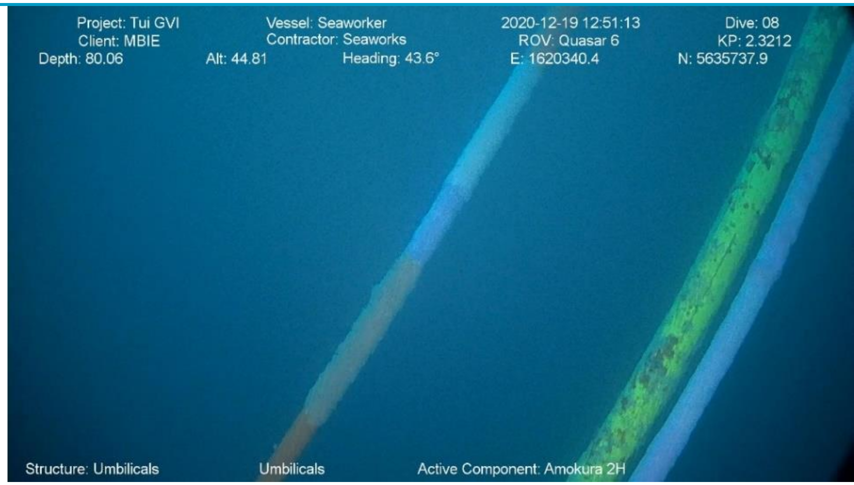


Figure 11 Deeper water fouling communities observed on dynamic sections of production lines, gas-lift, umbilical and associated structures

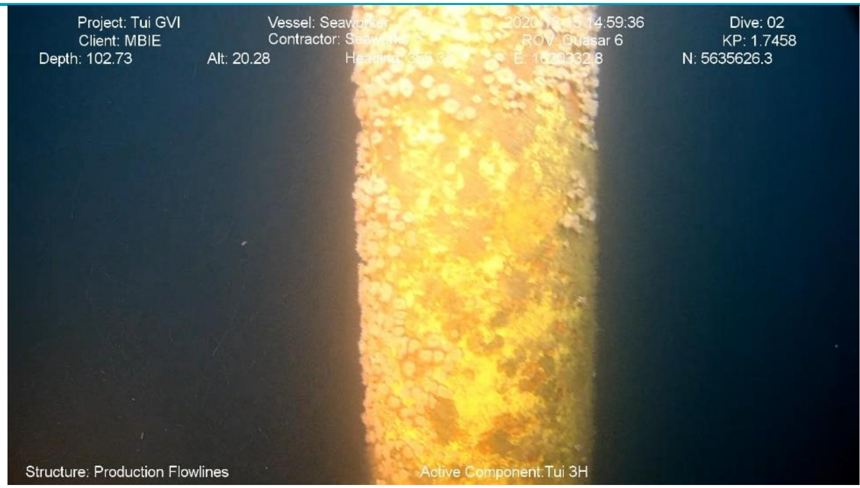
Dense jewel anemone fouling on production flowline

Dense jewel anemone fouling on umbilical and gas-lift lines



Dense tubeworm growth on umbilcal line flotation collar

Aneome, sponge, and coralline algae growth on production flowline



3.2.2 Observed Fish

Similar to seabed habitats and marine growths, the fish communities observed during the survey did not vary dramatically based on specific areas, but rather were largely concentrated in hotspots around the larger infrastructure features on the seabed (SST, MLC, UTS etc.) and in the water column (MWA, mooring lines, dynamic sections of flow, gas-lift, and umbilical lines).

Sea perch (**Figure 12**) were ubiquitous across all areas surveyed, likely taking advantage of the shelter/cover provided by the physical infrastructure and the increased abundance of suitable prey items such as smaller fish and crustaceans. Other common finfish taxa around the larger infrastructure objects were bastard red cod (*Pseudophycis* sp.) and big-eye (*Pempheris adspersa*)

Other mobile finfish taxa such as tarakihi (*Nemadactylus macropterus*) and john dory (*Zues faber*) were encountered occasionally but were found both around the larger infrastructure (SST, Manifolds UTA etc.) as well as along the more open sections of the production flowlines and/or umbilicals. Conger eels were observed utilising the cryptic habitats provided by most of the larger structures like the SST, UTA, mid-line connections (**MLC**), gravity bases etc. Occasional juvenile gurnard (*Chelidonichthys kumu*), rough skate (*Zearaja nasuta*) and short-tailed stingray (*Dasyatis brevicaudata*) were observed on the seabed near the longer stretches of production flowlines.

Across all larger seabed structures small (~80 mm) egg-cases were observed. While it was not possible to directly identify what species the egg cases belonged to, they were most likely an elasmobranch – possibly carpet sharks (*Cephaloscyllium isabellum)*.

Two of the MWAs and one of the umbilical hold-back clamps were observed to have small New Zealand rock lobster (*Jasus edwardsii*) present within the structures which, while not common, is not altogether unexpected as this species requires suitable cryptic habitat to hide safely within and structures like these are the only option in what is a relatively featureless seabed area in the Taranaki Basin. It is likely that the observed individuals were not the only crayfish present and most likely would have settled out of the water column during their puerulus phase and then remained in these areas as they could find sufficient food and suitable protection from predators.

Several pipefish (possibly *Stigmatophora longirostris*) and seahorses (*Hippocampus* sp.) were occasionally observed near seabed infrastructure, but not consistently around any particular well or set of lines.

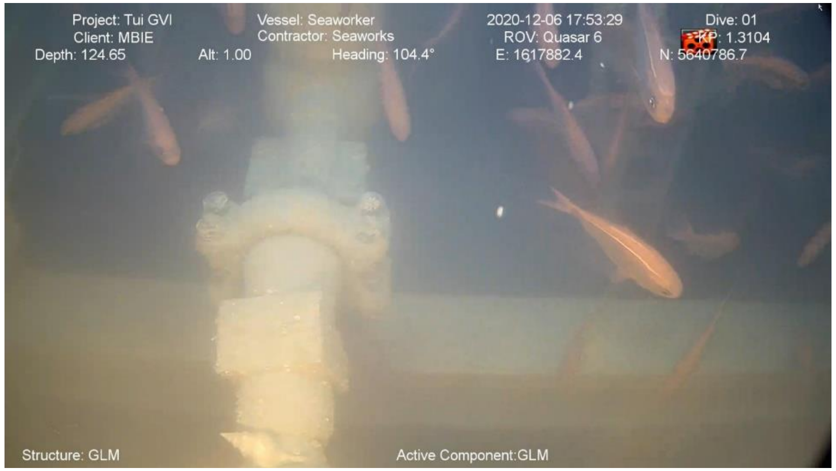
Pelagic species such as kingfish (*Seriola lalandii*) were regularly observed higher in the water column, mainly around the MWA structures and in shallower depths in close proximity to the FPSO around the dynamic sections of the lines and the mooring line structures.

Figure 12 Example Images of Fish Species Observed in the Tui Field During the Survey.

Sea perch

Red cod

Big-eye



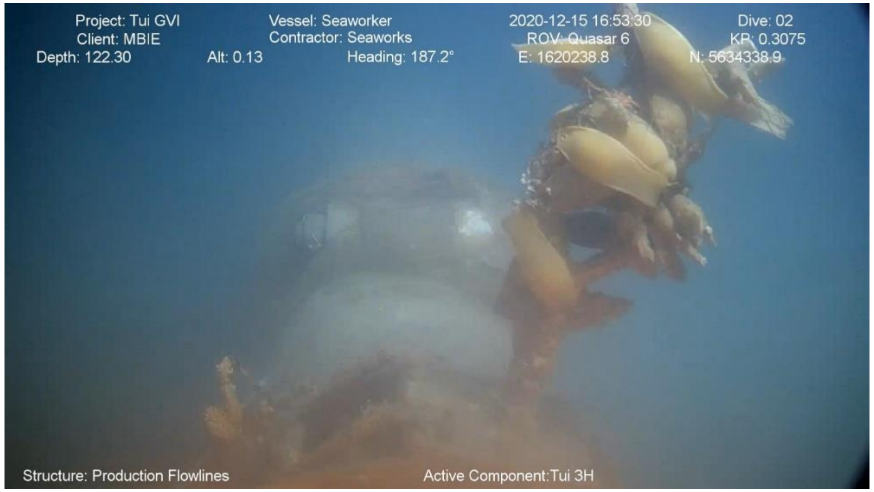
Tarakihi

John Dory

New Zealand rock lobster

Seahorse

Conger eel

Rough skate (left) and Short-tailed stingray (right)	Egg-cases
	

3.2.3 Sensitive Environments

As outlined in **section 2.2,** ‘sensitive environment’ definitions have been developed as part of assessing the impacts of permitted activities. However, these definitions are not applicable to communities found to have established upon installed anthropogenic structures – in this case the subsea infrastructure of the Tui field. Despite this, as these definitions are the only legislated definitions that exist for sensitive environments they have been utilised here to assess whether any such environments may exist within the Tui field, including areas around the subsea infrastructures where previous specific benthic surveys have not been undertaken in the past.

While species characteristic of sensitive environments were observed during the survey (e.g. seapens and calcareous tubeworms) the densities of these taxa and the specific forms that they existed did not reach the threshold criteria to qualify any observed areas as ‘sensitive’ (according to the definitions of MacDiarmid *et al*., 2013).

3.2.4 Protected Species

No fish species or coral taxa covered by Schedule 7 of the Wildlife Act 1953 were observed within the areas of the Tui field covered during the survey.

3.2.5 Marine Mammals

New Zealand fur seals were frequently observed during the survey, both at the sea surface nearby the FPSO and also at the seabed in ~125 m of water. Pilot whales were observed on several occasions during the survey, both within the Tui field itself and to the east and south of the field while the survey vessel was in transit or on weather standby. A larger whale was also observed on the sea surface to the south of the Tui field and, although rough sea conditions at the time made for difficult identification the size, shape, coloration, and the shape of the animals blow most closely resembled a pygmy blue whale.

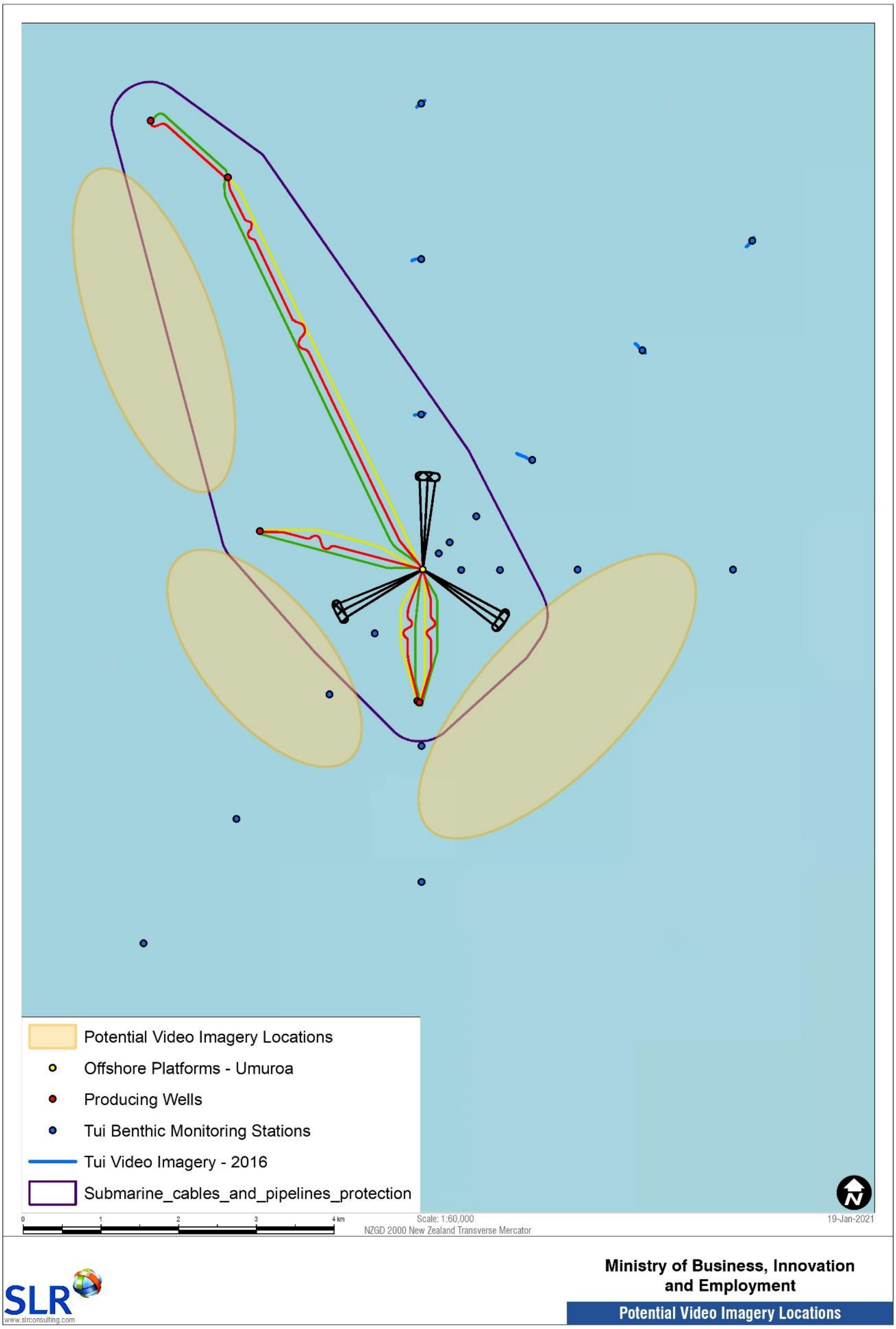
4 Conclusions and Recommendations

The infrastructure present within the Tui field is a biodiversity 'hotspot' relative to the wider offshore Taranaki Area. The subsea infrastructure, including lines and moorings, provides suitable attachment substrate and cryptic habitats for a wide range of organisms which then provide a food source for other epifauna and mobile taxa. The presence of the infrastructure creates artificial habitats that are not normally present within the relatively flat and featureless muddy-sand/sandy-mud sediment habitats present across much of the offshore Taranaki area. The infrastructure provides refuge for many taxa, including mobile fish and crustacea, that might not otherwise be present, or at least not present in such concentrated abundances. While removal of all subsea infrastructure from the Tui Field would result in returning the area to a more 'natural' state in terms of the biological communities and habitats present, it will likely result in a net loss of overall biodiversity it the area relative to what currently exists.

No sensitive environments or protected species were observed during the survey, either on the Tui field subsea infrastructure, or on/in the surrounding areas of seabed that were surveyed. Biological communities observed on and around the subsea infrastructure in December 2020 were typical of those observed on other similar artificial structures in the offshore Taranaki area. No taxa were observed that would be considered particularly unique or highly localised to this area.

It is recommended that additional benthic imagery is collected during the 2021 Tui Field Annual Benthic monitoring survey, currently scheduled for February 2021. Benthic imagery collection should cover the areas of the Tui field infrastructure not covered in previous benthic imagery collection or the 2020 survey, where these can safely be surveyed with the towed video array that will be utilised. Suggested areas are outlined in **Figure 13**.

Figure 13 Areas of seabed suggested to be targeted for Benthic Imagery Collection During the 2021 Annual Benthic Monitoring Survey



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APPENDIX A

Defining Criteria for Sensitive Environments – As taken from MacDiarmid *et al.*, 2013.

Table 2 Schedule 6 Sensitive Environment Definitions

Sensitive Environment	Indicator of existence of sensitive environment
Stony coral thickets or reefs	A stony coral reef or thicket exists if – • Live or dead colonies of a structure-forming species covers 15% or more of the seabed in a visual imaging survey of 100 m^2 or more; or • A specimen of a thicket-forming species is found in two successive point samples; or • A specimen of a structure-forming species is found in a sample collected using towed gear.
Xenophyophore beds	A xenophyophore bed exists if average densities of all species present found (including fragments) equal or exceed one specimen per m^2 sampled.
Bryozoan thickets	A bryozoan thicket exists if – • Colonies of large frame-building bryozoan species cover at least 50% of an area between 10 m^2 and 100 m^2; or • Colonies of large frame-building bryozoan species cover at least 40% of an area that exceeds 10 km^2; or • One or more colonies of large frame building bryozoan species occur per m^2 of seabed sampled using towed sampling gear; or • One or more large frame-building bryozoan species is found in successive point samples.
Calcareous tube worm thickets	A sensitive tube worm thicket exists if – • One or more tube worm mounds per 250 m^2 are visible in a seabed imaging survey; or • Two or more intertwined specimens of a mound forming species of tube worm are found in any point sample; or • Mound-forming species of tube worm comprise 10% or more by weight or volume of a towed sample.
Chaetopteridae worm fields	A sensitive chaetopteridae worm field exists if worm tubes and/or epifaunal species – • Occupy 25% or more of the seabed in a visual imaging survey covering an area of 500 m^2 or more; or • Make up 25% or more of the volume of a sample collected using towed gear; or • Are found in two successive point samples collected using point sampling gear.
Sea pen fields	A sea pen field exists if - • One or more specimens of any species of sea pen is found in two successive samples collected using point sampling gear; or • Two or more specimens per m^2 are found in a visual imaging survey or a survey collected using towed gear.

Sensitive Environment	Indicator of existence of sensitive environment
Rhodolith (maerl) beds	A rhodolith bed exists if – • A single specimen of a rhodolith species is found in a sample obtained using mobile or point sampling gear; or • There is more than 10% cover of living coralline thalli in a visual image.
Sponge gardens	A sponge garden exists if metazoans of classes Demospongiae, Hexactinellida, Calcerea, or Homoscleromorpha – • Comprise 25% of successive samples obtained using point sampling gear; or • Comprise 20% or more by volume of any sample taken using towed gear; or • Cover 25% or more of the seabed over an area of 100 m^2 or more in a visual imaging survey.
Beds of large bivalve molluscs	A bed of large bivalve molluscs exists if living and dead specimens – • Cover 30% or more of the seabed in a visual imaging survey; or • Comprise 30% or more by weight or volume of the catch in a sample collected using towed gear; or • Comprise 30% or more by weight or volume in successive point samples.
Macro-algae beds	A macro-algae bed exists if a single specimen of a red, green, or brown macro-algae is detected.
Brachiopods	A brachiopod bed exists if one or more live brachiopods – • Are found per m^2 sampled using towed gear; or • Are found in successive point samples using point sampling gear.
Deep-sea hydrothermal vents	A sensitive hydrothermal vent exists if a live specimen of a known vent species is found in visual imaging survey or any sample. See MacDiarmid *et al*. (2013) for a list of known vent species.
Methane or cold seeps	A methane or cold seep exists if a single occurrence of one of the taxa listed in MacDiarmid *et al*. (2013) is found in a visual imaging survey or any sample

Stony Coral Thickets or Reefs

Coldwater corals include the Scleractinia (stony corals), Octocorallia (soft corals), Antipatharia (black corals), and Stylasteridae (hydrocorals). Stony corals provide the most complex habitats and can form three-dimensional reefs or thickets (Roberts *et al.*, 2006). They are fragile, sessile, slow-growing, long-lived and have limited larval dispersal and a restricted distribution (Consalvey *et al.*, 2006). The distribution of stony corals is determined by the presence of favourable conditions such as high nutrient and food supply, currents or mixing to deliver food and nutrients, and low sedimentation rates (Roberts *et al.*, 2006). There are five main habitat-forming species of stony coral in New Zealand waters, all of which (with the exclusion of *Oculina virgosa* which is only found along the Kermadec Ridge) are found in water 800 – 1,000 m deep and are typically associated with seamounts (Tracey *et al.*, 2011). Corals are protected in New Zealand waters under the Wildlife Act 1953. Based on records of fishing by-catch in commercial trawl fisheries, the presence of corals is greatest in the north and east of New Zealand (particularly the Chatham Rise (Consalvey *et al.*, 2006)). Johnston (2016) reported stony corals to be present in the offshore Taranaki area; however, no stony corals have been identified in benthic surveys of the Tui Field.

A one-off record of black coral by-catch in the South Taranaki Bight was made in 2009 (NABIS, 2018). This record was based on fisheries observed data which was collected in December 2009 while the vessel was trawling for jack mackerel (at 40.15667, 174.075); however, black corals have not been recorded in the Taranaki Bight since.

Xenophyophore Beds

Xenophyophores are large single-celled protozoans that live on the seabed and form an external test of mineral grains, sponge spicule fragments and organic debris (Hayward *et al.*, 2012), and as a result are often mistakenly identified as broken and decaying parts of other animals (Tendal, 1975). Seven species of xenophyophore have been recorded in New Zealand including three endemic species (MacDiarmid *et al.*, 2013). They are particularly abundant below areas of high surface productivity (Hayward *et al.*, 2012). Sampling locations in New Zealand include the eastern, northern, and western continental slopes and on the Chatham Rise in depths of 500 – 1,300 m (Tendal & Lewis, 1978; Hayward *et al.*, 2012). Johnston (2016) has reported a xenophyophore bed offshore of the Taranaki Bight; however, this recording was in water depths in excess of 1,200 m. Xenophyophores have not ben observed in the Tui field during annual monitoring surveys in the past.

Bryozoan Thickets

Bryozoans are suspension feeding organisms that are colonial, benthic or epibiotic on algae, seagrass and animals. Habitat-forming bryozoans are defined as frame-building species that dominate square metres of seafloor. They are most commonly found in temperate continental shelf environments where there is suitable stable substrate and relatively fast and consistent water movement (MacDiarmid *et al.*, 2013). New Zealand has a particularly abundant and diverse assemblage of habitat-forming bryozoans (MacDiarmid *et al.*, 2013), with important species including *Cinctipora elegans, Celleporaria agglutinans,* and *Hippomenella vellicata* (Wood *et al.*, 2012). Bryozoans have been reported by Johnston (2016) in the Taranaki Basin but no large frame-building bryozoans (i.e. >50 mm in three dimensions) have been observed in previous benthic surveys.

Calcareous Tube Worm Thickets

Worms of the family Serpulidae secrete calcium carbonate to form hard-cased tubes. A number of these species occur in New Zealand waters from the intertidal to abyssal depths, but mainly in coastal waters (MacDiarmid *et al.*, 2013). The mound-forming species *Galeolaria hystrix* is the best described example of mounds in New Zealand, and can be found from the Taranaki Coast down to Stewart Island (Morton, 2004; Davidson *et al.*, 2010) at depths down to 30 m (Davidson *et al.*, 2010). Records of calcareous tube worms in Johnston (2016) have been made within the CMA (on the rocky shore within and south of the Sugar Loaf Marine Protected Area), but tubeworm mounds have not been found in the Tui field in the past.

Chaetopteridae Worm Fields

Chaetopteridae tube worms belong to a family of filter-feeding polychaetes that form burrows in soft sediment (Johnston, 2016). Little is known of their role in New Zealand, although worm fields have been reported as widespread in a number of regions, particularly the species *Phyllochaetopterus socialis* on the South Island's east coast (MacDiarmid *et al.*, 2013). The Taranaki Bight was not identified by MacDiarmid *et al.* (2013) as an area of importance for chaetopteridae tube worms; however, Johnston (2016) reported a number of records of chaetopteridae tube worms in the general area of the Tui field (offshore Taranaki area west of Cape Egmont).

Analysis of the infauna samples collected during annual monitoring surveys in the Tui field found that chaetopteridae worms (specifically *Phyllochaetopterus socialis*) were present on a very occasional basis. Where present most samples contained only single individuals. However, video imagery collected across the seabed within the Tui field in previous surveys has not encountered any of the distinct worm-fields, and the low-relief worm-meadows that *P. socialis* is known to form.

Sea Pen Fields

Sea pens are colonial marine cnidarians that occur on fine gravels, soft sand, mud and the abyssal ooze, in areas where turbulence is unlikely to dislodge their anchoring peduncle but where a current exists to ensure a continuous flow of food (MacDiarmid *et al.*, 2013). Sea pens have been reported by Johnston (2016) in the offshore Taranaki area, particularly towards the middle of the Taranaki Bight. The sea pen species *Virgularia gracillima* has also been reported to be widespread throughout the Taranaki offshore soft sediment communities and was regularly observed in video sled tows completed within the Tui field. However, all reports have been for individual, or very small groups of sea pens; therefore, it is not possible to determine if sea pen 'fields' (based on thresholds with MacDiarmid et al., 2013) are present. Definitive identification is also difficult from video sled imagery, so knowing whether all the organisms that were tagged as sea pens were *Virgularia gracillima* in previous surveys is not possible.

Rhodolith Beds

Rhodoliths are free-living calcified red algae that form structurally and functionally complex habitats and support high benthic diversity (MacDiarmid *et al.*, 2013). Rhodolith beds provide refuge for juvenile fish and settlement habitat for shellfish larvae (Nelson *et al.*, 2012), and are often associated with areas of high fisheries productivity (MacDiarmid *et al.*, 2013). They have been identified as important nursery areas for commercial species such as scallops, crabs and fish, and are home to high densities of broodstock bivalves (Nelson, 2009). Although there is little information with regard to the location or extent of rhodolith beds in New Zealand, the offshore Taranaki Basin has not been identified by MacDiarmid *et al.* (2013) as a known location. Furthermore, Johnston (2016) and previous annual monitoring surveys in the Tui field did not record any rhodoliths in the EEZ of the Taranaki Bight.

Sponge Gardens

Sponges are found throughout a variety of environments including shallow coastal rocky reefs, seamounts, hydrothermal vents and oceanic ridges. In New Zealand, demosponges dominate the shelf and coastal area in water depths down to 250 m. Deeper waters are dominated by the hexactinellid (glass) sponges (MacDiarmid *et al.*, 2013). Examples of known locations of sponge gardens in New Zealand include the North Taranaki Bight (MacDiarmid *et al.*, 2013), with the Sugar Loaf Islands Marine Protection Area particularly well known for its diverse sponge communities. Although small individual sponges have been observed in benthic imagery collected in the Tui field during previous surveys, no sponge gardens (as defined in MacDiarmid *et al*., 2013) were identified. While there is potential for sponge gardens to be present in the Tui field outside of areas previously surveyed, all records within Johnston (2016) were for shallow coastal waters.

Beds of Large Bivalve Molluscs

When bivalve molluscs form aggregations on the seabed, the aggregations are referred to as 'beds' (for infaunal species such as cockles) or 'reefs' (for emergent species such as mussels). The presence of aggregations may result in complex biogenic structures in what would otherwise be a homogenic habitat; modifying the surrounding habitat and influencing the communities present (MacDiarmid *et al.*, 2013). In New Zealand, bivalve beds/reefs mainly occur in water depths less than 250 m on the continental shelf (Rowden *et al.*, 2012). Suspension feeders are particularly well represented on the west coast of the North Island out to mid-shelf depths (Rowden *et al.*, 2012). Common species include horse mussels, scallops and dredge oysters (MacDiarmid *et al.*, 2013), with Johnston (2016) reporting *Glycymeris modesta, Scalpomactra scalpellum, Nemocardium pulchellum, Notocallista multistiata* and *Tawera spissa* as the most common mollusc taxa within the wider Taranaki Bight. Johnston (2016) states that bivalves were the most common of the possible habitat indicators in the Taranaki Bight and has recorded bivalves as present in the offshore Taranaki area. It is worth noting that as these records are based on presence/absence it is not possible to determine whether records are of bivalve beds/reefs or individuals (Johnston, 2016).

While small bivalves have been identified within infauna samples collected during benthic surveys of the Tui field, larger bivalves (such as scallops, oysters and horse mussels) have not previously been found/observed in either grab samples or imagery, in particular no large bivalve aggregations/beds/reefs have been observed.

Macro-algae Beds

Macro-algae beds occupy areas of hard rocky substrate from the intertidal down to depths of 200 m. Small foliose brown, red, and green algae, as well as large brown algae/kelp form dense beds and are important components of reef ecosystems (MacDiarmid *et al.*, 2013). While MacDiarmid *et al.* (2013) reported that macro-algae beds are present throughout New Zealand's EEZ no specific Taranaki sites were mentioned. There were no reports of red, brown or green macro-algae beds in the vicinity of the Tui field by Johnston (2016). Likewise no macro-algae beds have been observed during previous benthic surveys conducted in the Tui field.

Brachiopods

Brachiopods, commonly referred to as lamp shells, are small bilaterally symmetrical filter feeders that superficially resemble bivalve molluscs (Lee & Smith, 2007; Tracey *et al.*, 2011). They typically anchor to hard substrates such as on rocks, gravel, or shell debris by a muscular stalk. Brachiopods occur throughout New Zealand at all depths in areas of significant water movement that are free of fine sediment (Lee & Smith, 2007). While brachiopods have been found at all depths, the majority of species occur in depths less than 500 m (MacDiarmid *et al.*, 2013). The presence of both live and dead brachiopods increases habitat complexity (MacDiarmid *et al.*, 2013). Diverse and numerically abundant brachiopod assemblages have not been reported for the Taranaki Bight (MacDiarmid *et al.*, 2013); however, Johnston (2016) has reported two records of brachiopods that are in relatively close proximity to the Tui field, and benthic surveys of areas north of the Tui field have collected isolated individuals in seabed grab samples. Previous annual monitoring surveys in the Tui field, including grab sampling and benthic imagery collection, have not found any living individuals or large accumulations of empty brachiopod shells. Live specimens are required in order to meet the MacDiarmid *et al*. (2013) criteria of a sensitive habitat.

Deep-sea Hydrothermal Vents

The distribution of deep-sea hydrothermal vents is related to tectonic plate boundaries, with New Zealand deep-sea hydrothermal vents forming at the subduction zone of the Pacific Plate under the Australian Plate (De Ronde *et al.*, 2001). This occurs to the north of New Zealand along the Kermadec Volcanic Arc (GNS, 2018), well away from the Taranaki Basin and the Tui Field.

Methane or Cold Seeps

Methane or cold seeps occur when methane-rich fluids escape into the water column from underlying sediments. Active seeps are usually associated with gas hydrates in the Gas Hydrate Stability Zone, typically in the upper 500 m of sediments beneath the seabed in water depths of at least 500 m (Pecher & Henrys, 2003). Active and relict cold seeps have been confirmed at the Hikurangi Margin on the North Island's east coast (Greinert *et al.*, 2010).

There have been no methane or cold seeps definitively identified in the Taranaki Basin (Johnston, 2016) and this is supported by no observations being made during previous benthic monitoring programmes in the Tui field. Nevertheless, the Taranaki Basin contains numerous active faults that would be expected to have sporadic discharge of thermogenic and biogenic gases, released respectively from the deep hydrocarbon source rocks and from shallower buried organic matter. Most of the active faults would occur on the east of the Tui field, related to the Cape Egmont Fault System. In the absence of continuous venting of gases, no impact on the benthic environment has been observed or would be expected in the offshore Taranaki Basin, but seabed pockmarks and mounds (mud volcanoes) are evidence of historical impacts and have been observed on seismic data in some areas (Ilg *et al.*, 2012).

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APPENDIX D

Tui Field Decommissioning Plan

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

Tui Oil Field Decommissioning Plan

TUI PROJECT

July 2021

New Zealand Government

Disclaimer

This document is a guide only. It should not be used as a substitute for legislation or legal advice. The Ministry of Business, Innovation and Employment is not responsible for the results of any actions taken on the basis of information in this document, or for any errors or omissions.

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Terms & Abbreviations

Term/Abbrev.	Definition
AHTV	Anchor Handling Tug Vessel
BWU	BW Umuroa Pte. Limited, the owner of the FPSO *Umuroa*
CSV	Construction Support Vessel
EEZ	Exclusive Economic Zone
EMP	Environmental Monitoring Plan
EPA	Environmental Protection Authority
FPSO	Floating Production, Storage & Offloading vessel
GLM	Gas Lift Manifold
IMO	International Maritime Organisation
Km	Kilometre
MBES	Multibeam Echo Sounder, a sonar method used to survey the seabed
MBIE	Ministry of Business, Innovation & Employment
MNZ	Maritime New Zealand
MODU	Mobile Offshore Drilling Unit
P&A	Plugged and Abandoned
PGB	Permanent Guide Base, sits on a well to support and align the Xmas tree
ROV	Remotely Operated Vehicle
SDU	Subsea Distribution Unit
SSXT	Subsea Xmas Tree
Te	Tonne
TKoT	Te Kāhui o Taranaki Iwi
Tui	The Tui, Amokura and Pateke subsea oil field development
UTA	Umbilical Termination Assembly
Wellhead	An assembly that sits at seabed level above a well, where the wellbore terminates, with facilities for installing casing hangers and hanging production tubing
WIV	Well Intervention Vessel
Xmas Tree	An assembly containing piping and valves that is installed on a wellhead to allow flow control and well intervention

List of References

Reference	Title
[1]	Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act, 2012
[2]	Resource Legislation Amendment Act, 2017
[3]	United Nations Convention on the Law of the Sea (UNCLOS), 1982
[4]	Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Exconomic Zone, International Maritime Organisation (IMO), 1989
[5]	Health and Safety at Work (Petroleum Exploration and Extraction) Regulations, 2016
[6]	Well Decommissioning Guidelines – Issue 6, Oil & Gas UK, 2018
[7]	Interpretive Guidelines – Petroleum: Well Operations and Well Examination Schemes, WorkSafe NZ, 2017

1 Executive Summary

1.1 Introduction

The Tui oil field (Tui field) is a subsea oil development that lies approximately 50km off the western coast of Taranaki, New Zealand. It is located in 120m of water and has five subsea production wells that produced from three separate hydrocarbon accumulations – named Tui, Amokura and Pateke.

Production from the Tui field commenced in 2007, with an anticipated field life of 15 years.

Unlike the other offshore fields in Taranaki, the Tui field does not have a fixed production platform. It is a subsea installation which used a floating production facility, the floating production, storage and offloading (FPSO) vessel *Umuroa*.

During the life of the field, the Tui field produced around 40 million barrels of oil via a network of flowlines attached to the FPSO. The oil from Tui was transferred from the FPSO to cargo tankers and shipped overseas for processing.

In November 2019, the operator of the Tui field, Tamarind Taranaki Limited, ceased production from the field and in December 2019 was placed into liquidation. In February 2020, Cabinet decided to fund and undertake the decommissioning of the Tui field in order to protect the Taranaki marine environment. A Project Team was subsequently established in the Ministry of Business, Innovation and Employment (MBIE) to plan and manage decommissioning. It is planned to occur across three separate phases of offshore work, over a four-year period from 2020-2023.

The Tui Project has attracted significant interest in the Taranaki region, particularly from iwi, who have a shared interest in sustaining the environment surrounding the Tui field. In conducting activities, MBIE is focused on honouring the Crown's Treaty of Waitangi obligations. For this project MBIE has partnered with Te Kāhui o Taranaki (Taranaki Iwi) to ensure their cultural values and interests, particularly in relation to the environment, are identified and mitigated throughout the decommissioning programme. Additionally, MBIE engages with other interested parties such as the local Taranaki community and service providers in the oil and gas industry, some of whom are likely to be involved in decommissioning activities. MBIE is committed to proactive, consistent and positive engagement to deliver the Project.

This is New Zealand's first offshore oil field decommissioning project and a new role for the Crown and MBIE. Under normal circumstances, planning would ordinarily occur for several years in advance of delivering an offshore decommissioning project of this nature. However events in 2019 have meant that MBIE has needed to plan decommissioning in parallel with delivering it.

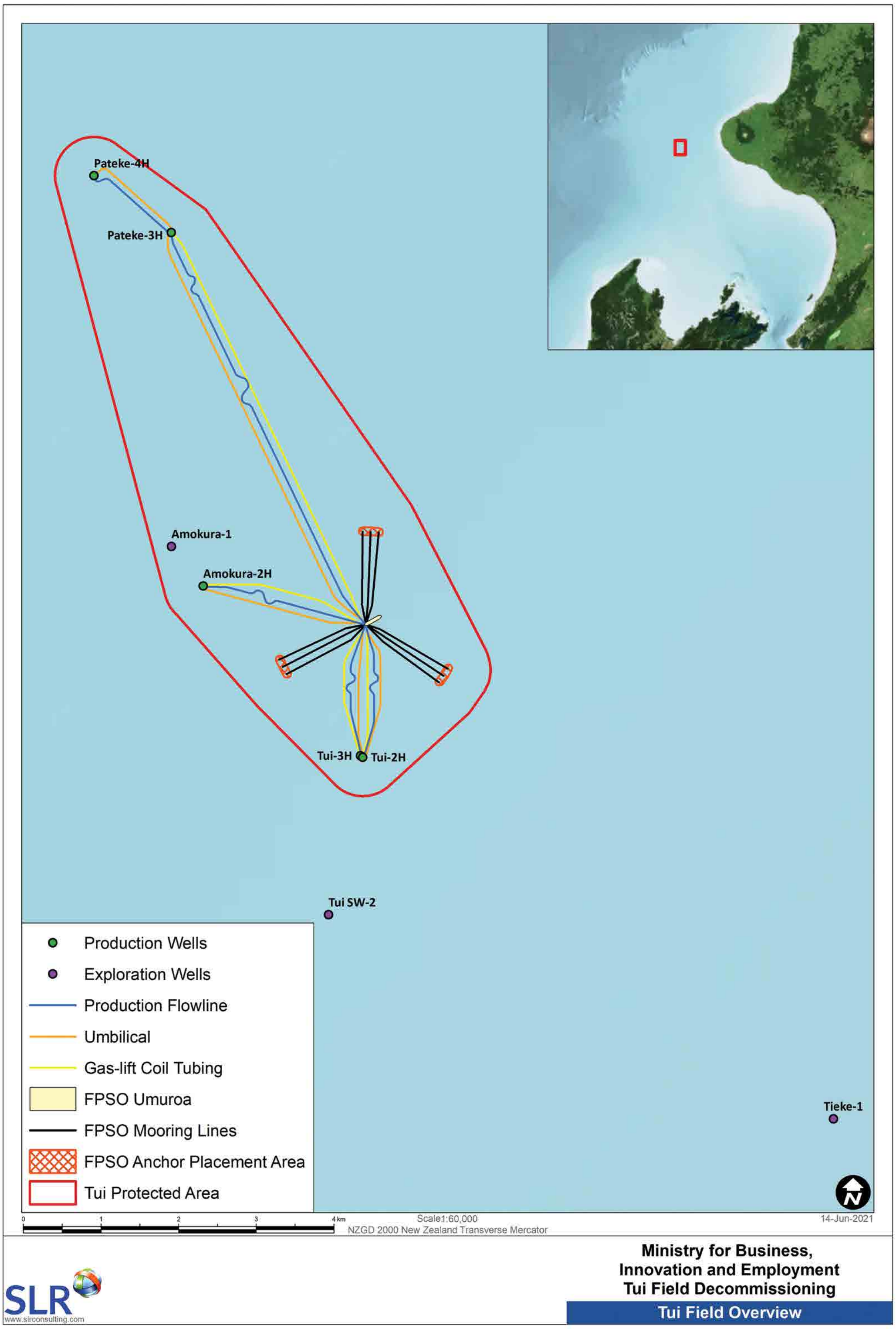

Figure 1: Location and layout of the Tui field off the west coast of Taranaki, NZ

1.2 Purpose

The purpose of this Decommissioning Plan is to:

- Summarise MBIE's plans for decommissioning the Tui field, including how they were formulated and why this is seen to be the best practicable approach.
- Describe the anticipated decommissioning methods, timeframes and equipment.
- Describe MBIE's engagement with Treaty of Waitangi partners and how feedback has been reflected in our plans.
- Describe MBIE's consultation with persons with existing interests and other interested parties.
- Describe the monitoring that is planned after decommissioning has been completed.

1.3 Scope

This document describes the Decommissioning Plan for the infrastructure and wells in the Tui field, which includes the following items:

- FPSO *Umuroa*
- Mooring Lines and Anchors
- Flowlines and Umbilicals
- Subsea Structures & Equipment
- Subsea Wells
- Xmas Trees, Wellheads and Casing Stubs

1.4 Field Overview

The Tui field consists of five subsea wells that were connected via flowlines to a turret-moored FPSO *Umuroa* which was anchored over the field. The FPSO was held on location above the Tui field by nine mooring legs, arranged in three sets of three legs. Each leg comprised sections of chain, wire rope and an anchor, arranged in a star pattern around the FPSO.

The FPSO was connected to the Tui subsea production infrastructure via a dynamic riser system. Oil was produced from the subsea wells with downhole gas lift. Flexible production flowlines, gas lift flowlines and control umbilicals tie the subsea wells back to the FPSO via the riser system. The riser system consists of four riser groups, each containing a 9.5" production riser, a 3" gas lift riser and a control umbilical. Each riser group was suspended from underneath the FPSO, resting on a mid-water arch (MWA) before continuing down to the seabed. The system has a variety of riser base structures, hold-back systems, clamps and other supporting architecture.

Refer to Figure 2 for a schematic of the Tui field and Section 4 for a complete description of the items of equipment in the field that will be decommissioned.

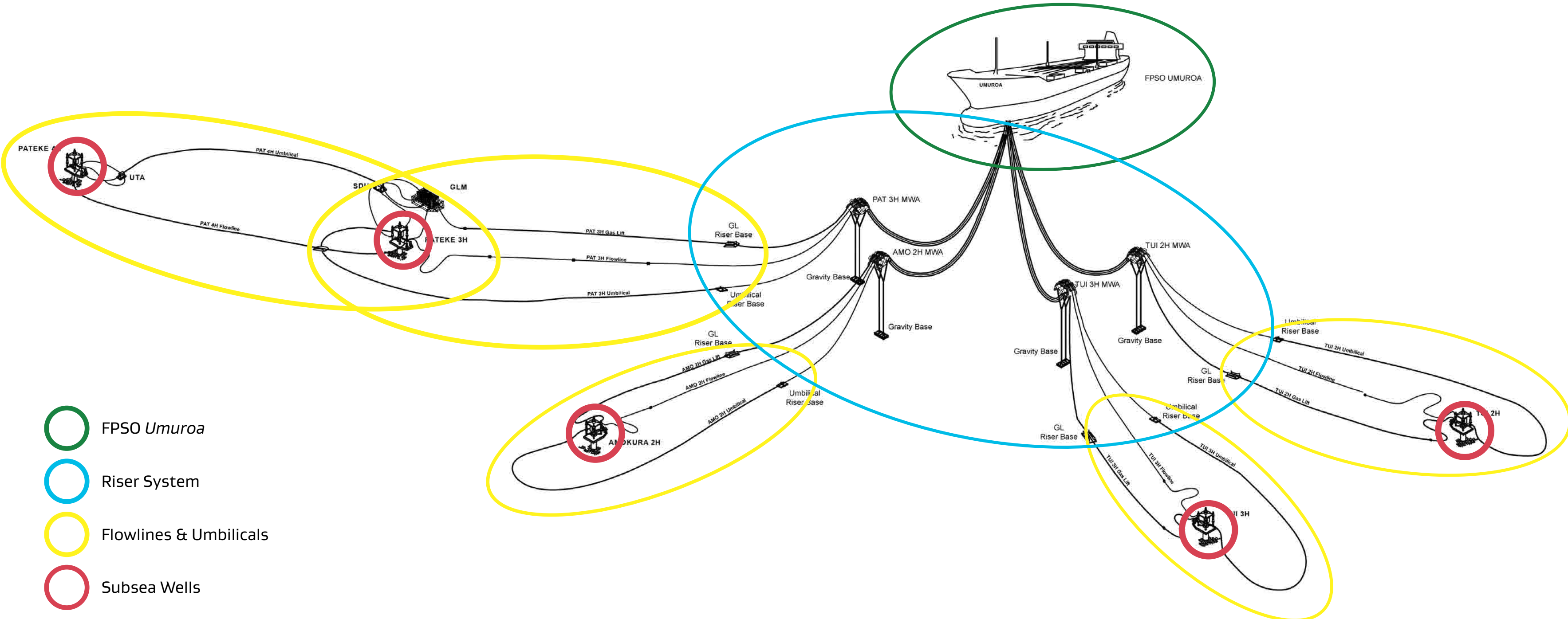

Figure 2: Tui Field Schematic with FPSO & Subsea Infrastructure

1.5 Selected Decommissioning Solution

MBIE evaluated the options available for decommissioning the Tui field and adopted a staged approach, with decommissioning broadly divided into three separate phases.

These are:

- **Phase 1** – Demobilisation of FPSO *Umuroa* – completed in May 2021
- **Phase 2** – Removal of Subsea Infrastructure
- **Phase 3** – Plugging and Abandonment of Wells

The overall approach selected is to leave a 'clear seabed' through recovery of all subsea equipment and removal of all wellheads to below the seabed. The rationale for selecting this approach, and solutions adopted are discussed more fully in Section 5.

1.6 Progress to Date

Phase 1 of the Tui Project, demobilising the FPSO from the field, was completed in May 2021.

To achieve this, MBIE entered into a Demobilisation Agreement with the owner of the FPSO, BW Umuroa Pte. Ltd. (BWU), in November 2020. Preparatory works commenced in December 2020, with flushing of the flowlines and umbilicals completed in February 2021. In March, a Construction Support Vessel (CSV) and an Anchor Handling Tug Vessel (AHTV) arrived in Taranaki for Phase 1 works, with two Tug Support Vessels arriving in early April. Offshore work to disconnect the FPSO from the subsea riser system were completed in late April, and the FPSO was disconnected from its moorings and towed away from the Tui field on 5 May 2021. In addition, the FPSO moorings and anchors were recovered from the field in late May.

Phases 2 and 3 require a decommissioning marine consent from the Environmental Protection Authority (EPA). MBIE commenced this process in February 2021. Simultaneously, MBIE is conducting a procurement process to select one or more contractors to undertake Phases 2 and 3.

2 Background

2.1 Tui Location and History

The Tui field is located within Petroleum Mining Permit 38158, approximately 50km off the west coast of Taranaki, New Zealand in 120m water depth. It was discovered in 2003 by New Zealand Overseas Petroleum and production commenced from four subsea wells in July 2007. An FPSO, the *Umuroa*, was used to process and store the oil produced from the wells and to control subsea operations.

During its early years, the Tui field was New Zealand's largest producing oil field and sixth largest oil reserve, with almost 20 million barrels extracted in the first 18 months of operation through to the end of 2008. Statutory reserves reported during the early operating life of the Tui field indicated an anticipated end of field life of 2019, which was the timeframe used in early planning for the decommissioning of the field. A fifth production well was drilled and connected to the existing infrastructure in 2014. In total, around 40 million barrels of oil was produced from the Tui, Pateke and Amokura accumulations that make up the larger Tui development during the 12 year life of the field.

2.2 Decommissioning Regulatory Framework

Decommissioning activities in an offshore context are regulated by the EPA under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (EEZ Act) [1]. The Act provides a framework for environmental management in New Zealand's Exclusive Economic Zone (EEZ) and continental shelf, and aims to promote the sustainable management of natural resources in these locations. The Act also seeks to protect the EEZ and continental shelf from pollution by regulating marine discharges and dumping. MBIE requires a marine consent to be issued under the EEZ Act to allow it to undertake the activities required during the Tui decommissioning, for example disturbance of the seabed during removal of the assets.

In 2017, the Resource Legislation Amendment Act [2] introduced changes to the EEZ Act relating to decommissioning. These include a requirement for the owners of offshore oil and gas installations to submit a decommissioning plan to the EPA before applying for a decommissioning-related marine consent. The requirements in relation to the content of the plan are to be set out in regulations. The changes made to the Act do not come into force until regulations are made.

Although it is not currently a regulatory requirement, MBIE has decided to prepare a decommissioning plan for the Tui field in order to:

› provide a high-level overview of the facilities to be decommissioned, how this will be done and what impacts are anticipated, and
› assist with project planning and stakeholder engagement.

3 Existing Environment

3.1 Environmental Characteristics

The offshore Taranaki area is one of the harshest marine environments in New Zealand, with the best weather occurring in summer and early autumn. The predominant wind direction, with associated long-period ocean swell, is from the southwest. Significant wave heights in excess of 8m can occur during stormy conditions. Water quality in and around the Tui field is generally high due to the significant distance from major riverine inputs, the influx of oceanic water from the Tasman Sea and the distance from upwelling of deep water nutrients.

3.2 Biological Environment

3.2.1 Benthic Invertebrates

Subsea infrastructure on and near the seabed has low to moderate levels of marine growth, dominated by tubeworms, barnacles, anemones and sponges. Benthic macrofauna communities found in the field are similar to those found across the offshore Taranaki area, being dominated by small crustaceans, polychaete worms and bivalves.

3.2.2 Fish

The oceans within and surrounding the Tui field support a number of commercially, culturally and recreationally important fish species. The fish populations within the Tui field are represented by various demersal and pelagic species, most of which are widely distributed from north to south, and from shallow coastal water to beyond the continental shelf edge. Higher densities of sea perch, conger eels, bigeye, kingfish and john dory have been noted in close proximity to the subsea infrastructure. All fish species that could potentially be present in the Tui field are known to be mobile and none are known to be endemic to the Tui field or in areas immediately adjacent to it.

3.2.3 Marine Mammals

New Zealand fur seals are regularly seen in the Tui field. Many different marine mammal species have also been documented in the wider area, including Māui dolphins, Hector’s dolphins and sperm whales. Review of sightings data, modelling and knowledge of ecology and migration patterns suggests that four marine mammal species are considered ‘likely’ to be present in the area (blue whale, common dolphin, killer whale and long-finned pilot whale).

