



Environmental
Protection Authority
Te Mana Rauhi Taiao

EPA Staff Report

EEZ000006

Chatham Rock Phosphate Limited Marine Consent
Application

August 2014



Executive Summary

On 14 May 2014, Chatham Rock Phosphate Ltd (CRP) lodged an application with the Environmental Protection Authority (EPA) for a marine consent. Consent is being sought by CRP to mine phosphate nodules from the Chatham Rise, initially within CRP's 820 km² mining permit area for the first five years. In future, CRP's proposed mining may occur within a wider area (5,207km²) for up to a further 30 years.

The proposed mining activity, using a conventional drag-head to remove up to 0.5 m of the seabed, has the potential to adversely affect benthic communities, pelagic species, marine mammals, seabirds, human health, commercial fisheries and Māori/Moriori cultural interests. The EPA staff consider that the proposed mining activity would result in two primary environmental effects: the direct effects associated with the extraction of "living" and non-living natural material which will destroy the seabed down to a sediment depth of 0.5 m, and the discharge of mine tailings that would generate a suspended sediment plume, some of which would deposit on the seabed.

The proposed marine consent area on the Chatham Rise provides habitat for a biologically diverse benthic community, including protected species, such as stony corals, other sensitive species including sponges, bryozoans and brachiopods and unique species such as giant isopods and bivalve molluscs. Many of these species perform important ecosystem services by providing habitat for a diverse and abundant range of other species. The proposed mining activity would result in the total destruction of these species and their habitats within the mined area, with the potential for minimal recovery (if any) of many of these species. The extent to which this destruction would affect the biological diversity of the Chatham Rise ecosystem and the protection of rare and other vulnerable ecosystems is the most significant uncertainty.

The generation of a sediment plume from the discharge of mine tailings would increase sedimentation rates and the levels of total suspended solids. The disturbance and mobilisation of the sediment also has the potential to alter biogeochemical processes within the proposed marine consent area. Significant uncertainty remains with respect to the validity of many of the environmental models used by CRP, and the exact extent to which the sediment plume would impact on benthic communities and fish species beyond the mining blocks. Many of the species identified in the proposed marine consent area are likely to be vulnerable to increased rates of sedimentation and total suspended solids. Therefore, the EPA staff consider that the discharge of mine tailings may also have significant adverse effects on benthic communities and associated species beyond the areas that are to be mined.

The Chatham Rise is home to New Zealand's most productive commercial fisheries. The proposed marine consent area covers over 90 % of the Mid-Chatham Rise Benthic Protection Area (considered a Marine protected Area by the International Union for the Conservation of Nature and the United Nations Environment Programme), an area closed to bottom fish trawling since 2007. The destruction of benthic habitats and the disturbance of some commercial fish species at key stages of their life cycle could affect fish stocks and, therefore, commercial fishing interests.

With respect to any potential effects on existing Māori/Moriori cultural interests, the EPA staff consider that these interests must be taken into account when making a decision on the application.

CRP's proposed mining activities would have significant adverse effects on a biologically diverse benthic community. Significant gaps in the information remain, and there is uncertainty about the ability to avoid, remedy or mitigate the adverse effects of these proposed mining activities. The EPA staff are not currently

able to recommend granting this marine consent on the face of CRP's application as it stands, but recognise that there is more information to be provided, which may change our view. Should the DMC be of the mind to grant the consent subject to conditions, after taking into account any relevant information, the EPA staff have attached a preliminary set of draft conditions to this report as a starting point.

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1. SCOPE OF REPORT

- 1 This Staff Report is a commissioned report under section 44 of the EEZ Act to inform the Decision-making Committee (DMC) and parties to the application for marine consent by Chatham Rock Phosphate Ltd (CRP).
- 2 Section 4 of this report presents a brief analysis of submissions made on the application.
- 3 Section 6 provides some background information from CRP's application and a consideration of the uncertainties associated with this information, the use of best available information, and the potential effects of the proposed mining activities on the environment and human health.
- 4 Section 7 provides some background information from CRP's application and a consideration of the uncertainties associated with this information, the use of best available information, and the potential effects of the proposed mining activities on Māori and existing interests.
- 5 In preparing this report, the following documents were taken into account:
 - a. the Environmental Protection Authority's (EPA) prescribed application form, submitted by the applicant on 14 May 2014
 - b. the applicant's Marine Consent Application and Environmental Impact Assessment (MCA-EIA) and associated Appendices ('the application'), lodged 14 May 2014
 - c. the review reports that were commissioned from external reviewers for the EPA by the EPA staff under s44 of the EEZ Act: Jacobs New Zealand Ltd (received 11 June 2014), Boffa Miskell (received 19 May 2014), Sapere Research Group (received 19 May 2014), Johanna Pierre Environmental Consulting (received 23 May 2014) and Gardline Marine Sciences Pty. Ltd (received 21 May 2014)
 - d. the Analysis of Submissions Report dated July 2014
 - e. Māori iwi and Moriori imi submissions (submissions 110221, 110139 and 110095), received during the submission period 12 June to 10 July 2014
 - f. the Cultural Impact Assessment Report from Ngāi Tahu, received 9 July 2014
 - g. the Ngāi Tahu Claim Settlement Act (1998)
 - h. additional information received from the applicant on 27 June 2014, 1 July 2014, 7 July 2014, 8 July 2014, 21 July 2014 (including the revised response provided on 5 August 2014), 25 July 2014 and 1 August 2014, in response to further information requests (FIRs) under s42 of the EEZ Act.

Note: Not all of CRP's responses to the FIRs were considered for the purposes of this Staff Report due to the timing of their receipt. For completeness, the following

responses to FIR, 12 - 15, 17 - 18, 28 - 33, 34 - 37 and 41 - 43, and any other FIRs that the DMC requested in July 2014 will need to be considered by the DMC.

2. APPLICATION SUMMARY AND BACKGROUND

2.1 Summary

Application Code EEZ000006	
Application Type	Marine consent to undertake a discretionary activity under Section 38 of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 ('the EEZ Act')
Application Sub-Type	Notified
Applicant	Chatham Rock Phosphate Ltd (CRP)
Purpose of the application	To mine phosphate nodules from the crest of the Chatham Rise (250 - 450 m depth) for a duration of 35 years, for use as low-cadmium content, slow-release land fertiliser
Date Application Received	14 May 2014
Submission Period	12 June - 10 July 2014
Submissions received	293
Information request	Further information was requested of CRP by the EPA on 9 June 2014 and received in separate parts on 27 June, 1 July, 7 July, 8 July, 21 July, 25 July (revised on 5 August 2014), and 1 August 2014 (responses to <i>FIR</i>, 12 – 15, 17 – 18, 34 – 37 and 41 – 43 had still not been received on 7 August 2014) Further information was also requested by the DMC on 17 and 25 July 2014. Responses to these requests had not been provided by 7 August 2014
Hearing dates	25 September - 20 November 2014

2.2 Background

- 6 CRP propose to mine phosphate nodules from the Chatham Rise (250 - 450 m depth), approximately 450 km east of Christchurch, initially within CRP's 820 km² mining permit area¹ for the first five years. In future, CRP's proposed mining may occur within the wider marine

¹ The mining permit was granted by New Zealand Petroleum and Minerals under the Crown Minerals Act 1991 until December 2033

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consent application area (5,207km²) for up to a further 30 years. That area includes CRP's existing mining permit area, its revised continental shelf licence area, and one new prospecting permit area for which it has applied (Figure 1). On 1 August 2014, CRP informed the EPA staff of the removal of the eastern block (PP55967) from the proposed marine consent application area. CRP proposes to mine at least 30 km² of seabed per annum (in mining blocks, 2 km wide x 5 km long) to meet its annual minimum production target of 1.5 million tonnes of phosphate nodules².

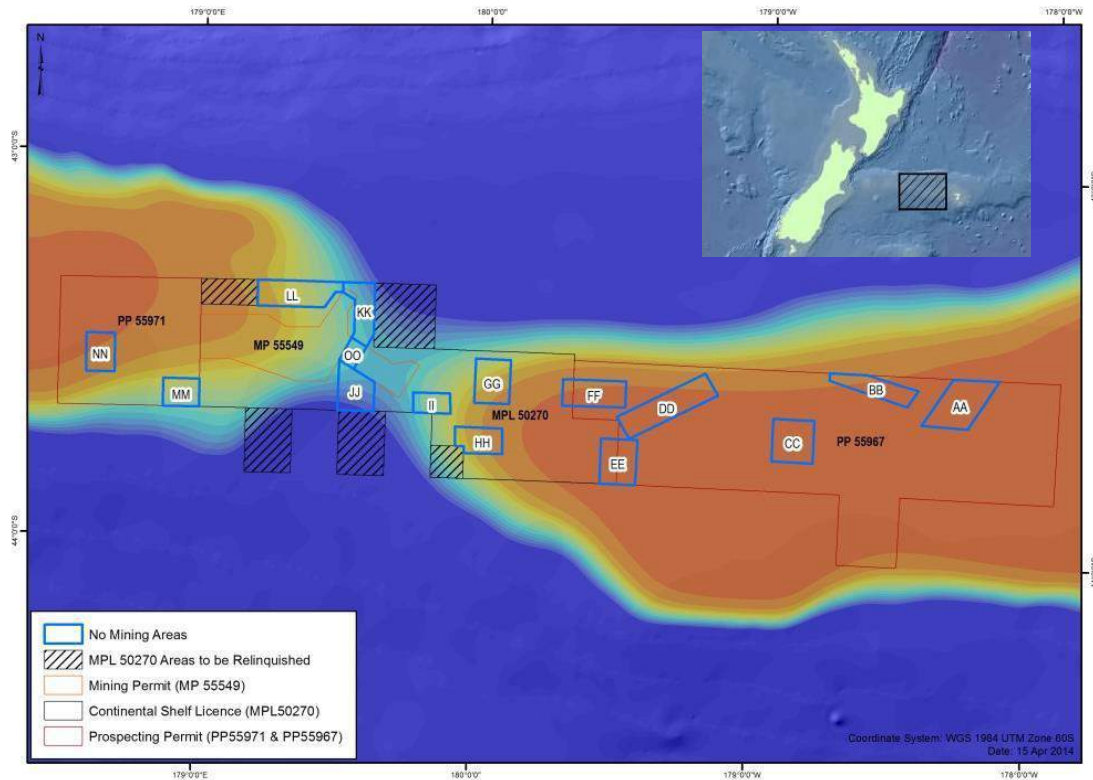


Figure 1. CRP's original proposed marine consent area (10,192 km²), including the mining permit area MP55549, the revised continental shelf license area MPL50270 for prospecting and the prospecting permit area PP55971 for which it has recently applied. The original proposed mining exclusion areas are shown in blue. Prospecting permit area PP55967 on the eastern end of this map is no longer a part of the marine consent area

- 7 The mining method will involve 'sucking' up to a 0.5 m deep layer of the seabed (all material < 15 cm, filtered by a screen) with a 4.5 - 6 m wide trailing suction head dredger (drag-head). The drag-head will be connected to a pump frame (combined weight of 330 - 350 tonnes) that is

² For clarification purposes, this production target represents the phosphate nodules after separation from the total amount of material excavated

suspended from a vessel by wires. The final design and building of the mining equipment has not yet been carried out. Dependent on final design, the drag-head could also be assisted by cutting teeth³. The pumping unit will contain oil and will be equipped with a hydraulic power pack to pump jet-water to the drag-head to loosen seabed material. The mined sediment will be pumped through flexible hoses to a mining vessel where phosphate nodules > 2 mm will be separated from other material using sieves, logwashers and cyclones (but no chemicals), and stored on the vessel. The remaining material (including phosphate nodules < 2 mm and any marine organisms < 15 cm) will be released back into the water, close to the seabed through a sinker and diffuser hose.

- 8 The mined phosphate nodules will be transported once every 10 days (or once the vessel's hold is at full capacity) to a designated New Zealand port, the location of which is yet to be confirmed. The port of call will have handling and storage capabilities for delivery of the phosphate nodules to national and international destinations.
- 9 CRP also proposes to undertake environmental surveying and monitoring activities that includes seabed sampling, the placement of mooring landers, hard substrate trials and possible habitat creation for the purposes of encouraging the re-establishment of benthic communities in mined areas.

2.3 Proposed activities

- 10 Section 20 of the EEZ Act describes the restrictions on activities in the Exclusive Economic Zone, and in or on the Continental Shelf. No person may undertake an activity described in subsection (2) or (4) unless the activity is a permitted activity, authorised by a marine consent or authorised by sections 21, 22 or 23.
- 11 The activities that CRP have applied for in their marine consent application⁴ relate to sections 20(2) and 20(4) of the EEZ Act:
 - a. *the construction, placement, alteration, extension, removal or demolition of a structure on or under the seabed (s20(4)(a));*
 - b. *the removal of non-living natural material from the seabed or subsoil (s20(2)(d));*
 - c. *the disturbance of the seabed or subsoil in a manner that is likely to have an adverse effect on the seabed or subsoil (s20(2)(e));*
 - d. *the deposit of any thing or organism in, on, or under the seabed (s20(2)(f));*

³ Sections 4.4.3, 4.4.4, 8.7.3 and 12.4.2 of the application

⁴ See the EPA's prescribed application for a marine consent, pages 3 - 4

- e. *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 (s20(2)(g));*
 - f. *the causing of vibrations (other than vibrations caused by the normal operation of a ship) in a manner that is likely to have an adverse effect on marine life (s20(4)(b));*
- 12 CRP has also identified parts of its proposed mining operation as s20C activities (mining discharges). Section 20C of the EEZ Act is not yet in force. Activities described as s20C activities have been considered by the EPA for the purposes of understanding the proposal as a whole, for example, the effects associated with the discharge of mine tailings. However, these activities have not been considered as s20C activities for which consent are sought.
- 13 The specific activities from CRP's mining plan⁵ that are associated with s20 of the EEZ Act activities described above are:
- The placement of monitoring equipment, consisting of up to four mooring landers, including their relocation and eventual removal, on the seabed as part of CRP's proposed monitoring programme (s20(2)(a)).
 - The removal of non-living natural material (phosphorite nodules from the mining operations and seabed samples from the environmental monitoring programme) from the seabed and subsoil (s20(2)(d)).
 - The disturbance (if not damage) of the seabed and subsoil from CRP's mining operations and the collection of seabed samples from the environmental monitoring programme, such that there is the potential for adverse effects on the seabed and marine species and habitats (ss20(2)(e)(g)).
 - The deposition, or discharge (mining discharge from a ship), of material back onto the seabed through the return of the non-phosphatic material following processing of the mined material on the vessel (ss20(2)(f), 20A(2) and 20C⁶).
 - The deposition of hard substrate onto the seabed as part of the proposed monitoring programme's recolonisation trials, and any subsequent habitat creation activities that may follow these trials (s20(2)(f)).
 - The generation of noise, and possibly vibrations, that may be associated with the operation of the mining equipment in the water column and on the seabed, specifically the drag-head and associated equipment, and with the return of non-phosphatic material to the water column and seabed (s20(4)(b)).

⁵ Section 2.3 of the application

⁶ As noted above, ss20A and 20C are not yet in force

2.4 Permitted activities

- 14 CRP has sought marine consent for activities that could be undertaken without consent under the Exclusive Economic Zone and Continental Shelf (Environmental Effects — Permitted Activities) Regulations 2013 ('the Permitted Activity Regulations'). A marine consent is not required provided the conditions set out in the regulations are complied with.
- 15 Those permitted activities include the placement of monitoring equipment, the collection of seabed samples and the deposition of hard substrate as part of possible recolonisation trials (classified as marine scientific research and prospecting and exploration), which are captured by regulation 5.
- 16 The reason for CRP including these activities in its marine consent application is because it considered that *"seabed mining is a discretionary activity, not a permitted activity, and these components of the monitoring and exploration programmes are inherently linked to CRP's mining operations"*⁷.
- 17 Section 59(2)(k) of the EEZ Act requires the DMC to take into account relevant regulations in deciding this application.
- 18 Therefore, in considering any final conditions on those activities, the DMC will need to consider the default conditions that would otherwise apply to those permitted activities. The DMC may consider a departure from those default conditions where it considers that imposing those conditions would result in the duplication of this consenting process.

3. PROCESS, NOTIFICATION AND CONSULTATION

3.1 Process and notification

- 19 The application was lodged pursuant to s38 of the EEZ Act on 14 May 2014.
- 20 CRP's application was considered against the requirements of ss38 and 39 of the EEZ Act for a determination of completeness. The application was not returned as incomplete on 28 May 2014.
- 21 The DMC must make an informed decision on CRP's application according to the specific matters outlined in ss59 - 60 of the EEZ Act and base its decision on the best available information, including taking into account any uncertainty or inadequacy in the information available as outlined in s61 of the EEZ Act. To this end, the EPA requested the applicant to provide 44 items of further information under s42 of the EEZ Act on 9 June 2014.

⁷ Section 2.3 of the application

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- 22 Responses to 12 of the 44 Further Information Requests (FIRs) requested on 9 June 2014 were provided by the applicant on 27 June 2014, six by 8 July 2014, four on 21 July 2014 (one of which was later revised on 5 August 2014), six on the 25 July 2014 and two on 1 August 2014. As at 7 August 2014, fourteen responses to the FIRs were outstanding. Only the responses to FIR 1 - 11, 16, 19, 20 - 27, 38 - 39, 40 and 44 were considered in this report.
- 23 Under section 45 of the EEZ Act, if the EPA is satisfied that an application for a marine consent is complete, public notice of the application must be given and a copy of this notice must be served to: Government Ministers with responsibilities that may be affected by the activity for which consent is sought; Maritime New Zealand (MNZ); iwi authorities; customary marine title groups; protected customary rights groups; other persons that the EPA considers have existing interests that may be affected by the application; and, regional councils whose regions may be affected by the application.
- 24 The application was publically notified on 12 June 2014 under section 45 of the EEZ Act.
- 25 A total of 1037 parties were served a copy of the public notice by post and/or email, including:
- a. ten Ministers with responsibilities that may be affected by the activity for which consent is sought
 - b. Maritime NZ
 - c. 98 iwi authorities, including those with existing fisheries interests
 - d. groups that the EPA considered to have existing interests that may be affected by CRP's application, including six Chatham Island groups, 909 commercial fishers as identified by FishServe⁸, Deep Water Group and Seafood NZ
 - e. groups that the Department of Conservation (DOC) considered to have existing interests that may be affected by CRP's application including, Heritage Expeditions Ltd, Hotel Chathams, Hokotehi Moriori Trust, Chatham Island Taiko Trust, DOC (Marine Species and Threats), Executive NIWA, GNS, Wrybill Birding Tours NZ and South East Shipping Ltd
 - f. Chatham Islands Council
 - g. Environment Canterbury.
- 26 The submission period was from 12 June 2014 until 10 July 2014 (see Section 4 below).
- 27 Public notice of the hearing is expected to take place on 28 August 2014. The hearing procedures can be found on the EPA website.

⁸ A company contracted by MPI to administer fisheries quota and other related information

3.2 Consultation

- 28 CRP has been consulting with a range of people and groups with existing interests since 2010⁹. CRP advise that some of the ideas and concerns that these conversations raised during consultation were incorporated into the application during the design and planning phases.
- 29 CRP note in its application that the parties consulted included:
- a. commercial fishing industries, including Deep Water Group Ltd, Ngai Tahu, Sanford Ltd and Talley's Group Ltd, New Zealand Rock Lobster Industry Council, Paua Industry Council Ltd, Seafood New Zealand, Te Ohu Kai Moana, Koau Capital
 - b. Māori iwi, including Ngati Mutunga o Wharekauri, Te Runanga o Ngai Tahu, Ngati Kahungunu, Rangitane o Wairarapa, the iwi of Te Tau Ihu (particularly Rangitane o Wairau), Ngati Toa Rangatira, and Taranaki Whanui ki te Upoko o Te Ika a Maui
 - c. other Māori interest groups including the Iwi Chairs Forum and the Federation of Māori Authorities
 - d. Moriori imi
 - e. the Chatham Islands' community, including the Chatham Islands' Council, leaders of the fishing and farming communities (such as Federated Farmers of New Zealand), and conservation and voluntary organisations (such as Chatham Islands Enterprise Trust, Chatham Islands Heritage and Restoration Trust, and Chatham Islands Conservation Board), and landowners in and around Ocean Bay and Port Hutt
 - f. the public, including community groups such as Kaingaaroa and school groups
 - g. several government officials and politicians (including MPs, Ministers)
 - h. political parties, including the Labour and Green parties
 - i. government agencies, including Ministry of Primary Industries (MPI); Ministry of Business, Innovation and Employment (MBIE); NZ Trade and Enterprise; DOC; Ministry for the Environment (MfE)
 - j. non- governmental environmental organisations, including ECO, Ecologic, Pew Foundation, Kiwis Against Seabed Mining (KASM), Worldwide Fund for Nature (WWF), Royal Forest and Bird Protection Society, Environmental Defence Society (EDS), Soil and Health Association and Greenpeace New Zealand

⁹ See Chapter 7 of the application

- k. other industry groups, including Business New Zealand, Fonterra Co-operative Group Ltd, Straterra and the Oceans Group.

4. SUBMISSIONS

- 30 Under section 59(3)(a) of the EEZ Act, the DMC when making its decision must have regard to any submissions made and evidence given in relation to the application.
- 31 The EPA received 293 submissions on CRP's application, 75 of which wish to be heard at the hearing. The Analysis of Submissions includes a complete list of the submissions received (See Appendix 1).

4.1 Submissions by location

- 32 The submissions received were mostly from New Zealand, from 17 different regions. The highest number of submissions came from the Wellington, Waikato, Auckland, Taranaki, Canterbury, Otago and Chatham Islands regions.
- 33 Twenty four submissions were received from international locations including Namibia, Switzerland, United Kingdom, Australia, the Netherlands, United States, Singapore, Canada, Malaysia and the United Arab Emirates.

4.2 Submissions with Māori/Moriori cultural (existing) interests

- 34 The EPA received 11 submissions from Māori iwi and Moriori imi.
- 35 A discussion on Māori/Moriori cultural (existing) interests is provided in Section 7.3 using the following information:
 - a. Sections 7 (consultation) and 9 (Social, Cultural and Economic Impact Assessment) of CRP's application
 - b. the Cultural Impact Assessment Report from Ngāi Tahu
 - c. Ngāi Tahu Claim Settlement Act (1998)
 - d. submissions: Te Rūnanga o Ngāi Tahu (110221); Ngāti Mutunga o Wharekauri Trust (110139); Hokotehi Moriori Trust (110095).
- 36 Draft Cultural Impact Assessments (CIAs) from Ngāti Mutunga o Wharekauri Trust (NMoWT) and Hokotehi Moriori Trust (HMT) were provided by CRP, as part of its application. CRP advised via their response to FIR 44, received on 27 June 2014, that these CIAs would not be updated, as both parties would be finalising their position via submissions. Therefore, any reference to Ngāti Mutunga and Moriori information in this report refers to their submission rather than the CIA included in CRP's application.

5 STATUTORY FRAMEWORK

37 The following sections set out a general description of the statutory framework that the DMC must apply when considering CRP's marine consent application.

5.1 Decision to grant or refuse the application

38 Section 62 provides that the DMC may grant an application for a marine consent, in whole or in part, and either issue a marine consent or refuse the application. If the DMC decides to grant an application for a marine consent, then the DMC may impose conditions to deal with any adverse effects in accordance with s63 of the EEZ Act. However, a decision under s62 can only be made after the DMC has complied with ss59 - 61 of the EEZ Act. Sections 59 - 61 are the key sections that apply to the DMC's decision and are set out below:

59 Environmental Protection Authority's consideration of application

- (1) *This section and [sections 60](#) and [61](#) apply when the Environmental Protection Authority is considering an application for a marine consent and submissions on the application.*
- (2) *The EPA must take into account—*
 - (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*
 - (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*
 - (c) *the effects on human health that may arise from effects on the environment; and*
 - (d) *the importance of protecting the biological diversity and integrity of marine species, ecosystems, and processes; and*
 - (e) *the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species; and*
 - (f) *the economic benefit to New Zealand of allowing the application; and*
 - (g) *the efficient use and development of natural resources; and*
 - (h) *the nature and effect of other marine management regimes; and*
 - (i) *best practice in relation to an industry or activity; and*
 - (j) *the extent to which imposing conditions under section 63 might avoid, remedy, or mitigate the adverse effects of the activity; and*
 - (k) *relevant regulations; and*
 - (l) *any other applicable law; and*
 - (m) *any other matter the EPA considers relevant and reasonably necessary to determine the application.*
- (3) *The EPA must have regard to—*
 - (a) *any submissions made and evidence given in relation to the application; and*

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- (b) *any advice, reports, or information it has sought and received in relation to the application; and*
- (c) *any advice received from the Māori Advisory Committee.*
- (4) *When considering an application affected by section 74, the EPA must also have regard to the value of the investment in the activity of the existing consent holder.*
- (5) *Despite subsection (3), the EPA must not have regard to—*
 - (a) *trade competition or the effects of trade competition; or*
 - (b) *the effects on climate change of discharging greenhouse gases into the air; or*
 - (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 but the person withdraws the approval by giving written notice to the EPA—*
 - (a) *before the date of the hearing, if there is one; or*
 - (b) *if there is no hearing, before the EPA decides the application.*

60 Matters to be considered in deciding extent of adverse effects on existing interests

In considering the effects of an activity on existing interests under section 59(2)(a), the Environmental Protection Authority must have regard to—

- (a) *the area that the activity would have in common with the existing interest; and*
- (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 interest can be exercised only in the area to which the application relates; and*
- (d) *any other relevant matter.*

- 39 It is clear from an initial consideration of s59 that there are a number of matters that must be taken into account. The extent to which each factor is relevant and the significance of each factor will depend on the type of application before the DMC, the nature of the environment and the nature of any existing interests that may be affected if a marine consent were granted. In other words, s59 is to be applied according to the facts and circumstances of CRP's application for a marine consent.
- 40 In addition, the matters are relatively broad. As an example, it is not only the effects on the environment and human health of CRP's proposed activities that must be considered by the DMC, but also the effects on existing interests. There must also be consideration of positive effects of the proposal, such as the economic benefit to New Zealand of allowing the application.
- 41 Indeed, the broad nature of s59 is further emphasised by the inclusion of a "catch all" provision which requires the DMC to consider *"any other matter that is relevant and reasonably necessary to determine the application."*¹⁰

¹⁰ Section 59(m) of the EEZ Act

- 42 When considering the effects on the environment of allowing the activity, the DMC must not only consider the effects on the environment in the proposed marine consent area but must also consider the effects beyond this area. As indicated above, the definition of environment and s59(2)(a)(ii) of the EEZ Act clearly require such consideration¹¹ to be applied by the DMC.
- 43 The DMC is required to consider the effects of CRP's activities on existing interests by virtue of s59(2)(a) of the EEZ Act, and s60 of the EEZ Act provides some guidance about the manner in which such an assessment is to be undertaken.
- 44 Section 59(2)(h) of the EEZ Act requires the DMC to consider the nature and effect of other marine management regimes. The information provided by the relevant government departments may assist the DMC in consideration of the marine management regimes relevant to CRP's application.
- 45 Consideration is also required of the extent to which imposing conditions under s63 of the EEZ Act might avoid, remedy or mitigate the adverse effects of the activity. It is against this backdrop that the DMC must consider the conditions proposed by parties to CRP's application.
- 46 Section 59(3) of the EEZ Act requires the DMC to have regard to submissions, evidence, advice, reports and information received in relation to the application. In addition s59(3) requires the DMC to consider any advice received from the EPA's Maori Advisory Committee (Ngā Kaihautū Tikanga Taiao).

5.2 Information principles

- 47 Section 61 of the EEZ Act directs the DMC to do the following when considering CRP's application:
- a. make full use of its powers to request information from the applicant, obtain advice, and commission a review or a report
 - b. base decisions on the best available information
 - c. take into account any uncertainty or inadequacy of the information available.
- 48 At a general level s61 of the EEZ Act requires the DMC to ensure that it has good information before it to base its decision on. It is directive in that, it imposes a positive obligation on the DMC to request information or advice, and it is for this reason that several further information requests in accordance with both ss42 and 44 of the EEZ Act have been made. Further information or

¹¹ Section 59(2)(a)(ii) requires the DMC to take into account any effects on the environment or existing interest of allowing the activity including effects that may occur in New Zealand, or in the waters above or beyond the continental shelf beyond the outer limits of the EEZ

advice may well need to be sought by the DMC as a result of evidence submitted by the applicant and submitters.

- 49 Section 61(5) of the EEZ Act sets out a definition for “best available information” which means *“the best information that, in the particular circumstances, is available without unreasonable cost, effort, or time.”* This definition suggests that a level of judgement is required and suggests that, in some cases, a full suite of information may not be necessary to make a decision. What amounts to unreasonable cost, effort or time in one context may be perfectly reasonable in another.
- 50 Section 61(2) of the EEZ Act sets out what is required when the DMC is faced with uncertainty or inadequacy of information. In situations of uncertainty and inadequacy, the DMC must favour caution and environmental protection. Where favouring caution and environmental protection means that an activity is likely to be refused, the DMC must first consider whether taking an adaptive management approach would allow the activity to be undertaken.
- 51 What amounts to “favouring caution and environmental protection” will depend on the particular facts of this application before the DMC.

5.3 Purpose and Principles of the EEZ Act

- 52 It is also important to consider the purpose and principles of the EEZ Act. The EEZ Act contains a statement of the Act's purpose and principles in Part 1, Subpart 2, and it is against this backdrop that the DMC should consider CRP's proposal. Part 1, Subpart 2, includes sections 10 – 12 of the EEZ Act.
- 53 Section 10(1) states that the purpose of the Act is to *“promote the sustainable management of the natural resources of the exclusive economic zone and the continental shelf”*.
- 54 The matters that determine what sustainable management means are set out in s10(2) of the EEZ Act:

10 Purpose

- (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.*
- 55 Section 4(1) of the EEZ Act defines natural resources as:
- (a) *in relation to the exclusive economic zone, includes seabed, subsoil, water, air, minerals, and energy, and all forms of organisms (whether native to New Zealand or introduced); and*
 - (b) *in relation to the continental shelf, means the mineral and other non-living resources of the seabed and subsoil and sedentary species*
- 56 Section 4(1) of the EEZ Act also defines the word “environment”:

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environment means the natural environment, including ecosystems and their constituent parts and all natural resources, of—

(a) New Zealand;

(b) the exclusive economic zone;

(c) the continental shelf;

(d) the waters beyond the exclusive economic zone and above and beyond the continental shelf

57 It is also worthwhile to note the broad definition of “effect”, set out in s6 of the EEZ Act:

6 Meaning of effect

(1) In this Act, unless the context otherwise requires, effect includes—

(a) any positive or adverse effect; and

(b) any temporary or permanent effect; and

(c) any past, present, or future effect; and

(d) any cumulative effect that arises over time or in combination with other effects; and

(e) any potential effect of high probability; and

(f) any potential effect of low probability that has a high potential impact.

(2) Subsection (1)(a) to (d) apply regardless of the scale, intensity, duration, or frequency of the effect.

58 Section 10(2) of the EEZ Act provides decision makers under the EEZ Act with guidance about the way to achieve its purpose and provides:

(3) In order to achieve the purpose, decision-makers must—

(a) take into account decision-making criteria specified in relation to particular decisions; and

(b) apply the information principles to the development of regulations and the consideration of applications for marine consent.

59 The decision making criteria referred to in s10(3)(a) are set out in ss59 and 60 of the EEZ Act and the information principles referred to in s10(3)(b) are set out in s61 of the EEZ Act.

5.4 International Obligations

60 Section 11 provides that the EEZ Act continues or enables the implementation of New Zealand’s International Obligations relating to the marine environment. Those international obligations include the United Nations Convention on the Law of the Sea 1982 and the Convention on Biological Diversity 1992.

5.5 Treaty of Waitangi

61 Section 12 sets out, for the purposes of the EEZ Act, the Crown’s responsibility to give effect to the principles of the Treaty of Waitangi. In particular, s12 provides:

12 Treaty of Waitangi

In order to recognise and respect the Crown's responsibility to give effect to the principles of the Treaty of Waitangi for the purposes of this Act,—

(a) [section 18](#) (which relates to the function of the Māori Advisory Committee) 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; and

(b) [section 32](#) requires the Minister to establish and use a process that gives iwi adequate time and opportunity to comment on the subject matter of proposed regulations; and

- (c) [sections 33](#) and [59](#), respectively, require the Minister and the EPA to take into account the effects of activities on existing interests; and
- (d) [section 45](#) requires the Environmental Protection Authority to notify iwi authorities, customary marine title groups, and protected customary rights groups directly of consent applications that may affect them.

6 EFFECTS ON THE ENVIRONMENT AND IMPACT ASSESSMENT

62 This section provides the EPA staff's review of the potential effects of the proposed mining activities (described in Section 2.3 of this report) in relation to the following s59(2) matters;

- (a) any effects on the environment 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
- (b) the effects on the environment 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
- (c) the effects on human health that may arise from effects on the environment; and
- (d) the importance of protecting the biological diversity and integrity of marine species, ecosystems, and processes; and
- (e) the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species.

63 CRP provided an Environmental Impact Assessment (EIA) with its application. From a scientific perspective, an EIA usually involves the process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant future consequences (or effects) of a current or proposed action from a proposed project¹². The evaluation must be carried out in order to understand the significance of the effects that a mining activity may have on the environment and existing interests (s39(2)(a)). The potential impact (ecological risk) of a particular activity can be qualitatively assessed by taking into account the magnitude and likelihood of the consequence

¹² Senécal P., Goldsmith B., Conover S., Sadler B., Brown K. et al. (1999). Principles of Environmental Impact Assessment Best Practice. International Association for Impact Assessment (IAIA) in cooperation with the Institute of Environmental Assessment (IEA), UK. Retrieved at http://www.iaia.org/publicdocuments/special-publications/Principles%20of%20IA_web.pdf on 24 July 2014

(effect). The level of ecological risk is then calculated as the product of consequence and likelihood, in a similar way as carried out by CRP in their application¹³.

- 64 The EPA staff followed a methodology to account for the potential effects of the mining activities and their impact on human health, the environment and existing interests. This methodology was in accordance with accepted New Zealand and Australian standards for the evaluation of ecological effects (see Appendix 3 for a description of each individual consequence level), and included:
- a. a description of the potential effect and its impact on key groups of marine organisms (e.g. positive, neutral or adverse effect to benthic organisms)
 - b. the likelihood (probability) of causing the effect (rare, unlikely, possible, likely, almost certain)
 - c. the magnitude of the effect or consequence level (negligible, minor, moderate, serious, major, catastrophic), and
 - d. the level of ecological risk (negligible, low, moderate, high, extreme).
- 65 According to these criteria, the EPA staff defined an effect as being short-term and reversible if the time for recovery of the affected communities and habitat is < six months (consequence level = minor), long-term and reversible if the time for recovery of the affected communities and habitat is six months to 10 years (consequence level = moderate to severe) and permanent and irreversible if the time for recovery of the affected communities and habitat is > 10 years (consequence level = major to catastrophic). Table 1 (in Section 15 of this report) provides a summary of the EPA's overall assessment of the potential adverse effects of CRP's proposed mining operation, and the extent to which the imposition of conditions would avoid, remedy or mitigate those effects.
- 66 In the current section, a description of the aspects of CRP's application that the EPA staff considered were important to highlight is provided. This is followed by EPA staff comment on whether the best available information (s61(1)(b)) has been used by CRP, whether any uncertainty in the information remains or whether the information was inadequate (s61(1)(c)). The EPA staff then provide conclusions on their consideration of the potential effects of CRP's proposed mining activities on the environment ((s39(1)(c),(2) and s59(2)). Where possible, the EPA staff also provide conclusions about the extent to which imposing conditions under section 63 might avoid, remedy, or mitigate adverse effects of the proposed activity (s59(2)(j)).

¹³ Appendix 2 of this report (from Section 8.2 of the application)

6.1 Physical environment

67 This section summarises and evaluates the information provided by CRP in relation to different aspects of the physical environment including oceanography, geology, and geochemistry.

6.1.1 General description of the physical environment

68 CRP has characterised the physical oceanography (bathymetry, wind, currents, waves), geology and geochemistry of the area within the Chatham Rise for which CRP holds a current mining permit (MP55549). The data provided by CRP relating to the area outside of MP55549 is not as comprehensive. However, CRP consider that it has *“adequate information throughout the wider marine consent area and the surrounding region to understand and predict the seabed features, the likely distribution of the sediments and the large-scale oceanographic properties of the water column”¹⁴*.

69 CRP states in its application that *“the seabed and oceanographic conditions in and around the marine consent area are among the best known, if not the best known, in New Zealand’s EEZ”* and that *“the level of information about the shape of the seabed, the nature and properties of the sediments, and the oceanographic conditions... is adequate throughout the marine consent area and the surrounding region to understand and predict the major seabed features, the likely distribution of the sediments and the large-scale oceanographic properties of the water column”¹⁵*.

Uncertainty or inadequacy

70 The physical oceanography, and the geochemistry of the water column was described in greater detail for the current mining permit area (MP55549) than the wider marine consent area¹⁶. The geomorphology of the seabed was described for approximately half of the current mining permit area (MP55549)¹⁷, but not for the other half of MP55549, the wider marine consent area or the surrounding area. Therefore, the EPA staff consider that uncertainty remains with respect to the current state of the environment in the area where it is proposed that the activity will be undertaken, and the environment surrounding this area. This limits the understanding of the baseline marine environment against which to assess effects of seabed mining. For example, the behaviour of the sediment plume may be affected if it encounters unknown variations in seabed

¹⁴ Section 5.1 of the application

¹⁵ Section 5.1 of the application

¹⁶ Sections 5.5 and 5.6 of the application

¹⁷ Figure 29 of the application

morphology. CRP has stated that it would undertake further environmental surveys prior to mining in new areas¹⁸.

6.1.2 Physical oceanography

- 71 CRP's application reports that over the Chatham Rise, currents may be strong enough to resuspend and cause horizontal and vertical transport of sediment¹⁹. Velocities of tidal currents, internal tides and residual flow (e.g. associated with mesoscale eddies) have been measured on the Chatham Rise using an Acoustic Doppler Current Profiler (ADCP) or a crest array, including within CRP's mining permit area (MP55549)²⁰.
- 72 Tidal flows appear to determine most of the water flow on the Chatham Rise. Maximum water current velocities of up to approximately 75 cm/s were recorded near the seabed²¹. The mean direction of the flow of surface currents is to the east with the direction of flow of the tidal current component rotating anticlockwise over a tidal cycle (twice a day). Wind and wave directions, however, are predominantly towards the northeast²².
- 73 Internal tides (waves) result in the water column from surface tides moving stratified water over underwater topography and density gradients. Velocities of the internal tide component of up to 20 cm/s were estimated in CRP's application during seasons that favour unstratified ocean conditions (e.g. winter, early spring and late autumn).
- 74 Measurements of sea level anomalies, which indicate the presence of mesoscale eddies (large oceanic whirlpools), were provided by CRP using merged satellite altimetry data from a single week in August 2011²³. The passage of a mesoscale eddy within a period of approximately three months was identified in the top 200 m of the water column. Velocities of the residual flow component of up to 7 cm/s were recorded with a dominant northwesterly direction (lowest 100 m of the water column), and a less dominant southwest and southeast direction.

