

Application Ref:EEZ000006

DECISION ON MARINE CONSENT APPLICATION

Chatham Rock Phosphate Limited

To mine phosphorite nodules on the Chatham Rise



1

EXCLUSIVE ECONOMIC ZONE AND CONTINENTAL SHELF (ENVIRONMENTAL EFFECTS) ACT 2012

Decision on marine consent application by Chatham Rock Phosphate Limited to mine phosphorite nodules on the Chatham Rise

Application	To mine phosphorite nodules on the Chatham Rise at depths from 250 m to 450 m in a			
	10,192 km ² area located over 400 km east of Christchurch. For the first five years mining			
	would be restricted to 820 km ² , with the operation extending to the wider marine consent			
	area depending on the presence of other economic concentrations of phosphorite nodules			
	and the securing of the requisite further mining permits. After the application was lodged, the			
	proposed mining area was reduced by the applicant to 5,207 km ² , by removal of the eastern			
	block from the marine consent application.			
	The applicant proposed to mine 30 km ² of seabed per year (ie three mining blocks			
	approximately 2 km wide and 5 km long) to achieve an annual minimum production target of			
	1.5 million tonnes of phosphorite nodules. In the initial 15 years it was anticipated that an			
	area of 450 km ² would be mined. Over 35 years a total mined area of approximately 1,050			
	km ² was envisaged. The phosphorite nodules would be mined using a conventional trailing			
	suction hopper dredger or drag-head and separated from the other seabed material on board			
	a vessel, with waste tailings being discharged using a sinker pipe with a diffuser 10 m above			
	the seafloor.			
	More specifically, the application sought approval for the following activities:			
	• the construction, placement, alternation, extension, removal, or demolition of a			
	structure on or under the seabed (Section 20(2)(a));			
	• the removal of non-living natural material from the seabed or subsoil (Section			
	20(2)(d));			
	• the disturbance of the seabed or subsoil in a manner that is likely to have an adverse			
	effect on the seabed or subsoil (Section 20(2)(e));			
	• the deposit of any thing or organism in, on, or under the seabed (Section 20(2)(f));			
	• 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 (Section 20(2)(g));			
	• specified activities in the waters of the EEZ, including activities related to structures,			
	causing of vibrations and causing of explosions (Section 20(3) and (4)).			

Decision Summary

 Pursuant to Section 62(1)(b) of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (the EEZ Act), the application by Chatham Rock Phosphate Ltd (CRP) for a marine consent is refused.

The application

- ii. On 14 May 2014 CRP lodged an application with the Environment Protection Authority (EPA) for a marine consent to mine phosphorite nodules from the crest of the Chatham Rise.
- iii. Initially consent was sought for a 35 year operation over an area of 10,192 km². On 1 August 2014 the area for which consent was sought was reduced to 5,207 km² by the withdrawal of the application's eastern mining block. CRP proposed to undertake the mining in stages, restricting the first five years of the operation to the 820 km² mining permit area (MPL 55549). Over the full 35 year period for which consent was sought, a total of some 1,050 km² was to be mined.
- iv. Details of the specific activities for which a marine consent was sought are given in Chapter 2 of this decision.
- v. The mining was to be carried out by a specially built or modified vessel using a mining system designed by Royal Boskalis Westminster nv (Boskalis). Phosphorite-bearing material was to be retrieved from the seabed by means of a trailing suction drag-head and mechanically processed on board the vessel. Phosphorite nodules greater than 2 mm would be separated from other material using sieves and logwashers and stored on the vessel. Waste material would then be released close to the seabed, using a discharge (sinker) pipe with a diffuser.
- vi. CRP proposed to mine three of its 10 km² mining blocks each year, giving an estimated annual production of some 1.5 million tonnes. The mining would be at depths of up to 450 m.
- vii. The applicant's outline mining plan included provision for establishing mining exclusion areas aimed at protecting areas of particular scientific or conservation sensitivity and values as identified through a marine spatial planning exercise. The applicant stated that it intended to undertake a range of monitoring and environmental surveys, including seabed sampling and habitat creation trials. It also

proposed to set up an Environmental Trust Fund, an Environmental Reference Group and a Chatham Islands Trust. It submitted in support of its application an Environmental Impact Plan, a draft Environmental Management and Monitoring Plan and a proposed set of conditions for the mining operation.

The Process

- viii. The application was heard and determined by a Decision Making Committee (DMC) appointed by the EPA under Schedule 5 of the Crown Entities Act 2004. A detailed procedural history of the application is given in Appendix 1 to this report.
- ix. Chapters 13, 14 and 15 explain how, in reaching its decision, the DMC applied the information principles of the EEZ Act and took into account the matters specified in Sections 59 and 60 of the EEZ Act.

Effects on the environment and existing interests

- x. As required by the EEZ Act, the DMC took into account the effects of the proposal on the environment, including the significant and permanent adverse effects on the benthic environment of the Chatham Rise. The DMC also took into account the effects of the return of waste material to the seabed following processing aboard the vessel. Other risks to the environment considered by the DMC included: effects on the trophic web (including primary production, microbes and zooplankton), fish and other pelagic fauna, rock lobsters, paua, water quality and seabirds; the effects of miningrelated noise, including on marine mammals; and the risks to biosecurity and human health.
- xi. Existing interests considered by the DMC were: interests arising from Treaty of Waitangi settlements; commercial fishing; marine eco-tourism; customary fishing; and other vessels traversing the area. Consideration was also given to the effects of the proposal on other marine management regimes, including the Mid Chatham Rise Benthic Protection Area.
- xii. Under Section 59(2)(m) of the EEZ Act, the DMC gave consideration to the interests of Chatham Islanders and to the effects of the proposal on Māori and Moriori cultural interests.

Decision

- xiii. The destructive impact of the drag-head on the seabed and on the benthic fauna in and on the seabed was a major concern, given that:
 - (a) these effects could not be avoided, remedied or mitigated
 - (b) the mining would largely be occurring in an area where the seabed is currently protected from trawling and dredging by the Mid Chatham Rise Benthic Protection Area
 - (c) the effects would include the destruction of communities dominated by protected stony corals which are potentially unique to the Chatham Rise and which the DMC concluded are rare and vulnerable ecosystems
 - (d) the habitat would not return to its present form but rather would be transformed wholly into soft sediment habitat.
- xiv. Moreover, the return of waste material to the seabed stood to have adverse effects on the benthic habitat in and around the mining blocks and across the wider marine environment.
- xv. Notwithstanding the efforts of the applicant to research, document and substantiate its case, the DMC was left with a lack of certainty about both the receiving environment and the adverse effects of the project on that environment and existing interests. Partly this is explained by the current state of scientific knowledge about the Chatham Rise marine environment, albeit well researched in some dimensions. But there were other uncertainties stemming from the fact that this would be the first seabed mining project ever undertaken at such depths anywhere in the world, and from the heavy reliance placed on insufficiently validated modelling to predict the impacts of the project.
- xvi. The DMC gave consideration to the likely economic benefit to New Zealand of the proposal. It was not persuaded that the proposal's economic benefit to New Zealand would be of the significance argued by the applicant, or that reliance could be placed on economic benefits as a potential offsetting factor.
- xvii. The DMC gave careful consideration to whether an adaptive management approach would allow the activity to be undertaken. It also, as required by Section 59(2)(j) of the EEZ Act, considered the

extent to which imposing conditions under Section 63 of the EEZ Act might avoid, remedy or mitigate the adverse effects of the activity.

xviii. The DMC's finding is that the destructive effects of the extractive activity, coupled with the potentially significant impact of the deposition of sediment on the areas adjacent to the mining blocks and on the wider marine environment, could not be mitigated by any set of conditions or adaptive management regime that might reasonably be imposed. The conditions proposed by the applicant, although they went some way towards addressing some of the risks associated with the proposal, did not allay the DMC's basic concern about the adverse effects of the proposal on a distinctive and important marine environment. The various proposals made by the applicant for environmental compensation did not in the DMC's view amount to mitigation. After weighing all the information and evidence, and taking into account the matters listed in Section 59 of the EEZ Act, the DMC concluded that the application could not be approved either in part or in whole. The DMC's decision therefore is to refuse consent.

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1. Abbreviations and Acronyms

1. The abbreviations and acronyms are:

ANZECC	Australian and New Zealand Environment and Conservation Council
	Water Quality Guidelines 2000
AUV	Autonomous underwater vehicle
Boskalis	Royal Boskalis Westminster nv
BPA	Benthic Protection Area
CBD	United Nations Convention on Biological Diversity
CGE	Computable General Equilibrium
CRMS	Craft Risk Management Standard
CRP	Chatham Rock Phosphate Limited (also known as "the applicant")
DMC	Decision Making Committee
DOC	Department of Conservation
DSCC	Deep Sea Conservation Coalition
EDS	Environmental Defence Society
EEZ Act or the Act	Exclusive Economic Zone and Continental Shelf (Environmental
	Effects) Act 2012
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EPA	Environmental Protection Authority
FAO	United Nations Food and Agriculture Organisation
FIR	Further information request
Greenpeace	Greenpeace New Zealand
HSE Act	Health and Safety in Employment Act 1992
IUCN	International Union for the Conservation of Nature
KASM	Kiwis Against Seabed Mining
London Convention	Convention on the Prevention of Marine Pollution by Dumping of
	Wastes and Other Matter 1972 and its 1996 Protocol
MSC	Marine Stewardship Council
MarLin	Marine Life Network
MARPOL	International Convention for the Prevention of Pollution from Ships
	1973, as modified by the Protocol of 1978.
MEC	Marine Environmental Classification
MPL	Marine Prospecting Licence

MPUC	Maximum permissible uranium concentration
MTA	Maritime Transport Act 1994
NIWA	National Institute of Water and Atmospheric Research
Noumea Convention	Noumea Convention for the Protection of the Natural Resources and
	Environment of the South Pacific Region
NZAX	New Zealand's Alternative Share market
NZCPS	New Zealand Coastal Policy Statement
NZIER	New Zealand Institute of Economic Research
NZPAM	New Zealand Petroleum and Minerals
PP	Prospecting Permit
QMA	Quota management area
QMS	Quota management system
RMA	Resource Management Act 1991
SSC	Suspended sediment concentration
SST	Sea surface temperature
STF	Sub tropical front
TSS	Total suspended sediment concentration
The Regulations	The Fisheries (Benthic Protection Areas) Regulations 2007

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2. Introduction and Background

2.1. EPA / DMC roles and responsibilities

- One of the functions of the Environmental Protection Authority (EPA) pursuant to Section 13(1) of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 (the EEZ Act or the Act) is to decide marine consent applications.
- The EPA has the ability to delegate its power to decide an application for marine consent to a committee appointed under clause 14 of Schedule 5 of the Crown Entities Act 2004 (Section 16(a) of the EEZ Act).
- 4. On 16 May 2014, the EPA Board appointed a Decision Making Committee (DMC) under clause 14 of Schedule 5 of the Crown Entities Act 2004 to hear Chatham Rock Phosphate Limited's (CRP) marine consent application, and delegated to it the powers and functions of the EPA relating to the processing, hearing and deciding of a marine consent application under the EEZ Act. The DMC comprised Mr Neil Walter (Chair), Dr Nicola Crauford (EPA Board Member), Mr David Hill, Mr Lennie Johns and Dr Greg Ryder.
- 5. In considering and deciding on this marine consent application, the DMC has acted independently from the EPA.

2.2. The applicant

- CRP was incorporated in April 2004 as WPL (Newco) Limited, a wholly owned subsidiary of Widespread Portfolios. In May 2006 its name was changed to Widespread Energy Limited, and in April 2011 it became Chatham Rock Phosphate Limited.
- CRP is listed on New Zealand's alternative share market (NZAX). As at March 2014 it had a market capitalisation of approximately NZ\$ 41.8 million, assets of approximately NZ\$ 22.4 million and some 665 shareholders in total.
- 8. In addition to being a CRP shareholder (through Boskalis Offshore nv), Royal Boskalis Westminster nv (Boskalis) was responsible for undertaking the design engineering, logistics studies and preliminary design work, including consideration of methods to minimise potential environmental impacts, for the mining proposal. CRP's expectation was that Boskalis would manage the mining vessel and related mining operations.¹

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¹ Section 3.3.2, Marine Consent Application and EIA, May 2014

2.3. The application

9. On 14 May 2014, the applicant lodged an application with the EPA for a marine consent to conduct a seabed mining operation on the Chatham Rise over a term of 35 years. The applicant proposed to mine phosphorite nodules at depths from 250 to 450 m in a 10,192 km² area located over 400km east of Christchurch (*Figure 1*).



Figure 1. Chatham Rise and CRP's marine consent application area as at May 2014. (Source: Figure 1 of the EIA, May 2014)

10. For the first five years mining would be restricted to the 820 km² area for which a mining permit (MPL 55549) was already held by CRP. This area is located at the western end of the area covered by marine prospecting licence MPL 50270 granted to CRP in 2010 (*Figure 2*).



Figure 2. CRP's original proposed marine consent area (10,192 km²), including mining permit area MP 55549, the revised continental shelf license area MPL 50270 for prospecting and the prospecting permit area PP 55971 for which it has recently applied. The original proposed mining exclusion areas are shown in blue. Prospecting permit area PP 55967 on the eastern end of this map is no longer a part of the marine consent area. (Source: Figure 18 of the EIA, May 2014)

11. Prospecting licence MPL 50270 covered an area of 5,207 km². In November 2013, CRP lodged applications with New Zealand Petroleum and Minerals (NZPAM) for two additional prospecting permit areas to the west and east of MPL 50270. CRP offered to relinquish 1,019 km² of MPL 50270 as part of this application. Those prospecting licence applications had not been determined by the completion of this decision.

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- 12. Although initially the mining would take place within the area covered by mining permit MPL 55549, in the future the operation could extend to the wider marine consent area depending on the presence of other economic concentrations of phosphorite nodules and the securing of the requisite further mining permits.
- 13. On 1 August 2014, the applicant informed the EPA of its decision, in light of the work it had undertaken and in response to the issues raised by a number of parties, to remove the eastern mining block (PP 55967) from its marine consent application. This left a revised marine consent area of 5,207 km².
- 14. The Deepwater Group sought to have the application re-notified on the basis of the reduced marine consent application. The DMC considered this unnecessary, and its decision is recorded in Minute 7 of 22 August 2014.
- 15. The applicant proposed to mine 30 km² of seabed per year (ie three mining blocks approximately 2 km wide and 5 km long) to achieve an annual minimum production target of 1.5 million tonnes of phosphorite nodules. In the initial 15 years it was anticipated that an area of 450 km² would be mined. Over 35 years a total mined area of approximately 1,050 km² was envisaged.
- 16. The applicant's Environmental Impact Assessment (EIA) stated that, if mining did extend to new areas within the marine consent area, there would be no change to the mining operations in terms of the production target, the areas of seabed directly affected and the fundamentals of the mining operation.
- 17. The proposed mining operation is described in Chapter 5 of this report. It involved building or modifying a vessel to meet the specific requirements of this proposal, using a conventional trailing suction hopper dredger or drag-head. The mined material would be pumped through flexible hoses to the mining vessel, where phosphorite nodules would be separated from other seabed material using sieves and log-washers. The remaining material would be released back into the water just above the seabed through a sinker and diffuser hose. When the vessel's holds were full, the mining vessel would proceed to a port where the phosphorite would be unloaded, stored and distributed to the market.
- 18. The applicant proposed to undertake various surveying and monitoring activities, including seabed surveying and sampling. It also intended to undertake a hard substrate trial aimed at the re-establishment of benthic communities.

2.4. Activities requiring approval

19. The applicant sought marine consent for the following activities under the EEZ Act:

Section of the Act	EEZ Act Provision	Description of the Activity
20(2)(a)	The construction, placement, alternation, extension, removal, or demolition of a structure on or under the seabed.	Monitoring equipment consisting of no more than four mooring landers, would be placed, relocated on the seabed and eventually removed.
20(2)(d)	The removal of non-living natural material from the seabed or subsoil.	Phosphorite nodules, a non-living material, would be removed from the seabed and subsoil. In addition, as part of the environmental monitoring programme, seabed samples, including non-living material, would be collected and removed from the seabed and subsoil.
20(2)(e)	The disturbance of the seabed or subsoil in a manner that is likely to have an adverse effect on the seabed or subsoil.	Mining would disturb the seabed and subsoil. In addition, the collection of seabed samples would also disturb the seabed and subsoil.
20(2)(f)	The deposit of any thing or organism in, on, or under the seabed.	Non-phosphorite material, following processing on the mining vessel, would be returned / deposited on the seabed. Note: This material is also defined as a harmful substance, being a mining discharge from a ship. In addition, hard substrate is to be placed on the seabed initially as part of the proposed recolonisation trials, and if successful then possibly as part of subsequent habitat creation.

Section of the Act	EEZ Act Provision	Description of the Activity
20(2)(g)	The destruction, damage, or disturbance of the seabed or subsoil in a manner that is likely to have an adverse effect on marine species or their habitat.	The seabed and subsoil, and associated marine species and habitats, would be disturbed, if not damaged, as a result of the mining proposal. In addition, the collection of seabed samples would also disturb the seabed and subsoil and associated marine species and habitats, although the application considers impacts of this activity are minor.
20(3) and (4)	Specified activities in the waters of the EEZ, including activities related to structures, causing of vibrations and causing of explosions.	Section 20(4)(b) is potentially applicable in relation to noise. The applicant states that CRP's mining proposal is unlikely to cause vibrations that adversely affect marine life.

- 20. Under Section 36 of the EEZ Act, the applicant's proposed activities are discretionary activities because they are not classified in regulations made under the EEZ Act.
- 21. The applicant also described the proposed release of non-phosphorite material to the seabed (after processing) as a discharge to which Section 20C would apply when it comes into force. As Section 20C is not yet in force, a consent can neither be sought nor granted under that provision. The release of waste material is, however, an integral part of the proposal. To the extent that the material deposits on the seabed, that deposition is an activity regulated under Section 20(2)(f). To the extent that the material is released into, and may remain for some time within, the water column, that is plainly an inevitable effect of the proposal, and requires to be considered along with all other effects of the proposal, irrespective of whether 'discharges' are yet an activity expressly regulated by the Act.
- Further, as Ms Taylor (planner for the applicant) acknowledged,² there were two activities forming part of the proposal that might require consents that the applicant had not yet sought. They were specifically:

² Line 32, page 2373 of the Transcript, 18 November 2014

- a) CRP's application did not specify that consent was being sought for multibeam mapping, which may be an activity for which consent would be required under Sections 20(3) and (4)(b) due to its vibration effects
- b) CRP's application was expressly limited to the placement of no more than four mooring landers on the seabed, which is a limit the applicant might have wished to exceed as part of its proposed monitoring activity.
- 23. The DMC has proceeded on the basis that the applicant could not enlarge the scope of its application and that if these elements of the proposal required marine consent then appropriate applications would need to be lodged.

2.5. Other activities

- 24. The EIA identified other components of CRP's proposed mining proposal as being:³
 - operations at a port facility, namely the unloading, storage and dispatch of the mined material
 - mining support activities including environmental monitoring and medical evacuation support facilities, potentially based on the Chatham Islands
 - on-going research and investigations for both prospecting and mining components of the proposal, to assess resource distribution and benthic habitats for the purposes of future mine planning, survey work to identify optimal mining locations and review the areas that have been mined and environmental research and monitoring
 - on-going consultation with interested parties to keep them informed about CRP's operations and as part of CRP's commitment to continue to listen to and resolve issues or ideas raised by these parties.

2.6. Process

- 25. A full procedural history of the application is contained in Appendix 1. The following is a brief summary.
- 26. The application was lodged on 14 May 2014 and assessed by the EPA for completeness under Sections 38 and 39 of the Act. It was not returned as incomplete by 28 May 2014.
- 27. The EPA and the DMC requested the applicant to provide a number of items of further information. Responses to all requests were given by the applicant by 2 September 2014.

³ Section 3.3.4, Marine Consent Application and EIA, May 2014

- 28. The application was publicly notified on 12 June 2014, and the submission period ran from 12 June 2014 until 10 July 2014. In all, 294 submissions were received.
- 35 statements or supplementary statements of evidence were filed by the applicant, and 39 by submitters. A pre-hearing meeting on existing interests and twelve expert conferencing meetings were held.
- 30. The hearing ran for 26 sitting days, starting on 25 September 2014 and adjourning on 19 November 2014. Sessions were held in Wellington, the Chatham Islands and Hamilton. The hearing formally closed on 12 December 2014.
- 31. The DMC completed its deliberations and issued this decision on 10 February 2015.

2.7. Acknowledgements

- 32. The EEZ Act sets a demanding timeframe for decision-making on marine consent applications.
 This was the view of a number of legal counsel, submitters and experts as well as the DMC.
 Given the scale and complexity of this particular application, the timeframe has been a constant source of challenge.
- 33. The DMC endeavoured at every point to ensure not only that all participants were treated fairly but that they were given every opportunity to prepare and present a considered view on the matters the DMC needed to determine. Much of the material presented in evidence was highly technical and complex in nature, and the task for participants in reading and responding to that material has been difficult.
- 34. The DMC is grateful for the considerable efforts made by the applicant, witnesses and submitters to respond constructively to the challenges presented by the process. It wishes particularly to record its appreciation of the work done by the experts who met in the various expert conferencing sessions. Their professionalism and constructive approach helped greatly in identifying and narrowing the issues.
- 35. The DMC held a one-day hearing in the Chatham Islands and a two-day hearing in Hamilton. The DMC wishes to acknowledge the warmth with which the Chatham Islanders received it, and the efforts made by individual and group submitters both there and in Hamilton to review the material relating to the application and present their views on it.

- 36. The DMC also wishes to record its appreciation to counsel representing the various parties for the positive way they went about the task of questioning experts and assisting it to clarify matters arising from the large amount of information and evidence placed before it.
- 37. Finally, the DMC wishes to record its appreciation of the excellent support received from staff involved in the management of the hearing. They showed commendable efficiency throughout a lengthy and challenging exercise.

3. The Legislative Framework

3.1. Introduction

38. This chapter outlines the legislative framework within which the application has been considered.

3.2. Purpose of the EEZ Act

- 39. The purpose of the EEZ Act is stated in Section 10(1) as "to promote the sustainable management of the natural resources of the exclusive economic zone and continental shelf."
- 40. The term "natural resources" means, "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, in relation to the continental shelf, means the mineral and other non-living resources of the seabed and subsoil and sedentary species." ⁴
- 41. Many parties to the application referred the DMC to Section 10(2) of the EEZ Act which sets out the definition of "sustainable management"⁵ as "managing the use, development and protection of natural resources in a way, or at a rate, that enables people to provide for their economic wellbeing while—
 - (a) sustaining the potential of natural resources (excluding minerals) to meet the reasonable 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.
- 42. Section 10(3) provides that in order to achieve the purpose of the EEZ Act, decision-makers must take into account the decision-making criteria specified in relation to particular decisions (in this case, Section 59) and apply the information principles set out in Section 61 to the consideration of marine consent applications.
- 43. In the course of the hearing differences of opinion emerged as to precisely how the provisions of Section 10(2)(a), (b) and (c) of the EEZ Act should be interpreted in the context of this application.

⁴ See definition of "natural resources", Section 4 of the EEZ Act

⁵ For example, Paragraph 33, Opening Submissions for CRP, 25 September 2014; paragraph 20, Opening Representation of Te Rūnanga o Ngāi Tahu, 25 September 2014; paragraph 14, Legal Submissions on behalf of the Royal Forest and Bird Protection Society of New Zealand Incorporated, 26 September 2014 (document states 27 September 2014); paragraph 6, Opening Submissions of Counsel for EDS, 26 September 2014

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- 44. Mr Enright (EDS) submitted that because the purpose of the EEZ Act was essentially the same as that of the RMA, RMA jurisprudence should be highly persuasive,⁶ and particularly therefore the Supreme Court's decision in EDS v NZ King Salmon Ltd⁷. In that case, the Court had found that the word "*while*" means "*at the same time as*", and Mr Enright submitted that therefore the same 3 sub-paragraphs that are copied into the EEZ Act should be read as bottom lines that "*must be observed*" as the Court had determined.⁸
- 45. Mr Enright also urged the DMC to accept the Court's finding in that case that environmental protection was a core element of sustainable management.⁹
- 46. In reply, Mr Winchester disagreed with Mr Enright's analysis and repeated his opening argument that the sustainable management purpose envisaged a balancing exercise whereby provision for economic development is balanced against environmental considerations, rather than setting sub-paragraphs (a) (c) as environmental bottom lines that must be met.¹⁰ He submitted that a proper and more plausible reading of the Court's decision was that neither the sub-paragraphs nor the preceding part of the definition prevailed but that they should be read as an integrated whole as should the purpose. He argued that fundamentally the EEZ Act was a *"resource and economic development statute"* rather than an environmental protection statute.¹¹ Furthermore, he suggested that while the decision-making criteria referred to in Section 10(3) must be taken into account and applied, they did not encapsulate the purpose.¹²
- 47. The DMC was referred to the then Minister for the Environment's third reading speech in which she said¹³ "... we saw merit in aligning the purpose of the exclusive economic zone bill more closely with that of the Resource Management Act by incorporating explicit reference to "sustainable management".

In making this change, I reflected in particular on the use of the word "balance". Although balance is an easily understood expression conversationally, as a legislative provision of such import, however, I saw it as less than ideal. The use of "sustainable management" relating to the use and development of our resources, in conjunction with the detailed information principles within the bill, is designed to provide for fundamentally the same process but directed through better-understood legal mechanisms. Certainty of how the purpose will be interpreted was a key issue for industry and NGOs alike, which were concerned that the balancing purpose

⁶ Lines 21-29, page 173 of the Transcript, 26 September 2014

⁷ Environmental Defence Society Inc v New Zealand King Salmon Company Ltd (2014) NZSC 38

⁸ Lines 28-32, page 174 of the Transcript, 26 September 2014

⁹ Lines 39-40, page 174 of the Transcript, 26 September 2014

¹⁰ Paragraphs 46-52, Closing Submission of CRP, 19 November 2014

¹¹ Paragraph 55, Closing Submission for CRP, 19 November 2014

¹² Paragraph 57, Closing Submission for CRP, 19 November 2014

¹³ Adams, Amy: Exclusive Economic Zone and Continental Shelf (Environmental Effects) Bill — Third Reading [Sitting date: 28 August 2012. Volume:683;Page:4779.]

considered at the select committee could result in extensive litigation to clarify its interpretation. The concept of sustainable management, on the other hand is well defined in domestic legislation, through more than 20 years of resource management case law.... This bill will help us unlock the enormous economic potential that lies in our oceans in an environmentally responsible way that supports our clean, green reputation."

48. From the above, the DMC concludes that the Minister was reflecting a position somewhere between the approaches of Mr Winchester and Mr Enright. As the words of the Minister imply, the intention was that the EEZ's economic resource be unlocked "*in an environmentally responsible way that supports our clean, green reputation*".

3.3. Restricted activities

49. Section 20 of the EEZ Act lists the activities that may not be undertaken in the exclusive economic zone or in and on the continental shelf without a marine consent. There are some exceptions to Section 20, however, such as where regulations have been brought into force that prescribe one or more of those activities to be permitted or prohibited. In the absence of regulations classifying an activity that is listed in Section 20, the activity would be a "discretionary activity" and a person must have a marine consent before undertaking that activity. Activities listed in Section 20 include: the removal of non-living natural material from the seabed or subsoil; the disturbance of the seabed or subsoil in a manner likely to have an adverse effect on the seabed or subsoil; the deposit of any thing or organism in, on or under the seabed; and the destruction, damage or disturbance of the in habitat.