3.2.4 Seabirds

Several seabird species are known to either pass through the offshore Taranaki region during migrations or foraging voyages or are permanent residents. Several bird species are considered regionally significant/distinctive on account of their coastal indigenous biodiversity values. These species include the Antipodean, Northern royal and Southern royal albatrosses; Flesh-footed, Sooty, Fluttering and Buller’s shearwaters; Grey-headed mollymawk; Little blue penguin; Black, Northern giant, White-faced storm, Northern diving and Grey-faced petrels; Sooty tern; Broad-billed, Fairy and Antarctic prions.

3.3 Cultural Environment

Aotearoa's marine environment is highly valued by Māori and plays an important role in historic and present-day culture. The values placed on the marine environment stem from a wide range of elements including the provision of kaimoana (seafood), a sacred pathway which provides a means of historic and contemporary transport and communication, and the habitat of numerous taonga (treasured) species.

There are eight iwi (tribe) within the Taranaki Region, all of which have traditions that demonstrate an ancestral, cultural, historical and spiritual connection to the coastal environment. Taranaki Iwi describe their rohe (boundaries/territory) as extending from Paritūtū (North Taranaki), around the western coast of Taranaki Mounga, south to Rawa o Turi Stream (South Taranaki) and seaward (inclusive of the EEZ).

Because TKoT and the relevant hapū (sub-tribe) exercise kaitiakitanga (guardianship) for the area adjacent to the Tui field, they have prepared an independent Cultural Impact Assessment (CIA) in relation to the Tui field and the anticipated impacts to cultural values. The purpose of the CIA is to assess the actual and potential effects on the existing interests of Taranaki Iwi and the relevant hapū groups of Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi that may result from the Tui decommissioning in order to inform the requisite marine consent and marine discharge consent.

3.4 Socio-Economic Environment

The Tui field lies within Fisheries Management Area 8 (Central) which extends along the Taranaki and Whanganui coastline, with a valuable recreational, customary and commercial fishery.

Due to the distance offshore the Tui field is not an actively targeted area for recreational fishing. In the Taranaki area this is concentrated close to the coastline and targets mainly blue cod, red gurnard, kahawai, snapper, red cod, tarakihi and trevally. Summer months also see pelagic fish species such as striped marlin, tuna (albacore and skipjack), dorado and mako shark present in the offshore Taranaki waters.

4 Items being Decommissioned

The Tui field comprises the following infrastructure and equipment that will be decommissioned during this programme of work:

› FPSO *Umuroa* – demobilised in May 2021
› FPSO Mooring Legs and Anchors x 9 – retrieved in May 2021 following FPSO demobilisation
› 9.5" Production Risers and Flowlines x 4
› 8" Production Flowline
› 3" Gas Lift Risers and Flowlines x 4
› Control Umbilicals x 5
› Mid-water Arches x 4
› Umbilical and Gas-Lift Riser Bases x 4
› Subsea structures: UTA, SDU, Gas-Lift Manifold and Intermediate Skid
› Production Wells and Xmas Trees x 5
› Exploration Wells x 3
› Spools, Jumpers and Flying Leads

The FPSO *Umuroa* was a tanker that was converted into a floating production facility before deployment at the Tui field. It had facilities on board for processing, storing and offloading the oil and gas produced from the field. The vessel was 180m long and was permanently moored over the Tui field from 2007.

The FPSO had a turret mooring system which allowed it to rotate into the weather. The FPSO moorings connected in through the turret and kept the FPSO located centrally within the field. The mooring system comprised nine separate mooring legs made up of lengths of steel chain and wire rope. These were grouped into three groups each with three mooring legs, and the groups were evenly spread around the FPSO and spaced 120 degrees apart. Each leg had a 20 tonne anchor on the end of it that was embedded into the seabed.

Figure 3: FPSO Umuroa

The field comprises two production wells in the Tui accumulation (Tui-2H, Tui-3H), one well in Amokura (Amokura-2H) and two wells in the Pateke accumulation (Pateke-3H, Pateke-4H). Four of the wells were connected directly to the FPSO, with the fifth (Pateke-4H) connected to Pateke-3H. There are also three exploration wells within the permit area (Amokura-1, Tieke-1, and Tui-SW2) that are not connected to the production facilities and are plugged and suspended.

All of the five production wells have horizontal Xmas trees installed on their wellheads to facilitate production flow control and well isolation. The trees weigh approximately 36 tonnes each.

The production wells were connected to the FPSO via a network of flexible flowlines, risers, tubing and umbilicals that total almost 40km in length. This network was the means by which oil, gas, produced water, chemicals, power and signals were passed between the FPSO, the subsea control equipment and the wells.

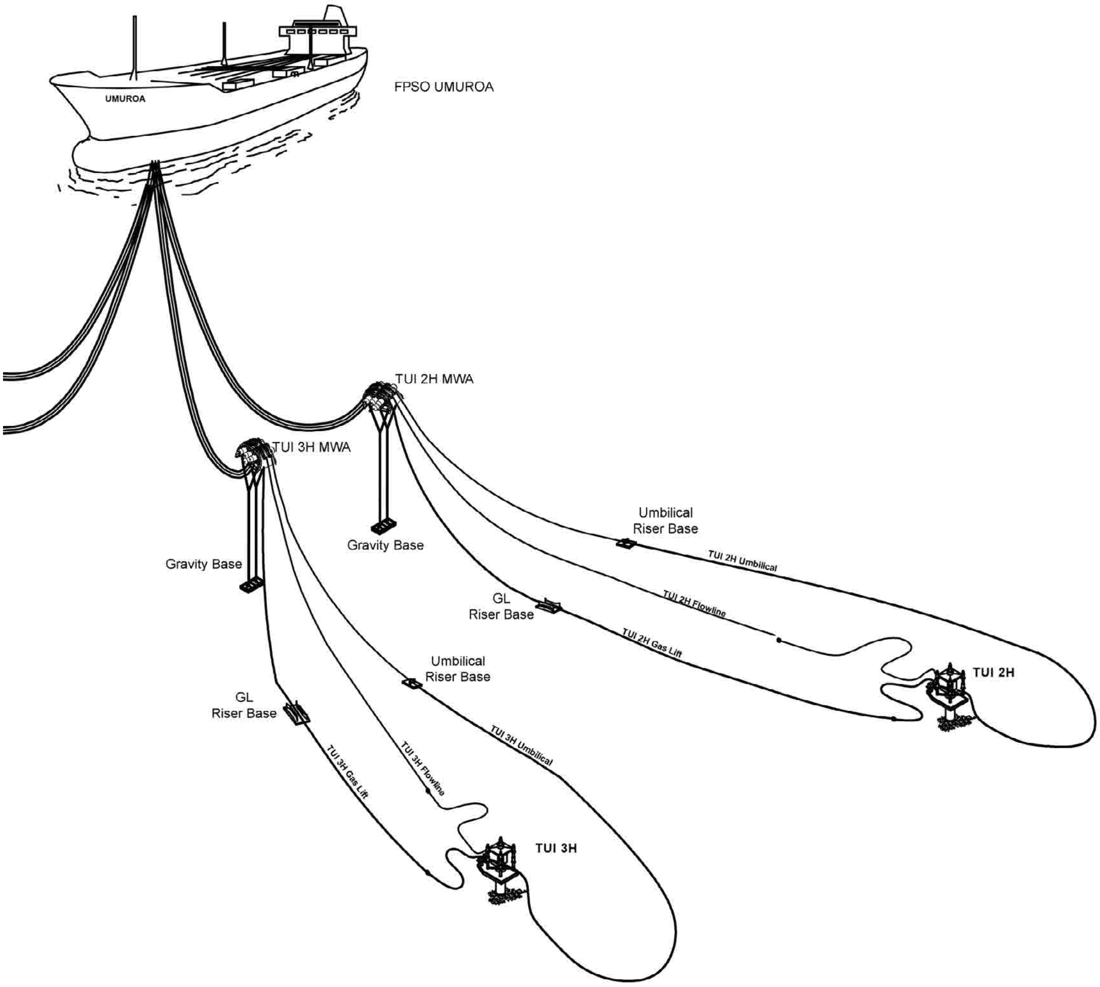

Figure 4: Tui-2H & Tui-3H wells showing equipment layout (rest of field omitted for clarity)

Control of each well was achieved via a series of umbilicals that passed hydraulic fluids, chemicals, power and control signals from the FPSO down to each well. The Tui field has five umbilicals totalling over 12km in length. The umbilicals are flexible bundles of cables and tubes encased in layers of plastic and steel for protection.

Almost 12km of 3-inch gas lift risers and 3.5-inch gas lift coil tubing flowlines were also used to transport compressed gas from the FPSO to the subsea Xmas trees to assist with lifting the well fluids from the reservoirs.

Four 9.5-inch flexible production flowlines and their associated risers were used to carry the produced oil, water and gas from each subsea tree to the FPSO. There is over 13km of production flowlines at the Tui field.

All of the risers and flowlines are composites of steel and plastics that were specially designed to accommodate the movement of the floating FPSO as well as the temperatures and pressures needed for oil and gas production.

The risers and umbilicals are supported by four mid-water arches (MWA's). Each arch sits at a depth of 68m below sea level and comprises an upper product guidance arch and four buoyancy tanks that are moored using steel chains and floats to a 100 tonne gravity base.

The gas lift risers and umbilicals are also attached to riser base structures where they come down on to the seabed, which helps to stabilise the lines and prevent damage.

On the seabed there are several items of production equipment, mainly located around the Pateke-3H wellsite. These are the Gas Lift Manifold (GLM), the Subsea Distribution Unit (SDU) and the Intermediate Skid. These are steel structures on support bases that rest on the seabed. They allowed the Pateke-4H well to be connected into the existing Tui field facilities when it was developed in 2014.

There is also a similar structure, the Umbilical Termination Assembly (UTA), located near the Pateke-4H well.

The total mass of equipment on and above the seabed at Tui is in excess of 6,000 tonnes.

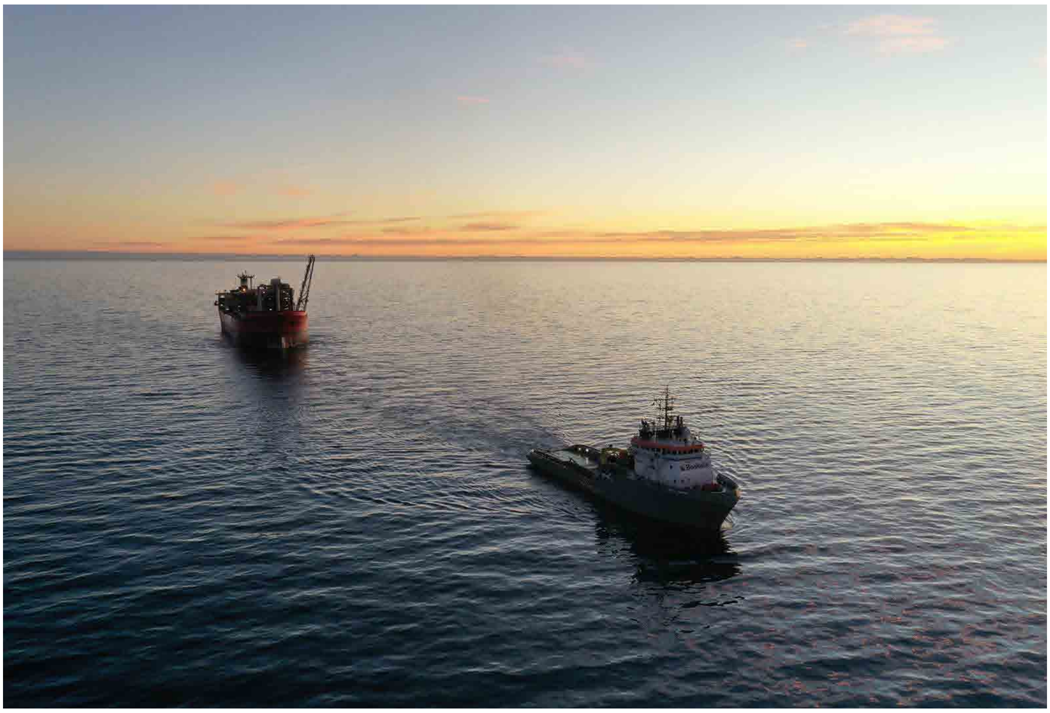

Figure 5: FPSO Umuroa under tow away from Tui in May 2021.

5 Approach to Decommissioning

5.1 Options

International guidelines relating to the protection and preservation of the marine environment outline an obligation on coastal states to remove any offshore installations or structures which are abandoned or disused [3], and to take into account generally accepted international standards when determining whether to allow any of these installations or structures to remain on the seabed [4]. These obligations are not binding, but reflect international good practice.

Methods available for completing the decommissioning of subsea oil and gas assets vary based on many factors. In New Zealand, principal considerations when determining the preferred approach include:

- the regulatory regime in force at the time of decommissioning
- the cultural values and interests of iwi and Māori
- feedback from the community and other interested groups
- the location of the field relative to ports and infrastructure
- the type of equipment that requires removal and availability of suitable vessels and equipment
- the sensitivity of the surrounding marine environment, and
- the metocean conditions and water depth.

Taking these factors into consideration, MBIE used the following criteria to determine the best practicable option when decommissioning the Tui field subsea infrastructure:

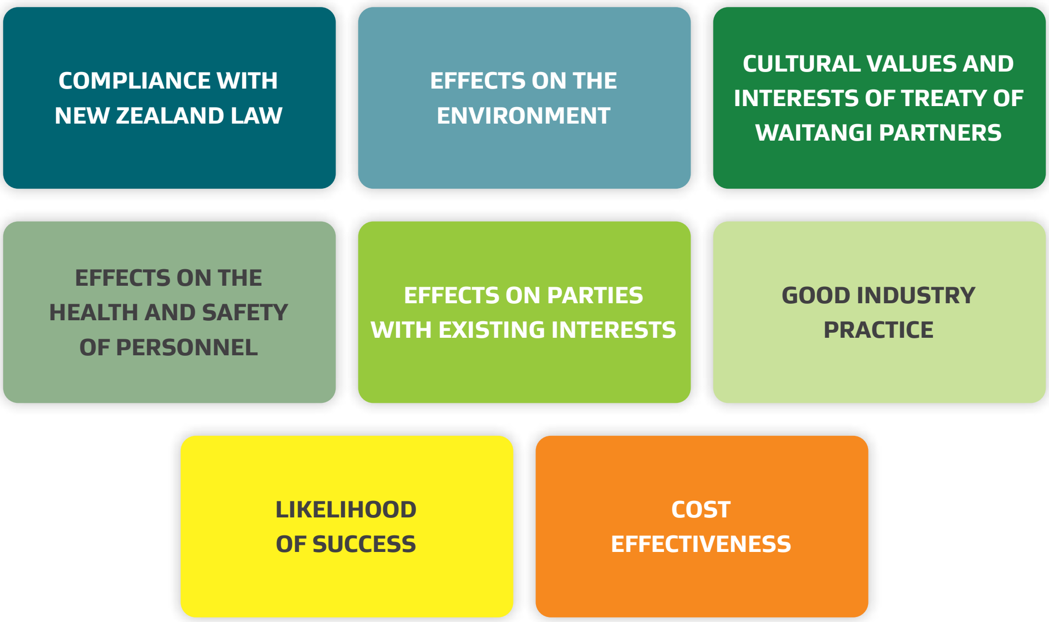

Figure 6: Key Factors during Evaluation of Decommissioning Options

5.1.1 Subsea Infrastructure

There are several approaches that can be taken when decommissioning the infrastructure in a subsea field such as Tui. Each item can be either removed or abandoned in place ('dumped'). The three main options are to:

(1) abandon the assets in-place;

(2) remove the assets that can be most easily recovered and leave others in place; or

(3) remove all assets to leave a 'clear seabed'.

Past operators of the Tui field had commenced work on identifying options for how best to decommission the field prior to it becoming the responsibility of the Crown. This work was able to be leveraged to accelerate the planning process.

Fields that include fixed platforms and rigid subsea pipelines present particular challenges when it comes to decommissioning. The decommissioning of the Tui field is simplified by the nature of the field and the fact that it utilised a floating production facility and flowlines and structures that had been placed on the seabed, rather than being anchored, piled, trenched or buried. This assists the decommissioning in two ways:

- The use of a floating vessel (FPSO) to process and store the oil, rather than a fixed production platform, removes any need to dismantle, deconstruct or leave in place platform topsides, jacket or piles.
- The use of flexible flowlines and gas lift lines, as well as skid-mounted subsea equipment, and the absence of any rigid steel pipelines on or under the seabed means it is a feasible option to recover these items of equipment from the field without causing significant disturbance to the seabed.

5.1.2 Wells

The only aspect of the plugging and abandonment (P&A) where there was some flexibility in approach relates to the subsea wellheads, and whether they are recovered or left in place to support marine life following the abandonment of the wells.

With regards to this, the decommissioning programme must comply with New Zealand regulations [5], as well as align with good industry practice, which for this aspect of the programme is generally acknowledged to be the Oil & Gas UK (OGUK) Well Decommissioning [6]. These recommend that all well casings and wellheads be cut below the seabed and removed. This should be balanced against the technical and economic viability of completing the removal.

5.2 Selected Approach

After considering the options for decommissioning, MBIE has chosen to pursue a 'clear seabed' approach and remove all subsea infrastructure from the Tui field. This approach is aligned with the Project's intention to ensure protection of the Taranaki marine environment. It also allows the field to return to its pre-development condition as soon as possible.

There are five production wells and three exploration wells requiring decommissioning within the Tui permit area. By the end of this programme, all the wells will be plugged with cement and abandoned, with their wellheads removed and the well casings cut below the seabed and recovered.

It has been determined that this is the best approach for decommissioning of the Tui field by testing various options against several key evaluation factors, as given in Figure 6. Complete removal of the subsea infrastructure and plugging and abandonment of the wells achieves the best outcomes across these factors. A summary of this evaluation is included as Appendix A: Decommissioning Options Analysis, Table 5 and Table 6.

5.2.1 FPSO

During the first half of 2021 the FPSO *Umuroa* was disconnected and demobilised and its moorings retrieved. It is owned by BWU. Therefore, decisions on what will happen to it now that it has been disconnected and demobilised from the Tui field rest with BWU and are outside the scope of this plan.

5.2.2 Subsea Infrastructure

In keeping with the 'clear seabed' approach, there needed to be a compelling reason before consideration was given to leaving subsea infrastructure in place at the Tui field.

The Tui field does not contain any buried subsea pipelines or flowlines, which can be costly and environmentally disruptive to remove and recover. Neither does it contain any assets that have been piled into the seabed or buried under significant quantities of stabilisation material (e.g. rock dumped). All the assets at the Tui field are freely accessible and retrievable using standard offshore vessels and equipment.

Due to their location and water depth, Tui's subsea assets are covered with low to moderate levels of marine growth at seabed level. This also does not provide a compelling reason for leaving the structures permanently in place.

It has therefore been concluded that all of Tui's subsea assets will be retrieved during the decommissioning process. This includes all the risers, flowlines, umbilicals, subsea infrastructure and various items of ancillary equipment as listed in Appendix B: Field Infrastructure, Table 8.

5.2.3 Wells

P&A makes a well permanently inoperative in that fluids cannot escape from the well or its connected strata. There are two separate components to P&A – the downhole works to permanently seal the well, and the surface works to remove the wellhead and casing at the seabed.

WorkSafe NZ – Petroleum and Geothermal High Hazards Unit is the regulatory body that oversees well operations in NZ. While the regulations [7] do not prescribe specific standards for P&A, wells should be abandoned in line with internationally accepted good practice. The well abandonment design must also be approved by an independent well examiner. Currently, the OGUK Well Decommissioning Guidelines [6] are the most widely accepted guidelines for well abandonments, and as such, have been chosen for the Tui field.

Regarding the downhole works, these will align to the well abandonment design and this will be undertaken during Phase 3 of this Decommissioning Programme (refer Section 5.3.3). In addition to this, in relation to the surface works, the decision has been made to remove and recover each well's wellhead and casing stub to 3m below seabed, to retain alignment with the guidelines as well as the Project's 'clear seabed' approach.

This has also factored in feedback from the fishing industry to remove potential obstacles to fishing from the seabed.

5.3 Decommissioning Programme

Decommissioning of the Tui field will take several years to complete and require specialist vessels, equipment and personnel that will need to be sourced from within NZ and overseas.

Much of the detailed design relating to the exact execution methodology will be developed in partnership with the successful vessel and equipment providers. What follows is a 'best estimate' as to the most likely methods that will be employed during the Tui Decommissioning Programme.

The programme that MBIE has designed will occur in three phases, with each phase targeted at decommissioning a distinct part of the Tui field.

Table 1: Summary of Selected Decommissioning Solutions

Selected Option	Proposed Solution	Reason for Selection
Phase 1 – Demobilisation of FPSO *Umuroa*		
› **FPSO:** Disconnection and demobilisation by FPSO owner BW Umuroa Pte. Ltd. › **Moorings:** Complete removal and recycling	› FPSO disconnected and removed from site › Moorings and anchors removed and recycled	› Removal of FPSO *Umuroa* allows for clear access to Tui field for Phases 2 and 3 › Removal of moorings and anchors returns seabed to original state
Phase 2 – Removal of Subsea Infrastructure		
› Complete removal of all subsea infrastructure for reuse / recycling / disposal	› All flowlines, gas-lift lines, umbilicals, manifolds, clump-weights and other structures will be recovered for recycling / disposal › Flowlines are at the end of their design life so are not expected to be reused › Other structures will likely be recycled	› Reflects IMO guidelines and standards › Removes obstructions to fishing / anchoring on seabed › Removes future environmental / debris risks from degrading assets › Consistent with established good industry practice for decommissioning (e.g. UK North Sea) › Reflects feedback from local iwi on the adverse cultural impacts from leaving infrastructure in place
Phase 3 – P&A of Wells		
› Plugging & abandonment of subsea wells › Recover casing stubs, wellheads and subsea Xmas trees for recycling / disposal	› To be completed in accordance with Tui Project Well Examination Scheme. Detailed programmes for each well will be developed › All casing stubs, wellheads and subsea Xmas trees will be recovered for reuse / recycling / disposal	› In compliance with the Health and Safety at Work (Petroleum Exploration & Extraction) Regulations 2016 [5] and aligned with OGUK Decommissioning Guidelines [6] › Good industry practice › Leaves a clear seabed, removes any potential obstruction to fishing operations, maximises recycling of materials

Phase 1 was successfully completed during summer 2020/21. Phases 2 and 3 are likely to proceed in sequence over the coming years.

The removal methods for equipment recovered from the Tui field, and the expected timing of the removal are summarised in Table 2.

Table 2: Removal Methods

Item	Method	Timing
FPSO vessel	Disconnect and tow away	Phase 1
Mooring lines and anchors	Recover with Construction Support Vessel (CSV) and Anchor Handling Tug Vessel (AHTV)	Phase 1
Flowlines, risers and umbilicals	Recover with CSV	Phase 2
Subsea structures and equipment	Recover with CSV	Phase 2
Xmas trees	Recover with Well Intervention Vessel (WIV)/ Mobile Offshore Drilling Unit (MODU)	Phase 3
Wellheads and casing stubs	Recover with WIV/MODU	Phase 3

5.3.1 Phase 1

Prior to starting Phase 1 of the decommissioning works, a survey of the Tui field was undertaken to verify the condition and location of the assets to be decommissioned. This information was needed to allow for planning of the complete Tui Decommissioning Programme and was accomplished using an ROV deployed from a Support Vessel.

During Phase 1 the flowlines, risers and umbilicals were flushed to remove residual hydrocarbons and chemicals remaining from production operations. After the lines were flushed, a CSV and AHTV were deployed to assist in disconnecting the risers and umbilicals from underneath the turret of the FPSO. These were then capped and laid down on the seabed within pre-determined corridors, ready for recovery during Phase 2.

Following this, the nine mooring legs that held the FPSO *Umuroa* on location in the Tui field for the past 14 years were disconnected. The legs were each about 1km long and comprise lengths of chain and wire rope connected to a large anchor that was embedded in the seabed. An ROV was deployed from the CSV and used to cut the mooring chains and wire mooring ropes so that they could be recovered to the CSV. The AHTV was used to recover the anchors. Two tug support vessels were used to control the FPSO heading during this work.

When all the mooring legs had been cut the FPSO *Umuroa* was towed away from the field by one of the tow vessels. The FPSO mooring legs and anchors were cleaned and transferred to shore for recycling.

This work commenced in March 2021 and was completed in May 2021.

Figure 7: FPSO Umuroa being towed from Tui following disconnection in May 2021

5.3.2 Phase 2

At the start of Phase 2, a survey of the seabed within the field will be completed to determine the precise location of assets to be recovered prior to the works commencing.

Next a CSV will work through the Tui field, disconnecting all the items of subsea production equipment and recovering them from the seabed using the vessel's heave-compensated crane. This will include the flowlines, risers, umbilicals, jumpers, structures, production skids and hold-back anchors.

The equipment recovery process is expected to comprise:

› a survey of the equipment to be recovered using an ROV, possibly with cleaning of the lifting and cutting points if required (e.g. by high pressure water jetting)

› disconnection of the flowlines, risers, umbilicals and other items (e.g. by undoing flanged connections or by cutting with a super-grinder, hydraulic shear cutter or other multi-cutter tool) in order to separate them in preparation for removal

› retrieval of the subsea equipment using rigging, recovery frames, lift baskets and grabs

As it is disconnected, the subsea equipment will be lifted and stored on the vessel until it can be transported back to shore. The CSV will either reel the flowlines, risers, tubing and umbilicals onto large spools or reels on the vessel, or cut them into short lengths as they come onto the deck and then stack them. The mid-water arches also have options around their recovery, for example through floating to surface or through sinking prior to recovery. These options will be assessed by MBIE once the Phase 2 contractor has been selected. A CSV will periodically transport the recovered equipment back to shore for re-use, recycling or disposal. This work is expected to occur during summer 2021/22.

Figure 8: A Mid Water Arch being lowered into position at Tui in 2007

5.3.3 Phase 3

In Phase 3, a WIV or MODU will enter the four production wells that require plugging downhole (Amokura-2H, Pateke-3H, Pateke-4H, Tui-2H) and will complete the abandonment of them. This will involve pumping cement into the wells to create plugs that seal off the reservoirs.

As the plugging of each well is completed, the casings will be cut below the seabed and the SSXT, wellhead and conductor stub will be retrieved. The wellsite will then be clear of all Tui equipment. Tui-3H production well already has downhole cement plugs in place; however, this well will require the casings to be cut and the SSXT, wellhead and conductor stub retrieved in the same way as the other production wells.

Three exploratory wells in the field (Amokura-1, Tieke-1, Tui-SW2) and one of the production wells (Tui-3H) are already adequately plugged with cement and are considered suspended. They do not require further work downhole. Each well still has a wellhead on it and these will also be removed to leave a clear seabed. All recovered equipment will be transported to shore for reuse, recycling or disposal.

This work is planned to occur in either summer 2021/22 or summer 2022/23. The exact timing of it is subject to an ongoing procurement process and the marine consent process.

Following completion of the decommissioning works, further surveys of the field will be undertaken to confirm that all equipment has been recovered.

A summary of the decommissioning tasks is included in Appendix C: Sequence of Decommissioning Tasks.

Figure 9: A Subsea Xmas Tree prior to installation in the field in 2007

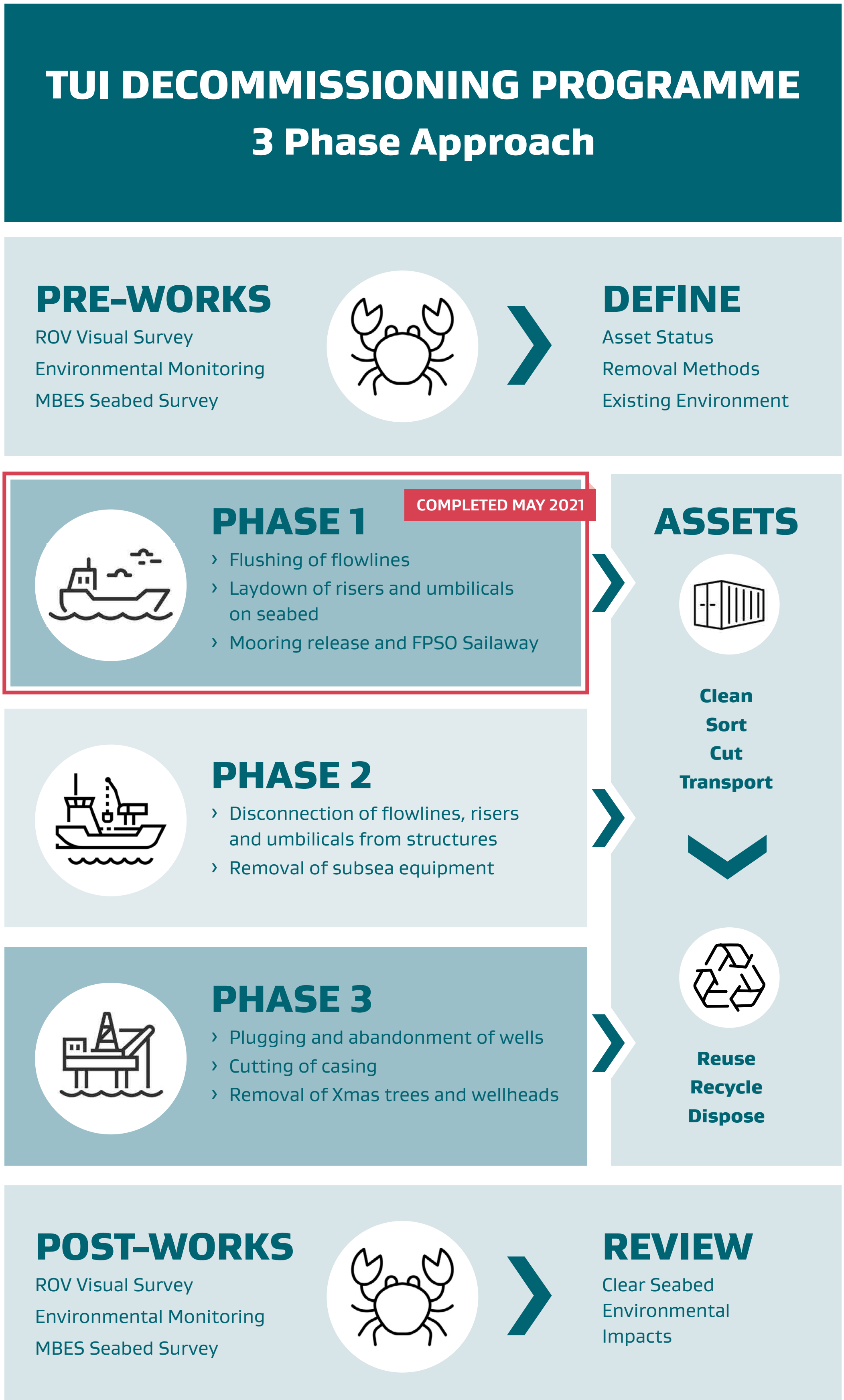

Figure 10: Tui Decommissioning Programme Overview

5.4 Equipment Likely to be Used

Decommissioning of the Tui field will require a variety of vessels, equipment and personnel. Due to the highly specialised nature of the work and the fact that this is the first subsea decommissioning project to be undertaken in NZ, most of the vessels needed to safely and efficiently execute the work (as well as items such as tools for setting cement plugs and cutting flowlines) are not available in NZ and will have to be bought in from overseas. However, it is anticipated that many of the functions that support the decommissioning work (e.g. personnel, logistics services, consumables) will be sourced locally where possible.

An overview of the equipment likely to be required for decommissioning is provided in Table 3. It is important to note that, at the time of preparing this Decommissioning Plan, the precise specification of the equipment required cannot be fully defined. Final details will only be determined after the decommissioning procurement process is completed.

Table 3: Equipment likely to be used during Decommissioning

Phase	Description	Equipment
1	Demobilisation of *FPSO Umuroa*	**CSV** Supported by: › AHTV › Tow Vessels › Remotely Operated Vehicles (ROVs) › Ancillary equipment (e.g. for cutting, handling moorings) › Helicopters
2	Subsea Infrastructure	**CSV** Supported by: › Remotely Operated Vehicles (ROVs) › Ancillary equipment (e.g. for cutting, subsea lifting) › Helicopters
3	P&A of Wells	**WIV or MODU** Supported by: › Support Vessel › Remotely Operated Vehicles (ROVs) › Well Intervention Equipment (e.g. for well control) › Cementing, Wireline, Pumping Equipment › SSXT Control and Removal Equipment › Ancillary Equipment (e.g. for cutting, subsea lifting) › Helicopters

5.5 Disposal Plan

MBIE's intent is that the subsea infrastructure recovered from Tui is reused or recycled wherever possible, in preference to disposal, in order to minimise the effects on the environment of the Tui Decommissioning Programme.

Almost 34,000 tonnes of material will be recovered from the Tui field during the three phases of the decommissioning project.

This comprises the FPSO, as well as all the equipment that has been installed subsea. Only the wells, that are cemented into rock below the seabed and cannot be practically recovered, will be left in place. The major categories of equipment being decommissioned are summarised in Table 4.

Table 4: Materials Being Decommissioned from Tui

Item	Mass (tonnes)	% of Total	Responsibility
FPSO vessel	27,200	80.1	BWU
Mooring lines and anchors	2,887	8.5	MBIE
Flowlines, risers and umbilicals	2,315	6.8	MBIE
Subsea structures and equipment	1,196	3.5	MBIE
Xmas trees	178	0.5	MBIE
Wellheads and casing stubs	196	0.6	MBIE
Total (approx.)	**34,000**	**100**	

The FPSO weighs about 27,200 tonnes and accounts for approximately 80 percent of the total mass of materials being removed or recovered from Tui. The FPSO has already been removed from the field. The subsea infrastructure makes up the balance of the inventory and comprise over 6,700 tonnes, approximately 20 per cent.

As discussed in Section 5.2.1, the FPSO *Umuroa* is not owned by the Crown and therefore MBIE is not responsible for decisions over its future reuse, recycling or disposal. For this reason, the rest of this section excludes the FPSO *Umuroa* and focuses only on the items of infrastructure for which MBIE has responsibility.

These items of subsea infrastructure are predominantly made up of carbon steels and stainless steels, non-ferrous metals such as aluminium and copper, plastics and concrete. A breakdown of each main material type is given in Figure 9.

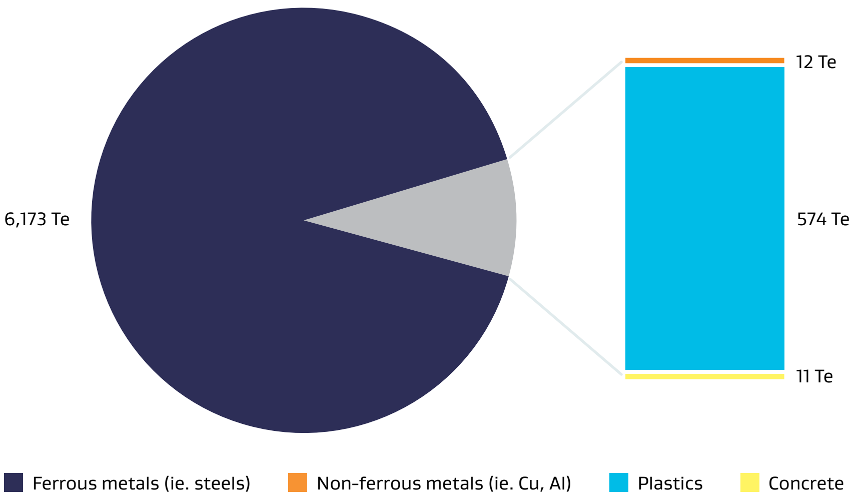

Figure 11: Types of Materials being Decommissioned (excl. FPSO)

Approximately 90 per cent of the items recovered from the subsea infrastructure at Tui may be able to be recycled. This means that over 6,000 tonnes of materials will potentially be used as feedstock for new products. Furthermore, it is estimated that about 3 per cent of the equipment at Tui can possibly be reused. The balance of 7 per cent of materials is expected to require disposal through approved waste handling facilities. Overall, MBIE's objective is to ensure all waste is dealt with in a responsible manner.

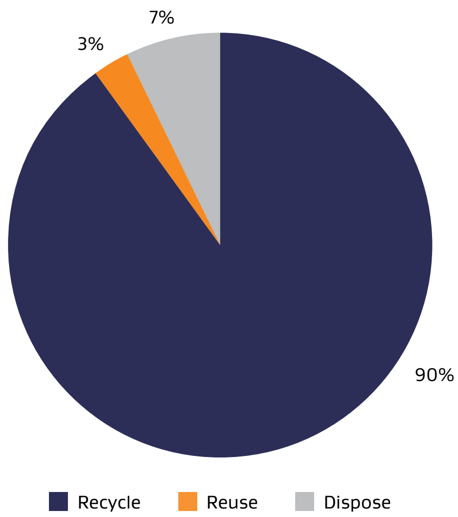

Figure 12: Estimated Waste Stream Allocations for Subsea Infrastructure

5.5.1 Reuse

Unfortunately, reuse of the Tui subsea equipment is unlikely to be possible in most instances. This is because much of the field infrastructure is at the end of its 15 year design life, or has been designed specifically for the production and environmental requirements of the Tui field. This makes it unattractive to potential buyers. There are possibly a few items of equipment that could be reused (up to 3 per cent), and work continues to investigate potential options to facilitate this. Failing this, recycling of the materials is seen as the next best outcome.

5.5.2 Recycling

Different methods will be required for separating the various materials based on the types of equipment being recycled. The large volumes of steel chains, wire ropes, clump weights and structural steels will all be cleaned, sorted, cut down and recycled.

The flowlines, umbilicals and risers are expected to be stripped into their individual components, with the majority of these metals and polymers able to be recycled. There are significant volumes of steel, stainless steel, copper and aluminium that can be recovered and recycled. The polymer coatings on these materials, such as high-density polyethylene and nylon, should also be able to be recycled.

Any metals such as aluminium or zinc that are remaining on anodes protecting the flowlines and structures will also be able to be recovered for recycling.

This recovered material can be used as feedstock for new steels and other metal alloys, reducing the amount of virgin ore needed as well as the energy consumed in the smelting process. MBIE are investigating what capacity there is to perform this recycling in New Zealand, otherwise it will have to be sent to facilities overseas.

There may be some items of equipment where recycling of the constituent components cannot be fully achieved (e.g., if they are comprised of multiple materials that cannot be separated, or significant contamination has occurred) in which case the materials will have to be disposed of. This will be done using approved materials handling and disposal facilities.

6 Consultation

MBIE is committed to ongoing engagement with all stakeholders and interested parties throughout the decommissioning of the Tui field. MBIE has engaged widely during the planning of the programme to ensure that all parties are brought along and involved in their relevant capacities.

6.1 Treaty of Waitangi Partners

In planning for and undertaking decommissioning, MBIE is committed to honouring the Crown's Treaty of Waitangi obligations to Māori and iwi. Both Treaty partners have an interest in ensuring that decommissioning activities occur in a safe and responsible manner.

MBIE and the Te Kāhui o Taranaki Trust (TKoT, the Post-Settlement Governance Entity of Taranaki Iwi) have been working closely together since 2020 to understand and reflect Taranaki Iwi cultural values and interests in the decommissioning of the Tui field.

In March 2021, MBIE and TKoT entered into a partnership agreement for the duration of the project. The purpose of this agreement is to support engagement between MBIE and TKoT to increase understanding of and participation in the decommissioning process across Taranaki Iwi. TKoT are represented by a dedicated engagement lead and a wider Ohu group (working group) that provides both technical expertise and cultural knowledge.

MBIE has provided TKoT with a wide range of material describing the current state of the Tui field and the proposed decommissioning plans: this includes seabed surveys, as built surveys, ecological studies and detailed information on the proposed subsea infrastructure removal activities and well abandonments.

TKoT have been actively involved in the development of the marine consent application and have prepared a Cultural Impact Assessment (CIA) to accompany the application. The CIA assesses the actual and potential effects that may result from the Tui Decommissioning Programme on the existing interests of Taranaki Iwi and the relevant hapū groups of Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi. This information has been used as input to the marine consent application, especially the proffered consent conditions which include environmental monitoring, progress updates and communication during decommissioning, and post decommissioning activities such as surveys and reporting.

MBIE and TKoT will continue to engage iwi groups throughout the decommissioning programme.

6.2 Persons with Existing Interests

The following parties have been identified as having an existing interest that may be affected by the decommissioning of the Tui field:

- Fisheries Groups
  - Deepwater Group
  - Te Ohu Kaimoana
  - Aotearoa Fisheries Limited/Moana New Zealand
- Tamarind Taranaki Limited (through its liquidator Grant Thornton)

Fisheries groups have been contacted and an information sheet containing a summary of the proposed decommissioning was distributed to the three interested parties in the second quarter of 2021.

The Tamarind Taranaki Limited liquidator has also been provided information on the decommissioning programme in June 2021 and have provided their approval of the proposed plan.

6.3 Other Interested Groups and Relevant Regulators

The relevant marine management agencies (EPA and MNZ) as well as WorkSafe NZ are also being actively engaged on an ongoing basis throughout the planning and execution of the Tui Decommissioning Programme.

The form and frequency of this engagement is variable, based on which stage of the programme is occurring. Regular calls and meetings, workshops/presentations and emailed progress updates have all been used to keep the agencies informed of developments relevant to their oversight of the Decommissioning Programme.

MBIE updates the wider public on progress with decommissioning primarily through a dedicated web page (www.mbie.govt.nz/building-and-energy/energy-and-natural-resources/tui-project/), and through news media releases and webinars. In 2020 and 2021, MBIE regularly attended and presented at the Taranaki Energy Forum and the Joint Petroleum Operators and Regulators Forum. Additionally, MBIE along with TKoT, meet with Venture Taranaki and the Taranaki Chamber of Commerce to update on progress and plans of relevance to the local industry.

7 Timeline

MBIE anticipates the Tui Decommissioning Programme will take up to four years to complete from the time the field's assets were disclaimed to the Crown in April 2020. This includes the formation of a dedicated project team to frame, plan and execute the work.

It is MBIE's preference that the offshore works will be executed during the more settled summer months (December to April) to minimise the project's exposure to weather downtime. Because of this, the remaining phases of offshore decommissioning work will most likely be staggered across summer 21/22 and summer 22/23.

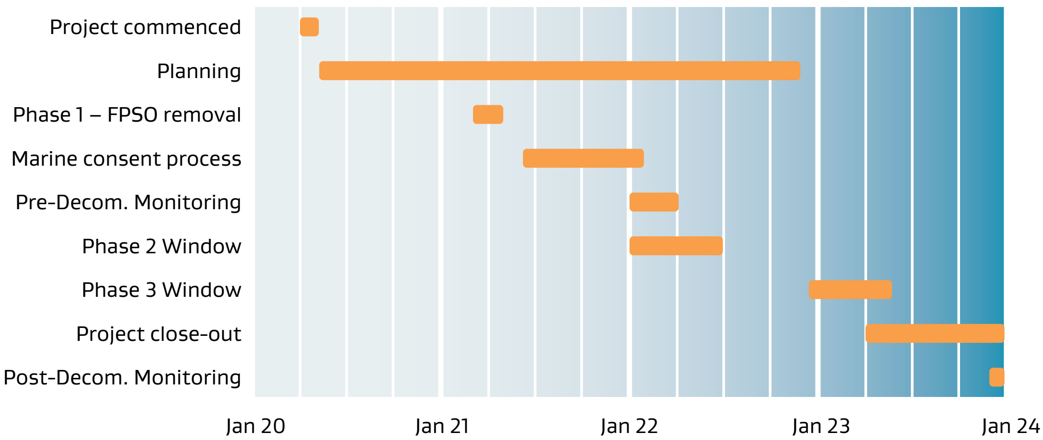

Figure 13: Tui Decommissioning Timeline

Following the completion of the offshore works there will be a project close-out period. It is expected that, based on the above assumptions and subject to vessel and equipment availability, the physical works within the project will be finished by the end of 2023.

However, post-decommissioning monitoring may occur beyond this time (refer to Section 8.1).

8 Post-Decommissioning Monitoring & Maintenance

8.1 Monitoring

As part of the decommissioning activities in the Tui field, MBIE intends to undertake environmental monitoring in two phases: pre-decommissioning and post-decommissioning. The purpose of the monitoring is to assess the extent of the seabed disturbance that may occur during the decommissioning activities, to monitor the recovery of the benthic marine environment and to determine any changes in the sediment physico-chemical properties and biological communities.

Consistent with best practice, MBIE is preparing an Environmental Monitoring Plan (EMP). The EMP envisages that pre-commissioning monitoring will be undertaken in the upcoming 2021/22 summer. MBIE proposes to undertake the initial post-decommissioning monitoring survey, with benthic imagery and collection of sediment samples, in the first summer following completion of activities, which is likely to be summer 2023/24. It is likely that a further monitoring survey will be included in the EMP up to five years after decommissioning, to assess the longer term recovery of any field locations showing impacts from the decommissioning activities.

A report will be prepared following the completion of each monitoring survey, with the final report summarising the monitoring results and providing an assessment of the level of recovery that has occurred at each field location.

The methodology that will be proposed within the EMP is anticipated to include the following elements:

8.1.1 Benthic Imagery Transects

The post-decommissioning benthic imagery will target areas where the greatest disturbance has occurred during the decommissioning works. Seabed imaging technology will be utilised to obtain epibenthic data including the physical features of the seabed, sediment and epifauna.

8.1.2 Sediment Analysis

Similarly, post-decommissioning seabed sampling is proposed to be undertaken at the locations of greatest physical disturbance, focussing on areas where larger scale disturbance of the seabed has occurred. This is expected to cover approximately 70 sample sites across Tui.

8.2 Maintenance

As the field will have had all subsea equipment and materials removed from it, MBIE considers there to be no need for any ongoing maintenance activities to be planned or executed following completion of the Tui Decommissioning Programme.