Best available information

- 75 Tides, internal tides and residual flow are all important physical processes that will influence sediment plume dispersion that would occur during and after mining. Internal tide velocities were not measured during stratified ocean conditions, typical of late spring, summer and early autumn,

¹⁸ Section 4.4.2.2 of the application

¹⁹ Section 5.7.2 and 5.7.3 of the application

²⁰ Section 5.5.4 of the application and Appendix 10

²¹ During the 2011 IX Survey; Section 5.5.4.5 of the application (Figure 33)

²² Sections 5.5.3 and 5.5.4 of the application

²³ Section 4.3.2 of Appendix 10

when they are most pronounced²⁴. Therefore, the EPA staff consider that best available information was not used with respect to the seasonal variance of internal tide velocities and the degree to which they influence the resuspension and dispersion of sediments. The EPA staff consider that this information would be readily available without incurring unreasonable cost, effort or time.

Uncertainty or inadequacy

- 76 The internal tide component velocity may amount to > 25% of the maximum tidal current velocity during seasons of the year that influence ocean stratification (e.g. summer and early autumn). The EPA staff note that the modelling does not resolve the internal tide component velocity when modelling the currents in the mining permit area (MP55549). This may have the implication of underestimating the total current velocity and the extent of the sediment plume.
- 77 Warm-core anticyclonic and cyclonic eddies are important oceanographic features to the east of New Zealand that determine the flow of Subtropical Water (STW)²⁵. Significantly higher residual flows than those stated by CRP in its application may be recorded on the Chatham Rise, depending on the season of the year. The EPA staff consider that there is uncertainty with respect to the variation in eddy dynamics throughout different seasons of the year (and associated changes in mixed layer depth), and therefore the degree to which these eddies may influence the density dynamics of the water column and the dynamics of modelled or assumed horizontal and vertical transport of sediment in the proposed mining area²⁶.
- 78 The limitations in CRP's application are of concern when overlaid with the proposed mining activities. When placing this into context, mining to a depth of 0.5 m will effectively disturb and remove all of the existing environment, including benthic habitat and communities in the mined area (as discussed later in this report). The DMC will need to consider this level of environmental effect against the uncertainties and inadequacy of information with respect to the overall composition of that environment.
- 79 Aside from the mining itself, the effects of discharging mined materials (and marine organisms) back into the water column and onto the seabed are some of the most significant effects for this proposal. The DMC will need to be satisfied that the effects of this discharge can be avoided, remedied or mitigated via conditions. However, the DMC will also need to address the uncertainty and inadequacy of information associated with the effects of the discharge.

²⁴ Section 5.5.4.5 of the application

²⁵ Chiswell S. M. (2005). Mean and variability in the Wairarapa and Hikurangi eddies, New Zealand. *New Zealand Journal of Freshwater and Marine Research* 39: 121-134

²⁶ Section 5.7.2 and 5.7.3 of the application

80 These effects point the DMC to two hurdles. The first is whether any conditions may address these effects such that they are remedied or mitigated. The second is the hurdle of environmental protection, given the uncertainties and inadequacies of the information available about the existing environment to be mined. Central to the DMC's consideration must be whether in allowing the proposed activities, caution and environmental protection can be provided for.

6.1.3 Geology and Geomorphology

81 The Chatham Rise extends from Banks Peninsula (near Christchurch) to beyond the Chatham Islands. The Rise was formed more than 60 million years ago and consists of basement rock, overlain by sediments. The seabed of the Chatham Rise has been modified by sedimentation and tectonic deformation. The Rise is relatively flat, however several banks and seamounts are also present in the area²⁷.

82 The formation of phosphate nodules occurred during the late Miocene (< 10 million years ago). During the Pleistocene (11,700 years ago - 2.7 million years ago), gouging by icebergs led to a redistribution of phosphate nodules across the Chatham Rise. The phosphate bearing sediments typically make up a layer that is approximately 0.4 to 0.6 m thick²⁸. The mining permit area (MP55549) also contains ridges, crests, slopes, depressions and troughs that have been formed by icebergs colliding with the seafloor²⁹.

83 CRP summarises the extent of seabed samples that were collected by previous (1950s, 1978 and 1981) and recent (2011 and 2012) research voyages to characterise the phosphate nodule mining resource³⁰. CRP also state that "*At present there are too few high quality samples to reliably estimate the distribution and grade of the phosphorite within the broader marine consent area*"³¹.

84 Sediment core and grab samples were used to map the grain size distributions of the seabed in the current mining permit area (MP55549)³². Grain size data was derived from the 1978 and 1981 historical research voyages, and more recent voyages carried out by CRP's contractors³³. The particle-size data from surface sediments that was used related to the upper 15 cm of the

²⁷ Section 5.3.1 of the application

²⁸ Section 5.3.1 of the application

²⁹ Section 5.4.1 of the application

³⁰ Tables 2 - 3 and Figure 25 of the application

³¹ Section 5.3.1 of the application

³² Section 5.1 of the application and Appendix 9

³³ Figure 2-1, Appendix 9

sediment layer. Sediment samples were extracted from the main corer using a 40 cm push-corer.³⁴

- 85 There were discrepancies between the sieved fractions used to characterise Particle Size Distribution (PSD) and composition. As a result, only three fractions were used to characterise the surface sediments: mud (grain diameter < 63 μm ³⁵), sand (grain diameter 63 to 2000 μm) and gravel (grain diameter > 2000 μm). In the case of the 1981 voyage (which appear to constitute approximately 50 % or more of the total samples analysed), only the > 1 mm fraction was analysed.
- 86 Rocks and boulders are also present on the seabed of the Chatham Rise, but the approximate area occupied or the size of the rocks and boulders have not been characterised³⁶.

Best available information

- 87 PSD and sediment composition will vary with sediment depth. The drag-head will penetrate into sediment layers that are at least up to 50 cm deep (where chalk may be present), and therefore, it is of relevance to characterise PSD and sediment composition down to this depth, instead of only down to 15 - 40 cm, as described in CRP's application. The depth of the sediment layer sampled is important as the composition and PSD of sediments will vary with depth. This will influence the degree to which resuspended sediments from the mining activities are transported and dispersed. Therefore, the EPA staff conclude that the best available information was not used to characterise the state of the sediments in the area. The EPA staff acknowledge that this information may not be readily available without incurring a degree of cost, effort or time. However, the EPA staff do not consider that the cost, effort or time is unreasonable given the importance of the information. If CRP decides not to provide this information, the PSD and composition of the sediment below a depth of 40 cm would remain an uncertainty.

Uncertainty or inadequacy

- 88 For the current mining permit area (MP55549), the EPA staff consider that the distribution of the phosphate nodule resource is well known. However, the phosphate nodule resource in other parts of the proposed marine consent area has not been described to the same level of detail. For example, the distribution of this mining resource in prospecting licence area PP55971 is virtually unknown. This has implications for understanding the long-term viability of the proposed mining project, and whether suitable habitat for communities associated with phosphate nodules is as widespread in the wider marine consent area or the surrounding area.

³⁴ Section 2 of Appendix 11 and Section 2.3.2 of Appendix 15 of the application

³⁵ One micrometer (μm) is equal to one thousandth of a millimetre (mm)

³⁶ Section 5.3.1 of the application

- 89 Box cores and grabs were used to collect sediment samples to characterise the state of the area. The mud fraction (one of the fine sediment fractions) was found to constitute around 40 % in surface and sub-surface sediment samples³⁷. Because of their lower sinking velocities, fine sediment fractions tend to disperse more widely in the water column and persist for longer periods of time, compared to coarser sediment fractions. It is unclear which samples CRP used to determine the PSD of the marine consent area and whether these samples included chalk fractions, which typically contain a higher proportion of fines³⁸.
- 90 The implications of the uncertainties identified for PSD and sediment composition by EPA staff above are that it is unclear whether the PSD samples collected by CRP are representative of the proposed marine consent area and the depth to which CRP intends to mine. Therefore, these uncertainties could be reflected as inaccuracies in the predictions of the sediment plume model. To address this uncertainty, the EPA requested that CRP provide supporting information on whether the underlying ooze/chalk layer was incorporated in the modelling (see FIR 3).
- 91 In its response to the EPA's further information request (FIR 3), CRP state that *"if a proportion of chalk is dredged and released in the mine tailings, on average it will not result in increased suspended solids in the water column as it will have characteristics that have been accommodated within the modelling"*³⁹. However, the EPA staff consider that uncertainty remains as to whether clay fractions have been incorporated into the modelling, because inputs into the model appear to be made up of coarser sediments than chalk.⁴⁰ Figure 1 in FIR3 provides an analysis of the PSD of sediment samples collected on the Chatham Rise, which shows that approximately 75 % of the particles in chalk are < 100 µm. The model from Deltares appears to assume that only 54 % of the particles are < 100 µm⁴¹. If this is the case, modelling may underestimate the extent of the plume if a chalk layer is encountered during mining.
- 92 The distribution of rocky outcrops that could provide a potential habitat for unique marine organisms has not been described. Therefore, there is uncertainty on how CRP will comply with its proposed condition 9 (c) that rock outcrops > 2 km² will not be mined⁴².
- 93 Because the impact of the sediment discharge is a significant effect of the activity, the DMC will need to address the uncertainties discussed above in order to determine the outcome of this application.

³⁷ Section 5.6.3 of the application and Appendix 11

³⁸ Table 1 Appendix 11 of the application

³⁹ Section 2.2 CRP Response to FIR 3, dated 21 July 2014

⁴⁰ Section 2.4 in Appendix 25 of the application

⁴¹ Table 2.2 in Appendix 25 of the application

⁴² Section 11.4.4 of the application

6.1.4 Geochemistry and biogeochemistry

- 94 The levels of major and trace elements in Chatham Rise sediments and phosphate nodules was provided in CRP's application⁴³. Some trace elements (e.g. strontium and barium) have been found to be associated with the fine sediment fractions (silt and clay) found in the proposed marine consent area. Data analysis indicated that approximately 50 % of the variance of trace element abundances was strongly associated with the fine sediment mud fraction⁴⁴.
- 95 During CRP's recent on site surveys, Remotely Operated Vehicle (ROV) transects identified eight different substratum classes during seabed habitat classification. Approximately 22 % of the observations ($n = 3536$) identified chalk patches⁴⁵. The chalk patches are predominantly formed of calcium carbonate, siliceous silt and clay. Calcium carbonate is a key component of the Chatham Rise sediments, showing abundances of up to 40 %⁴⁶.
- 96 In most cases, only 10 % of these samples were deemed appropriate for PSD analysis, and the sand and mud fractions were indistinguishable⁴⁷. This means that PSD may not have been characterised adequately and, especially the fine sediment fraction, may have been underestimated, which has implications for the sediment plume modelling predictions.
- 97 In CRP's application, the total major element or trace element composition in the 1 - 8 mm and > 8 mm fractions (after adding up the concentrations of each element) did not add up to 100 %, and the trace element concentrations were separate to the total composition⁴⁸. The level of moisture and impurities in mineral samples is measured through a process called Loss of Ignition (LOI). In CRP's application, LOI ranges of 11 to 20 % weight were measured in phosphate nodules and seabed sediments.
- 98 Elutriation testing was performed on selected sediment samples that were collected from the Chatham Rise using a box corer⁴⁹. An assumption was made that the mined sediment would contain up to 20 % chalk⁵⁰. The results of the elutriation testing carried out by CRP showed that some trace elements were above ANZECC (Australian and New Zealand Environment and

⁴³ Tables 4 and 5 of the application

⁴⁴ Section 5.6.6 of the application

⁴⁵ Table 4-1 in Appendix 9 of the application

⁴⁶ Section 5.6.5 of the application

⁴⁷ Section 3.4 of Appendix 9 of the application

⁴⁸ Tables 4 and 5 of the application

⁴⁹ Appendix 11 of the application

⁵⁰ Section 5.2 of Appendix E of Appendix 11 of the application

Conservation Council) (2000)⁵¹ guideline levels for fresh and marine water quality and that further assessment is required to determine adverse effects⁵².

- 99 Measurements of total suspended solids (TSS) on the Chatham Rise were considered to be generally < 1 mg/L (with some variability). The resuspension of photosynthetic material (phytodetritus) close to the seabed was inferred by increases in fluorescence measurements. Turbidity data collected by an Acoustic Doppler Current Profiler (ADCP) turbidity logger was presented by CRP to infer the level of sediment in suspension in the water column. This data was not calibrated with actual concentrations of suspended sediment collected *in situ*. In spite of this, CRP's application concludes that "*The plots show...that there is no dominant flux direction associated with the turbidity values throughout the water column*"⁵³.
- 100 Macronutrient (silicon, nitrate and phosphate) and trace nutrient (iron) concentrations are provided to describe the current state of the water column for the Subtropical Front (STF)⁵⁴, located between the two main water masses Subtropical Water (STW) and Sub-Antarctic Water (SAW). Some of these concentrations provide an average of a maximum of four replicates (occasionally two) for an unknown depth of the water column and season of the year⁵⁵.
- 101 Annual mean macronutrient concentrations at 10 m (possibly, below the sea surface) and trace metal concentrations (which also appear to include silicon and phosphate macronutrients) in the water column were also provided in CRP's application for a depth range which appears to be 400 to 3000 m for the proposed mining area (43 to 44° S latitude)⁵⁶.
- 102 The application states that "*No trace element sampling has been undertaken of waters on the Rise specifically for this project as there is no indication that trace element release and mobilisation is a concern associated with mining of seabed sediments*"⁵⁷.
- 103 CRP state that oxygen concentrations on the Chatham Rise are relatively high. Dissolved oxygen concentrations were provided down to 350 m from four different voyages (3122, 3131, 3135 and 3142) that occurred between 8 July 2006 (3122) and 1 May 2008 (3142)⁵⁸.

⁵¹ See <https://www.mfe.govt.nz/publications/water/anzecc-water-quality-guide-02/>

⁵² Section 8.5.3 of the application

⁵³ Section 5.7.3 and Figure 44 (legend) of the application

⁵⁴ Also known as the 'Convergence Zone'

⁵⁵ Table 6 and Section 5.7.6 of the application

⁵⁶ Figures 46 and 49, and Figure 21 of Appendix 11, of the application

⁵⁷ Section 5.7.6 and Appendix 11 of the application

⁵⁸ Section 6. 2 (e.g. Figure 19) of Appendix 11 of the application

Best available information

104 The EPA staff are of the view that the macronutrient and trace nutrient concentrations provided by CRP do not constitute the best available information. Macronutrient and trace nutrient concentrations could change in the water column from microbial action on resuspended and/or deposited sediment (and the dumping of dead marine organisms) as a result of the mining activity. The concentration of macronutrients and trace elements (of which only iron was provided) may vary significantly with depth and the season of the year⁵⁹. Therefore, to provide an accurate representation of the current state of the proposed marine consent area the EPA staff would expect CRP to provide an average of macronutrient and trace element concentrations throughout various depths of the water column (e.g. approximately every 30 to 50 m) for, at least, alternate seasons of the year⁶⁰. The EPA staff consider that this information may be readily available from selected research institutions without incurring unreasonable cost, effort or time.

Uncertainty or inadequacy

105 Because it is unclear whether the mud fraction was accurately characterised for the proposed marine consent area, the large variance of trace element abundances (up to 50 %) associated with the fine sediment mud fraction highlights uncertainties with respect to the *maximum* concentrations of *all* trace elements that may be present in these sediments. Finer fractions of sediment have the potential to move further in suspension and may also be associated with higher levels of trace elements. The EPA staff consider that this issue needs to be addressed further in order to adequately assess the effects of CRP's proposed activity on water quality and sediment chemistry.

106 The final maximum concentrations of major and trace elements that are present in Chatham Rise sediments and phosphate nodules, and the relative proportion of these components with respect to the overall chemical composition of sediments and phosphate nodules, has not been fully described. Therefore, there is uncertainty with respect to the final chemical composition of the sediments, and so the potential effects (and cumulative effects) of discharging the mine tailings into the water column cannot be adequately considered.

⁵⁹ Nodder SD, Boyd PW, Chiswell SM, Pinkerton MH, Bradford-Grieve JM, Greig MJN 2005. Temporal coupling between surface and deep ocean biogeochemical processes in contrasting subtropical and subantarctic water masses, southwest Pacific Ocean. *Journal of Geophysical Research: Oceans* 110: C12017 [referenced in the application]

Ellwood M.J. (2008). Wintertime trace metal (Zn, Cu, Ni, Cd, Pb and Co) and nutrient distributions in the Subantarctic Zone between 40-52S, 155-160E. *Marine Chemistry* 112: 107-117.

⁶⁰ NIWA coordinated the Biophysical Moorings Programme from 2000 until 2011 for the time-series collection of biophysical and biogeochemical data throughout the water column of STW and SAW (east of New Zealand), with some data also collected in the STF

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- 107 Elutriation tests are used to provide an accurate assessment of the physical and chemical characteristics, and potential toxicity and bioaccumulation, of dredged material⁶¹. It is usually expected that the elutriation tests be performed in an environment that resembles the one where the mining activity is proposed to occur. To perform these tests, CRP's contractors used coastal seawater from the Tasman Sea (Raglan harbour), which has different biogeochemistry and nutrient loading than that from the oceanic environment of the STF, typical of the water column above the Chatham Rise⁶². Therefore, the use of seawater from the Raglan harbour was not appropriate for comparison, and may have influenced the elutriation results obtained.
- 108 It is uncertain how a comparison of some trace element concentrations obtained from the elutriate experiments to ANZECC (2000) levels satisfies the overall purpose of elutriation tests, specifically with respect to physical characteristics, potential toxicity and bioaccumulation of dredged material. However, in its response to the EPA's request for further information (FIR 19), CRP explain that ANZECC (2000) trigger values are management tools that protect against sustained chronic effects. CRP also conclude that *"ANZECC (2000) trigger values provide sufficient protection as the triggers provide a benchmark to "trigger" when future investigations should be undertaken, rather than indicate thresholds for toxic effects"*⁶³.
- 109 CRP's application originally concluded that trace element concentrations (including radioactive elements) will be diluted 200 times in the near field and 2,000 times within 15 km of the returns discharge⁶⁴. This conclusion was amended in CRP's response to the EPA's requests for further information (FIR 8, 9,10), in which Deltares modelled dilution from the discharge of sediment at 10 m above the seabed. Deltares calculated that dissolved constituents would be diluted 750 times in the near field (250 m from the point of discharge), with varying levels of dilution in the far field.⁶⁵ The updated dilution estimates used additional elutriate on the following trace elements: cobalt, barium, molybdenum, thallium, strontium and vanadium. Dilution estimates were calculated using the maximum values of elements that were obtained from the elutriate tests. CRP conclude that the modelled dilution shows that the discharge of mine tailings will not result in adverse toxic effects on marine biota due to increased levels of dissolved elements⁶⁶.

⁶¹ US EPA 503/8-91/001 Evaluation of dredged material for Ocean Disposal (USEPA 1991)

⁶² Nodder SD, Boyd PW, Chiswell SM, Pinkerton MH, Bradford-Grieve JM, Greig MJN 2005. Temporal coupling between surface and deep ocean biogeochemical processes in contrasting subtropical and subantarctic water masses, southwest Pacific Ocean. Journal of Geophysical Research: Oceans 110: C12017 [referenced in the application]

⁶³ Section 3.2 CRP response to FIR 11, dated 25 July 2014

⁶⁴ Appendix 11 of the application (page 296)

⁶⁵ Table 1 CRP response to FIR 8, 9, 10, dated 25 July 2014

⁶⁶ Section 5.2.4 CRP response to FIR 19

- 110 There is also uncertainty with respect to the conversion factors that were used by CRP to convert units of elutriate trace element concentration (including radioactive elements) (from ppm to mg/m^3)⁶⁷. This unit conversion is dependent on temperature and pressure, and so these variables will change depending on water column depth⁶⁸ and season of the year. The implication is that if the changing temperature and depth have not been considered in the unit conversion, the estimated calculations of elutriate trace element concentrations may not necessarily be representative of the depth or temperature range where the mining operations are proposed to occur (250 - 450 m, equivalent to absolute pressures of 26 - 46 atm and temperatures of $< 9^\circ\text{C}$).
- 111 CRP's dilution estimates do not consider the effects that may occur as elements are removed from the water column⁶⁹. Removal from the water column of these dissolved elements may occur when they are adsorbed by particles, taken up by microorganisms or undergo chemical reactions. This means that there is uncertainty with respect to the effect that the mining activities (especially the disposal of mine tailings, marine organisms and any resuspension events) will have on biogeochemical cycles, on and directly above the seabed, within the proposed marine consent area.
- 112 Sediments in the marine environment play important roles in transformation and exchange processes of organic matter and nutrients⁷⁰. The proposed mining activity will influence sediment composition (PSD) and increase the flux of organic carbon to the seabed⁷¹. This may affect biogeochemical processes within the area disturbed by CRP's proposed mining activities. CRP state that bacteria dominate the biomass of the benthic community within the Chatham Rise⁷². The EPA staff note that prokaryotes (bacteria and archaea) are also highly abundant in the water column. Therefore, the EPA requested further information on the importance of microbial dynamics in regulating biogeochemical cycles at these depths and how microbial roles could be influenced by CRP's proposed mining activities (see below). Without this information the potential effects on biogeochemical processes of discharging the mine tailings (and marine organisms) cannot be adequately considered.
- 113 Concentrations of elements (e.g. trace metals) can show significant variation with water column depth or season of the year. While CRP conclude that trace metal release and mobilisation is not

⁶⁷ Section 8.5.3 of the application (Table 20 and page 297)

⁶⁸ For every 10 m depth, there is an increase of 1 atm of pressure

⁶⁹ Section 2.2 CRP response to FIR 8, 9, 10, dated 25 July 2014

⁷⁰ Thrush & Dayton (2002) Disturbance to marine benthic habitats by trawling and dredging: Implications for marine biodiversity. *Annual Review of Ecology and Systematics* 33: 449-473

⁷¹ Appendix 11 of the application

⁷² Appendix 11 of the application

a concern associated with mining, the EPA staff consider that samples of trace metals should have been collected from different depths within the water column (from the surface to depth at which CRP intend to mine, i.e 0 - 450 m) at different seasons. This would enable the establishment of a baseline by which to assess any potential effects of CRP's proposed mining activities.

114 Oxygen is fundamental to sustain most life forms. The exact location on the Chatham Rise of the various voyages (3122, 3131, 3135 and 3142) where dissolved oxygen was measured is uncertain, as well as the exact period of the year that each voyage covered. While dissolved oxygen concentrations appear to be relatively high, the sampled depth range (0 - 350 m) and location could not be directly related to the proposed mining area⁷³ and depth (down to 450 m).

Further information requested

115 To address the uncertainty in CRP's application with regard to the state of the physical environment and the effects of CRP's proposed activities, the EPA requested further information on 9 June 2014 (see FIR 3, 8 - 11, 16, 19).

116 CRP responded to FIR 3 on 21 July 2014 and to FIRs 8 - 11, 16 and 19 on 25 July 2014. These responses have been considered in the sections above and the evaluation of effects below.

6.2 Radioactive elements

117 This section summarises and evaluates the information provided by CRP relating to radioactive elements.

6.2.1 Radioelements on the Chatham Rise

118 Uranium and strontium, radioactive elements, comprise up to 73 % of the trace element composition in phosphate nodules and seabed sediment from the Chatham Rise⁷⁴.

119 The topic of uranium has been discussed in various parts of CRP's application⁷⁵. Generally, marine phosphate nodules are recognised as a key global resource of uranium, with mineral deposits containing uranium concentrations as low as 200 ppm being targets for exploration⁷⁶. In

⁷³ Appendix 11 of the application

⁷⁴ Section 5.6.6 of the application

⁷⁵ Pages 90, 92, 255, 295, 297, 373-374 of the application, Appendix 11 and associated Appendices (e.g. Appendices D and E)

⁷⁶ Cullen DJ 1978. The uranium content of submarine phosphorite and glauconite deposits on Chatham Rise, east of New Zealand. Marine Geology 28: 67-76 [as referenced by CRP in their application]

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phosphate nodules from the Chatham Rise, uranium is enriched (20 - 480 ppm) compared with phosphate deposits from other sources (64 - 140 ppm)⁷⁷.

120 CRP's application uses the definition of radioactive material from the New Zealand Radiation Protection Act 1965⁷⁸ as a threshold of radioactivity to determine whether Chatham Rise phosphate nodules are potentially radioactive⁷⁹.

121 Based on this definition, the specific radioactivity of one of the most stable isotopes (chemical forms) of uranium (uranium-238) is calculated in CRP's application using a uranium concentration of 200 ppm, and an assumed highest measured uranium concentration in seafloor phosphorites of 524 ppm⁸⁰. The estimated specific radioactivity concentration was 35 kBq/kg for the 200 ppm uranium concentration and 91 kBq/kg for the 524 ppm uranium concentration. The conclusion was that, because these specific radioactivities are below the level defined by the New Zealand Radiation Protection Act 1965 as being radioactive (100 kBq/kg), none of the samples collected from the Chatham Rise were considered radioactive material.

122 In the calculations of specific radioactivity of U-238, CRP's application assumes that in phosphorites, all the decay products of U-238 are in secular equilibrium⁸¹ with U-238⁸².

123 CRP's application states that any significant change in uranium concentration in fish muscle tissue would be unlikely as a result of the estimated dilution of uranium away from the discharge of mine tailings, and that uptake in fish occurs mainly in their bony tissues⁸³.

124 Based on the specific radioactivity concentrations of uranium estimated above and the statement quoted in CRP's application that "*Uranium from the Rise was not considered to present a radioactive hazard to the environment or people by Cullen (1978b)*", CRP considered that uranium does not present a radioactive or toxicity hazard to the environment during the return of mining tailings to the water column or from resuspension events. However, unlike other trace

⁷⁷ Section 5.6.6.3 of the application (Table 5)

⁷⁸ The Radiation Protection Act 1965 defines radioactive material as **any article** containing a radioactive substance giving it a **specific radioactivity exceeding 100 kilobecquerels per kilogram** and a **total radioactivity exceeding 3 kilobecquerels**

⁷⁹ Appendix D of Appendix 11 of the application

⁸⁰ From a study published in 1970 [as stated in CRP's application]

⁸¹ Secular equilibrium is defined in nuclear physics as a state in which the quantity of a radioactive isotope remains constant, especially when its production rate is equal to its decay rate

⁸² Appendix D of Appendix 11 of the application

⁸³ Section 8.5.3 and Appendix 11 of the application

elements, no threshold concentrations from ANZECC (2000) were provided for uranium⁸⁴. CRP's application mentions that there is no guidance for uranium in marine waters⁸⁵.

125 CRP's application identifies five geochemical layers that are present within phosphate nodules⁸⁶.

126 The location of uranium on the phosphate nodules appears to depend on the oxidation state of uranium. Two oxidation states of uranium are present in the phosphate nodules of the Chatham Rise: tetravalent (IV; reduced/anoxic state) and hexavalent (VI; oxidised state). Uranium (IV) is reactive and usually comprises almost an 80% average of the two oxidation states; it also replaces the calcium that is bound to phosphate in the geochemical apatite layer (layer IV) of phosphate nodules.

127 In seawater, the predominant oxidation state of uranium is Uranium (VI), due to the presence of dissolved oxygen. Uranium (VI) is adsorbed to the surface of the apatite layer⁸⁷ but the propensity of Uranium (VI) to adsorb onto sediment surfaces decreases under oxygenic conditions. Therefore, remobilisation of precipitated uranium and release into the water column could occur during exposure of previously anoxic mine tailings to oxygen (either in the water column or in air)⁸⁸.

128 The release of other radioisotopes into the environment, such as caesium-137 and strontium-90, is expected to increase near-field radioactivity by a maximum factor of ten during the disposal of mine tailings into the water column⁸⁹. According to CRP's application, this increase is 100 times lower than benchmark values for the protection of aquatic biota⁹⁰, but no consideration was provided with respect to unstable isotopes, their potential contribution to generate increased doses of radiation and any associated impact on the environment.

Best available information

129 The estimation of the composition of each of the oxidation states of uranium (80 % tetravalent and 20 % hexavalent) was quoted in CRP's application from an outdated reference, the focus of which was South American phosphorite nodules⁹¹. Given the importance of uranium oxidation

⁸⁴ Table 20 of the application

⁸⁵ Section 8.5.3 of the application

⁸⁶ Figure 8 of Appendix 11 of the application

⁸⁷ Sections 3.3 and 5.6.6 of the application, and Appendix E of Appendix 11 of the application

⁸⁸ Appendix E of Appendix 11 of the application

⁸⁹ Sections 5.6.6 and 8.5.3 of the application, and Appendix D of Appendix 11

⁹⁰ Appendix D of Appendix 11 of the application

⁹¹ Burnett WC, Veeh HH 1977. Uranium-series disequilibrium studies in phosphorite nodules from the west coast of South America. *Geochimica et Cosmochimica Acta* 41: 755-764 [as referenced by CRP in their application]

states for the determination of total radioactivity of uranium in Chatham Rise phosphate nodules, the EPA considers that the proportion of oxidation states of uranium of samples collected in the 1970s, as referenced from two bibliographic references, may not necessarily represent the use of best available information. The EPA staff consider that this information would be readily available from existing sources without incurring unreasonable cost, effort or time.

Uncertainty or inadequacy

- 130 There is the potential for uranium release (and other radioisotopes) into the aquatic environment from the disposal of mine tailings and resuspension of sediment. Therefore, background levels of uranium concentrations at various depths of the water column, and for various locations throughout the proposed marine consent area, may be required to assess the current state of the area.
- 131 Natural uranium is comprised of three chemical forms (isotopes) of uranium which are Uranium-234 (U-234), Uranium-235 (U-235), and Uranium-238 (U-238). Although U-235 and U-234 are present in low concentrations in natural uranium (< 1 %), because of their relatively shorter half-lives, they are more radioactive per unit mass than U-238. In the case of U-234, approximately 50 % of the total amount of radiation is emitted from this single isotope in natural uranium. Despite its low natural abundance, the isotope U-235 is important because certain environmental conditions influence its fission and subsequent release of large quantities of energy⁹². CRP's impact assessment on the potential effects of uranium has focused solely on the concentrations and estimations of specific radioactivity derived from uranium-238 (the most radioactively stable isotope with the longest half-life). This means that, the isotopes of natural uranium for which > 50 % of radioactivity is usually attributed to (U-234 and U-235)⁹³ have not been taken into account in the estimation of radioactivity carried out in CRP's application. Therefore, there is significant uncertainty in (and inadequacy of) the results obtained from these calculations.
- 132 The relative abundance of the stable (U-238) and unstable (U-234 and U-235) (more radioactive) isotopes of uranium on the phosphate nodules will also depend on the oxidation states of uranium and the age of the phosphate nodules. Because different oxidation states of uranium may be located in different geochemical layers of phosphate nodules, the level of potential radioactivity may be different for each geochemical layer. A higher frequency of radioactive disintegrations (radioactive decay) occurs over time, which will increase the abundance of unstable oxidised U-234 (an alpha emitter). There is uncertainty whether this situation challenges any state of secular equilibrium that may have been assumed during CRP's calculations of specific radioactivity of uranium in phosphate nodules from the Chatham Rise.

⁹² <http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Uranium-Resources/Uranium-and-Depleted-Uranium/>

⁹³ <http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Uranium-Resources/Uranium-and-Depleted-Uranium/>

- 133 This is especially relevant to any conversion factors that were used to convert uranium concentrations (in ppm) to specific radioactivity (kBq/Kg)⁹⁴, as some conversion factors will only be valid if U-238 and its decay progeny (up to 14 radioactive isotopes) are in secular equilibrium. There is uncertainty around which conversion factors were used in the calculations of specific radioactivities and whether these conversion factors were the correct ones to use. Likewise, there is uncertainty with respect to the contribution of the specific radioactivities of U-235 and U-234, especially when considering that the specific radioactivity of these unstable isotopes of uranium is higher by a factor of 6 (80 kBq/g) and 19 (238 kBq/g) than for U-238 (12.4 kBq/g)⁹⁵.
- 134 Uranium binds to carbonate complexes and therefore, a higher concentration of uranium would be expected in chalk samples (and bones) that were not used in the elutriation tests. Therefore, considering that U (IV) carbonates (and other particulate matter) are insoluble⁹⁶, it is uncertain whether the uranium concentrations from the elutriation tests⁹⁷ provide a realistic representation of natural uranium concentrations and “dilution” estimates.
- 135 The ability of uranium to bind to calcium carbonate also means that uranium may be distributed throughout the phosphate nodule geochemical layers that contain chalk (layers I and II)⁹⁸. The degree of sorption (binding) of U (VI) to carbonate complexes can change in the presence of varying concentrations of Si, Mg, Ca and Sr⁹⁹. The degree of sorption onto geochemical layers and potential mobilisation through to other layers in the phosphate nodules is uncertain, based on the information provided in CRP’s application.
- 136 Different valency states (degree of binding with other atoms or molecules) in uranium have varying degrees of sorption for different rocks and minerals. In the presence of phosphate, the situation is more complex¹⁰⁰. The degree to which the location of each oxidative state of uranium on the apatite (surface or sub-surface) may dictate the degree of uranium mobilisation outside of the apatite to other geochemical layers and/or into the surrounding environment is uncertain, considering that the apatite layer of phosphate nodules may occasionally become the outermost

⁹⁴ Appendix D of Appendix 11

⁹⁵ <http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Uranium-Resources/Uranium-and-Depleted-Uranium/>

⁹⁶ Appendix E of Appendix 11 of the application

⁹⁷ Table 20, Section 8.5.3 of the application

⁹⁸ Figure 8 of Appendix 11 of the application

⁹⁹ Page 763, The New Uranium Boom: Challenge and lessons learned. Chapter: “Effect of Mg-Ca-Sr on the sorption behaviour of Uranium (VI) on silica” [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

¹⁰⁰ Page 627, The New Uranium Boom: Challenge and lessons learned. Chapter: “Thermodynamic data dilemma” [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

layer¹⁰¹. Likewise, there is uncertainty with respect to the degree of variation of the two main oxidation states of uranium in different phosphate nodules from the Chatham Rise, and how this variation could affect the total radioactivity, or the mobilisation of uranium.

- 137 Radioactivity of uranium derived from rock phosphate can vary according to particle size by as much as 60 % between the coarse and fine size fractions¹⁰². There is uncertainty about the percentage variation in potential radioactivity across PSD in sediment from the Chatham Rise. Coarse particles (> 2 mm) did not appear to be used in elutriation testing¹⁰³, and so would not have been subject to any estimations of dilution. The implication of this is that the potential radioactivity risk to fish and other benthic organisms from deposition of particles could be higher than anticipated by CRP; however, this is currently an unknown variable.
- 138 The release of mine tailings into the seawater (some of which would have been previously surrounded by seabed sediments) would expose the dominant reduced/anoxic state of Uranium (IV) to dissolved oxygen. There is uncertainty with respect to the likelihood of causing a shift in the ratio of the two oxidation states of uranium in the mine tailings upon their release into seawater, and whether this could influence any levels of radioactivity or concentration of uranium in the water column.
- 139 There is uncertainty on how CRP concluded in their application that any significant change in uranium concentration in fish muscle tissue would be unlikely when CRP did not fully evaluate the potential effect of uranium uptake in fish (or other marine organisms) from the release of mine tailings or resuspension of sediment. The level of the effect, risk, the overall potential impact (as done for the other effects), or potential doses of exposure were not estimated. The fisheries value of the Chatham Rise means that its important that these potential effects are well understood.
- 140 Section 4 of the EEZ Act defines radioactive substance within the meaning of The Radiation Protection Act 1965, but the EEZ Act does not make any reference to radioactivity thresholds. CRP used the radioactive thresholds as defined in The Radiation Protection Act 1965 and Radiation Protection Regulations 1982 to determine whether U-238 in phosphate nodules were potentially radioactive. Sections 2 and 18 of the Radiation Protection Act 1965 define the scope of this legislation, which was to regulate exposure of humans to radioactivity from enclosed irradiating apparatus or radioactive materials, used for medical purposes in a terrestrial environment. The chemical environment in the marine ecosystem (including any potential for

¹⁰¹ Figure 8 of Appendix 11 of the application

¹⁰² Page 279, *The New Uranium Boom: Challenge and lessons learned*. Chapter: "Distribution of uranium related to particle size of phosphogypsum from phosphoric acid production" [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

¹⁰³ Section 2.2.2 of Appendix 11

biomagnification through the food chain) means that other processes, than those present in an atmospheric medium, could influence the behaviour of any potential radioactivity. The EPA staff consider that the use of any radioactivity threshold (as defined in The Radiation Protection Act 1965 and Radiation Protection Regulations 1982) is inadequate to assess any potential effects on marine organisms (and humans) from radioelements from marine phosphate nodules.

- 141 A similar assessment for other radioisotopes present in mobilised sediment and phosphate nodules from the Chatham Rise, such as strontium and caesium, may also be required.

Further information requested

- 142 The EPA staff consider that significant uncertainty regarding the human and environmental safety of radioelements from the effects of CRP's proposed activities remain. To address some of this uncertainty FIR 19 was requested of CRP by the EPA on 9 June 2014. The response from CRP stated that *"the available dilution as the plume moves further from the discharge point is now estimated to be greater than that used in the assessment presented in Golder (2014a)"*¹⁰⁴

- 143 The DMC asked on 17 July 2014 for the EPA to commission a qualified radiation expert, with a view to providing reports to the DMC prior to the hearing.

EPA assessment of potential environmental effects (s59(2))

Effects on the marine environment

- 144 The presence of radioactive elements in phosphate nodules and seabed sediment adds another level of complexity to the EPA staff's consideration of effects on the environment, and human health. To consider biological effects, the potential estimated dose received from a specific concentration of a contaminant would need to be taken into account. This is because biological effects are usually dependent on a received dose.
- 145 For ionising radiation, the dose is dependent to the amount of energy absorbed by living organisms from two pathways: external irradiation from the contaminant (e.g. alpha, beta, gamma emission) and internal irradiation from the absorption of radionuclides. Exposure to different doses of radiation will have different effects (acute versus chronic) which will be dependent on the dose received, the exposure time (dose rate) and whether the exposure is repeated or not.
- 146 Radioactive decay generates emissions of varying energy intensity, depending on the type of radionuclide and particle emitted (e.g. those emitted during the decay of U-234). The level of effectiveness of any radiation to cause biological damage depends on the the type of radiation emitted (e.g. alpha, beta, gamma particles). Depending on the type of radiation emitted, the

¹⁰⁴ Section 5.2.4 CRP response to FIR 19, dated 25 July 2014

absorbed dose will have a different radiation weighting, with alpha particles producing the highest harm.