3.4. Decision-making criteria

50. Section 59 of the EEZ Act spells out the criteria to be observed in considering an application for a marine consent. There are several matters to take into account, including *"any other matter that the EPA considers relevant and reasonably necessary to determine the application"*.¹⁴

51. For completeness, Section 59 is 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-

¹⁴ Section 59(2)(m) 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; 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
- (I) 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
- (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.
- 52. With respect to the effects on the environment, the DMC refers to the definitions of 'environment' and 'effect' and notes that, while the activities for which CRP sought a marine consent were to take place in the exclusive economic zone, the scope of effects to be taken into account includes those that occur beyond the exclusive economic zone, such as effects that occur in New Zealand.¹⁵
- 53. In addition to effects on the environment, the DMC must also take into account the effects of the applicant's proposed activities on existing interests.
- 54. The EEZ Act's definition of existing interests covers an interest a person has in any lawfully established existing activity such as rights of access, navigation and fishing; the settlement of historical claims under the Treaty of Waitangi Act 1975; the settlement of a contemporary claim under the Treaty of Waitangi as provided for in an Act, including the Treaty of Waitangi (Fisheries Claim) Settlement Act 1992; and a protected customary right or customary marine title recognised under the Marine and Coastal Area (Takutai Moana) Act 2011.¹⁶
- 55. Section 60 of the EEZ Act provides guidance to the DMC about the manner in which the effects on existing interests of allowing the activity are to be taken into account.

¹⁵ See definition of "environment" in Section 4 of the EEZ Act and the definition of "effect" in Section 6 of the EEZ Act

¹⁶ See definition of existing interest, Section 4 of the EEZ Act

- 56. Section 59(2)(b) of the EEZ Act also requires the DMC to take into account the effects on the environment or existing interests of other activities undertaken in the area covered by the application or in its vicinity.
- 57. Another matter to be taken into account is the nature and effect of other marine management regimes.¹⁷ Marine management regimes are regimes established under various Acts set out in Section 7(2) of the EEZ Act. The DMC cannot impose a condition to deal with an effect if the condition would conflict with a measure required in relation to the activity by another marine management regime.¹⁸
- 58. The implications for the activities for which consent was sought by the applicant of the legislation, regulations, conventions, regimes and Codes mentioned above are dealt with in the relevant chapters of this decision.
- 59. Section 59(2)(j) of the EEZ Act requires the DMC to take into account the extent to which imposing conditions might avoid, remedy, or mitigate the adverse effects of the activity. Section 63 of the EEZ Act then confers discretion to impose conditions that deal with the adverse effects of the activity.
- 60. 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 and to have regard to advice received from the EPA's Māori Advisory Committee.
- 61. Finally, the relevance and significance of the matters in Section 59 of the EEZ Act depends on the facts and circumstances of the particular application before the DMC.¹⁹

3.5. Information principles

- 62. Section 61 of the EEZ Act sets out the information principles that the DMC must apply when considering an application for marine consent. Section 61 of the EEZ Act is directive and requires decision-makers to make full use of their powers by:
 - requesting information from the applicant
 - obtaining advice
 - commissioning reviews or reports.

¹⁷ Section 59(2)(h) of the EEZ Act

¹⁸ Section 63(4) of the EEZ Act

¹⁹ Paragraph 222, Opening Submissions for CRP, 25 September 2014

- 63. Furthermore, the DMC must base decisions on the best available information and take into account any uncertainty or inadequacy in the information available.
- 64. The term 'best available information' is defined as "*the best information that, in the particular circumstances, is available without unreasonable cost, effort or time*".²⁰
- 65. The EEZ Act stipulates that when the information available in relation to an application is uncertain or inadequate, decision-makers must favour caution and environmental protection. If this means that an activity is likely to be refused, consideration must then be given to whether taking an adaptive management approach would allow the activity to be undertaken.²¹
- 66. Section 64 of the EEZ Act sets out examples of an adaptive management approach. It provides *inter alia* for conditions to be set requiring the activity to be undertaken in stages, with regular monitoring and reporting determining whether the next stage of the activity may be undertaken.

3.6. Decisions on marine consent applications

67. Applications for a marine consent may be granted either in whole or in part, or be refused. Section 62(2) of the EEZ Act states, for the avoidance of doubt, that the application may be refused if the decision-makers consider that they do not have adequate information to determine the application.

3.7. Treaty of Waitangi

- 68. Section 12 of the EEZ Act states:
 - 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

²⁰ Section 61(5) of the EEZ Act

²¹ Section 61(2) and (3) of the EEZ Act

- (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.
- 69. In other words, the Treaty of Waitangi is taken into account in terms of both the decision-making process and its outcome.

3.8. International obligations

- 70. Section 11 of the EEZ Act states:
 - This Act continues or enables the implementation of New Zealand's obligations under various international conventions relating to the marine environment, including—
 - (a) the United Nations Convention on the Law of the Sea 1982;
 - (b) the Convention on Biological Diversity 1992.
- 71. Among the other international conventions to which New Zealand is a signatory, and which are relevant to CRP's application, are the International Convention for Prevention of Pollution from Ships 73/79 (MARPOL), the Convention on the Conservation of Migratory Species (Bonn Convention) and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London Convention) which deals with radiological risks in the marine environment. The International Marine Minerals Society's Code for Environmental Management of Marine Mining (commonly known as the Marine Mining Code) and the International Council on Mining and Metal's sustainable development principles are also relevant.
- 72. The applicability of international conventions and laws to marine consent applications was the subject of much discussion during the hearing. The applicant's stance, outlined in its opening legal submission, was that to apply conventions not specified in the Act would be incorrect in law.²² In CRP's view, Section 11 applied to all New Zealand's international obligations under international conventions, not just those listed in (a) and (b). The applicant considered that, in making a decision in accordance with the EEZ Act, the DMC would have implemented all New Zealand's international obligations.

²² Paragraphs 234 – 240, Opening Submissions for CRP, 25 September 2014

- 73. The DMC received legal advice from its counsel on this issue.²³ The legal advice considered in particular the relevance of New Zealand's obligations under the Noumea Convention for the Protection of the Natural Resources and Environment of the South Pacific Region (the Noumea Convention), which some submitters argued put New Zealand under certain obligations in relation to the assessment of risks associated with release of uranium.²⁴
- 74. DMC's counsel considered that the risks associated with the release of uranium fell within the assessment required under Section 59 due to the potential for such releases to affect the environment within the meaning of Section 59(2)(a) or to affect human health within the meaning of Section 59(2)(c). Section 59(2)(l) required the DMC to take into account any other applicable law such as the Maritime Transport Act 1994, which deals with the dumping and storage of radioactive waste and other radioactive matter. Radioactive waste or other radioactive matter is defined in the Radiation Protection Act 1965 and it was the DMC's counsel's conclusion that the statutory language in the Radiation Protection Act should prevail.²⁵
- 75. Counsel for Kiwis Against Seabed Mining Incorporated (KASM), Greenpeace New Zealand Incorporated (Greenpeace) and the Deep Sea Conservation Coalition (DSCC) took an alternative view. In his closing submission, Mr Currie suggested that the words *"continues or enables the implementation of New Zealand's obligations"* should be seen as evincing an intent that decision-makers under the Act should comply with New Zealand's international obligations. He argued that the DMC should take into account New Zealand's international obligations and international best practice, and in the exercise of its statutory discretion, strive to reach a decision consistent with them.²⁶ Mr Currie concluded that there was reasonably common ground that international instruments were relevant.²⁷
- 76. The applicant was in general agreement with the conclusions of the DMC's counsel and accepted that, while international conventions might have some relevance in terms of providing guidance on best practice in relation to an industry or activity, they were not relevant as "*any other applicable law*" because international agreements are not part of New Zealand law unless incorporated into domestic legislation.²⁸
- 77. The DMC took the view that decision-makers on marine consent applications were not required to do anything more than apply the decision-making criteria in the EEZ Act in order to

²³ Memorandum of Counsel to assist the DMC 12 November 2014

²⁴ Paragraphs 35 and 37, Statement of Evidence of Tara Ross – Watt on behalf of Te Rūnanga o Ngāi Tahu, 11 September 2014; and Paragraph 88, Opening Representation on behalf of Te Rūnanga o Ngāi Tahu, 25 September 2014 ²⁵ Paragraph 21, Managraphum of Caunael to activit the DMC 12 Neuropher 2014.

²⁵ Paragraph 21, Memorandum of Counsel to assist the DMC 12 November 2014

²⁶ Paragraph 9, Closing Submissions by KASM, Greenpeace and Deep Sea Conservation Coalition, 17 November 2014

²⁷ Paragraph 10, Closing Submissions by KASM, Greenpeace and Deep Sea Conservation Coalition, 17 November, 2014

²⁸ Paragraphs 110 – 111, Closing Legal Submissions for CRP Limited, 19 November 2014

implement New Zealand's international obligations. That view is supported by the Supplementary Order Paper describing the final changes to the section.²⁹ Although the EEZ Act does not explicitly preclude decision-makers from having regard to international instruments, it seems to the DMC that the direction provided in the EEZ Act must take precedence over guidance contained in an international instrument to which New Zealand is a signatory.

3.9. The EEZ Act and the Resource Management Act

78.

A number of parties to this application have referred to precedents and case law involving the Resource Management Act 1991 (the RMA). There are indeed many parallels that may be drawn between the RMA and the EEZ Act. However, as noted in the Trans-Tasman Resources Marine Consent decision, there are significant differences between the two pieces of legislation.³⁰ For example, the Acts have different stated purposes; the term "*natural resources*" is defined more narrowly in the EEZ Act; and the EEZ Act does not refer specifically to either communities or social and cultural wellbeing as factors in decision-making. On the other hand, the EEZ Act is more explicit than the RMA in spelling out the matters to be taken into account, and information principles to be observed by decision-makers. Given these differences, it is important to be mindful that, while the precedents and case law which have developed in light of the RMA may be relevant, they cannot automatically be applied in an EEZ Act context.

²⁹ Explanatory Note, House of Representatives, Supplementary Order Paper No. 100 of 14 August 2012

³⁰ Paragraph 78, Trans-Tasman Resources Ltd Marine Consent Decision, June 2014

4. Chatham Rise Description

79. The DMC received a good deal of information from the applicant and submitters describing the nature of the Chatham Rise. It has summarised this information here to provide a brief overview of the natural environment.

4.1. Geomorphology

- 80. The Chatham Rise is a broad submarine ridge, that extends from the shelf off Banks Peninsula to beyond the Chatham Islands, with steeply sloping flanks rising to less than 500 m from water depths of more than 3000 m (the Hikurangi and Bounty troughs) (Figure 3). The crest of the Rise, which is relatively flat and generally at 350 450 m below sea level, averages approximately 130 150 km in width and covers over 100,000 km², or roughly the equivalent of two-thirds the area of the South Island.³¹
- 81. Smoothly sloping flanks are prominent features along the northern and southern sides of the Rise. The northern slope extends down to 2,500 m and is much steeper than the slopes to the south, which deepen gradually to approximately 4,000 m below sea level.
- 82. Local features along the crest of the Rise include several raised bank areas (eg Mernoo Bank, Reserve Bank, Veryan Bank), isolated groups of volcanic peaks or seamounts, occasional kilometre-scale sea-valleys and depressions on the flanks and the Chatham Islands which rise above sea level near the eastern end of the Rise.³² 'Pockmark' fields have been discovered in several locations, some approaching 1 to 5 km across and 50 to 150 m deep. They are assumed to be the remnants of seabed degassing.³³
- 83. Iceberg furrows are another feature of the Chatham Rise seabed. These were caused by icebergs that carved off the decaying Antarctic ice-sheet at the end of the five extreme glacial periods in the Pleistocene age. Some of the furrows are large, up to 25 km long, 200 m across and 10 m deep.³⁴
- 84. The surface sediments on the Chatham Rise crest are predominantly glauconitic sandy muds or muddy sands, typically <1 m thick. These sediments bear phosphorite nodules which are generally in the 0.5 to >1 mm size-fraction, up to maximum diameters of 50 mm to 200 mm. Carbonate sediments are also present which are derived largely from the deposition of residual

³¹ EIA, Section 1.1 and Paragraph 23, Evidence of Mr Sandy Bartle for Royal Forest and Bird Protection Society of New Zealand Incorporated, 12 August 2014

³² Paragraph 25, Statement of Evidence of Dr Scott Nodder for CRP, 25 August 2014

³³ Section 5.4.3 of Appendix 12 of the EIA, Natural Sedimentation on the Chatham Rise, August 2012 (updated April 2013)

³⁴ Section 5.4.2, Marine Consent Application and EIA, May 2014

biological material (eg fragments of plankton and benthic foraminifera, molluscs and echinoderm fragments) over thousands of years. Underlying these surficial sediments are softened chalky limestones (ooze).³⁵

85. The proportion of sand on the seabed is greatest towards the Chatham Islands, and muds become more dominant towards New Zealand. Compared to sedimentation rates of previous eras, modern sedimentation rates are relatively slow³⁶ and expected to be substantially less than estimates of 1 to 6 cm per 1000 years for the sediments sampled on the flanks of the Rise.



Figure 3. Map showing the location of the Chatham Rise in relation to other prominent ocean features and CRP's revised marine consent area.

³⁵ Section 5.6.3 of Appendix 12 to the EIA, Natural Sedimentation on the Chatham Rise (Nodder 2013).

³⁶ Section 4.1 of Appendix 11 to the EIA, Review of sediment chemistry and effects of mining (Golder 2014a)

4.2. Oceanography

- 86. The crest of the Chatham Rise lies beneath an area of the ocean where warm, saline subtropical water, flowing around northern New Zealand as the East Cape Current, mixes with cool and less saline, but nutrient-rich, sub-Antarctic water flowing around southern New Zealand as the Southland Current. The boundary between these currents is referred to as the Subtropical Convergence or Subtropical Front (STF), which flows in an easterly direction beyond the Chatham Islands before dipping to the southeast at the eastern end of the Rise.³⁷
- 87. Typically, warmer water is found to the north of the STF and cooler water to the south, but eddies and intrusions of water from either side of the front into the other can occur at any time.
- 88. Over the Chatham Rise, the STF is relatively narrow (about 150 km wide) and limited vertically by the shallow bathymetry of the Rise relative to the ocean floor on either side. The STF featured heavily in the hearing and the DMC learned that it has a strong, possibly defining, influence on the ecology and productivity of the Rise.
- 89. Maximum ocean current velocities of up to 45 cm/s have been recorded near the seabed of the Rise, with the strongest flows associated with tides. Tides account for more than 70 % of the total variance of the flows measured at the applicant's mooring site within the consent application area. Tidal velocities at this site ranged from 10 cm/s near the bottom to 40 cm/s near the surface, and showed a fortnightly spring-neap cycle due to the difference in the lunar and solar semi-diurnal tidal period. Tidal currents changed direction every semi-diurnal tidal cycle (approximately twice a day). The direction of the flow moved anti-clockwise and changed in magnitude every tidal cycle.³⁸
- 90. Internal (baroclinic) tides are associated with the vertical movement of density surfaces within the water column. Similar to surface (barotropic) tides, internal tides may be broken into higher modes (higher harmonics), each with a distinct vertical distribution of horizontal velocities that often extend to the seabed. Heath (1984) observed internal tides on the crest of the Chatham Rise with a M2 baroclinic signal accounting for about a quarter of the M2 tidal variance.³⁹
- 91. Waters on the Chatham Rise and its flanks are vertically stratified, and both temperature and salinity display seasonal changes with water depth.

³⁷ Section 5.5.2, Marine Consent Application and EIA, May 2014

³⁸ Section 5.5.4.5, Marine Consent Application and EIA, May 2014

³⁹ Heath RA 1984. Summary of Current Observations from the Chatham Rise (SO-17 Cruise). Geologishces Jahrbuch 64: 25 – 26. Cited in Marine Consent Application and EIA, May 2014
4.3. Ecology and productivity

- 92. Water quality on the Chatham Rise is good, with low turbidity and relatively high dissolved oxygen levels. Water temperatures are coldest at depth (between about 3 and 4.5 °C) rising to between 11 and 14 °C at the surface. Temperatures are higher on the north side than the south by about 2 °C. Nutrient levels show the contrast between high nutrient sub-Antarctic waters over Campbell Plateau and Bounty Trough and low nutrient subtropical waters north of the Chatham Rise.⁴⁰
- 93. The Chatham Rise is highly productive compared to the surrounding waters and, in general, other parts of New Zealand's EEZ. The subtropical front has a strong influence on this biological productivity. Elevated phytoplankton productivity is attributed to the presence of the STF, which is 'locked' to the Rise by its bathymetry. The mixing of nitrate-depleted subtropical water with nitrate rich sub-Antarctic water in the Chatham Rise region leads to this elevated phytoplankton productivity, which supports a complex ecosystem including deep-water fisheries, an unusually rich benthic environment and significant seabird and marine mammal populations.⁴¹ Dr Pinkerton described the Chatham Rise food web as complicated, involving thousands of species interacting at a variety of spatial and temporal scales. Sizes of individuals and population biomasses on the Rise span more than four orders of magnitude (ie they vary by more than a factor of 10,000).⁴²
- 94. Phytoplankton can be considered the engine of the Chatham Rise food chain. They are present in the upper-lit section of the water column and are preyed on by a diverse array of zooplankton species and represent food for a range of larger invertebrates (including squid and benthic dwelling organisms), fish and some species of whale. Mr Bartle told the DMC how all oceanic birds, fish and squid that live in the open ocean are totally dependent, firstly on phytoplankton production and, secondly on the efficient grazing of phytoplankton by zooplankton, leading to a consequential increase in abundance of the latter.⁴³
- 95. Zooplankton animals are short-lived, with some living for only a few days and most for less than one year. If they are not consumed by other pelagic animals they fall to the seabed as detritus and provide a food resource for benthic organisms. The Chatham Rise benthic environment is regarded as one of the most studied in New Zealand's EEZ. While many benthic species from the Rise are yet to be identified, a number of benthic communities, some of which are not known outside of the Chatham Rise crest, have been identified through surveys. The sea surface temperature gradient (SST) is known to be particularly important in structuring benthic

⁴⁰ Section 5.7.5, Marine Consent Application and EIA, May 2014

⁴¹ Section 2.1 of Appendix 22 to the EIA, Ecosystem Modelling of the Chatham Rise, April 2013

⁴² Paragraph 33, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

⁴³ Paragraph 48, Evidence of Mr JA (Sandy) Bartle for Royal Forest and Bird Protection Society of New Zealand Incorporated, 12 September 2014

communities across a wide area of the central Chatham Rise,⁴⁴ and there are different biological communities existing on the northern and southern slopes of the Rise. These differences have been attributed to the differing quantity and quality of benthic flux generated from the water masses on either side of the STF. There also appears to be a positive relationship between biodiversity in the benthic environment and the presence of phosphorite nodules, most likely reflecting the dependence of sessile (immobile) epifaunal organisms such as stony corals, brachiopods and bryozoans on hard substrate for attachment. The DMC discusses these relationships in more detail in Chapter 8.

- 96. The productive food chain of the Chatham Rise supports valuable deep water commercial fisheries, primarily for hoki, orange roughy, ling and oreo species. Other fish species are also caught on the Rise. Differences in the distributions of some deepwater fish species exist between the north and south sides of the Rise. Spawning grounds and nurseries for some commercial fish species (eg juvenile hoki) occur on the Rise, particularly the flanks. A scampi (a form of crustacean that build burrows in the seabed) fishery was established in the 1980s. The commercial importance of these fisheries is reflected in the level of fisheries and environmental research that has been undertaken in the area.
- 97. A number of fishing methods are employed on the Rise, including bottom and midwater trawling and bottom longlining. Most bottom trawling occurs along the flanks of the Rise.
- 98. The fisheries of the Chatham Rise are well known for their ecological importance. More than 200 species of fish have been identified.⁴⁵ Fish species of the Rise have been grouped by scientists into nine 'guilds' based on their method of feeding and target prey (eg jellyfish, squid, shrimps and other crustaceans or smaller fish species).
- 99. The Chatham Islands are renowned for their local inshore fisheries, particularly paua, rock lobster, and blue cod. These and a range of other species support commercial, traditional, recreational and tourism fisheries.⁴⁶
- 100. Marine mammals (cetaceans) have been observed along the Chatham Rise, although there has been no systematic study of their distribution. The majority of the recorded sightings of cetacean are of sperm whales and pilot whales, which prefer the Chatham Rise slopes where they forage in steep slope habitat. Various other species of dolphins, baleen whales and beaked whales use and transit through the area, including killer whales and southern right whales.⁴⁷

⁴⁴ Section 6.3.3.2, Marine Consent Application and EIA, May 2014

⁴⁵ Section 6.6.2, Marine Consent Application and EIA, May 2014

⁴⁶ Section 6, Marine Consent Application and EIA, May 2014

⁴⁷ Section 6, Marine Consent Application and EIA, May 2014

Recent habitat modelling has revealed that the southern edge of the Chatham Rise is an important foraging ground for southern right whales during summer and autumn. There is some evidence that several species of cetaceans have a strong regional linkage to the environment on the south flank of the Chatham Rise.⁴⁸ An abundant food supply appears to be one of the main attractants of cetaceans to the Rise.

- 101. Observations of whales off the South Island eastern coast near Kaikoura led to the establishment of a thriving eco-tourist industry in 1987, centred on sperm whales. This and other whale species that frequent the area are known to range across the Chatham Rise.
- 102. The Chatham Rise is widely regarded as one of New Zealand's most important seabird areas.⁴⁹ Fifty-two seabird species or sub-species have been observed on the Chatham Rise. This number of species represents 70 % of the seabirds that regularly breed in the New Zealand area. By comparison, only seventeen oceanic species live and breed in the much larger temperate North–east Atlantic area.
- 103. Most New Zealand albatross and petrel species are present on the Chatham Rise. The only New Zealand seabirds not seen there are tropical or subtropical. At least three species that nest on the Chatham Islands are considered rare or endangered. A number (such as albatrosses and petrels) travel large distances and breed on land well away from the Rise, in some cases many thousands of kilometres away.⁵⁰

⁴⁸ Section 6, Marine Consent Application and EIA, May 2014

⁴⁹ Paragraph 207, Evidence of Mr JA (Sandy) Bartle for Royal Forest and Bird Protection Society of New Zealand Incorporated, 12 September 2014; Issue 2, Joint Statement of Experts in the Field of Seabirds, 23 September 2014.

⁵⁰ Section 6.9, Marine Consent Application and EIA, May 2014

5. The Mining Proposal

5.1. The mining proposal

5.1.1. The proposal

- 104. In order to understand the effects of the proposed activities on the environment and existing interests, the DMC considered it important to first understand the mining proposal itself. Detailed information on this was provided by the applicant and Boskalis in the initial application, in responses to the DMC's requests for further information and at the hearing. The following summary draws on the applicant's and Boskalis' statements and testimony.
- 105. The applicant envisaged a contract mining model whereby the dredge operator would be responsible for the capital costs of the dredging venture, manage the mining activities and be responsible for all mining costs, including maintenance. To cover the dredge operator's capital and operating costs and provide a profit margin, the dredge operator would charge CRP a tonnage-related fee. CRP's only significant assets would be the mining permit and the marine consent, and its funding responsibilities would be confined to head office expenses and costs such as licence fees.
- 106. The DMC was told that, although no contract had yet been finalised, Boskalis was CRP's preferred partner to build and operate the dredging vessel, having already undertaken significant work on the proposal with CRP. However, if Boskalis elected not to maintain its involvement, CRP had received expressions of interest from four other dredging specialists. For its part, Boskalis confirmed its commitment to working with CRP on this proposal. To reflect expected international interest in the proposal, CRP was planning a listing on the London Stock Exchange once marine consent was granted.⁵¹
- 107. Mr van Raalte, a Senior Expert at Boskalis / Hydronamic bv in the Netherlands, told the DMC that the proposed mining process would use existing state of the art techniques applied in a new context.⁵² The mining concept was based on conventional trailing suction hopper dredger operations widely used around the world to dredge seabed materials.⁵³ Although this technology and equipment had been widely used at depths of up to 150 m, it was confirmed to the DMC by Mr van Raalte that it had not previously been used anywhere in the world at the depths envisaged on the Chatham Rise.⁵⁴

⁵¹ Edison Investment Research Report of 29 May 2014 https://www.nzx.com/markets/NZAX/securities/CRP/analysis and Paragraph 70, Statement of Evidence of Christopher David Castle for CRP, 28 August 2014

⁵² Paragraph 149, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁵³ Paragraph 2, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁵⁴ Paragraph 114, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

- 108. A trailing suction hopper dredger was to be employed, and the mined material would be pumped up to the vessel through a flexible hose or riser. The vessel, (a converted bulk material carrier or tanker built or modified specifically for deep seabed mining) would be equipped with an on-board separation system which separated the phosphorite nodules from the finer sediments. The phosphorite would be stored on board for transportation to shore and waste material returned to the seabed through a sinker with a diffuser.⁵⁵
- 109. The mining system design required knowledge of the nature of the sediments and their physical properties as well as the shape of the sea floor. The phosphorite nodules are loosely distributed within a layer of glauconitic sand. The glauconitic sand is about 20 cm thick on average but ranges up to a maximum of 70 cm. The sand comprises 20 40 % silt and 30 60 % fine or very fine sand. The thickness of the glauconitic sand varies significantly over distances of tens of metres or less, and the concentration of nodules varies both vertically and laterally. Underneath the sediment layer is an ooze or chalk layer, which is usually stiffer than the sediment layer.⁵⁶
- 110. The dredging unit would consist of a pumping unit and suction pipe (riser) with a drag-head. The pumping unit would be suspended above the seabed, with the drag-head being trailed over the seabed. One pump would suck up the seabed material and another push the mixture through the riser to the mining vessel. A third pump would provide the jet water for the drag-head. The total pump power was estimated to be 10 to 12 MW.⁵⁷
- 111. The drag-head would be about 5 m wide and 1 m long. Jets would direct high-pressure water into the seabed to loosen and fluidise the sediments, which would be vacuumed up through the riser using pumps. The internal diameter of the riser would be approximately 750 mm. The jet water pressure and flow could be modified to account for differences in sediment properties and to reduce disturbance of the underlying ooze or chalk layer. The drag-head would not have cutting teeth to assist in breaking up the sea floor as this would risk cutting into the chalk–ooze layer. The number and size of the jets could be modified.⁵⁸
- 112. The drag-head design was based on laboratory testing of the effectiveness of the jet size and power to fluidise the seabed material in order to collect phosphorite nodules from a layer that varied in thickness from 0 to 50 cm (35 cm on average) while avoiding dredging the underlying chalk-ooze layer. Where the sediment was thicker than 50 cm, the drag-head would not be able to mine the entire layer and would therefore leave some of the phosphorite behind.⁵⁹

⁵⁵ Paragraph 28, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁵⁶ Paragraphs 29 – 31, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁵⁷ Paragraph 34, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁵⁸ Paragraphs 36 and 38, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁵⁹ Paragraph 44, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

- 113. The pump-frame, riser and drag-head would be suspended from the ship on four steel wires: two connected to the pump-frame, one to the drag-head end of the riser and one to the forward end of the riser. The total weight of the pump-frame would be of the order of 300 tonnes and the expected force on the sea floor was 15 – 20 tonnes.
- 114. Pre-mining seabed surveys and core samples to be collected within the mining blocks would provide information about sediment depth and the stiffness of the underlying layer so that the mining operations could be adjusted in order to minimise contact with the chalk-ooze layer.⁶⁰



Figure 4. Diagram of the CRP mining proposal. (Source: Figure 5, Evidence from Gerard Van Raalte for CRP, 28 August 2014)

⁶⁰ Paragraphs 83 – 86, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

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- 115. After being pumped up to the mining vessel, all seabed material would be processed on board by a nodule separation plant. The plant would contain three or four parallel processing streams for coarse fraction separation, and a set of log-washers and two to four processing streams for finer fraction separation. The exact configuration of the processing streams would depend on the vessel design. No chemicals would be used in the processing system and no new or untested components would be used.⁶¹ A screen on the drag-head would ensure that material greater than 150 mm would not be taken onto the vessel but would remain on the seabed.⁶²
- 116. After extracting the phosphorite nodules, sediments less than 2 mm in size would be returned to the seabed via a sinker pipe positioned approximately 10 m above the seabed. The sinker pipe would be some 750 mm in diameter. A diffuser would limit turbidity and the spatial extent of the sediment plume. The release height of the discharge was expected to vary between 8 and 12 m from the bottom (10 m on average). A clump weight of some 50 tonnes would be attached to the sinker pipe to hold it in position.
- 117. Mining would take place in long parallel tracks with a 180 degree turn at each end, thereby forming a pattern of stretched ovals. In an optimised dredging process the drag-head would be kept on the seabed as long as possible, and so it would be preferable to dredge straight tracks with a section length as long as possible before turning. The central part of the oval and the curved ends would not be mined.⁶³ The mining pattern is shown in *Figure 5* below.