Appendix A Decommissioning Options Analysis

Table 5: Tui Decommissioning Options Analysis – Subsea Infrastructure

				Key Evaluation Factors							
Approach	Description	Advantages	Disadvantages	Relative Risk to Health & Safety	Relative Risk of Environmental Impacts (Short term)	Relative Risk of Environmental Impacts (Long term)	Relative Complexity of Project	Relative Risk of Negative Impacts on Treaty of Waitangi Partners	Relative Risk of Negative Impacts on Existing Interests	Relative Risk of Deviation from Regs. & Industry Best Practice	Relative Cost
Leave in Place	Flush system. Disconnect and demobilise FPSO. Gain consent to abandon field in place. Leave mooring lines and anchors in place on/under seabed. Leave flowlines, risers and umbilicals on seabed to self-bury. Leave structures on seabed.	› Lowest cost solution › Does not impact marine flora / fauna that has inhabited subsea assets › Minimal offshore works reduces exposure to health & safety risks › Lowest emissions from decommissioning activities	› May be perceived as only having done 'part of the job' of decommissioning › Not consistent with iwi desires for a fully restored seabed / marine environment › Leaves obstructions to fishing / anchoring on seabed › Potential for longer term impacts on environment as equipment breaks down › Not consistent with established industry practices for decommissioning (e.g. UK North Sea)	LOW	LOW	HIGH	LOW	HIGH	HIGH	HIGH	LOW

Partial Removal	Flush system. Disconnect and demobilise FPSO. Gain consent to abandon parts of the field in place. Recover moorings where it can be easily done. Recover flowlines, risers and umbilicals. Leave in place structures which may prove difficult to remove cost effectively (e.g. anchors).	› All exposed equipment is recovered › Technically simpler approach than full removal › Reduces costs associated with difficult subsea operations › Lower emissions from decommissioning activities	› May be perceived as only having done 'part of the job' of decommissioning › Not consistent with iwi desires for a fully restored seabed / marine environment › Leaves obstructions to fishing / anchoring on seabed › Cost and complexity of revisiting assets that had been left in place should a future need to do so arise › Not consistent with established industry practices for decommissioning (e.g. UK North Sea)	MEDIUM	MEDIUM	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Full Removal	Flush system. Disconnect and demobilise FPSO. Remove all subsea equipment including anchors.	› Removes obstructions to fishing / anchoring on seabed › Removes potential for longer term impacts on environment as equipment breaks down › Consistent with iwi desires for a fully cleared seabed › Consistent with established industry practices for decommissioning (e.g. UK North Sea)	› Highest cost solution › Highest emissions from decommissioning activities › Temporary disturbance of seabed during recovery of assets › Technically most complex approach	MEDIUM	MEDIUM	LOW	MEDIUM	LOW	LOW	LOW	MEDIUM

Table 6: Tui Decommissioning Options Analysis – Wells

				Key Evaluation Factors							
Approach	**Description**	**Advantages**	**Disadvantages**	Relative Risk to Health & Safety	Relative Risk of Environmental Impacts (Short term)	Relative Risk of Environmental Impacts (Long term)	Relative Complexity of Project	Relative Risk of Negative Impacts on Treaty of Waitangi Partners	Relative Risk of Negative Impacts on Existing Interests	Relative Risk of Deviation from Regs. & Industry Best Practice	Relative Cost
Leave as is	No well abandonment activities are undertaken. Wells remain shut-in at the SSXTs but are not P&A. Wellheads and SSXTs are permanently left on the seabed.	› Not an option as NZ regulations require the wells to be plugged and abandoned	› Not an option as NZ regulations require the wells to be plugged and abandoned								
Abandonment without Subsea Wellhead Removal	P&A all wells. Remove and recover SSXTs. Leave wellheads and casings in situ on the seabed.	› Slightly lower cost solution due to fewer days work offshore › Lower emissions from decommissioning activities due to shorter works duration › Does not impact marine flora / fauna that has inhabited wellheads	› May be perceived as only having done 'part of the job' of decommissioning with wellheads remaining in place on seabed › Leaves obstructions to fishing / anchoring on seabed › Not consistent with iwi desires for a fully restored seabed / marine environment › Not consistent with established industry practices for decommissioning (e.g. UK North Sea)	MEDIUM	LOW	MEDIUM	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Full Abandonment & Removal	P&A all wells. Remove and recover SSXTs. Cut well casings below seabed and recover wellheads and casing stubs.	› Consistent with established industry practices for decommissioning (e.g. UK North Sea) › Consistent with iwi desires for a fully cleared seabed	› Highest cost solution › Highest emissions from decommissioning activities › Some disruption to existing marine flora / fauna	MEDIUM	MEDIUM	LOW	MEDIUM	LOW	LOW	LOW	MEDIUM

Appendix B Field Infrastructure

Table 7: Details of FPSO Being Decommissioned						
Description	**Installed at Tui**	**Age**	**Length (m)**	**Breadth (m)**	**Weight (Tonnes)**	**Main Materials**
FPSO *Umuroa*	2007	40 years	180	40	27,200	Steels, plastics

Table 8: Details of Key Subsea Infrastructure Being Decommissioned

Description	No.	Diameter (inches)	Length (km)	Weight (tonnes)	Installed	Condition	Product	Location	Main Materials
Production flowlines	5	8 & 9.5	12.2	1,436	2007 & 2015	Flushed	Well fluids (oil)	On seabed	Steel, plastics
Production risers	4	9.5	1.5	264	2007	Flushed	Well fluids (oil)	Under FPSO & on seabed	Steel, plastics
Gas lift risers	4	3.5	1.5	68	2007	Flushed	Lift gas	Under FPSO & on seabed	Steel, plastics
Gas lift coiled tubing	4	3.5	10.2	116	2007 & 2015	Flushed	Lift gas	On seabed	Steel, plastics
Gas lift jumpers	4	3.5	0.2	7	2007 & 2015	Flushed	Lift gas	On seabed	Steel, plastics
Control umbilicals	5	5 – 6.5	13.6	432	2007 & 2015	Flushed	Hydraulic fluid	Under FPSO & on seabed	Steel, plastics
Mooring lines	9	-	11.1	2,700	2007	-	-	Under FPSO & on seabed	Steel
Mooring anchors	9	-	-	180	2007	-	-	On seabed	Steel
Mid-water arch gravity base	4	-	-	527	2007	-	-	On seabed	Steel
Mid-water arch	4	-	-	226	2007	-	-	On seabed	Steel
Mid-water arch tether chains	4	-	-	30	2007	-	-	On seabed	Steel
Umbilical riser bases	4	-	-	52	2007	-	-	On seabed	Steel
Gas lift riser bases	4	-	-	52	2007	-	-	On seabed	Steel
Gas lift manifold	1	-	-	21	2007	Flushed	Lift gas	On seabed	Steel
UTA	1	-	-	4	2007	Flushed	Hydraulic fluid	On seabed	Steel, plastics
SDU	1	-	-	4	2007	Flushed	Hydraulic fluid	On seabed	Steel, plastics
Intermediate skid	1	-	-	3	2007	Flushed	Hydraulic fluid	On seabed	Steel, plastics
Crossing Plinth	1	-	-	11	2014	-	-	On seabed	Concrete
Gravity base anchors	4	-	-	167	2007	-	-	On seabed	Steel
Anode skids	10	-	-	8	2007 & 2015	-	-	On seabed	Steel
Xmas trees	5	-	-	179	2007 & 2014	-	Well fluids (oil)	On wellheads	Steel, plastics
Wellheads	8	-	-	196	2004 to 2014	-	Well fluids (oil)	On wells	Steel, plastics
Total (approximate)				**6,700**					

Table 9: Details of Wells Being Decommissioned							
Well	**Drilled**	**Type**	**Status**	**Wellhead/SSXT**	**Easting**	**Northing**	**Decommissioning Comments**
Amokura-1	2004	Exploration	P&A	Wellhead	2,527,914	6,198,527	Casing to be cut and wellhead/net deflector removed
Amokura-2H	2007	Oil production	Shut-in	Wellhead/SSXT	2,528,319	6,198,017	To be P&A, casing cut and wellhead/SSXT removed
Pateke-3H	2007	Oil production	Shut-in	Wellhead/SSXT	2,527,876	6,202,683	To be P&A, casing cut and wellhead/SSXT removed
Pateke-4H	2014	Oil production	Shut-in	Wellhead/SSXT	2,526,911	6,203,299	To be P&A, casing cut and wellhead/SSXT removed
Tieke-1	2006	Exploration	P&A	Wellhead	2,536,441	6,191,153	Casing to be cut and wellhead removed
Tui-2H	2006	Oil production	Shut-in	Wellhead/SSXT	2,530,379	6,195,809	To be P&A, casing cut and wellhead/SSXT removed
Tui-3H	2006	Oil production	Suspended	Wellhead/SSXT	2,530,348	6,195,831	Casing to be cut and wellhead/SSXT removed
Tui-SW2	2010	Exploration	P&A	Wellhead	2,529,937	6,193,784	Casing to be cut and wellhead removed

Appendix C Sequence of Decommissioning Tasks

Table 10: Planned Sequence of Decommissioning Tasks

Phase	Task	Description	Equipment Removed
-	› Pre-Decommissioning Survey	› Inspection by ROV from Support Vessel	
1	› Flush flowlines & umbilicals	› Circulate fluids from FPSO to flush lines clean	
	› Disconnect flowlines & umbilicals	› CSV to use ROV to disconnect lines from FPSO and lower to seabed	
	› Disconnect FPSO moorings	› CSV to use ROV to cut mooring lines, AHTVs in support	› Mooring Lines & Anchors
	› Tow FPSO away from site	› AHTV tows FPSO away from Tui field	› FPSO
2	› Survey subsea infrastructure	› Inspection by ROV from Support Vessel including seabed imaging	
	› Disconnect subsea infrastructure	› CSV uses ROV to attach lifting lines, cut & disconnect equipment	
	› Lift and remove subsea infrastructure	› CSV lifts equipment from seabed. Support vessel transports it from field	› Flowlines & Umbilicals › Subsea Structures & Equipment
	› As-left survey of field area	› Inspection by ROV from Support Vessel including seabed imaging to verify clear seabed (except wells)	
3	› Plug and abandon subsea wells	› Intervention Vessel/MODU sets cement plugs to permanently seal off wells	
	› Disconnect Xmas trees and recover	› Intervention Vessel/MODU recovers Xmas trees	› Xmas Trees
	› Cut casings and recover wellheads	› Intervention Vessel/MODU cuts well casings below seabed and recovers	› Wellheads, PGBs & Casing Stubs
	› As-left survey of field area	› Inspection by ROV from Support Vessel	
-	› Post-Decommissioning Monitoring	› Benthic and seabed imaging surveys	

BRM 6857

APPENDIX E

Cultural Impact Assessment

Taranaki Iwi

me tōngai harakeke

He Whakamārama – Decommissioning of the Tui Oil Field. Phases 2 and 3.

Prepared for:	*Ministry of Business, Innovation and Employment (MBIE)*
Prepared by:	*Te Kāhui o Taranaki, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi*
Date:	*30 June 2021*

Quality Assurance			
Date	Version	Change	Comment
20 June 2021	1	Initial draft circulated to ngā hapū for review.	
23 June 2021	2	Conditions updated. Baseline understanding of the existing environment updated. Addition of section 2 – project description.	Update
24 June 2021	3	Update recommendations	Update
25 June 2021	4	Update recommendations following Ohu hui.	Update
30 June 2021	5	Approval for distribution	

1.0 He Kupu Whakataki/Introduction

Introduction & Purpose

Taranaki Iwi exercise mana whenua and mana moana over the ancestral lands, waters, taonga species, wāhi tapu and wāhi taonga within the Taranaki Iwi rohe which extends from Ōnukutaipari in the north to Rāwa o Turi stream in the south, and from these points out to the outer most extent of the Exclusive Economic Zone. The rohe of Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi (along with other hapū) are located within these extents. These interests are recognised in the Taranaki Iwi Claims Settlement Act 2016.

Despite the wrongful legal confiscation of our traditional lands and waters in 1865, Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi have always maintained a living relationship with our moana and ourwhenua and maintained strong historical, cultural, traditional and spiritual connections with our rohe. In the context of the marine environment this relationship is guaranteed in the Treaty of Waitangi ("their fisheries") and in Te Tiriti o Waitangi (as taonga). Within the context of Te Tiriti o Waitangi, the marine environment can be conceptualised as a taonga as well as the principles, values and tikanga associated with it.

According to our worldview, the environment is a fundamental part of who Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi are as tangata whenua. In return, Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi as kaitiaki, have the responsibility and obligation of ensuring the mouri of our environmental and cultural resources are protected and enhanced for future generations.

The purpose of this Cultural Impact Assessment (CIA)[1] is to assess the actual and potential effects on the existing interests of Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi that may result from phases 2 and 3 of the Tui Oil Field decommissioning to inform requisite Marine Consent and Marine Discharge Consent.

Authors & Te Ao Māori

Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi with the support of Te Kāhui o Taranaki, have prepared this CIA to assess the effects of the proposal. Only tangata whenua who *whakapapa* have the mandate to carry out CIAs, and only tangata whenua can determine the issues that affect themselves and their natural and physical resources and to what extent these may be. Experienced resource management practitioners[2] provided technical science and planning input to compliment the cultural expertise of mana whenua.

Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi have a holistic view of the environment based around whakapapa (genealogy) and whanaungatanga (relationships), connecting us and all physical and spiritual things in the world. Our relationship with the environment stems from our whakapapa to Papatūānuku (Earth Mother) and Ranginui (Sky Father) who gave rise to many children, also known as the Atua (guardians) of the domains of the natural world. Therefore, it is important to understand that potential impacts of any proposed activity would be conceptualised holistically.

Over the last 200 years the prominence of the Māori worldview has been eroded across the political landscape of Aotearoa/New Zealand. This began with the denigration of Rangi, Papa and the other Atua

[1] Appendix 1 sets out general context around what a CIA does, and what matters they generally address.

[2] Sera Gibson (MSc (Marine Biology)(Hons), PGDip (Biological Science), BSc (Zoology/Animal Biology)), and Sean Zieltjes (MLS (Environment Law)(Hons), BREP (Ecology)(Hons), MNZPI).

with the arrival of the early Christian missionaries. This continued with the gradual loss of control by tangata whenua over land and other resources. The strengthening of the Western Worldview's focus over this time on the individual and his material needs, has further eroded the values inherent in the Māori Worldview. It is of no coincidence that over this time, the condition of natural and physical resources has degraded and the amount available for use has diminished. The reversal of this trend both in the condition of natural resources and the relevance of Te Ao Māori is welcomed by tangata whenua.

The values that this application is assessed against in this CIA are informed by this Worldview.

Methodology

For the purposes of this CIA Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi describe the impacts associated with the proposal on our cultural values in terms of mouri[3]. Whilst the difficulty in quantifying cultural impacts is acknowledged, where the impacts are tangible both the sensitivity and magnitude of the impacts should be described. Other impacts wholly cultural in nature need to be articulated in such a way that the concepts are understood and mitigation measures, if any, are applied.

The following were the key steps taken to inform the development of this CIA:

1 Review of the application, documentation and oral histories held by hapū kuia, kaumatua and pūkenga regarding the development history of the Tui Oil Field and the area.
2 Utilised the mōhiotanga of uri familiar with the industry, and the Tui Oil Field specifically.
3 Several meetings with the MBIE project team and their resource management consultants SLR to understand aspects of the application including proffered conditions.
4 Confirmation of the findings of this CIA by Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi hapū and Te Kāhui o Taranaki.

Presentation of the findings of this CIA to MBIE will be scheduled following these dates.

[3] Mouri is the active life-giving principal or physical life-principle. Mouri was created through the union of Ranginui (sky father) and Papatūānuku (earth mother) and became ora (active or life-giving) when Tāne Mahuta separated them, giving rise to many children each becoming the atua (deities) of respective domains of the environment, including Tangaroa who became the deity of the sea. Mouri radiates outwards from the environment to the species for which it was intended. Mouri is unable to protect itself against unnatural changes to the environment, though it does have the ability to mend and heal, given appropriate time and conditions. Our role as kaitiaki is to ensure the mouri of the ecosystem and environment is protected and enhanced.

2.0 Activity description and proffered conditions

The proposal is described at length in section 2 of the application. Key attributes of the proposal as Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi understand it includes:

- The complete removal of all sub-surface infrastructure from the seafloor. Various methodologies are proposed dependent on the which rig/vessel is available to undertake the work.
- The plug and abandonment of all remaining wells in the field (cut three metres below the current seafloor, with placement of cement plugs further down-hole). Modelling of these wells shows that there is not enough pressure for any remnant hydrocarbons to flow to the surface.
- Contingency measures that include the ability to dump faulty cement batches if required, however based on recent campaigns of a similar nature this is considered unlikely. Similarly, the use of explosives in the plug and abandonment phase, again considered unlikely but necessary to retrieve tools that may become stuck.
- The development of an Environmental Monitoring Plan (EMP) that will utilise best available bio-physical information from the field to confirm the return of the bio-physical environment to pre-decommissioning conditions. The EMP will implement the Offshore Taranaki Environmental Monitoring Protocol (OTEMP), recognised as industry best practise. Additional base-line data to inform this plan may be collected ahead of this monitoring plan (as a permitted activity). This EMP will also specify the timing and activities when a Marine Mammal Observer is to be on-board any vessel associated with the decommissioning.
- Based on comparable operations internationally, it is expected that the return of the biodiversity and seafloor to pre-decommission conditions should take between three and five years to occur, however some depressions in the seafloor may remain longer.
- The plug and abandon phase is proposed to follow the United Kingdom Standards – considered most appropriate for this field.
- A tight timeframe to complete these works, with a starting date for phase 2 in late 2021/early 2022. This has driven a tight timeframe for this regulatory process including the development of this CIA which has occurred over a five-week period.

A number of proffered conditions also form a part of the application. Regarding the existing interests of Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi key attributes of these conditions include the following:

- The development of the EMP includes a consultation requirement on the consent holder with Te Kāhui o Taranaki in the development of that plan to provide an opportunity for mātauranga to inform the EMP.
- The provision of these monitoring reports to Te Kāhui o Taranaki.
- The adoption of 'standard' marine mammal and seabird monitoring/observation conditions, this includes a review requirement should seabirds have negative interactions with any vessel associated with the operation, specifically to review lighting and whether changes would reduce that negative interaction.
- A reporting requirement for any marine mammal and seabird sightings to Te Kāhui o Taranaki.

3.0 Ngā Take/Actual and Potential Environmental Effects – Phases 2 and 3 of the Tui Oil Field Decommissioning

Table 1 below sets out an impact assessment for the activity within the existing environment as understood by Taranaki Iwi. Attributes of this environment are included in the ngā whakaaro/rationale column. Recommendations for how potential effects on the existing interests of Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi are then made within this context.

To assist the EPA in considering the application, this CIA has been aligned to *He Whetū Mārama*, the framework that guides the EPA in the undertaking of its statutory and other obligations to Māori. This is outlined in Table 1:

Ngā Mātāpono (Principles)	Ngā Whakamāramatanga (explanations)	Ngā Whakaaro (rationale)	Ngā Take me Ngā Tohutohu (assessment and recommendations)
WAKA HOURUA / PARTNERSHIP	The principle of PARTNERSHIP requires that the EPA acts reasonably, honourably, and in good faith to ensure the making of informed decisions on matters affecting the interests of Māori.	The application outlines existing interests associated with the Tui Oilfield at section 6. The depth of existing interest Taranaki Iwi have with this area and surrounds requires further explanation to ensure informed decision making regarding the impacts of the proposal on those interests are avoided, remedied or mitigated appropriately. As set out in the application article 2 of the Treaty contains an unqualified guarantee to the rangatira and hapū of New Zealand of "rangatiratanga" (in te reo Māori) and "full exclusive and undisturbed possession" (in English) in relation to their lands, estates, forests, fisheries and "taonga katoa". The exercise of those guaranteed rights and interests is a lawfully established existing activity for the purposes of the EEZ Act. The exercise of these rights and interests can be described as the most long-standing lawfully established existing class of activities in New Zealand. Those rights were not affected by the acquisition of sovereignty by the British Crown in 1840. Article 2 of the Treaty recognises the continued existence of these rights and interests[4]. This coastal marine area is subject to statutory acknowledgement afforded under the Taranaki Iwi Claims Settlement Act 2016, as well as Taranaki Iwi application (MAC-01-10-013) and claim for Customary Marine Title and Protected Customary Rights under the Marine and Coastal Act 2011. These amplify the basis for the existing mana whenua mana moana interests of Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi in the Tui Oil Field. Kaitiakitanga[5, 6] is recognised as an aspect of the existing interest of Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi. Hapū experts advise that it is important to note that kaitiakitanga includes the practise of use, development, restoration and protection of resources and relationships[7], not just the stewardship of resources as commonly misconceived[8]. It is also necessary to understand the inextricably linked concepts of whanaungatanga and kaitiakitanga; a system that enabled human exploitation of the environment, but through the kinship value (known in Te Ao Māori as whanaungatanga) they also emphasised human responsibility to nurture and care for it (known in Te Ao Māori as kaitiakitanga)[9]. These give context to the existing interest that Taranaki Iwi has in the Tui Oilfield, and the lands, estates, forests, fisheries and "taonga katoa" therein. Previous approvals that have facilitated the exploitation of resources from the Tui Oilfield have largely excluded Taranaki Iwi from exercising their rangatiratanga or kaitiakitanga in any meaningful way[10]. Regarding the resource use aspect of kaitiakitanga this has contributed to there being limited demonstrable positive impacts on the social or cultural well-being of Taranaki Iwi resulting from the exploitation of resources in the Tui Oil Field since operations began in 2005. Those factors which improve social and cultural wellbeing such as education, employment or the maintenance/development of cultural infrastructure such as marae/pā, whare wānanga and the like have not benefited from the exploitation of the Tui Oil Field as would be expected if the existing	To take into account the existing interests of Taranaki Iwi with respect to this proposal structuring whanaungatanga and kaitiakitanga into the project are recommended. It is important to note that this is interrelated with the mouri assessment undertaken below. The intervention of kaitiaki and cultural tools to address impacts on mouri are fundamental in taking into account the principle of waka hourua/partnership. The partnership agreement between MBIE and Te Kāhui o Taranaki, engaging a CIA to inform the regulatory process, and resourcing an Iwi Engagement Lead position are positive examples of this. However, it is recommended that the applicant goes further and considers how this is implemented through procurement and implementing its own advice with respect to Māori business[14], the ongoing role of kaitiaki and how those are structured into the project. Similarly, conditions of consent that provide assurance that whanaungatanga and kaitiakitanga will continue to play a role in the management of the effects of the proposed activities on the existing interests of Taranaki Iwi is recommended. A Kaitiakitanga Forum type process is one method of providing that. A condition that achieves this could be as follows: Recommended condition – *The Consent Holder shall convene and resource a Kaitiaki Forum. This Forum shall commence prior to commencement of works on site for the duration of the project.* *The function and purpose of the Kaitiaki Forum shall be formally agreed by the Consent Holder, Te Kāhui o Taranaki, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi and formally documented in a Forum Collaboration Agreement. This Agreement shall include, but not be limited to:* *a) reference to the Cultural Impact Assessment Decommissioning of the Tui Oil Field Phases 2 and 3; dated June 2021; prepared by Te Kāhui o Taranaki;* *b) the entities to be represented on the forum, and number of representatives;* *c) the frequency at which the forum will meet;* *d) the decision-making process to be utilised in the forum; and* *e) a dispute resolution clause.*

[4] Trans-Tasman Resources Ltd v Taranaki-Whanganui Conservation Board and others [2020] NZCA 86 CA573/2018

[5] kaitiakitanga is both an expression and affirmation of rangatiratanga" and explains that "rangatiratanga is the authority for kaitiakitanga to be exercised – Kawharu, M., Kaitiakitanga: A Maori anthropological perspective of the Maori socioenvironmental ethic of resource management. Journal of Polynesian Society, 2000. 109(4): p.349-370

[6] See section 6 of the application which includes a discussion regarding how the Courts of Appeal have interpreted this as a part of the Trans-Tasman Resources Ltd application.

[7] http://www.environmentguide.org.nz/issues/marine/kaitiakitanga/what-is-kaitiakitanga/

[8] Trans-Tasman Resources Ltd v Taranaki-Whanganui Conservation Board and others [2020] NZCA 86 CA573/2018

[9] Waitangi Tribunal Ko Aotearoa Tēnei: A Report into Claims Concerning New Zealand Law and Policy Affecting Māori Culture and Identity (Wai 262, 2011)

[10] It is noted that the 2018 process (EEZ100016) Tamarind offered to resource Taranaki Iwi to undertake a cultural impact assessment process to inform that approval process. However, key recommendations of submission of Taranaki Iwi were not executed – in particular the development of monitoring measures/methods from a Te Ao Māori perspective. These were not secured by way of condition of consent which may be one reason for why those requirements were not realised.

[14] https://www.mbie.govt.nz/dmsdocument/13457-supporting-the-maori-economy-and-achieving-economic-and-social-outcomes-through-te-kupenga-hao-pauaua-proactiverelease-pdf

		rangatira interests of Taranaki Iwi had been taken into account through those decisions[11]. The cumulative adverse effects on Taranaki Iwi resulting from this is significant[12]. This application is for what will be the last two phases of operations on the Tui Oil Field. Recently MBIE released a paper *Supporting the Māori Economy and Achieving Economic and Social Outcomes through Te Kupenga Hao Pāuaua*[13] recognising that increasing the proportion of relevant contracts awarded to Māori businesses will assist in improving social and cultural outcomes for Māori. It is considered that the approach recommended in that paper be applied to this application, noting that the Crown is the applicant in this instance. In respect to the resource protection or management aspects of kaitiakitanga it is considered that specific conditions are required to ensure that Taranaki Iwi are able to exercise that interest through the implementation of the programme of works. Fundamental to kaitiakitanga are requirements on tangata whenua to nurture relationships between people, and people and place. At a practical level this requires access into a kaupapa, to information, and to an area. It requires opportunities for Tangata Whenua to contribute to the decisions towards better health and well-being (cultural, social, economic and environmental). It is a continuous and ongoing process. It is reliant on a willingness of all parties to engage in that process and relationship to be successful. In large projects such as the proposal it is common that iterative changes in delivery to respond to changes in context will be made. Conditions which require the on-going engagement of Taranaki Iwi in those changes and certifying the management plans which are proposed to avoid, remedy and/or mitigate the adverse effects of the operation. As articulated in the assessment below with respect to mouri, there are a number of potential adverse effects which require management across the implementation of this consent. For this reason, a Kaitiaki Forum (or similar) that enables the consent holder to access cultural expertise in making operational decisions which affect those aspects of mouri is recommended.	*Advice Note: Given the scale of the development it is anticipated that a number of changes will be made through the construction phase and beyond. A Kaitiaki Forum enables the Consent Holder to obtain the necessary cultural expertise to inform those decisions, as well as providing for the role of Mana Whenua as Kaitiaki in managing, avoiding, remedying and mitigating the effects of the consented development.*
WHAI WĀHI / PARTICIPATION	The principle of PARTICIPATION informs the development of EPA strategy, policy, and process that enables the effective engagement and input of Māori.	This application sits within the context of how the overall development and exploitation of the Tui Oilfield has taken into account the existing interests of Taranaki Iwi. As outlined above, the exploitation of the Tui Oil Field since 2005 has largely excluded the existing rangatira and kaitiaki interests of Taranaki Iwi in any meaningful way. Where Taranaki Iwi has provided its cultural expertise to the EPA (see EEZ100016), this has not translated to conditions of consent and therefore key aspects of that advice that would be beneficial to this process are not able to be realised. This lack of participation results in a number of adverse effects on the existing interests of Taranaki Iwi; these include the following: • This exclusion of mātauranga Māori and tikanga Māori including the kaitiaki role of Māori and the protection and enhancement of the mouri, mana and tapu of the Tui Oil Field and surrounds. This results in significant adverse effect on cultural identity and the relationship Taranaki Iwi are able to have with this area and project. • This exclusion from participation adversely affected the ongoing rights of Taranaki Iwi to realise economic potential and generate economic benefit, or develop culturally, socially, spiritually, and physically through the development and exploitation of the Tui Oil Field traversed above. It is important to note that the cumulative adverse effects in successive campaigns since 2005 that result from this lack of recognition is significant.	It is considered that to avoid the continuation of the lack of participation and the resulting adverse effects on mana whenua that specific conditions are required for both the Marine Consent and Marine Discharge Consent are required that set structures in place that provide for the existing interests of Taranaki Iwi with this area. A Kaitiaki Forum, and co-development of any monitoring programme being two key mitigation in that respect. Taranaki Iwi recognise that whilst whakapapa is the fundamental difference between the Te Ao Māori perspective and western science, both views need to be utilised to inform the use and management of natural resources to achieve the common objective of environmental sustainability.

[11] This is outlined at length in the findings of the Waitangi Tribunal Petroleum Report, 2000 (Wai 796). The report recorded that Māori had legal title to petroleum in their land prior to 1937, and that the petroleum assets should be included in the Treaty negotiations. The Crown failed to honour the findings of the Tribunal. A further report was issued in 2011 highlighting how the petroleum regime was in breach of the Treaty of Waitangi. The Tribunal found flaws in the management regime including the lack of protection given to Māori rights and lands.

[12] This position is consistent with the information shared by ngā iwi o Taranaki to MBIE through successive block offer processes regarding the positive economic benefits of the oil and gas industry in the Taranaki Region. Māori in our region remain disproportionately represented in all depravation statistics. MBIE note there is concern among a range of submitters that oil and gas activity has not and therefore will not bring any benefits to iwi, hapū and whānau, or to the region in which the activity is occurring. The suggested jobs and wealth created by the activity is viewed sceptically by these groups who outline a level of poverty for their people despite claims that the royalties derived from the industry contributes greatly to the economy.

[13] https://www.mbie.govt.nz/dmsdocument/13457-supporting-the-maori-economy-and-achieving-economic-and-social-outcomes-through-te-kupenga-hao-pauaua-proactiverelease-pdf

PITO MATA / POTENTIAL	The principle of POTENTIAL recognises that EPA decision-making and activities have impacts on the direction for future growth and development in a Māori cultural and economic setting.	The Just Transition was announced in early 2018[15]. This is considered an important aspect of the socio-economic environment for the region. As outlined in the application other offshore fields in Pohokura, Māui, Maari, Tui and Kupe will in the coming decades require decommissioning and remediation as they come to the end of their productive life as Aotearoa transitions away from fossil fuels. MBIE in partnership with local government and ngā iwi o Taranaki have developed a Taranaki 2050 Roadmap to guide this transition. Tapuae Roa recognises that tangata whenua are major contributors to and will play an increasingly important role in the future of the Taranaki economy for the well-being of the entire community. These attributes of the current socio-economic environment are considered important context in which this project sits within. Specifically, this application is for the first decommissioning programme and therefore the first opportunity for the local Taranaki community (including our Māori communities) to develop the skills, knowledge and techniques to decommission infrastructure and restore our marine environment as a part of our Just Transition. Ensuring ngā iwi o Taranaki are not excluded from the opportunity to develop this mātauranga, should they wish to, is fundamental for the Tui Decommissioning project to take into account this principle of pito mata/potential.	Potential is realised through the opening of pathways for Taranaki Iwi to contribute to this kaupapa long-term. Ensuring the opportunity for Taranaki Iwi to utilise and develop mātauranga to participate meaningfully in this industry through this project is recommended. Opportunities for tikanga, kawa and mātauranga in the avoidance, remediation or mitigation of actual and potential adverse effects that may arise from those activities are considered to only add value in achieving the purpose of the EEZ Act. Structuring whanaungatanga and kaitiakitanga into projects and securing these through condition of consent are key building blocks in achieving this potential, to improve the ongoing social, cultural and economic well-being of Taranaki Iwi.
TIAKITANGA / PROTECTION	The principle of active PROTECTION requires the EPA to take positive steps to ensure that Māori interests, knowledge, and experience are valued in its decision making and activities.	The Act requires a description of the current natural environment and its constituent parts against which the impacts of an activity can be considered. In describing the current natural environment from a Te Ao Māori perspective requires the holistic and interconnected nature of that environment to be articulated/considered, including intrinsic responsibilities for Taranaki Iwi such as kaitiaki. These are the same issues that were highlighted to the EPA in the submission of Te Kāhui o Taranaki to the 2018 approval process for the last Tamarind drilling campaign (EEZ100016). To undertake an assessment against mouri it is important to note that the current state of the environment does not exist in a vacuum and that it is a direct result of the development of the coastal marine area over time. In the context of the Tui Oilfield this disruption of the area started in the 1950's and 1960's with early seismic survey of the broader Taranaki offshore area (including the location of the Tui Oilfield) through till today. In undertaking an assessment for mouri it is necessary to understand the environment in a less disturbed or more balanced state to which the effects of an application can be considered against. One method of considering this is through the activity of mahinga kai. Some of the narratives expressed through the development of this impact assessment talk to the abundance of seafood enjoyed from the ocean. The lived experience with respect to their relationships living, eating, and managing mahinga kai resources in the broader area. Some narratives included reflection on the percussion generated from early seismic survey work shaking their houses and being visible from shore, and going out following these events and filling their boats with dead fish following these activities. The lament the fact that their fisheries have never been the same with the impact that the cumulative effects of primary industries in the area including the development of oil and gas infrastructure and commercial fisheries. Overall, it was considered that these have suppressed the relationship they are able to have with the natural resources in the receiving environment currently. The decommissioning activities are occurring in this context where the natural environment is already heavily impacted from a cultural perspective, and the role of kaitiakitanga in the general management of those resources reduced significantly as outlined above. This must be reflected in any description of the current state of the existing environment. In undertaking this assessment, it is understood that in many cases impacts on the mouri of environmental features or species overlaps with the values derived from western science and those that have already been	The Impact Assessment set out in the application has been completed in the absence of an assessment against the current state of mouri. For mouri to be accurately assessed against the impacts of the proposal a baseline or current state of mouri must be determined for each of the receptors or environmental features and/or species of cultural significance to Taranaki Iwi. This determination can only be made by tangata whenua and is a determination of the mouri that will prevail in the absence of the project or in this case prior to the development of the Tui Oilfield. The current state of mouri also describes the historical trends for resources that have contributed to this state. As mentioned, this determination was absent in the initial scoping process for this proposal and was not undertaken as a part of previous approvals despite the feedback of Taranaki Iwi at that time. As a result, the negative effects, proposed mitigation measures and the assessment of the residual impacts have been identified without this baseline state of mouri. In lieu of that scoping process, Taranaki Iwi has determined the current state of mouri for each of the receptors or environmental features and/or species of cultural significance (Table 3) through hui. These determinations were then assessed in Table 2 against the predicted magnitude of environmental impact of the project as articulated throughout section 8 and summarised in Table 35 (where the natural environment is already heavily impacted from a cultural perspective). This resulted in a residual impact on mouri (in the absence of cultural mitigations measures). Where the level of residual impact is low it is assumed that generic control measures are already in place in the design process but require continuous monitoring and improvement. Where the level of residual impact is moderate or above it requires additional control measures to move the risk to lower the residual impact. This informs the basis of the recommendations made below.

[15] https://www.mbie.govt.nz/business-and-employment/economic-development/just-transition/

described in the Impact Assessment; nevertheless, these cultural impacts need to be articulated. The cultural values of specific concern to Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi are set out in the Ngā Kaupapa column below. A fuller description is contained in Appendix 2.

The modified criteria for determining residual impacts on mouri are outlined in Table 3 as follows.

Planned Activities	Ngā Kaupapa	Impact or interaction / Env. features and/or species	Current State of Mouri of Env. feature and/or Species interpreted by Mana Whenua	Predicted Magnitude of Env. Impact from the IA in the application	Residual Impact on Mouri under current proposal (n.b. following confirmation of conditions some of these levels may be reduced)
Temporary presence of objects in the water column	Ngā Taonga Koiora (native flora and fauna)	Displacement or entanglement effects on marine mammals	Severe degradation	Almost Negligible	Moderate*
		Ship strike effects on marine mammals	Major degradation	Almost Negligible	Moderate*
		Effects on seabirds	Major degradation	Almost Negligible	Moderate*
	Ngā Tangata (people) - Taha wairua (spiritual health), Taha whānau (family health), Taha hinengaro (mental health), Taha tinana (physical manifestation of health)	Effects on hauora (health and well-being)	Moderate degradation	Almost Negligible	Low
	Ngā Taonga Tuku Iho (valued flora and fauna)	Displacement of customary fisheries species	Moderate degradation	Almost Negligible	Low
	Ngā Moana (offshore waters)	Discharges to water	Minor degradation	Almost Negligible	Very low
	Te Hau (air)	Discharges to air	Minor degradation	Almost Negligible	Very low
	Ngā Taonga Tuku Iho (traditional Māori values and practices)	Inability to exercise rangatiratanga/mana moana, kaitiakitanga and undertake associated tikanga to protect and enhance mauri, mana and tapu	Severe degradation	Almost Negligible	Moderate**
	Whaioranga (economic development and sustainability)	Disregard for tangata whenua's ownership of minerals and resulting royalties, and restrictions to commercial fishing rights.	Major degradation	Almost Negligible	Moderate**
Seabed disturbance	Ngā Taonga Koiora (native flora and fauna)	Changes in prey availability for marine mammals	Moderate degradation	Less than minor	Moderate*
	Ngā Tangata (people) - Taha wairua, Taha whānau, Taha hinengaro, Taha tinana	Effects on hauora	Moderate degradation	Minor	Moderate*
	Ngā Taonga Tuku Iho (valued flora and fauna)	Mortality, displacement, suspended sediments and	Minor degradation	Minor	Low

Aspects of the proposal go some way to lessening the impact on mouri. Taranaki Iwi agree with the applicant that temporary disturbance to enable the complete removal of equipment and the resourcing of Marine Mammal and Seabird Observers suitably qualified and experienced to monitoring impacts are positive examples (*).

Other recommendations for the operation to better take into account our kaitiakitanga includes restricting the cutting of pipe to the deck of any vessel when retrieving infrastructure as far as possible (noting that some will be required where pipeworks attach to fixed infrastructure on the seafloor. Similarly restricting the discharge of further material (e.g., faulty cement) and disposing of this on-shore, acknowledging the extremely low likelihood of this being required (*).

It is recommended that the applicant considers further mitigation through the co-development and implementation of an Environmental Management Plan (EMP) with Te Kāhui o Taranaki. As shown in the matrix higher impact outcomes are generally related to the inability to exercise rangatiratanga/mana moana, kaitiakitanga and undertake associated tikanga to protect and enhance mouri, mana and tapu. The following recommendations are made noting that reducing impacts on mouri are not able to be achieved without mana whenua.

Environmental Monitoring Plan (**)

It is understood that monitoring programmes generally rely on methodologies set out in the Offshore Taranaki Environmental Monitoring Protocol, recognised as industry best practise with consistent use generating a data set that is replicable and comparable across multiple areas of the marine environment. The importance of this is not questioned, however it is expected that both western science and mātauranga Māori will be utilised in demonstrating performance of this consent and the overall health of the natural environment subject to this proposal.

The EMP is the primary tool and opportunity to reduced residual impacts on mouri (as stated under the current proposal) to a position of no net loss or net gain. The EMP should summarise the residual impacts from the Impact Assessment and provide an explanation of how a position of no net loss or net gain will be achieved via a series of practical management actions and associated timescales for their implementation. The time it will take to achieve a position of no net loss or net gain from a state of impacted mouri is unknown.

The Plan is proposed to define how the actual impacts of the project will be monitored and assessed, how the implementation of the management actions will be verified, and how the effectiveness of the management actions will be measured. Again, these must be done so in a way that will inform the state of impacted mouiri.

The Plan should also include the projects adaptive co-management strategy including when adaptive co-management is warranted (ie trigger points for additional management) and how it will be implemented. Adaptive co-

				clogging of benthic communities			
				Displacement of customary fisheries species	Moderate degradation	Minor	Moderate*
			Ngā Moana (offshore waters)	Discharges to water	Minor degradation	Minor	Moderate*
			Te Hau (air)	Discharges to air	Minor degradation	Minor	Moderate*
			Ngā Taonga Tuku Iho (traditional Māori values and practices)	Inability to exercise rangatiratanga/mana moana, kaitiakitanga and undertake associated tikanga to protect and enhance mauri, mana and tapu	Severe degradation	Minor	High**
			Whaioranga (economic development and sustainability)	Disregard for tangata whenua's ownership of minerals and resulting royalties, and restrictions to commercial fishing rights.	Major degradation	Minor	High**
		Removal of hard substrate	Ngā Taonga Koiora (native flora and fauna)	Displacement of marine mammals	Moderate degradation	Less than minor	Moderate*
			Ngā Tangata (people) - Taha wairua, Taha whānau, Taha hinengaro, Taha tinana	Effects on hauora	Moderate degradation	Minor	Moderate*
			Ngā Taonga Tuku Iho (valued flora and fauna)	Loss of artificial reef invertebrate assemblages	Minor degradation	Minor	Low
				Displacement of fish and cephalopods	Moderate degradation	Less than minor	Moderate*
			Ngā Moana (offshore waters)	Discharge to water	Minor degradation	Minor	Low
			Te Hau (air)	Discharge to air	Minor degradation	Minor	Low
			Ngā Taonga Tuku Iho (traditional Māori values and practices)	Inability to exercise rangatiratanga/mana moana, kaitiakitanga and undertake associated tikanga to protect and enhance mauri, mana and tapu	Severe degradation	Minor	High**
			Whaioranga (economic development and sustainability)	Disregard for tangata whenua's ownership of minerals and resulting royalties, and restrictions to commercial fishing rights.	Major degradation	Minor	High**
		Noise and vibration	Ngā Taonga Koiora (native flora and fauna)	Behavioural changes, avoidance and displacement of marine mammals from underwater noise	Severe degradation	Less than minor	Moderate*

management is critical to achieving long-term biodiversity commitments and goals. It is also well suited to traditional ecological knowledge and arguably kaitiakitanga, indigenous knowledge and mātauranga due to the dynamic nature of the processes of traditional ecological knowledge.

Finally, the Plan should also include Key Performance Indicators (KPI's) and cultural indicators which will determine the project's success in meeting a position of no net loss or net gain with respect to mouri.

A condition that achieves this could be as follows:

Recommended condition –
The Consent Holder shall co-design and implement the Environmental Management Plan which includes an adaptive co-management strategy with Te Kāhui o Taranaki Iwi to provide an opportunity for mātauranga to inform the Plan and its implementation.

The proffered conditions include a consultation feedback loop in the initial development of the EMP which goes some way towards these outcomes. The proffered conditions also outline who is considered a suitably qualified and experienced person to draft the EMP[16]. This definition is problematic in it does not recognise mātauranga Māori as expertise and could have a limiting factor on taking into account kaitiakitanga. Overall, this approach falls short of co-development and adaptive co-management as articulated above, and associated remediation on mouri that approach works towards. This is interrelated with other measures (i.e., the use of marine mammal observers and the like) which work together to reduce impacts on mouri overall.

Longer term exclusion of activities which impact negatively on mouri (**)
Taranaki Iwi understand from the application is that time is the primary tool that will enable the seabed and biodiversity to return to a more natural state once infrastructure is removed. Success of this is determined through the EMP process. The application considers that this should occur in a relatively short timeframe and has based the length of consent (out to 2030) to conservatively provide for that. Taranaki Iwi support this approach.

In the instance that this is not achieved, and a longer time period is required (depending on what the EMP considered 'success' to include) understanding the mechanisms available to extend that timeframe or consider other offsets or environmental compensation may be available in line with an adaptive co-management approach are recommended. Taranaki Iwi continue to advocate for this area to be excluded from commercial fisheries and other extractive industries until such time as that is achieved.

[16] *Suitably qualified and experienced person means a person who:*
(a) holds a degree qualification in the relevant subject matter, or holds relevant professional certification from a relevant professional body; and
(b) has at least eight years' relevant experience.

				Avoidance behaviour of marine mammals from helicopter noise	Moderate degradation	Less than minor	Moderate*	
				Avoidance behaviour of seabirds	Severe degradation	Less than minor	Moderate*	
			Ngā Tangata (people) - Taha wairua, Taha whānau, Taha hinengaro, Taha tinana	Effects on hauora	Moderate degradation	Minor	Moderate*	
			Ngā Taonga Tuku Iho (valued flora and fauna)	Displacement of fish	Moderate degradation	Less than minor	Moderate*	
				Avoidance behaviour of cephalopods	Minor degradation	Negligible	Very low	
				Effects mortality and abundance of plankton	Minor degradation	Negligible	Very low	
		Contingent activities - Explosives	Ngā Taonga Koiora (native flora and fauna)	Mortality, injury, permanent hearing impairment and/or behavioural responses of marine mammals.	Major degradation	Negligible	Low	
			Ngā Taonga Tuku Iho (valued flora and fauna)	Behavioural changes of benthic communities	Minor degradation	Negligible	Very low	
				Mortality, injury, behavioural changes of fish and cephalopods	Moderate degradation	Negligible	Very low	
		Other - Effects on existing interests	Ngā Taonga Tuku Iho (valued flora and fauna)	Exclusion from customary fishing	Moderate degradation	Negligible	Very low	
		Cumulative Effects - Discharge of harmful substances	Ngā Moana (offshore waters)	Discharge of faulty cement batches to the seafloor	Severe degradation	Negligible	Low	

Table 1: Cultural impact assessment table

Risk ranking/Potential impact	Predicted Magnitude of Environmental Impact	Current State of Mouri of Environmental Feature and/or Species					
		Pristine/undisturbed	Minor degradation	Moderate degradation	Severe degradation	Major degradation	Catastrophic degradation
		The mouri of the environmental features and/or species is pristine and undisturbed. The concerns of kaitiaki are negligible.	Minor degradation on the mouri of the environmental features and/or species. The concerns of kaitiaki are low.	Moderate degradation on the mouri of the environmental features and/or species. The concerns of kaitiaki are moderate.	Severe degradation on the mouri of the environmental features and/or species. The concerns of kaitiaki are moderate to high.	Major degradation on the mouri of the environmental features. The concerns of kaitiaki are high.	Catastrophic degradation on the mouri of the environmental features and/or species. The concerns of kaitiaki are very high.
Negligible Risk – *no* intervention or further monitoring is required. Negligible (at worst) environmental impact.	Negligible	Negligible	Very low	Very low	Low	Low	Low
Very Low Risk – where the level of risk is acceptable and *no* specific control measures are required.	Almost Negligible	Negligible	Very low	Low	Moderate	Moderate	Moderate
Low Risk – where the level of risk is broadly acceptable and *generic control measures are already assumed in the design process but require continuous monitoring and improvement.*	Less than minor	Negligible	Low	Moderate	Moderate	High	High
Moderate Risk – *requires additional control measures where possible or management/communication to maintain risk at less than significant levels.* Small environmental impact from the activity. Where risk cannot be reduced to 'Low' control measures must be applied to reduce the risk as far as reasonably practicable. Requires continued tracking and recorded action plans.	Minor	Negligible	Low	Moderate	High	High	Major
High Risk (intolerable risk) – *where the level of risk is not acceptable and control measures are required to move the risk to lower the risk categories.* Medium environmental impact from the activity.	Significant	Negligible	Low	Moderate	High	Major	Major
Extreme Risk – *unacceptable for project to continue under existing circumstances. Requires immediate action.* Equipment could be destroyed with large environmental impact as a result of the activity.	Very significant	Negligible	Moderate	High	Major	Major	Major

Table 2: Modified criteria for determining residual impact on mouri

3.0 Ngā Kupu Whakatepe me Ngā Tohutohu/Conclusions and Recommendations

Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi with the support of Te Kāhui o Taranaki have prepared this CIA to assess the effects of the proposal to decommission the Tui Oil Field.

The assessment has been articulated to *He Whetū Mārama* outlining how the cultural values of Taranaki Iwi are able to be expressed through the project. Whilst the proposal is to completely remove all of the remnant infrastructure and plug and abandon the wells the adverse effects of the exploitation of natural resources in the Tui Oilfield on the existing interests of Taranaki Iwi will remain until such time as the mouri of the area is able to rebalance itself. Taranaki Iwi support the expediated removal of infrastructure from Tangaroa and commend MBIE for their commitment towards the outcome. This is balanced with the need to ensure time is provided to ensure cultural expertise is utilised in designing the project and methods to avoid, remedy or mitigate adverse effects that may result from the programme. Recommendations to achieve this in the context of this project are as follows:

1. Update the Existing Interests section of the application to provide the greater depth regarding the existing interests of Taranaki Iwi with respect to rangatiratanga and kaitiakitanga.
2. Update the Existing Environment section of the application to ensure the description of the current natural environment notes the interconnection between those elements described and tangata whenua through whakapapa.
3. Take into account those existing rangatira and kaitiaki interests by structuring whanaungatanga and kaitiakitanga into the programme of works by:
    a. Resourcing consultation with ngā iwi o Taranaki (ACTIONED AND ONGOING through resourcing an Iwi Engagement Lead role and consultation programme).
    b. Engaging cultural expertise to develop the proposal (ACTIONED AND ONGOING through engagement of this CIA and adoption of outcomes for the programme like the complete removal of all sub-sea infrastructure).
    c. Implementing the MBIE recommendations regarding procurement and Māori business - https://www.mbie.govt.nz/dmsdocument/13457-supporting-the-maori-economy-and-achieving-economic-and-social-outcomes-through-te-kupenga-hao-pauaua-proactiverelease-pdf.
    d. Monitor the performance of the Tui Decommissioning Project against the targets set in that MBIE advice with respect to Māori businesses. Ensure reporting to the MBIE and Te Kāhui o Taranaki partnership outlining that if those targets are not met the reasons why this was the case, and what offsets were implemented instead of those procurement targets.
    e. Require that any sub-contractor to the project (including current contractors) are operating to the values of the MBIE and Te Kāhui o Taranaki partnership. This may require cultural induction of contractors to understand the world view of Taranaki Iwi. It is noted that similar recommendations have been made to operators in the past which have not come to fruition. Securing this requirement through condition of consent or similar agreement is required.
4. Take into account those existing rangatira and kaitiaki interests through the Impact Assessment/proffered conditions by:
    a. Implementing a Kaitiaki Forum secured by way of condition of consent.
    b. Committing to the co-development of Environmental Monitoring Plan(s) (EMP) for the project with Taranaki Iwi, ensuring our mātauranga has the opportunity to inform the

data relied upon for the performance of the Consent Holder. Secure this requirement by way of condition of consent, noting that previous advice to operators similar to this have not eventuated despite best intentions of those operators.

c. Consider the length of time consent is applied for to ensure sufficient time is available for the area to re-balance with respect to mouri, this being informed by the EMP, and an adaptive co-management approach.

These recommendations are designed to recognise the relationship of Taranaki Iwi to both the environment and area through whakapapa; and the practice of tikanga and kawa, and the application of mātauranga Māori by Taranaki Iwi kaitiaki, to ensure the mouri of the ecosystem and environment. Reducing these requirements to conditions of consent, or similar agreement provides assurance that the role of kaitiaki within the next two phases of the project.

Appendix 1 – Statutory Context for this CIA

Te Tiriti o Waitangi

The purpose of CIAs is to ensure that the spiritual and physical well-being of a resource, area or site is maintained and that the kaitiaki obligations of tangata whenua are upheld. These roles and responsibilities apply to the ocean, rivers, lakes, forests, fisheries and wildlife as they do to all natural and physical resources.

These resources were guaranteed to tangata whenua under Article 2 of the Treaty of Waitangi and Te Tiriti o Waitangi (the Māori language version) for as long as tangata whenua so desired. Tangata whenua have not relinquished these rights and responsibilities. Below is a transcript of the Second Article of Te Tiriti o Waitangi followed by the translation into English (Professor IH Kawharu) and the first part of "Article the Second" of the Treaty of Waitangi.