- 147 An appropriate dose assessment from potential radionuclides should include all exposure pathways and radioactive progeny. As an example, U-238 has a decay progeny of up to 14 radioactive daughter products, including Po-210 (an active alpha emitter with a short half-life of 138 days that reaches high environmental concentrations in marine organisms).
- 148 Most of the radiation dose acquired internally by aquatic organisms from natural uranium isotopes and some of their progeny (e.g. Po-210) is due to bioaccumulation of the isotopes in the organisms. Depending on the type of organism, Po-210 (50 - 20,000 times) can have a much higher bioconcentration potential than uranium, and can therefore result in a much greater absorbed internal dose by an organism than from an equivalent aqueous concentration of the parent U-238 (10 - 1,000 times)¹⁰⁵.
- 149 The chemo-toxicological effect of uranium is that it is genotoxic to fish. Because of its affinity to carbonate complexes and its ability to mimic calcium, uranium can be laid down in bones. This means that, in the event of fish (or other marine vertebrates) ingesting potentially radioactive mine tailings (or prey that had ingested mine tailings), uranium could concentrate and bioaccumulate in fish bones. In dogs, for example, uranium can penetrate into the bone marrow and end up in their blood system¹⁰⁶, and therefore most of the body tissues. However, because only 60 - 80 % of all incorporated uranium deposits in the skeleton, there is also uncertainty with respect to the destination of the remaining 20 - 40 % uranium.
- 150 Safety threshold levels with respect to radiation and radionuclides for aquatic biota have not been well defined. Irrespective of the radioactive source, the National Research Council of Canada recommends a basic dose benchmark of 1 rad day⁻¹ (1 Gy = 100 rads), as population effects in fish and other aquatic biota can occur at this dose.

¹⁰⁵ National Research Council of Canada, 1983. Radioactivity in the Canadian Aquatic Environment, Report Number NRCC No. 19250 of the Environmental Secretariat, available from Publications NRCC / CNRC Ottawa, CA K1A 0R6, original quotes from Thompson, SE., et. al, 1972, Concentration Factors of Chemical Elements in edible aquatic organisms. Lawrence Livermore Lab, University of California, Report Number UCRL-50564

¹⁰⁶ Page 534, The New Uranium Boom: Challenge and lessons learned. Chapter: "Challenges in assessing uranium-related health risks: two case studies for the aquatic exposure pathway from South Africa – Part I: Guideline and toxicity issues and the Pofadder case study" [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

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- 151 A screening benchmark level of $10 \mu\text{Gy h}^{-1}$ has been proposed for the protection of various ecosystems, and has been used recently in evaluating the impact of radiation doses to marine biota and human consumers of seafood from the Fukushima disaster¹⁰⁷.
- 152 In CRP's application, potential radiation exposures or doses have not been estimated for marine biota. Because of this and because there is uncertainty as to whether the same situation that occurs in dogs (mentioned above) could apply to fish (and therefore humans from the consumption of potentially contaminated fish), the overall effects on fish (or human health) from potential uranium exposure cannot be accurately determined. This is an issue given the significance of the fisheries resource on the Chatham Rise.

Effects on land

- 153 Background concentrations of uranium in soils are < 0.5 to $> 3 \text{ ppm}$ ¹⁰⁸. Phosphate nodules from the Chatham Rise are enriched with uranium ($20 - 480 \text{ ppm}$)¹⁰⁹ compared to other sources, and may be used to fertilise land in New Zealand (and overseas). There is uncertainty on whether this would represent an increased environmental hazard (and, therefore, human health hazard) from exposure to phosphate fertiliser that contains high concentrations of uranium, and whether any potential cumulative effects in the food chain could occur¹¹⁰.
- 154 After the mining of rock phosphate, the extraction of uranium from rock phosphate into usable forms of uranium using chemical procedures is a common practice in some countries of the world¹¹¹. There is uncertainty about the lifecycle of the phosphate nodules after mining. Therefore, there is uncertainty of any other potential effects arising through transport, storage or any further processing and packaging of phosphate nodules.

¹⁰⁷ Fisher N. S., Beaugelin-Seiller K., Hinton T. G., Baumann Z., Madiga D. J. and J. Garnier-Laplace (2013). Evaluation of radiation doses and associated risk from the Fukushima nuclear accident to marine biota and human consumers of seafood. PNAS 110 (26): 10670-10675 [as referenced by CRP in their application]

Garnier-Laplace J. et al. (2010). A multi-criteria weight of evidence approach for deriving ecological benchmarks for radioactive substances. Journal of Radiological Protection 30(2): 215-233 [as referenced by CRP in their application]

Beresford N., et al, eds (2007). An Integrated Approach to the assessment and management of environmental risks from ionising radiation. Description of purpose, methodology and application. EC project contract no. FI6R-CT-2004-508847. Available at www.ERICA-project.org

¹⁰⁸ Page 153, The New Uranium Boom: Challenge and lessons learned. Chapter: "How much uranium can be left at former U mining sites? The need for a complex assessment framework" [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

¹⁰⁹ Section 5.6.6.3 of the application (Table 5)

¹¹⁰ The Canadian guidelines SQG for uranium in soil (CCME 2007) for the protection of flora and fauna, and human health, identify a threshold of $23 \text{ mg(U)/kg (ppm)}$ for agricultural soil

¹¹¹ The New Uranium Boom: Challenge and lessons learned. [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

6.3 Human health

155 This section discusses and evaluates potential effects on human health that may arise as a result of CRP's proposed mining project.

6.3.1 Toxic and radioactive elements

156 CRP considered that uranium was not radioactive and, therefore, did not evaluate the potential effect of uranium radioactivity or toxicity to human health that could result from processing of the phosphate nodules onboard the vessel with respect to the level of the effect, the likelihood, the level of risk or the overall potential impact.

157 Concentrations of major and trace elements present in the phosphate nodules and seabed sediments were provided in CRP's application¹¹². Phosphorus from these sources is present in the form of diphosphorus pentoxide (P_2O_5), a hazardous substance that is present at concentrations of 19 - 24 % in the phosphate nodules, and 3 % in the sediments, of the Chatham Rise.

Uncertainty or inadequacy

158 In addition to the total concentration of the radioelement and how the specific radioactivity of different radioisotopes contributes to the total radioactivity, the assessment of several other variables is key in evaluating the potential effects of any ionizing radiation, and is standard practice in the evaluation of occupational exposure to radiation. These variables are the energy of the radiation (measured in kilo- or mega-electronvolts), absorbed radiation dose (measured in grays, Gy) and the radiation exposure to gamma ray intensity in the air or absorbed dose rate in the air (measured in grays per hour, Gy/h). Because these other variables have not been considered by CRP's application, there is uncertainty with respect to the actual hazard of the radioelements to the environment and human health.

159 There is uncertainty about whether there is any likelihood of potential radioactivity emission in the processing/sorting plant onboard the vessel from uranium, radon gas and/or other radioisotopes (and/or radiation progeny) from the phosphate nodules and sediment. Also, whether any potential radioactivity emission could be of concern with respect to any accumulated doses from exposure over the life-time of CRP's proposed mining project (35 years).

Further information requested

160 The EPA staff consider that significant uncertainty regarding the safety of radioelements and other potentially hazardous substances in the phosphate nodules remains. To address some of

¹¹² Tables 4 and 5 of the application and Appendix 11

this uncertainty, the same FIRs apply as for Section 6.2 of this report. This is an issue because of the potential to cause short-term and long-term effects on human health and the environment.

EPA assessment of potential human health effects (s59(c))

Diphosphorus pentoxide (P₂O₅)

- 161 Diphosphorus pentoxide is a potent dehydrating agent that reacts vigorously with water and water-containing substances. During its vigorous reaction with water, P₂O₅ can generate a high amount of heat and phosphoric acid, and may even cause fire. Several other hazards that are associated with P₂O₅ include corrosivity to metal, skin and eyes¹¹³. P₂O₅ is also toxic by inhalation and may cause burns to the respiratory tract at concentrations as low as 1 mg/m³. Therefore, some conditions to avoid when handling P₂O₅ are excess heat, dust formation and exposure to air or water.
- 162 When in seawater, P₂O₅ may either be chemically stable or locked into sub-surface layers of the phosphate nodules¹¹⁴ and hence have limited contact with air or humans. On the mining vessel, phosphate nodules containing P₂O₅ will be separated from other material, size-sorted and stored. There is the potential for the generation of dust from phosphate nodules and exposure of P₂O₅ to air and humans during the sorting and packing process onboard. The likelihood of exposing P₂O₅ contained in phosphate nodules or sediment to air or water and the formation of dust while in enclosed areas onboard the vessel, and the potential effect on human health, have not been discussed in any detail in CRP's application. However, while the potential effects of P₂O₅ on human health are uncertain at this time, the EPA staff considers that conditions may be developed to avoid such effects (see Appendix 6 of this report).

Radioactive elements

- 163 Uranium can be radioactive and chemically toxic, each of which have different effects on human health (and the environment). Radiation can be a significant hazard in mining, as well as the emission of alpha particles from uranium, radon gas (and its daughters, RaA and RaC)¹¹⁵. A dose/response relationship has been shown between lung cancer and the exposure of uranium miners to alpha particle emitters, such as radon and its decay products. The equivalent dose, after accounting for the difference in emitted radioactivity from different particles, is expressed in units of Sievert (Sv). The recommended threshold limit value (TLV) for exposure of the general

¹¹³ See Safety Data Sheet (SDS)

¹¹⁴ Figure 8 of Appendix 11

¹¹⁵ <http://www.nature.nps.gov/hazardssafety/toxic/uranium.pdf>

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public to average annual doses of radiation is 1 mSv (20 mSv for radiation workers, averaged over five years)¹¹⁶.

164 Radon gas is a decay product of uranium and, because of its very short life (~ four days), it is highly radioactive, which generates radon progeny (daughters) upon radioactive decay¹¹⁷. During radioactive decay, alpha particles are emitted into the air. The dose absorbed by the lungs will depend on the total concentration of radon and radon progeny in the air. The exposure of a worker to radon progeny is expressed in units of Working Level Months (WLM), which is equivalent to exposure of a worker for 170 nominal working hours per month¹¹⁸.

165 The chemo-toxicological effect of uranium is that it can cause damage to the kidneys (nephrotoxic) and biological tissues. It is also classified as an endocrine disruptive compound (as it mimicks the effects of estrogen) and, even at current levels in drinking water that are regarded as being safe, could increase the risk of fertility problems and reproductive cancers¹¹⁹. This is why the Tolerable Daily Intake (TDI) that the World Health Organization (WHO) provides, which has been quoted by the CRP application¹²⁰, should only be used as a preliminary guidance¹²¹.

166 If after accounting for all the other radiation variables mentioned in Section 6.2 of this report, the phosphate nodules or mine tailings are deemed to be radioactive, workers in the processing/sorting factory of the vessel could be exposed to uranium. Exposure of people to uranium can be via ingestion of contaminated water and food, or by inhalation of radioactive dust or aerosols¹²². The radiation dose is bioaccumulative in organs or tissues and is measured by calculating the committed dose, which takes into account the 50-year period after radiation exposure by inhalation or exposure.

¹¹⁶ From the American Conference of Governmental Industrial Hygienists (ACGIH) and the International Commission on Radiological Protection (ICRP)

¹¹⁷ Page 743, The New Uranium Boom: Challenge and lessons learned. Chapter: "Direct and indirect effects of uranium on microstructure of sedimentary phosphate: fission tracks and radon diffusion" [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

¹¹⁸ http://www.ccohs.ca/oshanswers/phys_agents/ionizing.html

¹¹⁹ Page 533, The New Uranium Boom: Challenge and lessons learned. Chapter: "Challenges in assessing uranium-related health risks: two case studies for the aquatic exposure pathway from South Africa – Part I: Guideline and toxicity issues and the Pofadder case study" [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

¹²⁰ Appendix E of Appendix 11 of the application

¹²¹ Page 157, The New Uranium Boom: Challenge and lessons learned. Chapter: "How much uranium can be left at former U mining sites? The need for a complex assessment framework" [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011

¹²² www.epa.gov/radiation/radionuclides/uranium.html

167 Because there has not been any assessment of indicative doses of radiation from any of the radioisotopes in CRP's application, the effects on human health cannot be adequately assessed. The EPA staff consider that appropriate conditions could be further developed to avoid these potential effects, if necessary (e.g. Condition 21; see Appendix 6 of this report).

6.4 Benthic environment (including demersal fish)

168 This section summarises and evaluates the information provided by CRP relating to the benthic seabed environment.

6.4.1 Benthic environment

General description

169 The crest of the Chatham Rise within part of the proposed marine consent area provides habitat for a diverse benthic community. Thirteen benthic *epifaunal communities* (living on top of the seabed) comprising at least 97 different taxa (> 50,000 individuals) were identified by surveys carried out in part of the proposed marine consent area in 2007, 2012 and 2013¹²³, from analysis of data from various historic databases and a 1981 survey.¹²⁴

170 The most diverse taxa were echinoderms (at least 32 taxa, including sea urchins, starfish, sea cucumbers), cnidarians (at least 25 taxa including corals, hydrozoans, sea pens, sea anemones and medusa), sponges (at least 17 taxa) and molluscs (at least seven taxa, including squid and octopus).

171 The most abundant taxon were encrusting bryozoans/sponges/ascidians (> 5,700 counts), sea urchins (> 4,000 counts), brachiopods (> 4,300 counts), stony corals such as *Goniocorella dumosa* and *Madrepora oculata* (> 3,600 counts), bryozoans/hydroids (> 2,000 counts), arthropods (> 600 counts) and squat lobsters (> 350 counts). Gorgonians (sea fans) were also identified within the mining permit area.¹²⁵

172 Five *infaunal community* groups (living inside the seabed) comprising 307 taxa (> 5200 individuals) were identified from box core samples. The most diverse taxa were arthropods (87 taxa), annelids (80 taxa), bryozoans (60 taxa), molluscs (36 taxa), echinoderms (27 taxa) and cnidarians (eight taxa). The most abundant taxon were annelids (worms, 51 % of total).¹²⁶

¹²³ Appendices 15 and 16 of the application

¹²⁴ Appendices 13 and 14 of the application

¹²⁵ Appendix 3 of Appendix 14 of the application

¹²⁶ Appendix 15 of the application

173 CRP's application assessed the endemism of 78 marine species from within MPL50270¹²⁷, which is equivalent to about 1 % of the known endemic species in the NZ EEZ.

174 The abundance of benthic fish species (some of commercial importance) within or close to the proposed marine consent area on the Chatham Rise were estimated using information from the scientific literature¹²⁸, most of which appeared to have been gathered from a single research voyage. Approximately 200 species of benthic fish, sharks, skates and rays were identified.

Effects of mining discharge and drag-head

175 The concentration of trace elements in the water column originating from the disposal of mine tailings has been estimated to be diluted 200 to 2,000 times and to occur from 100 – 200 m to 15 Km downstream of the point of discharge of the mine tailings, respectively¹²⁹. These dilution estimates have since been revised in response to an EPA request for information (see FIR 8). Dilution modelling now estimates that elements in the water column will be diluted 750 times within 250 m of the point of discharge, to more than 2500 times 2.5 km downstream of the point of discharge¹³⁰. Based on these dilution estimates, CRP concludes that adverse effects on marine biota from dissolved elements are not expected¹³¹. However, this estimation does not take into account particle deposition (see uncertainty section below).

176 Expected sensitivities of 150 species (representative of various groups of marine organisms from the Chatham Rise) to high TSS concentrations (100 mg/L) and a sedimentation threshold (5 cm) were measured and reported in CRP's application¹³².

177 CRP's application indicated through modelling that sedimentation of up to 25 cm (~ 12 cm fine sediment) can occur within 1 km of a mining block¹³³. Therefore, any cumulative environmental effects will be different from mining adjacent versus dispersed blocks in the mining permit area over longer time scales¹³⁴. A higher environmental impact may arise if exclusion mining areas are present in adjacent mined blocks. To understand these cumulative effects and the likely effectiveness of exclusion mining areas in maintaining biodiversity and ecosystem function, further information was requested of CRP by the EPA on 9 June 2014 (see FIR 6).

¹²⁷ Section 6.3.4 of the application

¹²⁸ Dunn et al. 2013 (submitted) in Appendix 22 and Stevens et al. (2014) in Section 6.6 of the application

¹²⁹ Section 8.5.3.2 and Appendix 11 of the application

¹³⁰ Section 2.2 CRP response to FIR 8,9,10, dated 25 July 2014

¹³¹ Section 5.2.4 CRP response to FIR 19, dated 25 July 2014

¹³² Appendix 29 of the application

¹³³ Appendix 25, Deltares (2014b) and Gardline review report (21 May 2014)

¹³⁴ As proposed in Figure 20 of the application

- 178 CRP provided a response to FIR 6 on 8 July 2014 which showed the estimated sediment footprint from mining for one, two, three, five, ten and 15 years. CRP also provided a comparison of sediment footprints that could be generated during oceanographic conditions typical of winter and summer. Up to two sedimentation episodes could be experienced by areas outside of the mining permit area (MP55549) over a 5-year period and up to eight sedimentation episodes in areas within this area over a 15-year period.
- 179 Sedimentation of > 10 cm within the mining permit area (MP55549) was estimated to occur as a result of the cumulative effects of mining several blocks over several years. Over timescales longer than 100 days (up to 15 years), deposition of 0.1 to 5 cm could extend 2 to 10 km from the boundary of the block that is being mined. These estimates have been produced by simplistic models and, therefore, could vary to an unknown degree from reality. To understand the effects of the proposed mining on the environment, the EPA requested that CRP provide a more detailed quantitative estimate of the extent of the sedimentation footprint (see FIR 7).
- 180 CRP responded to the EPA's request by providing quantitative estimates of the sedimentation footprint that would occur during the mining of a single block during summer and winter. It was estimated that mining a single block would result in > 1 mm of sediment covering an area of 82 km² during summer, and 103 km² during winter (for sake of comparison Wellington City is 290 km²). This level of sedimentation would extend about 6.8 km and 8.5 km from the edge of the mining block. Sedimentation of up to 5 cm will occur mostly in the mining block with sedimentation of between 1 - 5 cm covering more than 3 times (> 30 km²) the total area of the mining block¹³⁵. The model used to obtain these results assumed mine tailings would be released 10 m above the seabed.
- 181 Sediment plume modelling that assumed that the material was released at the seabed was also undertaken. Importantly, CRP's modelling experts concluded that these models were likely to be more representative of the actual plume behaviour that would occur as a result of the proposed mining activity. Modelling that mimicked discharge at the seabed produced sedimentation footprints that were significantly smaller in area (sedimentation footprint of > 1 mm in winter was 54 km², and in summer was 61 km²), than that which modelled discharge at 10 m.
- 182 With respect to sediment fractions remaining in suspension, CRP's application states that "*The multiple cycle simulations further revealed that near-bed suspended clay fraction can remain locally in suspension between mining cycles and result in a temporal build-up of concentration in the model domain (uploading behaviour)*"¹³⁶. The EPA requested CRP to provide further

¹³⁵ Section 5.2 CRP response to FIR 7, 21 July 2014

¹³⁶ Appendix 25 of the application

information on the cumulative effects associated with the potential long-term persistence of the plume (see FIR 5).

- 183 CRP provided a response to this request on 21 July 2014. This response suggested that very low suspended clay concentrations (< 1 mg/L) may remain in the water column between mining cycles but were unlikely to accumulate in the water column over periods of time greater than a mining cycle. Deltares used progressive vector diagrams to track the fate of water particles from several model locations. These diagrams suggested that water particles and fine suspended sediments will be transported far away from the mining permit area (MP55549) over a period of months. Therefore, CRP conclude that it is unlikely that sediments will accumulate in the water column for periods of time greater than a single mining cycle¹³⁷.
- 184 Estimates of the plume extent and variability were also provided in CRP's response to the EPA's request for quantitative predictions of suspended sediment (FIR 7). These models calculated the levels of total suspended solids (TSS) that would be generated from the deposition of mine tailings at 10 m above the seabed and at the seabed. The amount of area that is exposed to levels of TSS over 10, 30, 50, and 100 mg/L, over the course of mining a single block was calculated. These models showed that TSS > 100 mg/L would rarely occur outside of the mining block. However, significantly elevated levels of TSS (> 10 mg/L) can extend beyond the modelling domain, more than 15 km from the mining block, for short periods of time. When the discharge was modelled at the seabed, elevated levels of TSS generally did not extend as far away from the mining block, and did not occur as often¹³⁸.
- 185 The physical effects of returning the mine tailings to the seabed, as described by CRP¹³⁹, are:
- a. development and dispersal of a sediment plume
 - b. sedimentation, and
 - c. resuspension of deposited sediments
- 186 CRP has carried out an impact assessment of their mining activities on the environment using an environmental risk matrix to evaluate the level and likelihood of the effect of these activities, and assess the risk to the environment after taking into consideration its proposed avoidance, remediation and mitigation measures.¹⁴⁰

¹³⁷ Section 4.2 CRP response to FIR 5, 21 July 2014

¹³⁸ Section 5.2 CRP response to FIR 7, 21 July 2014

¹³⁹ Section 8.4 of the application

¹⁴⁰ Tables 19 and 27, Chapter 8 of the application

187 In their application¹⁴¹, CRP considered that the level of the effect on:

- a. Seabed disturbance (with or without entrainment of benthic organisms?) caused by the use of the draghead was *minor* with a *possible* likelihood and *low* risk. Therefore, the impact was considered to be *neutral to adverse, near-source confined, short-term* and *reversible*.
- b. Benthic organisms and their habitats by both the mining operations and sedimentation was *serious to high* with a potential likelihood of *almost certain* and *serious to medium* risk. Therefore, the impact was considered to be *adverse, near-source confined, medium to long-term* but ultimately *reversible*.
- c. Water and sediment quality was not considered nor the likelihood of causing the effect, but the impact was deemed to be *neutral, near-source confined, short-term* and *reversible*.

Lighting effects

188 Bright lights in the dark deep ocean could cause potential damage to visual systems of deep sea fauna. CRP state in its application that lights with a narrow light beam of between 60 and 90°(and cameras) may be attached to the drag-head to evaluate its performance, but that this will not be part of its routine mining operations¹⁴². The light intensity is unknown but the range of the light and camera system is expected to be sufficient to observe the immediate area around the drag-head, which is approximately 5 m. These observations are anticipated to be more common in the first few years of operations and will typically last between one to eight hours, depending on the process or equipment being observed. Over any mining cycle, CRP does not expect the total length of observations to last more than one or two days (i.e. 10 - 20 % of total mining time). The precise system has not yet been confirmed, but CRP expects that it is likely to be similar to the one used on the ROV during their 2012 environmental survey.

189 The effect of any drag-head lights on marine organisms has not been considered in detail due to the uncertainty of the lighting equipment that will be used.

Noise effects

190 CRP's application states that the "*noise associated with a trailing suction dredger, similar to the proposed mining vessel, can range from 186 to 188 dB re 1 µPa at 1 m*" and that "*this is similar to the noise generated from a large vessel which is 180 to 190 dB re 1 µPa at 1 m, depending on the frequency measured and the size of the vessel.*"

¹⁴¹ Section 8.3 of the application

¹⁴² Section 4.4.4 of the application

- 191 CRP's application also states that "*protection from physical damage on fish species from impulse noise can be provided by limits of SEL 187 dB and L_{peak} 208 dB at 10 m*" and that "*The noise generated from the mining operations is relatively constant and continuous and it is very unlikely that underwater noise from CRP's proposed mining could cause injury to fish.*"¹⁴³
- 192 CRP's application concludes that "*no avoidance, remediation or mitigation measures are considered necessary to protect fish species from the potential adverse effects of noise arising from CRP's proposed mining operations.*"
- 193 CRP considered that the level of the effect on fish by vessel- and mining-related noise was *low* with a potential likelihood of *possible* and *minor* risk. Therefore, the impact was considered to be *neutral, near-source confined, short-term* and *reversible*.

Best available information

- 194 Sedimentation threshold levels between 1 mm to 5 cm will have marked effects on benthic communities¹⁴⁴. With respect to total suspended solid (TSS) concentrations, avoidance thresholds as low as 10 mg/L for demersal species and ≥ 2 mg/L for eggs and larvae have been referred to in CRP's application¹⁴⁵. The EPA staff acknowledge, that there are limited studies on the effects of suspended sediments on NZ fish species. However, numerous studies from other parts of the world are available to inform a robust assessment of potential effects. The EPA staff consider that this could be further investigated without incurring unreasonable cost, effort or time and have made a FIR to this effect on 9 June 2014 (see below).
- 195 The data presented on the predicted distribution of benthic fish species within the proposed marine consent area appears to be the best available information on the likely distribution of fish species¹⁴⁶.

Uncertainty or inadequacy

General description

- 196 There is significant uncertainty with respect to infauna communities in most of the proposed marine consent area as sample collection and habitat suitability predictions were only carried out for approximately half of MP55549¹⁴⁷. The EPA staff requested further information about the benthic infauna communities in the wider marine consent area (FIR 22) on 9 June 2014.

¹⁴³ Section 8.7.5 of the application

¹⁴⁴ Appendix 29 of the application

¹⁴⁵ Appendices 27 and 28 of the application

¹⁴⁶ See Jacobs SKM review report, 11 June 2014

¹⁴⁷ See Figs. 52 and 68-71 of the application

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- 197 In its response, CRP stated that the infauna communities on the crest of the Chatham Rise are well understood, as a result of the benthic habitat and epifauna assessment provided in its application (Appendices 9, 13, 15 and 16)¹⁴⁸. CRP stated that *“the nature of infaunal communities over the broader marine consent area will be generally similar in nature to those identified within the mining permit area”*. However, Appendix 15 of CRP’s application is the only study that carried out sampling of infauna communities. This sampling was targeted within half of the current mining permit area (MP55549) and no habitat prediction models were run to predict habitat types outside of this area, as done for epifauna¹⁴⁹.
- 198 CRP also states that the uncertainty associated with the abundance and distribution of infauna communities in areas outside of the mining permit area (MP55549) may be able to be addressed as part of the adaptive management approach, specifically Condition 13¹⁵⁰, which includes the requirement to include *“sampling (defined as epibenthic photography and **infaunal sampling**) of the benthic ecology”*.
- 199 CRP’s application¹⁵¹ recommends that further studies need to be completed to determine the uniqueness of the proposed mining area. Occasionally, CRP’s application is not able to state any conclusions about the uniqueness of benthic communities within the proposed marine consent area¹⁵². The EPA staff agree that the ecological significance and the identity of taxa and community types of benthic communities to be disturbed is uncertain at most locations (those which have not been surveyed including most of the proposed marine consent application area). As an example, fossilised whale bones (also of cultural significance) have been collected from the Chatham Rise, which are a unique habitat to some mollusc species¹⁵³. However, the identity, importance or rarity, diversity or threat status of these mollusc species has not been determined. It should be noted that CRP has since relinquished the eastern block of its proposed marine consent area where these fossil bone beds had been found¹⁵⁴.
- 200 The analytical methods used to account for the presence of various benthic organisms within the mining permit area (MP55549) were to analyse one out of every four images taken of the seabed (which is estimated by NIWA to identify about 50 % of taxa present). The surveys carried out by CRP analysed one out of every eight images, which could presumably only account for the

¹⁴⁸ CRP response to FIR 22, dated 27 June 2014

¹⁴⁹ Appendix 16 of the application

¹⁵⁰ Section 11.4.4 of the application

¹⁵¹ Appendices 13, 14, 15 and 16 of the application

¹⁵² Appendix 13 of the application

¹⁵³ Section 5.3.2 of the application

¹⁵⁴ See Ngāi Tahu Cultural Impact Assessment Report

presence of about 25 % of the taxa present in the surveyed area. It is likely that the use of these methodology criteria would highly reduce the probability of detecting taxa that are rare, unique, or have a patchy distribution¹⁵⁵. This leaves uncertainty with respect to the proportion of reported benthic species by CRP, compared to the actual number and type of benthic species that could be present in the proposed marine consent area, especially with respect to rare, unique, endemic or threatened species.

- 201 The level of endemism of benthic species appears to have been determined only for MP55549 and the immediate surrounding area¹⁵⁶. Without the information for the wider proposed marine consent area, there is still significant uncertainty associated with the presence, abundance and uniqueness of benthic species within this area and their importance with respect to other trophic levels. Identification to a greater extent of the vulnerability, uniqueness (endemism) and the potential threat status of species and communities within the wider proposed marine consent area may be necessary to protect rare and vulnerable ecosystems, and the habitats of threatened species.
- 202 On occasions, the tools used by CRP for characterising benthic communities within the proposed marine consent area are considered by the EPA staff to be inadequate. For example, in Appendix 13 of the application the *Trawl* database was used to characterise the uniqueness of benthic communities of the Chatham Rise. However, the purpose of this database was to survey fish stocks. Therefore, the type of sampling equipment that was used was a bottom trawling net with a large mesh size, characteristically raised 25 cm off the bottom of the seabed. In addition, there was not a consistent approach for entering all captured benthic species into the database and, more importantly, most of the sampling was targeted outside of the proposed mining area (e.g. Graveyard and Box Hill seamounts and depths of 1,000 m)¹⁵⁷.
- 203 Therefore, many invertebrate species would not have been captured or entered into the database and so, the EPA staff conclude that the total abundance of benthic organisms from the *Trawl* database would not be representative of the benthic communities in the proposed marine consent area. This means that, in this case, there is uncertainty about the realistic abundance, distribution and uniqueness of benthic species on the Chatham Rise.
- 204 There is also uncertainty associated with any results obtained from the habitat predictive modelling used in CRP's application¹⁵⁸, as this model has not been validated, and not all identified epibenthic communities were included in the predictions.

¹⁵⁵ See Jacobs SKM review report, 11 June 2014

¹⁵⁶ Section 6.3.3 (Figure 52) of the application

¹⁵⁷ Sections 3.1 and 4.1 of Appendix 13 of the application

¹⁵⁸ Appendix 15 and 16 of the application

Effects of the drag-head and mining discharge

205 With respect to the sediment plume modelling, and the assessment of the likely effects of mining discharge, the EPA staff have identified that there is uncertainty about:

- a. which modelled situation (release at 10 m above the seabed or at the seabed) most accurately predicts the behaviour of the plume that would be generated by the discharges of mine tailings. CRP's modelling experts concluded "*that the model results with release of the material into the model domain at the seabed is a better approximation of the actual plume's behaviour from a discharge 10 m above the seabed*"¹⁵⁹.
- b. the particle size distribution that has been incorporated into CRP's plume model, and whether this is representative of all sediments which are likely to be encountered. CRP has stated the if a layer of chalk is dredged and released in mine tailings, it will not result in increased suspended solids¹⁶⁰. However, whether the sediment plume modelling is representative of the PSD that would be encountered in chalk layers, is unclear. If sediments containing a high percentage of fine materials are dredged, the model may not accurately predict the behaviour of a plume produced by these sediments.
- c. whether any TSS may end up in the water column (< 200 m), given the limitations and assumptions of the sediment plume model. For example, the modelling does not resolve the internal tide component velocity when modelling the currents in the mining permit area (MP55549)¹⁶¹.
- d. the exact number of sedimentation overlap events that are associated with the colour scale provided in response to FIR 6 (yellow, green, light blue, dark blue) and whether the interval between sedimentation events is the same as the mining activity cycle proposed in CRP's application¹⁶².

206 In CRP's application (Appendix 29), some sedimentation threshold values were used as exposures for characterising the *relative sensitivities* of different marine organisms. These sedimentation threshold values are not suitable thresholds to characterise *significant impact* to marine organisms, as reported in Section 8.6.3 of the application¹⁶³. This is because these sedimentation threshold values are considered to be well above what would be expected to cause an adverse effect on benthic organisms. Therefore, the EPA staff consider that the use of the sedimentation threshold values by CRP in this way was inappropriate, and that the minimum

¹⁵⁹ Section 7 CRP response to FIR 7, 21 July 2014

¹⁶⁰ Section 2.2 CRP response to FIR 3, 21 July 2014

¹⁶¹ Appendix 25 of the application

¹⁶² Figure 10 of response to FIR 6 and Section 4.7.1 of the application

¹⁶³ 100 mg/L and 5 cm deposition for at least a month

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sediment thresholds required to cause an adverse effect on benthic communities remains a significant uncertainty (see further information request below).

207 Rates and scales of recovery of benthic organisms are largely uncertain (though CRP's application acknowledges that they are likely to be decades to centuries), which would constitute a permanent (irreversible) effect on benthic biota. *"In the absence of additional information it should be assumed that communities in large parts of at least mined areas may never recover and will be replaced by different ecological communities."*¹⁶⁴

208 The EPA staff consider that the approach used in CRP's application to estimate dilution of dissolved elements, after the discharge of mine tailings into the water column, was inadequate. CRP provided further information in response to the EPA's requests (FIR 8, 9, 10) that modelled dilution rates that occurred, following the discharge of sediment at 10 m above the seabed¹⁶⁵. These dilution estimates were used to infer the levels of dissolved elements that would be present in the water column after the discharge of processed sediment. Although the results obtained from the elutriate samples showed that dissolved concentrations of arsenic, cadmium, copper and nickel released from the sediments of the mining permit area (MP55549) were higher than ANZECC (2000) guideline levels for the protection of marine life¹⁶⁶. CRP contends that dilution will ensure that these elements will not have adverse effects¹⁶⁷.

209 CRP's use of suspended clay concentrations (representative of one fraction of the fine suspended sediment) may have overestimated the dilution of dissolved metals in the water column, as other fractions of fine sediment in suspension do not appear to have been considered (e.g. mud and chalk)¹⁶⁸.

210 Particle deposition and the higher concentrations of potentially toxic elements present in these larger particles (unaffected by dilution from the surrounding water) may have a different effect on benthic communities, compared to TSS (which are affected by dilution). Marine particles (e.g. organic marine snow, that is a part of marine sediments) are complex and diverse structures where the concentration of chemical elements and nutrients can be orders of magnitude higher than the surrounding seawater¹⁶⁹. The EPA staff consider that any dilution estimates with respect to TSS provided by CRP may not be suitable for deposited particles. This is because any higher

¹⁶⁴ See Jacobs SKM review report, 11 June 2014

¹⁶⁵ CRP response to FIR 8, 9, 10, dated 25 July 2014

¹⁶⁶ See Jacobs SKM review report, 11 June 2014

¹⁶⁷ Section 5.2.4 of the application; CRP response to FIR 19, dated 25 July 2014

¹⁶⁸ See Jacobs SKM review report, 11 June 2014

¹⁶⁹ Alldredge A. L. and Y. Cohen (1987). Can microscale chemical patches persist in the sea? Microelectrode study of marine snow, faecal pellets. Science 235: 689-691

concentrations of elements in these particles would not have been taken into account in CRP's elutriation or modelling assessment of dilution of dissolved elements. Therefore, uncertainty remains with respect to the potential toxicity of particles to benthic fauna in the immediate vicinity of where mine tailings may be disposed of (this area is likely to eventually include every point within the mining area at the end of the mining period).

211 The adequacy of using ANZECC (2000) guideline levels at the proposed depths in the marine environment is uncertain and will be assessed by a commissioned expert, as requested by the DMC on the FIR document dated 17 July 2014. In response to the EPA's further information request about the effects of pressure on toxicity (FIR 11), CRP concludes that *"potential pressure related toxicity impacts on the Chatham Rise are expected to be 10% of those at significant depths"*. The EPA staff are uncertain about how this conclusion was reached and what depth CRP considers *"significant"*. CRP consider that the *"water quality trigger values provided by ANZECC (2000), which are inherently conservative, should provide acceptable guidance as to the potential for discharge to result in toxicity"*¹⁷⁰. CRP also concludes that *"it is not considered that potential water borne toxicity downstream of the discharge will be affected by hydrostatic pressure effects to such an extent that additional safety factors are required"*¹⁷¹.

212 CRP may modify its proposed Mining Plan in the future to maximise the utilisation of the mining resource¹⁷². Therefore, the EPA staff note that a significant uncertainty still remains with respect to the degree of variation that the proposed Mining Plan may undergo, including:

- a. the order in which the blocks will be mined
- b. whether an adjacent or dispersed approach to mining blocks will be followed
- c. the final thickness of the layer of sediment to be mined (up to 0.5 m stated in the application)
- d. the final diameter of the riser (75 cm, as stated in CRP's application), and
- e. the separation components of the size sorting machines.

213 All of the variables above contribute to the overall uncertainties that the EPA staff have about any potential effects caused by CRP's proposed mining activities.

Effects of noise

214 CRP's assessment of noise on fish was not considered by the EPA staff to identify any potential effects that may be caused by the type of noise emitted by CRP's proposed mining activities

¹⁷⁰ CRP response to FIR 11, dated 25 July 2014

¹⁷¹ CRP response to FIR 11, dated 25 July 2014

¹⁷² Section "Optimisation of resource utilisation" in the response to FIR 6 document

(with respect to sound and frequency level). The frequency levels for the noise emitted from the drag-head or mining vessel were not provided and the “safety threshold levels” provided for fish were expressed in units that were different to those provided for conventional trailing suction dredgers, which prevented a comparison between these two “safety threshold levels”.

- 215 The noise level and frequency generated from the riser, sinker, diffuser and pump unit were not provided by CRP. On occasions, inadequate or irrelevant references have been quoted (e.g. noise levels from wind turbines on land and reference to goldfish). Therefore, uncertainty remains with respect to the potential effects on fish from noise emitted by the vessel and mining activities.

Effects of lighting

- 216 Artificial lighting at depths below the photic zone is likely to have effects of varying scale on light-sensitive biota¹⁷³. The effects of lighting on marine organisms from lights on the drag-head have not been considered. There is uncertainty with respect to the power, wavelength and orientation of the lights to be used or how the very short range (5 m) asserted by CRP was estimated.

Further information requested

- 217 The EPA staff consider that significant uncertainty regarding the state of the benthic environment and the effects of CRP’s proposed activities remain. To address this uncertainty, the following information was requested of CRP.
- 218 To understand the effects of sedimentation on benthic communities from particle deposition and sustained and elevated TSS in the water column, FIRs 8, 14 and 15 were requested of CRP on 9 June 2014.
- 219 To ensure that a robust assessment has been undertaken on the best available information to assess the effects and cumulative effects of the mining activity on marine fish within the proposed marine consent area and the surrounding area, FIR 35 was requested of CRP on 9 June 2014.
- 220 To better inform the assessment of the spatial extent of potential adverse effects of underwater noise on fish species and commercial fishing interests, FIR 36 was requested of CRP on 9 June 2014.
- 221 As at 7 August 2014, a response from CRP to the FIR 14 - 15 and 35 - 36 had still not been received.