Figure 5. Mining pattern – "spiralling out". The green area is not mined and the yellow areas are mined or have sediment deposited directly on them. (Source: Statement of Evidence from Gerard Van Raalte for CRP, Figure 8)

⁶¹ Paragraph 46, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁶² Section 4.4.3, Marine Consent Application and EIA, May 2014

⁶³ Paragraphs 58 – 59, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

- 118. The mining vessel would operate on an approximately 10 day cycle, and would be expected to complete about 30 trips per year, allowing for unforeseen events and weather disturbance. Cycles would consist of:
 - mining, onboard processing and hopper filling (4 to 5 days)
 - transit to port (1.5 days)
 - offloading and re-provisioning (3 days)
 - transit to Chatham Rise to commence the next mining cycle (1.5 days).⁶⁴
- 119. The port location had not yet been decided but several ports on New Zealand's east coast were being considered. A final decision would not be made until a vessel was chosen.⁶⁵

5.1.2. **Operational parameters**

- 120. The proposed mining operation would require accurate positioning and movement of the draghead and diffuser to follow the Mine Plan, avoid the chalk-ooze layer and maintain the discharge at the required height above the seabed. The position of the vessel and drag-head would primarily be controlled by a dynamic positioning and tracking system on the vessel, in conjunction with two electrically driven thrusters on the drag-head.⁶⁶
- 121. The DMC asked the applicant for more information on the measures proposed to ensure that the mining operation remained within the agreed parameters, for example for the depth of cut of the drag-head (0.5 m) and non-disturbance of the chalk layer.⁶⁷
- 122. In response, the applicant explained that there were a number of possible design solutions but they were constrained by geological and engineering factors such as limitations on the size of the pumps that could be installed and engineering and economic limits on the size of the riser and sinker pipes and on the processing plant on board the mining vessel. Ongoing monitoring and assessment of the performance of the systems would be required to minimise environmental impacts.⁶⁸

⁶⁷ DMC Request for Further information, 25 July 2014

⁶⁴ Paragraph 9, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁶⁵ Paragraph 123, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁶⁶ Paragraph 33, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁶⁸ Section 4.2.1, Response to the DMC's Request for Further Information (Part 1), August 2014 (date on EPA website – 8 August 2014)

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5.2. Operational control

5.2.1. Monitoring and compliance with thresholds

- 123. One of the objectives of the proposed monitoring activities was to collect further information on background environmental conditions in the marine consent area in order to measure the effects of the mining activities. The applicant's plan for this monitoring was set out in the EIA, in the proposed conditions and in the evidence of Mr Wood.⁶⁹
- 124. Monitoring would include:
 - long-term oceanographic information (turbidity, current speed and direction, temperature, conductivity and pressure) and sedimentation data
 - water turbidity (suspended solids) prior to, during and after mining
 - benthic ecology monitoring to assess the impacts of mining outside the mining blocks
 - benthic ecology monitoring to assess the nature and rate of recolonisation inside the mining blocks
 - sound levels of the mining vessel and mining system.
- 125. Mr Steenbrink from Boskalis told the DMC that monitoring at this depth and distance from the shore would present difficulties.⁷⁰ Some oceanographic data (total suspended solids (TSS), turbidity, current speed and directions, temperature, conductivity, pressure, sedimentation) would be collected by mooring landings at various sites. Other data would be collected using an underwater survey vehicle or Autonomous Underwater Vehicle (AUV) equipped with sensors. Sediment traps would be used to collect sediment near the sea floor. Surveys would take place every six months for the initial two years, then annually.⁷¹
- 126. Monitoring impacts outside of the mining blocks to identify spatial changes in benthic habitats and the marine environment as a result of the mining activities would include targeted observations of the seafloor and seafloor sampling. These surveys would take place every three months for the initial 18 months of mining and once a year thereafter.⁷²
- 127. Spatial changes in the marine environment would be monitored with photographs and data collected at monitoring sites. The applicant outlined in its proposed conditions the monitoring activities it intended to undertake. It proposed to forward a detailed plan to the Chief Executive of the EPA for certification prior to monitoring commencing.⁷³

⁶⁹ Paragraphs 80 – 88, Statement of Evidence of Raymond Allen Wood for CRP, 28 August 2014

⁷⁰ Paragraph 33, Statement of Evidence of Sander Steenbrink for CRP, 28 August 2014

⁷¹ Paragraphs 85 – 86, Statement of Evidence of Raymond Allen Wood for CRP, 28 August 2014

⁷² Paragraph 87, Statement of Evidence of Raymond Allen Wood for CRP, 28 August 2014

⁷³ Paragraph 88, Statement of Evidence of Raymond Allen Wood for CRP, 28 August 2014

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5.2.2. Best practice

- 128. Boskalis described its record in carrying out proposals requiring complex sediment processing and affirmed its commitment to research and development and environmental protection.⁷⁴ It also described its commitment to vessel safety and described a new programme introduced recently to improve its safety culture.⁷⁵
- 129. Boskalis confirmed that the operation on board the vessel would adhere to international laws and standards (specifically MARPOL) as well as any additional requirements under New Zealand law. A detailed environment and management plan would be drafted and agreed before mining started. This would cover oily water, hazardous substances, wastewater, garbage (solid waste), emissions to air, ballasting and hull bio-fouling.⁷⁶
- 130. Mr Ross-Watt for Te Runanga o Ngai Tahu (Ngāi Tahu) identified a number of good practice codes and guidelines that might be appropriate for example, the International Marine Minerals Society's Code for Environmental Management of Marine Mining (IMMC), the Noumea Convention, the London Protocol and the Mining Code issued by the International Seabed Authority.⁷⁷ Some of these codes and guidelines had not been incorporated into New Zealand law. However Mr Ross-Watt considered that they would have some value as further guidance on international standards and good practice.⁷⁸

5.3. Submitters' concerns

- 131. A number of submitters and participants in the hearing expressed concerns and reservations about the proposed mining operation. It was noted by several parties that no seabed mining operation had been undertaken anywhere in the world at such depths.
- 132. The question was raised whether the laboratory experiments and design work done by Boskalis accurately reflected the sea and weather conditions of the Chatham Rise. Wave heights for example would affect the movement of the ship and consequently the height of the discharge pipe above the seabed. Submitters also questioned if the speed that the sediment would enter the benthic environment could be accurately estimated, particularly as detailed design of the diffuser and other components had not yet been completed. Boskalis' ability to control the depth of mining to avoid the chalk-ooze layer was a concern shared by many submitters, particularly given the rugged terrain and varying depth of this layer. Mr Christensen noted that the level of

⁷⁴ Paragraphs 69 – 95, Statement of Evidence of Sander Steenbrink for CRP, 28 August 2014

⁷⁵ Paragraph 94, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁷⁶ Paragraph 12, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁷⁷ Paragraph 15, Statement of Evidence of Mr Tara Ross-Watt on behalf of Te Rūnanga o Ngāi Tahu, 11 September 2014

⁷⁸ Paragraph 111, Closing Submissions for CRP, 19 November 2014

sensitivity with a heavy drag-head, arm and clump weight at 400 m depth was astonishing⁷⁹. Concerns were raised that all these issues associated with the physical mining process could have flow on implications for the accuracy of the modelling of sediment dispersion.

- 133. The noise associated with the seabed material passing through the riser and sinker pipes was a concern to some submitters, as was the overall noise level associated with the mining process.
- 134. Mr Currie, representing Greenpeace, the Deep Sea Conservation Coalition and Kiwis Against Seabed Mining raised concern over which flag the mining vessel would fly and the implications for adherence to which regulatory system⁸⁰, Mr van Raalte stated that normally Boskalis' larger vessels sailed under the Cyprus flag. Mr Currie suggested that Cyprus was known as a flag of convenience, making liability compensation potentially difficult to obtain in the event of unforeseen circumstances.81
- 135. Concern was also expressed by a number of parties to the application about the absence of a contractual arrangement between CRP and Boskalis with regard to the mining operation. Although Boskalis had been involved with CRP for a number of years, and through a subsidiary was a significant shareholder of CRP, there was no absolute assurance that Boskalis would be undertaking the mining.82

5.4. **DMC** findings

- 136. Although both the applicant and Boskalis had gone to considerable lengths to provide information about the mining operation, the DMC was left with a number of uncertainties. Many of these stemmed from the fact that this was the first proposal of its kind in the world to be undertaken at such depths and the heavy reliance placed on incompletely validated modelling.
- 137. Prominent among the DMC's concerns were the technical and practical uncertainties associated with the mining operation itself. For example, controlling the extent of sediment dispersion would depend largely on avoiding the chalk-ooze layer and maintaining the discharge diffuser at the required height above the seabed. Achieving this would require accurate positioning and movement of the drag-head. However the testimony given by Mr van Raalte provided the DMC with only qualified reassurance: "As dredging or dredge-mining has not been attempted at depths of 400 m, a system has been designed on best available practices, supported by dedicated studies and expert assessments.

⁷⁹ Page 2, "CRP's Mining Proposal – What will we Get?" from the Closing Submission of Mr Christensen on behalf of Te Rūnanga o Ngāi Tahu, 18 November 2014 ⁸⁰ Lines 37 – 40, page 608 of the Transcript, 1 October 2014

⁸¹ Lines 14 – 17, page 610 of the Transcript, 1 October 2014

⁸² Lines 45 – 1, pages 205 – 6 of the Transcript, 26 September 2014

In my opinion, the system is able to cope with the variable seabed conditions, and will, whilst operating, provide adequate survey data for further optimisation and fine-tuning of the processes. The initial phase of mining will be used as a pilot / prototyping period to test and optimise the system in all conditions.⁸³

- 138. The applicant also acknowledged that monitoring at this depth and distance from shore would present challenges. The monitoring programmes Boskalis had deployed on other proposals around the world would not be possible on the Chatham Rise.⁸⁴ The absence of a detailed and approved mining plan, monitoring programme and adaptive management until shortly before the commencement of mining, while understandable in terms of the process being followed, would leave a great deal to be resolved well after the conclusion of the consent process.
- 139. The DMC acknowledges that the outline mining plan and proposed conditions went some way towards addressing the risks and uncertainties of the mining operation. Proposed Condition 9, for example, would limit the number of vessels and the areas of the seabed to be mined. The applicant had decided to limit the drag-head to a single pass and to forego the use of cutter teeth in the drag-head. Other mitigations and safeguards were also proposed.
- 140. Proposed Condition 10 would restrict the mining area for the first five years of mining. The DMC agree with EPA staff that this proposed condition would have needed strengthening, for example by linking the five year period to the notification of the commencement of mining as required by Proposed Condition 5,⁸⁵ and by the inclusion of details of the location of the proposed exclusion zones prior to mining commencement.
- 141. Proposed Conditions 25 to 28 required a Mine Plan to be developed which contained details of the operation such as the mining method, the separation method for seabed material, the method used to return processed material from the mining vessel to the seabed, management and maintenance requirements for key components and the precise location of areas to be mined as well as those to be avoided.
- 142. As indicated above, it might have answered some of the questions raised by submitters and resolved some of the uncertainties if it had been possible to run a pilot mining proposal over a limited period in order to verify Boskalis' initial design work. Such a test pilot was not however deemed viable by the applicant because of the initial investment required.⁸⁶

⁸³ Paragraphs 114 and 115, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁸⁴ Paragraph 33, Statement of Evidence of Sander Steenbrink for CRP, 28 August 2014

⁸⁵ Page 4, EPA Comment on CRP Proposed Conditions, 14 November 2014

⁸⁶ Line 45, page 2594 of the Transcript, 19 November 2014

143. The DMC acknowledges that the conditions and adaptive management approach proposed by the applicant in respect of the mining operation covered many of the points that would have needed to be covered. At the same time, there were a number of gaps that would have needed to be filled and some proposed conditions that would have required significant modification and development in order for the DMC to be confident that it knew what kind of operation it was authorising, and with appropriate safeguards. Since the DMC concluded after reviewing all the evidence and testimony that the application could not be approved (on grounds largely independent of the mechanics of the mining operation), the DMC did not consider it necessary to either seek more information from the applicant or ask the applicant to undertake further work on the proposed conditions and adaptive management regime relating to the mining operation.

6. Reliance on Modelling and Monitoring

144. A significant feature of this application was the applicant's extensive reliance upon modelling and (largely) post-operational monitoring in the absence of, or additional to, what might be considered necessary empirical or observational evidence.

6.1. Modelling

- 145. There is no question that the use of modelling is appropriate both legally under the EEZ Act and technically in order to produce forecasts and predictions and to reduce levels of uncertainty. However, the extent to which reliance is placed upon modelling in this particular application is unusual. Moreover, there were questions about the reliability of some of the models used, particularly as much of the data was manifestly far from complete and in many cases the results of the modelling had not been field tested.
- 146. Modelling underpinned assessments of effects in the following key areas:
 - oceanography / hydrodynamics
 - sediment plume dynamics and sedimentation
 - species' trophic relationships
 - operational noise propagation and marine mammals
 - benthic species' distribution
 - commercial fish species distribution and population
 - habitat prediction and spatial planning
 - economic benefits
 - ecotoxicology and human health
 - the mining operation itself at depth.
- 147. Mr Winchester noted in opening that: "Use of modelling in predictions is relatively common even in a terrestrial context. For many effects modelling and predictions based on existing data and observations are the best and only reasonable way to assess the nature or degree of impacts and frequently value judgments made by experts are imposed on top of the model outputs to reflect the context and environment."⁸⁷
- 148. The DMC agrees with that statement, as did most if not all of the technical experts who gave evidence. Certainly there was disagreement on particulars, scepticism expressed about aspects of the mechanics and dispute as to how far reliable conclusions could be drawn. What concerned many experts, including some of CRP's own witnesses, was the absence of "ground-

⁸⁷ Paragraph 42, Opening Submissions for CRP, 25 September 2014

truthing" of some of the more important models, which might have been internally verified but lacked empirical validation and more complete data collection.

- 149. For example, the Joint Statement of Experts in the Field of Sediment Modelling agreed that: "*at* present the model has not been calibrated nor validated against a measured discharge sediment plume" ⁸⁸, and that "Uncertainty pertaining to the model source terms and parameterization of the discharge sediments could be reduced by carrying out a model validation on the plume." ⁸⁹
- 150. Those experts concluded, with respect to adaptive management, that "*it should also be required that any subsequent plume model, utilised to decide whether to extend the mining area, is validated and implemented to demonstrate the ability to meet the SSC and sedimentation thresholds ...*" ⁹⁰
- 151. Further, the Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning agreed that "*lack of ground-truth verification of the model predictions in locations where there is a lack of underlying data*" could be addressed "*with targeted sampling in areas informed by the model predictions*".⁹¹
- 152. The DMC discusses the particulars of the models, where those are especially important to its determination, under their individual topic areas.
- 153. Throughout the hearing, the extent of empirical verification was a common concern among expert and lay witnesses alike. A number of parties opposed to the application asserted that there was too much uncertainty about the modelling for the consent to be granted. The DMC does not agree with Mr Winchester that uncertainty was merely a convenient and overused "*buzz word*".⁹² The DMC does however agree that beyond uncertainty lie risk and consequences that need to be assessed. A question the DMC sought to address was whether all the modelling, validated to the extent that it was internally or empirically, brought the DMC sufficiently close to closing the gaps between uncertainty, risk and consequence that the consent could be granted.
- 154. In that regard the DMC acknowledges that the applicant's final set of proposed conditions incorporated a number of field and *in situ* trials and surveys to ground-truth model predictions in

⁸⁸ Issue 6, Joint Statement of Experts in the Field of Sediment Modelling, 26 September 2014

⁸⁹ Issue 6, Joint Statement of Experts in the Field of Sediment Modelling, 26 September 2014

⁹⁰ Issue 6, Joint Statement of Experts in the Field of Sediment Modelling, 26 September 2014

⁹¹ Issue 4, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

⁹² Paragraph 47, Opening Submissions for CRP, 25 September 2014

key areas. As was pointed out however, the results of this monitoring and these surveys would not be known until after the mining operation was underway.

155. The hearing produced two main schools of thought on the matter of field validation: those who thought that this could reasonably be accomplished as part of operational mining with the necessary review loops, and those who thought it must be done prior to operational mining so that the activity would avoid unanticipated adverse consequences and not have to resort to reactive management of those consequences.

6.2. Monitoring

156. The initial application included as Appendix 35(i) a draft Environmental Management and Monitoring Plan (EMMP) which indicated monitoring of:

- water quality and oceanographic information, including
- baseline and turbidity data collection
- water column turbidity associated with mining
- ecological impacts outside the mining area
- recolonisation, including
- recolonisation after mining
- hard substrate trials.

157. The proposed monitoring programme was further amended during the hearing to include such matters as:

- composition of mined phosphorite nodules
- mining block ground-truthing
- sediment chemistry in areas to be mined
- toxicity testing
- on-board coarse material screening organic content
- discharge water quality
- baseline seawater quality
- baseline oceanographic information, including currents, temperature and salinity
- water turbidity (suspended solids) prior to, during and after mining
- benthic communities
- recolonisation
- colonisation of new substrate
- fish trace element uptake
- subsurface noise.

158. This EMMP was then replaced by a proposed monitoring Schedule 2 to the conditions, which included the following areas:

2A — Prior to Commencement — Baseline:

- noise / sound
- water quality
- water quality and oceanographic (fixed moorings)
- bathymetry in MPA completion
- mining exclusion area ground-truthing.
- 2B During Mining Operations:
 - elutriate testing
 - toxicity testing
 - noise / sound
 - water quality and oceanographic (fixed moorings)
 - plume water quality
 - sediment composition
 - discharge of processed material from the mining vessel
 - ecological impacts outside of mining area
 - trace elements in key commercial fish on the Chatham Rise
 - hard substrate trials.

2C — To meet staged Adaptive Management Survey Requirements:

- bathymetry
- seabed composition
- benthic ecology
- oceanographic.
- 159. While this evolution in the sophistication of the monitoring proposed was a welcome and expected part of the hearing process, it served to emphasise that significant additional data, testing and refinement of the operation and its effects would be necessary and remained to be developed in detail.

7. Sediment Dispersion and Sedimentation

7.1. Background

- 160. One of the principal issues associated with the proposal was the acknowledged adverse effects on the benthic environment (discussed in Chapter 8.1) associated with the removal of seabed surface sediments and sediments immediately below the surface (ie the act of dredging). Equally contentious were potential adverse effects associated with the deposition of sediment tailings back on to the seabed following the removal of phosphorite nodules (ie sedimentation) and the production of suspended sediments within the water column (ie a sediment plume) associated with the discharge of sediment tailings from the sinker line via a diffuser positioned at a nominal height of 10 m above the seabed.
- 161. A number of submitters expressed concern about the dispersion of sediment tailings and what effect it might have on various aspects of the Chatham Rise ecosystem. For example, long-line fisherman Mr Summerton was concerned about the direction and distance of travel of the sediment plume.⁹³ Other submitters expressed concern about effects on plankton (eg Mr Bartle), benthic organisms (eg Dr Berkenbusch) and various other components of the Chatham Rise ecosystem. This was a critical issue for many submitters and there was considerable information presented in the applicant's EIA and at the hearing on the merits of the approach used and the findings of the applicant.
- 162. As there is no existing or previous comparable mining operation in place, or data on how discharges of sediment might behave on the Chatham Rise, the applicant commissioned a series of studies modelling the dispersion and sedimentation from the mining vessel's discharge. Such an approach required a number of assumptions associated with how the mining operation would proceed as well as information on the receiving environment such as current and tidal movements and sediment particle character associated with the discharge. Issues associated with model validation and sediment monitoring were addressed, and the DMC summarises that information below together with its findings.

7.1.1. Modelling approach

163. Preliminary modelling was undertaken by the National Institute of Water and Atmospheric Research (NIWA) and more detailed modelling was subsequently undertaken by Deltares using a variety of inter-dependent modelling tools. Different approaches were used to describe (i) the

⁹³ Paragraph 71, Evidence of Mr Greg Summerton, 9 September 2014

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near-field transport of sediment released from the discharge (sinker) pipe via a diffuser and (ii) the transport of sediment away from the mine track and into the wider marine environment.⁹⁴

164. The primary tool was a collection of software modules notably Delft3D flow and sediment transport models. Delft3D simulates three-dimensional flow, sediment transport and morphology.

165. Appendix 25 of the applicant's EIA described what the modelling was required to account for as:

- large-scale oceanic flows over the Chatham Rise, including seasonal variations
- sufficient model resolution in time and space on top of the Rise enabling
- a proper simulation of the far-field sediment mine tailing plume dispersion
- a proper schematisation of the mining track and cycle
- associated processed waste material (or mine tailings release characteristics
- an appropriate characterisation and schematisation of the mine tailings (ie particle grain size distribution and sediment characteristics)
- an appropriate schematisation of the mine tailings disposal during the mining process.
- 166. As described in Appendix 25 to the Marine Consent Application and the EIA, a 'Regional' Delft3D model was used to model large-scale oceanic flow effects and seasonal variations, and an optimised, higher resolution 'Local' model (using Local Delft3D models and Jet3D) was used to model the far-field plume dispersion and the mining process.⁹⁵
- 167. The far-field modelling was initially set up to assess water movement and other oceanographic characteristics over three seasons; spring, summer and winter. Eventually, Delft3D was used to model water motion and large scale sediment plume motion over ten mining cycles in two seasons; winter and summer ⁹⁶. Ms Lescinski told the DMC that the ten mining cycles for the summer and winter periods had the largest variations in terms of ocean ambient conditions (ie (ie water temperature variations over depth, strength and direction of currents) and so it was considered that the expected ambient currents covered by these two 82 day periods covered the widest range of flow conditions, and thus the widest range in likely plume dispersion conditions. ⁹⁷

⁹⁴ CRP Marine Application and EIA: Appendix 23 Ocean model simulations of sediment plume behaviour (Hadfield 2013); Appendix 25 Modelling investigations on mine tailing plume dispersion on the Chatham Rise (Deltares 2014b)

⁹⁵ Appendix 25 to the Marine Application and EIA Modelling investigations on mine tailing plume dispersion on the Chatham Rise (Deltares 2014b)

⁹⁶ Paragraph 4, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

⁹⁷ Paragraphs 116 and 181, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

- 168. A wide range of assumptions were required for inputs to the modelling as described in the EIA and subsequently in the evidence of Ms Lescinski. Some of these are critical to the modelling outputs and included:
 - a discharge rate of 2.15 m³/s (0.31 m³/s solids and 1.84 m³/s water);
 - sediment release rate of 827 kg/s;
 - 44 % and 8 % of sediment mined has a particle size smaller than silt (60 μm) and clay (4 μm) size, respectively;
 - a discharge release velocity of 0.75 m/s (the same as the sailing speed of the mine vessel but released in the opposite direction to provide a theoretical zero velocity);
 - the time required to complete a mining cycle (ie it was estimated to mine one 5 by 2 km block would take 14 weeks and comprise of 10 mining cycles);
 - mine tracks progressively shift outwards around the centre of each mining block;
 - all far-field plume modelling excluded sand sized particles and larger as it was expected that sand would fall immediately to the seabed if the diffuser was at or near the seabed.
- 169. The results of preliminary modelling led the applicant to decide to return the processed nonphosphorite material at or near the seabed (ie no more than 10 m above the seabed). However, the EIA and further information requests presented the results of the modelling undertaken for disposal both at the seabed and at 10 m above the bed for comparison.

7.2. Model outputs

7.2.1. Water movement

170. Data from HYCOM and 2011 field measurements indicated that the long-term average seabed flows of water over the 2011 study period were most often directed towards the northwest. Tides accounted for about 70 % of the current speed and direction measured in the mining licence area by the 2011 field measurements. With respect to the three seasonal modelling periods, the summer, winter and spring periods were deemed reasonably representative with respect to the near-seabed currents.⁹⁸

7.2.2. Sediment plume dispersion

- 171. The plume dispersion modelling by Deltares produced four types of output:
 - snapshots of plumes of the suspended sediment concentration of silt and clay fractions nearest the bed

⁹⁸ Paragraphs 45, 62, 63, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

- plots showing the total proportion of the simulation for which concentrations of silts and clay (at the bed) exceed different concentration thresholds
- time series showing the variation of concentration in the water column through time
- snapshots of the deposited fine sediment (silt and clay together).⁹⁹
- 172. Modelling predicted sediment concentrations of several 100's to 1000's of mg/L near the seabed along the mine track, reducing to tens of mg/L as distance increased away from the mined area¹⁰⁰. For the ten mining cycles required to mine a block, the predicted distribution and duration of TSS of 10 mg/L or more, lasting for more than about one day, were modelled to extend more than 15 km beyond the mining block, outside the boundary of the model.¹⁰¹
- 173. Suspended silt material close to the sediment disposal location was found to dissipate completely in between cycles. The clay fraction also tended to dissipate completely in between mining cycles, though transit periods were noted during which concentrations remain above 0.1 mg/L. Ms Lescinski considered these would not be discernible from the background TSS over the Chatham Rise¹⁰². She considered the modelling outputs indicated that settlement and / or dilution and flushing of the suspended sediments between mining cycles would bring the TSS concentrations back down to background levels.
- 174. The DMC notes that background TSS concentrations on the Chatham Rise crest are considered to be $<1 \text{ mg/L}^{103}$, although this assessment is based on relatively few samples.