> *"Ko te Kuini o Ingarani ka wakarite ka wakaae ki nga Rangatira ki nga Hapū, ki nga tangata katoa o Nu Tirani te tino rangatiratanga o ratou wenua o ratu kainga me o ratou taonga katoa. Otiia ko nga Rangatira o te wakaminenga me nga Rangatira katoa atu ka tuku ki te Kuini te hokonga o era wāhi wenua e pai ai te tangata nona te Wenua - ki te ritenga o te utu e wakaritea ai e ratou ko te kai hoko e meatia nei e te Kuini hei kai hoko mona."*

> *"The Second The Queen of England agrees to protect the Chiefs, the subtribes and all the people of New Zealand in the unqualified exercise of their chieftainship over their lands, villages and all their treasures. But on the other hand the Chiefs of the Confederation and all the Chiefs will sell land to the Queen at a price agreed to by the person owning it and by the person buying it (the latter being) appointed by the Queen as her purchase agent." (trans. IH Kawharu)*

> *"Her Majesty the Queen of England confirms and guarantees to the Chiefs and Tribes of New Zealand and to the respective families and individuals thereof the full and exclusive and undisturbed possession of their land and Estates, Forests, Fisheries and other properties which they may collectively or individually possess so long as it is their wish and desire to retain the same in their possession....."*

Since the signing of the Treaty of Waitangi in 1840, land and other natural and physical resources have been gradually alienated from tangata whenua. This has diminished the authority of iwi, hapū and whanau over ngā taonga tuku iho for which kaitiaki responsibilities were previously held. Despite this loss, the tikanga, rights and responsibilities over natural and physical resources by mana whenua iwi, hapū and whanau still remain strong.

Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012

The purpose of this Act is to promote the sustainable management of the natural resources of the Exclusive Economic Zone and the Continental Shelf.

Indirectly, the Act will generate a wealth of research to be undertaken in this area, where very little is currently known. This information, along with current knowledge, could contribute to robust environmental impact reporting as well as identifying appropriate mitigation measures. Relevant provisions include:

Section 12 and 18: In order to recognise the Crown's responsibility to give effect to the principles of the Treaty of Waitangi for the purposes of this Act,—(a)… provides for the Māori Advisory Committee to advise the Environmental Protection Authority so that decisions made under this Act may be informed by a Māori perspective.

Section 33 and 59: Requires the Minister, in respect of regulations, and the EPA in respect of marine consents, to take into account the effects on existing interests, which may include Māori who have existing interests as defined in the Act.

Section 45: Requires the EPA to notify iwi authorities, customary marine title groups, and protected customary rights groups directly of consent applications that may affect them[17].

Summary

The Treaty of Waitangi/Te Tiriti o Waitangi 1840, particularly Article two, conferred on tangata whenua a right in respect of full exclusive and undisturbed possession of their lands and estates, forests, fisheries and other properties/taonga. The EEZ, and tangata whenua management plans, are amongst the legislation, policies and statements that affirm the mana whenua status of tangata whenua. The role of kaitiaki in regard to the management and monitoring is affirmed as is the relevance and practice of kaitiakitanga. Taiao, Taiora provides local context to these rights/roles/obligations as they apply to resource management within the rohe of Taranaki Iwi.

[17] EPA (2016) Incorporating Māori Perspectives Into Decision Making. https://www.epa.govt.nz/assets/Uploads/Documents/Te-Hautu/293bdc5edc/EPA-Maori-Perspectives.pdf. Accessed June 2021.

Appendix 2 – Expansion of cultural values utilised in the assessment of the impact the proposal has on mouri

The cultural values of specific concern to Taranaki Iwi, Ngāti Kahumate, Ngāti Tara, Ngāti Haupoto and Ngāti Tuhekerangi are as follows:

a) Ngā Tangata (people) - In te ao Māori, the inclusion of the wairua (spiritual health), the role of the whānau (family) and the balance of the hinengaro (mind) are as important as the physical manifestations (body). Should one of the four dimensions be missing or in some way damaged, a person, or a collective may become 'unbalanced' and subsequently unwell. These four dimensions are:
   - Taha wairua (spiritual health) - spiritual health and well-being obtained through the maintenance of a balance with nature and the protection of mauri.
   - Taha whānau (family health) - the responsibility and capacity to belong, care for and share in the collective, including relationships and social cohesion;
   - Taha hinengaro (mental health) – mental health and well-being and the capacity to communicate, think and feel;
   - Taha tinana (physical health) – physical health and well-being.

b) Ngā taonga koiora (native and important fauna) - degradation of the mauri of these taonga species, those being marine mammals, fish and benthic species;

c) Ngā taonga tuku iho (valued flora and fauna) - the degradation of the mauri of species valued by tangata whenua in Fisheries Management Area 8 (FMA8) including snapper, kahawai, blue cod, flatfish, small sharks, eels kina, mussels, toheroa, pipi, cockles and tuatua; and the inability to fish these species due to fishing exclusions in the Tui Field;

d) Ngā moana (coastal and offshore waters) - the degradation of the mauri of this element;

e) Parumoana (seabed) - the degradation of the mauri of this element;

f) Te Hau (air) - the degradation of the mauri of this element and its ability (or not) to sustain all forms of life;

g) Ngā taonga tuku iho (traditional Māori values and practices) - the inability to undertake kaitiakitanga to sustain ourselves and our tikanga;

h) Whaioranga (economic development and sustainability) - The complete disregard for tangata whenua's ownership of minerals and resulting royalties, restrictions to commercial fishing rights has limited our ability to be economically sustainable.

APPENDIX F

2021 Tui Field Ecological Effects Monitoring Report

TUI FIELD ECOLOGICAL EFFECTS MONITORING

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BASIS OF REPORT

This report has been prepared by SLR Consulting NZ Limited (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Ministry of Business, Innovation and Employment (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
740.30000.00100-R01-v1.0	16 June 2021	SLR Consulting NZ Limited	Lachlan Barnes	Dan Govier

EXECUTIVE SUMMARY

On 27 September 2017, Tamarind Taranaki Limited (**TTL**) obtained Marine Discharge Consent EEZ300006 from the Environmental Protection Authority (**EPA**) to discharge harmful substances from the oil production facilities in the Tui Field. As part of the consent conditions, an Ecological Effects Monitoring Plan (**EEMP**) was required to be lodged and approved by the EPA which was completed in February 2018. In November 2019 production operations in the Tui field ceased and discharges associated with these activities slowed and later stopped completely. TTL went into receivership and liquidation in December 2019, and MBIE, on behalf of the Crown, took on the responsibility of TTL's assets within PMP 38158, including all wells and associated infrastructure.

MBIE engaged SLR Consulting NZ Limited (**SLR**) to undertake the Annual Ecological Effects Monitoring (**AEEM**) associated with production from the Floating Production, Storage and Offloading vessel (**FPSO**) *Umuroa* in the Tui Field. Benthic and water sampling was undertaken in 2018, 2019 and most recently in February 2021. The objective of the AEEM was to assess the effects of consented discharges associated with the FPSO *Umuroa* on the surrounding marine environment. This report presents and discusses the findings of the 2021 AEEM and provides comparisons to results collected during previous surveys in 2018 and 2019. The intent is to assess any spatial and temporal changes in the seabed sediment characteristics (physical and chemical) and benthic community structure which may arise due to Tui Field operations.

Methodology

The sampling methodology (video transects, macrofauna sampling and sediment sampling) and sediment physiochemical parameters examined during the 2021 monitoring programme were in accordance with the specific methodological descriptions provided in EEMP for the Tui Field (ERM, 2018).

MetOcean Solutions Limited has previously created dispersal modelling plots from which sampling transects for past surveys (and the current survey) around the Tui Field have been selected. These sampling transects were aligned with the predominant flow directions, in this case, the northeast/southwest and north/south axes. The area downstream of the major flow axis is considered more likely to show influences from production discharges; however, sample stations are also located along the minor flow axis (east) to enable comparisons and validation of spatial differences in dispersal patterns. The location of sampling stations surrounding the FPSO *Umuroa* was further complicated by the large amount of subsea infrastructure present, which restricted where seabed samples could be safely collected without unnecessary risk to equipment. Sample stations ranged from 300 m to 4,000 m from the FPSO *Umuroa*.

A modified double Van-Veen grab sampler was used to collect triplicate sediment samples at each of the sample stations. Sediments were analysed for grain size distribution; total organic carbon (**TOC**); trace metal/metalloid concentrations; benzene, toluene, ethylene, and xylene (**BTEX**); total petroleum hydrocarbons (**TPH**); and polycyclic aromatic hydrocarbons (**PAH**). Sieved sediment samples enabled the characterisation of the macrofaunal communities at each station and distance from the FPSO *Umuroa*.

Seafloor video imagery was obtained at selected representative stations and later reviewed by a suitably trained and experienced marine scientist. Obvious epifauna and presence of infauna were identified to the lowest practicable taxonomic level. The presence of any biogenic and anthropogenic structures, such as burrows, mounds, tracks, and cuttings piles, were noted. Where appropriate, relative abundance estimates of epifauna and biogenic structures were made.

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Receiving water samples were collected by SLR scientists at positions 500 m and 1,000 m down current of the discharge point, as well as at two control stations. Samples were collected from 1 m and 10 m water depths at each station to test the receiving water chemical composition (RWCC).

Key Findings

Key findings from the 2021 Tui Field AEEM were:

- Visual observations of sediment cores revealed fine grained mud sediments, light-grey/light-brown in colouration and relatively cohesive in nature. There was no evidence of any distinct apparent Redox Potential Discontinuity (**aRPD**) layering or anoxic sediments detected during sample collection;
- Some measure of anthropogenic debris was found at 13 Tui Field and both control sampling stations across 32 types of debris including rusted materials, paint flakes, plastic pieces, garnet grains (likely a remnant of historical abrasive blasting), mica, dark 'coal-like' coloured fragments of rock and small balls of welding slag. Debris abundances were highest at stations closest to the FPSO *Umuroa* but still reasonably high at the control stations;
- The finest size class (silt and clay) particles dominate grainsize distributions in Tui Field sediment samples classifying sediments as muds/sandy-muds . One replicate sample from the SE control station (replicate C) was found to contain obvious larger pieces of dark, 'coal coloured' materials. The 300 m and to a lesser extent 500 m, stations showed coarser grainsize that stations at greater distance, likely due to altered near-field currents as a result of the presence of FPSO and associated subsea infrastructure. Sediments were generally comparable with those measured in 2019, but still finer than those recorded in 2018; and
- Concentrations of all metal/metalloids were below ANZECC (2018) Default Guideline Values (**DGV**s) for possible biological effects, where guideline values exist. Some metal/metalloids showed weak spatial trends of decreasing concentrations with distance, but patterns were very similar to those of silt and clay likely reflecting the greater surface area provided by fine sediments for adherence of contaminants such as metals. Barium concentrations also showed a decreasing trend with distance from the FPSO but the spatial pattern was not always consistent, likely reflecting the discharges of barite weighted drilling muds from exploration and production wells drilled around the location of the FPSO *Umuroa*.

Macrofaunal communities identified during the 2021 survey were in general similar to communities identified in previous surveys at the Tui Field and surveys across the wider offshore Taranaki area, being dominated by small polychaete worms, gastropods, crustaceans, bivalves and ostracods. The following are the key findings on macrofaunal community variability in relation to the FPSO *Umuroa*:

- Univariate index values calculated in 2021 were largely comparable to other years, with the highest numbers of macrofauna taxa found at the stations closest to the FPSO *Umuroa*, but overall mean abundances and taxa numbers similar between Tui Field and controls. Evenness and diversity index values were moderate to high, and largely uniform across the Tui Field and controls;
- No sensitive environment as per the Exclusive Economic Zone and Continental Shelf (Permitted Activities) Regulations 2013 were observed during benthic imagery surveys, although taxa characteristic of sensitive environments were present in the area, similar to previous surveys; and

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- Macrofauna community composition was not significantly different between Tui Field and southeast control sampling stations, but communities at the northeast control area were observed to be different. Results indicate that there is some limited natural variability in the macroinfauna community composition amongst all sampling stations in 2021 and the differences detected are related to subtle rather than large changes in community composition indicating that discharges from the FPSO *Umuroa* do not appear to be directly having a significant influence on the macroinfauna community composition.

Testing of the receiving water in February 2021 revealed that the concentration of the extensive number of analytes tested for were largely below ADL and in the few cases where they were detected above ADL, the concentrations were well below applicable guideline thresholds. Results showed no suggestion of any influence from FPSO *Umuroa* discharges, consistent with the non-producing status of Tui Field operations at the time of sample collection.

The results of the 2021 monitoring programme indicate that each of the following monitoring hypotheses are met:

- H_0. 1 - Consented discharges will not result in any significant changes to the benthic ecology 500 m or more from the FPSO, and
- $H_{0.}$ 2 - Consented discharges will not result in an exceedance of the current sediment ISQG-Low criteria of the ANZECC Guideline values (where a value exists) 500 m or more from the FPSO, except where similar exceedance concentrations measured at Control sampling stations also exceed the current ANZECC Guideline values.

The results of this report do not provide evidence of any non-compliance with the conditions of the Marine Discharge Consent EEZ300006.

Recommendations

Given that the FPSO *Umuroa* has been disconnected and removed from the Tui Field in May 2021 there are no longer discharges related to production activities occurring in the Tui Field. The decommissioning of the Tui Field is likely to begin in 2022 and therefore further monitoring of the seabed environment in this area would be incorporated as part of the Marine Consent Application for decommissioning.

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1 Introduction

SLR Consulting NZ Limited (**SLR**) was engaged by the Ministry of Business Innovation and Employment (**MBIE**) to undertake the Ecological Effects Monitoring Programme (**EEMP**) associated with production from the Floating Production Storage and Offloading vessel (**FPSO**) *Umuroa* in the Tui Field. The Tui Field, located within Petroleum Mining Permit 38158 (**PMP 38158**), was previously operated by Tamarind Taranaki Limited (**TTL**) until December 2019 when the company went into receivership and liquidation, and all production activities within the field and onboard the FPSO *Umuroa* ceased. MBIE, on behalf of the Crown, has taken on the responsibility of TTL's assets within PMP 38158, which include the wells and associated infrastructure.

Environmental monitoring associated with production from the FPSO *Umuroa* has been completed at the Tui Field since 2012 on an annual basis. Based on the results of the 2014 monitoring (which indicated few discharge-related effects) it was agreed by Maritime New Zealand (who were the regulators at the time) that survey efforts around the Tui Field should be conducted biennially (every two years) in future. As such, the next round of monitoring following that decision took place in February 2016. Annual Ecological Effects Monitoring (**AEEM**) resumed in 2018 as specified in the EEMP which was developed as a condition of the Marine Discharge Consent which was granted to TTL in September 2017 (see **Section 1.1**). However, due to TTL entering receivership in December 2019, the 2020 AEEM was not undertaken.

This report provides the results of the 2021 AEEM and compares these results with those reported for 2018 and 2019. The overall objective of the AEEM is to assess any changes to seabed composition and community structure which may have arisen due to production operations in the Tui Field.

1.1 Regulatory Requirements for Ecological Effects Monitoring

On 23 June 2017, TTL lodged an application for a Marine Discharge Consent to discharge harmful substances from the FPSO Umuroa within the Tui production field. The Marine Discharge Consent was lodged to replace TTL's existing Discharge Management Plan, which was deemed a Marine Discharge Consent under Section 87F of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 and was due to expire on 30 October 2017. The application (EEZ300006) was originally granted on 27 September 2017 and subsequently amended on 5 January 2018 to correct minor mistakes and defects.

EEZ300006 contained numerous conditions which the consent holder must adhere to, including the submission of an EEMP under Condition 14 for approval by the Environmental Protection Authority (**EPA**). The EEMP document (ERM, 2018) was approved by the EPA in February 2018 and outlined the requirements of the AEEM.

This AEEM report has been prepared in accordance with the approved EEMP for the Tui Field. To ensure this work is consistent with previous ecological surveys undertaken in the Tui Field and so that appropriate comparisons can be made, the sampling was undertaken at the same time of the year as previous surveys to remove any seasonal influence.

1.2 Monitoring Hypotheses and Aims

The overall purpose of the monitoring programme, as stated in the EEMP (ERM, 2018), is to "*monitor the effects of the consented discharges and to comply with environmental thresholds*".

The purpose of the sediment physicochemical characterisation and benthic community composition section of the EEMP is to assess whether benthic changes have occurred that could be related to TTL's operations. To satisfy that purpose, the monitoring hypotheses (as stated in the EEMP) for the sediment physicochemical characterisation and benthic ecology monitoring to be assessed in the AEEM are as follows:

- For sediment: The consented discharges will not result in an exceedance of the current sediment ISQG-Low criteria of the ANZECC Guideline values (where a value exists) 500 m or more from the FPSO, except where similar exceedance concentrations measured at Control sampling stations also exceed the current ANZECC Guideline values[1]; and
- For benthic ecology: The consented discharges will not result in any significant changes to the benthic ecology 500 m or more from the FPSO. Changes are defined by number of taxa, total abundance, Shannon-Wiener diversity and Pielou's evenness, and difference between sample locations and groups of samples.

The purpose of the receiving water chemical composition (**RWCC**) monitoring is to indicate the toxicity of the plume from the discharged waters in the receiving environment. No testable hypotheses relating to the RWCC monitoring are specified within the EEMP or are incorporated into the 2021 AEEM.

[1] Note that the ANZECC sediment guidelines were updated in 2018 (see **Section 3.4.2**) and these more recent guidelines are applied where applicable.

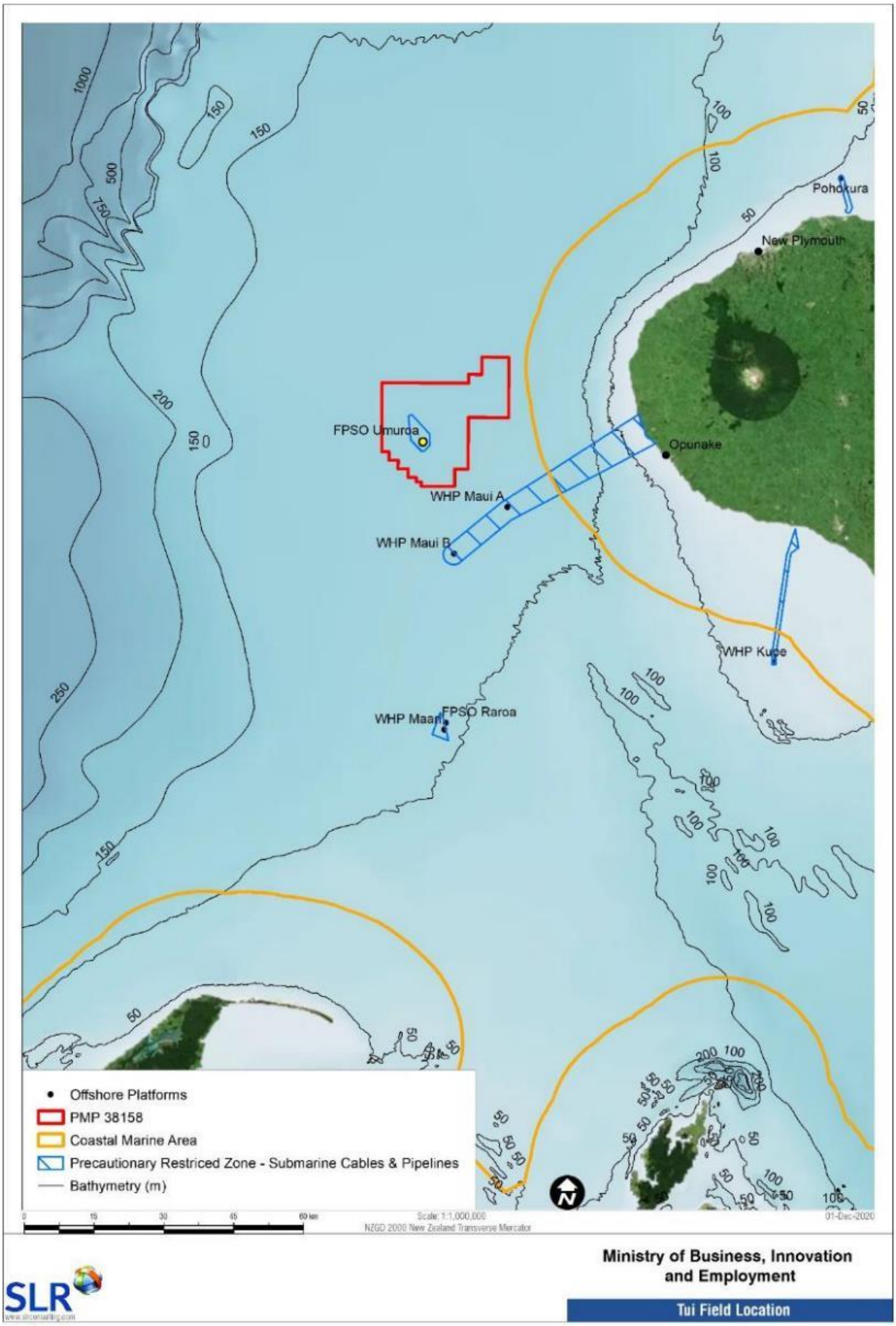
2 Study Location

The Tui Field lies in 120 - 125 m of water approximately 50 km off the Taranaki Peninsula (**Figure 1**), within Petroleum Mining Permit (**PMP**) 38158. The site is within the potential area of influence (<10 km) of numerous recent and historical exploration well sites (e.g., Tui-1, 2H, 3H, Tui-SW2, Amokura-1, 2H, Pateke-1, 2, 3H and 4H, Tieke-1).

As mentioned in earlier monitoring reports (Johnston *et al.*, 2014b; Elvines *et al*., 2013; Johnston & Forrest, 2012), it is likely that evidence of minor substrate variation will be detected at the Tui Field sampling stations on account of these previous drilling activities in the wider area. This variation is most likely to be observed in barium concentrations, organic content, and anthropogenic debris levels. Close to the FPSO *Umuroa*, large areas of the seabed are occupied by subsea infrastructure including anchor chains, flowlines, gas lift lines and umbilicals and the presence of these structures restricts safe access to locations to collect samples. At the time of the 2021 AEEM preparations were underway aboard the FPSO *Umuroa* to begin disconnection from the flowlines and anchors in the first step to decommission the Tui Field.

Non-oil and gas related activities also occur in the area surrounding the Tui Field, including commercial fishing and commercial shipping. Fishing in the area is largely mid-water trawling for jack mackerel and barracouta; and a general shipping route passes within the wider area, although a Safety Zone prohibits vessels from approaching within 500 m of the FPSO *Umuroa* unless they are approved vessels servicing the facility.

Figure 1 Location Map Showing the Tui Field within PMP 38158



3 Methods and Approach

The sampling methodology and parameters used in this investigation were in accordance with the specific methodological descriptions provided in the EEMP for the Tui Field (ERM, 2018). These methodologies were followed for the first time during the 2018 AEEM and were again followed in 2019 and 2021, except for the relocation of the northwest control sampling station prior to the 2019 AEEM (see **Section 3.1.1**).

The 2021 AEEM was undertaken from the vessel '*Sea Surveyor'* between the 22nd-23rd February 2021, following the procedures detailed in the EEMP (ERM, 2018). Water sampling for the RWCC analysis took place on 22nd February 2021 (see **Section 3.1.2)**.

3.1 Sample Locations

3.1.1 Benthic Sampling

The location of benthic sampling stations around the Tui Field were initially established from dispersal modelling plots created by MetOcean Solutions Limited (as shown in Johnston & Tremblay, 2011) and have been monitored since then. Sampling effort was primarily aligned with the dominant flow directions, along northeast/southwest and north/south axes as well as along the minor flow axis (east) (**Figure 2**).

Sampling stations were located along these dominant and minor flow directions at distances ranging from 300 m to 4,000 m from the FPSO *Umuroa* (**Figure 2**). The exact location of sampling stations proximal to the FPSO *Umuroa* was influenced by the large areas of seabed occupied by subsea infrastructure, which restricted where samples could be safely collected. **Table 1** provides a summary of the benthic sampling effort completed during the 2021 AEEM. All sampling station coordinates are provided in **Appendix A**.

Two control sampling stations 'Control NW' and 'Control SE' were located approximately 10,000 m and 6,000 m to the northwest and southeast of the FPSO *Umuroa* respectively. The location of the control sampling stations was informed by the results of previous surveys and to ensure they are representative of the background conditions throughout the Tui Field and not influenced by other production activities that occur within the general vicinity (SLR, 2016; SLR, 2018; SLR, 2019).

Figure 2 Location of the Sediment Sampling Stations Used During the 2021 AEEM.

Table 1 Summary of Sediment Sampling Effort Completed During the Tui Field 2021 AEEM.

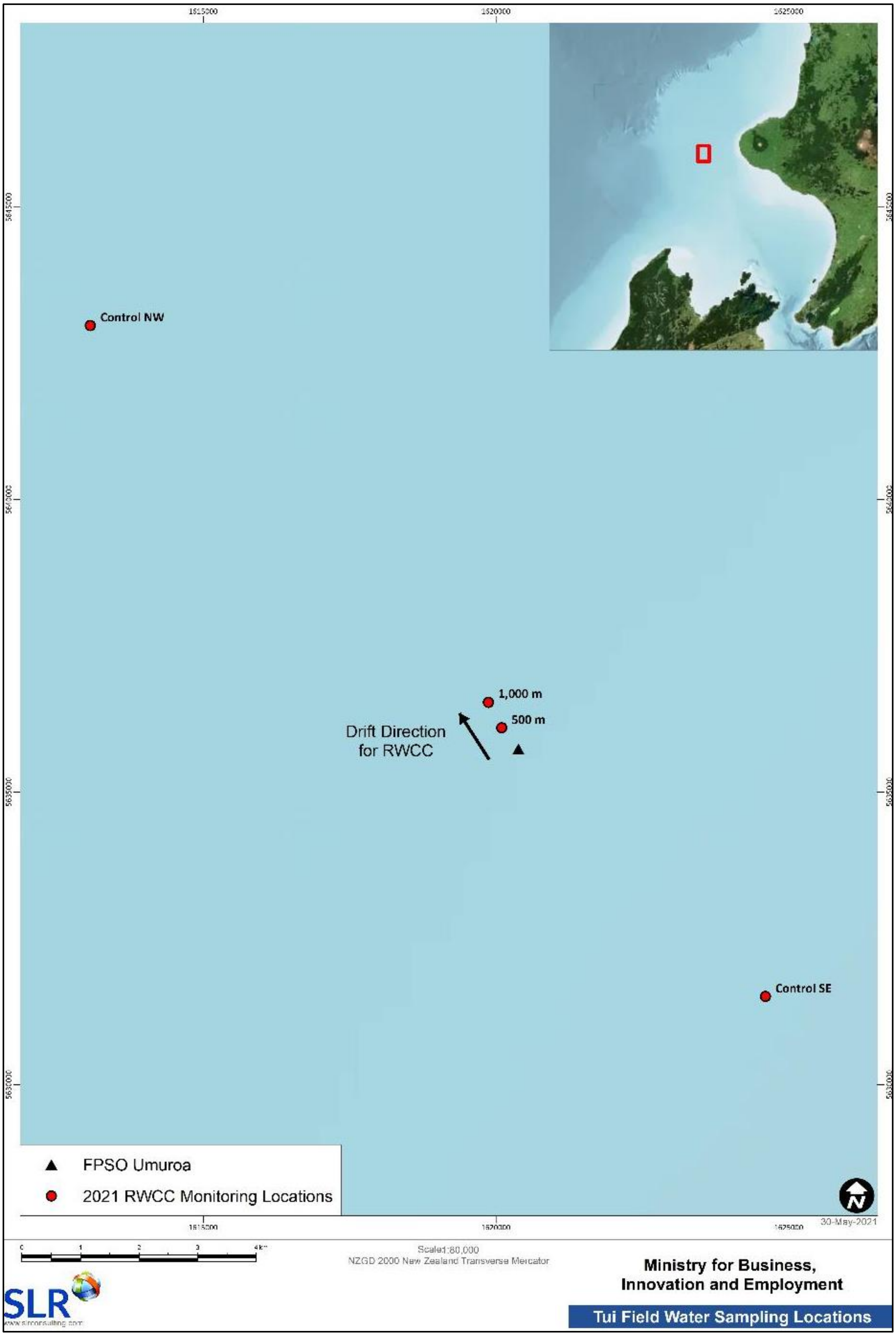
Axis	Station	Number of grab sampler replicates				
		Bucket 1	Bucket 2			
		Entire grab sieved for macrofauna	Sub-sample sediment for grain size and organic matter	Composite sub-samples for sediment chemistry		Sub-sample for archive
				TPH and PAH	Metals and metalloids	
Northeast	NE300	3	3	1	1	3
	NE500	3	3	1	1	3
	NE1000	3	3	1	1	3
	NE2000	3	3	1	1	3
	NE4000	3	3	1	1	3
Southwest	SW750	3	3	1	1	3
	SW2000	3	3	1	1	3
	SW4000	3	3	1	1	3
North	N2000	3	3	1	1	3
	N4000	3	3	1	1	3
North/Northwest	NNW750	3	3	1	1	3
West/Southwest	WSW750	3	3	1	1	3
South	S2250	3	3	1	1	3
	S4000	3	3	1	1	3
East	E500	3	3	1	1	3
	E1000	3	3	1	1	3
Control	Control-NW	3	3	1	1	3
	Control-SE	3	3	1	1	3
	Grand Total	**54**	**54**	**18**	**18**	**54**

3.1.2 Receiving Water Chemical Composition

Receiving water chemical composition sampling locations included two near-field stations at 500 m and 1,000 m down current from the point of discharge onboard the FPSO *Umuroa* (as measured in the Tui Field on the day as per Section 6.2.3 of the EEMP) (**Figure 3**). Samples were also collected at two 'control' stations, Control NW and Control SE, which were 10,000 m and 6,000 m from the FPSO *Umuroa*, respectively. These control sampling locations were considered well outside the zone being influenced by any discharges (modelling predicts no-effect dilution is achieved approximately 1,000 m from the FPSO *Umuroa* (RPS, 2017).

At each water sampling location, RWCC water samples were collected from near surface (approximately 1 m deep) and subsurface (approximately 10 m deep). These sampling depths were informed by modelling of the production discharge from the FPSO *Umuroa* that indicated the plume would initially plunge downwards due to expulsion by the discharge jet, and then the positively buoyant discharge would subsequently rise back to the surface (RPS, 2017).

Figure 3 Receiving Water Chemical Composition Sampling Locations Used During the Tui Field 2021 AEEM.

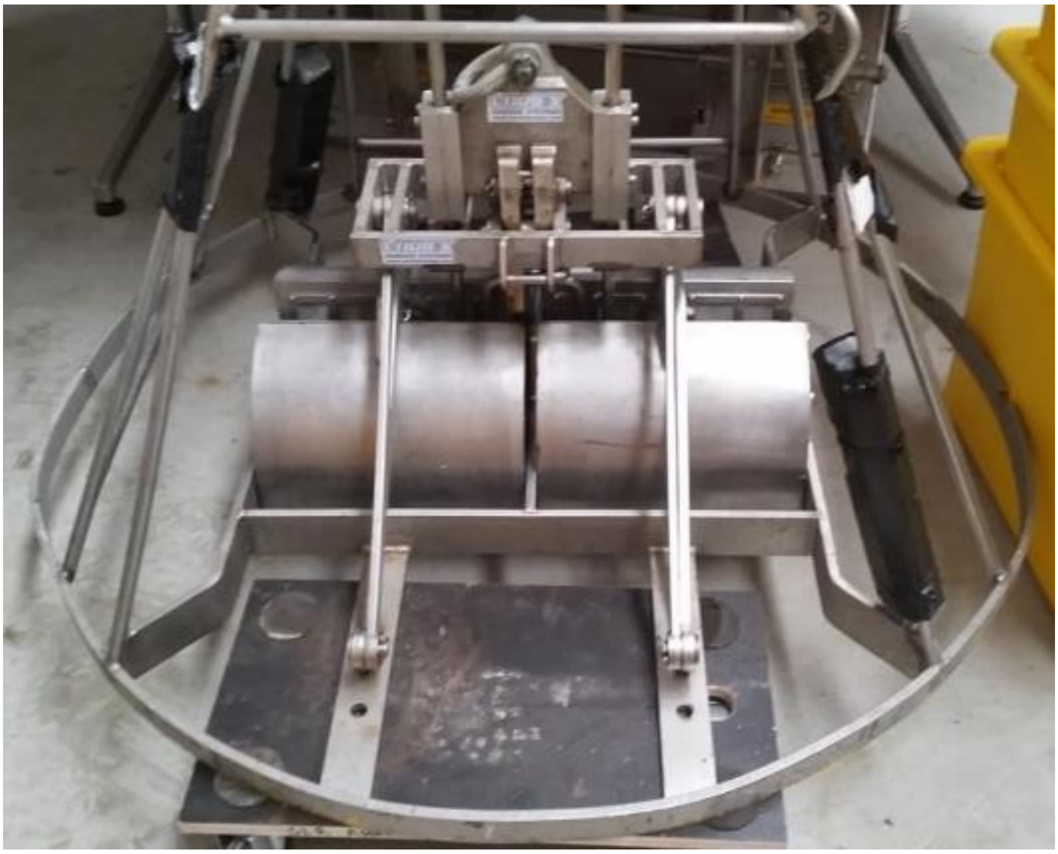


3.2 Sampling Procedures

3.2.1 Sediment Sampling

A modified double Van-Veen grab sampler ('the grab'; **Figure 4**) was used to collect three replicate sediment samples at each of the sampling stations. The grab was constructed entirely of stainless steel and features two independent 'buckets' which penetrate the surficial sediments to a depth of 0.16 m. In a successful sample, the grab collects approximately 0.01 m^3 of seabed sediment within each bucket.

Figure 4 Double Van-Veen Grab Sampler Used for Sediment Sampling



Upon arrival on the deck of the vessel, each benthic grab sample was carefully checked by SLR scientists and to be deemed successful, the following criteria needed to be met:

- The surface of the sediment was largely undisturbed;
- Enough sediment (≥75% of the grab capacity) was collected to enable the full suite of sediment analyses to be completed;
- The infauna sample bucket was filled to the same volume (approximately 10 L) for all infauna replicates throughout the survey; and
- The grab had not been over-filled (sediments pushing out of the doors or drains), indicating that it may have over-penetrated the sediment.

Each of the independent buckets from a replicate grab sample was used separately for infauna and sediment physical and chemical analyses, as follows:

Bucket one: infauna/macrofauna community analysis. The entire sample was sieved through 0.5 mm mesh until approximately 300 – 500 ml of residual sediment and organisms remained. This remaining material was transferred to a suitably sized labelled plastic container and preserved with an alcohol-based fixative, ready for later analysis by SLR taxonomists. Macrofauna and anthropogenic debris (e.g. paint flecks, plastics, rust etc.) greater than 0.5 mm were retained in the sample to be later inspected in the laboratory.

Bucket two: sediment physical nature and chemical analyses. A total of five clear Perspex sub-sampling cores with an internal diameter of 64 mm were pushed into the sediments from the centre of the second bucket to a depth of approximately 150 mm. Cores were collected from the middle of the grab bucket to ensure that cross-contamination from the stainless-steel structures of the grab sampler itself was avoided (as this could influence metal/metalloid concentrations). Cores were processed as follows (as outlined in the EEMP):

- **Sediment grain-size and organic content:** A single 63 mm diameter core was used to obtain a sub-sample of the top 50 mm of sediment for sediment grain-size (extended) and organic content (total organic carbon) analysis. The sample was placed in a labelled zip-lock bag;
- **Sediment chemistry:** Two 64 mm Perspex corers were used to obtain two full sediment cores from the grab. These were photographed for a qualitative record of sediment type boundaries. The top 50 mm of each core was composited across the three replicates, and analysed for:
    - Metal / metalloids (into a labelled zip-lock bag);
    - Organic compounds (into a labelled glass jar); and
- **Additional sediment samples**: The top 50 mm of two additional 63 mm cores of sediment were retained in a labelled glass jar and archived from each grab replicate in case additional analyses are required.

All sampling equipment, including the grab sampler were thoroughly washed with a high-volume hose prior to being redeployed and/or prepared for the next sample.

Following collection of all required sub samples sediment samples were stored chilled inside a dark cooler (held at ~4-6 ° C) during the remainder of the voyage and transportation back to port. Upon arrival at port the coolers containing the samples were filled with icepacks and shipped to R.J. Hill Laboratories for analysis. Samples arrived at Hill Laboratories within the recommended timeframes and were accompanied by the completed Chain-of-Custody (**COC**) documentation. Macrofauna samples were preserved in alcohol (>60%) and placed into chilled storage onboard the vessel for 24-48 hours. Following this the samples were removed from the chiller and kept in safe storage area onboard the vessel where temperatures remained around room temperature. Once back onshore macrofauna samples were transported back to the SLR Taxonomy laboratory accompanied by completed COC documentation.

3.2.2 Benthic Imagery

Benthic imagery was obtained using a customised tow-sled fitted with high-intensity LED lighting and a high-resolution video camera (**Figure 5**) at a number of locations around the Tui Field during the 2021 AEEM (**Figure 6**). The system was connected to the vessel via a 10 mm dyneema towline and a 300 m umbilical cable that supplied real-time video images to the camera operator on the research vessel. A parallel laser system on the video sled provided an indication of scale allowing features of interest in the imagery to be approximately sized.

The sled was launched from the vessel up-current of the pre-determined location and lowered to the seabed. At the point where the sled contacted the seabed, a GPS log was started, and this log continued throughout the duration of the tow. Video footage was continuously recorded for approximately 250 m as the sled was pulled behind the vessel; this ensured that footage was collected while the sled was passing as close as possible to the predetermined location.

Figure 5 The Towed Imagery System Used to Capture Benthic Imagery During the 2021 Annual Ecological Effect Monitoring.

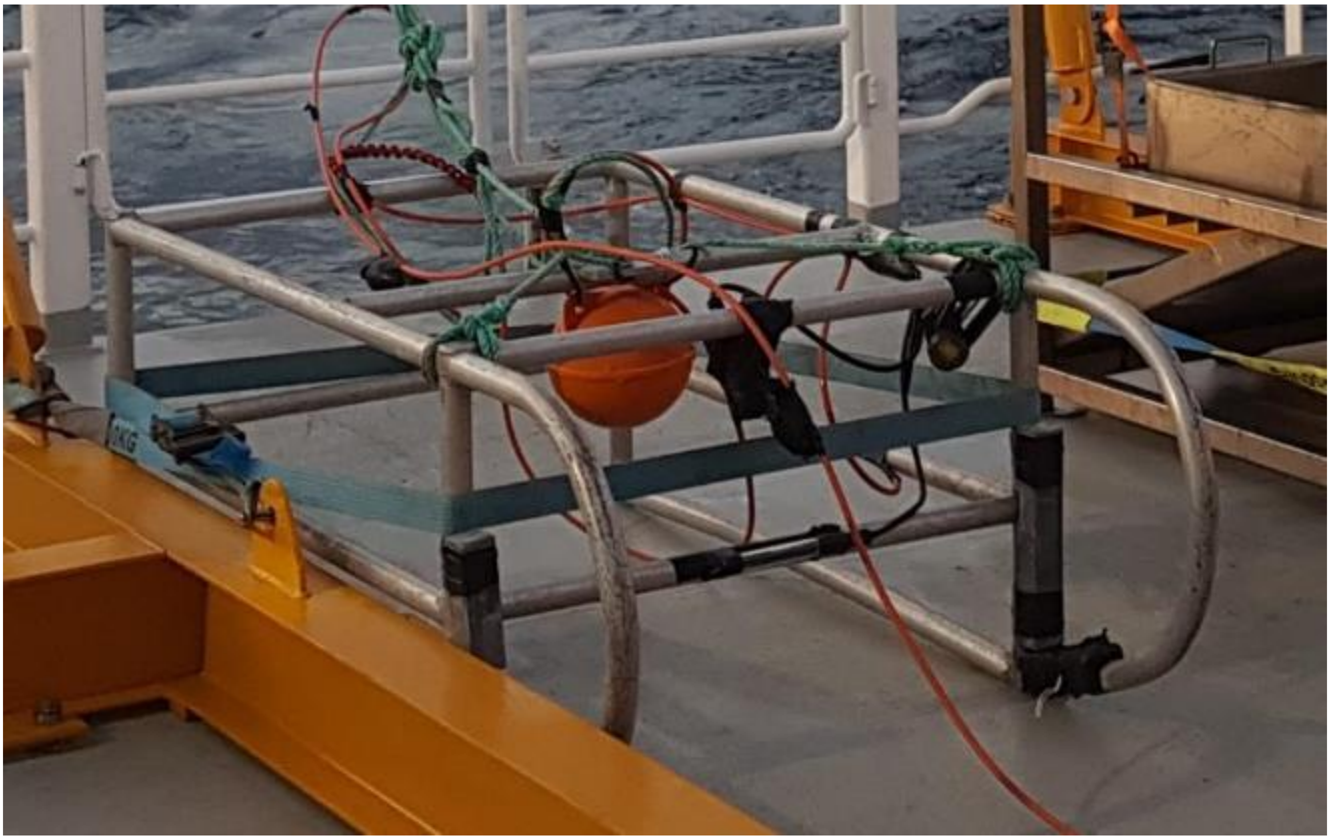
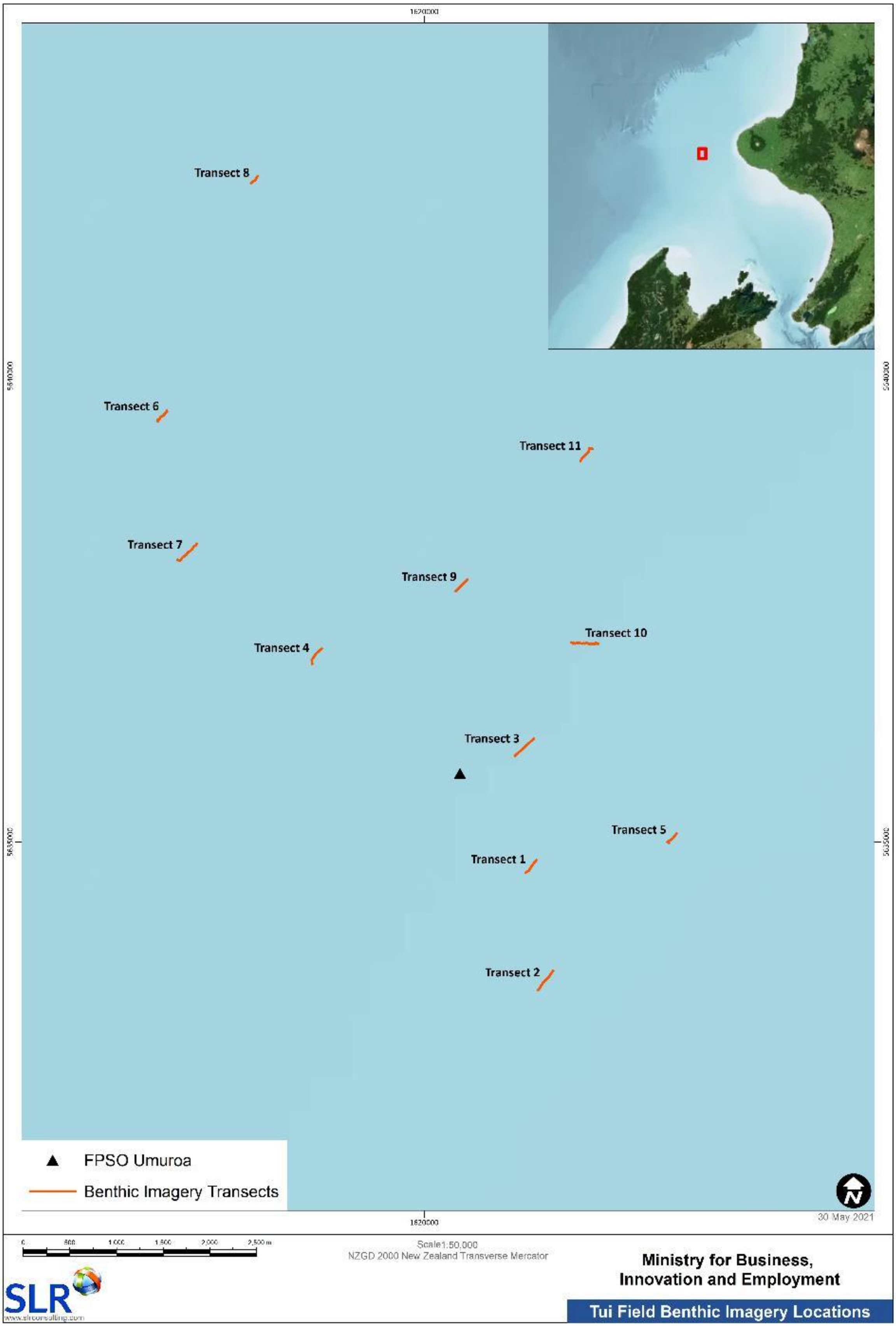


Figure 6 Location of Imagery Transects Completed During the 2021 Annual Ecological Effects Monitoring.



3.2.3 Water Quality Sampling

Due to the very light winds and small seas at the site on February 22nd water currents were able to be estimated based on vessel drift (0.2-0.4 knots towards NW (305°)) which concurred with the direction of an obvious surface sheen emanating from the FPSO *Umuroa* and trailing off towards the NW.

At each receiving water sampling station, water samples were collected from near-surface (1 m) and sub-surface (10 m) depths using an 8.2 L Van-Dorn sampler. The sampler was rinsed thoroughly with seawater and then ethanol between samples and stations, and upon deployment the sampler was hovered at the sampling depth for approximately two minutes to wash further before the sampler was triggered and a discrete water sample collected. At the time of collection, a water sampling field sheet (**Appendix B**) was completed by the field team which recorded sampling details including:

- Date and time of sample collection;
- Weather conditions;
- Wind direction and estimated strength;
- Position of the FPSO *Umuroa* and the points of discharge relative to the sample locations;
- Current speed and direction based on near surface current conditions (considered to be representative for the near-surface and ~10 m depth where samples are taken); and
- Comments on any other factors present at the site (e.g. visible surface slicks or debris, presence of other vessels, marine mammals, birds etc.) which could influence the results.

After collection, water samples were aliquoted into the relevant laboratory sample containers and stored inside a dark cooler in the chiller (held at 4°C) during transportation back to port. Upon arrival at port the chiller was filled with icepacks and the samples couriered to the receiving laboratory (Hill Laboratories) for analysis. Samples arrived at Hill Laboratories within the recommended timeframes and were accompanied by COC documentation.

3.3 Laboratory Analysis

3.3.1 Sediment Physicochemical Analyses

Sediments collected by the grab were analysed by Hill Laboratories for a variety of physical and chemical parameters (as specified in the EEMP). The aims of this analysis along with the analytical methods are summarised in **Table 2**.

Table 2 Analytical Methods Used for Determining the Physical and Chemical Characteristics of Sediments Collected During the 2021 Annual Ecological Effects Monitoring

Analyte	Aim	Method Number	Description
Particle grain size	Determine physical changes to substrate from production related discharges. Correlate with macrofauna distribution.	Hill Laboratories KB32136	Sediment was wet-sieved through the following screen sizes, as per the Udden-Wentworth scale (Wentworth, 1922): >2 mm (gravel) >1 mm (very coarse sand) >500 µm (coarse sand) >250 µm (medium sand) >125 µm (fine sand) >63 µm (very fine sand) <63 µm (silt and clay)
Total Organic Carbon Content	Determine level of organic matter in sediment. Correlate with macrofauna distribution.		Acid pre-treatment to remove carbonates present followed by Catalytic. Combustion (900°C, O_2), separation, Thermal Conductivity Detector. [Elementar Analyser].
Metals: As, Ba, Cd, Cr, Cu, Pb, Ni, Mg, Mn, Fe, Zn, Hg	Determine presence of production related metal/metalloid contamination in sediment. Correlate with macrofauna distribution.	US EPA 200.2 mod./APHA metals by ICP-MS	Dried sample underwent nitric/hydrochloric acid digestion. ICP-MS, trace-level (screen-level for Barium, Iron and Manganese).
Polycyclic Aromatic Hydrocarbons (**PAH**)	As for metals	USEPA 3540 & 3630	Sonication extraction, SPE clean-up, GC-MS SIM analysis.
Total Petroleum Hydrocarbon (**TPH**)	As for metals	US EPA 8015B/NZ OIEWG	Sonication extraction, Silica clean-up, GC-FID analysis.
BTEX	As for metals	US EPA 3550	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry), gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). Solvent extraction, head space, GCMS.

3.3.2 Macrofauna Laboratory Analyses

Macrofauna analyses focused on the infauna, or animals living within the sediment matrix which are larger than 0.5 mm. Benthic macrofauna samples were sorted and, with the aid of a binocular microscope, identified to the lowest practicable taxonomic level or most recognisable taxa (morphologically similar group). Counts were made to assess the relative abundance of each taxon. Taxa within the samples that were known to be not exclusively benthic were identified and enumerated during sample processing but were not included in the further analyses of the data.

Taxonomists sorting through the macrofauna samples also identified enumerated any incidental debris that were present in the retained material, particularly debris that appeared to be project-related/anthropogenic. The abundance of debris within each sample was classified based on the following criteria:

- Very abundant (>100 pieces per sample);
- Abundant (50-100 pieces per sample);
- Common (20–50 pieces per sample);
- Occasional (10–20 pieces per sample); and
- Low (1–10 pieces per sample).

3.3.3 Water Quality Analyses

The RWCC samples were analysed by Hill Laboratories for a variety of parameters (as specified in the EEMP). The aims of this analysis along with the analytical methods are summarised in **Table 3**.