¹⁷³ For example, Rich & Longcore 2006 [as stated in SKM review report, 11 June 2014]

222 To determine the benthic infauna communities that occur in the wider proposed marine consent area, FIR 22 was requested of CRP on 9 June 2014. A response to FIR 22 was received on 27 June 2014 and has been considered in this report.

EPA assessment of potential environmental effects (s59(2))

Effects of drag-head and mining discharge

223 The EPA staff consider that two main mining activities will cause effects on benthic fauna and habitat: the use of the drag-head and the discharge of mine tailings to the seabed. These activities will cause the following effects:

- a. destruction of benthic organisms by squashing from, or by direct entrainment into, the drag-head
- b. loss of benthic habitat from causing “disturbance” to, and removal of, the seabed
- c. deposition of sediment on benthic organisms
- d. effects of light from the drag-head on marine organisms
- e. a potential negative influence on water and sediment quality from the generation and dispersal of a sediment plume (several kilometres laterally from the mining area), as a result of the discharge of mine tailings and sediment resuspension from the use of the drag-head
- f. a potential negative influence on water and sediment quality from the release of dead marine organisms collected by the drag-head, and
- g. mining-related (and vessel-related) noise on benthic fish

224 CRP’s proposed mining approach¹⁷⁴ will, undoubtedly, cause the total destruction of benthic communities and their habitats in the mined areas which will have minimal recovery (if any) over a period of several decades to centuries (except for some mobile infauna species).

225 The effects on benthic organisms (epifauna and infauna) from elevated levels of sediments in suspension, and subsequent deposition of this sediment, can be direct or indirect. Direct effects are caused from abrasion, clogging of filtration mechanisms which would interfere with ingestion and respiration, and smothering and burial resulting in mortality. Indirect effects are caused through changes in substrate composition, and therefore habitat modification, which will affect the distribution of infaunal and epibenthic species¹⁷⁵. Some benthic marine species are more

¹⁷⁴ The mining approach involves using a 50-tonne draghead attached to a 300-tonne pump to remove sediment layers down to, at least, 0.5 m deep

¹⁷⁵ Berry W., Rubinstein N. and B. Melzian (2003). The biological effects of suspended and bedded sediment (SABS) in aquatic systems: a review. USA EPA Internal Report

sensitive than others and the response to burial by sediments will be different depending on species type, whether the organism is motile and whether it is tolerant of anoxic conditions (from burial or as a result of a decrease in water quality).

- 226 In addition, other effects may be created resulting from the potential toxicity of the mine tailings associated with the presence of trace metals (including radioelements). Benthic fauna on the Chatham Rise comprise a rich variety of marine organisms. According to size, these marine organisms can be classified as meiofauna (size up to 0.5 mm), macrofauna (> 3 mm) and megafauna (> 5 cm)¹⁷⁶. The discharge of mine tailings at a depth of 10 m above the seabed will create turbidity plumes of sediment which move down-current, and the deposition of sediment onto the seabed. The end-result of these processes is the smothering of sessile (including corals and sponges) or slow-moving benthic communities, and potential interference with the normal physiological function of many marine organisms (including fish).
- 227 A behavioral response from fish may occur from a low intensity and short-term exposure to TSS and sedimentation in the initial stages of mining. However, sub-lethal effects may occur as the duration and intensity of exposure increases. These sub-lethal effects can lead to mortality at more intense exposures of longer duration. The level of tolerance to specific thresholds of TSS by some fishes, their larvae and eggs, and the effect of sedimentation on them are known from published literature. For example, concentrations as low as 11.4 mg/L of suspended impure clay have been high enough to inhibit physiological functions in some fish after only a one-day exposure¹⁷⁷.
- 228 The sensitivity of most marine organisms from the Chatham Rise that underwent the sensitivity tests using arbitrary thresholds of TSS and sedimentation was rated "high" or "very high". This indicates that effects ranging from mortality/damage (with recovery rates of up to 10 years) to sub-lethal effects (with recovery rates of > 10 years) would occur.
- 229 The EPA staff consider that the removal of non-living (phosphate nodules and sediment) and living material from the seabed and subsoil from the suction exerted by the drag-head and its passage will cause disturbance and damage of the seabed and subsoil. This activity will also cause damage to most sessile and slow-moving marine species (including protected corals and an unknown number of endemic and unique species), such that significant adverse effects will be caused to all these organisms and their habitats.

¹⁷⁶ Section 6.3 of the application

¹⁷⁷ Sweeten, J. and C. McCreedy (2002). Suspended stream sediment: an environmental indicator of warmwater streams. 319 nonpoint source pollution report, ARN 98-175. Asherwood Environmental Science Center, Wabash, IN

- 230 The likelihood of causing significant adverse effects on benthic fauna is *almost certain*, the magnitude of the effect would be *catastrophic*, therefore the environmental risk is *extreme*. Some of the most significant sensitive communities (e.g. corals, brachiopods and sponges that rely on the phosphate resource as substrate) may never recover. Therefore, the effect will be permanent and irreversible. The EPA staff do not consider that the development of any conditions would be able to lower the level of risk to these benthic communities. All of these benthic organisms and habitats within the mined areas would be destroyed by this mining activity, and this effect would be permanent and irreversible for many of the species present.
- 231 The effects of discharging the mine tailings and resuspension of sediment from the use of the drag-head on water and sediment quality are difficult to evaluate. However, CRP's modelling suggests that water quality is unlikely to be affected when dilution is taken into account¹⁷⁸. The effects on sediment quality have not been addressed and cannot be adequately evaluated at this stage. The EPA staff consider that appropriate conditions may be able to lower the risk of any potential adverse effects that may occur on sediment quality, but uncertainty remains (see Table 1, Section 15 of this report).
- 232 The proposed mining method described by CRP uses a 15 cm screen as a filter to large marine organisms and potential obstacles¹⁷⁹. The effects on water and sediment quality of releasing considerable volumes of dead marine organisms back to the water column and seabed have not been evaluated by CRP. Adverse effects from this activity are *likely* and the magnitude of the effect could be *major* to *catastrophic*, and therefore represents an *extreme* risk. The magnitude of the effect will vary depending on the following processes that could occur in the water column above the seabed:
- a. the level of potential anoxia (lack of oxygen) from increased microbial activity on organic matter
 - b. any subsequent potential production of methane (a greenhouse gas) from anoxia¹⁸⁰, and
 - c. alteration of biogeochemical cycles and microbial dynamics.
- 233 The EPA staff consider that conditions may decrease the overall level of risk, but note that residual effects resulting from the release of dead marine organisms are likely to remain. Therefore, even with the imposition of conditions the level of risk could be *high*.

¹⁷⁸ Section 5.2.4 CRP response to FIR 19, dated 25 July 2014

¹⁷⁹ Section 4.2 of the application

¹⁸⁰ Naqvi S. W., Bange H. W., Farias L., Monteiro P. M. S., Scranton M. I. and Zhang (2010). Marine hypoxia/anoxia as a source of methane and nitrous oxide. *Biogeosciences* 7: 2159-2190

Lighting effects

234 The effects of lights on marine organisms from the drag-head has not been evaluated in CRP's application. However, CRP states that expected range of the light and camera system will be sufficient only to see the immediate area around the drag-head, which is approximately about 5 m¹⁸¹. If this holds true, the EPA staff consider that adverse effects from lighting would be *possible* but the consequences would be *minor*. Therefore, the environmental risk is considered to be *low*.

Noise effects

235 The effects of noise on fish (and other marine organisms) will vary depending on the source of the noise (e.g. seismic air gun or drag-head), the type of sound (e.g. pulse or continuous), the distance from which the noise originates, the sound and the frequency level (Hz) and the sensitivity of the particular marine organism affected. For example, some fish species elicit responses to noise levels in the range 90 - 180 dB μPa^{-1} SPW and a frequency range 100 - 600 Hz¹⁸². In cod, hair-cell destruction occurs at 180 dB μPa^{-1} SPW and a frequency of 300 Hz during sustained sound generation¹⁸³.

236 The effects of noise on fish are species-specific and include behavioural disturbance, masking of ambient noises relevant to fish, temporary hearing loss, physical damage, attraction of fish to vessels emitting noise and displacement of fish from the affected area¹⁸⁴. The effects of noise on fish (and other marine organisms) cannot be adequately evaluated because responses to the further information requests (FIR 14 and 35) requested of CRP on 9 June 2014 have yet to be received from CRP (as at 7 August 2014). However, if this information is provided by CRP, appropriate conditions may be able to be drafted to mitigate the potential adverse effects of noise on fish.

237 The effects on conservation values, such as protected benthic species of coral and the relevance of the Benthic Protection Area (BPA) are considered in Sections 6.6.3 and 10.4, respectively.

¹⁸¹ Section 4.4.4 of the application

¹⁸² The low frequency limits on radiated noise generated by research vessels developed by the International Council for the Exploration of the Sea (ICES) is well above the frequency required to cause an effect on fish (1 – 1000 Hz) [as stated by JPEC review report, 23 May 2014]

¹⁸³ Myrberg A. A. Jr. (1990). The effects of man-made noise on the behaviour of marine animals. *Environment International* 16: 575-586

¹⁸⁴ See JPEC review report, 23 May 2014. Note: the hearing capability of some marine commercial fish species ranges from a few Hz to possibly tens of thousands Hz

Protecting the biological diversity and integrity of marine species, ecosystems and processes, rare and vulnerable ecosystems, and the habitats of threatened species (s59(2)(d)(e))

238 Approximately 90 % of the proposed marine consent area by CRP is protected by a BPA¹⁸⁵, an area which has not been subjected to fishing pressure from bottom trawling since 2007 (see Section 10.4 of this report).

239 The benthic habitat assessment¹⁸⁶, the New Zealand Threatened Species List for marine invertebrates¹⁸⁷ and benthic invertebrate by-catch¹⁸⁸ indicate that vulnerable species and communities (including corals) not previously described in the Chatham Rise region occur within or around the proposed marine consent area. The New Zealand Threatened Species List for marine invertebrates also identifies octopus species and other corals that occur on the Chatham Rise. The bubblegum coral (*Paragorgia wahine*) is a Nationally Vulnerable species with an estimated area of < 1,000 ha remaining in New Zealand. There is significant uncertainty about the presence, distribution and abundance of this coral species (or threatened octopus species) within the proposed marine consent area, as no data was presented in CRP's application¹⁸⁹.

240 The results from some research surveys indicated that some epifauna communities within the mining permit area (MP55549) had not been found elsewhere on the Chatham Rise, and therefore could be unique to this area¹⁹⁰. Examples of potentially unique species include abundant populations of a giant isopod (*Serolis bromleyana*) which are associated with phosphate nodules; and the giant bivalve mollusc *Acesta* and brachiopods (e.g. *Dallina* and *Terebratulina*), which have not been detected elsewhere in New Zealand waters. For example,

¹⁸⁵ See Figure 6 of the application. Note the total proportion of the proposed marine consent area that overlaps with Mid Chatham Rise BPA has increased as CRP no longer seeks a marine consent for the eastern block outlined in Figure 6 of the application, see CRP's memorandum to the EPA dated 1 August 2014

¹⁸⁶ Appendix 13 of the application

¹⁸⁷ Freeman D. J., Marshall S. T., Ah Yong S. T., Wing S. R. and Hitchmough (2010). Conservation status of New Zealand marine invertebrates, 2009. New Zealand Journal of Marine and Freshwater Research 44(3): 129-148 [as referenced by Jacobs SKM review report, 11 June 2014]

¹⁸⁸ O'Driscoll, R.L., MacGibbon, D., Fu, D., Lyon, W. and Stevens, D.W. (2011). A review of hoki and middle depth trawl surveys of the Chatham Rise, January 1992–2010. New Zealand Fisheries Assessment Report 2011/47

Probert P. K., McKnight D. G. and S. L. Grove (1997). Benthic invertebrate by-catch from a deep-water trawl fishery, Chatham Rise, New Zealand. Aquatic Conservation: Marine and Freshwater Ecosystems 7 (1): 27-40 [as referenced by Jacobs SKM review report, 11 June 2014]

¹⁸⁹ See Jacobs SKM review report, 11 June 2014

¹⁹⁰ Appendices 13, 15 and 16 of the application

Chatham Rock Phosphate Limited Marine Consent Application

Acesta spp. have only been identified from six sites in New Zealand, all of which are on the Chatham Rise¹⁹¹.

- 241 The presence of a high diversity and abundance of stony corals, bryozoans, sea pens, sponges and brachiopods are indicators for what are considered to be sensitive environments, as set out in Schedule 6 of the EEZ and Continental Shelf (Environmental Effects — Permitted Activities) Regulations 2013.
- 242 Coral thickets and sponge beds provide a unique habitat for shelter and support a diverse and abundant range of species (including octopus and squat lobsters). Sponges are key benthic species that contribute to ecosystem productivity by coupling the benthic and pelagic environments through the flux of nutrients, carbon and oxygen. The high catch weights of sponges (> 2 tonnes) in the proposed marine consent area, with some sponges that were > 1 m, have been suggested to be linked to the high density of phosphate nodules on the seabed¹⁹².
- 243 Scleractinian stony corals (e.g. *Goniocorella dumosa* and *Madrepora oculata*), hydrocorals of the family Stylasteridae and all gorgonians are listed on Appendix II of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) and are also protected by Schedule 7A of the Wildlife Act 1953 (refer to Section 6.6.3).
- 244 With respect to infauna communities, one infauna community that was identified within the mining permit area (MP55549), had not been found elsewhere on the Chatham Rise¹⁹³.
- 245 It is unclear to the EPA staff how the current mining method and consent conditions proposed by CRP would protect the biological diversity and integrity of marine species, ecosystems and processes, rare and vulnerable ecosystems, and the habitats of threatened species.
- 246 The mining activities proposed by CRP will, without doubt, destroy the existing sensitive environment. In its determination of CRP's application for marine consent, the DMC will need to reconcile that the existing environment is currently protected from fishing by bottom trawling (and, as a result, is potentially more diverse and sensitive than other locations in the EEZ) against the total destruction of that environment that will result from mining. In the event that the DMC can anticipate the effects on the area being managed successfully through consent conditions, the uncertainties of the impact on the benthic communities remain. The DMC must then turn its mind to whether those uncertainties are such that favouring caution and environmental protection is required.

¹⁹¹ Appendix 14 of the application

¹⁹² Appendix 13 and Section 6.3.2 of the application

¹⁹³ See Jacobs SKM review report, 11 June 2014

6.5 Plankton, pelagic fish and cephalopods (including squid and octopus)

247 This section summarises and evaluates the information provided by CRP relating to the pelagic environment (water column).

6.5.1 Description of pelagic environment

248 The waters around the Chatham Rise are influenced by the STF, a major front that contributes to significant phytoplankton and primary production, and bisects the two main oceanic water masses around New Zealand. The elevated phytoplankton productivity in this area supports the pelagic and benthic ecosystems, and deep water fisheries¹⁹⁴. Phytoplankton productivity is suggested to be linked to the biomass of zooplankton, which vertically migrate throughout the water column each day¹⁹⁵.

249 Mean surface chlorophyll a concentrations were provided for the proposed marine consent area from February until May (the year is unclear)¹⁹⁶ and for the period 2002 - 2012 using the long-term annual-average¹⁹⁷, and for each month of an unknown year and location¹⁹⁸.

250 Current biogeochemical cycles operating in the water column of the Chatham Rise, the planktonic organisms that regulate these processes and the potential effects of sedimentation on them were not explained in CRP's application.

251 The mesopelagic (200 - 800 m) fish population of the Chatham Rise are an important diet to commercial fish species that are caught on and around this area, seabirds and marine mammals¹⁹⁹. Some estimations of the biomass of mesopelagic fish in the area have been provided by CRP by quoting some studies that used acoustic backscatter methods.

252 CRP state that squid (e.g. arrow squid, red squid, warty squid, giant squid) and octopus are an important food source for many fish species, marine mammals and seabirds, and have been found throughout most of the Chatham Rise area²⁰⁰.

253 CRP also mention that "*low levels of cephalopod taxonomic richness have been recorded in MPL50270*", which is where the largest catch rates of octopus were registered, as well as within

¹⁹⁴ Section 6.4 of the application

¹⁹⁵ Section 6.4.3, 6.5.4 and 6.5.5 of the application

¹⁹⁶ Section 5.7.5 and Figure 48 of the application

¹⁹⁷ Section 6.4 (Figure 72) and Appendix F of Appendix 22 of the application (Figure F1)

¹⁹⁸ Appendix F of Appendix 22 of the application (Figure F2a)

¹⁹⁹ Section 6.5 of the application

²⁰⁰ See Section 6.5.3 of the application

the BPA and on the east and west of the southern half of the Chatham Rise (e.g. dwarf octopus and deep water octopus). According to CRP, other species of octopus were found, the distribution of which appeared to be similar to that of sponges on the Chatham Rise.

254 A total of 118 specimens of molluscs (including cephalopods) were measured within the “licensed area” of the Chatham Rise, comprising > 100 kg²⁰¹.

255 Mining operations (including noise) and sedimentation were considered by CRP to have an effect on pelagic organisms and fisheries²⁰². The effect of these activities on fisheries was considered by CRP (see Section 7.2 of this report), but the level and likelihood of the effect, level of risk and impact on pelagic fish, cephalopods and plankton do not appear to have been considered by CRP.

Uncertainty or inadequacy

256 Chlorophyll a concentrations are an important biological indicator of phytoplankton biomass. Chlorophyll a concentrations are important for setting background baseline levels in the environment of CRP’s proposed marine consent area and surrounding area. The methodology used to estimate these chlorophyll a concentrations by CRP is unclear, as well as the year to which the chlorophyll a concentrations presented by CRP relate to²⁰³. This information would assist the EPA to identify whether best available information (most up to date) was used to characterise the current state of the area. However, if seasonal chlorophyll a concentrations are consistent between years, then this would not represent a significant uncertainty. Sampling at various depths could be undertaken by CRP prior to mining to establish a baseline.

257 Zooplankton are small sensitive predators of phytoplankton that vertically migrate through the water column. Zooplankton could be negatively influenced by a change in water quality below the photic zone from resuspended and/or deposited sediment (and the dumping of dead marine organisms) as a result of CRP’s proposed mining activities. An adverse effect on zooplankton could have an indirect cumulative effect on phytoplankton biomass and, hence, chlorophyll a concentrations in the photic zone.

258 Data representing large zooplankton was lacking in the trophic model, and therefore uncertainty remains with respect to the trophic interaction of zooplankton with phytoplankton, and fisheries. For example, CRP’s application does not discuss how phytoplankton would be impacted through a potential decline in the zooplankton predator population, as a result of the discharge of mine tailings, and if this would affect commercial fisheries in the area.

²⁰¹ Appendix 15 of the application (Table and Figure 13)

²⁰² Section 8.6.5 and 8.6.7 of the application

²⁰³ The legend of Figure F2a (Appendix F of Appendix 22 of the application) states that chlorophyll a concentrations were “*estimated as described in the text*”

259 There is no current information in CRP's application on the diversity and distribution of various planktonic groups (bacteria, archaea, phytoplankton, zooplankton, larval stages), or the biogeochemical cycles that some of these groups regulate in the water column above the seabed. Therefore, this leaves an uncertainty with respect to the current state of the area and whether adverse effects from CRP's proposed mining activities are likely to occur (see further information request below).

260 Acoustic backscatter is usually only considered to be a method that is able to estimate the abundance and distribution of some fish species. Therefore, uncertainty remains about the current depth distribution, abundance, role, rarity and vulnerability of mesopelagic fishes in the food chain within the proposed marine consent area. Furthermore, the ecosystem trophic model presented in CRP's application²⁰⁴ indicates that some data relating to mesopelagic fish from two recent research voyages had not yet been included into the model.

261 Uncertainty also remains about the current depth distribution, abundance, role, rarity and vulnerability of squid and octopus species, and their importance in the food chain within CRP's proposed marine consent area.

Further information requested

262 To address the lack of information regarding the epipelagic and mesopelagic environments FIR 12 - 13, 41 - 43 was requested of CRP by the EPA on 9 June 2014.

263 As at 7 August 2014, CRP had not responded to these FIRs.

264 Additionally, the DMC has asked the EPA on 17 July 2014 to commission an independent assessment of the sediment and trophic modelling with a view to providing reports prior to the hearing.

265 The DMC also asked for a FIR on 25 July 2014 to better understand the effects on water quality and cumulative effects on the food web of releasing dead marine organisms and mine tailings back to the water column and seabed.

EPA assessment of potential effects on the environment (s59(2))

266 The BPA Regulations 2007 cover the provision for a 'no fishing zone' that extends to 100 m above the seabed, which ensures that epipelagic fauna in the depth range from 150 to 200 m and mesopelagic fauna in the depth range from 200 to 450 m are protected from fishing trawling activities (see Section 10.4 of this report).

²⁰⁴ Appendix 22 of the application

267 The deposition of sediment onto the seabed from the discharge of mine tailings at a depth of 10 m above the seabed will create turbidity plumes of sediment that may displace some mesopelagic fish and cephalopods (squid and octopus).

268 If the modelling predictions for sediment plume dispersion hold true, the effects of the proposed mining activities on pelagic fish are expected to be minimal by EPA reviewers, as sediment would not be expected to reach the upper water column²⁰⁵. The EPA staff consider that the significance of the effects on epipelagic (< 200 m) and mesopelagic (200 - 800 m) fish and cephalopods cannot be adequately considered due to a lack of information and uncertainty associated with the modelling predictions. However, the development of conditions may ensure that the potential adverse effects on pelagic fauna are avoided or mitigated. These could include conditions on the discharge of mine tailings into the water column, for example, restrictions on the maximum content of mine tailings of fine size (see draft conditions in Appendix 6).

6.6 Protected species

269 This section summarises and evaluates the information provided by CRP relating to protected species including marine mammals, seabirds and corals.

6.6.1 Marine mammals

270 CRP's application describes the likely distribution of marine mammals within the proposed marine consent area and within a 100 km buffer zone, using mostly two datasets of incidental sightings by DOC and Martin Cawthorn, and a published report²⁰⁶. The datasets provided 137 records of 12 different cetacean species and, in addition, a group of beaked whales. Most of the sightings were of sperm whales and pilot whales which rely on the Chatham Rise as a preferred foraging ground. In addition, various species of dolphins (including the nationally endangered bottlenose dolphin), baleen whales and beaked whales, including the endangered killer whale and southern right whale use, and transit through, this area.

271 Two species of seal, Hooker's sea lion and NZ fur seal were considered as likely to be present in the proposed marine consent area²⁰⁷.

272 Mining operations, sedimentation and noise are considered by CRP to have an effect on marine mammals²⁰⁸. The level of the effect on marine mammals from CRP's proposed mining operations and sedimentation was considered by CRP to be *minor* with an *unlikely* likelihood and *low* risk.

²⁰⁵ See JPEC review report on commercial fisheries, 23 May 2014

²⁰⁶ Section 6.8 and Appendices 20 and 22 of the application; Berkenbush et. al. (2013), as stated in CRP's application

²⁰⁷ Section 6.8.5 of the application

²⁰⁸ Sections 8.6.6 and 8.7.4 of the application

Therefore, the impact was considered to be *neutral to adverse, near-source confined* (i.e., where and when mining is occurring), *short-term* and *reversible*.

273 The level of the effect on marine mammals from noise caused by the vessel and mining equipment was considered by CRP to be *minor* with a *possible* likelihood of causing the effect and a *low* level of uncertainty (risk). Therefore, the impact was considered to be *neutral, near-source confined, short-term* and *reversible*. Although, CRP acknowledges that “*this risk determination was made in light of the limited research into noise emissions for the mining system to be employed...*”.

274 A mitigation strategy has been proposed by CRP by including a buffer zone of 200 m to monitor the presence of marine mammals in the area around the vessel. This 200 m zone is to be scanned for at least 10 minutes. If marine mammals are detected within this zone, then mining operations would not commence until these mammals have left the area or have not been observed for more than 30 minutes²⁰⁹.

Best available information

275 No spatial or temporal surveys were completed to characterise the distribution of marine mammals throughout the proposed marine consent area. This gap has left many uncertainties with respect to how many and which type of marine mammal species use this area as exclusive habitat and how often do these marine mammals frequent this area. Therefore, the EPA staff do not consider that best available information was used to characterise the marine mammal population around the Chatham Rise. The EPA staff consider that information on marine mammal distribution on the Chatham Rise (other than from databases of incidental sightings) may be readily available from existing sources without incurring unreasonable cost, effort or time.

276 Although CRP’s application briefly mentions some regulatory guidance in relation to acceptable levels of underwater noise²¹⁰, it does not identify widely accepted sound threshold criteria from the published literature which are used for managing the impact of underwater noise on marine mammals²¹¹. The EPA staff consider that this information is readily available from existing sources without incurring unreasonable cost, effort or time.

Uncertainty or inadequacy

277 The information presented in CRP’s application on incidental sightings of marine mammals has a low reliance as most of this data would have been gathered by untrained observers, and may

²⁰⁹ Section 8.7.4.4 of the application

²¹⁰ Section 8.7.2 of the application

²¹¹ For example Southhall et al. (2007), as stated in Jacobs SKM review report (11 June 2014); and, Richardson W. J., Greene C. R., Malme C. I. and D. H. Thomson [Eds.] (1995). *Marine Mammals and Noise*. Academic Press, San Diego, 576 pp.

therefore be factually incorrect²¹². The disclaimer in some figures of CRP's application²¹³ stating that *"Reported sightings are from a variety of sources and need to be considered indicative only, as identifications may not be correct"* confirms this statement.

278 The significance of the proposed marine consent area as habitat for marine mammals is uncertain, due to lack of information.

279 No information has been provided on the use of all sonars or other sources of underwater vibration during CRP's proposed mining activities (e.g. type of sonar, frequency range and power level, frequency and duration of use, sonar location).

280 There is significant uncertainty when attempting to assess the effect of specific noise levels from the mining and prospecting operations on marine mammals compared to accepted threshold levels. This is because CRP's application simply refers to "noise" without having identified the specific noise metric that was used (i.e. sound pressure level (SPL) or sound exposure level (SEL); peak or rms levels). Occasionally, incorrect units have been used for the metric (e.g. dB re 1 μPa are used for SEL, when the correct units are dB re 1 μPa^2 -s). Using the correct units is critically important in order to assess the source and received sound levels with respect to threshold levels that would cause an acoustic effect on marine mammals.²¹⁴

281 The level of tolerance to specific thresholds of Total Suspended Solids (TSS) by some marine mammals and the effect of an increased TSS loading and sedimentation on them (according to appropriate TSS thresholds) is currently uncertain, although the significance of this depends on whether marine mammals are likely to forage in the vicinity of sediment plumes.

282 CRP's application modelled ecosystem interconnectedness through the food chain²¹⁵. The way in which the food web could be impacted from its proposed mining operations and the potential effect that it could have on marine mammals is uncertain, as cetaceans were one of the groups that could not be adequately modelled due to a substantial deficit in information.

Further information requested

283 The EPA staff considers that uncertainty regarding the effects of CRP's proposed activities on marine mammals remain. To address some of this uncertainty, the DMC has asked the EPA on 17 July 2014 to commission advice from a suitable marine mammal expert to provide an independent assessment of the effects of CRP's activities with a view to providing reports prior to the hearing.

²¹² See Jacobs SKM review report, 11 June 2014

²¹³ For example, Figs. 109, 111, 112, 114 and 115 of the application

²¹⁴ See Jacobs SKM review report, 11 June 2014

²¹⁵ Appendix 22 of the application

EPA assessment of potential environmental effects (59(2))

284 Potential effects on marine mammals from CRP's proposed mining operations include²¹⁶:

- a. decreased foraging efficiency through a potential reduction in sensory capability (visual and acoustic) and/or dispersal of prey resulting from disturbance to their habitat through an increase in turbidity from the sediment plume
- b. decreased capability of acoustic communication and perception due to a potential increase in noise levels in their environment
- c. entanglement with mining equipment
- d. ship strike
- e. environmental pollution

285 Decreased foraging efficiency through a potential reduction in sensory capability (visual and acoustic) and/or dispersal of prey could have *adverse effects* for those marine mammals that prey on benthic or mesopelagic species within the sediment plume. The magnitude of this effect would depend on how many individual marine mammal species were affected, how many marine mammal species use the area as exclusive habitat, how often marine mammals frequent the area and whether any affected species belonged to more than one group of marine mammals. The likelihood of causing this effect within the proposed marine consent area is *likely to possible*. However, without knowing the magnitude of the potential effect, the overall level of risk to a particular community of marine mammals cannot be accurately considered.

286 Noise emitted from the dredging and disposal equipment during CRP's proposed mining operations and from the use of a sonar during prospecting operations could *adversely affect* marine mammals. These potential effects include a decreased capability of acoustic communication and perception in marine mammals due to a potential increase in noise levels in their environment.

287 The classification of the effect (neutral or adverse) will depend on the acoustic sensitivity of each marine mammal species, on the intensity and frequency range of the noise emitted by the mining or prospecting operations and on a correct assessment (and without significant uncertainty) of noise levels on marine mammals. For example, the type of sonar used (or whether a seismic airgun array is used) will determine the frequency of sound range emitted (e.g. a shipboard echo sounder will emit at approximately 20 to 60 kHz, an ROV-mounted echo sounder can emit 400 KHz, a sidescan sonar will emit at 20 to 500 kHz and a seismic airgun array will emit at 1 Hz to 20 KHz)²¹⁷. Depending on the frequency level of sound emission (Hz), the propagation distance

²¹⁶ Appendix 20 of the application

²¹⁷ See Fig. 145 in section 8.7.4, and Section 5.1 of the application

through the water will also vary. The information provided in CRP's application is not sufficient to adequately consider the potential effects of underwater noise from the proposed mining and prospecting operations on marine mammals. However, the EPA staff have suggested some conditions that may avoid potential sound effects on marine mammals (see Appendix 6 of this report).

288 Entanglement of marine mammals with mining equipment could cause *adverse effects*. The magnitude of this effect would depend on how many individual species were affected, how many marine mammal species use the area as exclusive habitat, how often marine mammals frequent the area and whether any affected species belonged to more than one group of marine mammals. However, the likelihood of causing this effect would probably be *very unlikely* (rare) due to the thickness of the riser and diffuser, the tautness of the tow lines and the slow speed of the vessel (about half that of commercial fishing trawlers). Therefore, assuming that the magnitude of the effects would be *minor* to *severe*, the overall level of risk to a particular community of marine mammals could range from *low* to *moderate*.

289 Vessel strike could also cause *adverse effects* on marine mammals. The magnitude of this effect would also depend on the factors described above. However, vessel strike would be more likely to occur than an entanglement. The EPA staff consider that vessel strike is *likely* to occur and given the magnitude of the effect could be *minor* to *severe*, the level of risk could be *moderate* to *high*. A condition requiring observers onboard the mining vessel may reduce the likelihood of vessel strike to *unlikely* and given that the magnitude of effect would not change, the level of risk would become *low* to *moderate*.

290 Any cumulative effects that may occur on marine mammals through the food chain from CRP's proposed mining operations cannot be ascertained as a result of the significant uncertainty identified in the trophic model (See Section 6.7 of this report).

Protecting the biological diversity and integrity of marine species, ecosystems and processes, rare and vulnerable ecosystems, and the habitats of threatened species (s59(2)(d)(e))

291 All marine mammals are protected under the Marine Mammals Protection Act 1978 (MMPA), some of which have been declared a threatened species.

292 The Nationally Endangered killer whale and southern right whale use and transit through the Chatham Rise. The southern flank of the Chatham Rise is an important foraging ground for the southern right whale during summer and autumn.

- 293 The New Zealand Sea Lion (Hooker's Sea Lion) has been declared a threatened species by the Minister of Conservation under section 2(3) of the Marine Mammals Protection Act 1978²¹⁸.
- 294 Two incidental sightings of up to 50 nationally endangered bottlenose dolphins per sighting were made within 100 Km of MPL 50270 in 2002 and 2005²¹⁹.
- 295 It is unclear how CRP's proposed conditions will avoid, remedy or mitigate any adverse effects that may occur on marine mammals and their habitats (and/or prey species) from CRP's proposed mining operations (including how the 200 m zone will be measured or how this mitigation strategy will ensure that whales that dove outside of the 200 m buffer zone or that remain underwater for > 30 minutes will not be affected by the mining activities taking place on the seafloor).

6.6.2 Seabirds

- 296 An overview of the use of the Chatham Rise by New Zealand seabirds including their conservation ranking, breeding locations, population size, at-sea distributions, foraging locations and how seabirds are interconnected to some prey groups through the food chain was provided in CRP's application²²⁰. With respect to trophic importance, seabirds ranked in the lower third of all groups that were considered.
- 297 Mining operations, sedimentation, light and potential oil spills are considered by CRP to have an effect on seabirds²²¹.
- 298 CRP's application provides a Draft Vessel Lighting Management Plan²²² and assesses the effects of vessel lighting on seabirds, including contemplating the option of using green light onboard and shielding lighting sources to minimise bird disorientation²²³.
- 299 The effect of the mining operations and sedimentation on seabirds was considered by CRP to be *adverse to neutral, near-source confined* (i.e., where and when mining is occurring), *short-term* and *reversible*. However, the level of the effect on seabirds was deemed to be *minor* with an *unlikely* likelihood and *low* risk.
- 300 The effect of the vessel lighting on seabirds was considered by CRP to be *adverse, near-source confined, long-term* (i.e., as long as the mining occurs) and *reversible*. The level of the effect was

²¹⁸ See s44 letter received by the Department of Conservation, 11 July 2014 (and Section 10.8 of this report)

²¹⁹ Appendix 20 of the application

²²⁰ Sections 6.9 and 8.6.6.3 and Appendices 21 and 22 of the application

²²¹ Section 8.8.3 and Table 27 of the application

²²² Appendix 35(ii) of the application

²²³ Section 8.8 of the application

deemed by CRP to be *serious* to *minor* (depending on bird species) with an *unlikely* likelihood, and *low* to *medium* risk.

301 The effect of potential oil spills on seabirds was also assessed by CRP (see Section 8 of this report).

Best available information

302 Best available information with respect to most current seabird by-catch data, seabird threat rankings, population estimates of seabirds and effects of mining activities on seabirds was not provided by CRP in their application, which was the basis for the further information request that was sent to CRP on 9 June 2014 (see below). The errors and omissions of data with respect to seabird population estimates and threat classifications were of concern²²⁴.

Uncertainty or inadequacy

303 The potential direct and indirect effects of CRP's proposed mining activities on seabirds were not clearly assessed by CRP in their application, as most of the effects were related to fishing activities which are clearly different. This uncertainty also formed part of the further information request that was sent to CRP on 9 June 2014 (see below).

304 Despite the lack of use of best available information, CRP's application states that "*the proposed activity will not impact seabirds through this threat*"²²⁵. It is unclear how this conclusion was reached, when no adequate assessment of the potential effects of its proposed mining activities on seabirds was carried out²²⁶.

305 The use of seabird by-catch data should only be used as an indicative guide to the presence of some seabird species, as not all seabird species occurring around the Chatham Rise would be prone to being caught by fishing gear. Additionally, the generation of seabird by-catch data may vary considerably when fisheries observers are not onboard fishing vessels. Therefore, some seabird species that frequent the Chatham Rise may have gone undetected using these methods.

306 There is still considerable uncertainty remaining with respect to the use of the Chatham Rise by many seabird species.

Further information requested

307 FIR 23 - 27 were requested of CRP on 9 June 2014 to understand the direct and indirect effects of CRP's proposed mining activities on seabirds (FIR 23); to ensure that any seabird species

²²⁴ See Boffa Miskell review report, 19 May 2014

²²⁵ Sections 4.1 and 4.2 of Appendix 21 of the application

²²⁶ See Boffa Miskell review report, 19 May 2014

from by-catch data from the Chatham Rise after 2010 had been accounted for in the seabird by-catch data (FIR 24); to ensure that the best available information had been used to assess the effects of the proposed mining activities (FIR 25); to reduce uncertainty and increase consistency with respect to the IUCN Red Threat Classifications of seabird taxa and species provided (FIR 26); and, to reduce uncertainty of whether the Chatham Rise is habitat to threatened seabird species (FIR 27).

- 308 In response to FIR 23, CRP considered that the plume was highly unlikely to directly affect seabirds as the diving depths of seabirds would be out of range of the predicted depths affected by the modelled sediment plume (despite its current limitations and assumptions). With respect to any effects on seabirds that could occur through changes in food web structure and function, the response to FIR 23 refers the reader to the trophic modelling results in CRP's application²²⁷.
- 309 The provision of updated seabird by-catch data from FMA 4 (mainly the Chatham Rise area) in response to FIR 24 (in Table 1), identified an additional seabird species, the white-capped albatross. CRP states in their response that the addition of this seabird species should not alter any conclusions reached in the assessment of effects on seabirds.
- 310 In response to FIR 25 (first part), CRP states that "*there has been no systematic or quantitative survey of seabird occurrence and abundance on the Chatham Rise, and how these vary in space and time.*" CRP adds that an area to the east of the Chatham Islands appeared to be an important breeding area for Chatham albatrosses, but that it is not possible to state the frequency of use of the Chatham Rise by different seabird species or populations²²⁸. However, CRP then adds that species such as the northern Buller's albatross, Chatham Island albatross, sooty shearwater and others make relatively high use of the Chatham Rise.
- 311 In response to FIR 25 (second part), the potential effect of artificial lighting on the mining vessel was assessed with respect to rare and endangered seabird species. The potential effect of lighting would be greatest for those species or populations which both occur on the Chatham Rise and the proposed marine consent area, and which are relatively rare and endangered. Two species, were deemed to fit this criteria: the Magenta petrel (150 individuals) and the Chatham petrel (250 pairs). While ship strikes for these species have not been recorded, CRP concluded that this represents a significant threat, for the Magenta petrel in particular²²⁹.
- 312 To review the effects on seabirds of CRP's proposed mining activities and to identify appropriate mitigation measures, the DMC has asked on 17 July 2014 to commission advice from Boffa Miskell with a view to providing reports prior to the hearing.

²²⁷ Appendix 22 of the application; also see Section 6.7 of this report

²²⁸ As detailed by Deppe et al. (2014) using electronic tracking technology

²²⁹ CRP response to FIR 25, dated 7 July 2014

EPA assessment of potential environmental effects (s59(2))

- 313 The effect of the mining vessel lighting on seabirds may be higher than from fishing vessels, considering that the lights will be operating for 24 hours a day²³⁰. The EPA staff consider that the likelihood of seabird vessel strike occurring is *likely* with the consequence of the effects being *minor* to *moderate* depending on the species. Therefore, the overall level of risk is *moderate* to *high*. However, CRP has stated that it would update its Vessel Lighting Plan (VLP) which would reduce the likelihood of bird strike from occurring. The EPA staff consider that the strategies of the VLP could reduce the likelihood of bird strike to *possible* and, given that the magnitude of the effect would not change, the overall level of risk would become *low* to *moderate*.
- 314 Fisheries seabird by-catch data (Table 1) and other seabird species (Table 2) were identified in CRP's response to FIR 26. Without knowledge of the use frequency of the Chatham Rise by these seabirds having been identified and further certainty relating to the sediment plume and trophic models, the EPA staff are unable to adequately assess the effects of CRP's proposed mining activities on all seabirds that may frequent the Chatham Rise.