175. *Table 1* below provides a useful summary of typical predicted sedimentation levels:

% time	>100 mg/L (km²)	>50 mg/L (km²)	>30 mg/L (km²)	>10 mg/L (km²)
>1 % (~ 1 day)	26	40	71	>304
>10 % (~ 1 week)	16	22	33	126
>30 % (~ 1 month)	3	12	15	47

Table 1 Predicted area (km^2) with TSS levels above the threshold as a function of time (summer model, discharge at the seabed). (Source: Table 5 of FIR #7)

⁹⁹ Appendix 25 of the Marine Consent Application and EIA, Modelling investigations on mine tailing plume dispersion on the Chatham Rise (Deltares 2014b)

¹⁰⁰ Section 2.5 of the HR Wallingford review, attached to the Revised Response to EPA Request for Further Information 3,4,5 and 7, August 2014 (date on EPA website – 5 August 2014)

¹⁰¹ Page 23 of the Revised Response to EPA Request for Further Information 3,4,5 and 7, August 2014 (date on EPA website – 5 August 2014)

¹⁰² Paragraph 126, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

¹⁰³ Section 4 of Appendix 12 to the Marine Consent Application and EIA, Natural Sedimentation on the Chatham Rise, April 2013

176. For a discharge at 10 m above the seabed, the modelling predicted that the sediment plume would decrease rapidly with height above the seabed and remain within about 50 m of the seabed¹⁰⁴. This section of the water column is well below the euphotic zone¹⁰⁵, which extends to a maximum depth of about 150 metres, where primary production takes place. The implication of this finding is that if no sediment was suspended into the euphotic zone, the sediment from mining would not affect primary productivity by light shading and therefore no direct impacts on phytoplankton within the euphotic zone could be expected. The applicant concluded that as such no significant and direct impacts on primary production were expected on the Chatham Rise as a result of the proposed mining activities.¹⁰⁶ The DMC discusses this issue further in Chapter 8.3.

7.2.3. **Sedimentation**

- 177. Ms Lescinski stated that, of the estimated total volume of discharged sediments after ten mining cycles of 2,640,000 tonnes (including the sand fraction), roughly 88 % was predicted to deposit within the model domain (2,330,000 tonnes). The other 12 %, consisting of two thirds clay (8 %) and one third silt (4 %), would leave the model domain over the model boundaries (310,000 tonnes). The concentration in the plume, when leaving the model domain at a distance of 20 km from the source, was estimated at about 5 mg/L (silt plus clay)¹⁰⁷. Over the course of one mining cycle, the mean depositional height in the mining block (ie 5 km x 2 km mining region) was predicted to be around 10 cm, with small local peaks above 15 cm. This deposition was in addition to sand deposition, which was estimated to occur at a depth of approximately 5 cm per single track line.
- 178. Of the remaining 8 % of fines that settled to the seabed (mostly silt) for this 10-cycle winter scenario, half was predicted to settle on the seabed between 3 and 5 km from the centre of the mining tracks. Therefore, about 2 % of the discharged fines would be deposited further than 10 km from the centre of the mining tracks.¹⁰⁸
- 179. The modelling work revealed that the spatial extent of sedimentation varied in relation to the character of the sediment (eg size of the particles and particle fall velocity), and sediment

¹⁰⁴ Section 8, Appendix 25 of the Marine Consent Application and EIA, Modelling investigations on mine tailing plume dispersion on the Chatham Rise (Deltares 2014b)

¹⁰⁵ Euphotic zone: The upper, sunlit part of the water column where the intensity of light is >1 % of that incident on the sea surface

¹⁰⁶ Paragraph 161, Statement of Evidence of Mr Paul Cameron Kennedy for CRP on Assessment of Environmental Impacts (Updated), 29 August 2014 (Amended, 14 November 2014); Paragraph 147, Opening Submissions for CRP, 25 September ¹⁰⁷ Paragraph 135, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

¹⁰⁸ Paragraph 141, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

particles with larger fall velocities tended to be associated with a smaller but thicker total sedimentation footprint.¹⁰⁹

- 180. For example, the modelling predicted that sedimentation of up to 1 cm thick would occur over a seabed area of 35 km² and up to 1 mm thick over an area of 103 km² (both for a single 10 km² block mined over three months, with a discharge 10 m above the seabed using a winter mining scenario). The area of sediment deposition was predicted to decrease markedly if the discharge was released at the seabed (ie 18 km² area for a 1 cm thick cover and 61 km² for a 1 mm thick cover). A review of the Deltares modelling by HR Wallingford (see Chapter 7.3) concluded that the model results with release of the discharge material into the model domain at the seabed were likely to represent a better approximation of the actual plume's behaviour than a discharge 10 m above the seabed.¹¹⁰
- 181. Figure 9 of the Further Information Request on the cumulative footprints (reproduced below as *Figure 6*) depicts the predicted sediment footprint after 15 years of mining, based on CRP's proposed Mine Plan.



Figure 6. Predicted sediment footprint after 15 years of mining, based on release of tailings at 10 m above the seabed. (Source: FIR, Figure 9)

¹⁰⁹ Paragraph 110, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014; Section 3.2, Revised Response to Request for Further Information – Request Nos. 3, 4, 5 and 7.

¹¹⁰ Section 5.2, in Revised Response to Request for Further Information — Request Nos. 3, 4, 5 and 7

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182. The analysis shows that:

- cumulative sedimentation of 5 cm over 15 years is essentially contained within the mining permit area
- cumulative sedimentation of 1 cm over 15 years extends beyond the current mining permit area
- sedimentation of 1 mm over 15 years extends about 10 km north of the mining permit area from mining blocks located along the northern boundary of the area.
- 183. Mr Kennedy summarised these changes in his evidence in chief as a new soft sediment habitat comprising predominantly silt overlying sand over an area of 450 km² after 15 years of mining (or 1,050 km² if mining occurred for 35 years). He went on to note that this represented 0.6 % per year of the revised marine consent area, or 8.6 % over 15 years, and that in relation to the greater area of the Chatham Rise, this soft sediment habitat represented 0.6 % of the Chatham Rise shallower than 1,000 m.¹¹¹
- 184. The implications of these changes to the benthic ecology are discussed in Chapter 8.1.

7.3. Peer review

- 185. The sediment plume and sedimentation modelling work of Deltares was reviewed by ERM and HR Wallingford. The ERM review concluded that overall the modelling approach, assumptions and model predictability were appropriate to the study objectives. The review went on to conclude that while some suggested improvements would provide additional details around the estimates, the model results provided were sufficient for impact assessment.¹¹²
- 186. The HR Wallingford review concluded that the Deltares plume assessment had over-estimated the dispersion of the plumes arising from mining activities due to (i) over-coarse resolution of the numerical model which then reduced plume concentration and prevented collapse as a density current onto the seabed, and (ii) conservatively low values of particle settling velocity that were used in the modelling and which did not allow for sediment flocculation¹¹³ processes. As such, the review considered that the plume modelling presented a 'conservative' assessment of the dispersion of the plume. In other words, the plume modelling showed a wider dispersion of suspended sediment than was considered likely.¹¹⁴

¹¹¹ Paragraph 77, Statement of Evidence of Paul Cameron Kennedy for CRP on Assessment of Environmental Impacts (updated), 29 August 2014 (amended 14 November 2014)

 ¹¹² Letter from ERM / Fathom Consulting to the Deepwater Group dated 21 July 2013 (appended to the evidence of Mr Paul Starr and Dr David Middleton)
¹¹³ Flocculation is a process through which fine organic and inorganic particles stick together, forming loose, fragile structures,

¹¹³ Flocculation is a process through which fine organic and inorganic particles stick together, forming loose, fragile structures, which can easily break apart

¹¹⁴ Attachment A: HR Wallingford review of Deltares plume assessment, July 2014. Appended to FIR # 3, 4, 5 and 7

187. The HR Wallingford review also concluded that the currents predicted by the Delft-3D flow model were adequate for the purposes of the study, and compared with measured currents, the Delft-3D model predicted broadly the right currents over the general area most of the time.¹¹⁵

7.4. Sediment re-suspension

- 188. Re-suspension of settled sediment can occur when the bottom currents are strong enough to dislodge a particle from the seabed, but can also depend on the geotechnical properties of the sediments.
- 189. Ms Lescinski described in her evidence the analyses that were undertaken to assess the risk of sediment re-suspension occurring. She noted that current speeds near the seabed were likely not strong enough to erode the natural, inorganic sediments on the surface of the seabed on a regular basis. It was considered that discharged sediments, which are simply the seabed sediments minus the fraction that is smaller than 2 mm, would consolidate quickly (ie over several hours to a few days) and were unlikely to easily re-suspend¹¹⁶. This assessment was somewhat at odds with the view of Professor Watling, who stated in his evidence "*In addition, the time for sediment de-watering, known as self-consolidation, seems to be very hard to predict, but could easily be of the order of decades. It is also likely that as the sediment is consolidating, it will be subject to shear forces generated by tidal currents, so may well tend to move around*".¹¹⁷
- 190. It was Mr Spearman's (HR Wallingford) opinion that any re-suspension would be 'tiny' compared to the discharge release rate that had been modelled.¹¹⁸ The expert conferencing group on sediment agreed that once the re-deposited sediment had been on the bed for, *"on the order of 24 hours"*, there was only very small potential for re-suspension.¹¹⁹

¹¹⁵ Paragraph 9, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

¹¹⁶ Paragraph 34, Evidence of Professor Les Watling on behalf of Greenpeace, KASM and DSCC, 11 September 2014

¹¹⁷ Paragraph 34, Evidence of Professor Les Watling on behalf of Greenpeace, KASM and DSCC, 11 September 2014

¹¹⁸ Line 23, Page 494 of the Transcript

¹¹⁹ Issue 12, Joint Statement of Experts in the Field of Sediment Modelling, 26 September 2014

7.5. Appropriateness of the modelling

7.5.1. Currents

- 191. A number of fishermen expressed concern about the applicant's information on Chatham Rise currents and how these were used in sediment plume modelling. For example, Mr Summerton stated in his evidence that currents at the seabed have a predominant north-easterly flow and were strong.¹²⁰ Mr Smith, a qualified deep-sea skipper, expressed similar concerns.¹²¹
- 192. The issue of Chatham Rise currents was discussed by the expert conferencing group on sediment, noting that while the plume modelling demonstrated plume transport to the north-west, fishermen reported extensive experience of water currents in a different direction (to the north-east).¹²² The experts agreed that it is only the water currents in the bottom 50 m or so of the water column nearest the seabed which influence the sediment plume transport from the proposed mining operation, and that the plume was not anticipated to occur higher in the water column based on the modelling work. They also considered that while six months of current data was reasonable for model validation purposes, it would be of great benefit to have a longer measurement period than six months that also captured a summer season.¹²³
- 193. Ms Lescinski considered that the current monitoring and modelling work showed that currents were faster in winter and so would transport the plume more quickly. She acknowledged the complexity of currents on the Chatham Rise, but considered this issue had been taken into account in the modelling work and subsequent environmental assessments.¹²⁴
- 194. Mr Greer considered that the model performed well against measured currents.¹²⁵

7.5.2. Plume dispersion

195. Appendix 25 of the marine consent application and the EIA notes that while Delft3D has been used and validated in several sediment plume dispersion studies, these have been mostly in shallower coastal waters, and in general little is known about the performance of models to predict plume dispersion in deep water due to a lack of observations¹²⁶. The expert conferencing group on sediment modelling agreed that the proposed condition of releasing the sediment

¹²⁴ Paragraph 129, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

¹²⁰ Paragraphs 78 and 79, Amended Statement of Evidence of Greg Summerton on behalf of Te Rūnanga o Ngāi Tahu, 29 September 2014

¹²¹ Paragraph 20, Statement of Evidence of Andrew Peter Smith on behalf of the Deepwater Group Limited, 12 September 2014

¹²² Issue 8, Joint Statement of Experts in the Field of Sediment Modelling, 26 September 2014

¹²³ Issue 8, Joint Statement of Experts in the Field of Sediment Modelling, 26 September 2014

¹²⁵ Line 20, page 622 of the Transcript, 1 October 2014

¹²⁶ Paragraph 71, Statement of Evidence of Jamie Lescinski for CRP, 29 August 2014

discharge on average no more than 10 m above the seabed over the mining block seemed reasonable.¹²⁷

- 196. Mr Greer commented on evidence prepared by himself and Dr Mead at the request of the DMC. Their review of the plume modelling reports concluded that the best available information had been applied to the development of numerical models of plume dispersion and sedimentation in the modelling undertaken by Deltares on behalf of the applicant.¹²⁸ Industry recognised and respected models had been applied, and in general the model assumptions made in the use of parameters in the plume model were considered reasonable and appropriate for the environment and scenarios being modelled.¹²⁹
- 197. The expert conferencing group on sediment agreed that the model had not been calibrated nor validated against a measured discharge sediment plume. The DMC finds its comments on this issue to be highly pertinent. It stated in the joint witness statement: "There is value to both the consent holder and EPA in undertaking a plume model validation for the initial mine permit area once data is available for the plume generated due to mining. The value would be in demonstrating the conservativeness or otherwise of the model as it was used for the consent. It can be then used to guide confirmation of monitoring locations and inform decisions for expanding mining beyond the initial mine permit area."¹³⁰ In relation to the same issue and adaptive management, the group stated: "It should also be required that any subsequent plume model, utilised to decide whether to extend the mining area, is validated and implemented to demonstrate the ability to meet the SSC [suspended sediment concentration] and sedimentation thresholds (as may be defined within the consent)."
- 198. The expert conferencing group identified an information deficiency in the plume model relating to internal tides and how these may influence sediment transport. While the group concluded that their influence remained unquantified, it thought that they were unlikely to significantly influence the dispersion of the plume.¹³¹

7.5.3. Sediment character

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199. A number of submissions expressed concern that the applicant's sediment modelling work was not based on analysis of seabed sediment character after it had been subject to on-board processing to remove phosphorite nodules. However, the expert conferencing group on

¹²⁷ Issue 4, Joint Statement of Experts in the Field of Sediment Modelling, 26 September 2014

¹²⁸ Paragraph 4, Executive Summary, Statement of Evidence of Mr Dougal Greer (Sediment Plume Models) (29 September 2014) – Annexure B: Assessment of the sediment plume models provided in the CRP marine consent application (9 September

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¹²⁹ Assessment of the sediment plume models provided in the CRP marine consent application, 9 September 2014. Prepared by Dr Shaw Mead and Mr Dougal Greer, eCoast Marine Consulting and Research

¹³⁰ Issue 6, Joint statement of experts in the field of sediment modelling, 26 September 2014

¹³¹ Issue 13, Joint statement of experts in the field of sediment modelling, 26 September 2014

sediment concluded that the particle size distribution applied to the sediment modelling adequately represented the initial mine permit area for the purpose of the mining assessment. While the group noted that it was possible that the particle size distribution would be altered slightly by way of transportation during the mining and processing procedures (eg by the potential effects of flocculation), it anticipated this not to be an issue due to the conservative nature of the modelling.¹³²

7.5.4. Sediment plume generated by the drag-head

- 200. The EIA indicated that the drag-head could generate up to 25 % of the sediment mobilised by mining, with some of this material becoming suspended.¹³³ This level of suspended sediment material was considered by some submitters to be significant and they expressed concern that its fate had not been modelled or accounted for in assessments associated with sediment discharges and mobilisation. There remained some conjecture about the magnitude of this sediment source at the hearing. Mr Spearman (HR Wallingford), who peer reviewed the sediment modelling work undertaken by Deltares for the applicant, considered that the 25 % estimate was a gross over-estimate and thought it was likely to be much less. In response to questioning from the DMC, he stated he had provided evidence to the expert conferencing group regarding several studies that showed that the plumes from drag-head disturbance represented less than 1 % of the overflow, which he considered was a more reasonable estimate.¹³⁴
- 201. Dr Longdill stated that in his experience drag-heads were capable of generating significant amounts of suspending sediment. However, he did not expect it to reach anywhere near 25 % and considered that 2 to 3 % was a more realistic estimate¹³⁵. The expert conferencing group on sediment modelling agreed that 25 % was an extreme overestimate.¹³⁶
- 202. Dr Longdill stated that ultimately the issue of sediment plume generation, regardless of whether it was caused by the discharge from mining vessel or the drag-head, or both, could be best managed by assessing the plume against consent conditions.¹³⁷

7.6. Proposed conditions, adaptive management and monitoring

203. At the hearing, the applicant proposed a revised suite of conditions including several under the title of adaptive management and monitoring. Other proposed conditions stipulated operational

¹³² Issue 1, Joint statement of experts in the field of sediment modelling, 26 September 2014

¹³³ Section 8.3.5, Marine Consent Application and EIA, May 2014

¹³⁴ Line 20, page 503 of the Transcript, 1 October 2014

Line 40, page 652 of the Transcript, 2 October 2014

¹³⁶ Issue 5, Joint statement of experts in the field of sediment modelling, 26 September 2014

¹³⁷ Lines 6-10, page 653 of the Transcript, 2 October 2014

constraints that would affect the character of the sediment plume. For example, Proposed Condition 12 set out the requirements for the return of tailings. The sediment plume modelling (and therefore most of the effects as a result of the sediment plume) was based on a release of tailings 10 m above the seabed. Proposed Condition 12 specified the release height above the seabed as an average for each mining block. While the DMC acknowledges that the operator would not have the luxury of a static discharge point due to vessel movement caused by waves and tides, it considers that the height of discharge above the seabed would have been more appropriately expressed as an upper limit with sediment being required to be released a maximum of 10 m above the seabed. The sediment modelling experts group also

- 204. The expert conferencing group on sediment modelling emphasised the need for validation of the plume model before mining expanded beyond the initial mine permit area.¹³⁹ The applicant proposed to confirm the suspended sediment concentrations predicted by the plume model through monitoring sediment (indirectly using turbidity as a surrogate for sediment concentration) as provided for in 1A of Schedule 1 of the proposed conditions. This schedule contained a concentration trigger of 50 mg/L (at a point 5 km or greater away from the edge of the mining block being mined, or at a point 50 m or greater above the seabed at any location). Mr Kennedy explained that the 50 mg/L threshold was an ideal concentration for the underwater turbidity monitoring vehicle (Autonomous Underwater Vehicle or AUV) to track and therefore provided a more accurate comparison with the sediment plume model for that particular threshold (ie if the model is verified at this point then, by implication and back-calculation, other distances and concentrations could be verified).¹⁴⁰
- 205. Schedule 1 of the proposed conditions also contained a similar condition for sedimentation, based on a 1 mm sediment deposition threshold at a point no more than 7 km from the edge of mined mining blocks.
- 206. If any threshold level were exceeded under the criteria set out in Schedule 1, Proposed Condition 41 set out procedures including a requirement to complete an assessment of adaptive management approaches that could be implemented to "*avoid, remedy or minimise the exceedance of the environmental threshold identified in Schedule 1 or an unexpected adverse impact*". One of the difficulties the DMC identified with this proposed condition is that it would be left to the Chief Executive of the EPA to determine the significance of any exceedance of the environmental threshold or unexpected adverse effect, with any such determination subject to challenge by the consent holder.

¹³⁸ Issue 4, Joint statement of experts in the field of sediment modelling, 26 September 2014

¹³⁹ Issue 6, Joint statement of experts in the field of sediment modelling, 26 September 2014

¹⁴⁰ Lines 15 – 20, page 2226 of the Transcript, 17 November 2014

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- 207. Proposed Schedule 2A outlined monitoring to be undertaken prior to mining, including total suspended solids and turbidity, measured by landers to measure turbidity at the seabed and AUVs. Similarly Proposed Schedule 2A(ix) required installing a sedimentation trap to measure the ambient sedimentation levels. The DMC understands that these were to enable a comparison to be made with measurements taken once mining began. Proposed Schedule 2B(iii) provided for the comparison of turbidity levels during mining.
- 208. Although the applicant's witnesses expressed confidence in the applicant's ability to implement a sediment monitoring programme, the DMC has some reservations over the ability to adequately monitor any sediment plume and associated sedimentation at the depths proposed and at the levels of accuracy the DMC considers would be necessary. Firstly, the type of equipment required is not easy to obtain, deploy and maintain. For example, the AUV referred to by Mr Woods was, according to him, booked up for 90 per cent of the year and so there was difficulty getting it to New Zealand. He also stated that to test this equipment on the Chatham Rise could cost in the order of \$1.5 2 million or between \$30,000 and \$40,000 per day.¹⁴¹ Consequently, cost might limit its application.
- 209. Secondly, it seemed uncertain whether the technique of monitoring of sedimentation by visual observations, as described by Mr Kennedy¹⁴², would provide a sufficient level of accuracy. Mr Kennedy stated in response to questioning from the DMC that he had been assured that it was possible to get a general indication of the depth of sediment through photographs. He then went on to say however that it was extremely difficult to measure sedimentation depths when they are at the millimetre level. ¹⁴³ The DMC heard from Dr Hewitt that sedimentation levels as low as 1 mm may be sufficient to adversely affect some benthic organisms. ¹⁴⁴
- 210. Mr Wood described the proposed monitoring of currents, turbidity (as a surrogate for suspended sediment) and sedimentation in the event that consent to mine was granted. He described the applicant's discussions with scientists at Woods Hole Oceanographic Institution regarding the provision of monitoring equipment. Measurements of turbidity before, during and after mining would be used to verify and calibrate the oceanographic and plume dispersion models. Proposed monitoring of sedimentation would be mainly by visual observation using an AUV taking photographic transects.¹⁴⁵ Mr Kennedy considered these and other proposed

¹⁴¹ Lines 25 – 20, pages 247 – 248 of the Transcript, 26 September 2014

¹⁴² Paragraph 183, Statement of Evidence of Paul Cameron Kennedy for CRP on Assessment of Environmental Impacts (Updated), 29 August 2014 (Amended, 14 November 2014)

¹⁴³ Lines 30 – 35, page 2236 of the Transcript, 17 November 2014

¹⁴⁴ Line 45, page 727 of the Transcript, 3 October 2014

¹⁴⁵ Paragraph 164, Statement of Evidence of Raymond Allen Wood for CRP, 28 August 2014

measurements associated with the sediment plume would provide a robust mechanism for ensuring that the environmental standards of the project were maintained.¹⁴⁶

211. Reservations over the proposed approach to sediment monitoring were expressed by Mr Govier¹⁴⁷ and Dr Longdill. Dr Longdill implied that although turbidity and suspended sediment monitoring associated with shallow water dredging operations was fairly routine, he was not familiar with programmes in deep water or with robust methods that would get real time turbidity or suspended sediment measurements at the depths proposed.¹⁴⁸

7.7. **DMC** findings

- 212. The DMC accepts that the sediment dispersion model can be regarded as being conservative with respect to the predicted dispersion of sediment from the diffuser. Arguably this is due to some inappropriate assumptions used by Deltares in the initial model set-up. Any dispersion of suspended sediment and sedimentation is however highly reliant on the nature of the mining operation, of which there are many possible operating and environmental variables that can affect the physical behaviour of the discharged sediment. If one or more of these variables was altered (or found to differ) relative to the assumptions and inputs used in the modelling to date (eq the design of the discharge diffuser, the speed of currents or the degree of sediment suspension created by the drag-head), it could potentially alter the behaviour and distribution of the sediment plume and subsequent sediment deposition on the seabed.
- 213. Limited empirical validation of the sediment model has been undertaken to date and substantially more in situ monitoring and validation would be required before the accuracy of the model, and its predictive capability, could be confirmed. While the DMC accepts that validation could be achieved through monitoring of the sediment plume and associated sediment deposition once mining commenced, it has reservations regarding the ability to accurately monitor these parameters at the depths and scale that mining would take place at, in order to protect the surrounding ecosystems. Provision would be needed for a rapid response when environmental thresholds were triggered. Questions also remain over the availability of specialised equipment.
- 214. The DMC finds that the proposed adaptive management conditions of the applicant surrounding the behaviour of suspended sediment and sediment deposition contain a good deal of residual uncertainty in terms of the likely environmental outcomes. The DMC also retains reservations

¹⁴⁶ Paragraph 181, Statement of Evidence of Paul Cameron Kennedy for CRP on Assessment of Environmental Impacts (Updated), 29 August 2014 (Amended, 14 November 2014)

Line 25, page 340 - Line 40, page 341 of the Transcript, 29 September 2014

¹⁴⁸ Lines 27 – 43, page 655 of the Transcript, 2 October 2013

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about suspended sediment threshold levels in the proposed conditions. While it accepts that they may be a convenient trigger for verification of the sediment plume model, the DMC notes that other thresholds were discussed through the hearing in terms of environmental impacts. For example, 3 mg/L suspended solids was agreed as a suitable threshold criterion for fish avoidance of the plume.¹⁴⁹ The DMC discusses these issues in more detail in Chapters 7 and 8.5.

¹⁴⁹ Issue 2, Joint statement of experts in the field of Impacts on Fish, 18 September 2014

Effects of the Proposal on the Environment 8.

215. Section 59 of the EEZ Act sets out a number of matters which the DMC must take into account when considering an application for a marine consent and submissions on the application. This part of the decision identifies the main environmental effects in the context of Section 59 of the EEZ Act. It then discusses the applicant's proposed conditions and outlines the DMC's findings.

8.1. **Benthic environment**

8.1.1. Background

216. The seabed of the Chatham Rise where the proposed mining would take place is a benthic environment. The term benthic refers to anything associated with or occurring on the bottom of a body of water, and the animals and plants that live on or in the bottom are known as the benthos. Benthic macroinvertebrates are typically split into those organisms that live within the sediment (infauna) or on the seafloor surface (epifauna). Hyper-benthic organisms are mobile species associated with the seabed but predominantly living up to about one metre above it rather than on or in it.

8.1.2. **Physical description**

217. As described in Chapter 4, the crest of the Chatham Rise is generally flat, although punctuated in places with local typographical features such as banks, isolated volcanic peaks or seamounts and iceberg scours. The seabed sediments in the applicant's mining licence area are predominantly muddy sands, with localised areas containing variable amounts of gravel-sized phosphorite nodules¹⁵⁰. In order to see what the benthic environment looked like, Mr Wood showed the DMC some of the footage taken in March 2012 by a remotely operated vehicle which conducted photographic transects of the seafloor within the proposed mining area. Examples of hard and soft bottom dominated sediments within the consent application area are shown in Figure 7. 151

8.1.3. Seabed surveys and benthic communities

218. Benthic communities of the Chatham Rise were extensively reviewed in the applicant's EIA¹⁵² and this information was summarised largely in the evidence of Dr Rowden. Video and still images taken of the seafloor by a remotely operated vehicle were used to determine the structure (composition and relative abundance) of epifaunal communities. Direct samples of the seabed were collected by a box-corer to determine the structure of infaunal communities.¹⁵³

¹⁵⁰ Section 4.5 of Appendix 9 of the EIA, Seafloor morphology and substrate characterisation on Chatham Rise, May 2013

¹⁵¹ Pages 220 – 226 of the Transcript, 26 September 2014 ¹⁵² Appendices 13, 14, 15 and 16 of the EIA

¹⁵³ Section 2.1.2, Benthic Epifauna Communities of the Central Chatham Rise Crest (NIWA, 2014)

- 219. Dr Rowden described how infaunal communities on the Chatham Rise are dominated numerically by polychaetes and peracarid crustaceans, with differences within these communities reflecting differences in the quantity and quality of the food supplied to the seabed as controlled by the spatial and temporal dynamics of the subtropical front.¹⁵⁴ He noted that eight distinct benthic epifaunal communities were found in an extensive survey in 2007 (Ocean Survey 20/20), three of which were found only on the Chatham Rise and the remaining five were also found on the Challenger Plateau. However this survey did not sample the central crest of the Chatham Rise.¹⁵⁵
- 220. Subsequent surveys in 2012 and 2013 were used to identify and describe benthic communities on the central crest of the Rise, including sites within the applicant's marine consent application area. Five infaunal communities were identified in the consent area. One of these communities exhibited a positive relationship with phosphorite nodule density and was characterised mainly by amphipod and polychaete species.¹⁵⁶
- 221. Up to thirteen epifaunal communities were identified in these later surveys and the overall structure of the epifaunal communities is related primarily to the presence of mud / sand and phosphorite nodules. Two of the epifaunal communities were dominated by the stony coral *Goniocorella dumosa* (*G. dumosa*) and showed a patchy distribution in the study area that was associated with the presence of phosphorite nodules (see *Figure 7*) that were concentrated in the marine consent area, particularly the mining permit area.¹⁵⁷
- 222. The DMC was told that although the benthic macrofaunal communities of the Chatham Rise are one of the best sampled and studied deep-fauna of New Zealand's EEZ¹⁵⁸, the survey data varies spatially, with some areas surveyed more thoroughly than others. Not surprisingly, most of the information relating to this consent application concerned mining permit area MPL 55549. Geographical coverage of the surrounds, including the prospecting areas, was more limited¹⁵⁹. The expert conferencing group on benthic ecology and spatial planning concluded that while there was sufficient knowledge to inform decision-making with regard to potential major impacts on the benthic resources within MPL 55549, there was inadequate geographical coverage of information in surrounding areas such that they could not predict with confidence the overall impacts of mining on organisms, communities and ecosystems at the broader Chatham Rise scale.¹⁶⁰ The DMC returns to this issue in subsequent chapters of this decision.