Table 3 Summary of the Analytical Methods Used for the Analysis of RWCC Water Samples

Analyte	Aim	Description
Metals/ metalloids: As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Zn	Determine presence of production related metal/metalloid contamination in production related discharges	Use of standard methods for Digestion and analysis of metals/metalloids, e.g. inductively coupled plasma methods following acid digestion
PAHs BTEX	As for metals	GC-MS analysis
TPH	As for metals	GC-FID analysis

3.4 Data Analyses

Sediment chemical parameters were assessed against relevant sediment contaminant guidelines (ANZECC 2018 Default Guideline Values (**DGV**)). Macrofauna data were subjected to a series of statistical tests to characterise community composition. Further detail on these analyses are provided below.

3.4.1 Sediment Classification

Sediment grainsize distribution data was analysed with GRADISTAT (Blott & Pye, 2001), a software package that classifies the sediment data for each sample according to the Folk and Ward (1957) ternary classification method.

3.4.2 Sediment Quality Analyses

Levels of Total Organic Carbon (**TOC**) were assessed, and their relationship with the proportion of mud (silt and clay) at each station was assessed using a Pearson Correlation test (regression analysis) in excel.

Sediment trace metal and metalloid concentrations were compared against national sediment quality criteria (ANZECC, 2018). These commonly used guidelines are based on statistical models of toxicity data for a wide range of contaminants and aim to predict levels of contaminants in aquatic sediments above which adverse ecological effects may occur. The criteria are defined as DGVs which indicate the concentrations below which there is a low risk of unacceptable effects occurring. The 'upper' guideline values (GV-high), provide an indication of concentrations at which toxicity-related adverse effects may already be expected to occur – GV-high should only be used as an indicator of potential high-level toxicity problems, not as a guideline value to ensure protection of ecosystems.

Sediment PAH concentrations were compared against both the ANZECC (2018) DGV (and GV-High) values, and the ANZECC (2000) Interim Sediment Quality Guideline (**ISQG**) values. The reason for this is that ANZECC (2018) DGVs exist for Total PAHs only whereas ANZECC (2000) ISQG values provide comparisons for specific PAHs.

3.4.3 Macrofauna Community Analyses

All macrofauna (both epifauna and infauna) taxa were included in the analyses of abundance data. Taxa identified in the samples as not being exclusively benthic (e.g. pelagic species) were excluded from the analyses. Prior to beginning analyses, taxonomic data was standardised between the surveys to account for variances in taxonomic detail between years. Several taxa were grouped to higher taxonomic levels during the current survey to allow direct comparisons with previous years data.

The 2021 macrofauna dataset was analysed using a combination of descriptive statistics; to describe the characterising classes of taxa within each community, and non-metric Multi-Dimensional Scaling (**MDS**); to visually assess the relationship of samples with one another based on macrofauna community composition using Bray Curtis similarities (Bray & Curtis, 1957) as the distance metric.

The biodiversity of the Tui Field macrofauna communities from 2018 to 2021 were also assessed using univariate diversity indices as described in the following section.

3.4.3.1 Univariate Diversity Indices

Diversity indices (number of taxa S, total abundance N, Shannon-Wiener diversity H', and Pielou's evenness J', Species Richness (d), Simpsons Evenness (1-λ')) were calculated from the macrofauna abundance data using the PRIMER software package (PRIMER v6.1.16; PRIMER-E 2000; Clarke 1993; Clarke & Warwick 1994; Clarke & Gorley, 2006) (**Table 4**).

Table 4 Description of Univariate Indices Used to Describe the Macrofauna Community

Index	Formula (where applicable)	Description
Number of Taxa (S)	Count of total number of different taxa identified within the *x* sample	Total number of taxa identified within a sample
Total Abundance/ number of individuals (N)	Sum of all individual taxa abundances within the *x* sample	Total number/count of all organisms within a sample

Index	Formula (where applicable)	Description
Shannon Diversity (H')	H' = -SUM [(p_i) × $\log_e$ (p_i)] p_i = Number of individuals of taxa i /total number of samples	A single value (log scale) that is used to describe the different types and numbers of organisms present within an assemblage. The index value increases as assemblages have greater numbers of taxa and when the numbers of individual organisms are more evenly distributed across the different taxa. Samples dominated by single taxa will have lower values towards zero.
Pielou's Evenness (J')	J= H'/ $\log_e$ (S)	A value theoretically between zero and one which indicates how evenly the number of individual organisms are distributed amongst the different taxa in an assemblage. High values (closer to 1) indicate an even spread amongst the taxa present, whereas a low value indicates an uneven spread, or an assemblage highly dominated by only a few, or even a single taxon.
Species Richness (d)	D= (S-1)/Log(N)	Species richness S is the simplest measure of biodiversity and is simply a count of the number of different species in a given area. This measure is strongly dependent on sampling size and effort.
Simpsons Evenness (1-λ')	$1-\lambda' = 1-\sum(N_i*(N_i-1)/N*(N-1))$	Simpson's Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. As species richness and evenness increase, so diversity increases.

3.4.3.2 Multivariate Analyses

The conditions in Marine Discharge Consent EEZ300006 and the hypotheses in the EEMP are the guiding documents for the analyses in this report. Condition 15. ii. of Marine Discharge Consent EEZ300006 requires that the discharge activities "*do not result in any significant changes to the benthic ecology… 500 m or more from the point of discharge*". The EEMP stipulates that temporal factors must be used in analyses to allow the effects of time to be considered. Therefore, the multivariate analyses in this report were also carried out with the aim of testing if during 2021 or through time (between 2018 and 2021) benthic ecology (hereinafter referred to as macrofauna community composition) had significantly changed at distances of 500 m or more from the consented discharge location.

3.4.3.2.1 Macrofaunal Community Composition in 2021

The PRIMER software package (Clark & Gorley, 2006) was used to analyse the macrofauna community composition using abundance data. Relative abundances of each taxa for each of the three replicate samples retained at each sampling station were averaged. This approach reduces variability in the data which can help elucidate subtle effect signals that would otherwise be masked by inherent variability in the dataset which is critically important for effective impact assessments (Andrew and Mapstone, 1988; Bishop et al., 2002).. Sample station averaged macrofauna abundance data is commonly used in applied assessments of benthic communities (Clarke, 1993; Forde et al., 2012).

The averaged macrofauna abundance data matrix was then square root transformed prior to analysis to down weight the influence of numerically abundant taxa on the analyses. A resemblance matrix was produced for the square root transformed macrofauna abundance data using Bray Curtis similarity as the distance metric (Bray & Curtis, 1957).

A similarity profile (**SIMPROF**) test was applied to the entire square root transformed abundance matrix. When used in this way SIMPROF can identify if patterns in macrofauna abundance are statistically significant by comparison to a distribution created by randomising the sample stations and permutating the data (in this case 999 permutations of randomised data). If the observed pattern is statistically significant then the histogram produced by the SIMPROF test will show that it lies outside of the distribution created by the randomised data and provide a measure of significance (Sample statistic = *Pi*; where significance is provided as percentage).

To assess statistically significant group structure in the macrofauna abundance data a hierarchical cluster (CLUSTER) analysis along with a similarity profile (SIMPROF) test were run on the Bray Curtis resemblance matrix. CLUSTER analysis detects group structure within multivariate abundance data and visually depicts group structure on a dendrogram[2]. The SIMPROF test carries out a significance test at every node in the dendrogram to assess if the sampling stations in the group below that node are significantly similar based on macrofauna abundances. This analysis provides an indication of significant structure that may be present in the macrofauna communities.

Similarity percentage (**SIMPER**) analysis was carried out to assess which taxa characterised the macrofauna community in the survey area in 2021. A pairwise SIMPER analysis was also used to assess the level of dissimilarity between the communities at the 300 m sampling stations with the communities at every other distance of sampling station (e.g. 500 m, 750 m, 1,000 m, 2,000 m, 2,250 m, 4,000 m, 6,000 m, South East Control and North West Control).

Non-metric Multi-Dimensional Scaling (**MDS**) was used to visually display the relationship of samples with one another based on macrofauna community composition using Bray Curtis similarities (Bray & Curtis, 1957) as the distance metric. Permutational Analysis of Variance (**PERMANOVA**: Anderson 2001; Anderson et al., 2008) was used to test for the effect of the fixed factor of Distance (n = 9) on macrofauna community composition (this analysis is hereinafter referred to as PERMANOVA Model 1). Post hoc pairwise comparison in PRIMER was then used to test for significant differences between the different levels of the factor Distance.

3.4.3.2.2 Analysis of Macrofauna Communities from 2018 – 2021

A SIMPROF test was applied to the entire square root transformed abundance matrix collected between 2018 and 2021. An MDS ordination was used to visually display multivariate distances between sampling stations in two-dimensions using Bray Curtis similarity as the distance metric, where a 50 % Bray Curtis similarity contour was overlaid to show the level of similarity between the sampling stations over time. A second PERMANOVA model (PERMANOV Model 2) was used to test for the effect of the random factor Year (n = 3) as well as the effect of the fixed factor Distance on macrofauna community composition. Post hoc pairwise comparison in PRIMER was used to test for any significant differences between all pairs of the level Distance for each level of the factor Year.

3.4.4 Water Quality Analyses

RWCC sample constituent (including metal, metalloid, TPH, PAH and Benzene, Toluene, Ethylbenzene and Xylene (**BTEX**)) concentrations were compared against ANZECC (2018) DGV 95% level of protection (**LOP**) values for marine waters. Results from the RWCC samples proximal to the FPSO *Umuroa* were also compared against those from the control sampling stations to assess for the level of difference compared to background.

[2] A dendrogram in hierarchical clustering, illustrates the arrangement of the clusters produced by the corresponding analyses.

4 Results and Discussion

4.1 Sediment Physical and Chemical Characteristics

4.1.1 Visual Observations

Representative images of the sediment cores collected from sample stations during the 2021 AEEM are shown in **Figure 7**. Observations on texture, colour and any notable features of the sediment samples that were recorded within the field are presented in **Appendix A**, and the full set of sediment core photographs are provided in **Appendix C**. The following discussion pertains only to visual observations of the sediment cores following their collection within the field; quantitative results are provided and discussed in later sections (**Sections 4.1.2** to **Section 4.1.5**).

Sediment cores collected from the grab sampler during the 2021 AEEM were observed to contain fine grained mud sediments which were generally light-grey/light-brown in colouration and often showed gradation from brown near the surface to grey deeper in the profile (**Figure 7**). Sediments were generally quite cohesive in nature, and although a small number of samples were found to be somewhat softer this did not appear to be specifically in any area or along particular sampling axes. During sample collection no evidence of any distinct apparent Redox Potential Discontinuity (**aRPD**) layering or anoxic/black sediments was found, and obvious hydrogen sulphide odours were not detected in any of the cores, indicating that sediments were relatively well oxygenated at all sample stations[3]. Sediments in the sampler and the corer were not observed to contain a large quantum of obvious anthropogenic debris such as drilling or production related cuttings materials, drilling muds/gels or rust/paint flakes.

[3] To the depth sampled

Figure 7 Representative Sediment Core Photographs from the 2021 AEEM.

NE300_C

NE500_C

WSW750_A

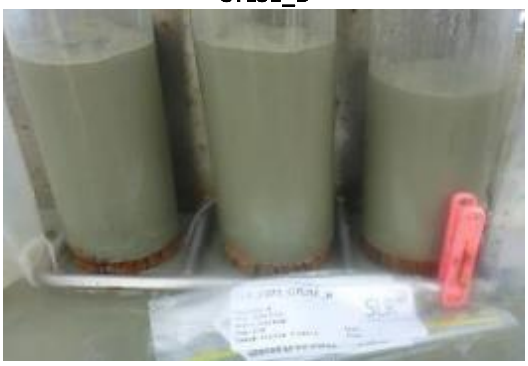
E1000_C

SW2000_A

S4000_B

CTLNW_B

CTLSE_B



4.1.2 Incidental Observations and Anthropogenic Debris

Some project-related anthropogenic debris was found at thirteen of the sixteen Tui Field sampling stations and at both the Control sampling stations during the 2021 AEEM, although some individual replicate samples collected at these sampling stations did not contain any observable anthropogenic debris. Overall, 32 types of anthropogenic debris were identified including rusted materials, paint flakes (in various colours), plastic pieces (of several colours), garnet grains (likely a remnant of historical abrasive blasting), mica, dark 'coal-like' coloured fragments of rock and small balls of welding slag (**Figure 8**). A full list of anthropogenic debris recorded is presented in **Appendix D**.

Consistent with previous monitoring at the Tui Field, the abundance of anthropogenic debris generally decreased with increasing distance from the FPSO *Umuroa*, particularly for categories such as mica, drill cuttings and paint flakes (**Appendix D**). The occurrence of anthropogenic debris such as 'coal-like' rock, garnet, rust flakes, welding balls and welding material were more common at the Southeast Control station compared to other sampling stations. Samples from the Northwest Control station were found to have lower levels of these anthropogenic debris types compared to samples from the South East Control station.

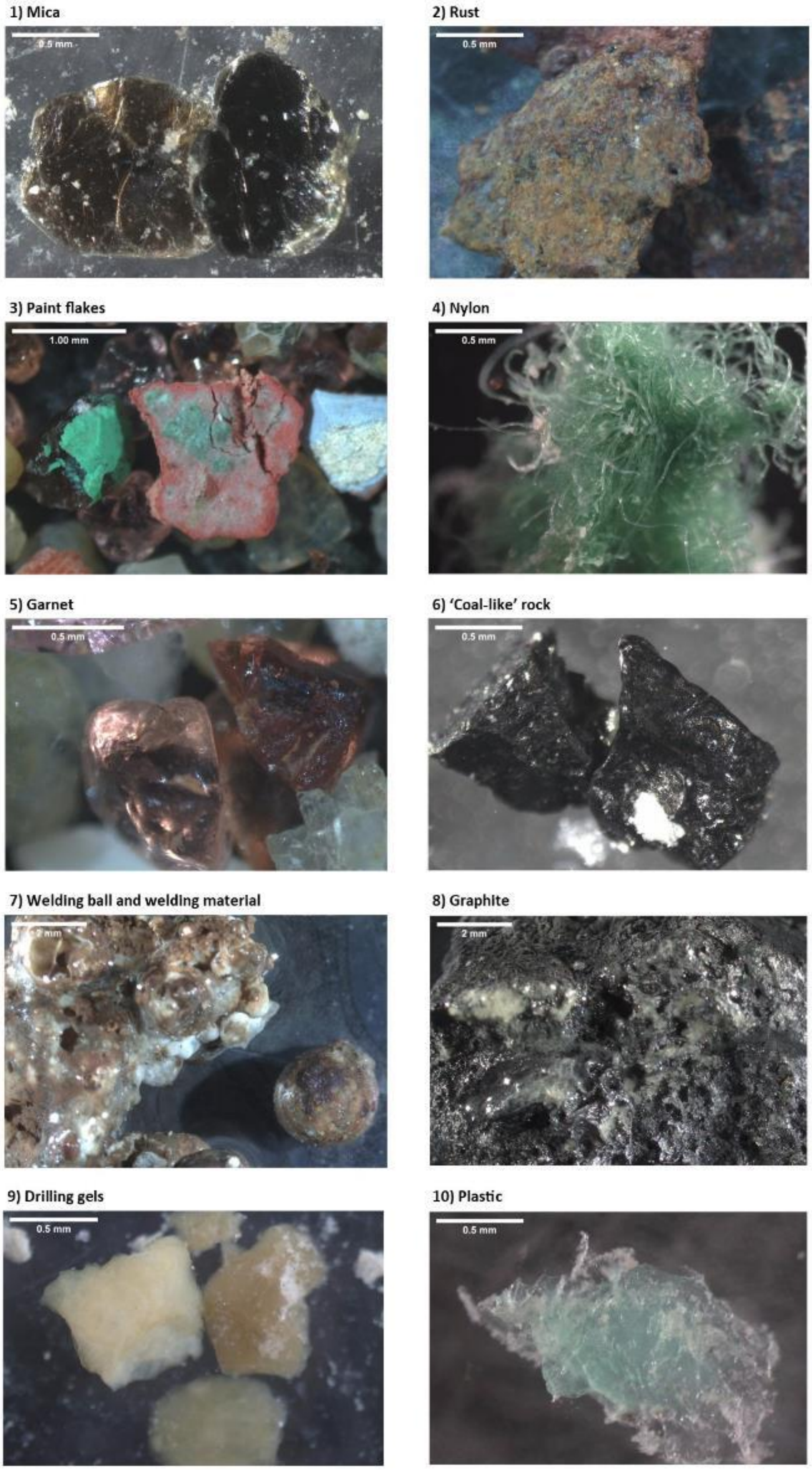
Overall, mica was the most numerically prevalent anthropogenic debris recorded during the 2021 AEEM, occurring at low to common levels at 89% of the sampling stations (**Table 5**). The presence of mica in Tui field samples is unlikely to be entirely project related as mica is a commonly occurring mineral found in many rock types present in the Taranaki region. The weathering of such rocks can deposit mica and other minerals in the marine sediments of the region. Rust flakes and paint flakes (all colours combined) were the next most frequently recorded and were found mostly at low levels of abundance, found at 83 % and 61 % of sampling stations respectively. Paint flakes were not recorded at either control sampling station (**Table 5**).

Table 5 Most Frequently Observed Incidental Debris in Macrofauna Samples Collected During the 2021 AEEM.

Incidental Debris	Overall Occurrence (%)	Sampling Station Occurrence (%)	Control Station Occurrence (%)
Mica	89	94	50
Rust	83	81	100
Total Paint Flakes	61	69	0
Total Nylon	61	63	50
Garnet	61	56	100
Sand-Like (Orange)	61	63	50
Coal-Like Rock	39	31	100
Welding Ball	33	25	100
Graphite	28	19	100
Welding Material	22	13	100
Drilling Gels	11	13	0
Organic/Wood	11	13	0
Total Plastic	11	13	0
Drilling Muds	6	6	0
Drill Cuttings	6	6	0

PERMANOVA Model 1 detected a significant effect of distance on the occurrence of anthropogenic debris in the Tui Field during the 2021 AEEM ($p<0.001$ (**Appendix K** – **Table K1**)). Pairwise comparisons revealed that the abundance of anthropogenic debris at the 300 m station was significantly greater compared to other distances and control sampling stations (**Appendix K** – **Table K2**). Additionally, the abundance of debris at a distance of 750 m was found to be significantly different to all other sampling stations at and beyond 1,000 m, including the Northwest control sampling station (**Appendix K** – **Table K2**). While the abundance of debris at the 500 m sampling station was significantly different to sampling stations at and beyond 2,000 m, including the Southeast Control sampling station. The Southeast control sampling station was most distinct in terms of debris occurrence and found to be significantly different from every other sampling station across the study location, except the Northwest Control sampling station, which had low abundances of similar anthropogenic debris present. Thus, there is a spatial gradient of decreasing abundances of anthropogenic debris in relation to increasing distance from the FPSO *Umuroa* and therefore some effect of the presence of the FPSO *Umuroa* and ongoing activities in the Tui Field. However, debris are widely occurring right across the Tui field including at the distant control stations so the level of any potential effect needs to be tempered by this knowledge.

Figure 8 Representative Images of Anthropogenic Incidental Debris Observed During the 2021 AEEM



4.1.3 Sediment Particle Size Distribution and Organic Content

4.1.3.1 Particle Grainsize Distribution

Particle grainsize distributions in Tui Field sediment samples were dominated by silt and clay and sand sized particles (very fine, fine and medium sands), and were classified as sandy-muds (**Figure 9** and **Figure 10**). One replicate sample from the SE control station (replicate C) was found to contain 0.7% gravel sized particles, which matches with observations from the macrofauna sample analyses where larger pieces of dark, coal coloured material were found in the sample. The mean proportion of very fine sand were similar or had decreased at most of sampling stations compared to 2019, the exceptions being the sampling stations on the S and WSW axes as well as the SE Control station (**Figure 9**). The proportion of silt and clay sized particles were largely comparable to those reported in 2019, while the results from both years still were higher than those recorded in 2018 (**Figure 9**). The proportion of various grain size fractions were generally comparable to the control sampling stations at distances greater than 500 m from the FPSO *Umuroa* (**Figure 9**). Natural variability in the proportion of fine sand, very fine sand and silt and clay were recorded between control sampling stations.

It is unlikely that production discharges from the FPSO *Umuroa* would be directly influencing the particle grainsize distribution on benthic sediments as there does not tend to be particulates discharged with the produced water. The general coarsening of sediments observed close to the FPSO *Umuroa* is therefore likely a result of altered near-seabed currents due to the presence of production related infrastructure and anchoring systems on and above the seabed in the Tui Field.

Full particle grain size distribution results can be found in **Appendix E**.

Figure 9 Particle Grainsize Distribution Recorded at the Tui Field and Control Sampling Stations Between 2018 and 2021 (Error Bars Represent 1 Standard Error of the Mean).

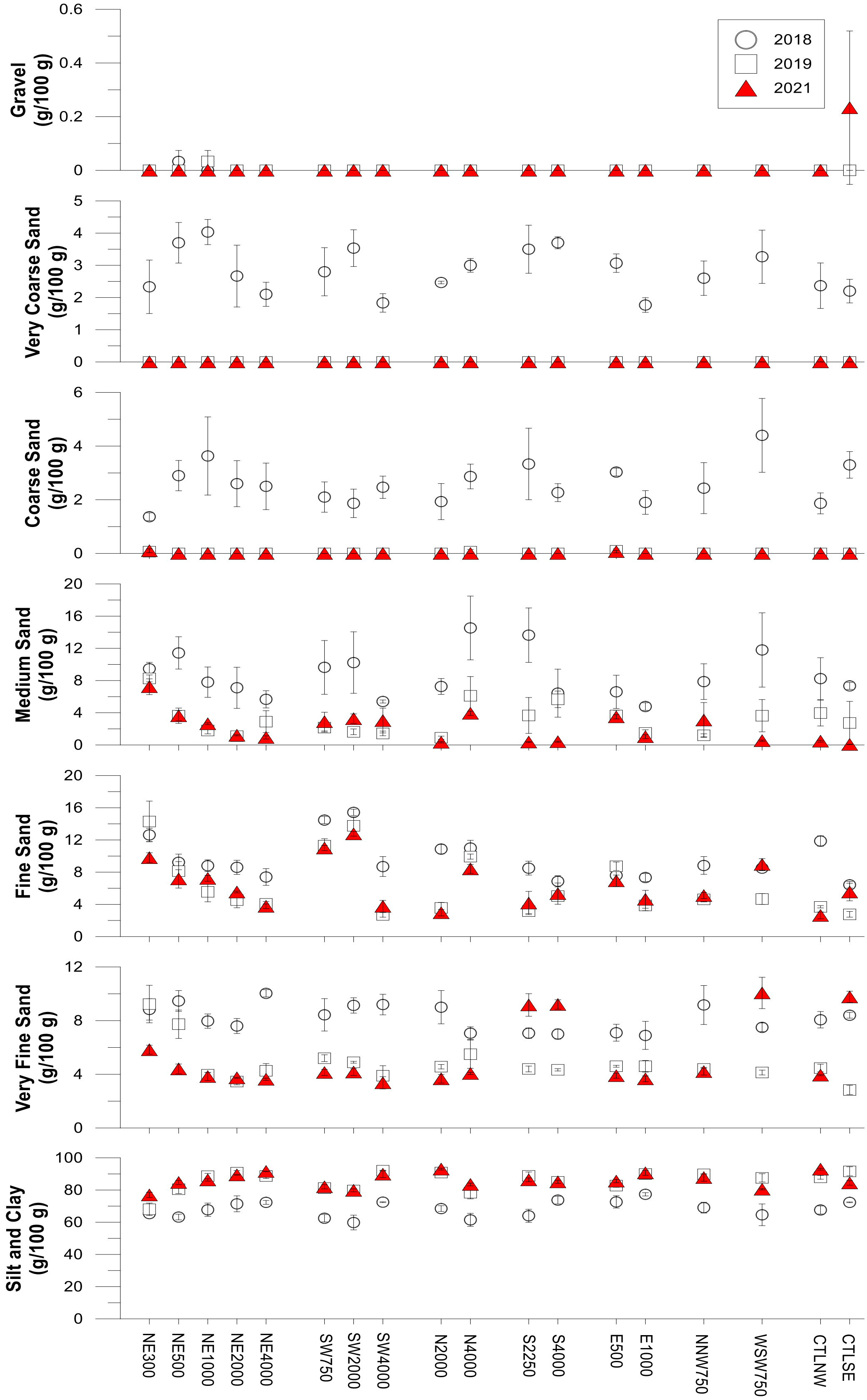
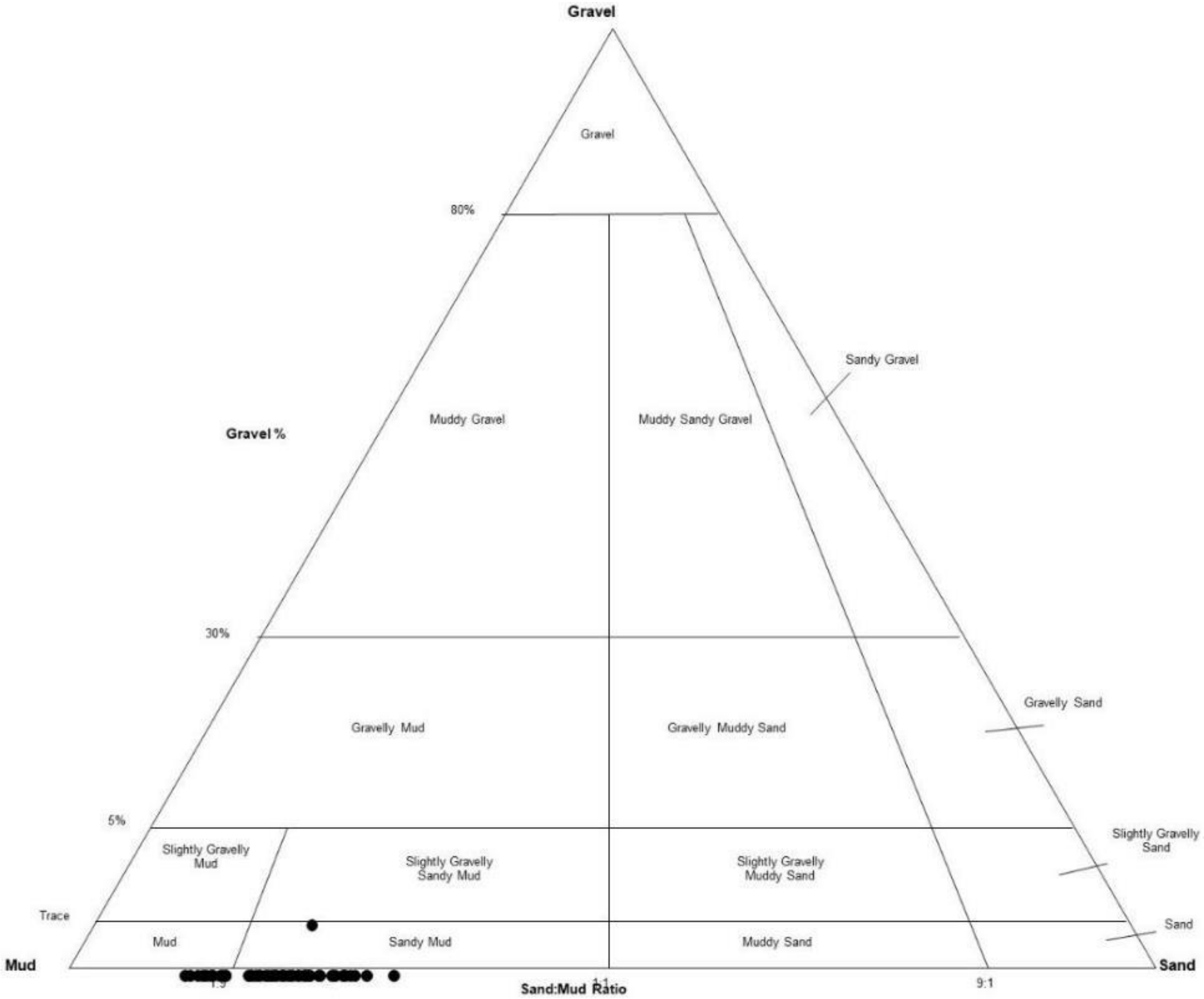


Figure 10 Folk and Ward (1957) Ternary Classification Triangle with all sampling Stations from the 2021 AEEM Super Imposed to Show Their Distribution Across the Sediment Textural Groups.



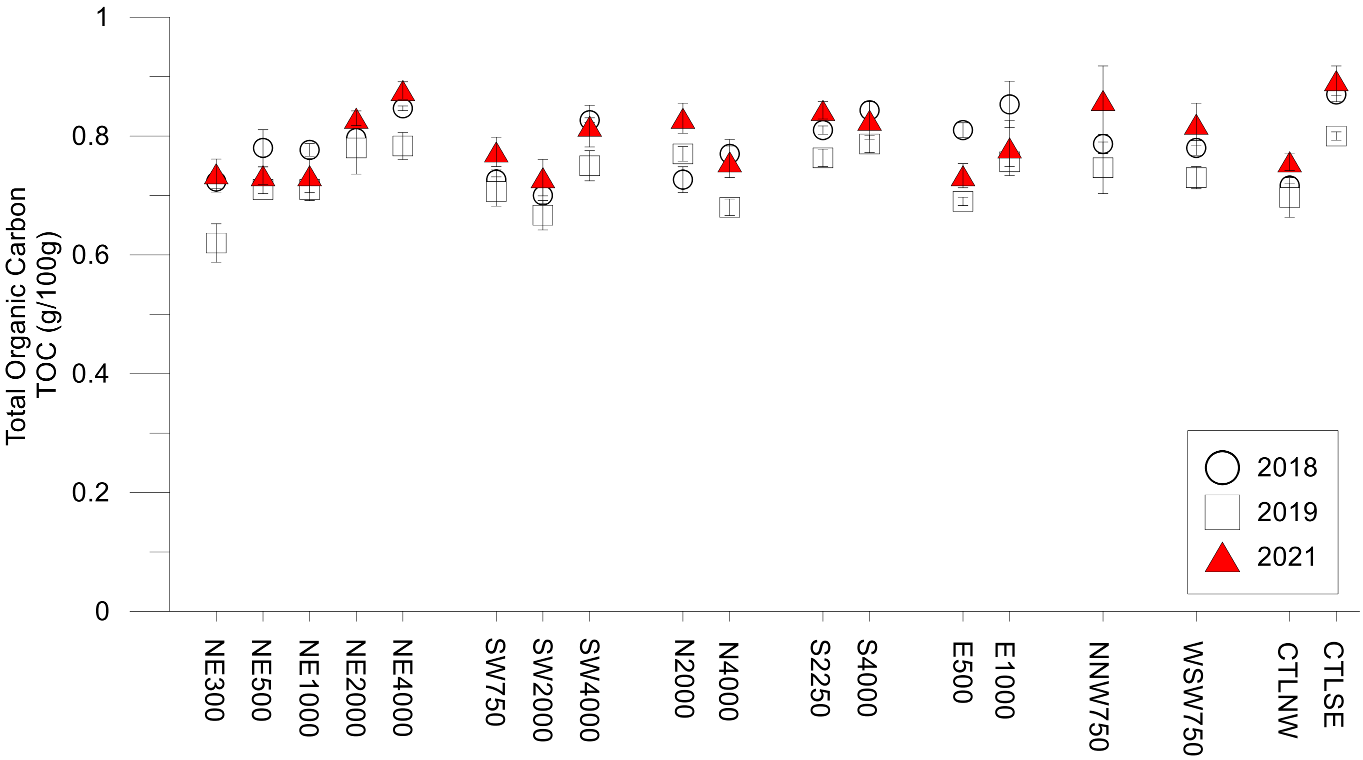
4.1.3.2 Organic Carbon Content

Mean organic matter content (as TOC) was highest at the South East Control sampling station (0.89%) and the NE4000 sampling station (0.88%) (**Figure 11**). On the northeast, east and to a lesser extent the southwest sampling axes there was some evidence of trend of increasing TOC content with distance from the FPSO *Umuroa*, although along the northeast axis the three sampling stations closest to the FPSO *Umuroa* (300 m, 500 m and 1,000 m) the TOC content was very similar. As discussed in the previous section, the northeast and east sampling axes showed obvious trends of increasing proportions of fine sediments (silt and clay) with distance from the FPSO *Umuroa*. Therefore, the increasing organic matter content of the sediments moving away from the FPSO *Umuroa* is likely linked to the greater proportions of fine sediment rather than to production related discharges. The greater surface area to volume ratio of silt and clay (mud/fine) sediments gives a greater area for adsorption of organic matter particles (Hedges *et al*., 1993) and therefore a higher probability of elevated percentages compared to coarser/sandier sediments subjected to the same level of enrichment.

The concentration of TOC recorded in 2021 was generally higher than that recorded in 2018 and 2019. In offshore sediments the mean TOC typically ranges between 0.5% and 2% (Seiter *et al*., 2004). The TOC recorded at the Tui Field is within this general range and is consistent with other surveys completed in the offshore Taranaki region (e.g. SLR, 2020a).

Full TOC results for all replicate samples collected in 2021 are presented in **Appendix D**.

Figure 11 TOC in Sediment Samples Collected from the Tui Field between 2018 and 2021



4.1.4 Metals and Metalloids

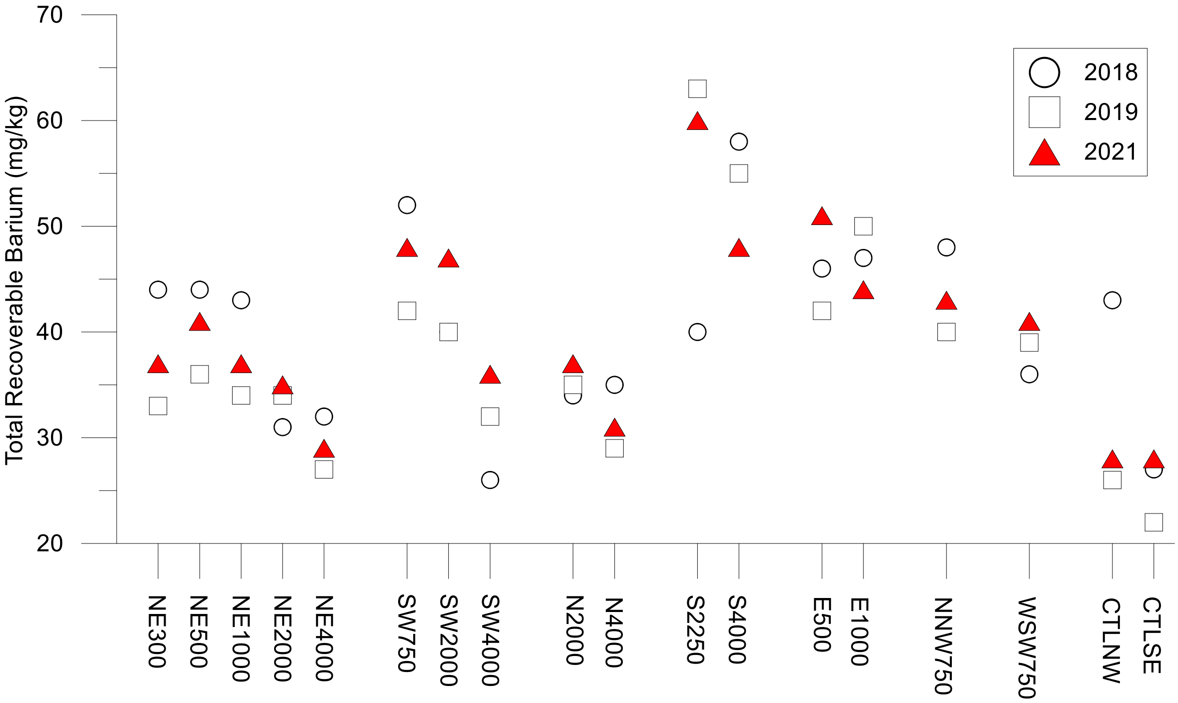
The concentrations of Ar, Ca, Cr, Cu, Pb, Hg, Ni and Zn in composite samples[4] from all sampling stations during the 2021 AEEM were below applicable ANZECC DGV values (**Appendix E**). The concentration of Fe, Mg and Mn were comparable amongst sampling stations and consistent with previous survey periods (**Appendix E**). As recorded in previous years at the Tui Field, as well as across the offshore Taranaki area since monitoring began in 2011, the concentration of nickel at all sampling stations was close to DGV**.** Nickel concentrations in the offshore Taranaki area are naturally elevated, likely from the onshore weathering and then marine deposition of nickel containing minerals, similar to that observed in Tasman Bay (Gillespie *et al.*, 2011). Peak nickel concentrations in 2021 was detected at the S2250 sampling station (17.9 mg/kg), down from the 2019 peak of 18.8 mg/kg.

There was some evidence to suggest that the concentration of the metals and metalloids analysed increased with distance from the FPSO *Umuroa* which is consistent with previous survey periods. This is likely associated with the increase in the proportion of smaller sized particles with distance from the FPSO *Umuroa* as smaller sediment particles provide a larger surface area to volume than larger particles and providing a greater area for metals/metalloids to adhere.

[4] Composite samples were produced by combining the sediments from the three replicate samples collected at each station.

The concentration of barium generally decreased with distance from the FPSO *Umuroa* (ranging from 28 mg/kg to 60 mg/kg) and was generally comparable to previous survey periods (**Figure 12**). In 2021 the concentration of barium in the sediments were comparable between the NE4000, N4000 and control sampling stations. Barium sulphate (barite) is a weighting agent commonly used in drilling muds. As it is relatively insoluble in seawater it precipitates quickly from the water column and deposits on the seabed around a well, allowing it to be used to trace the deposition footprint of drilling-related discharged (VKI, 1999; Ellis *et al*., 2012; Kennicutt *et al*., 1996). The drilling of the production and exploration wells that lie in relatively close proximity to the sampling stations (e.g. Tui-1, 2H, 3H, Amokura-1, 2H, Pateke-1, 2, 3H and 4H) is likely to have resulted in the discharge of barite containing materials to the seabed and at least some portion of the patterns in barium concentrations seen is likely to be indicative of these historical activities.

Figure 12 Concentrations of Barium in Sediments Collected from the Tui Field and at Control Sampling Stations Between 2018 and 2021.



4.1.5 Polycyclic Aromatic Hydrocarbons (PAH) Total Petroleum Hydrocarbons (TPH) and BTEX Compounds

The concentration of PAH, TPH and BTEX in sediment samples collected during the 2021 AEEM were all below ADL, and therefore were well below the applicable ANZECC (2000) ISQG-low and/or ANZECC (2018) DGV for sediment quality.

In 2019 low, but detectable concentrations of PAHs were found in sediments collected in the Tui Field (20 of the 418 PAH results at nine sampling stations) particularly along the eastern sampling axis. No broad spatial trends in the concentration of PAHs with distance from the FPSO *Umuroa* were detected (SLR, 2019). The 2021 results indicate that since the ceasing of production operations onboard the FPSO *Umuroa* the low concentrations of PAH species present in Tui Field sediments have decreased.

Detailed results for PAH, TPH and BTEX are presented in **Appendix G**, **H** and **I** respectively.

4.1.6 Monitoring Hypotheses

The monitoring hypothesis within the EEMP states that the consented discharges will not result in an exceedance of the current DGV 500 m or more from the FPSO *Umuroa* (except where exceedances are also seen at the control stations). It is considered that the concentration of metals/metalloids, PAH, TPH and BTEX in sediments sampled in 2021 are consistent with this monitoring hypothesis.

While there is no DGV associated with barium, placing it outside of the monitoring hypothesis, the concentrations of this metalloid remained above background levels beyond 500 m from the FPSO *Umuroa*. Given barium is considered relatively inert and non-toxic in marine environments, with minimal bioavailability (Neff, 2005; 2008) it is unlikely that the elevated concentrations are having an impact on the biota present.

4.2 Benthic Imagery

Although not required under the Tui Field EEMP, imagery of the seabed within the wider Tui Field was collected as part of the 2021 AEEM to assess seabed conditions and provide further background information to help inform the upcoming Impact Assessment for the decommissioning of the Tui Field. In December 2020 an underwater Remote Operated Vehicle (**ROV**) survey was undertaken to inspect and assess the subsea infrastructure within the Tui Field ahead of the disconnection of the FPSO *Umuroa* – the first stage of the Tui Field decommissioning. Imagery of the benthic environments within the Tui Field garnered during the ROV survey were limited to areas directly adjacent/underneath the subsea infrastructure but revealed soft seabed environments (muds) well colonised by infauna but relatively sparse epifauna, with mobile fish taxa utilising the anthropogenic structures for their cryptic habitats to shelter and aggregate around/within (SLR, 2021). The subsea infrastructure was covered in light to heavy marine fouling assemblages, with fouling heaviest on the shallower structures and those clear of the seabed (catenary sections of flowlines, gas-lift lines, umbilicals, anchor warps, mid-water arches etc.). Benthic imagery collected in February 2021 focussed on areas of the seabed within the Tui Field which had not previously been assessed in either the ROV survey or previous benthic monitoring surveys in the Tui Field where video tows were undertaken (i.e. prior to the implementation of the EEMP in 2018).

Each of the benthic imagery tows completed during the 2021 AEEM (**Figure 6**) revealed the seabeds to be of a similar nature – that being relatively flat and appearing to be composed primarily of mud sediments (**Figure 13**), often heavily pockmarked with infauna/epifauna burrows (**Figure 13A-H**) and occasional larger mounds from shrimps/worms (**Figure 13B**) as well as mound/hollow features (**Figure 13D**) from the feeding activities of larger fish species. No obvious anthropogenic physical disturbance of the seabed or debris were observed on any of the imagery transects completed.

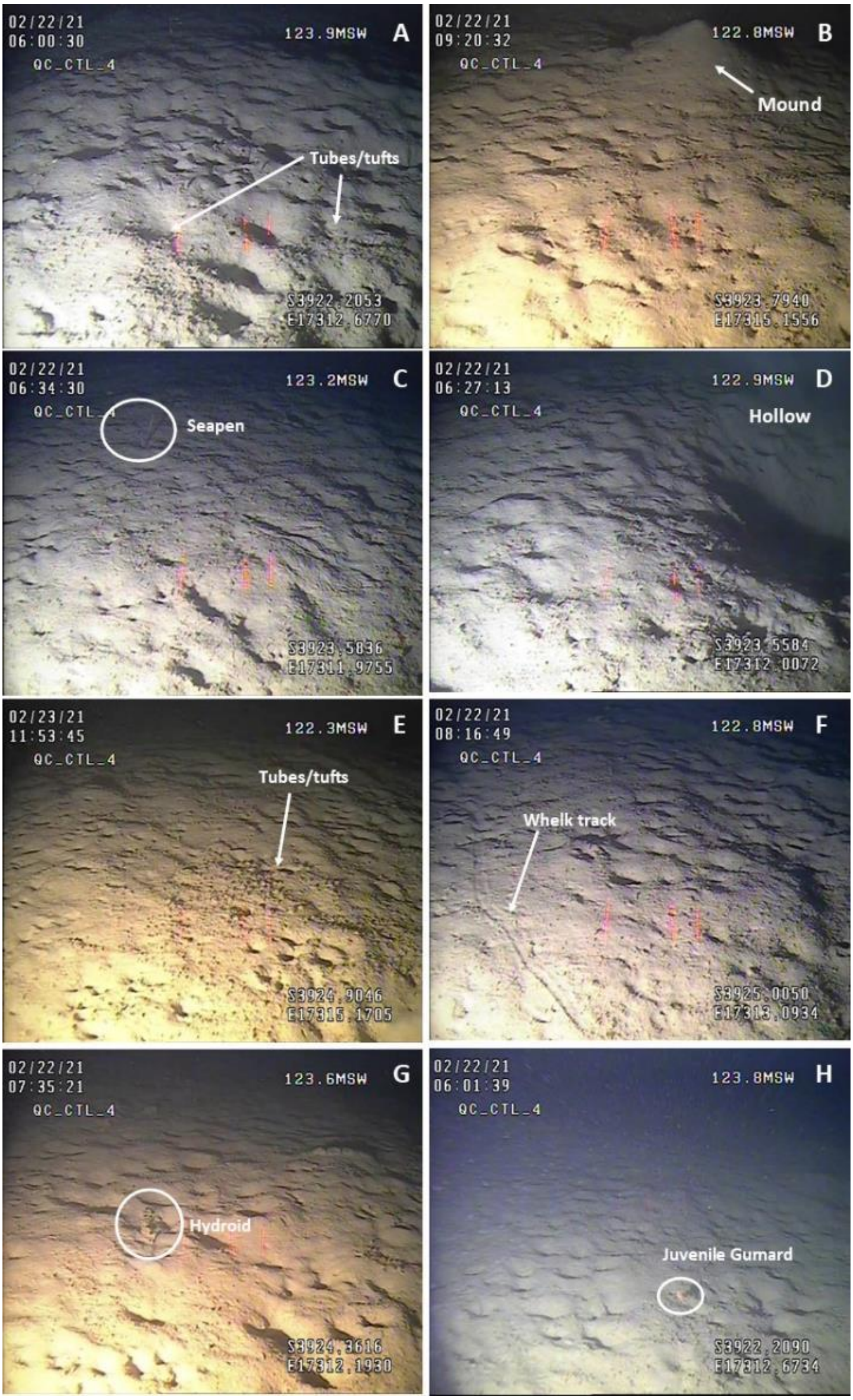
While definitive positive identification of infauna, epifauna and more mobile taxa is difficult from the video imagery alone, probable identifications have been made based on distinctive features, colours and shapes of organisms and in some cases the confirmed presence of similar looking individuals within the infauna samples. Epifauna taxa observed in 2021 included sea pens (likely *Virgularia* sp.) (**Figure 13C**), sponges, hydroids (**Figure 13G**), whelks (likely *Austrofusus sp.*) hydroids, and a worm tube. Epifauna tracks across the sediment surface (**Figure 13F**) were observed at all imagery transects indicating that mobile fauna such as whelks and hermit crabs move throughout these areas.

While sea pens are classified as sensitive environment taxa and were observed in all tows, their abundances were low and across the overall area covered by each transect would be well below the threshold required to determine any of the locations as sensitive environments as per the Exclusive Economic Zone and Continental Shelf (Permitted Activities) Regulations 2013.

Mobile fish species observed included bandfish (*Cepola haastii*), flatfish, juvenile red gurnard (*Chelidonichthys kumu*) (**Figure 13H**) as well as small fish which were only seen briefly as they darted away from the oncoming imaging platform and it was not possible to make definitively identify these individuals.

Small tufts were visible on the sediment surface at various times along each transect and in places were quite highly abundant (**Figure 13A** and **Figure 13E**). Given their prevalence and commonality across the area these tufts are likely to be the upper end of tubes formed by one of the common worm taxa found living within the sediment in the area, but definitive identification could not be made. Similar tufts have been recorded from benthic imagery collected from across the offshore Taranaki area (e.g. SLR, 2020b and c).

Figure 13 Representative Images of the Benthic Environments, Epifauna and Lebensspuren Observed During the 2021 AEEM.



4.3 Benthic Community Composition

4.3.1 Univariate Indices of Macrofauna Communities

The mean number of taxa found during the 2021 AEEM varied amongst sampling stations, although generally within range recorded in previous years (**Figure 14**). In 2021, the highest mean number of taxa were found to occur at the NE300 and NE500 sampling stations. No observable trend in number of taxa with distance from the FPSO *Umuroa* was detected. The number of taxa at the Tui Field sampling stations were comparable to the control sampling stations.

Mean total abundances of macrofauna in 2021 was either higher or comparable to that observed in previous years (**Figure 14**). Between 2018 and 2021, the total abundance of macrofauna has been quite variable at each sampling station and distance from the FPSO *Umuroa* as well at the two control sampling stations. This result indicates that there is a relatively high amount of natural variability in the abundance of macroinfauna within the study location.

Mean Pielou's evenness in 2021 was consistent amongst sampling stations and comparable to previous monitoring periods (**Figure 14**). High evenness values observed from 2019 to 2021 indicate that the Tui benthic macrofauna communities at all sampling stations were generally composed of a wide number of taxa, with no notable dominance by any single taxon.

Mean Shannon-Wiener diversity index in 2021 was consistent amongst sampling stations and comparable to previous monitoring periods (**Figure 14**). All sampling stations including control sampling stations were found to be similarly diverse between 2018 and 2021, with index values ranging between 3.2 and 3.4. This result is typical of moderate to highly diverse macrofauna community.

Figure 14 Mean Total Number of Taxa, Total Abundance, Pielous's Evenness and Shannon-Wiener Diversity Indices for Macrofauna samples Collected During Between 2018 and 2021.