Protecting the biological diversity and integrity of marine species, ecosystems and processes, rare and vulnerable ecosystems, and the habitats of threatened species (s59(2)(d)(e))

- 315 All New Zealand seabirds are legally protected species, except the black-backed gull²³¹. Table 2 in CRP's response to FIR 26 identifies 22 seabird species with New Zealand Conservation Status of Threatened (Nationally Critical and Nationally Vulnerable) and Vulnerable, Endangered or Critically Endangered by the IUCN Threat Ranking.
- 316 CRP's response to FIR 26 considers that, although the grey-headed albatross, black-billed gull, black-fronted tern and Caspian tern are classified as threatened, the likelihood of these species being affected by CRP's proposed mining activities is relatively small (however, no justification for this conclusion has been provided).
- 317 The EPA staff note that many threatened or vulnerable seabird species provided in CRP's response to FIR 26 (Table 2) were caught as fisheries by-catch (Table 1), for example Gibson's albatross, southern royal albatross, Chatham albatross, Salvin's albatross and white-chinned petrel. This indicates that these threatened or vulnerable seabird species are present in the Chatham Rise area and could be impacted by CRP's proposed mining activities.
- 318 These threatened seabird species include rare petrel species that breed at the Chatham Islands: the Magenta petrel (total population of only 150 individuals) and the Chatham petrel (total

²³⁰ Section 8.8.1 of the application

²³¹ <http://www.doc.govt.nz/conservation/marine-and-coastal/conservation-services-programme/>

population of only 250 pairs), which have been identified as being at risk of deck strike from artificial nocturnal lighting on the mining vessel²³².

6.6.3 Corals

319 CRP's application states that "*the direct impact of the mine footprint appears to have a low likelihood of impacting on any scarce or critically important habitat*" and that "*the probability of disturbing critical or sensitive habitat or species is low*"²³³.

320 Research surveys carried out by CRP (and contractors) in its proposed marine consent area identified corals of the orders Alcyonacea (soft corals), Antipatharia (black coral), Corallimorpharia (closely related to stony or reef building corals), Scleractinia (stony corals); and hydrozoan hydrocorals (lace corals)²³⁴.

321 Four types of Scleractinian corals were observed in the proposed mining permit area (MP55549) including cup corals, corals of the genus *Flabellum* sp., *Madrepora oculata* and the species *Goniocorella dumosa*²³⁵. A large area of habitat that is suitable for the growth of *G. dumosa* was also predicted to occur within the wider proposed marine consent area (e.g. MPL50270) using habitat predictability modelling²³⁶.

322 CRP assessed the level of effect on corals as being *neutral*, given that corals were distributed throughout the Chatham Rise and EEZ and that the effects on conservation values were separate from the loss of benthic habitat. However, CRP subsequently mentions that the level of effect on corals would be *adverse* within the proposed marine consent area, as assessed in relation to benthic habitat and fauna loss²³⁷.

323 CRP considered that the level of effect on benthic organisms and their habitats by both its proposed mining operations and sedimentation was *serious* with a potential likelihood of *almost certain, serious risk*, and therefore an impact which was considered to be *adverse, near-source confined, medium to long-term* but ultimately *reversible*.

Uncertainty or inadequacy

324 A significant uncertainty remains with respect to the distribution and abundance of all coral communities (including protected and/or 'sensitive' species, and communities such as *G.*

²³² CRP response to FIR 25, dated 7 July 2014

²³³ Sections 4.2.1 and 4.2.3 of Appendix 6 of the application

²³⁴ Appendices 13, 15 and 16 of the application

²³⁵ Appendix 13 and Appendix B of Appendix 15 of the application

²³⁶ Appendix 16 of the application (Fig. 3-16)

²³⁷ Table 27 of the application

dumosa and Stylasteridae hydrozoans) within the proposed marine consent area (especially PP55971).

325 This uncertainty may be able to be addressed as part of the adaptive management approach, specifically CRP's proposed Condition 13 which specifies the requirement to include "*sampling (defined as **epibenthic photography** and infaunal sampling) of the benthic ecology*", if the intensity of epibenthic photography is similar to that carried out for MP55549 and MPL50270 (see Figure 2).

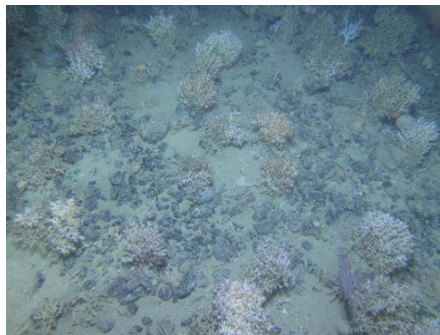


Figure 2: Coral-dominated benthic community on phosphate nodules on the Chatham Rise²³⁸

Further information requested

326 The EPA staff consider that significant uncertainty regarding the effects of sedimentation on corals from the effects of CRP's proposed activities remains. To address some of this uncertainty FIR 14 and 15 were requested of CRP by the EPA on 9 June 2014.

327 As at 7 August 2014, CRP had not responded to these FIRs.

328 Additionally, the DMC reminded CRP of these requests on 25 July 2014.

EPA assessment of potential environmental effects (s59(2))

329 The EPA staff have identified that two of CRP's main proposed mining activities will cause adverse effects on corals and their habitat: the use of the drag-head and the discharge of mine tailings at 10 m. These activities will cause the following effects:

- a. destruction of corals from squashing by, or direct entrainment into, the drag-head
- b. loss of benthic habitat from causing "disturbance" to, and removal of, the seabed (including hard substrate required for attachment)
- c. deposition of sediment on the corals

²³⁸ From Appendix 15 of the application

Chatham Rock Phosphate Limited Marine Consent Application

- d. a potential negative influence on water and sediment quality from the generation and dispersal of a sediment plume (tens of kilometres laterally from the mining area), as a result of the discharge of mine tailings and sediment resuspension from the use of the drag-head, and
- e. a potential negative influence on water and sediment quality from the release of dead marine organisms collected by the drag-head.

330 Sediment deposition has caused reduced growth rates and bleaching of corals²³⁹, and a decline in living coral²⁴⁰. In CRP's adaptive management approach (e.g. Condition 14), TSS trigger values of 50 mg/L above background levels are suggested for remedial action. The EPA staff consider that this trigger value may be well above a level that would cause adverse effects on corals. TSS levels below this threshold have been shown to adversely affect other sessile benthic organisms, for example, a significant drop in the condition of a sponge (*Tethya burtoni*) was observed when exposed to TSS levels of 15 mg/L over 10 days²⁴¹.

331 The EPA staff consider that the likelihood of causing an adverse effect on the corals (and any marine organisms that may use the coral as habitat) would be *almost certain*, the magnitude of the effect would be *catastrophic* and, therefore, the level of the risk is *extreme*. Coral patches may require > 100 years to recover from destruction, without taking into account the complete destruction of habitat (i.e. removal of phosphate nodules)²⁴². The effect is therefore, permanent and irreversible.

332 The EPA staff consider that no conditions will avoid, remedy or mitigate the adverse effects on protected coral species. Therefore, CRP's proposed mining activities represent an *extreme* environmental risk to these species.

333 As discussed earlier, a significant key decision for the DMC when determining the outcome of this application will be whether the absolute destruction of the seabed to be mined is an effect that opens itself, at the very least, to any conditions that may provide any degree of remediation or mitigation.

²³⁹ With sediment deposition rates of 10 - 20 mg cm⁻² d⁻¹

²⁴⁰ Berry W., Rubinstein N. and B. Melzian (2003). The biological effects of suspended and bedded sediment (SABS) in aquatic systems: a review. USA EPA Internal Report

²⁴¹ Appendix 29 of the application

²⁴² Probert P. K., McKnight D. G. and S. L. Grove (1997). Benthic invertebrate by-catch from a deep-water trawl fishery, Chatham Rise, New Zealand. *Aquatic Conservation: Marine and Freshwater Ecosystems* 7 (1): 27-40

Protecting the biological diversity and integrity of marine species, ecosystems and processes, rare and vulnerable ecosystems, and the habitats of threatened species (s59(2)(d)(e))

- 334 The EPA staff note that black corals, Scleractinian stony corals (a group of deep water corals) and hydrozoan lace corals of the family Stylasteridae (e.g. *Calyptopora* sp. and *Lepidothea* spp.), which were identified in the mining permit area (MP55549), are listed in Appendix II of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) and are protected by Schedule 7A of the Wildlife Act 1953 (see Appendix 4 of this report).
- 335 The EPA staff note that two epifauna communities, dominated by the Scleractinian stony coral *G. dumosa* in high densities, were almost exclusively observed within the mining permit area (MP55549), and have not been registered in such densities elsewhere in New Zealand²⁴³. *G. dumosa* is a protected species and coral communities of this species, as observed in the densities recorded at (MP55549), may conform to the definition of a “coral thicket”, and may therefore be considered ‘sensitive environments’ under the EEZ and Continental Shelf (Environmental Effects — Permitted Activities) Regulations 2013 (Schedule 6).
- 336 *G. dumosa* (like many other corals) is dependent on hard substrate for attachment, including that provided by relatively large phosphate nodules. Similar corals to *G. dumosa* constitute important habitats for a diverse community of invertebrates, which may also include larval or juvenile stages of fish.
- 337 The mining activity and method and conditions proposed by CRP will not be able to protect the biological diversity and integrity of corals, their habitats and the habitats that are created by corals for other marine organisms, especially considering that the hard substrate required for their survival includes the targeted phosphate mining resource.
- 338 The findings in the recolonisation and recovery study in CRP’s application are concerning with respect to any prospect of recovery by benthic communities²⁴⁴. CRP’s proposed mining activities, method and conditions proposed by CRP will not be able to protect the rarity, biological diversity, integrity and vulnerability of ecosystems, the habitats of threatened coral species (e.g. hydrozoans and scleractinians that are present within the proposed marine consent area) and the habitats that are created by corals for other marine organisms, especially considering that the hard substrate required for their survival includes the targeted phosphate mining resource. These organisms are unlikely to return to the disturbed area and are likely to be replaced by soft bottom communities instead.

²⁴³ Jacobs SKM review report, dated 11 June 2014

²⁴⁴ Appendix 30 of the application

6.7 Cumulative effects on the ecosystem (and of other activities)

339 This section discusses the potential of CRP's proposed mining activities to have cumulative effects on the Chatham Rise ecosystem, in combination with other existing activities, such as commercial fishing. A summary of CRP's description of the potential cumulative effects is followed by EPA staff comment on whether the best available information (s61(1)(b)) has been used, and whether any uncertainty in the information remains (s61(1)(c)). The EPA staff then provide their conclusion on the potential cumulative effects of CRP's proposed mining activities.

6.7.1 Chatham Rise ecosystem

340 CRP's application modelled ecosystem interconnectedness (and non-trophic transfers of organic carbon) by quantifying energy flow through the Chatham Rise food web using various trophic groups. This was done to identify potential indicators of the state of the ecosystem for monitoring future changes in this ecosystem over time, but not to identify potential cumulative effects of CRP's proposed mining activities²⁴⁵.

341 CRP's application provides the modelling results to conclude *that "the short-term trophic impacts associated with removing benthic fauna in a mining block are minor when considered across the proposed marine consent area or a sub-region of the Chatham Rise"*²⁴⁶

342 CRP's application also provides a discussion on other cumulative effects of its proposed mining activities on the Chatham Rise²⁴⁷.

Uncertainty and inadequacy

343 The EPA staff consider that the use of the trophic model is an appropriate tool to characterise the current state of the area with respect to trophic interconnectedness. However, the EPA staff consider that it is inadequate to use this tool to predict how the mining activities may affect the trophic interconnectedness, as was done in CRP's application. The EPA staff acknowledge that this information may not be readily available without incurring a degree of cost, effort or time.

344 With respect to the trophic model, CRP's application states that substantial deficits in information remained in all trophic groups, particularly cetaceans (as abundance of whales in the proposed marine consent area were unknown for different times of the year), mesopelagic fishes and large zooplankton. The assumptions of the trophic model included that no long-term trends were occurring in the ecosystem and that the ecosystem remained balanced throughout the year. It is unclear how any effects and/or imbalances caused by CRP's proposed mining activities over a

²⁴⁵ Appendix 22 of the application

²⁴⁶ Section 8.6.7.2 of the application

²⁴⁷ Section 8.12 of the application

long-term of 35 years could affect the outputs of the trophic model. In addition, the model was not validated (e.g. using isotope analyses), and therefore brings into question any results that were generated.

345 The functions of the marine organisms used in the model were not considered. For example, the ecological importance of corals and their role in energy coupling between the benthic and pelagic environments. Such ecological functions are not considered by trophic models, and therefore, the implications of removing organisms of particular ecological importance cannot be predicted using this type of analysis.

Further information requested

346 The EPA staff considers that significant uncertainty regarding cumulative effects of CRP's proposed mining activities remains. To address some of this uncertainty FIRs 5 - 7, 16, 37 and 40 were requested of CRP by the EPA on 9 June 2014. CRP's responses to FIRs 5 - 7 have been considered in Section 6.4 of this report because these responses were associated with the cumulative effects of suspended sediment plumes and sedimentation.

347 As at 7 August 2014, CRP had not responded to FIRs 37 and 40.

EPA assessment of potential environmental effects (s59(2))

348 Any cumulative effects that may occur through the food chain from CRP's proposed mining operations cannot be ascertained as a result of the significant uncertainties associated with the trophic model, and because the overall objective of the model was not the identification of cumulative effects.

7 EFFECTS ON EXISTING AND MAORI INTERESTS (s39(1)(c)(d), (2)(a)(b); s59(2)(a)(b)(h)(l); s60)

7.1 Legislative context

349 In addition to considering the effects on the environment, the DMC must, among other matters, take into account any effects on existing interests of allowing the activity:

350 Under section 4 of the EEZ Act, existing interest means:

In relation to New Zealand, the exclusive economic zone, or the continental shelf (as applicable), 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.

351 Under section 12 of the EEZ Act:

In order to recognise and respect the Crown's responsibility to give effect to the principles of the Treaty of Waitangi for the purposes of this Act,—

(a) [section 18](#) (which relates to the function of the Māori Advisory Committee) 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; and

(b) [section 32](#) requires the Minister to establish and use a process that gives iwi adequate time and opportunity to comment on the subject matter of proposed regulations; and

(c) [sections 33](#) and [59](#), respectively, require the Minister and the EPA to take into account the effects of activities on existing interests; and

(d) [section 45](#) requires the Environmental Protection Authority to notify iwi authorities, customary marine title groups, and protected customary rights groups directly of consent applications that may affect them.

352 Under section 39 (1), an impact assessment must —

(c) 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

(d) identify persons whose existing interests are likely to be adversely affected by the activity;

353 Under section 39 (2), an impact assessment must contain the information required by subsection (1) in —

(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

(b) sufficient detail to enable the EPA 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.

354 Under section 59(2) of the EEZ Act:

- (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
- (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

355 Under section 60 of the EEZ Act:

In considering the effects of an activity on existing interests under [section 59\(2\)\(a\)](#), the Environmental Protection Authority must have regard to—

- (a) the area that the activity would have in common with the existing interest; and
- (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 interest can be exercised only in the area to which the application relates; and
- (d) any other relevant matter.

7.2 Commercial interests

356 This section discusses the potential effects of CRP's proposed mining activities on commercial fishing interests operating on the Chatham Rise. A summary of CRP's description of the existing commercial fishing activity and the effects of its proposed mining operation on this activity, is followed by EPA staff comment on whether the best available information (s61(1)(b)) has been used, and whether any uncertainty in the information remains (s61(1)(c)). The EPA staff then provide their conclusion on the potential cumulative effects of CRP's proposed mining activities on existing commercial interests.

7.2.1 Commercial fisheries

357 The main commercial users of the Chatham Rise are commercial fishers.

- 358 CRP consulted with several parties that were considered by CRP to have commercial interests, mostly related to fishing²⁴⁸. CRP's application provides a list of quota and/or annual catch entitlement (ACE) holders in QMA 3 and 4, obtained from FishServe²⁴⁹.
- 359 Several concerns were raised by affected parties with existing commercial interests, which have been summarised in CRP's application²⁵⁰. These concerns included potential effects on fishing grounds and the fishing industry, the Chatham Island rock lobster fishery and spawning areas of commercial fish species.
- 360 Several fishing methods are used on the Chatham Rise including mid-water trawling, bottom-trawling and long-lining. Approximately 90 % of the area proposed for mining by CRP has been protected by a BPA since 2007, and therefore closed to bottom trawling. For the proposed marine consent area that lies within the BPA, the areas assigned to trawling mostly lie north and south of this area²⁵¹.
- 361 CRP's application predicted the distribution of benthic fish species within the proposed marine consent area and their probability of capture for 121 fisheries of the Chatham Rise using the fish community classifications developed for NZ's EEZ²⁵².
- 362 Fifty eight commercial fish species showed some degree of probability of capture, and therefore of being affected by CRP's proposed mining activities. Twenty six commercial fish species showed a probability > 50 % (e.g. hoki, hake, ling)²⁵³. For hoki and ling, this probability is close to 100% in most of the proposed marine consent area²⁵⁴. Hake is predicted to be caught throughout the proposed marine consent area, with the highest probabilities of capture in MPL50270. However, it is important to note that the level of fishing effort within the proposed marine consent area (which was revised by CRP on 1 August 2014), appears to be minimal based on the summary of reported fishing events recently provided by CRP²⁵⁵.

²⁴⁸ See Section 3.2 of this report

²⁴⁹ Appendix 34 of the application

²⁵⁰ Table 17 in Section 7.5 of the application

²⁵¹ Figure 94, section 6.7.2 of the application

²⁵² Section 6.6 and Appendix 17 of the application; and, Leathwick & Julian (2006)

²⁵³ Table 1 of Appendix 17 of the application

²⁵⁴ See JPEC review report on commercial fisheries, 23 May 2014

²⁵⁵ Table 1 CRP response to FIR 38 and 39. 97.8% of the fishing effort within the originally proposed marine consent area was in prospecting permit area 55967, which is no longer a part of CRP's proposed marine consent area

- 363 The estimated export revenues for hoki in 2012 were \$195 million and for ling in 2007 were \$54 million²⁵⁶.
- 364 CRP's application provides catch rates and distribution maps for quota species such as hoki, hake, ling, silver warehou, orange roughy, oreos, white warehou, giant stargazer, dark and pale ghost shark, alfonsino, sea perch and spiny dogfish, caught in 2013²⁵⁷.
- 365 By-catch quota fish species that are also of commercial importance include jack mackerel, barracouta and lookdown dory. Non-quota fish species include javefinfish, rattails, deep water sharks (e.g. shovelnose spiny dogfish), slickheads, deepsea flathead, chimaeras, spineback and basket work eel²⁵⁸.
- 366 CRP's application identifies that most fishing effort on the Chatham Rise has been directed at hoki, hake, ling, silver warehou, and scampi in depths of 200 to 800 m, and orange roughy and oreos in depths of 800 to 1,300 m.
- 367 CRP states that the main commercial fisheries of the Chatham Rise are hoki (57 %), orange roughy and oreos²⁵⁹. From the trophic model results, hoki showed the highest trophic importance²⁶⁰.
- 368 CRP's application presents some information on commercial trawling effort for hoki, silver warehou, stargazer, ling and scampi, and long-lining effort for ling in MPL50270 from 1989 to 2009²⁶¹. Bottom long-line ling fishery catch effort and how it overlaps with the proposed marine consent area (mostly the eastern block PP55967)²⁶² is also provided in CRP's application for 2002 to 2013²⁶³. On 1 August 2014, CRP provided a comprehensive report that summarises all of the commercial catch data from the proposed marine consent area from the 2003/04 to 2012/13 fishing years²⁶⁴.
- 369 The abundance of scampi burrows was estimated from analysis of seabed images for half of the mining permit area (MP55549)²⁶⁵.

²⁵⁶ See JPEC review report on commercial fisheries, 23 May 2014

²⁵⁷ Figures 96 - 106, in section 6.7.4 of the application; Appendices 17 and 18

²⁵⁸ Section 6.6 of the application

²⁵⁹ Section 6.7 of the application and Appendix 22

²⁶⁰ Appendix 22 of the application

²⁶¹ Figures 3 and 4 of Appendix 14 of the application

²⁶² Note: CRP revised their proposed marine consent area on 1 August 2014. The prospecting permit area PP55967 of the original proposed marine consent area has been withdrawn from the application

²⁶³ Figure 95 (section 6.7.2) and Appendix 19 of the application

²⁶⁴ CRP response to FIR 38 and 39, dated 1 August 2014

²⁶⁵ Figure 93 in Section 6.6.17 of the application

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- 370 CRP's application states that some important local inshore fisheries (commercial and recreational) also occur around the Chatham Islands, such as paua, rock lobster, shortfin and longfin eels, blue cod, and hapuku. Other commercial inshore fisheries species include blue moki, tarakihi, trumpeter, butterflyfish, dredge oysters, kina, and paddle crabs.
- 371 Spiny rock lobsters and shortfin and longfin eels have not been caught on the Chatham Rise. Juvenile and adult stages of rock lobsters are restricted to depths of < 250 m and are, therefore, highly unlikely to be affected by CRP's proposed mining activities (250 - 450 m). Because of their entrainment into eddy systems and currents mostly located to the north of the Chatham Rise, CRP's application concludes that rock lobster larvae are unlikely to be affected by its proposed mining activities.²⁶⁶
- 372 The distribution of juvenile, spawning, pupping or egg-laying fish on the north and south Chatham Rise (NCR and SCR) was also provided, many stages of which are from fish species of commercial importance (e.g. hoki, hake, ling)²⁶⁷.
- 373 CRP's application considers potential effects of TSS and sedimentation on some fish of commercial importance and their life stages (eggs, larvae), and states that dedicated research would be required to accurately assess the effects of TSS on fish and their life stages²⁶⁸.
- 374 CRP's application also states that "*thresholds of TSS for eggs and larvae are likely to occur above 2 mg/L...ling and hake eggs, and their larvae could be impacted by elevated TSS in the proposed mining area*"²⁶⁹.
- 375 CRP's application also states that "*it is unlikely that suspended solids from the mining operations will have a significant impact on eggs or larvae of key commercial fish species on the Chatham Rise*"²⁷⁰.
- 376 The effect on fisheries resources from the mining activities was considered by CRP to be *adverse*, the level of the effect *medium* with an *unlikely* likelihood, and *low* risk. The impact was considered to be *near-source confined* (i.e., within the mining area), *short-term* and *reversible*. The extent of these effects, in comparison with the area affected by bottom trawling, was considered by CRP in their application to be very small²⁷¹.

²⁶⁶ Appendix 31 of the application

²⁶⁷ Tables 11 and 12 in section 6.6.3 of the application; from O'Driscoll et al. (2003)

²⁶⁸ Section 8.6.5.2 and 8.5.6.3, and Appendices 27 and 28 of the application

²⁶⁹ Appendix 27 of the application

²⁷⁰ Section 8.6.5.2 of the application

²⁷¹ Section 8.12 of the application

Best available information

377 References and methods that were more than a decade old were used to characterise the distributions of various life stages of commercial fish species on the Chatham Rise²⁷². The EPA staff consider that this information is not best available information (most updated) for characterising the distributions of various life stages of commercial fish species present within the proposed marine consent area, given new developments in knowledge and analytical methods since 2000 - 2003²⁷³. The information provided was not in a useful format, as only scientific names were provided for fish species, the depth range for each species was not included and it is unclear how NCR (north Chatham Rise) and SCR (south Chatham Rise) relate to the proposed marine consent area. The EPA staff consider that this information is readily available from existing sources without incurring unreasonable cost, effort or time.

378 CRP has provided substantial information about commercial fisheries on the Chatham Rise. In response to the EPA's request for information (FIR 38 - 39) about commercial fisheries that occur in and around the proposed marine consent area, CRP provided a report that summarised all commercial catch from this from the 2003/04 to 2012/13 fishing years. This now constitutes the best available information.

Uncertainty or inadequacy

379 CRP's application highlights the deficiency of information available on TSS that may be relevant to fish stocks of commercial importance (including their life stages) occurring on the Chatham Rise²⁷⁴. This highlights uncertainty with respect to the effects of TSS on NZ fish species (including commercial species), considering that sensitivities of eggs and larvae of non-New Zealand fish species to TSS span several orders of magnitude (3 - 1000 mg/L). CRP's application acknowledges that, specifically, TSS thresholds for ling and hake cannot be predicted with certainty without experimental studies²⁷⁵.

380 Any study undertaken or provided to inform the effects of TSS on fish should be evaluated with caution, especially with respect to the time of exposure which is likely to be short-term (a few hours or days). Therefore, the long-term effects (months to years) of having elevated concentrations of TSS in the water column on all life stages of fish that remain in the proposed marine consent area will be unknown. However, modelling suggests that the sediment plume will be highly variable over space and time, but that cumulative effects between mining blocks will not

²⁷² Hurst et al. (2000) and O'Driscoll et al. (2003) for Tables 11 and 12 (section 6.6.3 of the application)

²⁷³ See JPEC review report on commercial fisheries, 23 May 2014

²⁷⁴ Appendices 27 and 28 of the application

²⁷⁵ Appendix 27 of the application

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occur²⁷⁶. CRP conclude that significantly elevated levels of TSS are only likely to occur near the blocks which are being mined²⁷⁷.

381 There is limited information on the abundance of fish eggs within CRP's proposed marine consent area²⁷⁸. This leaves uncertainty with respect to the effect of its proposed mining activities on some of the lifecycles of fish species (some of which could be of commercial value). Therefore, the EPA staff consider that the current state of the area has not been well characterised with respect to the distribution of eggs and larvae to adequately evaluate the effects of mining.

382 There is uncertainty about the distributions of the various life stages (juveniles, spawning and egg-laying stages) of some key commercial fish species present in Fisheries Management Area (FMA) 4, as not all species have been described in CRP's application²⁷⁹ (e.g. frostfish, ribaldo, scampi, gemfish and sea perch). There is also uncertainty about the distributions of the various life stages of some commercial fish species that are present in CRP's application, but for which there is no data (e.g. black cardinal fish and ruby fish).

383 It is uncertain how the conclusion that the cumulative effects of CRP's proposed mining activities on benthic communities (including commercial fish species) will be small in contrast to bottom-trawling fishing was reached by CRP, especially considering that approximately 90 % of the proposed marine consent area is closed to bottom-trawling fishing (as per BPA Regulations 2007).

384 Scampi are an important prey for benthic fish, including ling. There is uncertainty about the distribution of scampi and their burrows outside of the mining permit area (MP55549).

385 There is uncertainty on the economic effects of displacing fishing effort to other parts of Quota Management Areas (QMAs) and how this could affect quota value. However, the EPA staff note that fishing activity within the proposed marine consent area appears to be very low²⁸⁰.

386 More importantly, there is significant uncertainty about whether displaced commercial species will ever be able to recolonize the mined areas. This may be particularly important if the marine consent area provides habitat for commercial fish species at key stages of their life cycle.

²⁷⁶ CRP response to FIR 5, dated 21 July 2014

²⁷⁷ CRP response to FIR 7, dated 21 July 2014 (revised 5 August 2014)

²⁷⁸ Appendix 27 of the application

²⁷⁹ Tables 11 and 12 of the application

²⁸⁰ CRP response to FIR 38 and 39, 1 August 2014

Further information requested

387 The EPA staff consider that significant uncertainty regarding cumulative effects of CRP's proposed activities on existing interests remain. To address some of this uncertainty FIRs 34 - 40 were requested of CRP by the EPA on 9 June 2014. The response to FIR 38 and 39 was provided by CRP on 1 August 2014 and this response was considered in this report.

388 As at 7 August 2014, CRP had not yet responded to FIRs 34 - 37 and 40.

389 Additional FIRs were made to CRP by the DMC on 25 July 2014 to understand the effects of CRP's proposed mining activities on the migration of shortfin and longfin eels. CRP provided a response to this request on 8 August 2014, however, this response was not considered in this report.

EPA assessment of potential effects on commercial fishing interests (s59(2))

390 The EPA staff note that many of the effects applying to benthic communities are applicable to commercial fish species²⁸¹.

391 FishServe provided the EPA with contact details of members of the fishing industry who operate within, and in the vicinity of, the proposed mining area and that could be affected by CRP's proposed mining activities. A list of approximately 900 commercial fishers was provided to the EPA by MPI that held quota and/or ACE within FMA4, including all fish stocks within that area:

- a. Black cardinal fish
- b. Frostfish
- c. Dark ghost shark
- d. Hake
- e. Ling
- f. Ruby fish
- g. Ribaldo
- h. Scampi
- i. Gemfish
- j. Sea Perch
- k. White Warehou
- l. Hoki

392 Some of the fish species listed above were identified by CRP as having commercial importance, but some were given little consideration (e.g frostfish, ribaldo and gemfish)²⁸² while others appeared not to have received any consideration at all (e.g. black cardinal fish and ruby fish).

²⁸¹ See Section 6.4 of this report

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393 Effects on fish stocks of commercial importance can occur mostly through effects on their eggs and larval, juvenile and spawning stages. The distribution of juvenile hoki over the Chatham Rise in CRP's application shows that the Chatham Rise is a major nursery ground for juvenile hoki between one and two years old²⁸³. More than 80 % of hoki between two and three years old occur on the Chatham Rise²⁸⁴.

394 The Chatham Rise within and/or in the vicinity of the proposed marine consent area is a habitat for juvenile and spawning or egg-laying fish species of commercial importance including alfonso, hoki, hake, ling, smooth skate, ghost shark, warehou, lookdown dory and giant stargazer which may be negatively impacted by CRP's proposed mining activities²⁸⁵. The EPA staff note that some non-quota fish species are used by the commercial fish industry to create fish meal for aquaculture farms, which is a highly valued commercial product.

395 In addition to the same effects that have been identified for benthic communities²⁸⁶, key commercial fish and crustacean (e.g. scampi) species may be potentially impacted through effects from CRP's proposed mining activities on:

- a. spawning behaviour
- b. fish eggs, by affecting their buoyancy from increased concentrations of TSS (effects occur from 5 mg/L)²⁸⁷
- c. destruction of burrow habitats (e.g. scampi)
- d. displacement from their habitat for an unknown period of time.

396 The EPA staff agree with CRP's application in that *"The maximum predicted concentration of 100 mg/L suspended solids in the water column within the active mining block is above the Australia and New Zealand Environment Council (ANZECC) guideline trigger of 2 - 3 mg/L, and the 2 mg/L turbidity threshold set by FeBEC (2013) for fish eggs and larvae. Eggs and larvae of ling are most likely to be affected by silt and clay fractions greater than 25 mg/L, as this species is thought to lay benthic eggs and is known to occur in spawning condition within the proposed mining area"*²⁸⁸.

²⁸² Section 6.6 of the application (eg Tables 10 and 13)

²⁸³ Section 3.2 and Figure 6 of Appendix 18 of the application

²⁸⁴ See JPEC review report on commercial fisheries, 23 May 2014

²⁸⁵ Tables 11 and 12 and Appendix 27 of the application

²⁸⁶ Section 6.4 of this report

²⁸⁷ Appendix 27 of the application

²⁸⁸ Appendix 27 of the application

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397 Despite the limitations of the trophic model, the model identifies that indirect cumulative effects through the food chain may occur as a result of any changes in hoki biomass. The model also highlights the interconnectedness of six prey groups of demersal fish (arthropods, small demersal fish, mesopelagic fish, squid, krill and salps), which include many commercial fish species. Significant changes in the biomass of these prey species could have a significant effect on the biomass of the commercial fish predator communities.

398 Other cumulative effects include that any mining within a BPA would significantly contribute to causing significant effects on benthic communities in an area where bottom trawling fishing is no longer permitted. A report on fishing activity by seabed trawling released by the Ministry for the Environment²⁸⁹ clearly demonstrates that the Chatham Rise outside of the proposed marine consent area has been heavily trawled.

399 There is the potential for CRP's proposed mining activities to cause *adverse effects* on commercial existing interests through loss of habitat and impact on early lifecycles of some commercial fish species. Although fish are mobile species, the loss of habitat, nursery grounds and/or prey species for some key commercial fish species (e.g. hoki, hake, ling) indicates that they could be impacted by displacement to other unknown areas or by a significant reduction in adult recruitment from impact on early life stages, if not caught by the draghead or buried by sedimentation. The magnitude of this effect could be *serious* to *major* and the likelihood of causing this effect is *likely* to *almost certain*. Therefore, the overall level of the risk to a particular community of commercial fish may end up being *high* to *extreme*. The EPA staff consider that the development of appropriate conditions may reduce the likelihood of impacting commercial fish species at key stages of their lifecycle. However, this may require CRP's proposed mining activities to avoid areas of particular importance to commercial species, such as spawning grounds.

400 Potential significant effects of CRP's proposed mining activities on existing commercial interests through the displacement and exclusion of fishing effort are less likely to occur, due to the recent reduction in size of CRP's proposed marine consent area. The eastern block of the original proposed consent area (PP55967) constituted 97.8 % of the total fishing effort that occurred in the original area between 2003/04 and 2012/13. The level of fishing effort within the revised marine consent area appears to be very low²⁹⁰. Therefore, the EPA staff consider that the likelihood of directly displacing fishing effort is *possible* and the consequence of this effect could be *minor* to *moderate*. The overall level of risk of displacing fishing effort from the proposed marine consent area is *low* to *moderate*. However, this could be significantly higher if the loss of

²⁸⁹ Fishing Activity: Seabed Trawling, Environmental Snapshot 2010, Figures 2 and 6

²⁹⁰ CRP response to FIR 38 and 39, Table 1 and Section 3.1, dated 1 August 2014

habitat and impact on early lifecycles means that fishing effort is impacted outside of the proposed marine consent area.

7.3 Māori/Moriori cultural (existing) interests

Legislative context

401 The EPA is required to take into account effects of activities on existing interests under section 59 the EEZ Act *“in order to recognise and respect the Crown’s responsibility to give effect to the principles of the Treaty of Waitangi for the purpose of [the EEZ] Act”*.²⁹¹

402 The definition of existing interest in the EEZ Act is set out below in part and includes interests of Māori.

existing interest means, in relation to New Zealand, the exclusive economic zone, or the continental shelf (as applicable), 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:...

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

(d) 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

403 More particularly, section 59(2) requires the DMC when considering an application to take into account the following matters:

(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

(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

²⁹¹ Section 12, EEZ Act

7.3.1 CRP's analysis of existing interests

404 In order for CRP to assess the effects of its proposed mining activities on iwi/imi²⁹² interests it has provided its interpretation of existing interests under section 4 of the EEZ Act. CRP consider that to be an existing interest, a person must fall within one of the categories as outlined in paragraphs (a) to (f) of the definition of "existing interest"²⁹³.

405 CRP state that it consulted with iwi and imi in relation to cultural values and provided an overview of those values. CRP assert that cultural interests, with the exception of commercial fishing, are not considered to be existing interests (as defined by the EEZ Act).

406 CRP state in their application that fossilised whale bones have been collected from the Chatham Rise²⁹⁴.

EPA assessment of potential effects on Māori/Moriori cultural (existing) interests (s59(2))

407 In addition to CRP's view, in this section the EPA staff consider the potential effects of CRP's proposed activities on cultural (existing) interests of Māori/Moriori, as provided for under s4 of the EEZ Act. The EPA staff's approach recognises that the cultural interests and identity of iwi and imi are intertwined with their legal and other interests, including fisheries.

408 This section also refers to specific information obtained by CRP during their consultation with Māori/Moriori, as well as information from various other sources, to highlight or explain existing interests of Māori/Moriori that may not specifically be covered in other sections of this report.

409 The following key cultural associations have been identified as having particular importance to CRP's proposed mining activities. However, this is by no means an exhaustive list, and iwi/imi will determine for themselves which cultural associations are most appropriate. As identified in Section 4.2 of this report, several submitters have provided information that reinforces the importance of these cultural associations to the Chatham Rise, and the wider area likely to be impacted by CRP's proposed mining activities.

Whakapapa

410 Whakapapa can be described as the line of descent from which Māori are able to trace their ancestry back to the beginnings of the universe²⁹⁵. It is not restricted to the genealogies of

²⁹² Iwi can be defined as an extended kinship group, tribe, nation, people, nationality and/or race. Imi has the same definition, and is the language used by Moriori to refer to the same groups defined for iwi

²⁹³ Section 9.2.2 of the application (Table 28)

²⁹⁴ Section 5.3.2 of the application

humankind but the many spiritual, mythological and creationist philosophies that connect people to physical and spiritual aspects of the environment such as the mauri (life force) of mountains, rivers and native species. It is this relationship that informs the identity and mātauranga (knowledge) of tangata whenua, binds them to their lands and waters, and also informs their responsibilities and behaviours toward each other and the natural environment.

- 411 NMoWT (Submission 110139) note that all iwi have an identity that makes them unique. For Ngāti Mutunga, this identity is intertwined with the surrounding marine environment and the resources that it provides, particularly kaimoana (seafood). This association is so close and intergenerational that they are often called Ngā tamariki a Tangaroa (children of Tangaroa). In addition, fishing is at the core of the Ngāti Mutunga cultural identity and economy, so any negative impact on the marine environment and customary or commercial fishery will pose subsequent negative effects on their identity and economy.

Rangatiratanga

- 412 Rangatiratanga can be described as the right of iwi/imi to make decisions and to act on issues affecting their interests in a culturally appropriate way in accordance with tikanga (protocols) and mātauranga²⁹⁶. The Waitangi Tribunal have noted that the Treaty of Waitangi (Tiriti o Waitangi) gives the Crown the right to govern. In return, the Crown is required to protect the tino rangatiratanga (full authority) of iwi and hapū in relation to their 'taonga katoa' (all that they treasure)²⁹⁷.

- 413 The submission by NMoWT (110139) states that their rohe (tribal region) extends into CRP's proposed marine consent area and that the management and control of all resources in their rohe comes under their direct authority as tangata whenua.

- 414 Similarly, the submission from Te Rūnanga o Ngāi Tahu (TRoNT) (Submission 110221) notes that, although the point of extraction will occur outside the Ngāi Tahu Takiwā, it poses impacts that will affect mobile species within their rohe. As the Ngāi Tahu settlement articulates, the Crown recognises Ngāi Tahu as the tangata whenua of, and as holding rangatiratanga within, the Takiwā of Ngāi Tahu Whānui. Therefore, the Crown is obliged to protect the tino rangatiratanga (full authority) of iwi/imi and hapū in relation to their 'taonga katoa'.