¹⁵⁴ Paragraph 27, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

¹⁵⁵ Paragraph 29, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

¹⁵⁶ Paragraph 38, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

¹⁵⁷ Paragraph 39, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

¹⁵⁸ Paragraph 25, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

¹⁵⁹ Issue 1, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

¹⁶⁰ Issue 1, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

223. The expert group also agreed that there was uncertainty about the full degree of biodiversity due to restricted sampling effort and limited taxonomical resolution.¹⁶¹



*Figure 7. Top: Seafloor image of hard sediment showing an epifauna community characterised by the stony coral G. dumosa associated with haed sediments (phosphorite nodules). Bottom: Seabed surface dominated largely by fine sediments.*¹⁶²

¹⁶¹ Issue 1, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

8.1.4. Significance of the benthic communities

- 224. The DMC was interested to understand the distribution and uniqueness of benthic communities within the consent application area. Dr Rowden stated that of the five infaunal communities identified in the marine consent area, two are probably also represented elsewhere on the Rise. He opined there is less certainty around that assessment because of the difference in the level of taxonomic identification between the various studies. However, the nodule-associated amphipod-dominated infaunal community appears not to have been observed before on the Rise or elsewhere in New Zealand's EEZ. Dr Rowden speculated the phosphorite nodules may influence the particular type of infaunal community through their physical character such as internal structure of the sediment, the sediment sizes, and the spaces between the nodules.¹⁶³
- 225. Dr Rowden also stated that the two epifaunal communities dominated by the stony coral *G*. *dumosa* within the marine consent area have not been found elsewhere on the Rise to date, or elsewhere in the New Zealand EEZ. The DMC was told that *G. dumosa* relies upon hard substrate, such as that provided by relatively large phosphorite nodules, for attachment. Similar corals, particularly when in high abundance, are known to provide habitat for a diverse community of other invertebrates, and potentially larval or juvenile fish¹⁶⁴. Dr Rowden stated that these communities can be classed as coral reefs or thickets which are sensitive environments under the Exclusive Economic Zone and Continental Shelf (Environment Effects - Permitted Activities) Regulations 2013, and the stony coral on which they are based is a protected species in New Zealand waters (under the Wildlife Act 1953).¹⁶⁵
- 226. Dr Berkenbusch stated that *G. dumosa* has been recorded as widespread throughout New Zealand's EEZ, but not as a dominant species that characterises benthic communities nor at such high densities and levels of abundance.¹⁶⁶ She explained that this coral species was determining the structure and distribution of the two unique epifaunal communities found within the marine consent area.
- 227. In response to questions from the DMC, Dr Rowden indicated that it was not possible to determine whether the stony coral communities could be classified as threatened because the level of identification for many of the organisms in these communities was not of sufficient resolution (ie not down to species level) to assess threat status as determined by the Department of Conservation.¹⁶⁷ Dr Rowden stated "… *species which are listed on the*

¹⁶⁵ Paragraph 40, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

¹⁶² Photos presented by Mr Ray Wood 26 September 2014

¹⁶³ Line 10, page 1997 of the Transcript, 6 November 2014

¹⁶⁴ Section 4.1.1 of Appendix 15 of the EIA, Benthic communities of MPL 50270 on the Chatham Rise, May 2013

¹⁶⁶ Lines 1 – 8, page 302 of the Transcript, 29 September 2014

¹⁶⁷ Lines 4 – 15, page 2013 of the Transcript, 6 November 2014
threatened list are always to the species level"¹⁶⁸. He also noted that people often used the terms 'communities' and 'ecosystems' interchangeably.

- 228. When asked whether these communities might be considered rare and vulnerable¹⁶⁹. Dr Rowden said they may be considered 'Vulnerable Marine Ecosystems' as defined by the United Nations Food and Agriculture Organisation (FAO), which considers a number of criteria such as whether the community is fragile, whether or not it provides habitat and whether or not it has a restricted reproductive cycle.¹⁷⁰ In response to a question from Ms Hazaan (Greenpeace, KASM, DSCC), Dr Rowden acknowledged the coral-based communities would classify as 'vulnerable' under the FAO Deep Sea Guidelines to regulate bottom trawling.¹⁷¹
- 229. With respect to rarity, Dr Rowden was more circumspect. He made the point that while most deep sea organisms are considered rare "you don't know if that's simply because generally the sampling in the deep sea is relatively poor and therefore rarity just means that that could simply be a sampling artefact. He went on to conclude "So most people in the deep sea try to keep away from the notion of rarity".¹⁷² However he did state "there are a number of communities which look like they could be unique".¹⁷³
- 230. Dr Hourigan considered that the branching stony corals present in the mining application area may be of particular significance due to both the size of the colonies, their abundance and density in the area, and their likely contribution to structuring habitats for other species. He considered the coral-dominated communities would also appear to meet the criteria set out by the Convention on Biological Diversity 2009 for 'Ecologically or Biologically Significant Marine Areas' in the deep sea. They represented rare or distinct habitats with comparatively higher diversity, composed of fragile, slow-growing species.¹⁷⁴
- 231. Dr Berkenbusch stated that the data that does exist indicates that benthic fauna on the Chatham Rise includes potentially unique and ecologically important communities in the marine consent application area. This included the epifaunal communities dominated by G. dumosa and one infaunal community that appear to be unique to the marine consent area. She explained the importance of coral in providing habitat for other species and fulfilling ecosystem functions.¹⁷⁵ The DMC also heard that while corals are important for forming habitats, sponges can fulfil this role as well.

¹⁶⁸ Line 15, page 2013 of the Transcript, 6 November 2014

¹⁶⁹ Under Section 59(2)(e) of the EEZ Act, the EPA must take into account the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species

¹⁷⁰ Lines 37 – 43, page 2013 and lines 1 – 4, Page 2014 of the Transcript, 6 November 2014

¹⁷¹ Lines 18 – 33, page 2029 of the Transcript, 6 November 2014

¹⁷² Lines 5 – 11, page 2014 of the Transcript, 6 November 2014

 ¹⁷³ Lines 21 – 24, page 2014 of the Transcript, 6 November 2014
 ¹⁷⁴ Paragraph 27, Statement of Evidence of Thomas Francis Hourigan for the Crown, 12 September 2014

¹⁷⁵ Lines 22 – 26, page 338 of the Transcript, 29 September 2014

- 232. The impact of acidification was raised by the experts involved in ecosystem effects conferencing and Dr Fulton explained the significance of this. She explained that the pH of the ocean may in the future constrain the extent of species sensitive to ocean pH such as corals, and the Chatham Rise may become the only suitable habitat for them. This would make any losses potentially more significant.¹⁷⁶
- 233. The experts who participated in conferencing on benthic ecology and spatial planning agreed that benthic communities on the crest of the Chatham Rise played an important role in ecosystem functions such as biodiversity, nutrient recycling and habitat provision, but noted that these specific aspects of ecosystem function had not been considered in the EIA.¹⁷⁷

8.1.5. Effects

- 234. Given the apparent uniqueness of some of the benthic communities within the consent application area, and the seabed's protection from bottom trawling by a BPA (discussed in Chapter 10.1), the DMC was particularly interested in the potential effects of the mining proposal on the benthic environment. Section 59(d) and (e) of the EEZ Act requires the DMC to take into account the importance of protecting the biological diversity and integrity of marine species, ecosystems and processes and the importance of protecting rare and vulnerable ecosystems.
- 235. The DMC considers it likely that there would be four broad physical changes to the benthic environment as a result of the proposed mining operation:
 - the removal of large tracks of seabed and any associated benthic communities and probably hyper-benthic species
 - the replacement of benthic habitat with a relatively thick layer of screened sands and silts of a more homogenous character minus the original hard substrate (ie phosphorite nodules) and living benthic biota
 - the deposition of mainly clay and silt sediment particles over un-mined seabed in areas adjacent to the mine tracks
 - iv) the creation of a turbid sediment plume in the water column immediately above the seabed that would persist for a limited period of time determined largely by when active mining takes places.

¹⁷⁶ Lines 19 – 25, page 1000 of the Transcript, 15 October 2014

¹⁷⁷ Issue 2, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

- 236. These four physical changes were broadly in line with the findings of the experts who participated in conferencing on benthic ecology and spatial planning. They agreed that the main potential effects on the benthic environment associated with the proposal would be:¹⁷⁸
 - removal and mortality of benthic organisms in the path of the drag-head
 - permanent removal of phosphorite nodules reducing hard substrate habitat for epifauna and changing the landscape
 - increased sedimentation for nearby organisms
 - enhanced suspended sediment
 - changing grain size of the sediment and sediment water content
 - possible changes in organic content and food quality.
- 237. Potential chemical changes to the benthic environment were also possible due to sediment agitation and mixing with seawater associated with the mining process. Water quality is discussed in Chapter 8.8.
- 238. In general, the DMC found that changes to the benthic environment were undisputed by any party to this application, and these physical and biological changes would be inevitable as a result of the proposed mining and sediment disposal methods. All these changes are adverse in nature. A key consideration for the DMC was determining how significant these changes would be, and in particular, the likely short and long term effects on benthic communities, and how they may be avoided, remedied or mitigated.¹⁷⁹ These effects are discussed below.
- 239. Potential adverse effects to seafloor communities would be both within the proposed mining area and beyond the area that is physically mined. Dr Berkenbusch summarised the knowledge of potential effects: while there was a general understanding of the immediate direct impacts in the actively mined area, there was considerable uncertainty about potential indirect adverse effects, including in adjacent areas. The indirect effects were linked to increased sedimentation, elevated levels of suspended sediment, changes to sediment grain size and water content and potential changes to the organic content and food quality.¹⁸⁰
- 240. Dr Hewitt provided further clarification by stating that the suspended sediment concentrations and the sediment deposition would decrease with distance from the area being mined and the impacts on the benthic organisms were also likely to form a gradient with distance. However this depended very heavily on the benthic species communities present at any point.¹⁸¹

¹⁷⁸ Issue 3, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

¹⁷⁹ Lines 12 – 21, page 722 of the Transcript, 3 October 2014

¹⁸⁰ Lines 5 – 10, page 298 of the Transcript, 29 September 2014

¹⁸¹ Lines 11 – 23, page 722 of the Transcript, 3 October 2014

Removal and mortality of benthic organisms due to the drag-head

- 241. The extraction of phosphorite nodules in the proposed mining area would remove both the phosphorite nodules and surrounding soft sediments, together with associated benthic faunal communities.¹⁸² The DMC accepts that it is unavoidable that all benthic organisms (both flora and fauna) to the depth mined by the drag-head would be killed, or at the very least displaced. This is an inevitable consequence of the proposed mining technique.
- 242. The spatial extent of destruction of the seabed and associated benthic organisms was determined largely by the applicant's proposed Mine Plan (the sequential mining of areas referred to as mine blocks), which was described in the EIA, and in the evidence of Mr van Raalte and Mr Kennedy. Mr Kennedy stated that the extent of benthic habitat change associated with seabed directly affected by mining would be 10 km² per block or 30 km² per year (ie three 2 x 5 km blocks mined each year). This would equate to 450 km² over 15 years of mining (see Figure 8 below). Mr Kennedy went to state that this area represents 0.6 % per year of the revised marine consent application area, or 8.6 % over 15 years. Mr Winchester said that if mining occurred for 35 years, this would equate to about 1,050 km² of mined seabed or about 20 % of the revised marine consent application area.¹⁸³



Figure 8. The current proposed sequence for 15 years mining blocks are shaded and labelled with the year they would be mined. Years 1 to 5 are indivually identified, years 6 to 10, and 11 to 15 are amalgamated and labelled as 10 and 15 respectively. (Source: FIR 6, 8 July 2014)

¹⁸² Section 5 of Appendix 30 of the EIA, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise. January 2013 (updated June 2013); and Issue 1, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

¹⁸³ Paragraph 22, Opening submission for CRP, 25 September 2014

- 243. The DMC understands that this 1,050 km² mined area did not include proposed mining exclusion areas located within the consent application area as proposed by the applicant (as identified in Attachment B of Ms Taylor's evidence)¹⁸⁴. Neither did it include potential additional mining exclusion areas identified through further proposed surveys undertaken after consent was granted, including further prospecting activities and areas of significant coral thickets, significant marine biodiversity and cultural significance. Some of these areas may be located outside of the consent application area and the BPA and so would require some form of regulation in order to provide effective protection from seabed disturbance activities (eg bottom trawling or future mining applications). The DMC discusses this issue later in the context of mitigation proposals.
- 244. Having accepted that mortality of benthic communities on a significant scale would be inevitable, the DMC turned its mind to the potential for recolonisation to understand the long term effects of the proposal. Recolonisation was explored during the hearing and is a complex matter. From the technical reports, evidence and joint witness statements, the DMC understands that the factors affecting recolonisation include the seabed sediment characteristics, a ready source of settling organisms and a suitable habitat. The DMC heard that resettlement of planktonic larvae is not well understood, with propagules demonstrating the ability to select surface characteristics that would enhance their chances of survival, for example biofilms, surface roughness / texture, colour and sediment particle size.¹⁸⁵
- 245. Dr Berkenbusch advised that in general there is little known about recolonisation and recovery of benthic species and communities at the depth of the proposed mining. Colonisation and recovery of benthic communities in areas where the sediment would be returned would not be likely to occur until the sedimentary habitats consolidated and became suitable.¹⁸⁶
- 246. Dr Rowden also noted that the lack of data available on recruitment and growth of benthic organisms in the deep sea made it difficult to estimate recovery time post-disturbance.¹⁸⁷ He went on to state that where fauna such as the stony coral *G. dumosa* depend upon the hard substrate provided by the nodules that have been removed, recolonisation would not be possible and significantly altered communities would result because of the loss of such key habitat-formers.¹⁸⁸

¹⁸⁴ Appendix B of Attachment A to Statement of Evidence of Carmen Taylor for CRP, 29 August 2014

¹⁸⁵ Section 2.2.3 of Appendix 30 of the EIA. Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)

¹⁸⁶ Lines 14 – 18, page 298 of the Transcript, 29 September 2014

¹⁸⁷ Paragraph 48. Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

¹⁸⁸ Paragraph 7, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

- 247. The DMC understands from the technical reports that there are two main pathways by which benthic invertebrates recolonise disturbed sediments: lateral migration of adults / juveniles of mobile taxa from nearby undisturbed habitats; and the dispersal of larvae from populations of reproductive adults. Larval dispersal was considered likely to be the main method for recolonisation of benthic communities following mining.¹⁸⁹ There was a risk that the wider effects of sedimentation and increased suspended sediment would affect the availability of larvae from surrounding areas for recolonisation.¹⁹⁰
- 248. While the absence of data makes it difficult to estimate recovery time post-disturbance, there was a general consensus that recovery of benthic communities following disturbance in the deep sea was likely to be slower than in coastal or continental shelf communities.¹⁹¹ It was also likely that as the size and frequency of disturbance increased, so would the length of time to recover to mature communities.¹⁹²
- 249. The initial phases of recolonisation of disturbed hard substrate habitat in the proposed mining area were expected to take at least months or years, and complete recovery of the slow growing sessile fauna-dominated communities was likely to take decades or longer. Because recolonisation is dependent on the availability of larvae from neighbouring source populations, it was also possible that recovery to pre-mining community structure would not occur at all.¹⁹³
- 250. Overall, the DMC agrees with Mr Kennedy that the benthic biota within the mining blocks would be removed and that this was a significant impact of the proposed mining operations that could not be avoided, remedied or entirely mitigated.¹⁹⁴

Removal of hard substrate habitat

251. Dr Hourigan told the DMC that *G. dumosa* and other sessile invertebrates including sponges, ascidians and bryozoans appeared to be growing directly on the phosphorite nodules or in close association with them as they provided the hard substrate that these animals need for attachment.¹⁹⁵ The 2012 survey of the area indicated that Cnidaria (including anemones, the cold-water coral *G. dumosa* and the cup coral *Flabellum* sp.), Porifera, Bryozoa, Ascidia, some

¹⁹¹ Page 23, of Appendix 30 of the EIA, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)

 ¹⁸⁹ Executive summary of Appendix 30 of the EIA. Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)
 ¹⁹⁰ Section 4.2 of Appendix 30 of the EIA, Potential for recolonisation and recovery by benthic communities following mining

¹⁹⁰ Section 4.2 of Appendix 30 of the EIA, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)

¹⁹² Section 5 of EIA of Appendix 30 of the EIA, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)

¹⁹³ Section 4.2 of Appendix 30 of the EIA, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)

¹⁹⁴ Paragraph 82, Statement of Evidence of Paul Kennedy for CRP on Assessment of Environmental Impacts (updated), 29 August 2014 (amended 14 November 2014)

¹⁹⁵ Lines 5 – 9, page 356 of the Transcript, 30 September 2014

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Mollusca and some Annelida were the main benthic taxa associated with hard substrate habitat such as rocks, boulders and ledges in the proposed mining area.¹⁹⁶ Colonies of *G. dumosa* were frequently observed attached to nodules, and this species was the dominant epifaunal organism of the phosphorite nodule-soft sediment matrix habitat community.¹⁹⁷

- 252. The benthic experts agreed that permanent removal of phosphorite nodules would reduce the available hard strata habitat for epifauna and change the landscape lived in by the infauna.¹⁹⁸ Where the fauna depended on the hard substrate provided by the nodules that were removed, recolonisation would not be possible and significantly altered communities would result.¹⁹⁹ The benthic experts agreed.²⁰⁰
- 253. The applicant proposed to assess artificial hard substrates with trials initially taking place in unmined areas. There have been no recolonisation trials, and the benthic experts involved in conferencing agreed that there was a high level of uncertainty as to whether this would be successful. They agreed there was a need to clearly outline what "*successful*" trials would constitute.²⁰¹ The benthic experts considered the method needed to be proven successful before it can be proposed as a mitigation technique and the DMC agrees.
- 254. The benthic experts also agreed that even if an alternate substrate was provided, the recovery of communities and species populations to pre-mining state was uncertain. In addition, the benthic experts agreed that there was uncertainty about the degree of dependence of corals on phosphorite nodules and their ability to colonise other hard substrates.²⁰² Dr Berkenbusch further explained this statement: that it was unknown if the phosphorite nodules provide more to coral over and above just providing hard substrate.²⁰³ The likely timeframes for potential colonisation of an alternate substrate were also unknown due a number of variables including sources of larvae, frequency of larvae production and vagaries of currents or temperature.²⁰⁴
- 255. Due to the dominance of *G. dumosa*, the recovery of the benthic community of the phosphorite nodule-soft sediment matrix habitat was very much tied to the recolonisation potential of this coral species.²⁰⁵

¹⁹⁶ Section 4.2, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise January 2013 (updated June 2013)

¹⁹⁷ Section 4.3, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise January 2013 (updated June 2013)

¹⁹⁸ Issue 3, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014 ¹⁹⁹ Section 5 of Appendix 30 of the EIA, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)

²⁰⁰ Issue 6, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

²⁰¹ Issue 7, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

 ²⁰² Issue 6, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014
 ²⁰³ Lines 16 – 17, page 303 of the Transcript, 29 September 2014

²⁰⁴ Lines 6 – 14, page 361 of the Transcript, 30 September 2014

²⁰⁵ Section 4.3 of Appendix 30 of the EIA, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)

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- 256. Dr Hourigan advised that any decisions on mining should not be premised upon expectations of significant restoration. In his evidence he stated "While the proposal to explore hard-substrate habitat creation that might encourage natural recolonisation is scientifically interesting, there is insufficient information on their potential for success. I am not aware of any examples of successful deep-sea coral restoration. The results of these experiments would not be seen for many years. Therefore, such untested experiments should not be relied upon as mitigation measures."206
- 257. From the information provided and evidence heard, the DMC agrees with Dr Hourigan that recolonisation trials are unlikely to prove successful in a short time span, if at all. The DMC also agrees with Mr Kennedy that if indeed recolonisation of the mined areas occurred, it would be by the benthic fauna and communities that characterise soft sediment habitats and would result in a notably different habitat and benthic community to the existing phosphorite nodule communities.207

Smothering from the deposition of tailings (sedimentation)

- 258. The effects of the direct removal of the seabed as determined by the Mine Plan could be quantified as far as the proposal has been put before the DMC, with a number of caveats associated with exclusion areas and avoidance of other sensitive areas and areas not mined due to operational constraints or other such matters. Indirect effects on non-mined areas were however, less easily quantified in terms of impacts on benthic fauna associated with sediment deposition (ie fallout from the sediment plume). The distribution and scale of this sediment deposition away from mining blocks was the focus of considerable evidence and debate amongst experts and submitters concerned about protection of biodiversity and commercial fish species.
- 259. The DMC understands that the spatial extent and depth of sediment deposited from the tailings very much depends on factors such as sediment size, currents and height of release of tailings above the seafloor (as described in Chapter 7). In her evidence, Dr Hewitt stated that sediment smothering occurs when the depositional rate of sediment from the water column is more than the seafloor animals living in the area are adapted to.²⁰⁸ The technical reports stated that sedimentation on organisms does not always directly result in death. Other potential effects included lower fertilisation, lower rates of larval survival and settlement, reduced juvenile

²⁰⁶ Paragraph F, Statement of Evidence of Thomas Francis Hourigan for the Crown, 12 September 2014

²⁰⁷ Paragraph 58, Statement of Evidence of Paul Cameron Kennedy for CRP on Assessment of Environmental Impacts (updated), 29 August 2014 (amended 14 November 2014)

Paragraph 17, Statement of Evidence of Judith Elaine Hewitt for CRP, 28 August 2014

survival, increased fragility and decreased fitness resulting in decreased growth and ability to escape predation.²⁰⁹

- 260. Dr Hourigan stated in his evidence that deep sea coral buried by sediments would die after several days, and explained during questioning that this was because the sediment would interfere with their feeding and probably with their gas exchange. If they were buried, they would be unable to clean their mouth parts and clean their polyps in order to continue to ingest food and to breathe.²¹⁰
- 261. The DMC heard from Dr Hewitt that the effect of sedimentation is determined by a large number of factors, for example mobility of the organism and the location, length and the mobility of the feeding apparatus.²¹¹ Depth and duration of burial are also important predictors of impact.²¹² Dr Hewitt informed the DMC that biological responses to stresses usually get worse with repeated events.²¹³ From this, the DMC considers that resuspension of sediment and consequential deposition could exacerbate the stress to organisms. Dr Hewitt informed the DMC that a series of lower level events were also likely to have more of an effect than a single event, if the animals could not recover condition between events.²¹⁴
- 262. Dr Hewitt described the international information on sensitivity of benthic organisms to suspended sediment and sediment deposition. She noted that of the dominant communities and the taxa that comprise them found in recent benthic biological surveys conducted over the applicant's marine licence area (summarised in Appendix 15 of the EIA), there was no known New Zealand information on the sensitivities of these taxa to suspended solids or sediment deposition²¹⁵. Dr Hewitt described how the MarLin (Marine Life Network) database was used to undertake an assessment of impacts of seafloor mining. This database lists sensitivities of 150 European benthic species. She described at least one of the dominant species in each epifaunal community as highly or very highly sensitive to smothering with the exception of Community H. Not surprisingly, the infaunal communities were comparatively less sensitive to smothering.²¹⁶ However Dr Hewitt acknowledged that the use of the MarLIN database for setting thresholds was questionable and that there was no information on the sensitivity of the benthic community to sedimentation in the application area.²¹⁷

²⁰⁹ Section 3.1 of Appendix 29 of the EIA, Impacts of sedimentation arising from mining on the Chatham Rise, August 2012 (updated July 2013)

²¹⁰ Lines 15 – 19, page 393 of the Transcript, 30 September 2014

²¹¹ Lines 30 – 38, page 720 of the Transcript, 3 October 2014

²¹² Section 3.1.2, Impacts of sedimentation arising from mining on the Chatham Rise, August 2012 (updated July 2013)

²¹³ Lines 38 – 40, page 720 of the Transcript, 3 October 2014

²¹⁴ Paragraph 49, Statement of Evidence of Judith Elaine Hewitt for CRP, 28 August 2014

²¹⁵ Paragraph 28, Statement of Evidence of Judith Elaine Hewitt for CRP, 28 August 2014

²¹⁶ Lines 9 – 15, page 720 of the Transcript, 3 October 2014

²¹⁷ Lines 42 – 44, page 722 of the Transcript, 3 October 2014

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- 263. Dr Hewitt characterised all the epifaunal communities described from camera images from MPL 50270 on the Chatham Rise as being highly or very highly sensitive to smothering, and highly sensitive to suspended sediment. She thought that those damaged by sedimentation would take greater than 25 years to recover "*if at all*".²¹⁸
- 264. The analysis of the MarLIN database led Dr Hewitt to conclude that epifaunal communities all had at least one defining taxon predicted to be destroyed or damaged, with recovery taking at least 10 years. The levels of sedimentation and suspended sediment concentrations expected to elicit this response were 5 cm sedimentation depth and 100 mg/L respectively, lasting for one month. However, on a cautionary note, Dr Hewitt went on to conclude that "*Also, while the depth of sedimentation is predicted to be <5 cm outside the actual mined area, the small size of some organisms and much experimental work within New Zealand on similar types of organisms, suggests that levels between 0.5 mm (height protruded by the small encrusting bryozoans found in the area) to 5 cm could have marked effects."²¹⁹*
- 265. The DMC clarified with Dr Berkenbusch that the experts were in agreement that the stony corals were *"highly sensitive"* to sedimentation and what this phrase meant. Dr Berkenbusch explained that this means that even small changes to the suspended sediment levels or to the sediment that is settling on to the coral are likely to have a dramatic adverse effect on the coral.²²⁰
- 266. From the evidence, the DMC understand that the effect of sediment deposition is greater than just the effects of smothering. The DMC heard from Dr Hourigan that if the hard substrate is covered by sediment, it can interfere with the settlement and attachment of larvae. Once they have settled, single polyps are barely a millimetre or two above the hard substrate on which they sit and are much more likely to get buried than would an adult coral colony which sits higher.²²¹ Dr Hourigan confirmed that in areas where there has been previous mining and polyps have settled then they are at risk again from sediment from subsequent mining.²²²
- 267. The experts for benthic ecology agreed that there was no information available on the sensitivity of organisms to increased sediment, and insufficient information to reliably assess the effects of changes to the sediment regime on benthic communities.²²³ The benthic experts agreed that validation of the sediment plume model to determine the extent and depth of sediment would allow more accurate estimation of the effects of increased sediment.