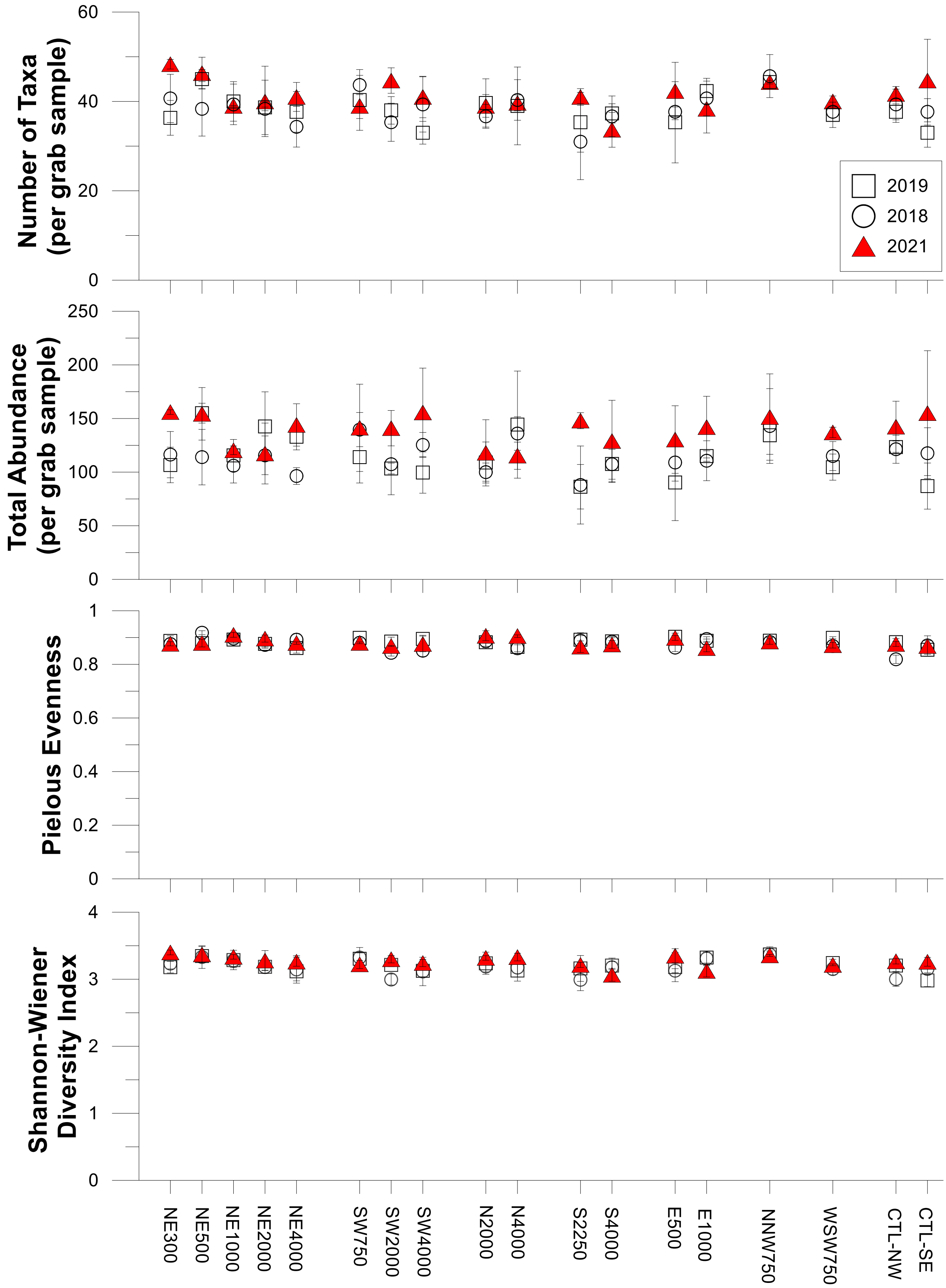


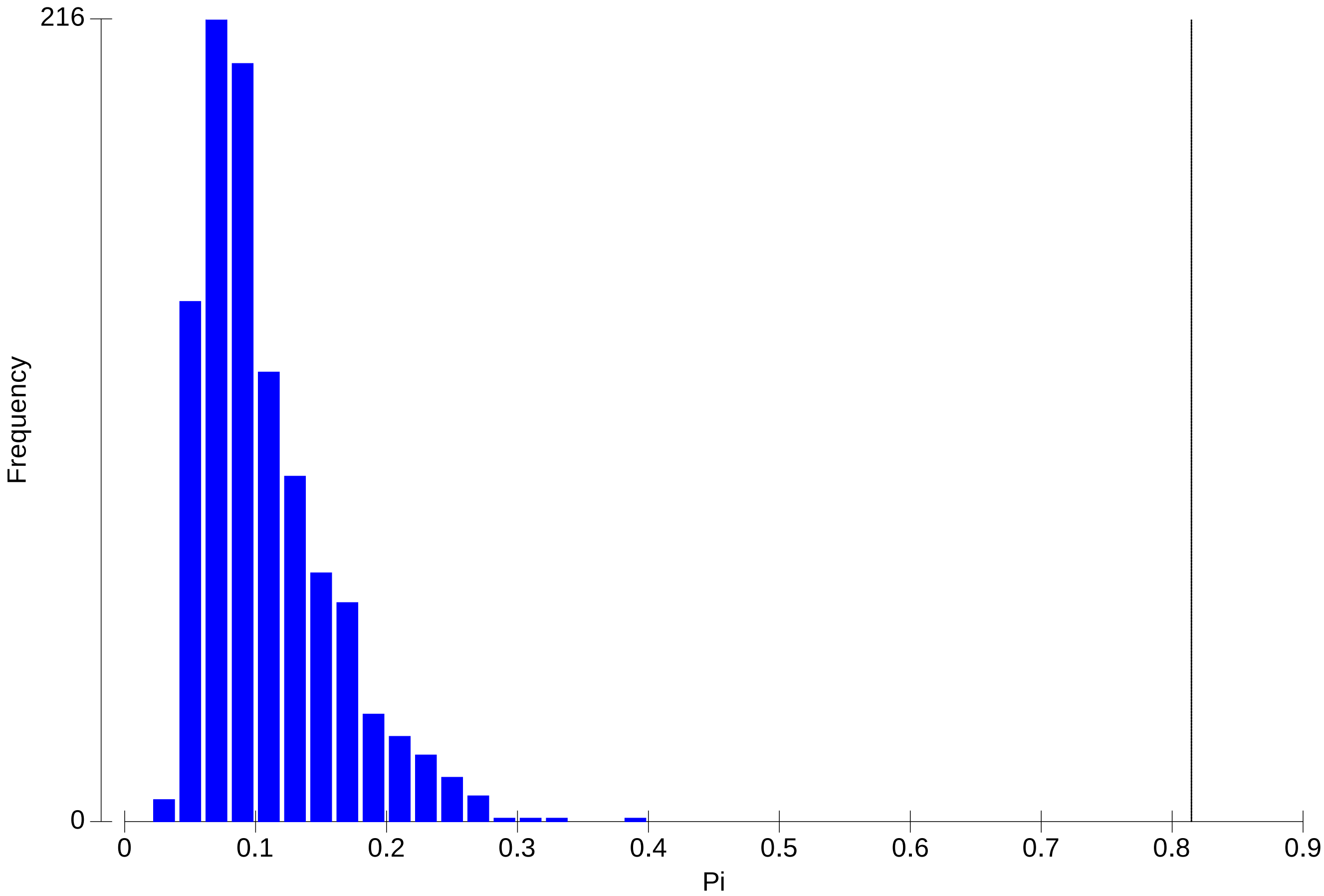
Figure indicates mean values ± the standard error of the mean.

4.3.2 Multivariate Community Structure

A total of 124[5] benthic macroinfauna taxa were identified during the 2021 AEEM. A full taxonomic list is provided in **Appendix J**.

The results of the SIMPROF test showed the observed pattern in macrofauna abundance (π = 0.815) falls outside the distribution of values generated and is therefore highly significant (p<0.001). These results indicate that differences exist in the macrofauna community composition beyond that expected from natural random variability (**Figure 15**).

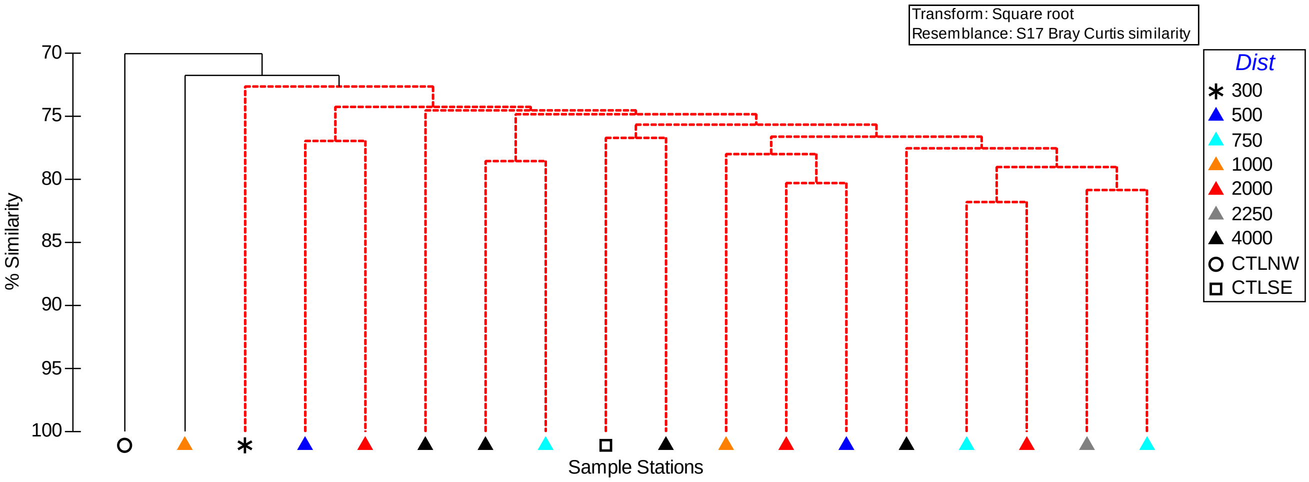
Figure 15 Histogram of the Observed Pattern in Macrofauna Abundance (black dotted line to the right) Relative to a Randomised Frequency Distribution (blue bars to the left).



2 This number excludes six pelagic taxa found in the samples: Chaetognatha (arrow worms), Euphausiacea (krill), *Cuvierina* sp. (pelagic amphipods; previously known as *Hyperia* sp. (unaccepted)), Stomatopoda larvae, Salpidae (planktonic tunicates), and Cnidaria (pelagic medusa stage). This number also excludes the following epifaunal taxa: Porifera and Bryozoa.

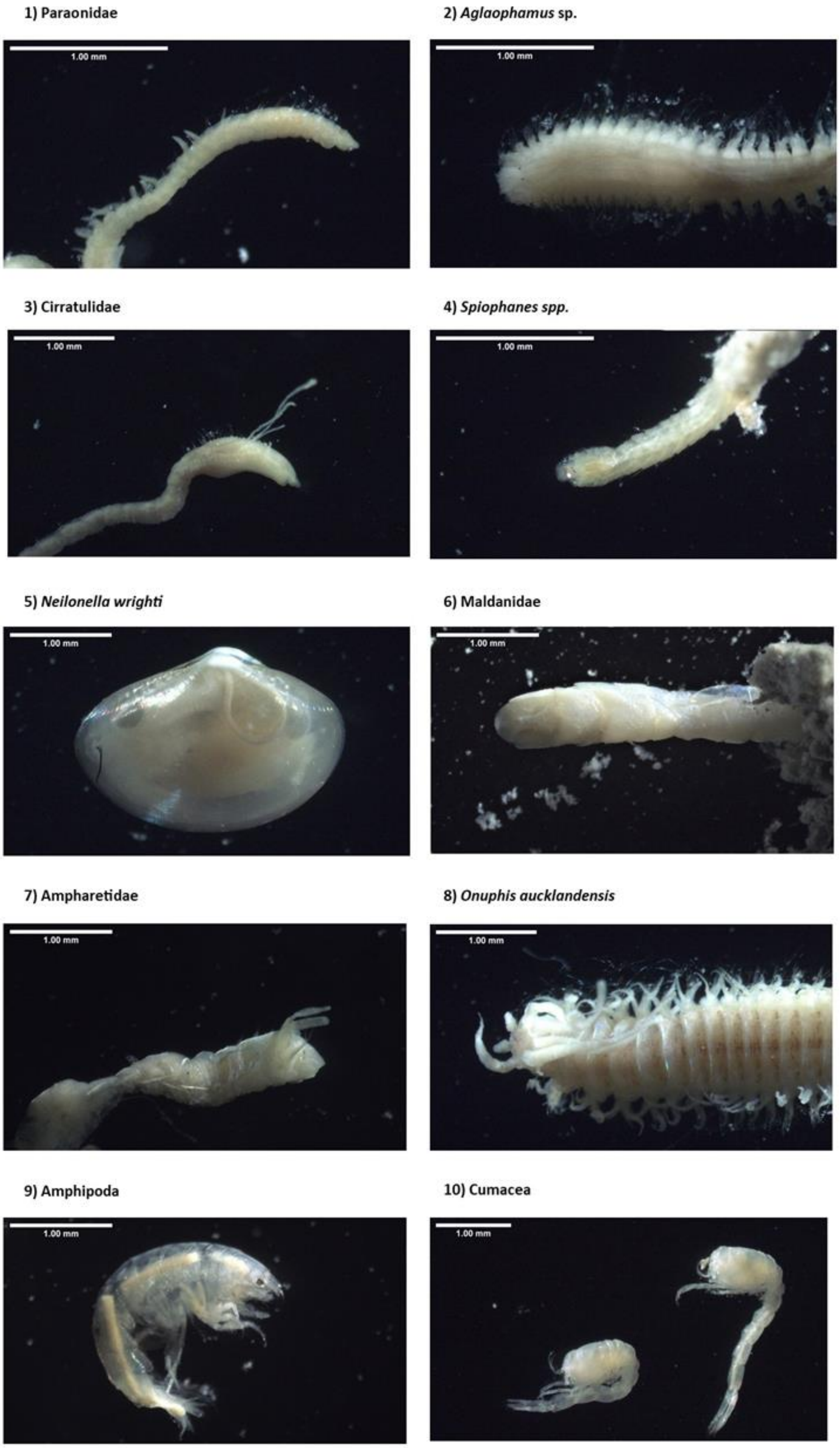
The macrofauna community composition was found to be at least 70% similar amongst all sampling stations (**Figure 16**). Despite this CLUSTER analysis detected some group structure in macrofauna communities across the survey area. The macrofauna community at the NW control sampling station was the most dissimilar to other sampling stations, followed by the E1000 sampling station, which separated at ~70% and ~72% similarity, respectively. These sampling stations were found to be significantly different from all others potentially due to frequency of what appear to be patchily distributed taxa including certain mollusc and sea pen species. SIMPER analysis of the 2021 macrofauna community found average within group similarity (Bray Curtis) to be 74.27%. Images of the most abundant taxa found during the 2021 AEEM are presented in **Figure 17**.

Figure 16 Dendrogram of Macrofaunal Group Structure Given Relative Similarity (Bray Curtis) Amongst Sample Stations During the 2021 Tui AEEM.



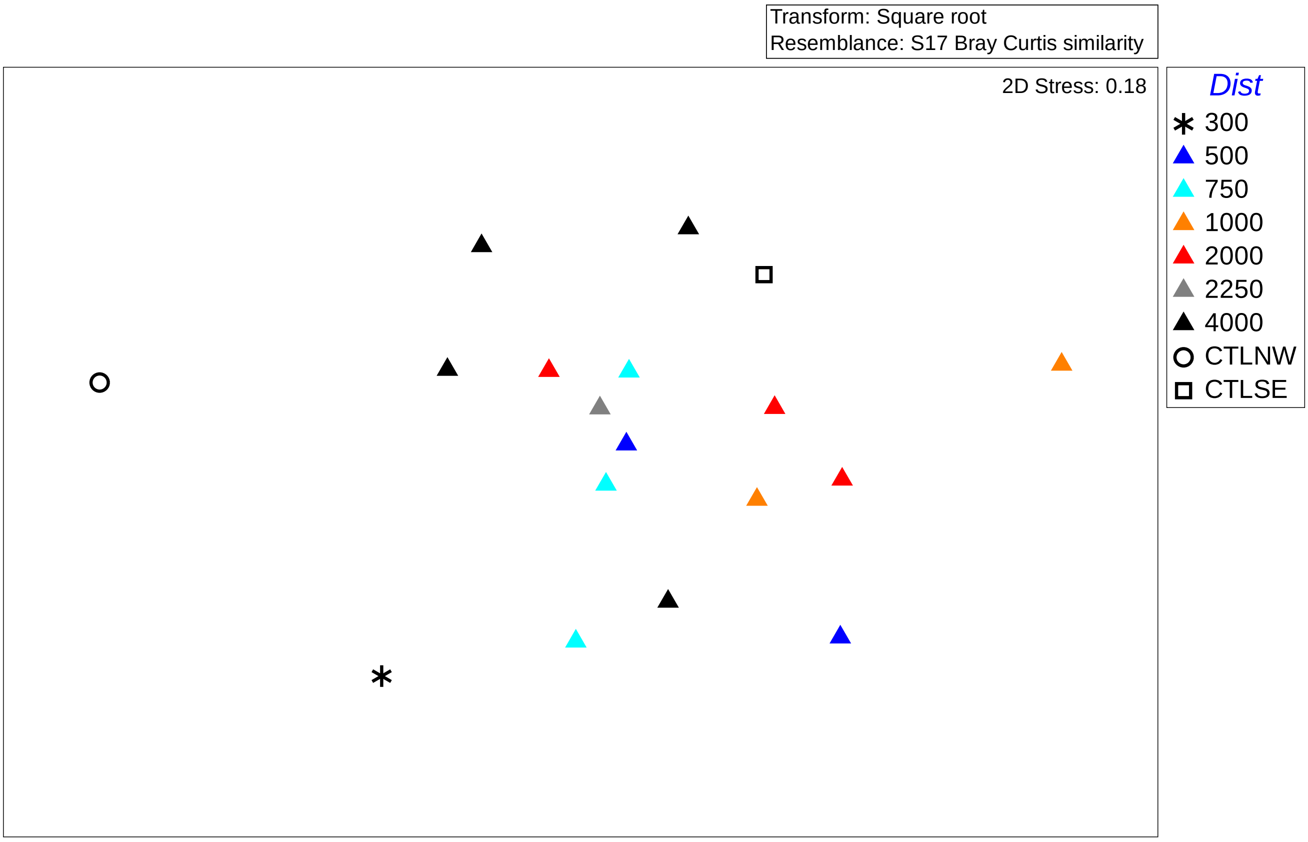
Note: Solid lines indicate significantly different community composition at the sample station (p<0.05), dashed red lines indicates no significant difference in the community composition amongst sampling stations (p>0.05).

Figure 17 Representative Images of the Most Abundant Macrofauna Taxa Observed During the 2021 AEEM.



The factor Distance significantly influenced the infauna community composition (P = 0.023) (**Appendix K – Table K4**). The two-dimensional ordination based on square root transformed average faunal abundances in 2021 at each sampling station is presented in **Figure 18**. Results of the pairwise comparisons revealed that the macroinfauna community composition at the 300 m and 500 m sampling stations were not significantly different to both control sampling stations. The infauna community composition at the north west control sampling station was significantly different to the 750 m, 1,000 m, 2,000 m and 4,000 m sampling stations (**Appendix K – Table K5**). There were significant differences in the infauna community composition amongst some sampling stations at various distances from the FPSO *Umuroa* (**Appendix K – Table K5**). These results indicate subtle differences in the infauna community composition amongst sampling stations which is probably related to natural variability rather than a gradient of change due to the FPSO *Umuroa*.

Figure 18 MDS of Macroinfauna Community Composition at Tui Field and Control Sampling Stations During the 2021 AEEM with Respect to the Factor Distance.



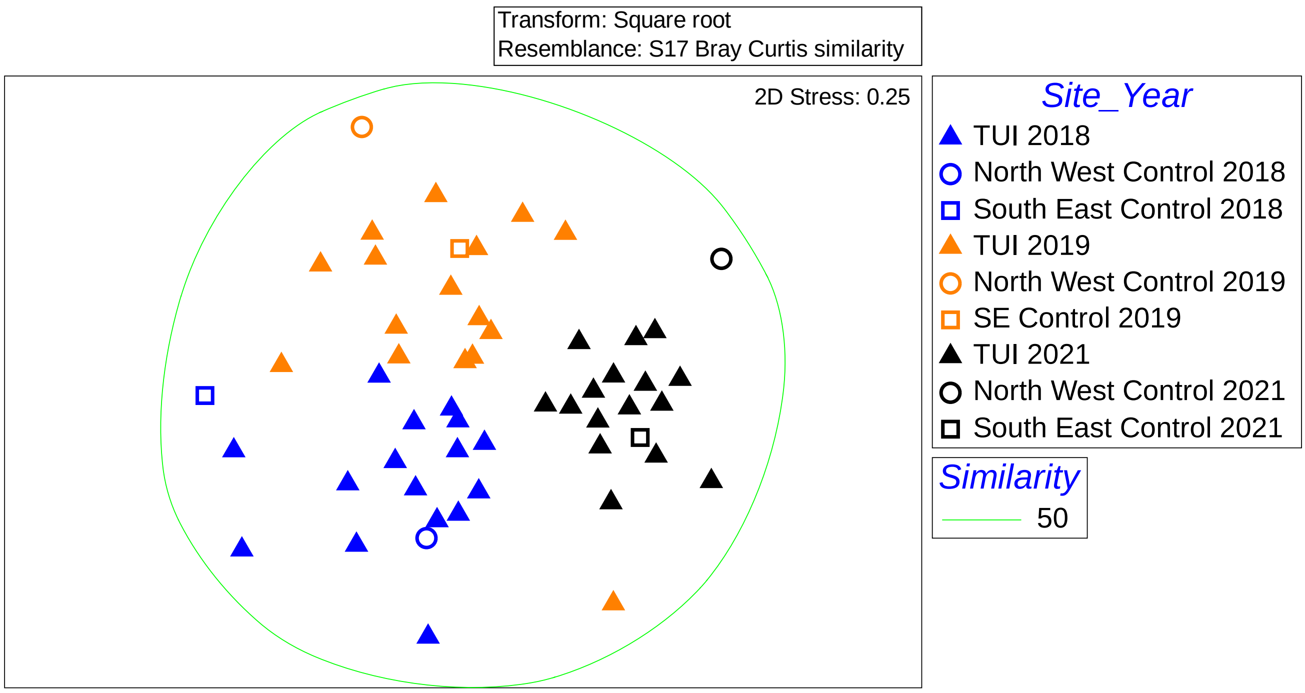
Note: The stress value (0.18) indicates this two-dimensional ordination adequately represents the multi-dimensional data.

4.3.2.1 Assessment of Long-Term Patterns of Community Structure

Results of the PERMANOVA Model 2 found the interaction between the Factors Distance and Year to have a significant effect on infauna community composition between 2018 and 2021 (P = 0.026) (**Appendix K – Table L6**). These results indicate that the effect of Distance on the infauna community composition is influenced by the Year and vice versa. Pairwise comparisons of the macrofauna community composition by Distance and Year, and the interaction of these Factors, did not find any significant effects, which is likely due to small sample sizes leading to a reduced statistical power.

The two-dimensional ordination based on square root transformed average macrofauna abundance data at each sampling station from 2018 to 2021 indicated that the community composition was more than 50 % similar regardless of the Distance or Year sampled **Figure 19**. Caution interpreting this plot should be used as the stress value is high (greater than 0.20) and the data may not be well represented by the MDS plot in two-dimensions. With this in mind, and in combination with other results, **Figure 19** shows distinctions between macroinfauna community composition based on the Factors Distance and Year, including the relevant control sampling stations. Generally, this pattern is likely a result of natural interannual (temporal) variability and not of associated disturbance due to the FSPO *Umuroa*.

Figure 19 MDS of Tui Field and Control Sampling Stations from 2018 to 2021. Ellipse Depicts 50 % Bray Curtis Similarity Contour.



4.3.3 Monitoring Hypothesis

In relation to the first monitoring hypothesis within the Tui Field EEMP, there is no evidence to suggest discharges from the FPSO *Umuroa* have resulted in any significant changes to the benthic ecology 500 m or more beyond the FPSO *Umuroa*. Results indicate that subtle differences exist in the macroinfauna community composition amongst sampling stations although these differences are unlikely to be associated with impact from discharge activities occurring since 2018 in the Tui Field.

4.4 Water Quality

4.4.1 Receiving Water Chemical Composition

Down-current water samples collected at two stations near to the FPSO *Umuroa* and at the two control stations during the 2021 AEEM revealed that most of the tested components had concentrations below the analytical detection limit of the test. Those results that were above the ADL were well below applicable ANZECC (2018) 95% LOP thresholds and showed no consistent spatial patterns that might indicate a source from the nearby FPSO *Umuroa*.

The lack of detectable levels of most contaminants in February 2021 is not unexpected given that at the time of sampling production activities in the Tui field, and onboard the FPSO *Umuroa* had ceased and had not occurred for some time. Visual assessment of the location where the produced water discharge from the FPSO *Umuroa* normally bubbles to the surface revealed no activity to be occurring on the day of sampling, in line with the cessation of production. A surface sheen/slick observed extending from the FPSO *Umuroa* at the time of sampling did not result in any elevated hydrocarbon concentrations in the near-surface samples.

No estimates of dilution were able to be made in 2021 as there was no production occurring onboard the FPSO Umuroa and therefore no discharges being diluted. Under a producing scenario the concentrations of chemicals within the down-current receiving water samples would be compared to concentrations of the same substances within the composite produced water samples in order to estimate the level of dilution which they had incurred.

Full results from the laboratory analysis of the RWCC samples can be found in **Appendix L**.

5 Key Findings and Recommendations

5.1 Sediment Characteristics

Sediments collected during the 2021 AEEM were observed to be light-brown coloured sandy muds showing a gradation to light-grey colouration with depth in the sediment profile. While sediments collected from sampling stations closest to the FPSO *Umuroa* were somewhat sandier in the upper layers there was no indication of any anoxic sediment or redox potential discontinuity layering, and no odours were detected. No obvious large project-related debris or evidence of discharges were encountered in the sediment samples during the initial sample collection and onboard processing.

Particle grainsize analysis revealed that sediments were dominated by the smallest particle size fraction (silt and clay), with a weak trend on some sampling axes of increasing silt and clay (and corresponding decreasing fine sands) with increasing distance from the FPSO *Umuroa*. A similar pattern was also observed in the TOC levels, which were higher at all stations in 2021 compared with 2019. The slight coarsening of sediments proximal to the FPSO *Umuroa* is likely the result of elevated near-field currents near the FPSO *Umuroa* and the associated subsea production and mooring infrastructure, which can result in the finest sediments being resuspended and removed.

The concentration of metal/metalloid, PAH, TPH and BTEX compounds were below applicable guideline thresholds at all sampling stations, with PAH, TPH and BTEX all below detection limits. Many of the tested metals/metalloids showed similar spatial patterns to those of the proportion of silt and clay in sediment samples, reflecting the comparatively greater surface area present in these smallest sediment particles for metals/metalloids to adhere to. The concentration of barium showed a distinct spatial gradient of decreasing concentrations with distance from the FPSO *Umuroa*, likely reflecting the use of barite on historical drilling activities as well as presence of barium in produced water discharges. This result is consistent with the results of the 2018 and 2019 EEMPs.

The results of the 2021 AEEM are considered consistent with the consent conditions that the concentration of analytes will not exceed current sediment ISQG-Low criteria of the ANZECC Guideline values (where a value exists) 500 m or more from the FPSO.

5.2 Benthic Communities

Video imagery collected during the 2021 EEMP revealed soft sediment seabed environments (muds) well colonised by infauna and relatively sparse epifauna, with occasional mobile fish taxa (including bandfish, flatfish and juvenile red gurnard) throughout the study location. Epifauna observed included sea pens, sponges, whelks (likely *Austrofusus* sp.), hydroids, and a worm tube. Small tufts visible on the sediment surface were highly abundant and are likely to be the upper end of tubes formed by a common worm taxa found living within the sediment (possibly O*nuphidae* sp.). No obvious anthropogenic physical disturbance of the seabed or debris were observed on the seabed.

A total of 124 different benthic macrofauna taxa were identified within the sediment samples collected during the 2021 AEEM. The benthic macrofauna taxa collected were typical of offshore benthic communities in the offshore Taranaki Bight region and similar to the communities identified during previous surveys (Johnston & Forrest, 2012; Johnston et al., 2013; Johnston et al., 2014a; Johnston & Elvines, 2015; SLR, 2016; SLR, 2017; SLR, 2018a; SLR, 2019). Crustacea belonging to the Order Cumacea were the most prevalent taxa followed by polychaetes belonging to the families Maldanidae and Cirratulidae. The high relative abundance of Cumacea at all sampling stations in 2021 is positive and indicates that the sediment conditions are such that they can support some sensitive taxa. The number of taxa did not vary distinctly among sampling stations with no observable trends with distance found and the total abundance of individuals was generally higher in 2021 compared to other sampling periods. Univariate evenness and diversity index values were largely uniform amongst sampling stations and were relatively typical for moderately diverse infauna communities. No sensitive environment as per the Exclusive Economic Zone and Continental Shelf (Permitted Activities) Regulations 2013 were detected.

No significant differences in the macroinfauna community composition between the southeast control sampling station and sampling stations at various distances from the FPSO *Umuroa* were detected. The infauna community composition at the northwest control sampling station was significantly different to the 750 m, 1,000 m, 2,000 m and 4,000 m sampling stations. Overall, sample stations, including controls, were found to be at least 70% similar based on relative abundance of macrofauna. These results indicate that there is some limited natural variability in the macroinfauna community composition amongst all sampling stations in 2021 and the differences detected are related to subtle rather than large changes in community composition. These results of the 2021 AEEM are generally consistent with the previous sampling periods and suggest that the discharges that have occurred from the FPSO *Umuroa* have not resulted in a significant influence on the macroinfauna community composition within the study location.

The results of the 2021 AEEM are considered consistent with the consent conditions that consented discharges will not result in any significant changes to the benthic ecology 500 m or more from the FPSO *Umuroa*.

5.3 Water Quality

The concentration of the extensive number of analytes tested for in water samples collected down current of the FPSO Umuroa during the 2021 RWCC survey were, when detected above ADL, well below applicable guideline thresholds. There was no evidence to suggest the concentration of these analytes were influenced by distance from the FPSO Umuroa. These results are consistent with the fact that at the time of sample collection Tui field operations had been in a non-producing status since November 2019.

5.4 Recommendations

Results of the 2021 AEEM have shown that previous production activities (and the associated discharges) at the FPSO *Umuroa* have not resulted in any significant detectable changes to the physicochemical and biological characteristics of the seabed environment. The results of the 2021 AEEM provide no evidence of any non-compliance with the conditions of the Marine Discharge Consent EEZ300006. Physical decommissioning activities are expected to commence at the Tui Field in 2022 and will have a monitoring programme associated with the decommissioning Marine Consent. It is recommended that future monitoring at the Tui Field is conducted under a field wide approach for the monitoring works associated with decommissioning activities and is focused on benthic monitoring rather than water quality.

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APPENDIX A
LOCATIONS AND OBSERVATIONS FROM SAMPLING DURING THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING

Grab Sampling Stations										
Station	Date	Time	Depth (m)	Grab 1		Grab 2		Grab 3		Notes
				Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	
E500	23/2/21	1043	118	39° 25.675'S	173° 14.540'E	39° 25.672'S	173° 14.563'E	39° 25.667'S	173° 14.559'E	0 - 3 cm dark brown Muddy Sand (dark sand grains), 3 - 5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Very clear layering. Moderately consolidated.
E1000	23/2/21	1107	118	039.25.671S	173.14.887E	039.25.669S	173.14.917E	039.25.669S	173.14.889E	0 - 3 cm dark brown Muddy Sand (dark sand grains) 3 - 5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Poorly consolidated. Small polychaetes and worm-tubes, Spiochaetopterus tubes? In Rep-C, wood debris in Rep-B
NE300	23/2/21	1018	119	039.25.557S	173.14.335E	039.25.540S	173.14.335E	039.25.561S	173.14.336E	0 - 3 cm dark brown Muddy Sand (dark sand grains) 3 - 5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Moderately consolidated. Shell material, polychaetes (incl. onuphidae), organic debris chunks in Rep-B, Mantis shrimp in A, Tusk shell in C.
NE500	23/2/21	0957	119	039.25.460S	173.14.458E	039.25.462S	173.14.442E	039.25.452S	173.14.444E	0 -5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Moderately consolidated. Shell material and small polychaetes, some worm-tubes
NE1000	23/2/21	0908	120	039.25.294S	173.14.701E	039.25.282S	173.14.705E	039.25.398S	173.14.690E	0 -5cm red brown sandy mud, 6 - bottom of core light grey sandy mud. Moderately to poorly consolidated. Small polychaetes, shell material, isopod in Rep-C.
NE2000	23/2/21	0838	120	039.24.909S	173.15.168E	039.24.910S	173.15.172E	039.24.903S	173.15.161E	0 -5cm red brown sandy mud, 6 - bottom of core light grey sandy mud. Poorly consolidated. Small polychaetes, worm-tubes, gastropod, hemichordate.
NE4000	23/2/21	0715	120	039.24.133S	173.16.150E	039.24.141S	173.16.139E	039.24.1224	173.16.152E	0 -5cm red brown sandy mud, 6 - bottom of core light grey sandy mud. Poorly consolidated. Small polychaetes and shell material.
NNW 750	23/2/21	1133	120	039.25.265S	173.14.071E	039.25.279S	173.14.082E	039.25.275S	173.14.060E	0 - 1 cm creamy light brown Sandy-mud layer (some dark sand grains), 1 -5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Soft/poorly consolidated. Gastropod shells, worm-tubes, small polychaetes (incl. onuphidae), tusk-shell
SW750	23/2/21	1349	119	039.25.963S	173.13.837E	039.25.941S	173.13.815E	039.25.957S	173.13.825E	0 - 1 cm creamy light brown Sandy-mud layer (some dark sand grains), 1 -5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Soft/poorly consolidated. Gastropod shells, worm-tubes, small polychaetes, shrimp

Grab Sampling Stations										
SW2000	23/2/21	1307	119	039.26.546S	173.13.374E	039.26.534S	173.13.367E	039.26.536S	173.13.359E	0 - 1 cm creamy light brown Sandy-mud layer (some dark sand grains), 1 -5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Soft/poorly consolidated. Shell material, worm-tubes, small polychaete (incl. onuphidae).
SW4000	23/2/21	1444	120	039.27.195S	173.12.222E	039.27.183S	173.12.229E	039.27.190S	173.12.232E	0 - 1 cm creamy light-brown Sandy-mud layer (dark sand grains), 1 -5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Poorly consolidated/soft. Worm tubes, small polychaetes (incl. Philine sp.), shrimp, Rep-B contained wood debris.
WSW750	23/2/21	1252	120	039.25.702S	173.13.679E	039.25.707S	173.13.681E	039.25.715S	173.13.672E	0 - 1 cm creamy light brown Sandy Mud layer (dark sand grains) 1 -5cm red brown sandy mud, 6 cm - bottom of core light grey sandy mud. Poorly consolidated. Worm tubes, small polychaetes (incl. onuphids), shell materials
N2000	23/2/21	0816	120	039.24.591S	173.14.183E	039.24.576S	173.14.201E	039.24.583S	173.14.206E	0 -5cm red brown sandy mud, 6 - bottom of core light grey sandy mud. Poorly consolidated. Small polychaetes, shell material, Rep-A contained mantis shrimp.
N4000	23/2/21	0751	120	039.23.511S	173.14.192E	039.23.499S	173.14.195E	039.23.495S	173.14.183E	0 -5cm red brown sandy mud, 6 - bottom of core light grey sandy mud. Poorly consolidated. Shell material and small polychaetes
S2250	23/2/21	1447	119	039.26.887S	173.14.204E	039.26.880S	173.14.203E	039.26.891S	173.14.197E	0 - 1 cm creamy light brown Sandy Mud (dark sand grains), 1 -5cm red brown sandy mud, 6 cm to bottom of core light grey sandy mud. Poorly consolidated. Small polychaetes and worm tubes, small material, shrimp, old calcareous tube in Rep-A (possibly fouling organism).
S4000	23/2/21	1509	118	039.27.826S	173.14.193E	039.27.835S	173.14.194E	039.27.840S	173.14.199E	0 - 1 cm creamy light brown Sandy Mud layer (dark sand grains), 1 -5cm red brown sandy mud, 6 cm - bottom of core light grey sandy mud. Moderately consolidated. Shell material, polychaetes (incl. maldanidae), tusk shell
Control NW	22/2/21	0759	119	039° 21.778'S	173° 09.105'E	039° 21.764'S	173° 09.115'E	039° 21.766' S	173° 09.107' E	Grey-brown Sandy Mud 0 -5cm, 6 - bottom of core light grey sandy mud. Small polychaetes, shell material, gastropods, shrimps, worm-tubes, wood debris in Rep-B.
Control SE	22/2/21	0927	119	039.27.963S	173.17.159E	039.27.969S	173.17.158E	039.27.942S	173.17.155E	Grey-brown, poorly consolidated Sandy Mud 0 -5cm, 6 - bottom of core light grey sandy mud. Polychaetes and worm-tubes, shrimps.

Water Sampling Locations							
Station	Date	Depth	Latitude	Longitude			
500m	22/02/2021	1m and 10m	39° 25’ 27.89” S	173° 14’ 00.58” E			
1000m	22/02/2021	1m and 10m	39° 25’ 13.78” S	173° 13’ 51.14” E			
Control NW	22/02/2021	1m and 10m	39° 21.754’ S	173° 09.106’ E			
Control SE	22/02/2021	1m and 10m	39° 27.941’ S 1	73° 17.161’ E			

APPENDIX B
WATER SAMPLING DATA SHEETS FROM 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING

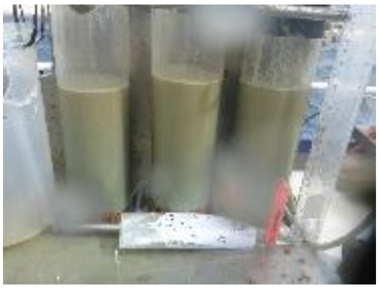
Water Sample Collection Data Sheet: RWCC	
Sampling Area	Tui Field – FPSO *Umuroa*
Date	22 February 2021
Time	0700
Weather conditions	Scattered low cloud with occasional fine periods and light winds
Sea conditions	Calm
Wind direction and speed	ENE ~6-8 knots.
Estimated current speed and direction	NW (~305°) at ~0.4 knots. As measured from survey vessel drift direction and speed.
Position of FPSO or other discharge point relative to sampling location	FPSO *Umuroa* pointing SSE. Produced water discharge location is on the is port-side, amidships
Samples collected	Surface 500m, 1000m, CTL-NW, CTL-SE Surface 500m, 1000m, CTL-NW, CTL-SE
General comments	FPSO *Umuroa* currently not producing from the wells attached to the FPSO. However upon arrival at the vessel this morning there was a very obvious surface sheen/slick extending from around the vessel towards the NW. Given this obvious sign of surface water drift direction as well as the survey vessels drift direction the downcurrent sampling points at 500 and 1000 m were positioned along this surface sheen line to the NW. Time of sampling (DST): 500 m - Surface 0700. 39° 25' 27.89" S, 173° 14' 00.58" E 500 m - Subsurface 0708 1000 m - Surface 0710. 39° 25' 13.78" S, 173° 13' 51.14" E 1000 m - Subsurface 0712 Control NW - Surface 0743. 39° 21.754' S 173° 09.106' E Control NW - Subsurface 0747 Control SE - Surface 0918. 39° 27.941' S 173° 17.161' E Control SE - Subsurface 0921 No DCC or DTA sampling being undertaken in Q1-2021 so samples were not collected for this. RWCC samples passed up to FPSO *Umuroa* at completion of sampling for transport back to shore on tomorrow mornings helicopter.

APPENDIX C
SEDIMENT CORE PROFILE IMAGES FROM ALL REPLICATE SAMPLES COLLECTED DURING THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING


Tui E1000 A.JPG

Tui E1000 B.JPG

Tui E1000 C.JPG

Tui E500 A.JPG

Tui E500 B.JPG

Tui E500 C.JPG

Tui N2000 A.JPG

Tui N2000 B.JPG

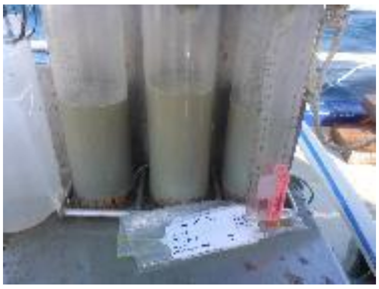
Tui N2000 C.JPG

Tui N4000 A.JPG

Tui N4000 B.JPG

Tui N4000 C.JPG

Tui NE1000 A.JPG

Tui NE1000 B.JPG

Tui NE1000 C.JPG


Tui NE2000 A.JPG


Tui NE2000 B.JPG


Tui NE2000 C.JPG


Tui NE300 A.JPG


Tui NE300 B.JPG


Tui NE300 C.JPG


Tui NE4000 A.JPG


Tui NE4000 B.JPG


Tui NE4000 C.JPG


Tui NE500 A.JPG


Tui NE500 B.JPG


Tui NE500 C.JPG


Tui NNW750 A.JPG


Tui NNW750 B.JPG


Tui NNW750 C.JPG

Tui S2250 A.JPG

Tui S2250 B.JPG

Tui S2250 C.JPG

Tui S4000 A.JPG

Tui S4000 B.JPG

Tui S4000 C.JPG

Tui SW2000 A.JPG

Tui SW2000 B.JPG

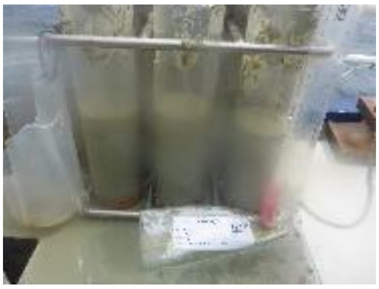
Tui SW2000 C.JPG

Tui SW4000 A.JPG

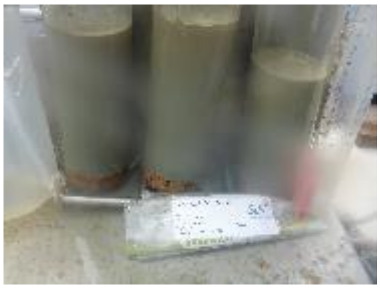
Tui SW4000 B.JPG

Tui SW4000 C.JPG

Tui SW750 A.JPG



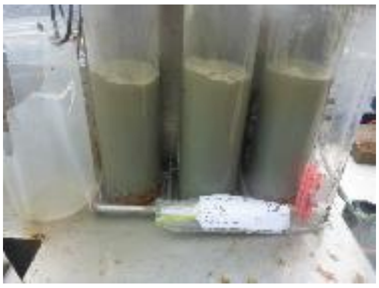
Tui SW750 B.JPG



Tui SW750 C.JPG


Tui WSW750 A.JPG


Tui WSW750 B.JPG


Tui WSW750 C.JPG


TUI_CTLNW_A.JPG


TUI_CTLNW_B.JPG


TUI_CTLNW_C.JPG


TUI_CTLSE_A.JPG


TUI_CTLSE_B.JPG


TUI_CTLSE_C.JPG

APPENDIX D
INCIDENTAL OBSERVATIONS OF PROJECT RELATED DEBRIS COLLECTED WITHIN MACROFAUNA SAMPLES COLLECTED AS PART OF THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING

Incidentals	2021_CTLNW_A	2021_CTLNW_B	2021_CTLNW_C	2021_CTLSE_A	2021_CTLSE_B	2021_CTLSE_C	2021_E1000_A	2021_E1000_B	2021_E1000_C	2021_E500_A	2021_E500_B	2021_E500_C	2021_N2000_A	2021_N2000_B	2021_N2000_C	2021_N4000_A	2021_N4000_B	2021_N4000_C	2021_NE1000_A	2021_NE1000_B	2021_NE1000_C	2021_NE2000_A	2021_NE2000_B	2021_NE2000_C	2021_NE300_A	2021_NE300_B	2021_NE300_C	2021_NE4000_A	2021_NE4000_B	2021_NE4000_C	2021_NE500_A	2021_NE500_B	2021_NE500_C	2021_NNW750_A	2021_NNW750_B	2021_NNW750_C	2021_S2250_A	2021_S2250_B	2021_S2250_C	2021_S4000_A	2021_S4000_B	2021_S4000_C	2021_SW2000_A	2021_SW2000_B	2021_SW2000_C	2021_SW750_A	2021_SW750_B	2021_SW750_C	2021_SW4000_A	2021_SW4000_B	2021_SW4000_C	2021_WSW750_A	2021_WSW750_B	2021_WSW750_C
Blue Paint																								L	L	L	L		L				O			L										L	L							
Green Paint										L	L	L													O	O	L	A				L	L		L	L																	L	L
Purple Paint																																			L							L			L									
Red Paint																									L	L	C				L	L	L		L				L							L	L	L				L	L	
White Paint																																	L		L			L		O			L			L								
Yellow Paint																									L	L	O				L		L		L											L							L	
Grey Paint																																															L							
Orange Paint										L																L						L		O			L																	
Black Paint																															L																							
Silver Paint																									;	L																												
Gold Paint																										L																												
Blue Nylon						L			L		L							L											L							L				L									L			L		
Green Nylon																L																																						
Black Nylon								L	L		L	L																											L															
Yellow Nylon								L																																														
Pink Nylon								L			L																																											
Red Nylon																								L																												L		
Coal-Like Rock	L	O		C	O	A				L	L	L													C	C	L				L			L											L									
Drilling Muds																					O																																	
Drilling Gels																									C	L									L																			
Drill Cuttings																									A																													
Garnet		L				C		L		L	L														A	A	A									L	L	L	L	L							L		L	O		L		
Graphite	L	A		L	C		L													L											L																							
Mica	L		L				A	L	C	C	A	O			L		L	O	L	A	C	C	O	O	A	C	A			O	A	A		O	C	O	A		L				A	O	C	O	C		L			A	O	C
Rust	L			A		C	L	L		L	L	L	L				L		L	L				L	A	A					L				O	C	L			L						L	L					L		
Sand-Like (Orange)			A				A	A	O	A	A	A				A	A	A		A					A	A						A					O	O		A			A	A		A	A	A						
Welding Material		O	L	A	A	A																		L			L																											
Wellding Ball	L		L	A		A											L							L			L																			L	L							
Orange Plastic												L																																										
Organic/Wood								A																																L														
Black Plastic																																								L														
Blue Plastic																																								L														

APPENDIX E
RAW RESULTS FOR PARTICLE GRAINSIZE DISTRIBUTION AND TOTAL ORGANIC CARBON LEVELS IN SEDIMENT SAMPLES COLLECTED DURING THE 2021TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING

Replicate Sample	TOC (%)	Gravel (%)	Very Coarse Sand (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Very Fine Sand (%)	Silt & Clay (Mud) (%)
NE300_A	0.77	< 0.1	< 0.1	< 0.1	6.7	8.8	5.3	79
NE300_B	0.74	< 0.1	< 0.1	0.2	8.8	10.3	6.2	74.5
NE300_C	0.7	< 0.1	< 0.1	0.1	6.2	10.3	6	77.4
NE500_A	0.75	< 0.1	< 0.1	< 0.1	2.7	5.3	5	86.8
NE500_B	0.74	< 0.1	< 0.1	< 0.1	4.5	8	4.1	83.3
NE500_C	0.71	< 0.1	< 0.1	< 0.1	3.7	8.2	4.1	84
NE1000_A	0.69	< 0.1	< 0.1	< 0.1	2.6	7.8	4.3	85.2
NE1000_B	0.77	< 0.1	< 0.1	< 0.1	2.5	6.8	3.5	87.2
NE1000_C	0.74	< 0.1	< 0.1	< 0.1	2.8	7.1	3.7	86.4
NE2000_A	0.84	< 0.1	< 0.1	< 0.1	1.1	5.5	3.7	89.6
NE2000_B	0.81	< 0.1	< 0.1	< 0.1	1.3	5.7	3.8	89.1
NE2000_C	0.84	< 0.1	< 0.1	< 0.1	1.2	5.4	3.7	89.6
NE4000_A	0.86	< 0.1	< 0.1	< 0.1	1.1	3.4	3.7	91.8
NE4000_B	0.9	< 0.1	< 0.1	< 0.1	1.1	3.7	3.5	91.6
NE4000_C	0.87	< 0.1	< 0.1	< 0.1	0.6	4.2	3.7	91.3
NNW750_A	0.95	< 0.1	< 0.1	< 0.1	0.9	4.5	4.6	90.2
NNW750_B	0.79	< 0.1	< 0.1	< 0.1	6.6	5.5	3.9	84.1
NNW750_C	0.84	< 0.1	< 0.1	< 0.1	1.8	5.3	4.1	88.9
SW750_A	0.77	< 0.1	< 0.1	< 0.1	4.8	10.9	4.4	80
SW750_B	0.74	< 0.1	< 0.1	< 0.1	1.8	11.5	4.2	82.6
SW750_C	0.81	< 0.1	< 0.1	< 0.1	2.1	10.6	3.8	83.5
SW2000_A	0.75	< 0.1	< 0.1	< 0.1	2.3	12.4	4.2	81.1
SW2000_B	0.68	< 0.1	< 0.1	< 0.1	3.8	12.7	3.8	79.7
SW2000_C	0.76	< 0.1	< 0.1	< 0.1	3.7	13.2	4.5	78.6
SW4000_A	0.76	< 0.1	< 0.1	< 0.1	2.6	4.5	4.1	88.8
SW4000_B	0.84	< 0.1	< 0.1	< 0.1	5.4	4.2	2.9	87.5
SW4000_C	0.85	< 0.1	< 0.1	< 0.1	1.1	2.6	3.1	93.2
N2000_A	0.8	< 0.1	< 0.1	< 0.1	0.4	3	4.2	92.4
N2000_B	0.82	< 0.1	< 0.1	< 0.1	0.2	2.4	3.4	93.9
N2000_C	0.87	< 0.1	< 0.1	< 0.1	0.4	3.5	3.4	92.7
N4000_A	0.74	< 0.1	< 0.1	< 0.1	4.1	9.3	4.2	82.2
N4000_B	0.73	< 0.1	< 0.1	< 0.1	4.2	8.1	4	83.6
N4000_C	0.8	< 0.1	< 0.1	< 0.1	3.5	7.8	4	84.6
E500_A	0.7	< 0.1	< 0.1	< 0.1	3.9	7.9	4.2	84

Replicate Sample	TOC (%)	Gravel (%)	Very Coarse Sand (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Very Fine Sand (%)	Silt & Clay (Mud) (%)
E500_B	0.75	< 0.1	< 0.1	0.1	3.4	7	3.8	85.7
E500_C	0.75	< 0.1	< 0.1	0.1	3.2	5.9	3.7	87
E1000_A	0.71	< 0.1	< 0.1	< 0.1	0.7	3.4	3.6	92.4
E1000_B	0.84	< 0.1	< 0.1	< 0.1	1.4	6.4	4	88.2
E1000_C	0.79	< 0.1	< 0.1	< 0.1	1	4.1	3.4	91.5
S2250_A	0.86	< 0.1	< 0.1	< 0.1	0.4	1.8	9.9	87.9
S2250_B	0.85	< 0.1	< 0.1	< 0.1	0.3	5.5	7.8	86.5
S2250_C	0.82	< 0.1	< 0.1	< 0.1	0.4	5.2	9.8	84.7
S4000_A	0.83	< 0.1	< 0.1	< 0.1	0.3	5.1	9.2	85.4
S4000_B	0.87	< 0.1	< 0.1	< 0.1	0.5	3.6	9.7	86.3
S4000_C	0.78	< 0.1	< 0.1	< 0.1	0.4	7.3	8.7	83.6
WSW750_A	0.82	< 0.1	< 0.1	< 0.1	0.4	8	11.9	79.8
WSW750_B	0.87	< 0.1	< 0.1	< 0.1	0.6	8.9	9.6	80.9
WSW750_C	0.77	< 0.1	< 0.1	< 0.1	0.6	10	8.7	80.7
CTLSE_A	0.86	< 0.1	< 0.1	< 0.1	< 0.1	4	9.7	86.3
CTLSE_B	0.93	< 0.1	< 0.1	< 0.1	0.1	7.1	10.4	82.4
CTLSE_C	0.89	0.7	< 0.1	< 0.1	0.1	5.5	9.2	84.5
CTLNW_A	0.78	< 0.1	< 0.1	< 0.1	0.5	2.7	3.9	92.8
CTLNW_B	0.74	< 0.1	< 0.1	< 0.1	0.6	3.2	3.9	92.3
CTLNW_C	0.75	< 0.1	< 0.1	< 0.1	0.3	2	4	93.7

APPENDIX F
RAW RESULTS FOR METAL/METALLOID CONCENTRATIONS WITHIN COMPOSITE SEDIMENT SAMPLES COLLECTED DURING THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING SURVEY AND GRAPHICAL REPRESENTATION OF METAL/METALLOID CONCENTRATIONS OVER TIME

Station	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Copper (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Magnesium (mg/kg)	Manganese (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)
NE300	4.6	37	0.051	21	7.1	25000	10.4	8100	270	< 0.02	15.5	50
NE500	3.4	41	0.042	22	7.2	25000	11.1	8400	270	< 0.02	16.1	51
NE1000	3.7	37	0.043	22	7.1	25000	10.9	8300	280	< 0.02	16.1	51
NE2000	3.4	35	0.045	22	7.4	27000	11.9	9100	310	< 0.02	16.4	53
NE4000	3.4	29	0.047	24	8.1	29000	12.9	9400	320	< 0.02	17.7	57
NNW750	3.4	43	0.047	23	7.8	28000	11.9	9400	300	< 0.02	17.1	55
SW750	3.5	48	0.042	22	7.1	24000	10.9	8600	280	< 0.02	16.2	51
SW2000	4	47	0.041	21	6.7	24000	10.8	8300	300	< 0.02	15.4	50
SW4000	2.7	36	0.041	22	7.5	25000	11.4	8600	290	< 0.02	17	53
N2000	3.2	37	0.041	22	7.6	26000	11.9	8800	300	< 0.02	16.8	54
N4000	3.2	31	0.041	22	7	25000	11	8200	280	< 0.02	16	50
E500	3.5	51	0.043	21	7	25000	11	8300	270	< 0.02	15.9	51
E1000	3.2	44	0.045	23	7.8	26000	12	9200	300	< 0.02	17.5	55
S2250	3.2	60	0.054	24	8	27000	12.2	9200	310	< 0.02	17.9	57
S4000	2.9	48	0.052	23	7.6	25000	11.4	8900	280	< 0.02	17.1	54
WSW750	3.3	41	0.049	23	7.6	26000	11.8	8800	290	< 0.02	17.2	55
CTLSE	3.2	28	0.046	22	7.9	26000	11.8	9300	290	< 0.02	17.3	55
CTLNW	3	28	0.041	21	7	25000	11	9200	280	< 0.02	16.2	52
DGV	**20**		**1.5**	**80**	**65**		**50**			**0.15**	**21**	**200**
GV-High	**70**		**10**	**370**	**270**		**220**			**1**	**52**	**410**

Figure F1 Concentrations of Arsenic, Cadmium, Chromium and Copper in Composite Sediment Samples Collected within the Tui Field between 2018 and 2021.