²⁹⁵ Hudson, M. (2007). "Whakapapa — A foundation for genetic research?" *Journal of Bioethical Inquiry* 4(1): 43-49

²⁹⁶ Reilly, M. P. J. (1999). "Te Mana Te kawanatanga: The politics of Maori self-determination." *Australian Journal of Political Science* 34 (2): 287-288

²⁹⁷ "<http://www.justice.govt.nz/tribunals/waitangi-tribunal/documents/generic-inquiries/flora-and-fauna/wai-262-resource-management>." Retrieved 22 July, 2014

415 These parties consider that the process, by which CRP's application is being considered, does not recognise or provide for the rangatiratanga of affected iwi/imi groups.

Mātauranga

416 Mātauranga is the considerable system of knowledge established over thousands of years of observation and experience in Aotearoa New Zealand and the wider Pacific region. This system of knowledge has and continues to be transmitted from generation to generation. Mātauranga includes a significant body of information about Māori/Moriori genealogy, marine ecosystems, the influences of the tides, weather patterns and the importance of sustaining balance for continued health and wellbeing of people and the environment.

417 For example, the submission from Hokotehi Moriori Trust (HMT) (Submission 110095) notes that the knowledge of sea currents, winds and relationships with sea creatures and birds enabled impressive feats of Polynesian voyaging, including settlement on Rēkohu. Further, Moriori tūpuna relied on their knowledge of the sea to thrive and, like most indigenous island dwelling communities, the sea is viewed as more significant to them than their land resource.

418 Similarly, TRoNT (Submission 110221) point to their association with Te Moana nui a Kiwa and the upwelling of the Chatham Rise. Their knowledge systems provide them with the lessons of their tūpuna, the voyages, and fishing practices, which all make up a wealth of mātauranga connected to the area. If there is any break in the transmission of this knowledge to following generations, then iwi/imi may consider that they will lose that established body of knowledge which reduces the exposure of its people to those activities and its associated language.

Mahinga kai

419 This is the customary gathering of food and natural materials, as well as the places where those resources are gathered. The practice of collecting and harvesting food for the sustenance of the people is central to the maintenance of mana, the ability of iwi and hapū to maintain their manaakitanga, and to protect and preserve good health and well-being.

420 TRoNT (Submission 110221) has a strong interest in the protection of mahinga kai resources, treasured fishing and spawning grounds, which have sustained their people for generations. In their opinion, CRP's proposed marine consent area contains nursery habitat and feeding grounds for key mahinga kai and taonga species, both within the BPA and the surrounding areas.

Kaitiakitanga

421 The kaitiaki role of Māori/Moriori has long been recognised with respect to the responsibilities and obligations that Māori/Moriori hold to nurture and care for the environment and its resources. Māori/Moriori generally recognise a broader role to undertake duties and activities inherited through whakapapa to provide for future generations, physically and spiritually.

422 The submission by HMT (Submission 110095) notes that extracting resources and material from the moana is not in keeping with respect to mauri or sustainable resource development. They consider that the potential for adverse effects outweighs the benefits and, therefore, is not consistent with kaitiakitanga and responsible stewardship.

Taonga species

423 Taonga species, as defined by the Waitangi Tribunal, are species of flora and fauna that are significant to the culture or identity of Māori/Moriori iwi/imi or hapū. For example, because there is a body of inherited knowledge relating to them, they are related to the iwi/imi or hapū by whakapapa, and the iwi/imi or hapū is obliged to act as their kaitiaki.

424 TRoNT has provided a Cultural Impact Assessment (CIA) that outlines the potential effects of CRP's proposed mining activities on one aspect of the Ngāi Tahu existing interest.

425 The two specific issues identified in the CIA are:

- a. the original proposed marine consent area includes a defined area of marine mammal fossil bone beds. This area was identified by Ngāi Tahu as an area of cultural significance as it is directly related to the contemporary value of the Chatham Rise fishing grounds. It is highly likely that CRP's proposed mining activities will destroy the fossil beds²⁹⁸
- b. there is significant uncertainty with regard to the effects of CRP's proposed mining activities on whales as taonga species, and the wider environment and ecology that they depend on.

426 The relationship between Māori/Moriori and taonga species is described by the Waitangi Tribunal as follows:

“Māori culture was created through the interaction between early Polynesian settlers and the environment of Aotearoa, including its species of flora and fauna. Those species were sources of technology (for example, relating to food, clothing, shelter, and medicine) and provided inspiration for forms of expression and cultural works such as mōteatea (song-poetry), carving, and the ubiquitous ‘koru’ or ‘pītau’ form. They are subject to considerable inherited knowledge relating to their characteristics and properties (such as habitats, growth cycles, sensitivity to environmental change, and requirements for their care). Thus, taonga species help to make Māori culture unique. The exercise of kaitiaki responsibilities towards

²⁹⁸ Note: CRP revised their proposed marine consent area on 1 August 2014. The prospecting permit area PP55967 of the original proposed marine consent area has been withdrawn from the application

those species is a fundamental aspect of Māori culture, and kaitiaki relationships are important sources of identity²⁹⁹.

427 In their CIA, Ngāi Tahu confirms this association when stating that their association with numerous taonga species, particularly whales, is derived through whakapapa and expressed through kaitiakitanga. Ngāi Tahu add that whales have provided for iwi and, in turn, people must provide for whales.

428 In the Ngāi Tahu Claims Settlement Act (1998) the Crown acknowledged the cultural, spiritual, historic, and traditional association of Ngāi Tahu with taonga species. Additionally, the Treaty of Waitangi entitles kaitiaki relationships with taonga species to a reasonable degree of protection. It also entitles Māori to a reasonable degree of control over traditional knowledge relating to taonga species and how that knowledge is used.

Summary of key submitters with existing interests

429 The following is a list of key submissions which consider that have existing interests that may be affected by CRP's application as listed below:

- a. Te Rūnanga o Ngāi Tahu (TRoNT) (Submission 110221), under paragraphs (a), (d) and (e) of the definition of existing interest
- b. Ngati Mutunga o Wharekauri Iwi Trust, under paragraphs (a) and (e) of the definition of existing interest
- c. Ngati Kahungunu Iwi Incorporated, under paragraphs (a), (d) and (e) of the definition of existing interest
- d. Whanganui Iwi Fisheries Limited, under paragraph (e) of the definition of existing interest
- e. Te Ohu Kaimoana, under paragraph (e) of the definition of existing interest who also note their disagreement with CRP's assertion that "with the exception of commercial fishing are not considered to be existing interests as defined by the EEZ Act." Te Ohu Kaimoana note that there are cultural elements to the broad interests that iwi have in fisheries which are, in part, reflected in the Fisheries Settlement Act and the Fisheries Act
- g. Hokotehi Moriori Trust note that they have deep water quota, an historic Treaty of Waitangi claim (WAI 64) that has yet to be settled, and a special relationship with the moana and other taonga in the marine environment
- h. Te Taumata Kaumatua o Nga Puhi Nui Tonu, under paragraphs (a), (d) and (e) of the definition of existing interest

²⁹⁹ "<http://www.justice.govt.nz/tribunals/waitangi-tribunal/documents/generic-inquiries/flora-and-fauna/wai-262-resource-management>." Retrieved 22 July, 2014

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- i. the Iwi Collective Partnership (lodged a submission on behalf of 14 iwi groups), under paragraph (e) of the definition of existing interest, who also acknowledge that they are “threatened by the proposed activity”.

Conclusion from the EPA staff

430 With respect to potential effects on existing Māori/Moriori cultural interests, the EPA staff disagree with CRP’s assertion that cultural interests are not existing interests as defined by the EEZ Act. The EPA staff consider that under s4 of the EEZ Act, the definition of “existing interest” (paragraph (a)) may provide for cultural interests if a party is able to prove that their interest is lawfully established, if they have the right to undertake that activity, and whether that right is presently being exercised.

431 As an example, within the coastal environment (up to 12 nautical miles), broad rights to undertake activities are recognised under both the Resource Management Act 1991 (section 354) and the Marine and Coastal Area (Takutai Moana) Act 2011 (sections 26, 27 and 28).

432 After assessing CRP’s application, the CIA from TRoNT, the submissions received from Māori/Moriori organisations and the Ngāi Tahu Claims Settlement Act, the EPA staff consider that there are sufficient grounds for showing that iwi organisations, such as Ngāi Tahu, are able to prove that their cultural interests have been lawfully established and are currently being exercised. Therefore, the cultural interests outlined above should be taken into account as existing interests by the DMC and balanced against other s59 matters in their consideration of CRP’s application.

433 Further, in arriving at an understanding of the nature of existing interests held by Māori/Moriori and how they might be affected by this proposal, it is appropriate that those existing interests should be defined and understood within the paradigm of mātauranga Māori.

Further information requested

434 To better understand the effects of CRP’s proposed mining activities on cultural interests, FIR 44 was requested of CRP by the EPA on 9 June 2014.

435 CRP responded to this FIR on 27 June 2014, as mentioned in the text above.

436 In a letter dated 27 June 2015, the EPA staff requested Ngā Kaihautū Tikanga Taiao under s44 of the EEZ Act to provide a report to the DMC.

8 OTHER EFFECTS FROM UNPLANNED EVENTS

8.1 Unplanned events

437 Effects on the environment could result from several unknown and unplanned events. CRP's application presents a list of unplanned events that could occur during its proposed mining activities³⁰⁰, and the mitigation strategies proposed to lower the risk to an acceptable level. The EPA staff consider that it is necessary to place some specific conditions (see Appendix 6 of this report) on the marine consent, should it be granted, to ensure that the risks associated with unplanned events, that may have a high likelihood of occurrence (prior to mitigation) and a major impact on the environment, are reduced as much as possible. These relate to unplanned events arising from:

- a. vessel collision (with an obstacle or another vessel) — fuel/oil spill
- b. rupture of riser, sinker or diffuser hose
- c. oil spill from the underwater mining pump (10 - 30 L) and/or vessel.

438 CRP states that Maritime New Zealand (MNZ) maintain a New Zealand Marine Oil Spill Response Strategy and National Plan and that, in accordance with the Maritime Transport Act, all commercial ships (including mining vessels) are required to have an International Oil Pollution Prevention Certificate (IOPPC). For ships having a tonnage > 400 gross tonnes, a Shipboard Oil Pollution Emergency Plan (SOPEP) is also required. The IOPPC and SOPEP is to be inspected by MNZ before the vessel can operate in New Zealand waters³⁰¹.

439 CRP mentions that Boskalis, who would operate the mining vessel, operate a risk assessment system on all its vessels for oil spills. This hazard system identifies all aspects of its operations of potential risk associated with specific activities (e.g fuel supply, bunkering and storage).

440 Potential oil spills are considered by CRP to have an effect on seabirds³⁰². The effect on seabirds from a potential oil spill was considered by CRP to be *adverse*, the magnitude of the effect *serious with a rare likelihood and low to moderate risk*. The impact was considered to be *near-source confined, medium-term and reversible*.

Uncertainty or inadequacy

441 There is uncertainty as to whether an oil Spill Contingency Management Plan (SCMP) that will outline the measures to be undertaken in the event of an oil spill to the environment will be

³⁰⁰ Sections 8.6.6.3 and 8.11 of the application

³⁰¹ Section 8.11.4 of the application

³⁰² Table 27 and Section 8.6.6.3 of the application

provided by CRP. Although, CRP has stated that it will operate in full compliance with all applicable Maritime NZ rules and requirements. The SCMP would be required to certify that the plan demonstrates how environmental performance objectives will be achieved and will be integrated with any Discharge Management Plans (DMPs) prepared pursuant to requirements of the Maritime Transport Act 1994 (see Section 10.10 of this report).

442 The risk assessment system, as operated by Boskalis, is currently unknown to the EPA staff.

EPA assessment of potential environmental effects (s59(2))

443 MNZ have clarified previously to the EPA staff that they do not undertake an environmental effects assessment as part of an oil spill contingency plan. MNZ advised that their role is to assess the potential spill size and whether the contingency planning arrangements are appropriate in the event of having to respond to an oil spill. The DMC might decide it prudent to consider the effects of an oil spill that could result from CRP's activities and impose further conditions on any marine consent granted relating to spill response and management.

444 Potential oil spills could impact on many marine organisms within and beyond CRP's proposed marine consent area, not only on seabirds. The effect of a potential oil spill on the marine ecosystem is considered by the EPA staff to be *adverse*, the magnitude of the effect *moderate* to *severe* with a *rare* to *unlikely* likelihood. Therefore the level of risk is determined to be *low to moderate*. Table 1 (Section 15 of this report) provides the EPA staff's overall assessment of potential effects.

9 BEST PRACTICE IN RELATION TO AN INDUSTRY OR ACTIVITY (s59(2)(i))

445 Under section 59(2), the EPA must consider the application by taking into account:

(i) best practice in relation to an industry or activity

9.1 Mining methodology

446 CRP's application was not clear about whether the mining equipment to be used is reliable and uses validated technology that has been used previously at the proposed depths. The drag-head illustrated in the application has no scale and is proposed to be modified by CRP for their operations. However, these proposed modifications have not been specified³⁰³.

³⁰³ Section 4.4.4 of the application

447 CRP's application states that *"the specifications for the drag-head and the diffuser include features designed to avoid and minimise the potential for significant adverse effects"*³⁰⁴.

448 CRP's application also states that their *"sea-bed mining operation, using a Royal Boskalis Westminster vessel to vacuum areas of the sea-bed, is selective, targeted..."*³⁰⁵ and that *"Boskalis operate approximately 30 trailing suction hopper dredgers around the world, most of which operate 120 hours a week and 45 weeks a year"*³⁰⁶.

Uncertainty or inadequacy

449 Validation and a detailed description of the mining method is fundamental for adequately assessing any potential environmental effects. The EPA staff consider that it is unclear whether the mining equipment to be used by CRP is reliable and uses validated technology, as current technology has not been used previously at the proposed mining depths anywhere else.

450 There is significant uncertainty on how the currently unknown modifications proposed to be made by CRP to conventional drag-head technology (see Appendix 5 of this report) will be able to prevent the drag-head from penetrating into sediment chalk layers that are > 0.5 m deep³⁰⁷; even if mining of each block is restricted to a single pass of the drag-head, as proposed in the modification of Condition 7 by CRP in their response to FIR 2 on 27 June 2014.

451 The technological details inside the drag-head and diffuser have not been disclosed (e.g. whether water jets alone will be used or together with a cutterhead to loosen sediments), or how their design will *"avoid and minimise the potential for significant adverse effects"*.

452 The EPA staff consider that there is uncertainty with respect to how the drag-head will be selective and targeted during the mining operation, as asserted by CRP.

Further information requested

453 To improve confidence in CRP's proposed mining method and associated assumptions, further information was requested of CRP on 9 June 2014. FIR 1 asked for a description of the use of similar proposed mining equipment at similar depths (250 - 450 m, equivalent to 26 - 46 atmospheres pressure) in the marine environment, any adverse effects that occurred and any mitigation strategies that were implemented.

454 The response by CRP to FIR 1 was received on 27 June 2014. In it, CRP stated that the proposed mining method and equipment for use on the Chatham Rise has not been used before

³⁰⁴ Section 11.4.2 of the application

³⁰⁵ Section 4.2.1 of Appendix 6 of the application

³⁰⁶ Section 8.11.4 of the application

³⁰⁷ Section 4.4.4 of the application

at similar depths in the marine environment anywhere in the world (maximum of 200 m depth). Therefore, an appropriate answer to FIR 1 was not able to be obtained from CRP.

455 CRP mentioned that Royal Boskalis Westminster followed best practice for the protection of the environment, that the likely effects of using conventional trailing suction hopper dredges³⁰⁸ are generally well understood and that Royal Boskalis Westminster had assessed the feasibility of mining at these depths from an engineering perspective. CRP offered that Mr. van Raalte (from Royal Boskalis Westminster) would address this matter further in expert evidence during the hearing.

456 In a request for further information that was sent to CRP on 17 July 2014, the DMC requested CRP to provide reports and studies on mining projects that use conventional suction hopper dredging, including any environmental impact assessments, and commentary on the efficacy and mitigation strategies that were implemented.

457 An additional FIR was sent to CRP by the DMC on 25 July 2014 to understand the measures proposed by CRP to ensure that the mining operation remains within the agreed parameters (e.g. consistent depth of cut of 0.5 m of the drag-head and non-disturbance to the chalk layer) and how the drag-head will adapt to changing topography.

10 OTHER MARINE MANAGEMENT REGIMES AND LEGISLATION (s11 and s59(2)(h)(k)(l))

10.1 Legislative context

458 Under section 59(2), the EPA must consider the application by taking into account:

(h) the nature and effect of other marine management regimes; and

(k) relevant regulations; and

(l) any other applicable law; and

(m) any other matter the EPA considers relevant and reasonably necessary to determine the application.

459 CRP cover the requirements of other marine management regimes and other legislation in their application³⁰⁹

³⁰⁸ See Appendix 5 of this report

³⁰⁹ See Sections 2.4 and 8.9 - 8.11 of the application

10.2 Crown Minerals Act 1991

- 460 In July 2014, the EPA staff received a response to a s44 request under the EEZ Act for advice from the MBIE with respect to the roles and responsibilities of NZP&M, in relation to CRP's application for marine consent. MBIE's letter is currently available on the EPA website.
- 461 The EPA staff note that NZP&M have developed a Minerals Programme for minerals other than coal and petroleum that was released in 1996 (pursuant to section 18 of the Crown Minerals Act 1991)³¹⁰. One of the purposes of the policy established in this Minerals Programme is to preclude prospecting, exploration and mining of the primary uranium and thorium minerals.
- 462 The Minerals Programme for Minerals policy is also in line with the Government's environmental policy of New Zealand being a Nuclear Free Zone and the New Zealand Nuclear Free Zone, Disarmament and Arms Control Act 1987.

10.3 The Atomic Energy Act 1945

- 463 With respect to the notification of discovery of uranium, section 4 of the Atomic Energy Act 1945 states that every person who has discovered that any prescribed substance (including uranium) occurs at any place in New Zealand shall, after making the discovery, report the discovery by written notice (which shall specify the place where the discovery took place, and the date of the discovery) to the Secretary.
- 464 The Atomic Energy Act 1945 states that any materials containing prescribed substances (including uranium) which may be extracted, isolated, or concentrated shall only be disposed with the prior consent of the Minister, and subject to any conditions that the Minister of Energy may impose. It is uncertain whether the Atomic Energy Act 1945 applies to the extraction of phosphate nodules from the Chatham Rise.

10.4 Fisheries Act 1996 and Benthic Protection Area Regulations 2007

- 465 On 11 July 2014, the EPA staff received a response to a s44 request under the EEZ Act for advice from the MPI with respect to their roles and responsibilities under the Fisheries Act 1996 (including the Benthic Protection Areas (BPA) Regulations 2007) and the Biosecurity Act 1993, in relation to CRP's application for marine consent. MPI's letter is currently available on the EPA website.
- 466 MPI advises that the purpose of the Fisheries Act 1996 (section 8 (1)) is "*to provide for the utilisation of fisheries resources while ensuring sustainability*". To ensure sustainability, the Quota

³¹⁰ <https://www.nzpam.govt.nz/cms/pdf-library/minerals-legislation/min-prog-for-min.pdf>

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Management System (QMS) was introduced in 1986. Annual Catch Entitlements (ACE) are allocated each year to quota fish holders.

467 MPI do not consider that the incidental removal of benthic fauna, as proposed by CRP in its application, is defined as fishing by the Fisheries Act 1996. However, MPI indicated that they reserve the right to revise their view based on further information.

468 Approximately 90 % of the area proposed for mining by CRP is protected by a Benthic Protection Area (BPA)³¹¹. The Fisheries Benthic Protection Areas (BPA) Regulations 2007 are a part of the Fisheries Act 1996. MPI advises that the BPA Regulations resulted from an Accord between the Minister of Fisheries and the fishing industry to close 17 areas of the EEZ to bottom trawling and dredging to avoid, remedy or mitigate the adverse effects of fishing on deepwater marine habitats and ecosystems.

469 The EPA staff note that Regulation 7 of the BPA Regulations 2007 provides:

7 *Prohibition on use of dredge in benthic protection area*

No person may use a dredge within any benthic protection area

470 The word 'dredge' is not defined in the BPA Regulations 2007, however, regulation 4(2) of the BPA Regulations provides:

"Any term in or expression that is defined in the Act or the Fisheries (Commercial Fishing) Regulations 2001 and used, but not defined, in these regulations has the same meaning as in the Act or those regulations."

471 The word 'dredge' is then defined in the Fisheries (Commercial Fishing) Regulations 2001 as:

***"dredge"** means a device towed on or over, or capable of being towed on or over, the seabed primarily for the collection of shellfish*

472 Therefore, it is the view of the EPA staff that because the definition of "dredge" is limited to circumstances where the "dredging" is "primarily for the collection of shellfish," CRP's mining activity cannot be said to fall within the prohibition because the mining activity is not "primarily for the collection of shellfish".

473 MPI advises that other risks to benthic biodiversity, such as mining, are not prohibited by the BPA.

474 Notwithstanding, MPI advises that a vertical buffer zone of up to 100 m from the seabed is included in the BPA. Therefore, fishing within 100 m of the seabed is an offence, and fishing within 50 m of the seabed is a serious offence.

³¹¹ Section 2.4 of the application (Figure 6)

10.5 Biosecurity Act 1993

475 MPI advises that it also administers the Biosecurity Act 1993, which is for managing biosecurity issues in New Zealand (e.g. pests and unwanted organisms). Under the provisions of the HSNO Act 1996, the Biosecurity Act 1993 also has power to deal with new organisms.

476 CRP states that it will need to comply with the provisions set out in the Biosecurity Act 1993³¹².

477 MPI advises that the Biosecurity Act 1993 has provisions to manage biosecurity issues associated with craft (vessels) that arrive in the Territorial Sea and EEZ. The major pathways for introducing marine species that may be unwanted pests are biofouling and ballast water.

478 MPI advises that the Biosecurity Act 1993 has had an Import Health Standard established since 2000, and recently issued the Craft Risk Management Standard (CRMS) for Biofouling on Vessels Arriving in New Zealand. The CRMS requires vessels to arrive with 'clean hulls' and is currently within the voluntary lead-in period. The CRMS will come into full force on 15 May 2018.

10.6 HSNO Act 1996

479 The purpose of the HSNO Act 1996 is to protect the environment and human health and safety of people and communities, by preventing or managing the adverse effects of hazardous substances and new organisms.

480 CRP states that no chemicals or hazardous substances will be used in the mining operation and that any substances that may be considered hazardous under the HSNO Act 1996 will be managed in accordance with that regime, as administered by MNZ³¹³.

481 There is potential for some of the elements present at the stated concentrations in the phosphate nodules to be hazardous, if released into the surrounding environment (e.g. P_2O_5 or uranium). CRP's proposal to mine phosphate nodules outside of the 12-nautical mile (n.m.) territorial sea may require CRP to apply for a HSNO permit to import phosphate nodules and/or manufacture fertiliser made from the rock phosphate (if this is the intention), prior to entering the 12-mile territorial sea, if any of the components in the phosphate nodules are deemed to be hazardous as a result of their final concentrations.

10.7 Radiation Protection Act 1965 and Radiation Protection Regulations 1982

482 Radioactive substances are not covered by the HSNO Act 1996, but by the Radiation Protection Act 1965 and Radiation Protection Regulations 1982.

³¹² Sections 2.4.2 and 8.10 of the application

³¹³ Section 8.11.8 of the application

483 Under section 4 of the EEZ Act, *radioactive waste or other radioactive matter means any waste or other matter that contains any radioactive material within the meaning of the Radiation Protection Act 1965.*

484 It is unclear how the Radiation Protection Act 1965 (and Radiation Protection Regulations 1982) would cover the import and handling of any potentially radioactive substances into New Zealand or if any other legislation would be relevant to this purpose, should the phosphate nodules be determined to be radioactive (over a short-term, or long-term as a result of bioaccumulation).

10.8 Marine Mammals Protection Act 1978 and Wildlife Act 1953

485 On 11 July 2014, the EPA staff received a response to a s44 request under the EEZ Act for advice from DOC with respect to their roles and responsibilities under the Marine Mammals Protection Act 1978 (MMPA) and the Wildlife Act 1953, in relation to CRP's application for marine consent. DOC's letter is currently available on the EPA website.

486 DOC is the government agency responsible for the management of the MMPA, the Wildlife Act 1953 and has developed the *2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations*.

487 DOC are responsible for the conservation and management of marine mammals (all of which are legally protected), seabirds (all of which are legally protected except one species) and other marine wildlife (e.g. some coral species, and sharks and rays) within New Zealand and New Zealand fishery waters.

488 DOC state in their letter that the MMPA does not directly manage or control activities related to seabed mining. However, under the Wildlife Act 1953, DOC considers applications for wildlife authorisations to permit the undertaking of activities that can result in the disturbance or killing of protected wildlife.

489 DOC advise that CRP has made an application to them asking for an authorisation to kill corals within its proposed marine consent area. These permits are issued by the Director-General of Conservation (after seeking scientific advice), which may grant or decline such applications, or impose conditions if an authorisation is granted. These permits are not subject to any statutory timeframe.

490 DOC advise that the *2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations* provides effective, practical mitigation measures for minimising acoustic disturbance of marine mammals during seismic surveys. This Code has been endorsed as industry best practice and applies to seismic surveying, but not to other activities involving anthropogenic noise such as seabed mining.

10.9 Health and Safety in Employment Act 1992

491 On 17 July 2014, the EPA staff received a response to a s44 request under the EEZ Act for advice from WorkSafe New Zealand with respect to their roles and responsibilities under the Health and Safety in Employment Act 1992 ('HSE Act'), in relation to CRP's application for marine consent. This letter received from WorkSafe is currently available on the EPA website.

492 WorkSafe stated in their letter that the main jurisdictional responsibility for administering the HSE Act with respect to ships at sea lies with MNZ.

10.10 Maritime Transport Act 1994

493 On 18 July 2014, the EPA staff received a response to a s44 request under the EEZ Act for advice from Maritime New Zealand (MNZ) with respect to their roles and responsibilities under the Maritime Transport Act 1994 (MTA) (including marine protection) and HSE Act, in relation to CRP's application for marine consent. MNZ's letter is currently available on the EPA website.

494 MNZ stated in their letter that they had primary responsibility under the MTA and HSE Act for the following:

- a. health and safety responsibilities for work on board ships and ships as places of work
- b. maritime safety responsibilities, including the regulation of operators and seafarers for commercial ships and regulation of maritime and navigational safety
- c. marine protection responsibilities with respect to some discharges from vessels and installations, and disposal of wastes beyond 12 n.m.
- d. maritime security responsibilities with respect to securing operation of ports, associated maritime infrastructure and vessels.

495 CRP also state that "*The Maritime Transport Amendment Act 2013, previously referred to as part of the Marine Legislation Bill (which passed into law in October 2013), transferred responsibility for regulation of specific discharges and the dumping of waste under the MT Act from Maritime NZ to EPA and the EEZ Act.*"

496 In addition, section 20(5)(b)(i) of the EEZ Act states that the dumping or storing of radioactive waste or other radioactive matter is regulated or prohibited by the MTA (e.g. s258 - 259 and s263).

10.11 International Obligations

497 Under Section 11 of the EEZ Act the implementation of New Zealand's International Obligations relating to the marine environment is set out, including the United Nations Convention on the Law of the Sea 1982 and the Convention on Biological Diversity 1992 (CBD).

498 Under the CDB programme, New Zealand has made a commitment to establish several Marine Protected Areas (MPAs), and the Chatham Rise BPA is one of such MPAs, as recognised by the International Union for the Conservation of Nature (IUCN) and the United Nations Environment Programme (UNEP).

11 THE ECONOMIC BENEFIT TO NZ

11.1 Legislative context

499 Under section 59(2), the EPA must consider the application by taking into account:

- (f) the economic benefit to New Zealand of allowing the application; and*
- (g) the efficient use and development of natural resources; and*

11.2 Background from CRP's application

500 Under section 59(2)(f), the EPA must take into account the economic benefit to New Zealand of allowing CRP's application.

501 CRP's application has categorised the economic benefit from the proposed mining activities on the Chatham Rise as having direct and indirect (flow-on) effects³¹⁴.

502 Direct effects include:

- a. an increase in New Zealand's exports of rock phosphate (from none), resulting in an increased of wealth, which generates increased consumption spending
- b. a decrease in New Zealand's imports of rock phosphate.

503 Indirect effects include:

- a. an increase in household expenditure from retail goods and the hospitality industry (by a maximum of 0.38 %), as a result of increased spending from higher capital and labour returns, and increased export earnings
- b. a decrease in activity in downstream competing industries that export dairy cattle, horticulture and textiles (by a maximum of 0.07 %); due to increased demand for New Zealand dollars caused by increased rock phosphate exports.

504 CRP's application also assumes a decrease in environmental effects on soil, waterways and the atmosphere from substituting imported rock phosphate by Chatham rock phosphate in fertilisers, including a reduction in:

³¹⁴ Section 9.4 and Appendix 6 of the application

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- a. soluble phosphate run-off into waterways (leaching)
- b. cadmium build-up in soils³¹⁵ (despite cadmium being persistent in soil, bioaccumulative in organisms and showing bioconcentration in the environment)
- c. transport air emissions.

505 CRP states in their application that it has “committed to ensuring that the Chatham Islands community benefits from the proposal”³¹⁶ by:

- a. providing subsidised fertilisers to Chatham Island farmers
- b. providing unprocessed rock phosphate to local farmers at cost or lower
- c. establishing a medi-vac facility on the Chatham Islands
- d. basing a rescue helicopter on the island
- e. research funding
- f. providing employment opportunities and scholarships
- g. using Chatham Island resources to assist with environmental monitoring as well as bunkering and provision support services
- h. providing opportunities to enhance conservation values in and around the Chatham Islands from the proposed environmental compensation package
- i. flow on benefit by improving viability of other infrastructure, transforming the wider local economy and boosting the population.

506 The EPA staff note that there is currently a National Cadmium Management Strategy for New Zealand Agriculture (Report of the Cadmium Working Group, 2011), the purpose of which is “to ensure that cadmium in rural production poses minimal risks to health, trade, land use flexibility and the environment over the next 100 years”³¹⁷. The EPA staff consider that the use of low cadmium fertiliser from phosphate nodules from the Chatham Rise would be consistent with the purpose of this strategy.

³¹⁵ Note: “As recent research indicates leaching of uranium from arable soils and presence of fertiliser-derived uranium in ground- and drinking water, it is suggested that the uncontrolled loading of the toxic and radioactive heavy metal to soils should be regulated by state authorities, as it is done for cadmium”

See Pages 167-175, The New Uranium Boom: Challenge and lessons learned. Chapter: “Cadmium and uranium in German and Brazilian phosphorus fertilizers” [Eds. Broder Merkel and Mandy Schipek]. Springer-Verlag Berlin Heidelberg 2011.

³¹⁶ Section 7.3.4, Section 7.5 (Table 17) and Section 9.5 of the application

³¹⁷ http://www.massey.ac.nz/~flrc/workshops/11/Manuscripts/Rys_2011.pdf

Uncertainty or inadequacy

507 CRP states in its application that an additional benefit is the “*contribution to biodiversity*”³¹⁸. The EPA staff are unsure how CRP’s proposed mining activities contribute to biodiversity.

508 The EPA staff consider that there is uncertainty on how CRP has *committed* to providing community benefits to Chatham Islanders.

Further information requested

509 The EPA staff considered that significant uncertainty regarding the economic benefit derived from using the CGE model remained after the first list of FIR were requested of CRP. To address this uncertainty, FIR 28 to 33 were requested of CRP on 9 June 2014. A response was received on 27 June 2014 and is currently available on the EPA website.

510 Additional FIRs were requested of CRP by the DMC on economics with respect to commercial viability, benefit to New Zealand and commercial fishing on 17 July 2014.

511 Additional FIRs were made to CRP by the DMC on 25 July 2014 to understand the cumulative effects of contaminants in soil (e.g. radioactivity levels) and the proposed social and economic measures to be implemented for the Chatham Island community.

12 ADAPTIVE MANAGEMENT

12.1 Legislative context

512 If when making its decision the DMC is faced with uncertain or inadequate information it is required under s61(2) of the Act to favour caution and environmental protection. If favouring caution and environmental protection means that an activity is likely to be refused, the EPA must first consider whether taking an adaptive management approach would allow the activity.

513 Under s64(2) of the EEZ Act, an adaptive management approach may be incorporated into marine consent, and defines such an approach to include:

(a) *allowing an activity to commence on a small scale or for a short period so that its effects on the environment and existing interests can be monitored*

(b) *any other approach that allows an activity to be undertaken so that its effects can be assessed and the activity discontinued, or continued with or without amendment, on the basis of those effects.*

³¹⁸ Section 4.2.3 of Appendix 6 of the application

514 Under s64(3) of the EEZ Act, an adaptive management approach may be incorporated into a marine consent by imposing conditions under s63 to authorise an activity to be undertaken in stages, with a requirement for regular monitoring and reporting before the next stage of the activity may be undertaken.

515 Section 64(4) of the EEZ Act provides that a stage may relate to the duration of the consent, the area over which the consent is granted, the scale or intensity of the activity or the nature of the activity.

12.2 Consideration of adaptive management

516 This report has pointed out areas where the potential effects of CRP's activities remain uncertain and where further information is required to understand the effects of the proposed activity. If the DMC concludes that the information is uncertain or inadequate and, therefore, considers that favouring caution and environmental protection means that an activity is likely to be refused, the DMC must consider whether adaptive management would allow the activity to be undertaken.

517 In its recent decision on *Sustain our Sounds Inc v New Zealand King Salmon Company Ltd*³¹⁹, a case decided under the Resource Management Act (1991), the Supreme Court set out the tests to be applied when determining whether an adaptive management approach was appropriate. The Court found that it depended on an assessment of the following four factors:

- a. the extent of the environmental risk
- b. the importance of the activity
- c. the degree of uncertainty
- d. the extent to which an adaptive management approach will sufficiently diminish the risk and the uncertainty.

518 At this stage, the EPA staff consider that significant uncertainty about the effects of the application remains and some environmental effects from CRP's mining activities cannot be adequately determined, avoided, remedied or mitigated. Some of this uncertainty is due to a lack of information, and some as a result of not having received responses at this stage to some FIR made to CRP. In some cases, the information provided by CRP has not addressed the information gap that it was supposed to address in a satisfactory way³²⁰. On other occasions, the information provided by CRP has highlighted that significant adverse effects are very likely to occur or almost certainly will occur (e.g. sensitive and protected benthic communities).

³¹⁹ [2014] NZSC 40

³²⁰ See the further information requests dated 9 June (EPA), 17 and 25 July 2014 (DMC)

12.3 CRP's approach to adaptive management

519 CRP's application describes its approach to Environmental Management, Monitoring and Proposed Marine Consent Conditions³²¹. CRP state that *"given the capital investment needed for this equipment to start the proposed mining, it is not possible to commence mining on a significantly smaller scale than proposed in the application"*. CRP recognise in its application that there are limitations to applying an adaptive management approach to the proposed mining operations within the mining permit area (MP55549). Instead, CRP contends that adaptive management can be utilised to expand mining operations beyond the mining permit area. CRP's proposed conditions reflect this approach, and CRP notes that this staged approach is based on s64(3) of the EEZ Act³²².

520 Such an approach would require the DMC to be reasonably satisfied that known and unknown proposed effects of CRP's proposed activities will be avoided, remedied or mitigated. CRP provides some guidance with respect to the monitoring that will occur prior to the commencement of mining outside of MP55549, but it is unclear how the results of this monitoring (as part of the adaptive management framework) will feed into the Mine Plan and the draft Environmental Management and Monitoring Plan³²³. In order for the DMC to consider such an approach, the conditions should identify appropriate and measurable thresholds that will guide any adaptive management approach, and the decision as to whether a particular area should be able to be mined.

521 In this case, *Sustain our Sounds Inc v New Zealand King Salmon Company Ltd*, the Supreme Court stated that, before endorsing an adaptive management approach, it would have to be satisfied that:

- (a) *there will be good baseline information about the receiving environment*
- (b) *the conditions provide for effective monitoring of adverse effects using appropriate indicators*
- (c) *thresholds are set to trigger remedial action before the effects become overly damaging*
- (d) *effects that might arise can be remedied before they become irreversible.*

522 If the DMC are minded to apply similar principles, the EPA staff consider that the conditions and adaptive management approach proposed by CRP in its application fail to satisfy these criteria. There is currently an inadequate understanding of the baseline environment, particularly in the

³²¹ Chapter 11 of the application

³²² Section 11.4.2 of the application

³²³ EMS review report, 26 May 2014

area beyond MP55549 (and occasionally within MP55549), where most of the information provided by CRP was predicted using an unvalidated habitat model. The conditions that CRP propose are far from finalised in their current state, with only preliminary guidance around how monitoring will be undertaken by CRP, and there is little description of the indicators or performance measures that will be used to determine any likely effects. Most of the time, thresholds that will trigger remedial action have not been identified and in the single case where a threshold was identified³²⁴, the evidential basis for this threshold has not been clarified. The EPA staff consider that an adaptive management approach should not be used to determine matters such as an acceptable level of adverse effects.

523 The lack of clarity around CRP's mining methodology also creates uncertainty as to whether CRP would have the ability to modify its activities in response to exceedances of thresholds. The EPA staff consider that the conditions provided by CRP fail to ensure that effects will be able to be identified before they become irreversible. Condition 32 proposed by CRP lightly describes the type of monitoring that is required to be undertaken during mining operations, but provides no detail about the techniques that will be used to identify whether any thresholds have been exceeded, and how CRP will respond to such events.

13 CONDITIONS

13.1 Legislative context

524 Under s63 of the EEZ Act, the DMC may grant a marine consent on any condition that it considers appropriate to deal with adverse effects of the activity authorised by the consent on the environment or existing interests.

525 The types of conditions that the DMC may impose include requiring the consent holder to:

- a. provide a bond for the performance of any conditions imposed by the consent*
- b. obtain and maintain public liability insurance of a specified value*
- c. monitor, and report on, the exercise of the consent and the effects of activity*
- d. appoint an observer to monitor the activity and its effects on the environment*
- e. make records related to the activity available for audit.*

526 The DMC is not able to impose a condition on a consent if the condition would otherwise be inconsistent with the EEZ Act or any regulations, and the DMC may not impose a condition to

³²⁴ Condition 14 proposed by CRP relates to the monitoring of total suspended solids (TSS) and discusses potential actions to be taken when concentrations exceed 50 mg/L

deal with an effect if that condition would conflict with a measure required by another marine management regime or the HSE Act 1992.