²¹⁸ Paragraph 30, Statement of Evidence of Judith Elaine Hewitt for CRP, 28 August 2014

²¹⁹ Paragraph 50, Statement of Evidence of Judith Elaine Hewitt for CRP, 28 August 2014

²²⁰ Lines 17 – 28, page 304 of the Transcript, 29 September 2014

²²¹ Lines 28 – 35, page 266 of the Transcript, 30 September 2014

²²² Lines 2 – 9, page 367 of the Transcript, 30 September 2014

²²³ Issue 3, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

Increased suspended sediment levels

- 268. The sediment plume was seen as a temporary effect as it was expected to last for a relatively short period of time, depending on when active mining of the bed was taking place. This was in contrast to any deposited fine sediment, which was expected to remain indefinitely on the seabed due to currents on the Chatham Rise crest not having sufficient shear stress to resuspend fine sediments and disperse them further afield.
- 269. From the sediment modelling, the DMC understands that deposition of the tailings would create a sediment plume that would disperse outside of active mining areas. Increased levels of suspended sediment near the seabed can have an impact on organisms that feed on suspended organic particles such as filter feeders. Either the organisms consume additional energy sorting out the organic particles from the inorganic fraction or they must ingest both organic and inorganic particles together, thereby decreasing the average digestibility of their food. This can reduce the energy available for growth or reproduction, or even cause damage to feeding apparatus and gills.²²⁴
- 270. The DMC asked Dr Berkenbusch about the uncertainty around tolerance to suspended sediment and whether there is any practical way of addressing that information gap. Dr Berkenbusch considered that *in situ* experiments or even laboratory experiments could be undertaken.²²⁵ However, questions remained about the practicality of undertaking such experiments given the remoteness of the consent application area and the depth at which local benthic communities live.

Changes to the benthic sediment characteristics

- 271. The recolonisation report in the EIA considered that environmental factors such as sediment particle size are known to be important factors for settlement and recolonisation of soft sediments. Thus, changes to the sediments within the disturbed area (including those resulting from back-filling of the excavated area with tailings) could further inhibit or delay recovery, or could lead to long-term changes in community structure.²²⁶
- 272. Both Dr Berkenbusch and Professor Watling considered that the sediment that is returned would not be as consolidated as it was before, and it is very likely that nothing can settle in that sediment until it consolidates from a "*soupy*" state.²²⁷ Professor Watling opined that larvae that

²²⁴ Section 3.1.1 of Appendix 29 of the EIA, Impacts of sedimentation arising from mining on the Chatham Rise, August 2012 (updated July 2013)

²²⁵ Lines 11 – 17, page 305 of the Transcript, 29 October 2014

²²⁶ Section 4.1 of Appendix 30, of the EIA, Potential for recolonisation and recovery by benthic communities following mining disturbance on the Chatham Rise, January 2013 (updated June 2013)

²²⁷ Lines 1 – 4, page 316 of the Transcript, 29 September 2014

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are only two-tenths of a millimetre in diameter would have difficulty settling in sediment with very high water content, even if the high water content is only in the top centimetre.²²⁸ Fine sediment deposited over the top of coarser sediment may reduce sediment permeability by filling interstitial pore spaces, creating a cap on top of the coarser sediment through which pore water, nutrients and oxygen can no longer pass.²²⁹ The DMC understands that under such under hypoxic conditions, suspension feeders may be replaced by deposit feeders, and macrobenthos by meiobenthos, ultimately resulting in a change in benthic community.²³⁰

273. Regardless of how quickly deposited fine sediments would consolidate, there was little doubt that the benthic community within mined areas of the seabed would change to one dominated almost exclusively by species that favour a soft sediment environment. As to changes in the benthic community away from the mined areas, the only evidence received from experts in this field indicated that adverse effects were likely for those species and communities that prefer hard surfaces. The extent of these effects would vary depending on individual species (for which there was very little information) and the degree of sediment dispersion and subsequent deposition.

Changes in food

- 274. From the research and evidence presented, the DMC understands that this effect could be both positive and negative. Deposited sediment may differ from ambient underlying sediments with increased organic matter from organisms crushed by the mining process. The effects of increased organic content in deposited sediment include provision of an extra food source for deposit feeders and scavengers, but also a reduction in the redox potential.²³¹ In general, the DMC understands that this would favour species that tolerate living within fine sediments with limited oxygen availability.
- 275. The DMC heard from Professor Watling that the particle concentration in the water may increase to the point where either the organism that is filtering particles out of the water for its food would get overwhelmed by sediment particles, or the actual food particles themselves would be diluted by the mineral grains from the plume. In either case the animal would not be getting enough food.²³²

²²⁸ Lines 34 – 37, page 409 of the Transcript, 30 September 2014

²²⁹ Paragraph 18, Statement of Evidence of Judith Elaine Hewitt for CRP, 28 August 2014

²³⁰ Section 3.1.3 of Appendix 29 of the EIA, Impacts of sedimentation arising from mining on the Chatham Rise, August 2012 (updated July 2013)

²³¹ Section 3.1.4 of Appendix 29 of the EIA, Impacts of sedimentation arising from mining on the Chatham Rise, August 2012 (updated July 2013)

²³² Lines 27 – 34, page 414 of the Transcript, 30 September 2014

8.1.6. Mitigation and proposed conditions

- 276. Ms Taylor summarised in her evidence the applicant's range of proposed measures to avoid, remedy or mitigate the effects of mining.²³³ Those specifically relating to the benthic environment included:
 - not mining in large areas of rocky outcrops
 - identification of mining exclusion areas, defined through the marine spatial planning exercise, in order to avoid or minimise impacts on areas of particular sensitivity or value (including areas with marine mammal fossil)
 - ensuring the mining blocks in any year, during the first five years of mining, are sufficiently separated to avoid sedimentation impacts on other blocks and enable ecological monitoring of the actual impacts of sedimentation
 - evaluation of the feasibility and viability of creating hard substrate habitat to enhance recolonisation, and, if viable, creating of such habitat.
- 277. The applicant proposed to set protected areas aside (referred also as no-mining areas or exclusion areas). These areas were arrived at by combining information on the known or predicted distribution of benthic communities / taxa with data on the known or predicted distribution of phosphorite nodules to identify areas that can be closed to protect biodiversity and areas where mining can continue.²³⁴ This approach is a form of habitat modelling as described in the EIA and in the evidence and commentary of Dr Rowden.²³⁵
- 278. The Zonation modelling outcomes as described in the EIA and in evidence of the applicant's witnesses had a number of caveats. Dr Rowden noted that the Zonation analysis was undertaken to show how spatial planning can be used to develop management options for protecting biodiversity. He said that the initial selection of no-mining areas should be further evaluated and iterated by other stakeholders involved in the management process after predictive models have been verified.²³⁶ Potentially, no-mining areas may need to be adjusted if surveys proved the model predictions were incorrect.
- 279. Dr Hourigan also cautioned that care must be taken with habitat modelling for the distribution of corals until it has been validated by actually going down and looking to see whether there are indeed corals in the areas where they are predicted to be.²³⁷ The DMC's understanding of the validation was that while there were no independent *in situ* field validations of the model, there was validation using samples which were withheld from the original model. Rowden *et al*

²³³ Paragraph 14, Statement of Evidence of Carmen Taylor for CRP, 29 August 2014

²³⁴ Section 1.2 of Appendix 32 of the EIA, Developing spatial management options for the central crest of Chatham Rise, May 2014

²³⁵ Paragraphs 61 – 71, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

²³⁶ Paragraph 9, Statement of Evidence of Dr Ashley Rowden for CRP, 25 August 2014

²³⁷ Paragraph 32, Statement of Evidence of Dr Thomas Hourigan for the Crown, 12 September 2014

recommended further sampling and analysis in order to assess the potential uniqueness of some of the benthic communities in the licence area.²³⁸ The benthic experts agreed.

- 280. Although Dr Leathwick supported the use of the Zonation modelling tool, the DMC heard from him that further analysis would be desirable, with an expanded set of biodiversity and environmental layers, along with information describing both fishing intensity and mining prospectivity.²³⁹ He stated that fishing impacts need to be taken account of to avoid identifying or relying on sites for the protection of high biodiversity values that in fact are being compromised by fishing activity.²⁴⁰ He considered that this approach would provide a more transparent and informed basis for decision-making.
- 281. Importantly, the DMC notes that the experts recommended that model predictions need groundtruth verification before spatial management decisions are made. They also agreed that consideration of anthropogenic disturbances should be incorporated into either the habitat suitability models or the Zonation analyses.²⁴¹ While the DMC accepts that the Zonation model approach employed by the applicant has some merit, there remains a good deal of uncertainty around the validation of the predictions on locations of benthic communities and the influence of existing lawful activities that may affect their ongoing protection.
- 282. Ms Taylor stated that the proposed mining exclusion areas would cover a total area of 1,024 km² or around 19.7 % of the revised marine consent area.²⁴² Ms Taylor noted that "CRP has committed to use its best endeavours to try to ensure that the areas identified through this exercise are legally protected from all seabed disturbance activities as an alternative and enhanced protection mechanism to that provided by the BPA."243
- 283. Dr Hourigan considered that the no-mining areas along with adequate buffer zones to reduce potential sediment impacts were probably the most effective way of to ensuring conservation of high value deep sea coral habitats should mining proceed. The mining exclusion areas proposed by the applicant, however, did not appear to include significant amounts of verified G. dumosa habitat nor did they seem to include large areas of the predicted habitat for the most dense community.²⁴⁴ He opined that any no-mining areas established to protect corals should include a significant buffer zone to prevent secondary impacts from sedimentation.²⁴⁵

- ²⁴³ Paragraph 10, Statement of Evidence of Carmen Taylor for CRP, 29 August 2014
- ²⁴⁴ Lines 35 41, page 357 of the Transcript, 30 September 2014

²³⁸ Section 4 of Appendix 32 of the EIA, Developing spatial management options for the central crest of Chatham Rise, May 2014 ²³⁹ Paragraph D, Statement of Evidence of John Ralph Leathwick for the Crown, 12 September 2014

²⁴⁰ Paragraph 23, Statement of Evidence of John Ralph Leathwick for the Crown, 12 September 2014

²⁴¹ Issue 4, Joint statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014 ²⁴² Paragraph 118, Statement of Evidence of Carmen Taylor for CRP, 29 August 2014

²⁴⁵ Lines 4 – 6, page 358 of the Transcript, 30 September 2014

- 284. Ms Taylor acknowledged that the loss of benthic habitat and fauna within the mining blocks and sedimentation impacts on benthic habitat adjacent to the mining blocks remained a "*high or serious environmental risk, within the marine consent area, even after the adoption of proposed mitigation measures.*"²⁴⁶ The DMC presumes that her description of the impacts is consistent with the EIA's assessment criteria which included an environment risk matrix approach.²⁴⁷ Ms Taylor summarised this approach in her evidence in chief.²⁴⁸ This matrix considered 'consequence' and 'likelihood' categories for various potential effects (associated with mining) to produce a level of environmental risk ranging from low to serious. For example, a particular effect might be afforded a 'low' risk ranking because it is considered to have a rare likelihood of occurring and a minor consequence if it did. At the other end of the scale, a 'serious' risk ranking might be afforded to an effect that was almost certain to occur and would have a catastrophic consequence if it did.
- 285. In her evidence Ms Taylor's assessment of the loss of benthic habitat and fauna within the mining blocks was described as a 'serious environmental risk' in that the impacts were "*adverse, near-source confined, medium to long-term but ultimately reversible. Potential consequence is serious and the potential likelihood is almost certain*".²⁴⁹ The DMC agrees with most of this description but does not accept that it is reversible. The DMC has seen no evidence to suggest that benthic communities that live on hard substrates would re-colonise mined areas. Mr Winchester in his opening submissions on behalf of the applicant stated there would be "*significant and irreversible effects*" on the benthic environment where mining occurs.²⁵⁰ Indeed, he added that impact on corals in the areas where mining would occur would be "*permanent and significant*".²⁵¹
- 286. Ms Taylor went on to conclude that in her opinion the applicant's proposed mitigation measures would achieve the purpose of the EEZ Act (Section 10), notwithstanding that the benthic environment within the mining area would be adversely affected, in some instances irreversibly.²⁵² Her reasoning was that the life-supporting capacity of the wider Chatham Rise environment would be safeguarded because potential impacts beyond the mining area would effectively be avoided, remedied or mitigated. Her rationale is understandable, but the DMC does not agree that the likely adverse effects to benthic communities within and adjacent to the mine permit area can be dismissed before their significance has been established.

²⁴⁶ Paragraph 13, Statement of Evidence of Carmen Taylor for CRP, 29 August 2014

²⁴⁷ Section 8.2, Marine Consent Application and EIA, May 2014

²⁴⁸ Paragraphs 77 – 83, Statement of Evidence of Carmen Taylor for CRP, 29 August 2014

²⁴⁹ Paragraph 84, Statement of Evidence of Carmen Taylor for CRP, 29 August 2014

²⁵⁰ Paragraph 10(g), Opening Submissions for CRP, 25 September 2014

²⁵¹ Paragraph 11, Opening Submissions for CRP, 25 September 2014

²⁵² Paragraphs 18 – 20, Statement of Evidence of Carmen Taylor for CRP, 29 August 2014

- 287. The DMC agrees with Ms Rickard that it is unclear as to how meaningful proposed conditions could be drafted that address effects on benthic ecology when there was no agreed evidence regarding appropriate trigger levels.²⁵³ It appeared from the joint witness conferencing in the area of benthic ecology and spatial planning that very few proposed conditions were developed and agreed.
- 288. While mining would permanently destroy the benthic environment and its associated hard substrate communities within the mined area and in areas alongside mining blocks, protection of mining exclusion areas was proposed by the applicant. Proposed Condition 14 required avoidance of identified and additional mining exclusion areas and rock outcrops. The wording of Proposed Condition 14(b) does not allow objective assessment of compliance with wording such as "*significant*" coral thickets. Moreover, there were no identified mechanisms for identifying Proposed Condition 14(c) or ensuring compliance with it.
- 289. The DMC understands that Proposed Condition 14(b) dovetails with Schedule 2A(iv) and was intended to verify the spatial modelling exercise that identified the areas for exclusion from mining. A report was to be provided to the Chief Executive at least three months before mining commences and may have amended the mining exclusion areas (or added additional areas). This reflected the recommendations of the experts in the field of benthic ecology and spatial planning.²⁵⁴
- 290. The experts in the field of benthic ecology agreed that it was important to identify the order in which mining blocks would to be chosen and that initial mining should not be adjacent to the most sensitive communities.²⁵⁵ There was a requirement for monitoring in advance of mining in proposed Schedule 2A to confirm the Zonation model and a pre-mining report to be provided to the EPA. While this approach may allow the order of mining blocks to be altered depending on the results of the pre-mining monitoring, the proposed conditions as drafted appear to set the mining blocks for the first three years in Attachment B with little opportunity to change.
- 291. The requirement of Proposed Condition 14(b) regarding potential amendment of mining exclusion areas was consistent with the adaptive management approach recommended by the experts in the field of benthic ecology and spatial planning. They agreed that further surveys and spatial planning could identify further mining exclusion areas as part of an adaptive management process. They also agreed that, as a proposed condition, an EPA approved set of mining exclusion areas should be defined before operational mining commences.²⁵⁶ However,

²⁵³ Paragraph 25, Supplementary Statement of Evidence of Andrea Judith Rickard on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 16 November 2014

²⁵⁴ Issue 5, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

²⁵⁵ Issue 3, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

²⁵⁶ Issue 5, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

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reading Proposed Condition 11 and Proposed Condition 14, the DMC understands that any adjustment to the mining area to take into account verification of the modelling of benthic areas of particular interest would not be taken into account by the applicant until after the first three years of mining. The DMC considers this to be a significant limitation of the validation process.

- Most of the exclusion areas were outside the initial 820 km² mining area. While most exclusion 292. areas were within the BPA, those directly north of the mining blocks were outside the BPA and therefore would have no protection other than through this consent which protects the exclusion areas from the applicant's mining but not from other uses. Proposed Condition 60 acknowledged the need for a legal mechanism to provide protection for any mining exclusion areas from uses other than mining. The difficulty with this proposed condition was that any legal mechanisms could not be implemented by the applicant, and would rely upon the actions of third parties such as the Ministry for Primary Industries and the Department of Conservation. As stated in the opening legal submissions for KASM, Greenpeace and DSCC, this would involve an entirely different process with entirely different participants.²⁵⁷ The DMC understands that this is the primary reason for the use of the "best endeavours" concept in the proposed condition; in that the applicant would not have any control over the establishment of protection over the mining exclusion areas other than refraining from mining them. The DMC agrees with EPA staff that this proposed condition may not be enforceable. ²⁵⁸ The DMC concludes in any event that this proposed condition could not realistically be relied upon to provide effective protection for mining exclusion areas.
- 293. Proposed Schedule 1C set out environmental thresholds for sedimentation of the benthic environment. The threshold was no observed adverse impacts on benthic organisms beyond the distance predicted for 1 mm sedimentation from the mining block, at a point no more than 7 km from the mining block. The reference to 1 mm was in accordance with the threshold for sensitive benthic organisms identified by Dr Hewitt in her evidence.²⁵⁹
- 294. Proposed Schedule 2B(vi) was a monitoring requirement to be undertaken during mining and has two purposes: firstly to confirm that the extent of sediment deposition was in accordance with the models; and secondly to ensure that the impacts on ecological values beyond the area of predicted adverse impact from sedimentation are no greater than predicted. The DMC notes the requirement to identify regional reference sites that would not be impacted by mining or any other activities. The DMC questions how realistic this is given that the BPA would potentially be affected by the sediment plume and that the areas outside the BPA may potentially be affected by other activities such as trawling and fishing.

²⁵⁷ Paragraph 51, Opening Submissions by KASM, Greenpeace and DSCC, 26 September, 2014

²⁵⁸ Page 16, EPA Comment on CRP Proposed Conditions, 14 November 2014

²⁵⁹ Lines 40 – 41, page 728 of the Transcript, 3 October 2014

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- 295. The need for hard substrate recolonisation trials is contained in Proposed Schedule 2B(ix) during mining operation, and reporting is required by Proposed Conditions 38 and 39. The experts in the field of benthic ecology and spatial planning were agreed that recolonisation trials need to be proven successful before recolonisation could be proposed as a mitigation technique.²⁶⁰ Although there was a requirement for initial trials to be carried out in certain areas, there were no specifications for when, where, how many, surface area and so on. The proposed conditions as they were drafted did not contain enough detail for the DMC to actually understand what would be undertaken.
- 296. Proposed Schedule 2B(viii) was intended to monitor the recolonisation of mined blocks. The DMC understands that this would be an information gathering exercise and the proposed condition was to monitor rather than achieve any particular level of recolonisation.
- 297. Proposed Schedule 2C required representative seabed images and samples to confirm the nature and character of benthic habitats in accordance with Proposed Condition 40 in order to extend mining into additional areas.
- 298. The experts in the field of benthic ecology and spatial planning recommended the timing of mining to be adjusted to minimise effects on vulnerable life stages (eg presumed April to May reproduction period for *G. dumosa*).²⁶¹ This was not however reflected in the applicant's proposed conditions.

8.1.7. Adaptive management

As noted above, once consent had been granted, the applicant proposed to ground-truth its proposed mining exclusion areas, with possible adjustment or expansion to the exclusion areas. However our reading of the applicant's proposed conditions is that mining would be able to commence regardless of the ground-truthing outcomes. While Proposed Condition 14 requires research to be carried out verifying the Zonation modelling prior to mining commencing (Schedule 2), this related only to amendments to the mining exclusion areas and not to the mining blocks to be mined in the first three years. In accordance with Proposed Condition 11, mining would take place in the first three years in the areas identified in Attachment B of the proposed consent conditions. There was nothing in the proposed conditions that would prevent mining occurring, not even submitting the Mine Plan to the Chief Executive of the EPA, as he / she was only required to certify that the Mine Plan met the requirements of Proposed Conditions 25 and 26.

 ²⁶⁰ Issue 7, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014
 ²⁶¹ Issue 3, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

8.1.8. **DMC findings**

- 299. Section 59(2)(d) of the Act states that the DMC must take into account the importance of protecting the biological diversity and integrity of marine species, ecosystems, and processes, and the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species. There was some uncertainty as to whether the DMC could describe the benthic community as an ecosystem in its own right or whether it formed just a component of the wider Chatham Rise ecosystem. Making such geographical distinctions is not always easy in the biological world, and the terms 'community' and 'ecosystem' can arguably be used interchangeably.
- 300. As discussed in Chapter 15, the DMC views any distinction between referring to the benthic environment and its associated biota as a community or group of communities, rather than as an ecosystem, as a rather arbitrary one. One of points agreed to by the expert group on ecosystem effects was that ecosystems do not have well defined boundaries²⁶². One definition of ecosystem is *"A biological community of interacting organisms and their physical environment"*.²⁶³ The DMC sees no reason why parts of the benthic environment of the Chatham Rise should not be regarded as ecosystems in their own right. The two *G. dumosa*dominated epifaunal communities and one infaunal community were found to have a direct correlation with the presence of high-density patches of phosphorite nodules. That to the DMC constitutes an ecosystem.
- 301. The experts who participated in conferencing on benthic ecology and spatial planning agreed that benthic communities of the crest of the Chatham Rise play an important role in ecosystem functions, such as biodiversity, nutrient recycling and habitat provision.²⁶⁴
- 302. The DMC finds that several potentially unique benthic communities within the consent application area were identified and they included at least one species protected under the Wildlife Act (the stony coral *G. dumosa*). While there is a general lack of detailed benthic survey work throughout the EEZ, the DMC is satisfied that these communities may be rare on the Chatham Rise and within New Zealand's EEZ. Given the communities are potentially unique to the Chatham Rise, it follows they are likely to be rare in that area. While habitat modelling predicts that they may be present outside the mine permit area, their presence outside the mine permit area has not been verified. Their predicted locations include substantial areas where bottom trawling is not prohibited. There are substantial gaps in the knowledge of benthic communities on Chatham Rise as well as considerable uncertainty about the full extent of

²⁶² Issue 2, Joint Statement of Experts in the Field of Ecosystem Effects, 17 September 2014.

²⁶³ http://www.oxforddictionaries.com/definition/english/ecosystem

²⁶⁴ Issue 2, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

biodiversity and cryptic and rare species due to restricted sampling effort and limited taxonomic resolution.

- 303. Because this proposal was to mine the seabed to a depth of up to 0.5 m, benthic communities would be highly vulnerable to the effects of the proposed seabed mining. Those species that prefer hard substrates (or soft sediments for that matter) for habitat would be destroyed by the proposed mining operation. There is no dispute that this habitat and associated benthic communities would be destroyed over a large area if consent were to be granted. The DMC considers this is a significant matter. Compounding this effect, recolonisation of mined seabed by communities that prefer hard substrates (ie G. dumosa dominated communities) is unlikely to occur and the applicant has not committed to artificial recolonisation beyond a relatively small trial of unknown outcome. Given that recolonisation and recovery by other benthic communities are difficult to predict, the DMC finds that changes to the benthic environment through changes to substrate composition and sedimentation should be regarded as permanent at least in the timeframes relevant to re-colonisation by benthic organisms. In short, the DMC agrees with the applicant that the effects on the existing benthic communities within mining blocks would be significant and irreversible²⁶⁵ and that no avoidance, remediation or mitigation measures can be applied.266
- 304. Furthermore, the DMC notes that in order to undertake recolonisation trials, a marine consent would be required under Section 20(2)(f) of the EEZ Act (the deposit of any thing or organism in, on, or under the seabed). Although the applicant sought consent under this section of the Act, it did not provide details of the proposed recolonisation trials for the DMC to consider.
- 305. Overall, the DMC considers there to be a large degree of uncertainty associated with recolonisation of the deep-water benthic environment following significant disturbance to the seabed.
- 306. There is also uncertainty about the hyperbenthos and how it might be affected by the mining operation and what role it might play in providing food for dermersal fish. The benthic experts involved in conferencing agreed that hyperbenthic communities on the Chatham Rise are an important component of the ecosystem and may be vulnerable to the proposed mining method.
- 307. Outside of the mining blocks there are likely to be additional impacts to benthic communities associated with suspended sediment and sediment deposition. The area affected by these processes would depend on the nature and behaviour of the sediment plume, as discussed in Chapter 7, and the nature of the benthic communities, in particular their sensitivity to fine

²⁶⁵ Lines 20 – 22, page 9 of the Transcript, 25 September 2014

²⁶⁶ Paragraph 88, Statement of Evidence of Paul Cameron Kennedy for CRP (Updated), 29 August 2014

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sediment. As such, there is likely to be a gradient of effects away from the mining blocks. These matters carry a significant degree of uncertainty. While the movement of the sediment plume and associated sediment deposition has been modelled, the model outputs have not been verified. The sensitivities of the benthic communities and individual species are largely unknown and the applicant has had to rely on information on species that do not live on the Chatham Rise and in many cases are not found in New Zealand waters. Given these uncertainties, the DMC finds that it is not possible to quantify the scale of effects on benthic communities away from the mining blocks.

8.2. Trophic web

8.2.1. The importance of the trophic web

308. Section 59(2)(d) of the EEZ Act requires the DMC to take into account the importance of protecting the biological diversity and integrity of marine species, ecosystems, and processes. Trophic or food webs describe the flow of energy through ecosystems, typically by aggregating species into trophic levels, which are groups of species that have the same predators and prey in the food web. Dr Pinkerton developed a model of the structure of the trophic web of the whole of the Chatham Rise (*Figure 9*), using information from many different sources. He told the DMC that the model provided information about trophic connections (who eats whom) on the Chatham Rise, including all living biota from bacteria to whales, in 37 trophic groups.²⁶⁷ He noted that the purpose of the model was to calculate an "*index of trophic importance*" for each group. This index measured the average interaction strength between a group and all others in the trophic web, which can be indicative of how central to the food web each group is.²⁶⁸



Figure 9. Spatial Extent of Trophic Model. The region of the Chatham Rise trophic model is the bold black line. The area proposed for mining by CRP is in the centre of the model area on the crest of the rise. The colours give the depth of water: deep waters are shown blue and shallow waters red (range 0 - 5100m). Depth contours (thin black lines) are plotted at 500, 1000, 2000 and 3000 m. (Source: EIA, Appendix 22, Figure 1)

309. Dr Pinkerton explained the variety of organisms that make up the trophic web on the Chatham Rise, from the phytoplankton at the surface of the water column where there is sunlight through to benthic organisms on the seabed.²⁶⁹ His model included information on key species, their biomass, energetics (feeding and growth rates, assimilation efficiencies) and diets. The model

²⁶⁷ Paragraph 1, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

²⁶⁸ Paragraph 2, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

²⁶⁹ Lines 43 – 35, pages 957 – 958 of the Transcript, 15 October 2014

had 37 groups: seabirds; toothed whales and dolphins; baleen whales; seals; nine demersal fish groups (hoki; orange roughy; oreos; warehou; pelagic foragers; benthopelagic and benthic invertebrate feeders; benthopelagic and benthic predators; small demersal fishes), four mesopelagic groups (mesopelagic fishes; squid; krill; salps), 10 groups of benthic invertebrates (corals; other encrusting invertebrates; seastars and brittlestars; echinoderms; sea cucumbers; prawns and shrimps; large benthic worms; bivalves and gastropods; macrobenthos; meiobenthos); three groups of small zooplankton (mesozooplankton; ciliates; flagellates); phytoplankton, bacteria and detritus.