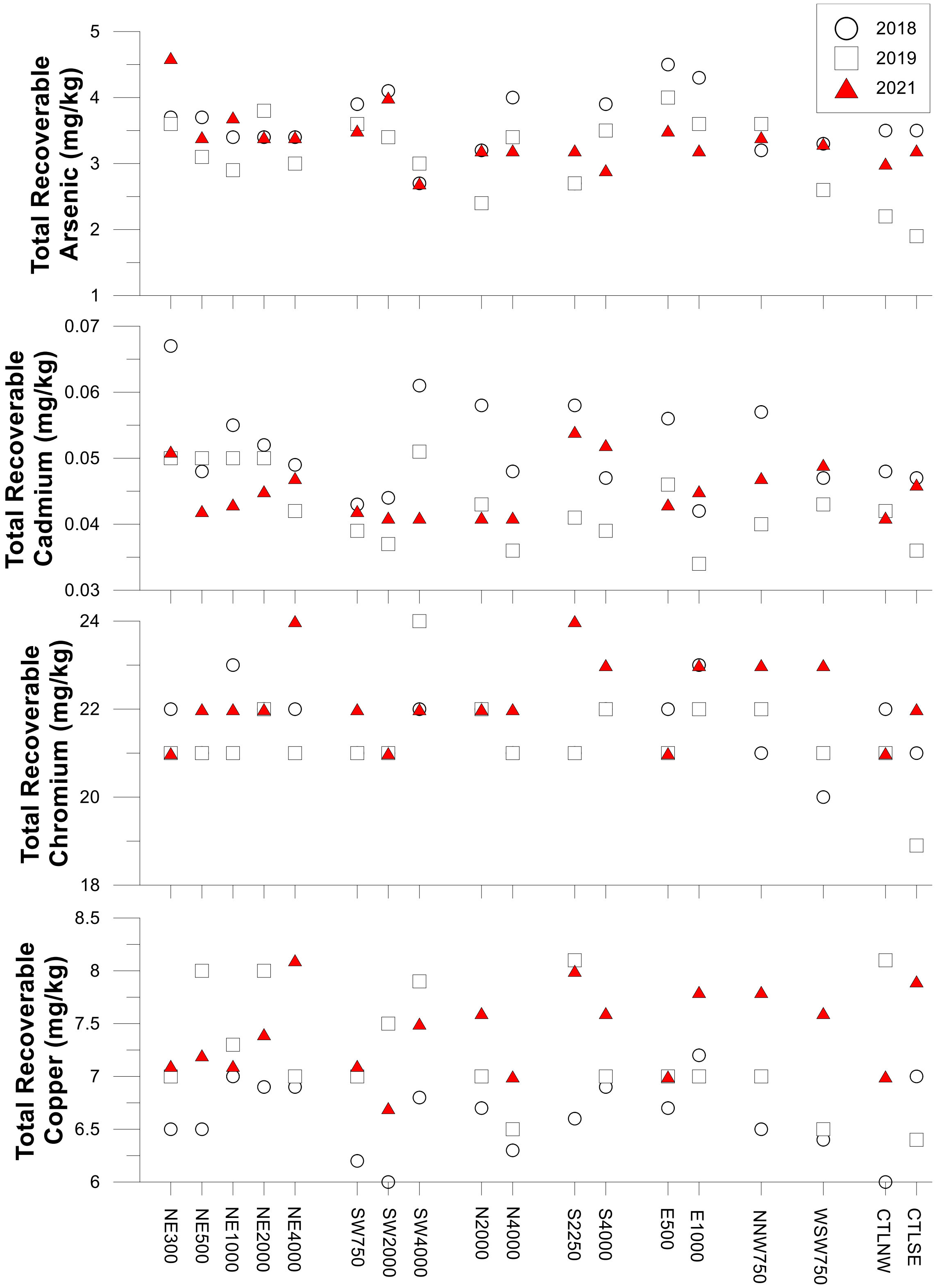
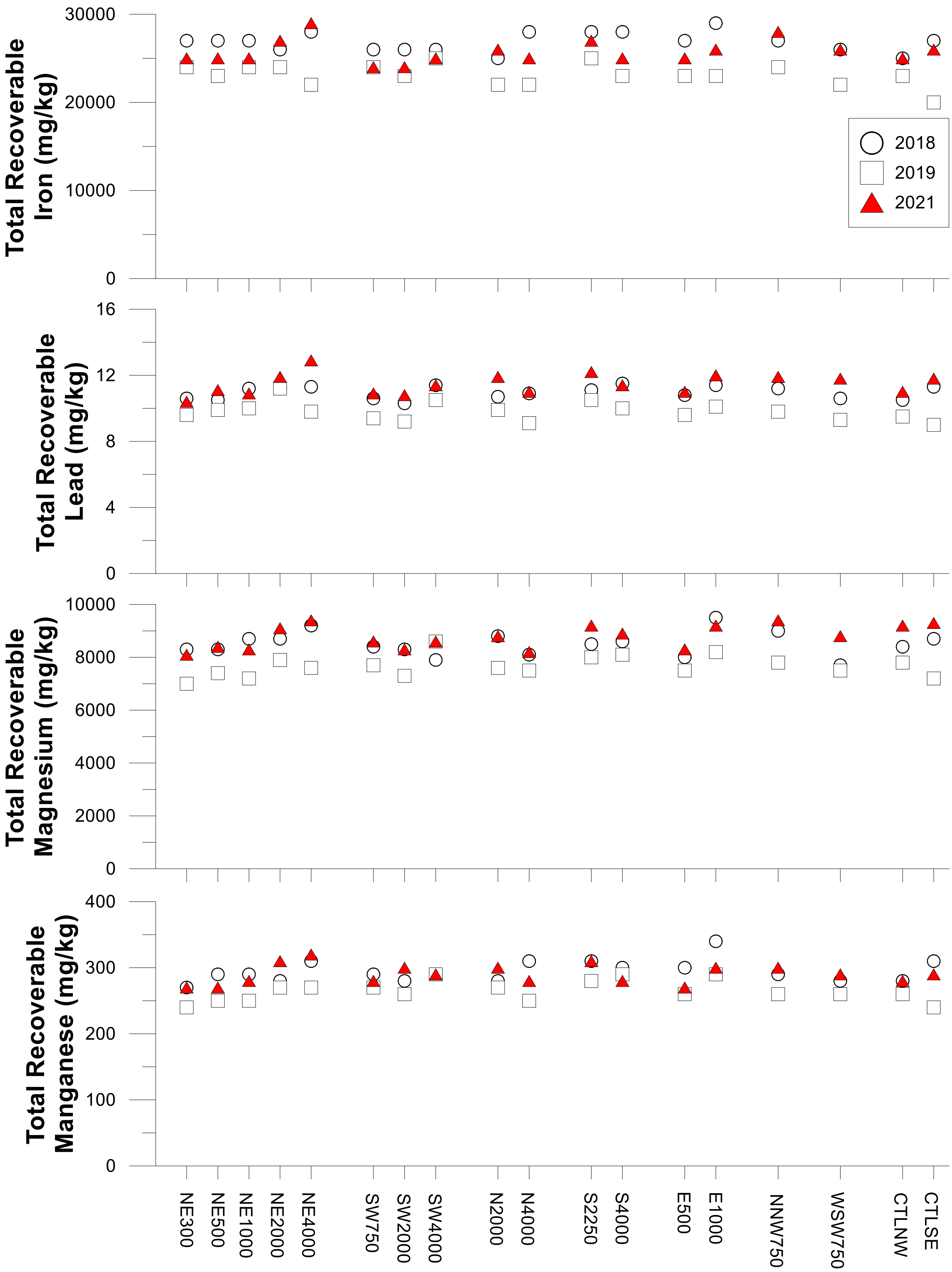
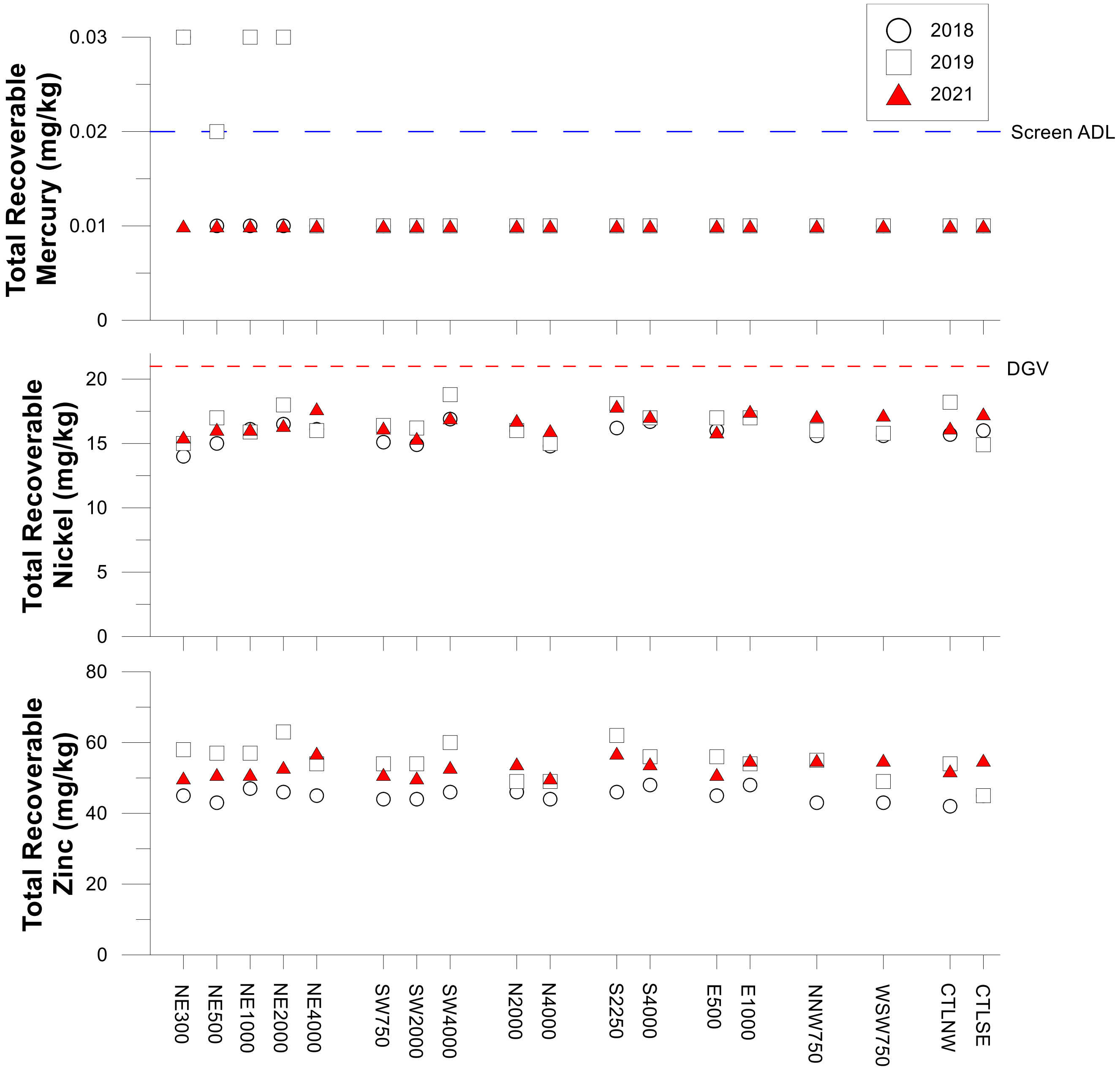


Figure F2 Concentrations of Iron, Lead, Magnesium and Manganese in Composite Sediment Samples Collected within the Tui Field between 2018 and 2021.



SLR

Figure F3 Concentrations of Mercury, Nickel and Zinc in Composite Sediment Samples Collected within the Tui Field between 2018 and 2021.



APPENDIX G
CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS IN SEDIMENT SAMPLES COLLECTED DURING THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING

Station	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	1-Methylnaphthalene	2-Methylnaphthalene	**Sum of Low Molecular Weight PAHs**	Fluoranthene	Pyrene	Benzo[a]anthracene
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
NE300	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
NE500	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
NE1000	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
NE2000	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
NE4000	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
NNW750	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
SW750	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
SW2000	< 0.014	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
SW4000	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
N2000	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
N4000	< 0.014	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
E500	< 0.014	< 0.003	< 0.003	< 0.003	< 0.004	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
E1000	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
S2250	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
S4000	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
WSW750	< 0.016	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.0000	< 0.004	< 0.004	< 0.004
CTLSE	< 0.015	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.0000	< 0.003	< 0.003	< 0.003
CTLNW	< 0.016	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.0000	< 0.004	< 0.004	< 0.004
ISQG-Low [1,2]	0.16	0.044	0.016	0.019	0.24	0.085			**0.5520**	0.6	0.665	0.261
ISQG-High [1,2]	2.1	0.64	0.5	0.54	1.5	1.1			**3.1600**	5.1	2.6	1.6
ANZECC (2018) DGV												
ANZECC (2018) GV-high[3]												

Station	Chrysene	Benzo[b]fluoranthene + Benzo[j]fluoranthene	Benzo[k]fluoranthene	Benzo[a]pyrene (BAP)	Indeno(1,2,3-c,d)pyrene	Dibenzo[a,h]anthracene	Benzo[g,h,i]perylene	Benzo[e]pyrene	Perylene	Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	Benzo[a]pyrene Toxic Equivalence (TEF)	**Sum of High Molecular Weight PAHs**	**Total PAHs**
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
NE300	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.008	< 0.008	0.0000	0.0000
NE500	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
NE1000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
NE2000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
NE4000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.008	< 0.007	0.0000	0.0000
NNW750	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.008	< 0.008	0.0000	0.0000
SW750	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.008	< 0.007	0.0000	0.0000
SW2000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
SW4000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.008	< 0.008	0.0000	0.0000
N2000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
N4000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
E500	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
E1000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.008	< 0.008	0.0000	0.0000
S2250	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
S4000	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
WSW750	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.008	< 0.008	0.0000	0.0000
CTLSE	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.007	< 0.007	0.0000	0.0000
CTLNW	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.008	< 0.008	0.0000	0.0000
ISQG-Low [1,2]	0.384			0.43		0.063						**1.7000**	**4**
ISQG-High [1,2]	2.8			1.6		0.26						**9.6000**	**45**
ANZECC (2018) DGV													**10**
ANZECC (2018) GV-high[3]													**50**

Notes:
Grey shading represents results below Analytical Detection Limits
Tan shading represents the sums of the Low Molecular Weight PAHs, High Molecular Weight PAHs and Total PAHs
The updated guidelines (ANZECC 2018) provide a DGV (and GV-High) value for Total PAHs only. ANZECC (2000) ISQG- values have also been included to provide comparisons for specific PAH's, where no ANZECC 2018 DGV exists.
Interim Sediment Quality Guideline–Low (ISQG-Low) and –High (ISQG-High) levels represent two distinct probability thresholds for possible and probable biological effects respectively.
1 – ANZECC (2000) and ANZECC (2018) specify that Total PAH is the sum of certain selected PAHs. OTEMP methodology follows a more conservative approach where all the low and high molecular weight PAHs are combined together to give the Total PAH value
2 – ANZECC (2000) Interim Sediment Quality Guidelines
3 – PAH results above ADLs have been normalised to 1% of TOC, as required by ANZECC (2018) advice notes. Values below ADL have been given a nominal value of half ADL to allow calculation of a total PAH value

APPENDIX H
CONCENTRATIONS OF TOTAL PETROLEUM HYDROCARBONS WITHIN COMPOSITE SEDIMENT SAMPLES COLLECTED DURING THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING

Station	C7 - C9	C10 - C11	C12 - C14	C15 - C20	C21 - C25	C26 - C29	C30 - C44	Total hydrocarbons (C7 - C44)
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
NE300	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 100
NE500	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 100
NE1000	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 100
NE2000	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 100
NE4000	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
NNW750	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
SW750	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
SW2000	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 100
SW4000	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
N2000	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
N4000	< 12	< 12	< 12	< 12	< 12	< 12	< 30	< 100
E500	< 12	< 12	< 12	< 12	< 12	< 12	< 30	< 100
E1000	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
S2250	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
S4000	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
WSW750	< 14	< 14	< 14	< 14	< 14	< 14	< 30	< 110
CTLSE	< 13	< 13	< 13	< 13	< 13	< 13	< 30	< 110
CTLNW	< 14	< 14	< 14	< 14	< 14	< 14	< 30	< 110

TPH ecological protection guideline values; ANZECC (2018) DGV = 280 mg/kg, ANZECC (2018) GV-high= 550 mg/kg

APPENDIX I
CONCENTRATIONS OF BTEX COMPOUNDS WITHIN COMPOSITE SEDIMENT SAMPLES COLLECTED DURING THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING

Station	Benzene	Toluene	Ethylbenzene	m&p-Xylene	o-Xylene
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
NE300	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
NE500	< 0.11	< 0.11	< 0.11	< 0.3	< 0.11
NE1000	< 0.11	< 0.11	< 0.11	< 0.3	< 0.11
NE2000	< 0.11	< 0.11	< 0.11	< 0.3	< 0.11
NE4000	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
NNW750	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
SW750	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
SW2000	< 0.11	< 0.11	< 0.11	< 0.3	< 0.11
SW4000	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
N2000	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
N4000	< 0.10	< 0.10	< 0.10	< 0.2	< 0.10
E500	< 0.10	< 0.10	< 0.10	< 0.2	< 0.10
E1000	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
S2250	< 0.11	< 0.11	< 0.11	< 0.3	< 0.11
S4000	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
WSW750	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12
CTLSE	< 0.11	< 0.11	< 0.11	< 0.3	< 0.11
CTLNW	< 0.12	< 0.12	< 0.12	< 0.3	< 0.12

APPENDIX J
RAW MACROFAUNA COUNTS FROM SAMPLES COLLECTED DURING THE 2021 ANNUAL ECOLOGICAL EFFECTS MONITORING

Taxon	Total	TUI_2021_CTLNW_A	TUI_2021_CTLNW_B	TUI_2021_CTLNW_C	TUI_2021_CTLSE_A	TUI_2021_CTLSE_B	TUI_2021_CTLSE_C	TUI_2021_E1000_A	TUI_2021_E1000_B	TUI_2021_E1000_C	TUI_2021_E500_A	TUI_2021_E500_B	TUI_2021_E500_C	TUI_2021_N2000_A	TUI_2021_N2000_B	TUI_2021_N2000_C	TUI_2021_N4000_A	TUI_2021_N4000_B	TUI_2021_N4000_C	TUI_2021_NE1000_A	TUI_2021_NE1000_B	TUI_2021_NE1000_C	TUI_2021_NE2000_A	TUI_2021_NE2000_B	TUI_2021_NE2000_C	TUI_2021_NE300_A	TUI_2021_NE300_B	TUI_2021_NE300_C	TUI_2021_NE4000_A	TUI_2021_NE4000_B	TUI_2021_NE4000_C	TUI_2021_NE500_A	TUI_2021_NE500_B	TUI_2021_NE500_C	TUI_2021_NNE750_A	TUI_2021_NNE750_B	TUI_2021_NNE750_C	TUI_2021_S2250_A	TUI_2021_S2250_B	TUI_2021_S2250_C	TUI_2021_S4000_A	TUI_2021_S4000_B	TUI_2021_S4000_C	TUI_2021_SW2000_A	TUI_2021_SW2000_B	TUI_2021_SW2000_C	TUI_2021_SW750_A	TUI_2021_SW750_B	TUI_2021_SW750_C	TUI_2021_W4000_A	TUI_2021_W4000_B	TUI_2021_W4000_C	TUI_2021_WSW750_A	TUI_2021_WSW750_B	TUI_2021_WSW750_C
Acrocirridae	6	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Aglaophamus sp.	366	6	11	15	6	3	8	5	5	5	10	6	4	5	8	5	10	9	12	7	2	4	8	6	5	4	6	7	6	4	8	4	7	3	5	8	3	7	4	4	3	11	8	11	5	3	3	9	12	6	11	11	6	16	6
Alpheus sp.	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Amalda sp.	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ampelisca sp.	33	2	0	2	1	0	1	1	2	1	1	1	1	1	0	0	0	0	1	0	0	1	1	1	0	0	1	1	1	0	0	1	0	1	1	0	1	0	0	0	0	1	0	0	1	1	1	1	0	1	0	2	0	0	0
Ampharetidae	301	7	7	14	4	0	3	3	1	2	2	4	6	2	5	7	3	10	11	5	6	6	4	4	4	7	7	6	4	5	6	13	5	3	4	12	3	6	3	5	0	5	8	6	4	4	8	8	6	5	16	5	8	3	6
Amphipoda	247	0	6	5	6	3	4	12	2	4	2	3	3	2	9	2	4	2	5	4	13	4	8	4	0	6	2	0	7	6	1	7	6	4	2	8	7	7	5	3	3	2	3	9	7	2	4	8	3	2	5	7	4	7	3
Anchisquilloides mcneilli	6	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anisodonta alata alata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antalis nana	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Anthozoa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Anthuroidea	16	0	0	1	0	0	0	0	1	1	0	2	1	0	1	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0
Aphroditidae	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Arachnanthus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aricidea sp.	24	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	1	1	1	2	1	0	2	0	0	0	0	0	1	0	0	0	1	2	1	0	2
Armandia maculata	60	0	0	2	2	0	2	3	1	1	0	1	2	3	3	1	0	0	1	5	2	0	1	0	1	3	1	2	0	0	0	3	2	0	1	1	0	1	0	3	1	0	0	1	2	1	0	4	0	0	1	1	1	0	0
Ascidiacea	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asellota	193	1	1	0	3	2	4	3	0	5	1	9	8	2	5	6	1	7	7	2	3	4	12	1	3	1	3	0	4	3	1	8	2	4	2	4	4	1	1	7	0	6	1	5	9	6	0	6	0	1	9	7	4	1	3
Austrofusus glans	11	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Austromitra sp.	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0
Axiopsis sp.	23	0	1	1	1	0	1	2	0	0	0	0	0	2	1	0	1	0	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	0	1	0	0	0	0	1	0	0	1	0	1	1
Bivalvia	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Bradleya opima	15	0	0	2	0	1	0	0	0	0	0	0	1	0	1	0	0	2	0	0	0	0	0	1	0	1	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Bryozoa	64	3	3	3	6	1	3	4	2	0	0	2	0	0	0	0	3	0	0	3	0	0	0	2	0	1	2	2	1	0	2	0	1	0	0	1	0	0	1	0	1	1	0	1	1	1	0	1	1	3	2	2	0	1	3
Buccinidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadulus teliger	205	0	1	0	7	0	10	7	4	2	1	2	7	4	5	6	1	1	4	3	4	6	5	1	2	4	2	1	3	0	1	3	2	5	3	6	1	3	7	1	3	3	6	2	1	8	4	8	3	6	1	4	10	10	11
Caprellidae	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Caudofoveata	30	2	0	0	0	1	1	1	0	0	1	0	0	2	0	0	0	0	1	0	1	0	2	1	0	2	0	4	0	1	1	0	1	0	1	0	0	0	0	0	0	0	1	0	2	0	2	0	0	0	1	1	0	0	0
Chaetognatha	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chloeia sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorotocus novaezealandiae	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
Cirolanidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirratulidae	653	7	7	14	28	3	15	13	4	8	5	6	10	6	19	6	8	22	11	6	8	9	8	7	6	17	15	3	16	17	12	22	15	10	4	18	14	21	24	10	12	18	20	19	14	5	8	22	8	3	15	23	9	9	14
Copepoda	20	1	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	2	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	1	0	0	1	0	1	0	0
Cossura consimilis	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumacea	673	4	12	14	41	8	28	19	7	8	5	6	6	21	13	6	12	20	18	6	10	14	22	10	7	7	7	4	18	16	13	12	7	9	4	16	10	19	5	16	3	17	18	19	14	17	2	22	10	4	16	12	14	17	8
Curveulima aupouria	10	1	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuvierina sp. (pelagic)	25	3	0	0	3	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	1	1	2	1	1	0	3	1
Cypridinodes sp.	30	2	0	0	3	1	0	0	0	0	0	1	2	0	2	1	0	0	0	0	2	0	1	0	0	0	1	0	3	0	0	1	1	1	0	0	1	1	0	0	0	1	0	1	2	1	0	0	0	0	0	0	0	1	0
Cytherella sp.	9	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
Decapoda	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diasterope grisea	5	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0
Dorvilleidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Duplicaria tristis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Ebalia laevis	5	0	0	0	1	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinocardium cordatum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echinoidea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Echiura	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Edwardsia sp.	8	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Ennucula strangei	44	0	2	0	0	0	0	0	1	0	0	3	1	0	5	1	0	0	1	0	2	3	2	1	0	0	1	1	5	0	1	0	0	2	1	0	0	0	0	4	0	1	2	0	0	0	0	0	0	0	1	0	1	1	1
Erycina parva	19	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	6	1	0	0	2	0	1	0
Euchone pallida	36	5	3	9	1	0	0	0	0	0	0	0	0	0	1	0	0	1	3	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	1	0	4	0	0	0	0	0	1	1	0	0	0	0
Eulimidae	4	1	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euphausiacea (pelagic)	21	0	0	0	0	0	2	0	1	1	1	0	0	0	1	2	0	0	1	0	2	0	0	0	0	1	0	0	0	1	1	0	0	0	2	1	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0
Exogoninae	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Flabellifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flabelligeridae	57	1	0	0	0	0	2	0	0	2	1	0	2	0	1	1	0	2	1	0	0	1	0	1	1	0	1	3	4	1	1	4	4	1	1	0	1	1	2	0	1	1	0	3	1	1	0	2	0	0	2	3	1	0	2
Funiculina	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Gastropoda	103	2	0	0	1	0	3	8	1	0	0	1	1	5	1	0	1	2	5	1	9	4	1	1	1	2	0	1	0	0	1	3	1	2	1	8	1	1	0	9	1	0	2	1	0	0	0	3	3	4	2	6	1	1	1
Glyceridae	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Gnathiidae	30	0	1	0	2	2	1	0	2	2	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	1	1	0	0	3	2	2	1	0	0	1	0	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	1	0	0
Goniadidae	10	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Hemichordata	8	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Hesionidae	12	0	0	0	1	0	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Heteromolpadia marenzelleri	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heterospio sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hiatella arctica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrozoa	32	1	0	0	1	1	1	0	1	2	1	1	1	0	0	0	1	1	1	1	0	0	0	1	1	1	0	1	0	0	0	1	1	0	1	0	1	1	1	1	0	1	1	0	1	1	0	1	0	1	0	0	0	0	1
Ischyroceridae	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leitoscoloplos	45	0	1	0	1	0	2	1	2	0	0	3	0	2	0	0	0	1	0	6	0	1	0	0	0	2	1	3	0	0	1	0	0	3	0	0	0	2	0	0	0	2	0	0	1	1	1	2	2	0	2	0	0	1	1
Limatula maoria	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Lumbrineridae	115	0	0	2	2	1	4	1	0	2	5	3	3	0	2	2	0	2	2	1	2	1	1	2	2	2	3	3	5	2	4	3	4	2	4	3	1	0	1	7	3	3	0	2	2	2	1	5	1	1	4	1	4	1	1
Lysianassidae	85	1	1	5	3	0	1	0	1	0	2	0	0	0	1	0	0	1	1	1	1	1	0	0	0	2	1	25	1	0	0	1	2	2	0	8	1	2	2	2	0	2	2	4	0	2	1	2	0	1	0	1	1	0	0
Magelona dakini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maldanidae	665	18	18	21	13	1	7	15	8	10	12	11	8	4	13	9	10	10	15	2	8	9	9	11	6	15	17	16	14	9	17	18	11	23	13	17	11	14	15	16	7	14	16	12	13	14	15	15	15	2	19	19	9	10	11
Maxacteon cratericulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maxacteon flammens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Medusa (pelagic)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Molgula sp.	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0

Myriochele sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Myriowenia sp.	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Musella sp.	7	0	0	0	4	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natatolana sp.	19	0	0	0	0	0	1	0	0	0	1	0	0	3	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	0	1	1	0	1	1	0	0	1	1	0	0	0	0	0	0	0
Naticidae	20	0	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0	0	0	1	1	0	1	0	1	1	0	0	1	0	1	0	0	1	0	1	0	1	2	0	0	0
Neilonella wrighti	299	4	0	1	8	1	11	4	3	7	4	10	2	8	6	1	2	10	3	9	5	3	8	3	9	7	0	0	5	5	3	15	9	2	13	19	2	4	5	6	3	7	3	3	9	3	7	4	6	9	7	7	6	1	7
Nematoda	57	0	0	0	1	0	3	0	6	2	0	2	1	2	6	0	0	0	2	0	1	2	4	0	0	2	0	0	0	0	3	0	2	0	0	3	1	2	0	3	1	1	0	0	1	0	0	2	1	0	2	0	0	0	1
Nemertea	46	2	1	2	1	0	1	1	0	0	0	0	0	1	1	1	2	0	2	1	1	2	1	1	0	0	0	1	1	2	0	1	1	0	1	3	1	1	1	0	0	0	0	0	2	1	0	2	1	1	2	2	0	1	0
Neolepton sp.	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neommatocarcinus huttoni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neomuelleriella hispida	38	0	0	0	0	1	1	2	0	1	0	0	3	0	0	0	2	0	1	0	1	3	5	0	1	0	0	0	3	3	0	0	1	2	0	0	1	1	0	0	1	2	1	0	0	1	0	0	1	0	0	0	0	0	0
Neonesidea sp.	81	0	3	1	6	2	2	3	0	0	1	0	0	1	0	0	1	1	0	0	1	0	0	1	0	1	3	4	2	1	0	6	2	0	0	2	7	2	1	2	1	1	0	2	4	1	0	2	2	4	1	2	3	1	1
Notomastus zeylanicus	162	0	2	5	2	5	2	3	1	1	1	3	0	2	1	1	7	2	2	4	2	3	4	3	7	3	2	1	3	2	6	5	0	3	3	6	2	3	6	5	0	3	0	5	1	7	2	5	4	5	3	4	3	3	4
Nucinella maoriana	41	0	1	0	1	0	0	0	0	0	0	0	0	2	3	0	1	0	0	5	1	0	1	2	1	1	0	1	1	0	0	1	0	0	1	2	0	0	2	0	0	0	3	2	1	0	0	1	0	2	1	0	1	2	1
Oligochaeta	15	0	1	0	1	0	0	0	2	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	1	1	1	2	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Onuphis aucklandensis	235	6	2	0	0	1	2	1	1	0	6	7	5	5	4	1	9	8	8	2	5	7	3	8	0	7	11	9	6	3	7	6	7	7	2	3	5	3	5	3	0	8	5	4	5	2	4	1	8	2	5	8	3	2	3
Ophiuroidea	101	1	2	2	1	4	6	1	2	0	1	3	3	3	1	2	0	1	2	0	0	1	1	3	0	8	2	7	2	3	2	5	1	1	2	7	2	1	0	3	0	1	0	0	1	2	1	2	2	0	2	2	0	1	1
Orbiniidae	38	0	0	2	2	1	0	2	1	0	1	1	0	0	2	0	0	0	0	1	0	0	1	0	0	1	3	0	1	0	0	1	0	1	2	1	1	0	1	0	1	0	3	1	0	1	0	1	1	0	0	0	2	1	1
Ostracoda	13	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	2	0	2	0	0	0	0	0
Owenia petersenae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Papawera zelandiae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paracaudina chilensis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraonidae	267	4	5	7	6	1	5	3	4	4	5	2	8	0	7	2	1	7	5	6	3	6	9	4	1	1	5	5	13	5	2	4	5	3	5	6	3	7	8	7	5	13	7	3	3	5	3	4	2	2	11	7	9	6	3
Paraprionospio coora	9	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
Parasterope quadrata	16	0	0	1	1	0	0	0	0	0	0	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1
Paravireia sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paucibranchia disjuncta	46	1	0	0	0	0	0	1	0	0	1	0	0	1	2	0	0	1	1	1	1	1	1	0	0	0	1	1	0	0	3	2	1	0	2	3	1	1	1	2	0	0	1	2	1	1	1	1	1	2	1	0	0	3	2
Pennatulacea	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pentaceraton cf.	41	0	0	0	1	0	3	0	1	0	0	1	0	1	2	0	0	0	3	0	2	0	1	0	1	5	1	1	1	0	3	1	2	0	0	1	1	2	0	0	0	1	0	0	1	1	1	0	1	0	0	2	0	0	0
Philine spp.	23	0	1	1	3	0	0	0	0	0	0	1	0	0	3	0	1	1	0	0	0	1	0	1	1	0	0	0	0	0	0	2	0	1	0	1	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
Phoxocephalidae	178	1	4	7	6	5	3	6	6	4	4	5	1	6	5	2	2	0	1	6	2	4	5	4	0	4	1	1	7	2	4	6	2	1	3	3	0	0	0	10	0	4	1	3	2	1	4	11	2	1	4	4	2	1	5
Phyllodocidae	14	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	1	0
Pilargidae	35	0	0	3	1	1	1	0	1	3	0	2	3	0	2	0	0	1	0	0	0	0	4	0	1	0	0	0	1	1	0	0	0	0	2	2	1	0	0	0	0	0	0	3	0	0	1	0	0	0	1	0	0	0	0
Platyhelminthes	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pleoschisma agilis	84	0	0	0	0	0	2	0	2	1	5	1	2	1	3	3	0	0	1	4	2	2	1	1	5	4	2	4	2	1	1	1	3	0	3	3	1	0	1	4	0	0	4	1	1	2	0	3	1	0	0	1	0	3	2
Poecilochaetidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polydorid	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polynoidae	14	0	0	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	3	0	1	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Pontophilus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Porifera	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poroleda lanceolata	22	0	0	0	1	0	0	0	2	0	2	1	0	0	0	0	0	0	0	1	2	1	0	1	0	1	1	3	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0
Pratulum pulchellum	117	4	5	7	6	0	2	3	0	0	0	2	5	5	4	1	2	7	4	5	0	0	3	0	0	1	2	2	2	4	0	4	3	3	1	3	3	1	0	1	1	4	1	1	0	0	1	1	0	1	1	2	1	6	2
Prionospio spp.	71	3	2	2	0	0	2	4	0	3	0	1	0	1	1	2	0	1	0	2	1	2	2	1	2	0	0	3	1	0	0	2	1	1	5	0	1	1	3	0	2	0	3	2	2	1	0	2	7	0	1	0	1	0	0
Pseudoneaera wellmani	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyura spp.	28	0	1	0	1	0	0	1	0	0	1	0	0	1	1	1	1	1	2	0	0	1	0	0	0	0	0	0	0	0	2	0	2	0	0	0	1	0	0	1	0	0	0	1	1	1	0	0	1	0	2	0	1	0	3
Relichna aupouria	16	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0	0	0	2	0	0	0	2	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0
Rhamphobrachium sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhinoclama traillii	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rutiderma sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rynkatorpa uncinata	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Sabellidae	27	2	1	2	0	0	0	0	0	0	1	2	2	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	2	1	0	1	2	1	0	0	0	2	1
Sacoella maxwelli	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salpidae (pelagic)	3	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scalibregma inflatum	13	0	0	0	1	0	0	0	0	0	1	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
Scalpomactra scalpellum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scintillona zelandica	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sclerochoncha sp.	6	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Serpulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serratina charlottae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sigalionidae	31	0	1	1	1	0	1	1	1	0	0	0	0	1	1	2	0	1	1	2	0	0	0	3	1	1	0	3	0	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2	0	1	0	0	1
Sigapatella sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sipuncula	15	0	0	0	1	0	0	0	0	0	1	0	0	0	0	2	2	1	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	1
Sphaerodoridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spio sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiochaetopterus sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiophanes spp.	475	10	7	11	11	3	18	11	1	4	2	10	10	7	8	5	3	11	18	10	1	1	2	6	5	10	14	11	9	6	11	11	4	10	7	16	10	13	9	5	4	15	11	8	13	7	1	7	5	8	8	31	10	10	16
Sternaspidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stomatopoda Juvenile (benthic)	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stomatopoda larvae (pelagic)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Syllidae	8	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Tanaidacea	46	1	0	0	0	0	1	2	0	1	1	0	1	1	1	0	0	1	1	1	0	0	3	0	0	1	2	0	1	2	2	0	1	0	0	1	2	2	1	0	0	6	0	1	2	0	0	0	2	1	3	0	0	1	0
Terebellidae	19	2	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	2	0	3	2	1	0	0	0	1	0	0	0	2	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1
Terebellides stroemii	65	2	1	0	2	0	0	0	0	1	0	1	1	1	0	0	1	4	0	0	0	2	1	0	0	4	6	2	1	3	2	1	2	0	1	0	0	1	2	0	0	2	1	4	2	1	1	4	0	2	0	4	1	1	0
Thraciidae	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thyasiridae	3	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trachyleberis lytteltonensis	27	0	0	2	1	3	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	3	1	0	1	1	3	0	0	0	0	0	0	1	0	0	0	1	0	2	0	0	1	0	1	2	0	0	0
Trochochaeta sp.	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Trochodota dendyi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Turridae	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Upogebia sp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uromunna	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urothoidae	32	0	0	1	2	0	1	1	2	1	2	1	0	0	0	0	0	0	0	0	1	1	1	2	0	0	0	1	1	1	2	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	3	1	1	1	0
Valvifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Varinucula gallinacea	209	3	4	3	7	0	7	10	2	4	1	4	0	7	5	0	0	1	3	5	2	5	2	1	4	3	5	3	8	0	0	2	5	3	6	6	5	3	4	7	1	6	10	3	1	2	4	16	7	0	1	1	2	7	8
Zeacolpus sp.	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

APPENDIX K
OUTPUTS OF STATISTICAL ANALYSES PERFORMED ON INCIDENTAL DEBRIS, MACROFAUNA AND ENVIRONMENTAL DATA FROM THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING SURVEY

Table K1 PERMANOVA Model 1 partitioning and analysis of the Tui Field incidental anthropogenic debris found in 2021 by distance, based on square root transformed abundances and Bray -Curtis dissimilarities.

Source	df	*SS*	MS	Pseudo *F*	*p*
Distance	8	427.88	53.49	5.42	**0.001**
Residuals	45	443.92	9.86		
Total	53	871.8			

Table K2 Significant pairwise comparisons of incidental anthropogenic debris occurrence by distance from the FPSO across the Tui Field during the 2021 monitoring programme. Monte Carlo tests were used to generate the *P*-value when permutations were <100, indicated with an asterisk.

Levels of Distance	*t*	*P*-value
CTLNW, 300	2.6264	**0.013**
CTLNW, 750	1.7504	**0.04**
CTLSE, 4000	3.3577	**0.002**
CTLSE, 2250	2.3979	**0.035**
CTLSE, 2000	3.4364	**0.002**
CTLSE, 1000	2.7822	**0.004**
CTLSE, 750	3.1409	**0.001**
CTLSE, 500	2.8285	**0.004**
CTLSE, 300	2.7463	**0.009**
4000, 750	2.1029	**0.002**
4000, 300	4.3446	**0.004**
2000, 750	1.7909	**0.033**
2000, 300	4.3191	**0.004**
1000, 4000	1.8208	**0.025**
1000, 750	1.6869	**0.019**
1000, 300	3.179	**0.002**
500, 4000	2.2988	**0.003**
500, 2000	2.1007	**0.007**
500, 300	2.2846	**0.008**
300, 2250	2.5113	**0.015**
300, 750	2.921	**0.005**

Table K3 Summary of SIMPER results for 2021 Macrofauna. The average abundance of characterizing taxa, their contribution to community structure, and cumulative total of contributions (90% cut-off) are given.

Taxa	Average Abundance (%)	Average Similarity (%)	Contribution to Similarity (%)	Cumulative Contribution (%)
Maldanidae	3.47	3.98	5.36	5.36
Cumacea	3.48	3.94	5.31	10.67
Cirratulidae	3.44	3.94	5.3	15.97
Spiophanes spp.	2.92	3.26	4.39	20.36
Aglaophamus sp.	2.58	2.97	4	24.37
Ampharetidae	2.32	2.58	3.48	27.85
Neilonella wrighti[6]	2.31	2.58	3.48	31.32
Paraonidae	2.2	2.52	3.39	34.71
Amphipoda	2.12	2.44	3.29	38.00
Onuphis aucklandensis	2.01	2.13	2.87	40.87

Table K4 PERMANOVA Model 1 partitioning and analysis of the Tui Field macrofaunal community in 2021 by Distance, based on square root transformed abundances and Bray Curtis dissimilarities.

Source	df	*SS*	MS	Pseudo *F*	*p*
Distance	8	2995.7	374.46	1.2446	**0.023**
Residuals	9	2707.8	300.87		
Total	17	5703.5			

Table K5 Significant pairwise comparisons of the macrofaunal community by distance from the FPSO across the Tui Field during the 2021 monitoring programme. Monte Carlo tests were used to generate the *P*-value when permutations were <100, indicated with an asterisk.

Levels of Distance	*t*	*P*-value
CTLNW, 4000	1.3806	**0.005**
CTLNW, 2000	1.5734	**0.006**
CTLNW, 1000	1.5582	**0.046***
CTLNW, 750	1.5117	**0.007**
CTLNW, 500	1.5204	**0.056**
4000, 2000	1.1917	**0.046**
4000, 1000	1.3371	**0.014**
4000, 300	1.3983	**0.009**
2000, 300	1.4592	**0.006**
750, 300	1.3742	**0.005**

6 Previously known as *Austrotindaria wrighti* (unaccepted).

Table K6 PERMANOVA Model 2 partitioning and analysis of the Tui Field macrofaunal communities by Distance and Year, and the interaction of these, based on square root transformed abundances and Bray Curtis Similarities.