13.2 CRP's proposed conditions

527 CRP has proposed 47 conditions in an attempt to avoid, remedy or mitigate the adverse effects of their proposed activities³²⁵, including some conditions that appear to accommodate an “adaptive management approach” and the development of an Environmental Management and Monitoring Plan (EMMP) (to also include biosecurity issues)³²⁶.

528 The EPA staff consider that the setting of relevant and acceptable conditions requires an evidential basis³²⁷. Any conditions must meet good practice guidelines (based on the Newbury Principles applied to Resource Management Act practice). They must be:

- a. within the EPA's powers under the EEZ Act
- b. for an EEZ management purpose
- c. certain – consent conditions must be certain so that the marine consent holder, the EPA and any lay person viewing the marine consent have no doubt about what is required by the conditions and the obligations of the marine Consent Holder. It is important that conditions are drafted in plain English and can be readily interpreted and understood by the EPA compliance team monitoring the consents and subsequent Marine Consent Holders
- d. relevant to the subject matter of the marine consent
- e. fair, reasonable and practical
- f. exclusively between the marine consent holder and the EPA.

529 When drafting conditions, the conditions themselves should be Specific, Measurable, Achievable, Reasonable and Time-Bound (SMART). In order to draft such conditions, it is necessary to understand the scale, nature and intensity of CRP's activities and any adverse effects that may be caused by these activities on the environment and existing interests. The significance of each effect and whether it will be controlled by an existing marine management regime must also be understood. Under s59(2)(j), the DMC must then take into account the extent to which imposing conditions under s63 of the EEZ Act might avoid, remedy or mitigate the adverse effects of CRP's proposed mining activities.

³²⁵ Section 11.4.4 of the application provides CRP's proposed conditions

³²⁶ Section 8.10 of the application

³²⁷ Resource Management Law Association Roadshow — Conditions of Consent

Adaptive management approach

530 CRP describes a staged approach to their proposed mining that will enable it to mine beyond the mining permit area (MP55549). This is offered by CRP under the heading of “adaptive management”, in accordance with s64(3) of the EEZ Act. The EPA staff consider that a pre-requisite of such an approach is the identification of quantitative thresholds that trigger remedial action, and the requirement to prevent irreversible effects through such action. The conditions provided by CRP do not enforce the requirement to alter operations³²⁸, and in any event, the lack of detail regarding methodology creates uncertainty around CRP’s ability to adapt its operations to ensure compliance with acceptable thresholds.

531 The conditions provided by CRP provide guidance about the type of data that will be collected prior to the occurrence of mining beyond the mining permit area (MP55549). The conditions do not provide appropriate and measurable thresholds to guide this proposed adaptive management approach, and fail to address any criteria that CRP may use to decide whether or not to mine a particular area. For example, the actions to be taken to avoid areas identified by monitoring as ecologically significant are not provided by CRP. In addition, no scientific justification is provided for the threshold identified by CRP for the requirement of a potential adaptive management approach³²⁹.

532 The EPA staff consider that the conditions specified by CRP as part of its adaptive management approach cannot be reasonably measured and enforced, and thereby preclude the use of an adaptive management approach. The EPA staff also consider that conditions should address a range of adverse effects identified within the EIA and by other parties.

Environmental Management and Monitoring Plan

533 CRP has provided a draft EMMP³³⁰ and specifies in Condition 27 that the development of an EMMP will be finalised prior to mining activities. While this is a common approach, it is only appropriate where clear objectives, matters to be covered, and measurable monitoring and environmental performance standards are specified³³¹.

534 The EPA staff consider that the role of the EMMP is to meet any proposed conditions by identifying procedures, but not to determine matters such as the acceptable level of adverse effects. The development and refinement of the EMMP should be underpinned by robust

³²⁸ For example, Conditions 14(d) and 15(b) of the application do not provide certainty about the actions to be taken (if any) and how they are to be enforced by the EPA

³²⁹ Condition 14 identified TSS levels exceeding 50 mg/L above background levels as threshold, at a point greater than 5 km away from the mining operations or at a point 50 m greater or above seabed at any location, as a level that may trigger an adaptive management approach

³³⁰ Appendix 35(i) of the application

³³¹ EMS review report, 26 May 2014

conditions selected using an evidential scientific rationale and quantitative environmental performance standards. The EPA staff consider that such conditions have not been developed and will require further refinement prior to a decision on the application.

Environmental Mitigation

- 535 CRP proposed several mining exclusion areas within its proposed marine consent area where direct physical effects of mining would be avoided. EPA reviewers identified that such areas are still likely to be impacted by indirect effects from elevated sediment deposition and TSS concentrations due to mining in adjacent areas³³². This has been confirmed in CRP's response to the EPA's further information request, dated 8 July 2014, which provides an overlap of the sediment footprint during the first five years of the mining project.
- 536 The appropriateness of using these areas as a mitigation measure depends on the validity of the habitat suitability model, and the effectiveness of these areas in maintaining biodiversity and ecosystem functioning³³³. The habitat suitability model was not validated with field data, which adds significant uncertainty to the spatial planning exercise undertaken by CRP for identifying mining exclusion zones³³⁴.
- 537 CRP's application provides conditions that in many cases do not reflect avoidance, remediation and mitigation measures that are proposed in other sections of the application. Measures, such as conditions, to mitigate the effects of noise are identified, but the details about how such measures will be implemented are not described. For example, the application identifies that the guidelines of the World Organisation of Dredging Associations (WODA 2013) will be used to assess underwater noise levels in CRP's proposed marine consent area, but information on how these will be implemented is not provided³³⁵. The procedures for how such measures will be met are important to learn how the effect will be avoided, remediated or mitigated, and these measures should be specified and prescribed within proposed conditions for any marine consent to be granted.

13.3 Framework for proposed conditions by the EPA

- 538 The EPA staff consider that the conditions provided in CRP's application do not provide sufficient detail to ensure that the adverse effects of its proposed activity will be avoided, remedied, or mitigated to an acceptable level. While at this stage the EPA staff do not consider that the information provided by CRP in its application would enable the development of SMART

³³² SKM review report, 11 June 2014

³³³ SKM review report, 11 June 2014

³³⁴ Appendix 32 of the application

³³⁵ JPEC review report, 11 June 2014

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conditions, a proposed framework for the further development of robust and SMART conditions is provided below. A set of draft conditions is provided in Appendix 6 to this report. It should be noted that further information and technical studies may be required to inform conditions, especially with respect to the establishment of appropriate thresholds.

539 Following the consideration of any further information, submissions, evidence and further technical input received, the DMC may choose to commission the EPA staff to produce a final set of conditions (in consultation with other parties) that may have the effect of avoiding, remedying or mitigating adverse effects to an acceptable degree.

540 The proposed framework by the EPA staff is:

- a. general conditions (in general accordance, lapse and duration)
- b. pre-commencement monitoring conditions
- c. Environmental Management and Monitoring Plan conditions
- d. operations and maintenance conditions
- e. reporting conditions
- f. review and adaptive management conditions
- g. insurance and bond conditions

General conditions

541 Conditions in this section would require the Consent Holder to undertake activities in accordance with its application and any amendments; control the duration and any lapse periods. What constitutes an appropriate lapse period depends on the environment in which the proposed activity would be undertaken. Longer lapse periods are more appropriate in stable environments that are not likely to change over extended periods of times. If the DMC is of the mind to grant consent, it will need to consider whether CRP's suggested 10-year lapse period is appropriate in the context of the Chatham Rise.

542 Conditions in this section should list specific operational limits, based on limits and specifications that were used as the basis for CRP's assessment of effects. If these limits are not considered appropriate to avoid, remedy or mitigate effects, amendments to operational limits should be made accordingly. Should CRP consider varying the operational methods, such amendments must only be made subject to approval by the EPA.

Pre-commencement

543 Pre-commencement conditions should specify CRP's monitoring requirements prior to the commencement of mining operations.

544 Consent conditions should also specify any consultation that must be undertaken prior to the commencement of mining, and the objectives of any consultation.

Environmental Monitoring and Management Plan

545 Conditions in this section should specify how CRP will manage the environmental effects of its activities. These conditions should refer to performance objectives, baseline monitoring, trigger thresholds, operational monitoring, remedial actions, and a mechanism to review relevant trigger thresholds.

546 Specific performance objectives should be set to provide sufficient certainty, clarity or robustness to ensure that the adverse effects of the activity are appropriately avoided, remedied or mitigated. In this case, specific performance objectives should be developed to manage:

- a. plume derived suspended sediments and deposited sediments
- b. noise effects
- c. effects on water quality
- d. effects on sediment chemistry
- e. effects of lighting
- f. effects on ecological values (seabirds, marine mammals, pelagic fauna, benthic communities)
- g. effects on commercial fishing

547 Quantitative performance triggers that underpin this environmental performance objectives should be specified within these conditions.

548 The EMMP will set out the protocols for operational environmental monitoring and management. The objectives of the EMMP must be Smart, Measurable, Achievable, Reliable and Time Bound. The EMMP should aim to:

- a. ensure that the adverse effects on existing interests, arising as a result of CRP's proposed mining activities, are appropriately avoided, remedied or mitigated and that the environmental performance objectives are met
- b. ensure that any triggers and values set as relevant thresholds identified to act as physical and biological indicators meet these objectives and that the thresholds are not exceeded by the effects caused by CRP's proposed mining activities
- c. outline CRP's approach to responding operationally to any breaches of triggers, thresholds or consent conditions, in order to avoid, remedy or mitigate any adverse effects on the environment or existing interest.

Management Plans

549 CRP should provide Management Plans to give effect to the conditions of its proposed marine consent. CRP will be required to prepare and submit these plans to the EPA for approval. All Management Plans must clearly state the methods to be followed and provide such other detail as required to demonstrate how the purpose and the objective(s) of such Plans will be achieved, as set out in the relevant condition(s). The EPA considers that the following Management Plans may be required (but cannot be used to replace any robust conditions):

- a. a Pre-Commencement Baseline Monitoring Plan
- b. Lighting Management Plan (LMP)
- c. Marine Mammal Monitoring and Management Plan³³⁶ (MMMP)
- d. a Spill Contingency Management Plan (SCMP)
- e. a Biosecurity Management Plan (BMP)
- f. a Vessel Operations Management Plan (VOMP)
- g. management of effects on:
 - (i) other ecological values, including benthic communities and pelagic fauna
 - (ii) water quality and sediment chemistry effects.

550 Conditions should also deal with other unplanned events that may result from the mining activities, including any blockages in the riser, sinker and diffuser.

551 The Operational Plan must outline the actions to be taken to ensure compliance with operational limitations identified within conditions of consent. The VOMP must also identify the actions to be taken during operations that will avoid, remedy or mitigate the potential effects on:

- a. archaeological sites
- b. sites of cultural significance
- c. marine mammals
- d. the health and safety of workers
- e. water quality and sediment chemistry
- f. commercial fisheries

³³⁶ This Management Plan must ensure compliance with DOC's 2013 *Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations*

- g. navigation and Maritime Safety Management.

552 Conditions in this section of the consent will also need to specify the operational requirements with respect to:

- a. the operational sediment plume
- b. the EMMP

Review

553 Consent conditions should be developed in accordance with s76 of the EEZ Act to enable the EPA to review the conditions of consent.

13.4 Permitted activities

554 In considering any permitted activities to be undertaken by CRP, the DMC must be mindful that to be held as permitted activities, CRP must meet any conditions as set out in the EEZ Regulations 2013, otherwise these permitted activities become discretionary activities.

555 If in future, seismic surveying is carried out by CRP as a permitted activity, then the proponent must adhere to the DOC's *2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations* (see Section 10.8 of this report). If a proponent fails to comply with the provisions of this Code, the EPA would be responsible for ensuring compliance and taking enforcement action³³⁷.

14 BONDS

556 Under s65(1), a bond required under s63(2)(a)(i) of the EEZ Act, may be given for the performance of any one or more conditions of a marine consent that the DMC considers appropriate. The bond may continue after the expiry of the consent to secure the ongoing performance of conditions relating to long-term effects, including a condition:

- a. *relating to the alteration, demolition, or removal of structures*
- b. *relating to remedial, restoration, or maintenance work*
- c. *providing for ongoing monitoring of long-term effects.*

557 Section 65(2) of the EEZ Act sets the framework for bond conditions in a marine consent.

³³⁷ See s44 letter from the Department of Conservation, received 11 July 2014

558 A bond is essentially a promise to comply with conditions of consent. The applicant lodges the bond money with the EPA, and the EPA may use that money to ensure compliance with any marine consent conditions, should CRP fail to do so.

559 If imposing a bond, the DMC will need to ensure that the term of the bond is adequate so that any adverse effects associated with the proposed activities can be remedied or mitigated. The quantity of bond money must be sufficient to ensure that all consent conditions can be complied with, should CRP fail to do so. To ensure that the bond is sufficient, the cost of CRP's mining project and its potential adverse effects should be robustly quantified when the bond is struck.

560 Bonds are often used to ensure remediation activities are undertaken following the abandonment of mined sites, or for remediation of effects on the environment and local communities caused by unplanned events (e.g. oil spills). In this situation, the DMC may require a bond to ensure that changes to agreed mining methodology can be made in response to unexpected adverse effects occurring. This may be particularly important where uncertainty around effects remains but the DMC is satisfied, that if it grants consent, caution and environmental protection is favoured. A bond may also be required to ensure that CRP complies with post-operational monitoring and remediation conditions.

561 New Zealand has a legacy of mine site clean up issues that have resulted in costs borne by the tax payer (e.g. the Tui Mine Remediation Project)³³⁸. Imposing a bond on CRP is one method that the DMC may choose to ensure that CRP meets any costs of compliance and necessary site remediation.

15 OVERALL EVALUATION

562 The basis of the DMC's decision is set out in ss59 - 61 of the EEZ Act. These provisions must be complied with before a decision on CRP's marine consent application can be made.

15.1 Context

563 The starting point for the decision on the marine consent is s59 of the EEZ Act. This requires the DMC to consider the broad range of matters set out in s59. In considering the s59 matters, the EPA staff make the following observations about the context for this application:

- a. CRP's application has some pioneering characteristics for activities in the EEZ that are managed by the EEZ Act. The mining activity is a large scale activity and it is:
 - ii. relatively remote, being 450 km offshore from Christchurch

³³⁸ <http://www.waikatoregion.govt.nz/PageFiles/13588/Project%20overview%2024.5.11.pdf>

- iii. deep, being in 250 - 450 m depth of water
- iv. long-term, being proposed for a 35-year term
- v. extensive, as it will involve mining of at least 30 km² per year within a 5,207 km² proposed area
- b. the activity is proposed in a rich marine environment that has been subject over several years to investigation and research, but with much that is still not known about it
- c. about 90 % of the proposed marine consent area is within a BPA
- d. the activity will use purpose-built technology and equipment that is new to New Zealand and has not been undertaken at that depth in any other part of the world
- e. the Chatham Rise has special features and associations for Māori/Moriori
- f. the act of mining by extracting up to 0.5 m of living and non-living natural material from the seabed, in the proposed marine consent area, will fundamentally change the marine environment and destroy the seabed and the benthic communities living on and within mined areas, with little prospect of recovery
- g. the return of a substantial fraction of the mined material to the water column as mine tailings (~ 85 % of all material collected) and its subsequent deposition will create significant adverse effects on non-mined but adjacent seabed and its associated biological communities.

564 By the nature of what this mining proposal sets out to undertake, the proposed mining activities, if granted consent, cannot be avoided. Therefore, the DMC must, in considering these effects turn its mind to how and to what degree the effects caused by CRP's proposed mining activities could be remedied or mitigated. Table 1 outlines the EPA staff's overall assessment of the potential effects of CRP's proposed mining operation and the extent to which imposing conditions would remedy or mitigate these effects.

565 The extent to which this context weighs on the decision is a matter to be considered by the DMC. The DMC is required to apply a set of statutory tests and address a number of matters (ss59 - 61 of the EEZ Act) based on the specific facts and circumstances of CRP's application, any further information sought from the applicant, s44 advice, and the evidence and submissions made by submitters.

15.2 Adverse effects on the environment

566 One of the focuses of CRP's EIA is the effects of CRP's activities on the environment. It is important to note that when the DMC is considering these effects, the DMC assessment is not limited to the consideration of effects in the areas that may be mined or CRP's proposed marine consent area. The DMC must also consider the effects outside of the mined areas *and* the effects

beyond the proposed marine consent area. Indeed, this is reflected in the definition of environment³³⁹ and section 59(2)(a)(ii) of the EEZ Act which clearly requires such consideration to be applied by the DMC. The adverse effects on the environment arise from the following types of activities:

- a. placement or removal of a structure on or under the seabed (s20(2)(a) EEZ Act)
- b. removal of non-living natural material from the seabed or subsoil (s20(2)(d) EEZ Act)
- c. disturbance of the seabed or subsoil in a manner likely to give rise to adverse effects on the seabed or subsoil (s20(2)(e) EEZ Act)
- d. deposition of material in or on the seabed (s20(2)(f) EEZ Act)
- e. destruction, damage, or disturbance of the seabed or subsoil in a manner likely to have an adverse effect on marine species and their habitat (s20(2) (g) EEZ Act)
- f. vibrations likely to have an adverse effect on marine life (s20(4)(b) EEZ Act)

567 The key effects arising from these activities include:

- a. destroying the seabed by excavating living and non-living natural material up to 0.5 m below the seabed using a 30-tonne drag-head extractor unit; effects include the loss of rare and protected marine species
- b. the potential smothering of benthic communities and environments adjacent to and beyond the mining sites, from the discharge of mine tailings back into the water column that deposits back on the seabed as sediment, or that remains suspended as sediment in the water column.

568 Other associated effects from these activities include:

- a. potential adverse effects from the potential release of major and trace elements, including potentially radioactive elements
- b. potential adverse effects on marine life from noise and vibrations
- c. potential adverse effects of lighting and vessel structures on seabirds
- d. potential adverse effects on marine mammals from vessel strike or entanglement

³³⁹ Environment means the natural environment, including ecosystems and their constituents parts and all resources, of –

- a. New Zealand:
- b. the exclusive economic zone:
- c. the continental shelf:
- d. the waters beyond the exclusive economic zone and above and beyond the continental shelf

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- e. potential navigation hazards
- f. potential oil spills and other unplanned events.

569 A summary of the EPA staff's overall assessment of the potential adverse effects of CRP's proposed mining activities can be seen in Table 1.

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Table 1. Overall EPA staff assessment of the potential adverse effects of CRP's proposed mining activities pre- and post-mitigation

Adverse effects on:	Adverse effects of:		Adverse effects of:		Adverse effects of:		Adverse effects of:		Adverse effects of:			
	Drag-head: Extraction of non-living and living natural material / sediment resuspension	Discharge of mine tailings (sedimentation, TSS, mobilisation of potentially toxic elements)	Noise/ vibration	Lighting and vessel structures	Oil spill/unplanned events	Processing the mining resource						
Benthic environment (including protected species)	No conditions	After conditions	No conditions	After conditions	No conditions	After conditions	No conditions	After conditions	No conditions	After conditions		
	Extreme	Extreme	Extreme (sedimentation) / Uncertain (TSS, toxic elements)	Uncertain ³⁴⁰	Uncertain	Low	Low	Low/Moderate	Low/Moderate	N/A	N/A	
Plankton, pelagic fish and cephalopods	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Low	Low	Low/Moderate	Low/Moderate	N/A	N/A	
Marine mammals	N/A	N/A	Uncertain	Uncertain	Uncertain	Moderate/High	Low/Moderate	Low/Moderate	Low/Moderate	N/A	N/A	
Seabirds	N/A	N/A	N/A	N/A ³⁴¹	NA	Moderate/High	Low/Moderate	Low/Moderate	Low/Moderate	N/A	N/A	
Ecosystem effects	Uncertain	Uncertain	Uncertain	Uncertain	N/A	N/A	N/A	Low/Moderate	Low/Moderate	N/A	N/A	
Commercial fishing	Low/Moderate	Low/Moderate	Low/Moderate	Low/Moderate	N/A	N/A	N/A	Low/Moderate	Low/Moderate	N/A	N/A	
Commercial fish species	Extremehigh	Uncertain	Extremehigh	Uncertain	Uncertain	Uncertain	Low	Low	Low/Moderate	Low/Moderate	N/A	N/A
Existing cultural interests	Uncertain	Uncertain	Uncertain	Uncertain	N/A	N/A	N/A	N/A	Low/Moderate	Low/Moderate	N/A	N/A
Human health	N/A	N/A	Uncertain	Uncertain	N/A	N/A	N/A	N/A	Low/Medium	Low/Medium	Uncertain	Uncertain

³⁴⁰ Where the effects are uncertain, the EPA staff do not have enough information to make an evaluation of the potential effect. This does not mean that this effect would be significant or unable to be avoided, remedied or mitigated

³⁴¹ N/A — Not applicable

15.3 Proposed Mining Area

- 570 The total area to be mined is at least 30 km² per annum. If CRP's proposed mining activities were undertaken for up to 35 years the total area to be mined would be at least 1,050 km².
- 571 It is clear from this Staff Report that the 5,207 km² proposed area in CRP's marine consent application on the Chatham Rise provides habitat for a biologically diverse benthic community. This community includes protected species, such as corals, other sensitive species including sponges, bryozoans and brachiopods, and unique species such as giant isopods and bivalve molluscs. Many of these species perform important ecosystem services by providing habitat for a diverse and abundant range of other species.
- 572 An issue for the DMC to consider is that the areas of the greatest concentration of phosphate nodules are also the areas of the greatest biological diversity. These nodules are part of the supporting environment for much of the richness in benthic communities in this part of the Chatham Rise.
- 573 A relevant matter is that the Chatham Rise is not a pristine marine environment. It has been subject to various commercial fishing efforts in the past, including bottom trawling. Evaluating the present state of the benthic environment in order to overlay the impacts of mining is an important part for assessing the scale and significance of the adverse effects of CRP's proposed mining activities.
- 574 Seabed mining in the manner proposed in CRP's application gives rise to a number of effects, some of which will not be confined just to the proposed marine consent area. The effects of mining within this area are relatively certain and well understood (this is the marine environment equivalent of quarrying).
- 575 It is also clear from this Staff Report and CRP's application that its proposed mining activities will result in the total destruction of these species and their habitats within the mined areas. While there is uncertainty about the extent to which this destruction would affect the biological diversity of the Chatham Rise ecosystem as a whole, it is clear that any effects will not be able to be avoided within the mined areas.
- 576 CRP's application describes and assesses the significance of the benthic environment within part of its proposed marine consent area, which has relied mostly on samples taken within the mining permit area (MP55549). The extent to which those samples can be extrapolated to provide an assumed environmental baseline for the entire proposed marine consent area remains unclear. The EPA staff have attempted to address this uncertainty by seeking information from the applicant and advice under s44 of the EEZ Act.
- 577 The EPA staff also consider that it is important for the information about the existing baselines of the environment within CRP's proposed marine consent area to be assessed by the DMC

against the definition of 'best available information'. The DMC will need to be satisfied that it has exercised its powers to ensure that it has a sufficient understanding of the nature of the existing environment (pelagic and benthic) in order to determine the effects of CRP's proposed mining activities, including the effects of sediment deposition, any effects on the water column and what will be lost from the environment as a consequence of its proposed mining activities.

15.4 Outside of the Proposed Mining Area

578 Seabed mining in the manner proposed in CRP's application gives rise to several effects, some of which are not confined just to the mining 'lanes' within the mining site. The effects of mining in the area proposed to be mined are relatively certain and well understood (this is the marine environment equivalent of quarrying).

579 It is evident from this Staff Report, that CRP's proposed mining activities would not only destroy the seabed in the mined "lanes", it also has the associated significant adverse effect of the deposition of mine tailings (sediments of different granularity and "dead" marine organisms) into the water column and onto mined and unmined seabed. This will adversely affect an area greater than the mined area. An issue for the DMC to consider is whether it can be satisfied that the modelling of sedimentation effects in CRP's application can be relied upon to properly assess the scale, extent and impact of this deposition. The Staff Report notes significant uncertainties with respect to the effects of deposition and the methodology used, and notes the further information requests that were directed at this issue.

580 The EPA staff also note that the DMC is required to have the best available information before it to understand the effects of allowing the activity in the areas outside of the proposed mined "lanes". If the DMC concludes that it is faced with inadequate or insufficient information (i.e. that it does not have the best information available within the parameters as defined in the EEZ Act), then the DMC will need to apply the reasoning set out in the section below relating to uncertainty and inadequacy of information. The DMC would also have to determine the appropriate consequence of this upon the outcome of the application.

581 This is important because that knowledge of the wider area needs to be held against a consideration of the direct and known effects of CRP's proposed mining activities. This is a relevant context for an overall assessment of these effects for the Chatham Rise as a whole and, arguably, for the benthic communities in the wider EEZ and continental shelf. The total destruction of part of CRP's proposed marine consent area (and accepting that this would represent the most significant adverse effect possible) may not be sufficient to consider a refusal of consent of part or all of the proposed marine consent application.

582 With respect to CRP's proposed mining activities outside of the area to be mined, the extent of the effects are less certain and the section below sets out how the DMC is to deal with any uncertainty or inadequacy of information. The amendment to CRP's application on 1 August

2014, which removed the eastern block (PP55967) from its proposed marine consent area, does not constrain the EPA staff advice to the DMC that it needs to consider the effects arising from within the mined areas and how those effects play out outside these areas including on parts of that eastern block (Section 59(2)(a)(ii) EEZ Act). In other words, despite the removal of the eastern block from CRP's application, that area is still relevant to the extent that the effects of CRP's mining activities may still occur in that area.

15.5 Conclusion

583 This Staff Report sets out the significance of the two primary environmental effects, mining of the seabed and deposition of sediment. The former comprises direct and catastrophic effects of the extraction of living and non-living natural material which will destroy the seabed up to 0.5 m deep; and, the latter is an associated significant adverse effect of the discharge of mine tailings depositing on the seabed as sediment and resulting in suspended sediment in the water column.

584 The DMC needs to consider these two primary effects of the proposed activities and reach conclusions on whether those effects are of such significance that they cannot be avoided because of the mining activities proposed by CRP, whether there is any probability that the effects may be remedied, and whether there is any mitigation possible (including by way of an adaptive management regime). The assessment, consideration and determination of these primary matters may be pivotal in the DMC's assessment of the application. Irrespective of whether the DMC is minded to grant or refuse consent on the basis of those major effects, the DMC will need to follow through on the ss59 - 61 matters to form its decision and to document its consideration and rationale supporting these broad matters.

585 If it is minded to consider a grant of consent albeit with conditions or in some modified form, then the DMC will need to turn its mind to the other relevant effects set out in para 566 of the Staff Report, as well as all the s59 matters outlined in the EEZ Act.

586 Where the scale, nature and extent of effects is less certain, the section below sets out how the DMC is to deal with any uncertainty or inadequacy of information.

Uncertainty and inadequacy of information

587 This Staff Report identifies many areas of uncertainty or inadequacy of information. In particular, there is significant uncertainty with respect to:

- a. methodologies: modelling and calibration methodologies used in CRP's application (Sections 6.1, 6.4 of this report)
- b. effects of the sediment plume, resulting from discharges of mined material into the water column and onto the seabed (Sections 6.4, 6.5, 6.6 of this report)

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- c. effects of trace elements, including radioactive elements (Sections 6.1, 6.2, 6.3, 6.4 of this report)
- d. cumulative effects (Sections 6.4, 6.7 of this report)
- e. effects on existing interests (Section 7 of this report)
- f. relationships with and impacts on the objectives of the BPA (Section 10.4 of this report)

588 While this Staff Report acknowledges that many of these information gaps or remaining uncertainties in information may be addressed by the further information requests, CRP's evidence, or the evidence of submitters. The EPA staff consider that areas of uncertainty are likely to remain. Inevitably, the spatial extent of the proposed marine consent area is such that our knowledge of the existing baseline of the environment (benthic and pelagic) is not complete and hence any assessment will carry a level of uncertainty that the DMC will need to consider against its responsibilities for favouring caution and environmental protection.

589 The EEZ Act provides guidance to the DMC about how to deal with the uncertainty.

590 The DMC is equipped with powers to request further information from the applicant, obtain advice and commission a review or a report. Indeed, the DMC is required to base its decision on the best available information. This means, that in situations of uncertainty or inadequacy of information, one option is for the DMC to utilise its information gathering powers to address the uncertainty or inadequacy. This can be done at any time up to the hearing and during the hearing. If the latter timing arises, then the DMC has the delegated authority to adjourn the hearing or seek the applicant's agreement to put the hearing on hold to secure any information or advice.

591 When considering the effects of CRP's proposed mining activities on existing interests as required by s59(2)(a) of the EEZ Act, the DMC will find further guidance in s60 of the EEZ Act. In the context of CRP's application, commercial fishing seems to be the dominant existing interest that may be affected by CRP's proposed mining activities. When considering the effects of CRP's proposed mining activities, the DMC will need to consider, in addition to any other relevant matter, the area that the proposed mining activities and the existing interest would have in common; the degree to which CRP's mining activities and commercial fishing must be carried out to the exclusion of other activities; and, whether the commercial fishing can be exercised only in the area to which the application relates.

592 It is also useful to note that the DMC must take into account any uncertainty or inadequacy³⁴² in its decision. In other words, if the uncertainty or inadequacy cannot be addressed, the DMC is

³⁴² Section 61(1)(c) of the EEZ Act

required to take such uncertainty/inadequacy into account in making a decision. Uncertain or inadequate information is not of itself reason to refuse consent; the EEZ Act is not a 'no risk' environmental statute. The DMC will need to balance the facts and circumstances of CRP's application with its level of comfort to assess whether it has a sufficient basis to proceed to apply that information to the matters set out in ss59 - 61, exercise caution and environmental protection and properly form a view on the merits of CRP's application and the submissions that have been lodged.

593 The EEZ Act is clear that if the information available is uncertain or inadequate, the EPA must favour caution and environmental protection. This could have several meanings for the purposes of CRP's application, including:

- a. the DMC may refuse consent
- b. the DMC may grant consent to a reduced proposal (area, term of consent, mined area per year)
- c. the DMC must consider using an adaptive management approach
- d. the DMC may add conditions of consent that address uncertainties.

594 Favouring caution and environmental protection may also mean that CRP's activities would be likely to be refused³⁴³. If this was a situation that the DMC was confronted with, the DMC is required, by virtue of s61(3), to consider whether taking an adaptive management approach would allow the activity to be undertaken.

595 Such an adaptive management regime needs to be capable of being implemented either on a 'learn as you go' basis, or in stages with hold and decision points determined by a precautionary approach. The latter approach would require the assessment of environmental effects at each stage of development to enable a decision to be made (if need be) to cease the mining activities before irreversible or unintended adverse effects arise.

596 A feature of most adaptive management regimes is that they enable an activity to commence on the basis that measurements and assessments will be performed once the activity is underway, and the management of the activity will be adapted according to the information that is obtained from those measurements and assessments. They can be useful in circumstances where uncertainty will only be reduced once the relevant activity commences. However, they must be cautiously tailored. If they leave matters too uncertain, they may amount to an inappropriate deferral of the decision. If the DMC considers an adaptive management approach, it must be

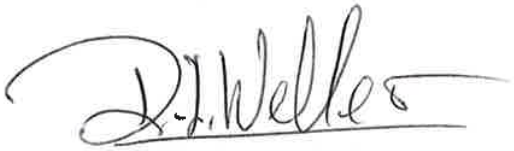
³⁴³ Section 61(2) of the EEZ Act

satisfied that the mechanism will ensure that the residual risks or uncertainties will be reduced and addressed.

16 RECOMMENDATION

597 The EPA staff are not currently able to recommend granting this marine consent on the face of CRP's application as it stands, but recognise that there is more information to be provided, which may change our view. Should the DMC be of the mind to grant the consent subject to conditions, after taking into account any further responses to FIR by CRP, applicant's and submitter's evidence, expert conferencing and any other relevant information, we have attached a preliminary set of draft conditions to this report as a starting point (see Appendix 6). If deemed appropriate, the DMC may wish to commission the EPA staff to provide a final set of conditions or further assessment of the information yet to be provided.

Signoffs



18 August 2014

Lead Author – Dr. David Weller, Senior Advisor, Date

EEZ Consenting



Richard Johnson, Manager,

Date

18/8/14

EEZ



Sarah Gardner, General Manager,

Date

18-8-14

Applications and Assessment

APPENDIX 1: Analysis of Submissions — July 2014

[See attached document]

[Refer to the separate attachment]

APPENDIX 2: CRP's impact assessment criteria

Potential consequences are defined and categorised by CRP as³⁴⁴:

- **Minor.** Near-source confined and promptly reversible impact on-site, with little or no off-site impact expected (i.e., beyond the mining area).
- **Medium.** Near-source confined and short-term reversible impact on-site, with little and promptly reversible off-site impact.
- **Serious.** Near-source confined and medium-term recovery impact on-site, with near-source confined and short-term reversible off-site impact.
- **Major.** Impact is unconfined and requiring long-term recovery, leaving residual damage on-site with near-source confined and medium-term recovery of off-site impacts.
- **Catastrophic.** Impact is widespread and requiring long-term recovery, leaving major residual damage on-site with off-site impacts that are unconfined and requiring long-term recovery and leaving residual damage.