8.2.2. Model findings

- 310. Despite quite a long list of caveats and reservations regarding the completeness of the model, Dr Pinkerton concluded that the trophic web modelling was able to suggest which groups of organisms are likely to be more or less important in terms of the energy flow through ecosystems and provide an ecosystem context to assessing ecological impact.
- 311. In this regard, the model determined phytoplankton had the highest trophic importance on the Chatham Rise, as the sole primary producer. Of the consumers, the highest trophic importance were demersal fishes (1st), mesozooplankton (2nd), hoki (3rd), microzooplankton (4th), benthic prawns and shrimps (5th), small midwater fishes (6th) and benthic meiofauna (7th).²⁷⁰

8.2.3. Model uncertainties

- 312. In terms of uncertainties associated with the model, the experts involved in the ecological effects conference agreed that there were many parameters in the model and the values are uncertain some more than others. However, they concluded that the way the model deals with uncertainty is appropriate, although the levels of uncertainty may be reduced through additional sensitivity analysis.²⁷¹
- 313. They agreed that the model was fundamentally sound in structure, comprehensive and met current standards,²⁷² but acknowledged its limitations such as seasonal dynamics and the fact that it represents a "*typical year*" only, focuses on major flows of energy, and has no recognition of the provision of habitat by one species for other.²⁷³ Dr Fulton, for example explained the significance of the habitat dimension: habitat is critical for the survival or growth of a life history stage (eg juveniles) or for a process or behaviour (such as spawning).²⁷⁴

²⁷⁰ Paragraph 36, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

²⁷¹ Issue 3, Joint Statement of Experts in the Field of Ecosystem Effects, 17 September 2014

²⁷² Issue 1, Joint Statement of Experts in the Field of Ecosystem Effects, 17 September 2014

²⁷³ Paragraph 26, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014 and Issue 1, Joint Statement of Experts in the Field of Ecosystem Effects, 17 September 2014

²⁷⁴ Paragraph C, Statement of Evidence of Elizabeth Ann Fulton for the Crown, 12 September 2014

8.2.4. Ecosystem effects of mining

- 314. In his presentation at the hearing, Dr Pinkerton helpfully summarised the potential ecosystem effects of the mining application. They included:
 - direct impacts such as the physical removal of organisms from the seabed, the effects of the sediment plume on organisms, noise and so on
 - habitat mediated effects, where the mining changes the physical habitat of the seabed and that has an effect on some organisms or on some life stages of organisms
 - ecosystem effects are those effects on the individual species moderated through the food web. For example, if there is a change in the abundance of one organism, its predators and prey can both be affected through feeding relationships (as described by the food web model).²⁷⁵
- 315. Dr Pinkerton considered that although phytoplankton and detritus had the most importance in the trophic model, the chances of impacts to these from seabed mining were relatively small as they would be spread throughout the Chatham Rise. Although there was potential for some mesozooplankton to be impacted by the sediment plume or by the mining. Dr Pinkerton regarded the potential for impacts as probably low overall when considered over the scale of the whole Chatham Rise.276
- 316. Dr Pinkerton concluded that out of the top eleven groups with the highest trophic importance, ten would have low likely impact from the proposed mining. He opined that there are four groups which cause concern as they have a relatively high trophic importance and unknown spawning patterns. He listed the groups as being small demersal fish, the hard-bodied macrozooplankton (eg krill), cephalopods (eg squid) and the rattails and ghost sharks. He stressed however that there was neither evidence nor lack of evidence as to whether those organisms do or do not form spawning aggregations near the mining site.²⁷⁷
- 317. As the proposal would kill or at the very least displace all benthic organisms (both flora and fauna) to the depth mined by the drag-head, the DMC was particularly interested in the importance of the benthic organisms. While the trophic web model determined that benthic macrofauna (12th) had above average trophic importance, all the benthic megafauna (such as corals, encrusting invertebrates, urchins, seastars and brittlestars) and large benthic worms had trophic importance in the lower half of groups in the model.²⁷⁸ Dr Pinkerton concluded that, based on the model, even guite large changes to the abundances of corals and encrusting invertebrates are likely to have only a small effect on the pattern of energy flow through the

 $^{^{\}rm 275}$ Lines 10 – 30, page 957 of the Transcript, 15 October 2014

²⁷⁶ Lines 31 – 40, page 964 of the Transcript, 15 October 2014 ²⁷⁷ Lines 35 – 46, page 966 of the Transcript, 15 October 2014

²⁷⁸ Paragraph 36, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

trophic web at the scale of the whole Chatham Rise.²⁷⁹ Dr Pinkerton told the DMC that if there is a change in abundance to some of the benthic groups, it is unlikely to have a trophic effect on the food web of the Chatham Rise.²⁸⁰

- 318. Dr Pinkerton described how he undertook sensitivity analysis to determine the effect of changes to corals to propagate through the food web. This was undertaken to address the concern that poor information on the abundance of benthic invertebrate groups may have affected the estimate of their trophic importance. Dr Pinkerton told the DMC that this sensitivity analysis showed that 10-fold increases in the biomass of corals and encrusting invertebrates led to only small increases in their trophic importance. He concluded that the low trophic importance of corals and encrusting invertebrates to the Chatham Rise trophic web as a whole was robust despite the lack of good information on the biomasses of these two groups.²⁸¹
- 319. The DMC takes it from this sensitivity analysis that if the abundance of coral on the Chatham Rise is reduced, there is not likely to be a significant effect on the trophic web. However as noted by Dr Pinkerton, there may be unforeseen effects that the model cannot demonstrate. For example, there may be effects on the trophic web because that coral provides habitat for something which has high trophic importance.²⁸² The DMC acknowledges that the model cannot consider the provision of habitat or the role of any particular species in the trophic web.²⁸³
- 320. The DMC asked Dr Pinkerton about the likely timeframes for an impact to be seen in the trophic web and its recovery. Dr Pinkerton opined that a big impact could be expected to be seen quite quickly because the organisms are quite short lived. As for recovery, it depended on whether their cycle of reproduction could pick up again after it has been affected.²⁸⁴
- 321. Dr Fulton drew to the DMC's attention that the trophic model also did not address other ecosystem processes such as nutrient cycling. She considered that disturbance of the seabed, direct removal or mortality of species in the mining path and potential smothering of benthic species under the plume have the potential to modify local scale nutrient cycling which could further exacerbate effects on bottom communities and detritus based food webs.²⁸⁵

²⁷⁹ Paragraph 7, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

²⁸⁰ Lines 14 – 15, page 980 of the Transcript, 15 October 2014

²⁸¹ Paragraph 4, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

²⁸² Lines 38 – 40, page 975 of the Transcript, 5 October 2014

²⁸³ Paragraph 5, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

²⁸⁴ Lines 4 – 17, page 973 of the Transcript, 15 October 2014

²⁸⁵ Paragraph E, Statement of Evidence of Elizabeth Ann Fulton for the Crown, 12 September 2014

322. Mr Bartle expressed concern there was a potentially significant risk of damaging ecosystem effects from the sediment plume; however the trophic model did not assist in addressing this concern.²⁸⁶

8.2.5. **Proposed conditions**

323. While the applicant's proposed conditions had a strong focus on the benthic ecology, the wider effects on the trophic web and ecology of the Chatham Rise were not addressed. There was some discussion at the hearing regarding monitoring of fish (eg for trace metal content), which raised the question as to whether monitoring of mobile species could be undertaken in a way that distinguished the effects of the applicant's activities from other activities taking place on the Chatham Rise (eg fishing) or from natural variation.²⁸⁷

8.2.6. **DMC findings**

- 324. From Dr Pinkerton's evidence, the DMC considers the value of the trophic model lies in its ability to show the predator-prey interactions between any two species, or groups of species with similar trophic status, and to indicate how important a particular organism might be to the structure of the Chatham Rise food web as a whole.²⁸⁸ He explained that a large impact on organisms with a higher trophic importance means a high risk of large scale ecosystem effects. Conversely a large scale change on something lower down the list of trophic importance has less chance of propagating widely through the food web.²⁸⁹
- 325. Dr Pinkerton stressed that the model cannot be used to estimate the effects on the ecosystem caused by mining as the model is not dynamic and cannot represent changes to the food web over time.²⁹⁰ Further, after considering the use of more sophisticated trophic models, FIR numbers 12 and 13 concluded "*Even with such a dynamic and spatially-resolved model, our ability to reliably forecast what will happen to the Chatham Rise ecosystem as a result of mining will be limited. The current state-of-the-art in this area of science is that the behaviour of complex and poorly-observed systems (such as the Chatham Rise ecosystem, even though it is the best known part of New Zealand's EEZ) cannot be reliably predicted."*
- 326. Additionally, Dr Pinkerton acknowledged that only predator-prey connections are considered.²⁹¹
 Provision of habitat was not considered²⁹² and the DMC sees that as a significant limitation to its

²⁸⁶ Paragraph 166, Evidence of Mr J A (Sandy) Bartle for Royal Forest and Bird Protection Society of New Zealand Incorporated, 12 September 2014

²⁸⁷ Lines 40 – 25, pages 827 – 828 of the Transcript, 14 October 2014

²⁸⁸ Lines 34 – 46, page 961 of the Transcript,15 October 2014

²⁸⁹ Line 41 page 963 – line 3, page 964 of the Transcript,15 October 2014

²⁹⁰ Paragraph 6, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

²⁹¹ Paragraph 5, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

²⁹² Lines 37 – 41, page 970 of the Transcript, 15 October 2014

application to an assessment of the effects of seabed mining, which potentially would destroy a substantial area of benthic habitat on the Rise.

- 327. Despite the limitations, the DMC takes it from Dr Pinkerton's modelling approach, which included some sensitivity analyses, that even quite large changes to the abundances of corals and encrusting invertebrates are predicted to have only a small effect on the pattern of energy flow through the food web at the scale of the whole Chatham Rise. In other words, because benthic species on the Chatham Rise do not appear to feature significantly in the flow of energy through the food chain, the direct impacts of mining the seabed in the consent application area are unlikely to have trophic effects at the level of the wider Chatham Rise ecosystem.
- 328. The DMC notes that this is not an ecosystem model, and models only the trophic web. The model had some usefulness but as Dr Pinkerton told the DMC, it was not dynamic and therefore had limitations. As such the model cannot be used to estimate the scale of effects on the ecosystem caused by the proposed mining.
- 329. Notwithstanding Dr Pinkerton's caveats regarding the application of the model to assess the effects of the mining proposal, he made some general comments on the potential effects of mining on some aspects of the Chatham Rise food web, concluding that the chances of an impact of the mining proposal on important trophic groups would be relatively small ²⁹³. His basis for reaching this conclusion essentially comes down to one of scale, whereby the size of the proposed mining area in relation to the size of the Chatham Rise is small, and that important trophic groups are spread out over the entire Chatham Rise and so a localised impact would not result in a widespread change.
- 330. The DMC notes that scale has been an issue throughout the process. Whether assessing the effect of the mining operation at the drag-head, at the mining block in the marine consent application area or on the Chatham Rise crest / flank / wider ecosystem, analyses and conclusions have been drawn at significantly different scales. It is self-evident that the more one zooms in or out, the more or less significance can be attributed to any particular effect. The DMC has in each case sought to apportion significance at an appropriate scale of effect.
- In the DMC's view it is unlikely that a sediment plume due to dredging would have significantflow-on effects to the wider Chatham Rise food web.

²⁹³ Pages 964 – 965 of the Transcript, 15 October 2014.

8.3. Primary production and marine microbes

- 332. Primary production is driven by phytoplankton (algae) that remain suspended in the lit part of the water column (known as the euphotic zone). Consequently, any change to the trophic web that could affect primary production could have potentially serious flow-on effects to the wider ecosystem.
- 333. Microbes, such as bacteria, are a fundamental component of food webs and are essential for ecosystem function. They consume detrital and dissolved organic material in the water column as well as on and in the seabed. In turn, they are fed on by other lower trophic level groups (eg ciliates, copepods, heterotrophic flagellates). Infaunal deep-sea communities, of which bacteria represent a significant component, are important in the processing and remineralisation of organic matter, in nutrient cycling and often providing the food upon which other benthic and pelagic organisms in the marine ecosystem rely.²⁹⁴
- 334. The relative importance of microbes in the Chatham Rise marine ecosystem was assessed by Dr Pinkerton via his trophic web model. Water column bacteria biomass and energetics were estimated based on published data while measurements of benthic bacterial biomass were made at ten stations across the Rise. These measurements of seabed sediment indicated that bacterial production decreases with depth into the seabed, and it was assumed that production below 9 cm depth is negligible.²⁹⁵
- 335. Mr Kennedy explained that bacteria were an important part of the Chatham Rise ecosystem.²⁹⁶ Because of this importance, a marine bioluminescent bacteria (*Vibrio fisheri*) was used in assessments of toxicity associated with Chatham Rise sediment elutriate tests (see Chapter 8.8).
- 336. The trophic modelling work of Dr Pinkerton found that water column bacteria in the Chatham Rise have high trophic importance, ranking them 10th out of 19 trophic groups, due to their role in processing detritus. Detritus was of very high importance in the Chatham Rise food web as the flux of detrital material from the water column to the seabed essentially supported the entire benthic ecosystem.²⁹⁷ He ranked bacteria in seabed sediment 18th.
- 337. The model determined that phytoplankton had the highest trophic importance on the Chatham
 Rise, as the sole primary producer.²⁹⁸ These findings reinforced the importance of primary

²⁹⁴ Section 1.2 of Appendix 13 of the EIA, Data on the Chatham Rise benthos: macro – faunal and infaunal communities, March 2011 (updated April 2013)

²⁹⁵ Appendix H of Appendix 22 of the EIA, Ecosystem Modelling of the Chatham Rise, April 2013

²⁹⁶ Lines 18 – 20, page 929 of the Transcript, 15 October 2014

 ²⁹⁷ Paragraph 24 of the additional report appended to Executive Summary of Evidence of Dr Matt Pinkerton on behalf of CRP,
 14 October 2014

²⁹⁸ Paragraph 36, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

production in the Chatham Rise ecosystem and that it underpinned the productivity of many other trophic groups including commercially important fisheries.

8.3.1. Effects on microbes

- 338. Hewitt and Lohrers' work on the effects of sedimentation on benthic organisms did not consider benthic bacteria or meiofauna (small infauna typically between 63 µm to 0.5 mm, mainly nematodes), however it was noted that these organisms can be affected by sedimentation and could play critical roles in determining whether effects are passed up trophic levels or affect ecosystem functioning, especially if reduced oxygen conditions in the sediment were affected.²⁹⁹
- 339. In terms of evaluating the direct effects of the mining on organisms (likely direct effects of mining and / or plume on productive capacity), Dr Pinkerton considered there would be *"negligible impact on bacteria at scale of Chatham Rise*" to both water column bacteria and benthic bacteria.³⁰⁰
- 340. One of the 30 minute sediment elutriates (PB1) used in toxicity tests induced a response in the bacterium tests at 90 % elutriate although no effects were reported for tests using the 24-hour elutriates. Mr Kennedy considered that these results suggest that the cause of toxicity in the 30 minute elutriate using the PB1 Sediment was transient with short-lived effects (ie less than 24 hours).³⁰¹ Mr Kennedy compared concentrations in undiluted elutriates to the Australian and New Zealand Environmental and Conservation Council (ANZECC) Water Quality Guidelines (2000) trigger values for marine species (assuming an undisturbed environment, 99 % species protection). Only copper and ammoniacal nitrogen exceeded the ANZECC (2000) trigger value. He opined that after 17.5 times dilution, no element for which there is guidance available would be elevated above the ANZECC (2000) 99 % trigger values for the protection of marine species. He noted that there is no toxicity data for uranium in the marine environment however.³⁰²
- 341. In terms of the effects of uranium on microbes, Dr Phillips cited previous research that suggested that marine cyanobacteria (variants of *Synechococcus* and *Anabena*) were effective absorbents of uranium and other metals and represent an important sink for metals in the marine environment. While the cyanobacteria were able to counter the toxic effects of the

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²⁹⁹ Section 3.3 of Appendix 29 of the EIA, Impacts of sedimentation arising from mining on the Chatham Rise, August 2012 (updated July 2013) ³⁰⁰ Table 2 of additional report opported to Excerting On any of Entry and Entry

³⁰⁰ Table 2 of additional report appended to Executive Summary of Evidence of Dr Matt Pinkerton on behalf of CRP, 14 October 2014

³⁰¹ Paragraph 57, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

³⁰² Paragraph 62, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

accumulated uranium, there was the potential for effects through consumption by other organisms.303

342. Dr Krause suggested that the change in temperature regime (bringing water from the very deep where it is cold up to what is essentially an industrial process and then depositing it back down) could change the amount and activity of bacterial action within the system. He considered that the pulverisation of organic material would lead to an increase in a demand for the dissolved oxygen that is in that water. The sediment and water ultimately returned down the pipe would likely be much lower oxygen. ³⁰⁴ Mr Kennedy thought it unlikely that depletion of dissolved oxygen would occur as a result of mining, and that mining would not produce anoxic conditions in the water column.

8.3.2. **DMC** findings

- 343. The DMC accept that both benthic and pelagic bacteria are fundamental components of the Chatham Rise trophic web as indicated by Dr Pinkerton's model. At the scale of the Chatham Rise, Dr Pinkerton considered the effects of mining on bacteria would be negligible. 305 While the DMC's understanding of the consequential effect of the proposal on the ecosystem within and immediately adjacent to the consent application area is limited, the DMC agrees with Dr Pinkerton's conclusion given the scale of the proposed activity relative to the size of the Chatham Rise.
- 344. Toxicity testing of sediment elutriate indicated some mild toxicity towards the bacterium test organism. However the DMC considers that the level of dilution of the discharge after leaving the diffuser would be sufficient to reduce the potential for toxicity effects. The same reasoning applies to the risk for significant oxygen depletion as raised by Dr Krause. The applicant did not propose conditions that address potential effects on microbial species or the changes to primary production. However, the DMC considers that monitoring of these potential issues could be required as a part of proposed consent conditions if a conservative approach was required.

³⁰³ Paragraph 50, Amended Statement of Evidence of Ngaire Robyn Phillips on behalf of Te Rūnanga o Ngāi Tahu and Te Ohu Kai Moana Trustee Limited, 22 September 2014 ³⁰⁴ Lines 4 – 12, page 2075 of the Transcript, 6 November 2014

³⁰⁵ Table 2, Summary of evidence of Dr Matt Pinkerton for CRP, 14 October 2014

8.4. Zooplankton

8.4.1. The issues

- 345. Zooplankton are organisms of varying size that primarily drift with currents, although some have locomotion that allows them to avoid predators. Zooplankton are grouped and referred to by their size. Microzooplankton are approximately 20 to 200 µm (0.02 to 0.2 mm) in size and include heterotrophic flagellates and ciliates and other organisms such as the early life stages of crustacea. They play a pivotal role in the transfer of microbial biomass to higher trophic levels as they are the primary grazers of bacteria and picophytoplankton. Mesozooplankton are larger (0.2 to 2 mm in size) and include crustacean such as copepods. Macrozooplankton (2 to 20 mm) include copepods, euphausiids, chaetognaths and larval crustaceans.³⁰⁶ Dr Pinkerton told the DMC these organisms are mostly in the middle of the water column, and can be hard bodied animals like arthropods or they can be soft bodied animals like salps or jellyfish.³⁰⁷
- 346. The DMC understands that zooplankton are a fundamental component of the pelagic ecosystem and food web. Mr Bartle told the DMC how important they are as a food for higher organisms.³⁰⁸ This was confirmed by Dr Pinkerton's trophic web model which indicated mesozooplankton and microzooplankton as being the second and fourth most important components respectively of the trophic web for the consumer groups.³⁰⁹ Microzooplankton were a key link between the microbial food web and the higher trophic levels, having a pivotal role in energy transfer from the lower food web to middle trophic level predators.³¹⁰
- 347. Mr Bartle explained that all oceanic birds, fish and squid etc that live in the open ocean are totally dependent firstly on phytoplankton production, and secondly on the efficient grazing of phytoplankton by zooplankton.³¹¹ For example, Dr Pinkerton estimated that 44 % of the seabird diet comprised macro and mesozooplankton.312
- 348. As outlined by Dr Pinkerton, despite the relative importance of the zooplankton in the trophic model, not a lot was known about their vertical distribution and migration behaviour.³¹³ He considered that while there is some information on zooplankton over the Chatham Rise, there is not a huge amount.314

³⁰⁶ Section 6.4.3.1, Marine Consent Application and EIA, May 2014

³⁰⁷ Lines 11 – 15, page 958 of the Transcript, 15 October 2014

³⁰⁸ Lines 9 – 10, page 744 of the Transcript, 3 October 2014

³⁰⁹ Paragraph 3, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

³¹⁰ Section 6.4.3.5, Marine Consent Application and EIA, May 2014

³¹¹ Paragraph 48, Evidence of Mr J A (Sandy) Bartle for Royal Forest and Bird Protection Society of New Zealand Incorporated, 12 September 2014 ³¹² Appendix A of Appendix 22 of the EIA, Ecosystem Modelling of the Chatham Rise, April 2013

³¹³ Lines 37 – 45, page 988 of the Transcript, 15 October 2014

³¹⁴ Lines 7 – 11, page 994 of the Transcript, 15 October 2014

8.4.2. Effects

349. The effects on zooplankton were not extensively discussed in either the application, evidence or the hearing. The DMC deduce from the evidence presented by Dr Pinkerton and Mr Bartle that the sediment plume may be one effect. Dr Pinkerton suggested that in assessing the potential impacts of mining on zooplankton, their vertical distribution in the water column, including diel (daily) migration behaviour, and that of their prey and predators should be taken into account.³¹⁵

Sediment Plume

- 350. The DMC heard from Mr Bartle that the most abundant euphausiid on the Chatham Rise (Nematoscelis megalops) reaches depths of 300 to 500 metres by day. At night they can be up on the surface or in mid water and available for food for fish and feeding themselves, but during the day they descend to depths of 300 to 500 metres. This means they may descend into the sediment plume.³¹⁶ Dr Pinkerton agreed that if zooplankton are migrating to depths where they may be affected by mining, then that could be a direct effect of mining.³¹⁷
- 351. Dr Pinkerton outlined that microzooplankton occur predominantly in the upper water column, while mesozooplankton and macrozooplankton can occur throughout the whole water depth. His evidence supported Mr Bartle's that diel vertical migration would occur for many organisms, especially mesozooplankton and macrozooplankton.³¹⁸
- 352. Dr Pinkerton opined that elevated concentrations of suspended sediment deep in the water column are likely to affect feeding (and productivity) of zooplankton, especially detrivores / herbivores.³¹⁹ However he considered it unlikely that zooplankton in the surface mixed layer (between the sea surface and shallower than ~150 m) would be negatively affected by the mining operation. This was due to the modelling of the sediment plume showing that the suspended sediment generated by the mining operation would remain close to the seabed.³²⁰
- 353. Dr Pinkerton considered that while there was potential for some mesozooplankton to be impacted by the sediment plume or by the mining, it was probably a low overall effect on the scale of that group over the whole Chatham Rise. 321
- 354. Dr Pinkerton did express concern about krill which are crustacean zooplankton living in the water column and form an important diet of a lot of fish, and some of these have a dependence

³¹⁵ Paragraph 46, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

³¹⁶ Lines 26 – 32, page 744 of the Transcript, 3 October 2014

³¹⁷ Lines 15 – 19, page 989 of the Transcript, 15 October 2014

³¹⁸ Paragraph 36, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

 ³¹⁹ Paragraph 59, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014
 ³²⁰ Paragraph 61, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

³²¹ Lines 37 – 40, page 964 of the Transcript, 15 October 2014

on the benthos for reproduction that is not particularly well known. From the acoustic data, he considered krill might have a particular higher abundance in the area over the top of the mining site which led to his concerns.³²²

- 355. In terms of the significance and effects of zooplankton being in the sediment plume, Mr Bartle explained that copepods do not distinguish between the inorganic particulates and phytoplankton they consume all particles in this size range, and their gut can become full of sediment and not food. Ingestion of sediment therefore causes reduced food uptake for copepods as a result of having full stomachs. Mr Bartle told the DMC that laboratory experiments on copepods with total suspended sediment concentrations from 1 to 100 mg/L in steps of 10mg/L had shown that the ingestion of suspended inorganic sediments reduced egg production rates and carbon turnover in the two zooplankton genera studied.³²³
- 356. Mr Bartle considered more work needed to be done to determine the effects.

Role in the trophic web

- 357. Dr Pinkerton's model suggested that changes to bentho-pelagic groups may have a relatively large effect on the pattern of energy flow through the food web at the scale of the whole Chatham Rise. Mesozooplankton is ranked second behind small demersal fish in terms of trophic importance and therefore is a critical component of the trophic web.³²⁴ Because everything in the food web is interrelated, Dr Pinkerton opined that grazing by zooplankton on live phytoplankton cells in the mixed layer was likely to be reduced if abundances of these species of zooplankton were reduced elsewhere because of the effects of the mining.³²⁵
- 358. Mr Bartle expressed concern that if ingestion of suspended inorganic sediments reduced egg production rates and carbon turnover in zooplankton, this would have ecosystem effects. ³²⁶ Given that the mean turnover time of copepods on the Chatham Rise was 7.3 days, Mr Bartle opined that the effect for marine productivity on the Chatham Rise could be significant if zooplankton were ingesting sediment rather than food.³²⁷ The DMC understands this could be particularly important if egg production of zooplankton is reduced due to ingestion of sediment, as is indicated by studies into the effects of suspended sediments on zooplankton.

³²² Lines 32 – 41, page 965 of the Transcript, 15 October 2014

³²³ Paragraph 163, Evidence of Mr J A (Sandy) Bartle for Royal Forest and Bird Protection Society of New Zealand Incorporated, 12 September 2014

³²⁴ Paragraph 8, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

³²⁵ Paragraph 44, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

³²⁶ Lines 32 – 35, page 748 of the Transcript, 3 October 2014

³²⁷ Lines 7 – 11, page 743 of the Transcript, 3 October 2014

359. Similarly Mr Bartle considered ingestion of sediment from the sediment plume would affect other species that prey on the zooplankton and thus ingest the grit, for example seabirds.³²⁸

8.4.3. **Proposed conditions**

360. No conditions were proposed by the applicant that address potential effects on zooplankton, or would have provided further baseline information. The proposed conditions would not enable any potential effects on zooplankton to be assessed or verified.

8.4.4. **DMC findings**

- 361. Zooplankton appear to be a critical group in the Chatham Rise trophic web, for example microzooplankton are considered a key link between the microbial food web and the higher trophic levels, having a pivotal role in energy transfer from the lower food web to middle trophic level predators.³²⁹ Trophic modelling suggests that significant changes to zooplankton could have a relatively large effect on the pattern of energy flow through the food web at the scale of the whole Chatham Rise. Such a level of change due to the effects of the mining proposal seems unlikely.
- 362. From both Dr Pinkerton's and Mr Bartle's evidence, it is apparent that zooplankton would be subjected to increased levels of suspended sediment from the plume. Microzooplankton occur predominantly in the upper water column, while mesozooplankton and macrozooplankton can occur throughout the whole water depth and daily vertical migration occurs for many organisms.
- 363. The DMC expects that the sediment plume would result in localised adverse effects to zooplankton through effects on the likes of health and reproduction, and the scale of these effects are likely to be proportionate to the size, intensity and duration of the sediment plume, characteristics which have a degree of uncertainty. Some zooplankton groups with a dependence on the benthos for reproduction (such as krill) may be more vulnerable than others. However, the risk to the wider Chatham Rise food web as a result of an adverse effect on zooplankton is probably low given their mobile nature, relatively short life cycles and the scale of the proposed activity relative to the size of the Chatham Rise.