Source	df	*SS*	MS	Pseudo-*F*	*p*
Distance	8	4431.5	553.94	1.5969	**0.004**
Year	2	3919.7	1959.80	6.7134	**0.001**
Distance X Year	16	5550.2	346.89	1.1883	**0.026**
Residuals	27	7882.0	291.93		
Total	53	22580.0			

APPENDIX L
RESULTS OF THE RECEIVING WATER CHEMICAL COMPOSITION (RWCC) WATER SAMPLE TESTING PERFORMED ON SAMPLES COLLECTED DURING THE 2021 TUI FIELD ANNUAL ECOLOGICAL EFFECTS MONITORING

	Unit	FPSO Umuroa Produced Water (Q1 2019 mean)	500m Surface	500m Sub-surface	1000m Surface	1000m Sub-surface	Control-SE Surface	Control-SE Sub-surface	Control-NW Surface	Control-NW Sub-surface	ANZECC (2018) DGV 95% LOP
Metals/Metalloids											
Total Arsenic	g/m³	0.16	< 0.0042	< 0.0042	< 0.0042	< 0.0042	< 0.0042	< 0.0042	< 0.0042	< 0.0042	
Total Barium	g/m³	11.7	0.0048	0.0052	0.0051	0.0054	0.0048	0.005	0.0049	0.0049	
Total Cadmium	g/m³	< 0.00021	< 0.00021	< 0.00021	< 0.00021	< 0.00021	< 0.00021	< 0.00021	< 0.00021	< 0.00021	0.0055
Total Chromium	g/m³	0.00185	< 0.0011	0.0013	0.0014	< 0.0011	0.0019	< 0.0011	0.0011	0.0018	0.0274
Total Copper	g/m³	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.0013
Total Iron	g/m³	0.895	0.0082	0.0131	< 0.0042	0.0047	< 0.0042	0.0066	< 0.0042	0.0085	
Total Lead	g/m³	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.0044
Total Magnesium	g/m³	13.15	1,280	1,300	1,300	1,320	1,330	1,320	1,320	1,330	
Total Manganese	g/m³	1.505	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	< 0.0011	0.08
Total Mercury	g/m³	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	< 0.00008	0.0004
Total Nickel	g/m³	< 0.0070	< 0.0070	< 0.0070	< 0.0070	< 0.0070	< 0.0070	< 0.0070	< 0.0070	< 0.0070	0.070
Total Zinc	g/m³	0.0073	0.0065	< 0.0042	< 0.0042	< 0.0042	< 0.0042	< 0.0042	< 0.0042	< 0.0042	0.015
Polycyclic Aromatic Hydrocarbons											
Acenaphthene	g/m³	0.001645	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Acenaphthylene	g/m³	< 0.00007	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Anthracene	g/m³	0.000365	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.0001
Benzo[a]anthracene	g/m³	0.000095	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Benzo[a]pyrene (BAP)	g/m³	0.00014	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.0001
Benzo[b]fluoranthene + Benzo[j]fluoranthene	g/m³	< 0.00007	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Benzo[g,h,i]perylene	g/m³	< 0.00007	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	

	Unit	FPSO Umuroa Produced Water (Q1 2019 mean)	500m Surface	500m Sub-surface	1000m Surface	1000m Sub-surface	Control-SE Surface	Control-SE Sub-surface	Control-NW Surface	Control-NW Sub-surface	ANZECC (2018) DGV 95% LOP
Benzo[k]fluoranthene	g/m³	< 0.00007	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Chrysene	g/m³	0.0002	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Dibenzo[a,h]anthracene	g/m³	< 0.00007	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Fluoranthene	g/m³	0.00027	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.001
Fluorene	g/m³	0.0058	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.00007	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Naphthalene	g/m³	0.365	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004	< 0.00004	0.07
Phenanthrene	g/m³	0.0147	< 0.000008	0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	0.0006
Pyrene	g/m³	0.000175	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	< 0.000008	
Total Petroleum Hydrocarbons											
C7 - C9	g/m³	1.925	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	
C10 - C14	g/m³	13.95	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.05	< 0.04	
C15 - C36	g/m³	8.25	< 0.08	< 0.08	< 0.11	< 0.08	0.09	< 0.08	0.15	< 0.08	
Total hydrocarbons (C7 - C36)	g/m³	24.5	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	
BTEX in VOC											
Benzene	g/m³	1.33	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	0.7
Ethylbenzene	g/m³	0.0875	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.005
Toluene	g/m³	0.795	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	0.18
m&p-Xylene	g/m³	0.305	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.275
o-Xylene	g/m³	0.235	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	0.35
Halogenated Aliphatics											

	Unit	FPSO Umuroa Produced Water (Q1 2019 mean)	500m Surface	500m Sub-surface	1000m Surface	1000m Sub-surface	Control-SE Surface	Control-SE Sub-surface	Control-NW Surface	Control-NW Sub-surface	ANZECC (2018) DGV 95% LOP
Bromomethane (Methyl Bromide)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Carbon tetrachloride	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Chloroethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Chloromethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,2-Dibromo-3-chloropropane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,2-Dibromoethane (ethylene dibromide, EDB)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Dibromomethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Dichlorodifluoromethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,1-Dichloroethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,2-Dichloroethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,1-Dichloroethene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
cis-1,2-Dichloroethene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
trans-1,2-Dichloroethene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Dichloromethane (methylene chloride)	g/m³	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	
1,2-Dichloropropane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,3-Dichloropropane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,1-Dichloropropene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
cis-1,3-Dichloropropene	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
trans-1,3-Dichloropropene	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Hexachlorobutadiene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	

	Unit	FPSO Umuroa Produced Water (Q1 2019 mean)	500m Surface	500m Sub-surface	1000m Surface	1000m Sub-surface	Control-SE Surface	Control-SE Sub-surface	Control-NW Surface	Control-NW Sub-surface	ANZECC (2018) DGV 95% LOP
1,1,1,2-Tetrachloroethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,1,2,2-Tetrachloroethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Tetrachloroethene (tetrachloroethylene)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,1,1-Trichloroethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,1,2-Trichloroethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Trichloroethene (trichloroethylene)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Trichlorofluoromethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,2,3-Trichloropropane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,1,2-Trichlorotrifluoroethane (Freon 113)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Vinyl chloride	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Halogenated Aromatics											
Chlorobenzene (monochlorobenzene)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,2-Dichlorobenzene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,3-Dichlorobenzene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,4-Dichlorobenzene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,2,3-Trichlorobenzene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,2,4-Trichlorobenzene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	0.08
1,3,5-Trichlorobenzene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Bromobenzene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
2-Chlorotoluene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	

	Unit	FPSO Umuroa Produced Water (Q1 2019 mean)	500m Surface	500m Sub-surface	1000m Surface	1000m Sub-surface	Control-SE Surface	Control-SE Sub-surface	Control-NW Surface	Control-NW Sub-surface	ANZECC (2018) DGV 95% LOP
4-Chlorotoluene	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Monoaromatic Hydrocarbons											
n-Butylbenzene	g/m³	0.0027	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
tert-Butylbenzene	g/m³	0.0031	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
4-Isopropyltoluene (p-Cymene)	g/m³	0.00295	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Isopropylbenzene (Cumene)	g/m³	0.01715	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
n-Propylbenzene	g/m³	0.0192	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
sec-Butylbenzene	g/m³	0.00355	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Styrene	g/m³	0.00105	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
1,2,4-Trimethylbenzene	g/m³	0.091	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
1,3,5-Trimethylbenzene	g/m³	0.035	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Ketones											
Acetone	g/m³	2.9	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
2-Butanone (MEK)	g/m³	0.245	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Methyl tert-butylether (MTBE)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
4-Methylpentan-2-one (MIBK)	g/m³	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	
Trihalomethanes											
Bromodichloromethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Bromoform (tribromomethane)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	

	Unit	FPSO Umuroa Produced Water (Q1 2019 mean)	500m Surface	500m Sub-surface	1000m Surface	1000m Sub-surface	Control-SE Surface	Control-SE Sub-surface	Control-NW Surface	Control-NW Sub-surface	ANZECC (2018) DGV 95% LOP
Chloroform (Trichloromethane)	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Dibromochloromethane	g/m³	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003	
Other VOC											
Carbon disulphide	g/m³	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	
Naphthalene	g/m³	0.815	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.07
Salinity			35	35	35	35	35	35	35	35	

Notes: Total chromium guideline level for Cr 3, Cr 6 is 4.4
Pink shaded values exceed ANZECC (2018) DGV 95% LOP

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APPENDIX G

New Zealand Cetaceans and their Likelihood of Occurrence in and around the Tui Field

Common Name	Scientific Name	NZ Conservation Status (Baker *et al*., 2019)	Qualifier *	IUCN Conservation Status www.redlist.org	DOC Sightings database (No. of reports in and around PMP 38158, including a 20 km buffer)	DOC Stranding database (from nearby coasts) **	Probability of occurrence modelling (Stephenson et al 2020)	Wider presence in Taranaki waters (Torres et al, 2012 and Stephenson et al., 2020)	Ecological considerations and Likelihood of Presence in and around PMP 38158
BALEEN WHALES									
Blue whales (Pygmy blue whale ◊)	*Antarctic blue whales* *Balaenoptera musculus intermedia* *Pygmy blue whales* *Balaenoptera musculus brevicauda*	Data deficient Data deficient	TO S?O	Critically endangered Data deficient	× 18***	Yes (5) Yes (4)	Moderate - High	Sightings common in STB	Two subspecies of blue whale occur in NZ waters. Both subspecies known to occur in the STB. Feeding and breeding of resident pygmy blue whales has been confirmed and migrating Antarctic blue whales pass through (Barlow et al., 2018). Feeding distribution is driven by concentrations of *Nyctiphanes australis* prey (Torres & Klinck, 2016). A reasonable number of sightings have been recorded in the vicinity and modelling suggests a moderate to high probability of occurrence; hence it is **likely** that blue whales could be present.
Bryde's whale	*Balaenoptera edeni*	Nationally critical	CD, DP, SO	Data deficient	×	Yes (2)	Low	Occasional sightings in offshore waters	In New Zealand, Bryde's whales are typically known from the north-eastern coastal region between East Cape and North Cape (Gaskin, 1963); with the Hauraki Gulf and Northland region supporting one of the few known resident populations in the world (Constantine et al., 2012). Sightings outside this range are less frequent and typically occur in deep water; therefore, this species is **unlikely** to be routinely present.
Fin whale	*Balaenoptera physalus*	Data deficient	TO	Endangered	×	Yes (5)	Moderate	Occasional sightings in offshore waters	Fin whales undertake long seasonal migrations and are usually found in deep offshore waters (Shirahai and Jarrett, 2006). They are occasionally seen in deep waters of the STB (Torres 2012) and habitat here is moderately suitable (Stephenson et al., 2020); hence occasional sightings are **possible.**
Humpback whale	*Megaptera novaeangliae*	Migrant	SO	Endangered	1	Yes (5)	Low	Migrating whales pass through the STB	Humpback whales migrate northwards along coastal NZ from May to August (Gibbs & Childerhouse, 2000), and southward from September to December (Dawbin, 1956). During migrations they typically use continental shelf waters (Jefferson et al 2008) and can approach closely to shore when passing headlands or moving through confined waters (e.g. Gibbs et al., 2017). A well-established northward migration route passes through Cook Strait and on through the STB in winter. Hence it is **possible** that this species will be present on a seasonal basis.
Minke whales	*Antarctic minke whale* *Balaenoptera bonaerensis* Dwarf minke whale *Balaenoptera acutorostrata*	Data deficient Data deficient	DP, SO DP, SO	Data deficient Least concern	× ×	Yes (2) Yes (11)	NA Low to moderate	Occasional sightings during migration; mostly in > 100 m water	The Antarctic minke is very abundant in Antarctic waters in summer, but outside of the summer months their distribution is less well-known (Cooke *et al*., 2018). Southern Hemisphere Dwarf minke whales also feed in Antarctic waters in summer and have a broad latitudinal distribution in other seasons (Cooke, 2018). Most minke whale sightings around New Zealand occur in spring; aligning with the southern migration towards the Antarctic feeding grounds (Berkenbusch *et al*., 2013). Based on the information presented here, occasional presence is **possible** in spring.
Pygmy right whale	*Caperea marginata*	Data deficient	S?O	Data deficient	×	Yes (17)	NA	NA	Pygmy right whales are the smallest, most cryptic and least known of the baleen whales (Fordyce & Marx, 2012). In New Zealand, sightings typically occur near Stewart Island and Cook Strait (Kemper, 2002). Therefore, it is **possible** that this species could be present given their apparent association with nearby Cook Strait, but ecological information is very scant for this species.

Common Name	Scientific Name	NZ Conservation Status (Baker *et al.*, 2019)	Qualifier *	IUCN Conservation Status www.redlist.org	DOC Sightings database (No. of reports in and around PMP 38158, including a 20 km buffer)	DOC Stranding database (from nearby coasts) **	Probability of occurrence modelling (Stephenson et al 2020)	Wider presence in Taranaki waters (Torres et al, 2012 and Stephenson et al., 2020)	Ecological considerations and Likelihood of Presence in and around PMP 38158
Sei whale	*Balaenoptera borealis*	Data deficient	TO	Endangered	×	Yes (1)	Moderate	Occasional sightings in waters > 100 m	This species is generally found in offshore, deep waters beyond the continental slope (Horwood, 2009). They are occasionally seen in deep waters of the STB (Torres 2012) and habitat modelling suggests moderate habitat suitability (Stephenson et al., 2020); therefore, occasional sightings are **possible.**
Southern right whale ◊	*Eubalaena australis*	Recovering	OL, RR, SO	Least concern	3	Yes (2)	Low	Occasional coastal sightings in winter	Coastal waters around mainland New Zealand represent a historic calving ground for this species, with recent evidence suggesting a slow recolonization of this breeding range (Carroll et al., 2014). Southern right whales utilise shallow coastal waters as their winter calving and nursery grounds (Patenaude, 2003). Three sightings have been reported from the vicinity. On this basis it is **possible** that southern right whales could have a seasonal presence, although winter sightings are expected closer inshore.
ODONTOCETES									
Bottlenose dolphin ◊	*Tursiops truncatus*	Nationally endangered	De, PF, SO, Sp	Least concern	×	Yes (17)	Low	Occasional sightings in offshore waters	The Marlborough Sounds supports a resident population of inshore bottlenose dolphins (Constantine, 2002). Offshore sightings are less common and typically occur in waters beyond the 100 m depth contour (Torres, 2012); hence an occasional presence is **possible**.
Common dolphin	*Delphinus delphis*	Not threatened	DP,SO	Least concern	3	Yes (71)	Moderate to high	Most frequently sighted species in STB.	This species is commonly seen in Taranaki waters (Torres et al., 2012; Stephenson et al., 2020); hence common dolphins are **likely** to be present.
Dusky dolphin	*Lagenorhynchus obscurus*	Not threatened	S?O	Data deficient	×	Yes (42)	Low	Occasional sightings	Dusky dolphins are known to feed in Admiralty Bay between April and July (Wursig et al., 2007). Sightings in the wider STB occur occasionally, but habitat modelling suggests low habitat suitability (Stephenson et al., 2020). Most strandings in the vicinity occur in the upper South Island. It is **unlikely** that this species will be present.
Dwarf sperm whale	*Kogia sima*	Data deficient	S?O	Data deficient	×	×	NA	NA	Based on the lack of sightings, this species is **unlikely** to be present.
False killer whale	*Pseudorca crassidens*	Naturally uncommon	DP, T?O	Data deficient	×	Yes (2)	Low	Occasional sightings in offshore waters	Mostly found in deep, offshore waters but also occasionally over the continental shelf and shallower areas (Berkenbusch et al., 2013). Forage down to water depths of 500 m (Shirahai & Jarrett, 2006). Based on the lack of sightings data and the low habitat suitability (Stephenson et al., 2020), it is **unlikely** they will be routinely present.
Fraser's dolphin	*Lagenodelphis hosei*	Data deficient	SO	Least concern	×	×	NA	NA	Based on the lack of sightings, this species is **unlikely** to be present.
Hourglass dolphin	*Lagenorhynchus cruciger*	Data deficient	SO	Least concern	×	×	Low	No sightings or strandings in STB	Based on the lack of sightings and the low habitat suitability (Stephenson et al., 2020), this species is **unlikely** to be present.

Common Name	Scientific Name	NZ Conservation Status (Baker *et al*., 2019)	Qualifier *	IUCN Conservation Status www.redlist.org	DOC Sightings database (No. of reports in and around PMP 38158, including a 20 km buffer)	DOC Stranding database (from nearby coasts) **	Probability of occurrence modelling (Stephenson et al 2020)	Wider presence in Taranaki waters (Torres et al, 2012 and Stephenson et al., 2020)	Ecological considerations and Likelihood of Presence in and around PMP 38158
Hector's/Māui's dolphin (Maui's dolphin ◊)	*Maui's dolphin Cephalorhynchus hectori maui* *South Island Hector's dolphin Cephalorhynchus hectori hectori*	Nationally critical Nationally vulnerable	CD CD, DP, PF	Not assessed Endangered	6 2	Yes (15) Yes (16)	Low Low	Sightings mostly inshore	There are two subspecies: Maui's dolphins are present on the west coast of the North Island, and South Island Hector's dolphins are present around the South Island. Māui's and Hector's cannot be readily differentiated at sea; however, both subspecies have coastal distributions thought to be largely constrained within the 100 m isobath (Slooten et al., 2006; Du Fresne, 2010). Maui's dolphins have a population stronghold between Manakau Harbour and Port Waikato (Slooten *et al*., 2005), but their total distribution is wider; from Maunganui Bluff (Currey *et al*., 2012) to Taranaki (DOC, 2020). The Tui field occurs offshore of the typical species distribution, but occasional offshore sightings have been made. Based on this information, it is **possible** that Hector's/Maui's dolphins will occasionally be present.
Killer whale ◊	*Orcinus orca*	Nationally critical	DP, S?O, Sp	Data deficient	×	Yes (3)	Low. But habitat modelling by Torres (2015) concludes a moderate habitat suitability.	Sightings occur from coastal areas to deeper offshore waters	Small groups of killer whales are typically seen around New Zealand where they travel an average of 100 – 150 km per day (Visser, 2000). Some groups of are thought to feed predominantly on rays which can bring them into very shallow coastal waters (Visser, 2000). Sightings not uncommon in Taranaki waters (Torres, 2012). On this basis, it is **likely** that this species will pass through the area on a sporadic basis.
Long-finned pilot whale	*Globicephala melas*	Not threatened	DP, S?O	Data deficient	10	Yes (76)	Moderate to High	Common particularly in summer	Pilot whale sightings occur in NZ waters year-round (Berkenbusch et al., 2013). Long-finned pilot whales commonly strand on New Zealand coasts; with the stranding rate peaking in spring and summer (O'Callaghan et al., 2001). Pilot whales forage at depth (i.e. several hundred metres; Berkenbusch et al., 2013). But given their presence in the sighting record and the modelling results it is **likely** they will be present.
Melon-headed whale	*Peponocephala electra*	Vagrant	SO	Least concern	×	×	NA	NA	This species occurs in deep oceanic waters. Sightings are relatively rare over the continental shelf (Brownell et al. 2009). They are primarily distributed in waters ranging from 300 to 2,000 meters in depth (Brownell et al. 2009). Based on this and the lack of sightings, it is **unlikely** that this species would be present.
Pantropical spotted dolphin	*Stenella attenuata*	Vagrant	SO	Least concern	×	Yes (1)	NA	NA	This species is considered a vagrant to New Zealand waters. Therefore, it is **unlikely** to be present.
Pygmy killer whale	*Feresa attenuata*	Vagrant	DP, S?O	Data deficient	×	×	NA	NA	This species is considered a vagrant to New Zealand waters. Therefore, it is **unlikely** to be present.
Pygmy sperm whale	*Kogia breviceps*	Data deficient	DP, S?O	Data deficient	×	Yes (17)	Low	No sightings in STB. Not a coastal species	Pygmy sperm whales are seldom seen at sea on account of their low profile in the water and lack of a visible blow; for this reason, little information is available on this species. They are known to be a deep-water species (Taylor et al., 2012) and this is reflected by habitat modelling (Stephenson et al., 2020). Despite this, a reasonable number of strandings occur nearby and given that ecological information is relatively scant for this species it would be appropriate to conclude that it is **possible** that this species could be occasionally present.

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Risso's dolphin	*Grampus griseus*	Data deficient	SO	Least concern	×	Yes (2)	Low	Occasional sightings	Found throughout tropical and temperate oceans in deep waters of the continental slope and outer shelf (Kruse *et al.*, 1999). Based on the low habitat suitability (Stephenson et al., 2020), this species is **unlikely** to be routinely present.
Rough-toothed dolphin	*Steno bredanensis*	Data deficient	SO	Least concern	×	Yes (1)	NA	NA	Based on the lack of sightings, this species is **unlikely** to be routinely present.
Short-finned pilot whale	*Globicephala macrorhynchus*	Data deficient	S?O	Data deficient	×	Yes (1)	Moderate to High	Occasional sightings	The short-finned pilot whale is less frequently encountered than the long-finned pilot whale in New Zealand waters on account of its preference for warmer sub-tropical habitat in deep offshore waters (Berkenbusch *et al.*, 2013). Based on habitat modelling (Stephenson et al., 2020) it is **possible** that this species will occasionally be present.
Southern right whale dolphin	*Lissodelphis peronii*	Data deficient	DP,S?O	Data deficient	×	Yes (8)	Low	Occasional sightings	Southern right whale dolphins are circumpolar and common throughout their range (Lipsky, 2002). They are predominantly oceanic, preferring deep, offshore waters (Lipsky, 2002); therefore, are **unlikely** to be routinely present.
Spectacled porpoise	*Phocoena dioptrica*	Data deficient	S?O	Data deficient	×	Yes (1)	Low	No sightings in STB	Spectacled porpoises occur only in cold temperate waters, with their distribution thought to be restricted to the circumpolar sub-Antarctic (Baker, 1999; Goodall, 2002). Based on this and the lack of sightings, it is **unlikely** that this species would be routinely present.
Sperm whale	*Physeter macrocephalus*	Data deficient	DP, TO	Vulnerable	×	Yes (32)	Low	Occur in deep offshore waters over summer.	Sperm whales have a wide global distribution but are predominantly found in deep waters (> 1,000 m) in the open ocean over the continental slope (Berkenbusch et al., 2013). However, the occurrence of a reasonable number of strandings nearby and sightings in the wider STB it is **possible** that sperm whales will occasionally be present.
Striped dolphin	*Stenella coeruleoalba*	Data deficient	SO	Least concern	×	Yes (1)	Low	No sightings in STB. Not a coastal species.	Based on the lack of sightings and the low habitat suitability (Stephenson et al., 2020), this species is **unlikely** to be present.
ODONTOCETES - BEAKED WHALES									
Andrew's beaked whale	*Mesoplodon bowdoini*	Data deficient	S?O	Data deficient	×	Yes (4)	Low	No sightings in STB. Not a coastal species.	Found between 32 – 55°S in the Southern Hemisphere. Presumed to inhabit deep, offshore waters (Pitman, 2002). Based on the global stranding record, New Zealand might represent an area of concentration (Taylor *et al.*, 2008c). However, based on the lack of sightings and the low habitat suitability (Stephenson et al., 2020), it is **unlikely** that this species will be present.
Arnoux's beaked whale	*Berardius arnuxii*	Data deficient	S?O	Data deficient	×	Yes (8)	Low	No sightings in STB	Circumpolar distribution in deep, cold temperate and sub-polar waters. Considered to be naturally rare throughout its range; however, higher densities may occur seasonally in Cook Strait (Taylor *et al.*, 2008d). New Zealand has the highest number of strandings recorded for this species (Jefferson *et al.*, 1993). However, based on the lack of sightings and the low habitat suitability (Stephenson et al., 2020), it is **unlikely** that this species will be present.

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Blainville's/Dense beaked whale	*Mesoplodon densirostris*	Data deficient	S?O	Data deficient	×	×	Low	No sightings or strandings in STB	Little known about this species. However beaked whales are generally considered to prefer deep water as they are deep divers and feed predominantly on deep-water squid and fish species. Based on this and the lack of sightings, it is **unlikely** that this species will be present.
Cuvier's beaked whale	*Ziphius cavirostris*	Data deficient	SO	Least concern	×	Yes (22)	Low	Occasional sightings	Found in deep waters (> 200 m) and is thought to prefer steep bathymetry near the continental slope in water depths greater than 1,000 m (Taylor et al., 2008). Despite the predicted habitat suitability being low (Stephenson et al., 2020), a reasonable number of strandings have occurred in the vicinity and acoustic recordings of this species have been made in Cook Strait (Goetz, 2017); therefore, it is **possible** that Cuvier's beaked whales will be occasionally present.
Gingko-toothed whale	*Mesoplodon ginkgodens*	Data deficient	S?O	Data deficient	×	Yes (3)	NA	NA	Most stranding and capture records for this species are from the tropical and warm temperate waters of the Indo-Pacific (esp. Japan). Only a few records from New Zealand. This species is **unlikely** to be present.
Gray's beaked whale	*Mesoplodon grayi*	Not threatened	S?O	Data deficient	×	Yes (35)	Low	No sightings in STB. Not a coastal species	This species has a circumpolar distribution south of 30° and occurs in deep waters beyond the shelf edge (Taylor et al., 2008). Based on acoustic detections (Goetz, 2017) and reasonable number of strandings, it is **possible** that they could have an occasional presence, particularly in nearby deep waters of Cook Strait.
Hector's beaked whale	*Mesoplodon hectori*	Data deficient	S?O	Data deficient	×	×	NA	NA	A Southern Hemisphere species. Majority of records are from New Zealand waters. There has only been one confirmed live sighting, suggesting Hector's beaked whales are naturally rare (WDC, 2018). Because of the lack of sightings, it is **unlikely** that this species will be present.
Lesser/pygmy beaked whale	*Mesoplodon peruvianus*	Data deficient	S?O	Data deficient	×	×	NA	NA	Very little known about this species. However beaked whales are generally considered to prefer deep water as they are deep divers and feed predominantly on deep-water squid and fish species. Based on this and the lack of sightings, it is **unlikely** that this species will be present.
Shepherd's beaked whale	*Tasmacetus shepherdi*	Data deficient	SO	Data deficient	×	Yes (6)	Low	No sightings in STB. Not a coastal species	A circumpolar distribution in cold temperate waters is presumed. Thought to be relatively rare and occur in deep water usually well offshore (Taylor et al., 2008e). Based on this and the lack of sightings and low habitat suitability (Stephenson et al., 2020), it is **unlikely** that this species would be present.
Southern bottlenose whale	*Hyperoodon planifrons*	Data deficient	SO	Least concern	×	Yes (2)	Low	No sightings in STB. Not a coastal species	This species has a circumpolar distribution in the southern hemisphere, south of about 30°S (Jefferson et al., 1993); however, most sightings are from about 57°S to 70°S (Taylor et al., 2008f). Knowledge of the biology of this species is scarce, but they are thought to be a deep-water species (Baker, 1999). Based on this and the lack of sightings, it is **unlikely** that this species would be present.

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Spade-toothed whale	*Mesoplodon traversii*	Data deficient	S?O	Data deficient	×	×	NA	NA	Little known about this species. However beaked whales are generally considered to prefer deep water as they are deep divers and feed predominantly on deep-water squid and fish species. Based on this and the lack of sightings, it is **unlikely** that this species will be present.
Strap-toothed whale	*Mesoplodon layardii*	Data deficient	S?O	Data deficient	×	Yes (14)	NA	NA	This species occurs between 35-60°S in cold temperate waters and prefers deep waters beyond the shelf edge (Taylor et al., 2008). Acoustic recordings of this species have been made in Cook Strait (Goetz, 2017) and explain the presence of this species in the stranding record. Despite the lack of sightings, it is **possible** that this species will occasionally be present, particularly in nearby deep waters.
True's beaked whale	*Mesoplodon mirus*	Data deficient	S?O	Data deficient	×	×	NA	NA	Very little known about this species. However beaked whales are generally considered to prefer deep water as they are deep divers and feed predominantly on deep-water squid and fish species. Based on this and the lack of sightings, it is **unlikely** that this species will be present.

* Qualifiers to the New Zealand Threat Classification System are as follows: Secure Overseas (SO), Uncertain whether the taxon is secure overseas (S?O), Threatened Overseas (TO), Data Poor (DP), Conservation Dependent (CD), Sparse (Sp), Range Restricted (RR), Increasing (Inc), One Location (OL), Designated (De), Population Fragmentation (PF)

** Including the following coastlines: Golden Bay, Tasman Bay, Outer Sounds, Whanganui, South Taranaki, North Taranaki

*** Species unspecified, but have assumed pygmy blue whale based on available ecological data

◊ Species listed in Schedule 4 of the Proposed Taranaki Regional Coastal Plan: indigenous species identified as being regionally significant for their coastal indigenous biodiversity values

APPENDIX H

Consultation Log

Tui Field Decommissioning Stakeholder Engagement Notes

Date	Tui Project Representative(s)	Organisation Name	Organisation Representative(s)	Stake in Project	Meeting Location / Engagement Activity	Meeting purpose / Notes
02-Oct-20	Lloyd Williams, Susan Baas, Pip Fox, Chris Bunny	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Puna	Local iwi - existing interests	Pastoral House, Wellington	Discuss TKoT concerns/expectations and Key Principles of establishing a Partnership Agreement.
17-Nov-20	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Mark Wipatene	Local iwi - existing interests	Taranaki Iwi offices	Project Update and Principles of Partnership Agreement.
26-Nov-20	Lloyd, Melanie Sole	Joint Petroleum Operators' & Regulators' Forum	O&G Operators, Regulators and Local Government	Multiple	Zoom	Tui Project update.
26-Nov-20	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Whare Wano, Mark Wipatene	Local iwi - existing interests	Taranaki Iwi offices	Project Update and Principles of Partnership Agreement.
30-Nov-20	Lloyd	Taranaki Chamber of Commerce	Arun Chaudhari	Local Business Representation	Chamber Offices	Project Update and local participation.
02-Dec-20	Lloyd	WorkSafe	Nick Dawtry	Regulator	WorkSafe offices	Project Update.
02-Dec-20	Lloyd	Venture Taranaki	Justine Gilliand	Local Business Representation	VT Offices	Project Update and VT participation.
09-Dec-20	Lloyd, Chris Mathieson	Maritime NZ	Harry Hawthorn, Stephanie Frame, Mike Campbell	Regulator	Maritime NZ Office, Wellington	Project Update and Certificate of Insurance.
13-Jan-21	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Mark Wipatene	Local iwi - existing interests	Taranaki Iwi offices	Project Update and Principles of Partnership Agreement.
10-Feb-21	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Mark Wipatene	Local iwi - existing interests	Taranaki Iwi offices	Project Update and Principles of Partnership Agreement.
16-Feb-21	Lloyd	Webinar for all Interested Stakeholders	O&G Operators, regulators, local government and suppliers.	Multiple	Webinar	Tui Project Webinar
24-Feb-21	Lloyd, Chris	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Mark Wipatene	Local iwi - existing interests	Taranaki Iwi offices	Finalise Details of Partnership Agreement.
24-Feb-21	Lloyd	Taranaki Energy Forum	O&G Operators, regulators, local government and suppliers.	Multiple	New Plymouth Club	Tui Project presentation to Taranaki Energy Forum
25-Feb-21	Melanie	Joint Petroleum Operators' & Regulators' Forum	O&G Operators, Regulators and Local Government	Multiple	Zoom	Tui Project update (highlights from Lloyd's presentation given at the Taranaki Energy Forum)
02-Mar-21	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Mark Wipatene	Local iwi - existing interests	Email correspondence	Final Clarifications on Partnership Agreement.
02-Mar-21	Melanie	WorkSafe	Nick Dawtry and Simon Frazer (video conference).	Regulator	WorkSafe offices	Tui Project presentation (from Energy Forum), update on FPSO disconnection/demob (incl diving), well examination, upcoming FPSO inspection, Safety Case update from WorkSafe.
08-Mar-21	Melanie (with Dan and Rob from SLR)	EPA	Sandra Balcombe, Teresa Calmeyer, Tim Roser, Michaela Aspell, Elliott Dennett, Jillian Kennemore	Regulator - Decom Marine Consent Application	Zoom	Kick-off meeting / introductions for Tui Decom Marine Consent application (MBIE/SLR & EPA)
15-Mar-21	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Leanne Horo,TKoT Board	Local iwi - existing interests	Taranaki Iwi offices	Powhiri to welcome Fran Davey and Partnership Agreement.
16-Mar-21	Lloyd, Melanie, Bob Sadler & Iain McCallum	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano & Fran Davey	Local iwi - existing interests	Tui Project Offices	Introduction of Fran Davey to Tui Project Team
22-Mar-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Shared first set of Tui Project documents: - Emergency Management Plan, Spill Response Plan and SLR's scope of work for preparation of marine consent application.
22-Mar-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Electronic copies of Seaworks ROV Subsea Inspection Report and SLR ROV Survey Assessment of Biological Communities Report.
25-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey, Geoff Otene & Mark Wipatene	Local iwi - existing interests	Email correspondence	Email containing answers to questions from TKoT on overall inventory of what will be recovered from Tui field. Detailed inventory provided as an attachment. Clarification of volumes - 6000 tonnes versus 600 tonnes.
26-Mar-21	Lloyd, Melanie, Bob and Chris Bunny	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Leanne Horo, Jamie Tuuta, TKoT Board	Local iwi - existing interests	Taranaki Iwi offices	Powhiri to Sign TKoT Partnership Agreement.
26-Mar-21	Lloyd, Melanie, Bob and Chris Bunny	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Port Taranaki	Visit to Skandi Hercules - DOF construction vessel contracted to BW for disconnection of FPSO Umuroa.
31-Mar-21	Lloyd, Allison Gandy	EPA	Jillian Kennemore, Teresa Calmeyer, Tim Roser (ph), Simon Coubrough,	Regulator - Compliance and Applications Teams	EPA Offices	Tui Project update presentation to EPA
08-Apr-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey and Geoff Otene	Local iwi - existing interests	Tui Project Offices	Discussion on SLR's scope of work, marine consent application process, proposed environmental monitoring, and TKOT cultural impact assessment. Agreed to provide weekly bullet point update on a Friday. Afterwards emailed through MBIE's letter of intent to EPA, EPA Decision-making timeframes for marine consents, Halliburton flushing procedures, Well Examination Report, Marine Mammal Sightings Forms (Benthic), and Flushing photographs.
09-Apr-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	First weekly bullet point update. Subjects covered; FPSO disconnection and decom marine consent progress re activity description for PnA.

09-Apr-21	Iain	WorkSafe	Nick Dawtry and Simon Frazer (video conference).	Regulator	Video Conference	Discussion on Tui well abandonment strategy.
16-Apr-21	Melanie, Lloyd, Iain, Bob and Ryan Shields	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey, Geoff Otene, Glenn Peri, Toka Walden, Te Uraura Nganeko, Mark Wipatene	Local iwi - existing interests	Taranaki Iwi offices	Introductions - Tui Project Team and TKOT Ohu group Tui Project update presentation, discussion on decom methodology plus fly-over video of Tui infrastructure.
16-Apr-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Weekly bullet point update. Subjects covered: FPSO disconnection progress and decom marine consent update re: pre-lodgement meeting with EPA.
19-Apr-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Email from Fran asking for a meeting with her and Geoff to prepare for Ohu meeting at the end of the week. Received subsequent email from Fran with some information requests/questions, and in response emailed through ROI's for phase 2 & 3, ROI supplier briefing slides, HIRA worksheet for FPSO disconnection, Safety Data Sheet for Transaqua plus answers/responses to questions raised re: FPSO disconnection.
21-Apr-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey & Geoff Otene	Local iwi - existing interests	Taranaki Iwi offices	Catch-up in advance of meeting/planning session between Fran and TKoT Ohu group scheduled for Friday 23rd April. On following day (22 April) emailed through Tui Field Flushing spreadsheet, final Xmas tree status, umbilical abandonment head picture, SLR memo on env monitoring and activities matrix. Plus additional information to be provided and timeframes.
23-Apr-21	Melanie	EPA	Jillian Kennemore	Regulator - Applications	Phone	Jillian called to thank us for pre-reading ahead of pre-lodgement meeting and gave heads-up that they will need to adjust BOI terms of engagement to reflect likely need for discharge marine consent too. I confirmed that initial assessments look like it would be required and best to work on that basis.
29-Apr-21	Melanie, Lloyd, Sean, Allison, Ayesha Amin & Chris	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey and Geoff Otene	Local iwi - existing interests	Monicas	Introductions - Wellington and Auckland based Tui Project team members and TKoT iwi engagement lead.
29-Apr-21	Melanie & Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey and Geoff Otene	Local iwi - existing interests	Taranaki Iwi offices	Discussion regarding actions/items arising from 16th April Ohu planning meeting. Items raised included: ceremony to remove name from Umuroa before she departs Tui field, update on mooring chain disconnection progress, environmental monitoring (benthic survey results from previous two years), 'partnership' between MBIE and TKoT (if this would be reflected in RFP), employment opportunities, long term monitoring of Tui Field, project reporting.
29-Apr-21	Melanie, Ryan & SLR - Dan & Rob	EPA	Jillian Kennemore, Tim Roser, Tuf Ioane, Michaela Aspell and Terry Calmeyer.	Regulator	Zoom	Pre-lodgement meeting - proposed monitoring of Tui field decommissioning and matrix of activities (triggering Reg 20 EEZ (Environmental Effects)).
30-Apr-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Weekly bullet point update. Subjects covered: FPSO disconnection progress and decom marine consent update re: pre-lodgement meeting outcomes, and decom procurement update. Requested from TKoT: engagement plan, monthly report, scope of work and costings for CIA to enable a contract to be prepared.
04-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey, Geoff Otene, Glenn Peri, Te Uraura Nganeko and Albie Martin	Local iwi - existing interests	Oaonui	Ceremony to uplift the name from FPSO Umuroa.
06-May-21	Melanie	WorkSafe NZ, Maritime NZ, EPA	Nick Dawtry and Simon Frazer, David Vincente, Simon Coubrough	Regulators	Email correspondence	Note advising FPSO Umuroa had been disconnected from Tui Field and was in Tasman Bay.
07-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Weekly bullet point update. Subjects covered: FPSO disconnection - departed on Wed 5 May. Decom marine consent update re: decom plan, existing interests section and activities description section. Attached report for Tui field benthic survey undertaken by TTL in 2019.
10-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Draft Existing Interests section for review and advised of our intention to engage with the commercial fisheries in next couple of weeks.
11-May-21	Lloyd & Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey & Geoff Otene	Local iwi - existing interests	Monicas	Meeting to review TKoT's draft monthly report, brief update from MBIE on FPSO disconnection, and process for CIA.
12-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey and Geoff Otene	Local iwi - existing interests	Email correspondence	Email response to TKoT questions regarding mooring chains and anchors recovery. Included copies of ruling certificates for FPSO disconnection and mooring spread recovery.
13-May-21	Lloyd & Fran (TKoT)	Taranaki Chamber of Commerce	Arun Chaudhari, Brad Kisby	Local Business Representation	Chamber Offices	Update meeting on Tui Decommissioning.

14-May-21	Dan (SLR)	Moana Seafoods	Online contact form	Fisheries	Online Contact form	No email or contact details could be found so an enquiry was sent through the online contact form. The note explained the upcoming decomissioning programme and consent application and a request was made to have a meeting or call with the appropriate person.
14-May-21	Dan (SLR)	Te Ohu Kaimoana	Kirsty Woods	Fisheries	Email correspondence	Email request was sent providing an update of the Tui Oil Field decomissionong programme and a request to meet to discuss what is being propoosed, the regulatory process and timings. Offered to meet in person or via Teams.
13-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey & Geoff Otene	Local iwi - existing interests	Email correspondence	Email with answers to questions and documents arising from catch-up on 11 May. Provided all documents associated with decom marine consent in one email: Proposed Tui Oil Field Monitoring memo, activity matrix, existing interests section, table of contents (marked-up to show what had been provided to-date), plus slide pack containing information on SLR's background and scope of work, decom regulations and decision timeframes, and decom marine consent application process.
14-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Weekly bullet point update. Subjects covered: final details of FPSO departure and advised that Siem Amethyst will be offloading mooring chains, plus plans to utilise Amethyst to remove the remaining anchors and chains. Decom marine consent procurement update and availability to meeting with TKoT, Sera and Sean regarding CIA.
17-May-21	Melanie & Bob	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey & Geoff Otene	Local iwi - existing interests	Email correspondence	Emailed response to questions from Fran re: mooring anchors and chain, including ownership and procedures for recovery. Attached table of quantities recovered to-date and BWU procedure.
18-May-21	Melanie & Dan (SLR)	The Deepwater Group	Richard Wells & one other	Fisheries	Microsoft Teams	Consultation with commercial fisheries - identified as having existing interests. Deepwater Group are familiar with the O&G industry. Provided with high level summary of activities and timelines. Some further information to be shared for circulation within group. Happy to provide supporting submission once consent is lodged. Query about access to footage from ROV survey in Dec.
18-May-21	Lloyd	Taranaki Energy Forum	O&G Operators, regulators, local government and suppliers.	Multiple	New Plymouth Club	Tui Project Update provided at Energy Forum.
24-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Weekly bullet point update. Subjects covered: retrieval of mooring chains and anchors progress, provided disposal certificate for sluge waste from Umuroa. Decom marine consent - attached draft activity description section for review and comment. Procurement update - PnA.
26-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Sean Zieltjes, Sera Gibson, and Fran Davey	Local iwi - existing interests	Email correspondence	Emailed all information applicable to CIA (following from Tui decom hui / CIA meeting on 19 May): proposed Tui Oil Field Monitoring Memo, Activities Matrix, Existing Interests and Engagement Section, Detailed Activity Description, plus Existing Environment Section. Offered to make Tui team available at any time to go through the information and/or answer any questions. Also provided SLR's Report - Tui Field ROV Survey Biological Communities.
27-May-21	Lloyd & Melanie	Joint Operators' and Regulators' Forum	O&G Operators, regulators (MfE, EPA) and local government.	Multiple	Zoom	Tui Project Update slides presented and some discussion around marine consent process.
28-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Follow-up email requesting scope of work, deliverables and costs for CIA, as well as update on progress. Offered to provide another Tui Project team update / presentation at the next Ohu group meeting.
28-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Weekly bullet point update. Subjects covered: confirmation that removal of all anchors and chains completed. Decom marine consent: updated well examination for all Tui wells expected in next couple of weeks. Reiterated no news from Sean re: CIA and that we hoped to hear on Monday on progress and timing to meet and review information provided.
31-May-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Following a call seeking update on the CIA, emailed through the Mauri Cultural Matrix previously used by Taranaki iwi, and shared the latest contents table for the marine consent application.
1-Jun & 2-Jun-21	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Phone calls (2x)	Progress on CIA.

03-Jun-21	Chris Mathieson	Grant Thornton	David Ruscoe & Malcolm Moore	Liquidators - holder of PMP 38158	Email correspondence	Letter sent (as holders of an existing interest) seeking written approval of Tui decommissioning activities. Update: Grant Thornton subsequently provided written approval on 14 June 2021.
03-Jun-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Sean Zieltjes, Sera Gibson, and Fran Davey	Local iwi - existing interests	Email correspondence	Emailed answers to questions raised by Sean on phone call regarding availability of environmental monitoring records / baseline information for Tui field pre production. Included attachments - 2019 ecological effects monitoring report.
04-Jun-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Sean Zieltjes, Sera Gibson, and Fran Davey	Local iwi - existing interests	Email correspondence	Emailed latest draft of decom activities section which included revised Tui oil field monitoring. Offered to talk through information provided.
08-Jun-21	Dan (SLR)	Moana Seafoods	Online contact form	Fisheries	Online Contact form	No email or contact details could be found so an enquiry was sent through the online contact form. The note explained the upcoming decomissioning programme and consent application and a request was made to have a meeting or call with the appropriate person to discuss the regulatory process and timings etc.
08-Jun-21	Dan (SLR)	Te Ohu Kaimoana	Kirsty Woods	Fisheries	Email correspondence	Folllow up email to request an opportunity to meet and go through the consent application that is being prepared for the decomissioning of the Tui field.
09-Jun-21	Lloyd, Melanie and Chris	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Fran Davey, Mark Wipatene, Sean Zieltjes, Sera Gibson	Local iwi - existing interests	Taranaki Iwi offices	Meeting to review progress on CIA, procurement update, stakeholder engagement plan.
11-Jun-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Sean Zieltjes, Sera Gibson, and Fran Davey	Local iwi - existing interests	Email correspondence	Emailed draft proffered conditions section.
11-Jun-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Weekly bullet point update. Subjects covered: decom procurement update, timing for submission of pre-lodgement of marine consent application to EPA.
16-Jun-21	Melanie	EPA	Jillian Kennemore	Regulator	Email correspondence	Submission of pre-lodgement draft of Tui decommissioning marine consent application for EPA review.
17-Jun-21	Lloyd, Melanie and Chris	Te Kāhui O Taranaki (Taranaki Iwi)	Mark Wipatene, Fran Davey, Geoff Otene, and Sean Zieltjes.	Local iwi - existing interests	Zoom	Discussion on CIA budget and scope.
17-Jun-21	Melanie, Ryan and SLR - Dan and Rob.	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey, Geoff Otene, Sean Zieltjes, and Sera Gibson.	Local iwi - existing interests	Tui Project Meeting Room @ Manifold & MS Teams.	Review of proffered consent conditions draft, input from CIA work to date, discussion on draft CIA findings / recommendations. Subsequently emailed through Impact Assessment section of application and on a further separate email provided Tui Field Ecological Effects Monitoring report for February 2021.
18-Jun-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Response to email question regarding restoration of seabed (discussed on Thursday). Provided some clarifications on what was outlined in proposed Tui decom monitoring and confirmed Fran's question had been passed onto SLR to answer. Dan from SLR subsequently provided detailed email response to Fran's question which was forwarded on.
18-Jun-21	Melanie	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey	Local iwi - existing interests	Email correspondence	Weekly bullet point update. Subjects covered: confirmation that pre-lodgement draft on marine consent application submitted to EPA on Wednesday, and SLR had marked-up proffered consent conditions document following meeting on Thursday and we were awaiting CIA information on Monday. Would make any further updates before sending back ahead of next meeting on Wed 23rd.
23-Jun-21	Melanie, Ryan and SLR - Dan, Rob and Stephen.	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey, Sean Zieltjes, Geoff Otene	Local iwi - existing interests	Taranaki Iwi offices and Zoom	Follow-up meeting on CIA to review draft conditions framework and updates to proffered consent conditions. Draft conditions framework has been further updated and issued to hapu for review/agreement. Deadline is 30 June. No further changes to proffered conditions identified.
06-Jul-21	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Wharehoka Wano, Fran Davey, Geoff Otene	Local iwi - existing interests	Taranaki Iwi offices	Preparation meeting for Iwi of Taranaki Dinner 7 July.
07-Jul-21	Lloyd, Bob, Ryan, Chris	Iwi of Taranaki	Leanne Horo, Wharehoka Wano, Fran Davey, Mark Wipatene, Tina (Taranaki Iwi); Dion Tuuta (Te Atiawa); Anaru Marshall, ANO (Ngati Maru); Te Uraura Nganeko (Nga Ruahine), Glen Peri and	Local iwi - existing interests	Novotel	Iwi of Taranaki Dinner jointly hosted by TKoT/MBIE. Presentation to describe TKoT Partnership and Decommissioning approach, followed by Q&As and discussion. Note: all eight Iwi were invited but four declined/did not attend.
09-Jul-21	Lloyd	Te Kāhui O Taranaki (Taranaki Iwi)	Fran Davey & Geoff Otene	Local iwi - existing interests	Taranaki Iwi offices	Review of Iwi of Taranaki Dinner and discussion of next steps for iwi engagement.

13-Jul-21	Dan (SLR)	Te Ohu Kaimoana	Te Ohu Kaimoana	Fisheries	Phone	A call was made to Te Ohu Kaimona, given no returned emails, which was due to Kirsty Woods no longer working there. An update was provided on the project and a request to meet was made - which was agreed. They provided contact details of her manager to send the request through to for a meeting invite.
13-Jul-21	Dan (SLR)	Te Ohu Kaimoana	Kim Drummond	Fisheries	Email correspondence	An email was sent providing Kim with an update on the Tui field decomissiong project and consenting process. A request was made to meet with Te Ohu to go through the proposed activities, consenting process and timings. The fisherires assessment was provided in the email and the fisheries specific information sheet was also provided.
16-Jul-21	Melanie, Dan (SLR)	Te Ohu Kaimoana	Kim Drummond	Fisheries	MS Teams meeting	A meeting was held to provide Te Ohu Kaimoana with an overview of the consenting programme, ruling application, FPSO demobilisation activities, regulatory process and timings of both consenting, removal of subsea infrastructure and plug and abandoning of the wells. Te Ohu Kaimoana are mandated to represent the 58 iwi quota holders so this applicaton was of interest to them. Overall they were glad to hear that all of the infrastructure will be removed. The fisheries assessment and commercial fisheries information sheet had been provided prior to the meeting for pre-reading. It was discussed that it was only the deepwater fisheries that this application would be of interest to, and of that, only the vessel Tokatu is likely to fish in this region. Tokatu is Sealords latest factory trawler which targets jack mackeral in the South Taranaki Bight when the season is in, and this vessel, via Sealords will also be aware of the application through the engagement with the Deepwater Group to date. MBIE are going to provide Kim with the final draft of the consent application, which will then be used to get a head start on the regulatory process which they said can often be tight, so were appreciative of the early documentation to provide a head start on discussions and review of the application.

APPENDIX I

Written Approval

Grant Thornton

Environmental Protection Authority
C/- Chris Mathieson
Ministry of Business Innovation & Employment
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14 June 2021

Dear Sirs

Affected person's written approval to an activity that is the subject of a marine consent application

For the purposes of section 59(5)(c) of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012

Name of person giving written approval: David Ian Ruscoe and Malcolm Russell Moore, Liquidators of Tamarind Taranaki Limited (in Receivership and in Liquidation), Stewart Petroleum Co Limited (in Receivership and in Liquidation) and W M Petroleum Limited (in Receivership and in Liquidation) (together "the Companies")

The Companies are the legal holders of Petroleum Mining Permit 38158, located within the Taranaki Basin.

This is written approval to the following activities that are the subject of an application for marine consent and marine discharge consent:

To undertake the following activities associated with the decommissioning of the Tui field:

- Removal of all the existing subsea infrastructure, including some located beneath the seabed;
- Plugging and abandoning of eight wells;
- Environmental monitoring involving grab samples of seabed material and benthic imagery;
- Contingency discharge of cement; and
- Discharge of harmful substances.

In signing this written approval, we understand that the consent authority must not have regard to any adverse effects on us as provided for by section 59(5)(c) of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012.

We understand that we may withdraw our written approval by giving written notice to the consent authority before the hearing, if there is one, or, if there is not, before the consent authority decides the application.

Yours sincerely

David Ruscoe
Liquidator
Tamarind Taranaki Limited (in Receivership and in Liquidation), Stewart Petroleum Co Limited (in Receivership and in Liquidation) and W M Petroleum Limited (in Receivership and in Liquidation)

APPENDIX J

Harmful Substances Assessments

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