The likelihood of consequences occurring are categorised by CRP as:

- **Rare.** Event that is very unlikely to occur during the lifetime of the project
- **Unlikely.** Event that is unlikely to occur during the lifetime of the project
- **Possible.** Event that may occur during the lifetime of the project
- **Likely.** Event that may occur frequently during the lifetime of the project
- **Almost certain.** Event that will recur during the lifetime of the project

The ecological risk is then calculated by CRP as the product of consequence and likelihood using the table below

³⁴⁴ From Section 8.2.2 of CRP's application

		CONSEQUENCE				
		Minor	Medium	Serious	Major	Catastrophic
LIKELIHOOD	Almost certain					
	Likely					
	Possible					
	Unlikely					
	Rare					

Key:

	L	Low risk
	M	Medium risk
	H	High risk
	S	Serious risk

APPENDIX 3: EPA's significance of effects criteria³⁴⁵

Consequence level	Recovery Period	Key species	Protected species	Ecosystem functional impact	Proportion of habitat affected
0 - Negligible	No recovery time needed	Undetectable for populations of these species	Almost none are impacted	Interactions may be occurring but it is unlikely that there would be any change outside of natural variation	Affecting <<1% of area of original habitat area
1 - Minor	Rapid recovery would occur if stopped - measured in weeks to months	Possibly detectable but little impact on population size and none on their dynamics	Some individuals impacted but no impact on population.	Affected species do not play a keystone role - only minor changes in relative abundance of other constituents	Measurable but localized; affects <1-5% of total habitat area
2 - Moderate	Recovery probably measured in months - years if activity stopped	Affected but long-term recruitment/ dynamics not adversely impacted	Level of interaction/ impact moderately affects population	Measurable changes to the ecosystem components without there being a major change in function (i.e. no loss of components)	Impacts more widespread; 5-20% of habitat area is affected
3 - Severe	Recovery measured in years if stopped	Affecting recruitment levels of populations or their capacity to increase	Level of impact severely affects population levels	Ecosystem function altered measurably and some function or components are missing/ declining/ increasing well outside historical acceptable range and/or allowed/ facilitated new species to appear.	Impacts very widespread; 20-60% of habitat is affected/ removed
4 - Major	Recovery period measured in years to decades if stopped	Likely to cause local extinctions if continues	Likely to cause local extinctions if continues	A major change to ecosystem structure and function. Different dynamics now occur with different species or groups now affected.	Activity may result in major changes to ecosystem; 60-90% affected
5 - Catastrophic	Long term recovery to former levels will be greater than decades or never, even if stopped	Local extinctions are imminent/immediate	Local extinctions are imminent/immediate	Total collapse of ecosystem processes. The diversity of most groups is drastically reduced and most ecological functional groups (primary producers, grazers etc.) have disappeared. Most ecosystem functions such as carbon cycling, nutrient cycling, flushing and uptake have declined to very low levels.	Entire habitat in region is in danger of being affected; >90% affected/ removed

³⁴⁵ From MacDiarmid et al. (2012). Expert Risk Assessment of Activities in the New Zealand Exclusive Economic Zone and Extended Continental Shelf. A Report prepared by NIWA for the Ministry for the Environment

APPENDIX 4: Schedule 7A of the Wildlife Act 1953

Reprinted as at 25 October 2013

Marine species declared to be animals

CNIDARIA

Anthozoa (corals and sea anemones)—

Black corals—

all species in the order Antipatharia

Gorgonian corals—

all species in the order Gorgonacea

Stony corals—

all species in the order Scleractinia

Hydrozoa (hydra-like animals)—

Hydrocorals—

all species in the family Stylasteridae

CHORDATA

Chondrichthyes (cartilaginous fishes)—

Carcharhiniformes (ground sharks)—

Oceanic whitetip shark (*Carcharhinus longimanus*)

Lamniformes (mackerel sharks)—

Basking shark (*Cetorhinus maximus*)

Deepwater nurse shark (*Odontaspis ferox*)

White pointer shark (*Carcharodon carcharias*)

Orectolobiformes (carpet sharks)—

APPENDIX 5: Conventional trailing suction hopper dredge



APPENDIX 6 Draft conditions proposed by the EPA

ACTIVITIES IN ACCORDANCE WITH THE APPLICATION		
	Subject to compliance with the conditions of this consent, the activities authorised by this consent must be undertaken in accordance with the application and documents submitted as part of the application, including further information requests and any amendments made to the application during the course of its consideration.	
1.	Where information contained in the application documents is contrary to the conditions of this consent or where there is contradictory information contained in the application documents, the conditions will prevail	
DURATION AND LAPSE		
2.	Duration condition as per section 73 of the EEZ Act	If the consent is to be granted, the DMC may wish to consider a shorter duration, considering the uncertainty associated with effects, particularly with respect to the benthic environment
3.	This consent will lapse [X] years after the date of its commencement unless the consent is given effect to prior to that date. For the purpose of this consent, "given effect to" means that: a) the Consent Holder has confirmed to the EPA that the mining and related activities as set out in CRP's application have commenced. b) [Add any other requirements]	

PRE-COMMENCEMENT BASELINE MONITORING		
CONDITION TO BE DEVELOPED		
The requirement for, and extent of, pre-commencement baseline environmental monitoring is a consideration for the DMC. Matters to consider include: a) extent of existing information provided in CRP's application and further information requests b) the level of confidence in the existing information, and where any gaps may remain c) whether the absence of any baseline information is a matter of concern regarding the principle of development. d) whether a requirement for baseline monitoring can be met by CRP, and whether the information gathered would be material to the marine consent decision or any adaptive management decisions. e) what the objectives of the monitoring would be and for which environmental criteria f) how long would the period of monitoring be required for g) what aspects of the environment would be monitored and whether there are any specific desired methodologies, geographic or temporal extents, etc.	Suggested environmental performance objectives should be developed to manage: a) plume derived suspended sediments, deposited sediments and resuspension b) noise effects c) effects on water quality	Conditions are proposed for marine mammal and benthic habitat pre-operational monitoring, as a minimum. The DMC may wish to also consider additional pre-operation monitoring. In considering pre-operational monitoring, the DMC may wish to consider whether this monitoring would be focused solely on the 820 km² area of MP55549 or whether it should also extend into PP55971 and MPL50270. The EPA staff note that it would make sense to require pre-operational monitoring in any area to be mined

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	d) effects on sediment chemistry e) effects of lighting on seabirds f) effects on ecological values (seabirds, marine mammals, pelagic fauna, benthic communities) g) effects on commercial fishing	
5.	The Consent Holder must prepare a Baseline Environmental Monitoring Plan (BEMP) to describe the baseline monitoring in accordance with the objectives set out in [Condition 4] including, as a minimum, the following: a) the sampling methodology, including parameters and techniques for each environmental component listed in Condition 05. b) monitoring locations that will provide a statistically robust representation of the mining area. c) frequency of sampling and number of sample replicates. The BEMP must be submitted to the EPA two months prior to the start of the baseline environmental monitoring for certification by the EPA that the objectives set out in [Condition 4] have been met	This condition links to the preceding condition requiring pre-commencement baseline monitoring. A Baseline Environmental Monitoring Plan would describe the programme to comply with the preceding condition
6.	Within three months of the completion of the baseline environmental monitoring as required by [Condition 4], the Consent Holder must provide a report to the EPA setting out the results of all monitoring undertaken under the BEMP, including the results of the Marine Mammal Baseline Survey and Pelagic and Benthic Baseline Survey required by [Conditions 7 and 8]	

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Marine Mammal Baseline Survey

7.	In giving effect to [Conditions 4 and 5], the Consent Holder must undertake a baseline survey for marine mammals (the Marine Mammal Baseline Survey), for a minimum period of two years. This survey must: a) be designed and undertaken by independent, qualified and experienced marine mammal scientists agreed to by the EPA in consultation with the relevant government department (currently DOC) b) follow scientific best-practice methodologies (which may include Passive Acoustic Monitoring), as agreed with the EPA and the relevant government department (currently DOC). c) monitor and assess marine mammal distribution, density and abundance within: i. the marine consent area ii. the Chatham Rise d) incorporated into the Environmental Monitoring and Management Plan, which must be reviewed annually e) these types of monitoring must be described in a Survey Plan that must be submitted and certified by the EPA and the relevant government department (currently DOC)	The EPA staff note that if this condition is included, the duration of the survey should be confirmed
Pelagic and Benthic Baseline Survey		
8.	CONDITION TO BE DEVELOPED The extent of any baseline monitoring for the pelagic environment and benthic habitat and	This condition represents a requirement for pre-operational monitoring. There is some overlap between the two proposed conditions

organisms is a matter for the DMC to consider. In undertaking that consideration, issues include: a) the duration and scope of monitoring b) the location of monitoring on the Chatham Rise c) any representative habitats that should be included d) any specific requirements associated with primary productivity e) specifics of location, methodology, reporting, etc.	
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ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

CONDITION TO BE FURTHER DEVELOPED Following the monitoring and evaluation period referred to in [Condition 4], and at least three months prior to mining activities commencing in accordance with this consent, the Consent Holder must prepare and submit to the EPA for certification an Environmental Monitoring and Management Plan (EMMP) that includes, but is not limited to, the following: a) the Consent Holder's environmental policy b) the purpose and objectives of the EMMP c) a list of key personnel and points of contact d) environmental performance criteria for each of the environmental components listed in [Condition 4] of this marine consent, informed by baseline monitoring results for those criteria e) ongoing operational monitoring schedules including but not limited to the location, duration, frequency, timing and reporting of monitoring proposed for each environmental component listed in [Condition 4, and conditions in section on	The DMC may wish to consider which other parties would be involved in preparation of the EMMP The DMC may also wish to consider the objectives of the EMMP, which should be articulated in this condition
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	operational monitoring] f) details of trigger values for each environmental component that will result in actions to reduce environmental effects and details of those actions, their duration, location and timing and proposed monitoring of the results of such actions g) the methodology to be used for gathering data generated during monitoring for each environmental component, including but not limited to details on data format and technologies proposed for use (e.g. telemetry) h) proposals describing how data collected during the monitoring process will be provided to the public, including details about how the Consent Holder will manage the reliability, accuracy and veracity of information drawn from this data, should it be used for independent public analysis and reporting i) management plans as listed in [Condition 15] j) an annual review that incorporates results from ongoing monitoring	
10.	All operational environmental monitoring provided for in the EMMP must be undertaken for the duration of the mining activity and within the term of the marine consent, with the exception of monitoring required by [Condition 11]. The EMMP must include but not be limited to monitoring of: a) benthic habitat and benthic organisms b) water quality, including optical effects, dissolved oxygen, turbidity and concentrations of trace metals [XYZ] in both the wastewater stream on board the mining vessel (if relevant) and within the sediment plume c) underwater noise d) marine mammals	This condition suggests environmental aspects to be monitored as part of the EMMP. The DMC may wish to consider fewer or more environmental aspects, as well as the duration of any monitoring. CRP has suggested a variety of aspects to monitoring, and proposed a monitoring framework in its proposed Condition 32

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	e) meteorological conditions (waves, wind) f) sedimentation (in particular, sediment deposition thickness in the extraction areas and outside the mining area) g) seabed sediment dynamics h) seabirds i) primary productivity j) total suspended sediment (TSS) concentrations k) redox levels of post-mined sediments	
11.	The Consent Holder must continue to monitor benthic habitats and organisms as specified in the EMMP (once mining in the area in [Plan B] has been completed) every [X years], for [X years], within the term of the marine consent. Monitoring must include, but not be limited to: a) ecological re-colonisation rates b) [Add any other requirements]	If minded to grant the marine consent, the DMC may wish to consider the specifics of benthic monitoring post mining, given the proposed mining methodology
OPERATIONAL MONITORING		
Marine Mammal Monitoring		
12.	In giving effect to [Condition 10], and with regard to marine mammals, the Consent Holder must undertake operational monitoring surveys for marine mammals (Marine Mammal Operational Monitoring Surveys). These surveys must follow the criteria as set out in the previous Condition for Marine Mammal Baseline Surveys (Condition 7).	Note that there is a proposed condition under Reporting (Condition 62), which also requires reporting of opportunistic marine mammal sightings

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	Reporting must be undertaken as part of the Marine Mammal Monitoring and Management Plan described in [Condition 62]	
13.	The Marine Mammal Operational Monitoring Surveys must occur concurrently with operational monitoring for seabirds, as in [Conditions 57 - 61]	
Benthic habitat and organisms		
14.	CONDITION TO BE DEVELOPED Benthic habitat and organisms pre-operational monitoring requirements to be developed	The DMC may wish to consider any requirements for monitoring of benthic habitat and organisms particularly from the perspective of re-colonisation of the benthic environment. CRP have suggested that re-colonisation of the mined area may be possible, and provided, in its proposed condition 32(c) and (d), for monitoring to that effect
MANAGEMENT PLANS		
	The following management plans must be prepared as part of the EMMP and submitted electronically to the EPA for certification, prior to mining:	
15.	a) Spill Contingency Management Plan (SCMP) b) Lighting Management Plan (LMP) c) Marine Mammal Monitoring and Management Plan (MMMP) d) Biosecurity Management Plan (BMP) e) Vessel Operations Management Plan (VOMP)	The DMC may wish to consider whether a Vessel Operational Management Plan is required to address any navigational or other issues related to the vessel and other equipment
16.	The activity authorised by this consent cannot commence until the EMMP, including the	

required management plans, are certified in writing by the EPA. The certified plans must be complied with for the duration of the marine consent

Spill Contingency Management Plan

Subject to [Condition 15] of this consent, the Consent Holder must ensure the Spill Contingency Management Plan (SCMP) includes, but is not limited to, the following:

- a) details of methodologies, technologies and operating procedures that will result in compliance with the requirements of this marine consent.
- b) details of processes, methods, responses and recovery that will be employed in the event of any spill of oil or other contaminants to the environment, including but not limited to details of measures taken to avoid, remedy or mitigate the effects of any such spill event.

17. *Advice note: The provisions of the SCMP may overlap with but do not replace spill contingency requirements set out in any Discharge Management Plan or equivalent, prepared pursuant to the requirements of the Maritime Transport Act 1994 or equivalent*

Vessel Lighting Management Plan

Subject to [Condition 15] of this marine consent, the Consent Holder must ensure that the Vessel Lighting Management Plan includes, but is not limited to:

18.
 - a) detail of methodologies, technologies and operating procedures that will result in compliance with this marine consent
 - b) the conditions during which operations may need to be suspended to reduce the chance of bird strike/impact (e.g. fog, heavy rain)
 - c) procedures for reporting bird strikes to ensure compliance with this marine consent

	and in particular with [Condition 63 and 64] d) consideration of night-time environmental conditions when some or all deck lights may be turned off e) procedures for deck maintenance to ensure that any seabirds which land on the vessel do not become entangled in deck equipment or get oil on their feathers f) details of specific mitigation measures to prevent unnecessary light emission, including use of light shades and black-out blinds, details of minimum vessel lighting to ensure safe navigation and operation, and details of the type of non-reflective paint to minimise reflective light	
Marine Mammal Monitoring and Management Plan		
19.	Subject to [Condition 15] of this marine consent, the Consent Holder must ensure that the Marine Mammal Monitoring and Management Plan includes, but is not limited to: a) operational procedures to follow in the event of a marine mammal encounter (e.g. sighting, strike, entanglement) and to ensure compliance with this marine consent. b) reporting procedures to ensure compliance with this marine consent	
Biosecurity Management Plan		
20.	Subject to [Condition 15] of this marine consent, the Consent Holder must prepare a Biosecurity Management Plan demonstrating how it will detect, mitigate and respond to biosecurity threats for all project activities. The Biosecurity Management Plan must include, but is not limited to: a) the measures to be undertaken to avoid the introduction of unwanted or risk species as identified by the relevant government department responsible for the	

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	administration of the Biosecurity Act 1993 (currently MP) b) how the Consent Holder will apply the voluntary Biofouling Craft Risk Management Standard (e.g. frequency of biofouling maintenance, application method of antifouling paints) c) evidence of compliance with [Conditions 55 and 56]	
Vessel Operational Management Plan		
	CONDITION TO BE FURTHER DEVELOPED	
21.	Subject to [Condition 15] of this marine consent, the Consent Holder must prepare a Vessel Operations Management Plan to address operational matters, including those related to worker health and safety, human health and effects on handling and exposure to hazardous substances	The DMC may wish to consider including this management plan to address potential gaps between Maritime New Zealand's health and safety responsibilities on vessels and the EPA's requirement to address human health
OPERATIONS AND MAINTENANCE		
22.	During the first five years of operations carried out in accordance with this consent, mining shall only occur in an 820 km² area within MP55549, as identified in [Plan A] attached to this consent	[Plan A] would show the extent of the mining permit and any other mining block areas for years 1 - 5. Note that if consent was granted, depending on the adaptive management approach, the duration of the consent may need amending
23.	The Consent Holder shall ensure that mining does not occur in the following areas, for the duration of this marine consent: a) the mining exclusion areas identified in [Plan B] attached to this consent	[Plan B] would show the mining exclusion areas in relation to the mining permit area and any other mining block areas for

	b) rock outcrop areas greater than 2 km ²	years 1 - 5
24.	At least six months prior to mining activities commencing in accordance with this consent, the Consent Holder shall notify the EPA, in writing, of the proposed mining commencement date At least three calendar months prior to mining activities commencing in accordance with this consent, the Consent Holder shall prepare and forward to the EPA a Mine Plan for certification which provides, as a minimum, the following information: a) a description of the mining method to be used, including, but not limited to, the seabed mining method, the separation method for separating the mining resource from other material, and the method used to return the "living" and non-living material to the seabed b) management and maintenance requirements for key components of the mining operations c) the location of the areas that are excluded from mining in accordance with [Condition 23] of this consent d) the location of the mining blocks to be mined over the next 12 months e) identification of the predicted extent of deposition associated with the return to the seabed of the "living" and non-living material f) restrictions, if any, that will apply to navigation while mining is occurring g) identification of the proposed vessel route to and from port that complies with the New Zealand's voluntary code for vessel routing and relevant local routing codes h) contingency procedures to prevent and deal with unusual events, including but not limited to, extreme weather events and equipment failure	
25.		

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	i) other actions necessary to comply with the conditions of this consent and any other relevant regulatory or legislative requirements	
26.	No later than 31 October of each year while mining operations in accordance with this consent continue to occur, the Consent Holder shall update the Mine Plan and provide the updated Mine Plan to the EPA for certification. The updated Mine Plan is to provide the information identified in [Condition 24] for the following calendar year, and at least the following additional information: a) confirmation of the areas mined in the previous 12-month period b) the volume of all material removed from the seabed, retained and transferred to port, and returned to the seabed in the previous 12-month period	Removed the ability for CRP to use the Mine Plan to amend the mining method because changes to the mining method could result in changes to the environmental effects. The DMC should consider whether it is necessary to specify either the method, or any other aspect, to provide certainty
27.	The Consent Holder shall ensure that mining operations are undertaken at all times in accordance with the Mine Plan required by [Condition 24]	
28.	The Consent Holder must make a hard copy of all set conditions that can be available to all staff as required (including all management plans and other documentation required in these conditions), and available for the EPA to inspect at any time: a) at the Consent Holder's head office b) on board all vessels undertaking activities provided for by this marine consent	All consent documentation should be accessible to all staff for training purposes. This condition also serves to clarify the information that the EPA staff may require during inspections under section 141 of the Act
29.	The Consent Holder must ensure that all staff (all persons working for and paid by CRP and any joint venture partner, contractor or consultant undertaking duties required to exercise this marine consent) on board any mining vessel receive the training required below prior to taking part in any employment duties related to giving effect to this consent. Training must be to a standard that ensures compliance with consent conditions when	

	giving effect to this consent, including training on, but not limited to: a) the Consent Holder's obligations under the marine consent, conditions and associated management plans b) their responsibilities under any condition or management plan, and how to meet those responsibilities c) their obligations under the Marine Mammals Protection Act 1978 and Marine Mammals Protection Regulations 1992 A record of all training carried out in accordance with this condition must be maintained for each member of staff and made available to the EPA on request	
30.	Whilst giving effect to this marine consent, the Consent Holder shall establish and publish its dedicated communication methods for receipt of complaints or advice about incidents, including phone numbers and email addresses of key staff holding delegated responsibility to respond to complaints. The communication methods will be notified to the EPA, the relevant government department (currently DOC), Ngāi Tahu, the Chatham Islands and published on the Consent Holder's company website, prior to commencing mining activities authorised by this marine consent, and must be updated within 5 working days of any change in staffs contact details	To ensure that the EPA and other identified parties are aware of any potential adverse effects on the environment. The DMC may wish to add or remove parties
31.	The Consent Holder must maintain a permanent register of any complaints or notification of incidents received by any person or company alleging the causing of any adverse effects from, or related to, this marine consent. The register must include: a) the name and address of the complainant	

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	b) the nature of the complaint c) the location of the mining vessel, date and time of the complaint, and of the alleged event d) weather conditions at the time of the complaint, including wind direction and approximate wind speed, the real-time New Zealand MetService forecast for the mining area and any forecast warning for the area and the presence of precipitation, fog or any other weather related impact on visibility e) the outcome of any investigation into the complaint f) any measures taken to respond to the complaint. This information must be provided in writing to the EPA within 24 hours of receiving the complaint or notification of the incident, and shall be held in a log on both the mining vessel and at the Consent Holder's head office for inspection by the EPA on request	
Removal of Material from the Seabed		
32.	The Consent Holder must not remove more than a maximum of [X] tonnes of seabed material from the defined mining "lanes" shown in Plan B, during any 12-month period of this marine consent. The Consent Holder must continuously record the volume of seabed material removed and report on this as part of the monthly Mining Report under [Condition 65]	This condition imposes a limit equivalent to the 15 mining blocks proposed to be mined in the first five years of the mining activity. The EPA staff suggest that if consent is granted, the conditions should include the requirement to provide a Mining Plan identifying the blocks to be mined for the first five years
33.	The Consent Holder must not mine deeper than 0.5 metres below the existing seabed when mining, as authorised by this marine consent. A report stating the average daily mining	This condition is to ensure that the amount of fine sediment entering the plume is not that different than what has been

	sediment depth must be provided to the EPA every six months from the start of mining	modelled by CRP
	On the discovery of any of the following, or other material not naturally found in the mining area, the Consent Holder must immediately stop mining activities authorised by this marine consent. a) steel b) brass c) other metals in solid state d) manufactured or worked timbers e) fossilised bones	
34.	The Consent Holder shall use trained DOC observers to monitor and report whether any of the above materials are discovered, and collect them. The Consent Holder, in conjunction with the trained DOC observer, must notify the EPA of the find and consult with Heritage New Zealand and iwi/imi representatives about confirming the origin of the find. Mining may not recommence until the EPA is satisfied that the finds are not part of a pre-1900 shipwreck, or significant to iwi/imi, or do not require preservation or recovery	The DMC may wish to identify relevant iwi/imi representatives if this condition was to be included on a marine consent approval
Deposition of Material on the Seabed		
35.	The Consent Holder must ensure that the "living" and non-living material mined under this marine consent into the water column and onto the seabed is discharged at no more than 1X metres above the mined seabed, within the block being mined by the mining vessel at the time. A diffuser or similar technology must be used at all times to reduce the velocity of the discharge. The Consent Holder must continuously record the depth at which tailings are	What is the best height above the seafloor to deposit material given the output of the two sediment models? Is it necessary to specify the velocity?

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	released and report on this in the monthly Mining Report required under [Condition 65]	
36.	CONDITION TO BE DEVELOPED A condition limiting or removing the cumulative effects of sedimentation on the proposed areas to be excluded from mining	The DMC may wish to consider whether conditions are required to reduce or remove the effect of sedimentation on the proposed areas to be excluded from mining activities
Discharges into the Water Column		
37.	The Consent Holder must ensure that all dissolved metal concentrations in the discharge from the mining vessel comply with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality guidelines (ANZECC) for the protection of 99% of species at the point of discharge	Condition included to provide a degree of certainty for managing adverse effects from potentially toxic elements present in the discharge of mine tailings. This condition is to ensure that best practice is employed to protect mesopelagic and benthic organisms from potentially toxic elements. The EPA staff propose that the discharges meet the relevant ANZECC water quality guidelines at the point of discharge. However, this condition only relates to dissolved metal concentrations, and therefore would not cover any potentially toxic levels of metals present in deposited particles
38.	The Consent Holder must not dispose of any chemicals or harmful substances at sea. Any hazardous waste and oily waste must be stored on board for transport in sealed and labelled containers or packaging to a shore-side reception facility, as per the Discharge Management Plan, and in accordance with the HSNO Act 1996 and the Maritime Transport Act 1994	
39.	Discharges to the sea of sediment from the mining vessel must not exceed a total combined mass flux of solids of [X tonnes/hour], with a maximum fines content (all seabed material finer than 90 microns) not exceeding [X tonnes/hour] and with a maximum ultra-fines content (all seabed material finer than 8 microns) not exceeding [X tonnes/hour].	This condition imposes a mass flux limit similar to that specified in the application and relied upon in the sediment model. The EPA staff consider that it would be useful to specify the time over which the measurement would be

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	Monitoring for compliance with these parameters must occur continuously at the point of discharge	averaged with reference to the sensitivity of key benthic species. Further information to inform this condition may be obtained from evidence and expert conferencing. The DMC may also wish to consider a limit on Particle Size Distribution, to keep it consistent with the sediment model, in conjunction with controls on mass flux
40.	Median values cited in [Condition 39] must be expressed on a three-month running average basis, derived from analysis of one representative daily composite sample, made up from eight sub-samples at three-hour intervals	
41.	The Consent Holder must monitor mass fluxes based on samples collected under [Condition 40] to record: a) the total run of mining material extracted b) the total mass of material discharged via the diffuser	
42.	The Consent Holder must avoid the uncontrolled loss or spillage of material (i.e. that is agitated or disturbed and is not subsequently extracted via the suction pipe) when operating any sub-sea equipment. The Consent Holder must ensure that sensors are present and operational on the mining extraction equipment to allow the operator to monitor compliance with [Condition 39] in real time and on an ongoing continuous manner	
43.	The results of continuous monitoring must be provided to the EPA in the monthly Mining Report with analysis of compliance with [Condition 65]	

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Generation of Noise from Vessels and Drag-head, Dredge Pump Unit and other Sub-sea Equipment		
44.	CONDITION TO BE DEVELOPED Operational noise limits for use of underwater equipment	It is recommended that the DMC consider appropriate limits for underwater noise, informed by any relevant expert advice
45.	In giving effect to this marine consent, the placement of only one drag-head, dredge-pump unit and diffuser unit on the seabed is provided for as part of the mining operations	This condition is to ensure that no more than one set of sub-sea equipment is in operation at any one time in different parts of the mining area. This should avoid the creation of two noise sources that would, otherwise, have affected marine mammals and fish in a wider area
Mining Vessel, Marine Mammals and Seabirds		
46.	At all times, the Consent Holder shall only operate one mining vessel in order to carry out mining operations in accordance with this consent	
47.	The Consent Holder must ensure that there are no floating ropes, lines or wires on the sea surface at any time associated with any vessel involved in giving effect to this marine consent	
48.	Prior to mining, including after the return of the mining vessel from port, the Consent Holder shall use trained DOC observers, in accordance with [Condition 51], to monitor a 500 m radius from the mining vessel for at least 30 minutes to ensure that there are no marine mammals within this radius. Mining operations shall not commence until a consecutive period of 30 minutes passes without having sighted any marine mammals. Records of observations must include, but not be limited to: a) date, time and location (in latitude/longitude) of all marine mammal sightings relative to the consented operation	CRP proposes monitoring of marine mammals in its application (Condition 10). The EPA staff note that this condition still requires additional wording to include the requirement to stop mining the mining (if the mining is already underway) if marine mammals enter the 500 m exclusion zone and if the noise levels are above the established safe threshold. The additional wording will also require consideration of the location of the drag-head relative to the mining vessel and the behavioural characteristics of

	b) number of marine mammal individuals and species associated with each sighting, including the number of marine mammal calves if present c) type of behaviour of marine mammals including, but not limited to, travelling, feeding, milling, swimming towards or away from the mining vessel, and any changes in behaviour d) marine mammal injuries or mortalities (including those attributable to the consented operation) e) any management responses in relation to disturbed, distressed or injured marine mammals f) name(s) of the observer(s) g) approximate size of each mammal h) interaction between the mammal and any equipment, vessels or other inanimate objects related to the Consent Holder giving effect to this marine consent. Records must be kept for each observation period prior to each soft start (of the mining equipment). Those records shall be made available to the EPA staff on request and provided in the monthly Mining Report required by [Condition 65] and the Marine Mammals Monitoring Report required by [Condition 62]	marine mammals (e.g. diving)
49.	The Consent Holder must ensure that the Marine Mammal Monitoring and Management Plan required by [Condition 19] provides methods to ensure that: a) masters of all vessels: i. reduce speed to no faster than the slowest marine mammal within 500 metres of the vessel in the marine consent area ii. take all practicable steps to avoid marine mammals in the marine consent area	

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	b) there are no collisions between any vessels associated with its operations and marine mammals	
50.	The Consent Holder must provide all employees, joint venture partners and contractors undertaking work at sea with a marine mammals species identification guide and shall prepare and implement a training package and programme (including assessment and certification) for staff and contractors to ensure the accurate identification and assessment of behaviour of marine mammal species to meet the obligations of [Condition 52] The Consent Holder must ensure: a) that observers that are trained in identification and behaviour of marine mammals by DOC, operational procedures and reporting are employed to monitor marine mammals on board any Consent Holder's mining vessel b) at least one assigned trained DOC observer is on active duty on the mining vessel engaged in works during daylight hours (including when travelling to and from the extraction area) c) trained DOC observers maintain regular checks for the presence of marine mammals around the operational area and report any marine mammal sightings d) trained DOC observers maintain a daily log of all marine mammal sightings and interactions, including those listed in [Conditions 48 and 50]	
51.		
52.	The Consent Holder must report, in writing, any effects, strikes, entanglements and any deaths of any marine mammals to the relevant government department (currently DOC) and the EPA within 24 hours, asking for advice. If an impact, strike or entanglement resulting in death involving a Hector's dolphin, the Consent Holder must, subject to the Consent Holder's obligations under the Marine Mammals Protection Act 1978:	

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	a) recover and freeze the carcass b) notify DOC, in writing, immediately and return the carcass to shore within 24 hours, for collection by DOC	
53.	The Consent Holder must report any sightings of a Hector's dolphin to the relevant government department (currently DOC) immediately by the fastest means of communication available and give details including location, time, weather conditions, and number and approximate size of individual dolphins <i>Advice note: The appropriate contact details for DOC are [no insert]</i>	
54.	At the beginning of each month and prior to the removal of seabed material, the Consent Holder must notify the EPA, Maritime New Zealand, local fishing operators (holding quota allocations for fisheries inside an area 2 km² from the boundaries of the area shown on [Plan A]), Ports of Lyttelton and Otago, and Land Information New Zealand, of the: a) coordinates of the area where seabed removal will occur b) VHF channel for communications c) dates of effect	This plan should show the mining areas and the permit boundary
55.	The Consent Holder must ensure that no unwanted or risk species, as identified by the relevant government department (currently Biosecurity New Zealand), are transported on any vessel or equipment associated with the exercise of this consent. The Consent Holder must provide a Biosecurity Management Plan as detailed in [Condition 20] to identify measures to ensure compliance	
56.	The Consent Holder must comply with the Requirements for Vessels Arriving in New Zealand 2010 administered by the relevant government department (currently the Ministry	This condition is to ensure that any potential biosecurity risk is addressed

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for Primary Industries)	
57. The Consent Holder must provide all employees and contractors undertaking work at sea with a seabird species identification guide and shall prepare and implement a training package and programme (including assessment and certification) for staff and contractors to ensure accurate identification and assessment of behaviour of seabird species to meet the obligations of [Conditions 58 - 60]	The EPA staff notes that the DMC may require CRP to have observers on board the mining vessel for specified periods to record and report the presence of seabirds. Alternatively, the DMC may wish to accept this condition as an alternative to having observers on board
58. The Consent Holder must maintain a log of all bird strikes on all mining vessels, at the time of the impact, including: a) date, time and weather conditions b) wind direction and approximate wind speed c) the real-time New Zealand Met Service forecast for the mining area and any forecast warning for the area d) the presence of precipitation, fog or any other weather-related impact on visibility e) a record of the bird species and the condition of the bird (mortality, released alive and unharmed, injured) This information must be provided electronically to the EPA and the relevant government department (currently DOC) within one week of the incident	
59. In the event that one of the following seabirds is injured in a deck strike the Consent Holder is to contact the relevant government department (currently DOC) immediately for advice, by the fastest means of communication possible: a) Chatham Islands taiko (Magenta petrel) (<i>Pterodroma magentae</i>) b) Chatham petrel (<i>Pterodroma axillaris</i>)	Given that almost every seabird is legally protected, the DMC may wish to amend this condition to include all seabirds

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60.	In the event that one of the following seabirds is killed in a deck strike, the Consent Holder is to inform immediately by the fastest means of communication possible and ensure that the bird carcass is returned to the relevant government department (currently DOC): a) Chatham Islands taiko (Magenta petrel) (<i>Pterodroma magentae</i>) b) Chatham petrel (<i>Pterodroma axillaris</i>)	Given that almost every seabird is legally protected, the DMC may wish to amend this condition to include all seabirds
61.	The Consent Holder must not operate in sea level conditions above the maximum identified by CRP (4 m) for safe operation of the mining vessel and deployment and operation of the sub-sea equipment	CRP's application states a maximum sea level of 4 m for undertaking safe operations
REPORTING		
62.	The Consent Holder must compile a report six months after the exercise of this consent, and thereafter every twelve months, detailing all marine mammal sightings from the previous six-month period. This must be provided to the EPA, the relevant government department (currently DOC), Ngāi Tahu and [any other relevant parties] electronically within four weeks after the end of each six-month reporting period. This report must include as a minimum: a) date and location of all marine mammal sightings relative to the consented operation b) number of individuals (including marine mammal calves) associated with each sighting c) behaviour of marine mammals including travelling, feeding, milling, swimming towards or away from the mining vessel, and any changes in behaviour d) any observed marine mammal injuries or mortalities within the marine consent area (including those attributable to the consented operation), as reported in [Conditions	Given Ngāi Tahu's Cultural Impact Assessment, the EPA staff suggest the inclusion of Ngāi Tahu in the list of people being supplied with information. The EPA staff also suggest a 12-month interval between the provision of reports

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	51 and 52 e) an assessment of the sightings data by a qualified marine mammal biologist approved by DOC and EPA, in particular assessment of the effect, if any, of the consented operation on the occurrence and behaviour of any marine mammals sighted	
63.	The Consent Holder must, within two weeks of the anniversary of the exercise of this marine consent, and for three consecutive years, commission an annual report that reviews data collected by the Consent Holder and any independent observers for the previous 12-month period on seabird mortality associated with bird strikes on all its vessels. The author(s) of the review shall be agreed with the EPA prior to its commencement	
64.	The Consent Holder must ensure that the relevant government department (currently DOC) is consulted as part of the process of the annual review as specified in [Condition 63] , and the Department's views, if provided, must be noted in the report. The author(s) of the report may recommend to the Consent Holder changes to operational management practices to reduce bird strikes. The report including the recommendations must be provided to the EPA within two weeks of completion, as well as any recommendations on changes to conditions relating to bird strike and/or the Vessel Lighting Mitigation and Management Plan, including the setting or revision of trigger indicators or values relating to seabirds.	
Monthly Mining Report		
65.	The Consent Holder must prepare a mining report at the end of each month of operation and provide this to the EPA electronically before the first Wednesday of the first week of each month during the mining activity. The mining report must include the following for the month prior to the operation: a) bathymetry of the seabed in the area where removal of seabed material has taken	The DMC may wish to include other matters as part of the Monthly Mining Report. These matters could include requirements to report on heavy metal levels, Total Suspended Solids (TSS), etc.

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	- place b) GPS positions of the sub-sea equipment and the four corners of each mining block and coordinates illustrated on a map c) GPS positions of the four corners of each mining block d) volume and rate of removed and deposited seabed material e) maximum and average depth of seabed removed by the sub-sea equipment throughout each mining "lane" f) average depth and GPS position of any unfilled pits remaining after completion of a mining "lane" g) Particle Size Distribution (PSD) of all seabed material discharged from the mining vessel h) location and height above the seabed of discharge "pipes" whilst discharging seabed material i) any other components required by conditions of this marine consent	
REVIEW CONDITIONS AND ADAPTIVE MANAGEMENT		
66.	CONDITION TO BE DEVELOPED Review condition as per section 76 of the EEZ Act	Review conditions will be required if consent is granted. CRP proposed an initial review after two years, followed by a five-yearly review. If they are minded to grant, the DMC may wish to consider a shorter review period tied into the completion of pre-operational monitoring, and preparation of the EMMP
67.	CONDITION TO BE DEVELOPED	CRP proposes an adaptive management regime predicated

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	Adaptive management approach as per section 64 of the EEZ Act	on completion of five years of mining within MP55549 and expansion of the mining operation into PP55971 (CRP proposed Conditions 13 - 15). If they are minded to grant consent, the DMC may wish to adopt CRP's proposal. In doing so, activities in the first five years would not be subject to an adaptive management approach
68.	CONDITION TO BE DEVELOPED A condition setting triggers and responses to allow for adaptive management of the operation if adverse effects of seabirds eventuate. The trigger should be measurable, such as the number of deck strikes above which operational responses are required, and should be set separately for threatened or endangered seabirds, migratory seabirds and non-threatened seabirds	If the DMC is minded to grant consent, the wording of this condition would need finalising, including identification of the species and trigger levels. The EPA staff notes that the Board of Inquiry decision for the Hauauru ma Raki windfarm application proposed an adaptive management approach for bird strike associated with wind turbines
69.	CONDITION TO BE DEVELOPED A condition requiring changes to the mining operation within the first five years if actual sedimentation effects are greater than predicted by the sedimentation model, with particular focus on Total Suspended Solids (TSS), and requiring changes to the technology or methodology to reduce TSS and return the actual effects to within the range of the predicted effects. The condition would require a timeframe within which the adaptation must occur, and identify appropriate trigger levels	CRP's adaptive management approach does not focus on the 820km² area of MP55549. If they are minded to grant consent, the DMC may wish to consider imposition of adaptive management conditions for mining within MP55549 with particular focus on TSS and Mass Flux
70.	CONDITION TO BE DEVELOPED Include a mechanism for additional spatial or temporal restrictions (or other mitigation) if future research indicates that the marine consent area is an important spawning area for species other than those already identified (e.g. ling, hoki)	The DMC may wish to consider an adaptive management condition focused on fisheries stocks. This condition could be incorporated into a review condition

PUBLIC LIABILITY INSURANCE

71.	The Consent Holder must ensure that it maintains insurance in respect of its potential liability for loss or damage while giving effect to this marine consent, including but not limited to public liability insurance for a sum not less than X, e.g. NZ\$100,000,000 (2014 dollar value)]³⁴⁶ for any one claim or series of claims arising from giving effect to this marine consent At a minimum, the public liability insurance must cover all costs of environmental restoration required as a result of an unplanned event occurring during the exercise of this consent	The amount of insurance required is a matter for the DMC to consider, considering that the current insurance requirement for oil spills is \$26M (although that will be increased to \$100M)
72.	The Consent Holder must submit a certificate demonstrating that it holds the insurance required by Condition 77 prior to giving effect to this consent and provide an updated certificate annually by 1 July of each year to the EPA for the term of this marine consent	

³⁴⁶ The CRA6 Rock Lobster Industry Association seeks \$100M whilst the PauaMAC4 Industry Association submitters request \$200M. Neither of these submitters provides a rationale for their suggested figure

Glossary

In this report, terms have the meanings given to them in the EEZ Act or EEZ Regulations made under that Act, unless specified below.

ADCP – Acoustic Doppler Current Profiler is a hydroacoustic current meter that measures water current velocities over a depth range.

Acute effects – describe the adverse effects of a substance that result either from a single exposure or from multiple exposures in a short space of time.

Anoxic – a total depletion in oxygen concentration.

ANZECC guidelines – Australian and New Zealand Environment and Conservation Council Guidelines for Fresh and Marine Water Quality.

Archaea – single-celled organism that is classified as a separate group of prokaryotes and is more ancient than bacteria.

Benthic – the environment on the seabed.

Biogeochemistry – the study of the cycles of chemical elements, such as carbon and nitrogen, and their interactions with other substances and organisms as they move through the Earth's atmosphere, water bodies, living organisms, and rock.

Cephalopods – any member of the molluscan class Cephalopoda including squid, octopus and cuttlefish.

Chronic effects – permanent effects that have developed slowly after to long-term and continuous exposure.

Demersal – the zone of the water column that is closest to the seabed.

Endemism – is an ecological term that means a plant or an animal that is confined to living in a particular area. If an organism is endemic to New Zealand, this means that it does not occur anywhere else.

Epifauna – organisms that live on the seabed.

Genotoxic – elements that have the potential to damage the genetic information within a cell by causing mutations, which may lead to cancer.

Gravel – means discharged sediment > 2 mm.

Infauna – organisms that live within the seabed.

Isotope – variant of a particular chemical element (e.g. uranium-238 and uranium-234) carrying different number of neutrons.

Macronutrient – the chemical elements that organisms consume in the largest quantities such as nitrogen (often in the form of nitrate), silicon (often in the form of silicate) and phosphorous (often in the form of phosphate).

Mesopelagic – the part of the water column in the ocean that lies between 200 – 1000 m.

Mesoscale eddy – an eddy represents the swirling of a fluid and the reverse current created when the fluid flows past an obstacle. Mesoscale eddies are between 10 – 500 km in diameter and can persist for periods of days to months.

Microzooplankton – a size class of zooplankton between 20 – 200 micrometres (µm).

Motile – the ability to move spontaneously and actively (e.g. a fish is a motile animal).

Mud – means discharged sediment < 63 micrometres (µm).

Pelagic – water that is not close to the shore or the bottom of the ocean (usually in the depth range 0 – 1000 m). Fish that live in the water column in the open ocean are often referred to as pelagic.

Phototrophic prokaryotes – bacteria or archaea that obtain energy from light.

Phytoplankton – microscopic organisms that inhabit the upper layer of the oceans and bodies of freshwater. These organisms obtain their energy from sunlight.

Prokaryote – single-celled organism (e.g. bacteria, archaea) that lack a membrane-bound nucleus, mitochondria, or any other membrane-bound organelles.

PSD – Particle Size Distribution.

ROV – Remotely Operated Vehicles. ROV are remotely operated underwater vehicles that can be used to film the seabed and carry out maintenance activities in the offshore energy industries.

Sand – discharged sediment between 63 micrometres (µm) and 2 mm.

SAW – Sub-Antarctic Water, which is the body of water that extends from the Chatham Rise towards the Antarctic circle where it converges with Antarctic Water (see Figure 31 of CRP's application).

Sessile – means fixed in one place. A sessile organism, such as a coral, is attached directly to another surface and is incapable of moving.

STF – Subtropical Front. This is a zone of water where Sub-Antarctic Water and Sub-Tropical Water converge. A part of this convergence zone runs over the Chatham Rise (see Figure 31 of CRP's application).

STW – Sub-Tropical Water is the body of water that extends from beyond the North of New Zealand and converges with Sub-Antarctic Water to the west, south and east of New Zealand (see Figure 31 of CRP's application).

Seamount – a mountain that rises from the ocean floor.

Sensitive environment – in relation to the Exclusive Economic Zone or Continental Shelf, an area that contains any of the habitats listed in the first column of Schedule 6 of the Exclusive Economic Zone and Continental Shelf (Environmental Effects – Permitted Activities) Regulations 2013.

Taxon – a group of one or more populations of an organism or organisms that forms a taxonomic unit.

Trace elements – elements that are required by organisms in small amounts but are often critical to metabolic functions such as iron, copper, iodine, selenium, zinc and molybdenum.

TSS – Total Suspended Solids, which is a measure of the total mass of solids in a given volume of water.

Turbidity logger – an instrument that measures the relative clarity of a liquid. It can be used to measure how much material (e.g. sediment) is suspended in water.

Water quality elutriation test – a test designed to measure the concentration of potentially toxic elements in sediment through their extraction into non-contaminated water.

Zooplankton – plankton consisting of small animals or the early life stages of some species (e.g. juveniles of many fish species), some of which migrate through the water column on a daily basis down to depths > 300 m. Zooplankton obtain their food by eating other organisms, including phytoplankton.