³²⁸ Lines 32 – 35, page 748 of the Transcript, 3 October 2014

³²⁹ Section 6.4.3.1 of the Marine Consent Application and EIA, May 2014

8.5. Fish and pelagic fauna

- 364. The DMC is required to take into account the importance of protecting the biological diversity and integrity of marine species, ecosystems and processes (Section 59(2)(d) of the Act). Fish and pelagic fauna are clearly part of this. Although linked to the biological effects on fish addressed below, the effects on fisheries and fishing are addressed in Chapter 9.8 and are not discussed further in this chapter.
- 365. As effects on the benthic environment are addressed in Chapter 8.1, this chapter looks at the potential effects of the proposal on pelagic organisms rather than benthic.
- 366. The DMC understands from the Jacobs review of the application that fish communities and species of the Chatham Rise are relatively well understood, with annual research trawls being undertaken in the area since 1992. Over 250 fish species have been recorded on the Chatham Rise, with this diversity thought to be driven by high levels of production. The commercial fish species on the Chatham Rise includes hoki, hake, ling, and silver warehou as well as orange roughy and oreos in deep waters.³³⁰
- 367. The DMC heard and received evidence from many witnesses about fish and fishing this included technical experts (Drs O'Driscoll, Helson, Huber, Krause, Middleton, Pinkerton, Tuck; Ms Baird; Messrs Page and Dunn; and Professor Popper), corporate fisheries managers and skippers (Messrs Clement, Connolly, Hollyman, Patrick, Paulin, Shaw, Smith, Summerton and Walls) and experienced local fishermen particularly from the Chatham Islands (Messrs Christiansen, Karatea and Maxwell).
- 368. In order to understand the potential impacts on fish, the DMC needed to understand the variety of fish species present on the Chatham Rise and the importance of this area for habitat and spawning. The key sources of data for Chatham Rise fish species and pelagic fauna derived from commercial catch records and research trawls supplemented by fisher observations. Knowledge of demersal fish distribution and abundance, particularly in the mining permit area, was scant.
- 369. The principal evidence on fish species was given by Dr O'Driscoll. He noted that more than 250 species had been caught on the Chatham Rise in the period 1992 2010 (the survey area³³¹ referred to as the Chatham Rise being an area of 139,496 km², of which 3.7 % ie 5,207 km² constitutes the revised marine consent area of the application).

³³⁰ Paragraph 3 of Annexure B (Assessment of effects on plankton and fish from the Chatham Rise Phosphate Limited marine consent application) of the Statement of Evidence of Michael Edward Huber (Effects on Plankton, Fish and Cephalopods), 12 September 2014

³³¹ Figure 1, Statement of Evidence of Richard O'Driscoll for CRP, 28 August 2014

- 370. Sixty-three species were identified from the MPL 50270 prospecting licence area (the area within the application area from which most commercial information is available). Of those 63 species, 45 species (43 important commercial and non-commercial fish species, New Zealand southern arrow squid, and scampi) had statistically useful information. None of these had more than 10 %³³² of their Chatham Rise estimated biomass (averaged over the past 10 years) within the revised marine consent area.³³³ On a year-on-year examination, 3 species (juvenile white warehou, adult silverside and adult red cod) demonstrated greater than 10 % biomass on 5 occasions (range 10.5 % 14.7 %).³³⁴
- 371. However, Dr O'Driscoll acknowledged that there was very little commercial catch effort information from within the revised marine consent area since 2003, mainly because of the imposition of the BPA in 2007, a total 10 year catch of only 165.6 t (99 t by longline, 64 t by trawl), but which included 49 species (predominantly ling, hoki, spiny dogfish, javelinfish and sea perch). This catch represented less than 0.5 % of the catch of the respective species from its associated quota management area (QMA), and less than 0.1 % from New Zealand's overall EEZ.³³⁵
- 372. Dr O'Driscoll also noted³³⁶ that species / maturity groupings with the greatest concentration within the revised consent area were juvenile and adult lookdown dory, adult silverside, banded bellowsfish, juvenile white warehou, juvenile spiny dogfish, scampi, and juvenile ling.
- 373. While hake, ling, spiny dogfish, lookdown dory, sea perch, Bollons's rattail, dark ghost shark, hapuku, long-nosed chimaera, pale ghost shark, ribaldo, silver warehou, giant stargazer, and white warehou may spawn in and / or around the revised consent area, Dr O'Driscoll noted no evidence that the revised marine consent area was a particularly important spawning ground for any of those species, acknowledging that data from this area was sparse (only one trawl tow in the MPL 55549 mining permit area over ten years).³³⁷
- 374. Mr Page noted³³⁸ that 17 benthic and 46 demersal or pelagic fish species were known to occur in prospecting licence area MPL 50270. Of those, fifteen spawn on the Chatham Rise and five (ling, hake, giant stargazer, lemon sole and lookdown dory) occur in the area.

³³² Dr O'Driscoll confirmed that there was nothing magical about the 10 % — simply the highest number of 9.9 % rounded up

³³³ Paragraphs 2 – 3, Statement of Evidence of Richard O'Driscoll for CRP, 28 August 2014

³³⁴ Paragraph 30, Statement of Evidence of Richard O'Driscoll for CRP, 28 August 2014

³³⁵ Paragraph 11, Statement of Evidence of Richard O'Driscoll for CRP, 28 August 2014

³³⁶ Slide 5 of powerpoint presentation of Statement of evidence by Richard O'Driscoll, 16 October 2014

³³⁷ Paragraph 26, Statement of Evidence of Richard O'Driscoll for CRP, 28 August 2014

³³⁸ Paragraph 3, Statement of Evidence of Mike Page for CRP, 28 August 2014
- 375. During consultation, the potential impact on freshwater eels migrating to the Pacific to breed was raised as an issue. Longfinned eel (*Anguilla dieffenbachia*) and shortfinned eel (*Anguilla australis*) both occur on the Chatham Islands³³⁹. While longfinned eels are known to swim at depths typically 200 to 300 m at night and at depths of 600 to 900 m during the day, larvae of other eel species are known to be present at shallower water depths of between 80 to 250 m during the day and 30 to 100 m at night, which is above the depths at which mining would occur. The EIA concluded that there was nothing that suggests eels were likely to be present within or adjacent to the proposed mining area on the Chatham Rise. Their spawning grounds were north of New Zealand in the subtropical Pacific, and it was unlikely that significant numbers of spawning eels would cross to the Chatham Rise.³⁴⁰
- 376. Research undertaken by Dr Patrick concluded that adult eels from the Chatham Islands were unlikely to traverse over the proposed mining area and eel larvae were unlikely to descend to the depths at which mining would occur.³⁴¹
- 377. Ms Page on behalf of Ngāti Mutunga expressed concern that few studies have been undertaken on Chatham Island eel migration.³⁴²

8.5.1. Effects

- 378. The experts on the impacts on fish who were involved in conferencing identified the following as potential effects of the proposal on fish³⁴³:
 - habitat loss
 - increased sediment in the water column
 - exposure to bio-available and bio-accumulative toxic substances
 - entrainment in the dredge and pump
 - noise.
- 379. The DMC also heard that there may be an effect on spawning and fish nurseries from the deposition of sediment. Dr Krause opined that there may be effects on the trophic web and the DMC has addressed this in Chapter 8.2.

³³⁹ McDowall RM 1978. New Zealand Freshwater Fishes: a Natural History and Guide. Auckland, New Zealand. Heinemann Reed.

³⁴⁰ Section 8.6.7.3 Marine Consent Application and EIA, May 2014

³⁴¹ Attachment A (Chatham Island Long Finned Eels – Breeding, Migration and Return) of Response to the DMC's Request for Further Information (Part 1), August 2014 (date on EPA website — 8 August 2014)

³⁴² Lines 24 – 26, page 2171 of the Transcript, 12 November 2014

³⁴³ Joint Statement of Experts in the Field of impacts on Fish 18 September 2014

Habitat loss

- 380. The proposed mining would result in a substantially modified benthic environment as discussed in Chapter 8.1.
- 381. The DMC understand that the benthic environment is a key part of the underwater habitat. The EIA identified these impacts as:³⁴⁴
 - impacts resulting from species dependencies, ie a detrimental impact on one benthic species may affect a species dependent on the impacted species for food or shelter (eg living in or on a coral)
 - trophic impacts affecting available food for other components of the ecosystem (eg demersal fish species)
 - biogeochemical impacts related to changes in sediment physical and biogeochemical properties that influence trophic components such as microbiology.
- 382. Dr Krause opined that all of these expected impacts to the benthic community would result in a decrease in available habitat and food resources to fishes.³⁴⁵
- 383. While the experts agreed that the relationship between habitat and fish on the Chatham Rise was not well understood, the experts involved in the conference for impacts on fish agreed that the removal of benthic habitat was likely to be the most significant effect on demersal fish in the mined area. The effects of this would be primarily on benthic species rather than pelagic. The experts involved in conferencing agreed that as a result of the change in habitat in the mined area, fish would be displaced to other areas.³⁴⁶
- 384. There was acknowledgement by experts involved in conferencing that the details of the associations between fish and their habitat were not fully understood.³⁴⁷

Increased sediment in the water column

385. Increased sediment in the water has the potential to affect fish at all of their life stages, including larvae and fish eggs. Mr Page explained that suspended sediments may affect fish directly by reducing visibility of pelagic food and clogging gills with associated acute and chronic effects such as physiological stress, reduced growth and reproductive fitness.³⁴⁸ Dr Krause also

³⁴⁴ Section 8.6.3.1, Marine Consent Application and EIA, May 2014

³⁴⁵ Paragraph 68, Statement of evidence of Dr Paul Richard Krause on behalf of Deepwater Group Limited and Te Rūnanga o Ngāi Tahu, 12 September 2014 ³⁴⁶ Issue 1. Jeint Statement of Everyte in the Field of Line and Te Rūnanga of Statement of Everyte in the Field of Line and Te Rūnanga of Ngāi Tahu, 12 September 2014

³⁴⁶ Issue 1, Joint Statement of Experts in the Field of impacts on Fish, 18 September 2014

³⁴⁷ Issue 1, Joint Statement of Experts in the Field of impacts on Fish, 18 September 2014

³⁴⁸ Paragraph 30, Statement of Evidence of Mike Page for CRP, 28 August 2014

considered that invertebrates may be affected by sedimentation, which in turn would affect those fish that prey on invertebrates.³⁴⁹

- 386. Mr Page considered that benthic species that live and breed on the seafloor on the Chatham Rise such as ling, giant stargazer, lemon sole, skates and rays are more likely to be affected by a sediment plume than demersal species such as hake and lookdown dory that spend a lower proportion of time close to the seafloor.³⁵⁰ This was due to pelagic species being more likely to spend time above most of the plume.
- 387. The experts in the field of impacts on fish agreed that mesopelagic fish were only likely to encounter the upper extent of the plume at their very lowest extent of their diurnal migrations. This would only be over a relatively small area compared to their overall distribution.³⁵¹ Mr Page anticipated no adverse effect on mesopelagic fish species, which migrate vertically to within 50 m of the seabed, other than avoidance behaviour if they contact the plume during elevated total suspended sediment concentrations.³⁵² Pelagic fish were unlikely to be affected to any significant extent provided that the plume behaved as predicted in the lowest 50 m of the water column.³⁵³
- 388. In terms of adult fish, the experts involved in the conference for impacts on fish agreed that the most likely effect of increased TSS would be avoidance of the plume, with motile species expected to actively avoid the plume.³⁵⁴
- 389. Although Mr Page considered that 2 mg/L could be used as a conservative threshold beyond which no effects would be experienced by fish³⁵⁵, the experts agreed that 3 mg/L TSS was an appropriate threshold criterion for fish avoidance of the plume. The predicted average of the maximum daily plume area coverage of TSS 3 mg/L is 49 km² based on modelling of the sediment plume.³⁵⁶
- 390. Mr Dunn estimated the long-term impact on future biomass and yields of the three key commercial species (hake, hoki and ling) known to be present in prospecting licence area MPL 50270. His analysis³⁵⁷ was a worst-case outcome assuming 100 % mortality of all displaced fish, maximum destruction of benthic habitat, and no recolonisation of mined areas following

³⁵² Paragraph 43, Statement of Evidence of Mike Page for CRP, 28 August 2014

³⁵⁵ Paragraph 28, Statement of Evidence of Mike Page for CRP, 28 August 2014

³⁴⁹ Paragraph 32, Statement of evidence of Dr Paul Richard Krause on behalf of Deepwater Group Limited and Te Rūnanga o Ngāi Tahu, 12 September 2014

³⁵⁰ Paragraph 7, Statement of Evidence of Mike Page for CRP, 28 August 2014

³⁵¹ Issue 2, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁵³ Issue 2, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁵⁴ Issue 2, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁵⁶ Issue 2, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁵⁷ Paragraph 3, Statement of Evidence of Alistair Dunn for CRP, 29 August 2014

initial impact. The detailed model assumptions and predictions were presented in his evidence, but in summary Mr Dunn concluded³⁵⁸ that for the avoidance scenarios the adverse effect was below the calculation accuracy of the model and was therefore negligible; and that for recruitment loss the adverse effect was small. As this represented a worst-case scenario he concluded that the actual effect was negligible.³⁵⁹

391. Dr Tuck's evidence related to a comparative analysis of sediment suspension arising from demersal trawling versus mining and its effect on benthic species. That has been discussed elsewhere in this decision in the context of the sediment plume and is not further discussed in this chapter.

8.5.2. Increased sediment on eggs and larvae

- 392. Mr Page explained that sediment adhesion to the egg chorion (the outermost membrane around the egg) and the gills of larvae could affect their dispersal and survival.³⁶⁰ Mr Page explained that increased suspended sediment can change buoyancy of eggs due to adhesion, but also can smother eggs and lower developmental rates and hatching success.³⁶¹ The experts considered that fish larvae are more susceptible to sediment than eggs and adults.³⁶²
- 393. The experts in the area of impacts on fish considered that ling are likely to be particularly vulnerable. Other species, including female hake in spawning condition, spawning and spent spiny dogfish, spent hoki, spent lookdown dory and spent sea perch occur in the consent area. There is also possible spawning of Bollon's rattail, dark ghost shark, hapuku, ling, long-nosed chimaera, pale ghost shark, ribaldo, silver warehou, stargazer, and white warehou. Hoki and hake are not expected to be affected by the sediment plume due to their migration and spawning patterns.³⁶³
- 394. While many of the expert witnesses expressed concern about the vulnerability of ling larvae and juveniles to increased sediment levels, Ms Baird noted that ling larvae are pelagic, at least 24 mm long before settling and may live in the water column for several months.³⁶⁴ However she did not consider plume total suspended sediment or sedimentation a larval threat. She also stated that there is little overlap between the bottom longline ling fishery and the three permit / licence areas.³⁶⁵ Dr Krause considered it unlikely that the early life-stages of hoki or hake would be adversely impacted by sedimentation given their general distribution, however

³⁵⁸ Paragraphs 32 and 33, Statement of Evidence of Alistair Dunn for CRP, 29 August 2014

³⁵⁹ Hearing Transcript, Page 1255

³⁶⁰ Paragraph 5, Statement of Evidence of Mike Page for CRP, 28 August 2014

³⁶¹ Paragraph 25, Statement of Evidence of Mike Page for CRP, 28 August 2014

³⁶² Issue 2, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁶³ Issue 2, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁶⁴ Paragraph 59, Statement of Evidence of Susan Jane Baird for CRP, 25 August 2014

³⁶⁵ Slide 4 of powerpoint presentation of Summary of Evidence of Susan Jane Baird, 16 October 2014

there was a high likelihood of the mining activity producing an effect on the early life stages of ling.³⁶⁶ Drs Starr and Middleton gave their opinion that ling eggs and larvae are vulnerable to sediment effects because ling produce a sticky egg mass that adheres to the seabed and hard structures in similar depths to that of the proposed mining.³⁶⁷

- 395. The DMC notes the absence of information on the distribution of fish eggs or larvae in the vicinity of the proposed mining operation and the area predicted to be influenced by the plume as modelled.³⁶⁸ Dr O'Driscoll considered that hake and ling may spawn within or in the vicinity of the revised consent area, with the area east of the revised mining area being a very important ling spawning location.³⁶⁹
- 396. Mr Page noted that eggs and larvae sensitivity to sediment adhesion is species and life-history specific, and that there were no egg or larval studies on species that occur within the revised marine consent area. ³⁷⁰ Mr Page therefore imported and adopted (with appropriate caution regarding comparability) a TSS concentration threshold tolerance of 2 mg/L, determined for eggs and larvae for the demersal Atlantic cod and pelagic herring and flounder. This is the value level at which no effects are likely to occur³⁷¹, noting that Atlantic cod and mackerel were found to avoid total suspended sediment concentrations of 3 to 5 mg/L.
- 397. The DMC understands from the experts in the field of impacts on fish that there were limitations to the data available: the Chatham Rock trawl survey research data only related to one time of the year, and there is limited knowledge of non-commercial species in terms of biodiversity.³⁷² Based on the available information, the experts in the field of impacts on fish agreed on a 2 mg/L total suspended sediment level as a suitable threshold criterion for effects on eggs and larvae.³⁷³

Exposure to toxic substances

398. Dr Krause told the DMC that the vigorous mixing associated with the mining process and disposal of tailings on the sea floor has the potential to release nutrients and contaminants.

³⁶⁶ Paragraphs 24 – 25, Statement of Evidence of Dr Paul Richard Krause on behalf of Deepwater Group Limited and Te Rūnanga o Ngāi Tahu, 12 September 2014

³⁶⁷ Paragraph 38, Statement of Evidence of Paul Joseph Starr and David Alexander Jon Middleton on behalf of Deepwater Group Limited and Te Rūnanga o Ngāi Tahu, 12 September 2014

³⁶⁸ Paragraph 22, Statement of Evidence of Mike Page for CRP, 28 August 2014

³⁶⁹ Figures 6 – 7, Statement of Evidence of Richard O'Driscoll for CRP, 28 August 2014

³⁷⁰ Paragraph 6, Statement of Evidence of Mike Page for CRP, 28 August 2014

³⁷¹ Paragraph 28, Statement of Evidence of Mike Page for CRP, 28 August 2014

³⁷² Issue 2, Joint Statement of Experts in the Field of impacts on Fish, 18 September 2014

³⁷³ Issue 2, Joint Statement of Experts in the Field of impacts on Fish, 18 September 2014

These can cause a variety of health issues for marine animals, including adversely impacting reproduction or egg development.³⁷⁴

- 399. Dr Krause expressed concern that conditions may be anoxic and there is the potential for the mining and tailings disposal process to release toxic and bioaccumulatable concentrations of metals that would impact fishes within the consent area.³⁷⁵ Despite these concerns, the experts in the field of effects on fish agreed that release of toxic substances in the water column itself was not a toxicological issue for fish because the contaminants were at a low concentration and fish would not remain in close proximity to the discharge due to other factors such as noise and the sediment plume.³⁷⁶
- 400. The experts did not expect there to be any significant toxicological effects but recommended further information on organic carbon concentrations in the deposited material to confirm that anoxic conditions would be unlikely to arise.³⁷⁷ This potential effect is explored in more detail in Chapter 8.8.

Entrainment in the dredge and pump

- 401. The experts in the field of impacts on fish agreed that a certain number of fish were going to be sucked up the riser and suffer mortality. However the experts considered this would not be a critical issue for any pelagic organisms across the Chatham Rise because it would impact on a negligible proportion of the population.³⁷⁸
- 402. The experts recommended screening the pump in-takes and designing to a maximum in-take velocity of 0.5 m/s to minimise fish entrainment.³⁷⁹

Noise

403. Noise was identified as a potential effect by the experts in the field of impacts on fish. Noise can cause physiological effects and behavioural effects. The experts in the field of impacts on fish considered that the intensity of sound from the dredging would not produce any physical trauma to fish but there would be potential for behavioural changes. The effects of sound emissions on

³⁷⁴ Paragraphs 34 – 35, Statement of Evidence of Dr Paul Richard Krause on behalf of Deepwater Group Limited and Te Rūnanga o Ngāi Tahu, 12 September 2014

³⁷⁵ Paragraphs 42 – 45, Statement of Evidence of Dr Paul Richard Krause on behalf of Deepwater Group Limited and Te Rūnanga o Ngāi Tahu, 12 September 2014

³⁷⁶ Issue 3, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁷⁷ Issue 3, Joint Statement of Experts in the Field of impacts on Fish, 18 September 2014

³⁷⁸ Issue 4, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁷⁹ Issue 4, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

fish were likely to be limited to species-specific behavioural effects. These may include attraction, avoidance, and / or not responding.³⁸⁰

- 404. The experts in the field of impacts on fish agreed that very little is known about behavioural responses of fish to sound. Although the lack of data on particle motion component of sound was acknowledged, the experts considered the uncertainty was acceptable as particle motion attenuates rapidly with distance from the source.³⁸¹ The most significant uncertainty was that it was unclear what behavioural responses the operational sounds may cause. Some species may be attracted while others may avoid or show no response at all.
- 405. Professor Popper gave evidence related to fish acoustics, noting that all fish species on the Chatham Rise hear by means of particle motion rather than sound pressure, and would not therefore be affected by the noise of the mining operation beyond a very limited distance from the source.
- 406. Mr Smith however noted³⁸² that skippers use noise (both mechanical and concussive) and water colour change in pelagic fishing to their advantage to keep mackerel, kahawhai and tuna species in the net when purse seining. He added "*Any deep-water fisherman will tell you that vessels and acoustic noise can have a drastic effect on orange roughy fishing, as the fish simply do not like the disturbance and will not aggregate.*"
- 407. The DMC understands that sound data for the proposed operation was not available and thus Dr Jones modelled sound source levels.
- 408. The experts in the field of impacts on fish agreed that 15 km from the sound source was a key distance for effects. The likelihood of effects on pressure-detecting species declined beyond 15 km, and for those fishes that do not primarily use sound pressure for hearing, the maximum distance at which they may detect sound was much less than 15 km.³⁸³
- 409. The experts in the field of impacts on fish agreed there would be no deleterious physical / physiological / mortality effects on fishes and invertebrates as a result of operation-generated sound from the dredging. Professor Popper opined that based on extensive experimental data, fish would not be physically harmed or killed by the sounds from the dredging operations.³⁸⁴

³⁸⁰ Issue 5, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁸¹ Issue 5, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁸² Paragraphs 24 – 25, Statement of Evidence of Andrew Peter Smith on behalf of Deepwater Group Limited, 12 September 2014

³⁸³ Issue 5, Joint Statement of Experts in the Field of impacts on Fish, 18 September 2014

³⁸⁴ Paragraph 22, Statement of Evidence of Professor Emeritus Arthur Popper for CRP, 28 August 2014

410. The experts in the field of impacts on fish also concluded that sound generated by the operation was unlikely to cause significant effects at the level of fish populations, with effects more likely to be on individuals. A very precautionary estimate of the maximum distance was 1 km for fish and invertebrates that primarily detect particle motion. They also concluded that significant ecological consequences as a result of noise effects were unlikely, as any effects would only be localised to the mining area, and not impact a large proportion of a population.³⁸⁵

8.5.3. **Proposed conditions**

- 411. Although the experts in the field of impacts on fish recommended conditions requiring monitoring of benthic and demersal fish both within the mining footprint and within the area of highest sedimentation, this was not reflected in the proposed conditions.³⁸⁶
- 412. Proposed Condition 15 required the avoidance of the ling spawning period and area and was in accordance with the recommendations of the experts in the field of impacts on fish.³⁸⁷ While the wording of the proposed condition could be improved, the concept of avoiding mining during August and September and areas east of longitude 180° would assist in reducing any impact on ling.
- 413. The DMC agrees with Ms Rickard that it is not clear whether any fish abundance or presence monitoring is proposed.³⁸⁸ The DMC acknowledges the difficulty in establishing a meaningful trigger level appropriate for such a proposed condition, particularly in the absence of baseline information on the abundance of fish species in the proposed mining site.
- 414. The DMC's understanding from the experts in the field of impacts on fish is that 3 mg/L TSS is an appropriately conservative threshold criterion for fish avoidance of the plume. The experts also agreed that 2 mg/L TSS was an appropriate threshold criterion for adverse effects on eggs and larvae. However the DMC notes that neither of these levels appears in the proposed conditions. Instead, a level of 50 mg/L monitoring level was given in proposed Schedule 1A as a trigger. Mr Kennedy explained that the 50 mg/L threshold was an ideal concentration for the underwater turbidity monitoring vehicle to track and therefore provided a more accurate comparison with the sediment plume model for that particular threshold.³⁸⁹

³⁸⁵ Issue 5, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁸⁶ Issue 1, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁸⁷ Issue 2, Joint Statement of Experts in the Field of Impacts on Fish, 18 September 2014

³⁸⁸ Paragraph 18a, Supplementary Statement of Evidence of Andrea Judith Rickard on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 16 November 2014

³⁸⁹ Lines 15 – 20, page 2226 of the Transcript, 17 November 2014

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8.5.4. **DMC** findings

- 415. Of all the potential effects on fish, the DMC concludes that the effect of increased sediment is the most significant. From the evidence and information provided to the DMC, the DMC finds that the most likely effect of increased total suspended sediment on mature fish and pelagic fauna would be avoidance of the sediment plume. The DMC accepts that fish are highly mobile and those not tolerant of high suspended sediment concentrations would likely move to more suitable habitats. However the DMC remains concerned that larvae and eggs are likely to be more affected by increased levels of sediment and do not have the same level of mobility as adults. The early life stages of ling in particular appear to be particularly susceptible to the effects of sediment, and the DMC heard from Dr O'Driscoll that the proposed mining area is an important ling spawning location. The DMC understands that there are limitations to the data available, not only the year-round distribution and numbers of fish species in the proposal area but also the sensitivity of those species to increased sediment levels.
- 416. The proposed conditions did not adopt the TSS thresholds as recommended by the experts in the field of impacts on fish³⁹⁰. In terms of the effect of sediment on fish and pelagic fauna, the DMC is left uncertain as to the importance of this area to fish and spawning and the effect of increased sediment, particularly as the proposed conditions did not reflect the sediment concentration recommendations of the experts in the field of impacts on fish.
- 417. While the DMC accepts the use of 50 mg/L as a threshold in the conditions may be a convenient number with which to measure and empirically calibrate the model, it has some difficulty accepting that this would provide a reliable spatial boundary for the expert recommended trigger levels of 3 mg/L and 2 mg/L. The DMC agrees with Ms Rickard that as the potential impacts could be felt at 2 mg/L, the trigger monitoring level should relate to that.³⁹¹
- 418. Dr Pinkerton's trophic model, based on the Chatham Rise as a whole, showed that of the 37 trophic groups, based solely on predator-prey relationships, small demersal fish were 1st in trophic importance of the consumers (ie as opposed to phytoplankton being the 1st and sole primary producer), followed by hoki (3rd) and small mesopelagic (ie mid-water) fish (6th). ³⁹² This indicated the importance of fish in the trophic web. He concluded that while there were unlikely to be species-wide (population) effects because of the wide distribution of all fish species over the Chatham Rise, impacts due to mining on small demersal fish, cephalopods, and rattails and ghost sharks could lead to indirect (trophically-mediated) effects on other organisms at the scale of the Chatham Rise food web, although there is no evidence one way or the other. 393

³⁹⁰ Joint Statement of Experts in the Field of Impacts on Fish 18 September 2014

³⁹¹ Paragraph 23(d), Supplementary Statement of Evidence of Andrea Judith Rickard on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 16 November 2014

³⁹² Paragraph 3, Statement of Evidence of Dr Matt Pinkerton of CRP, 29 August 2014

³⁹³ Paragraph 10, Executive Summary of Evidence of Dr Matt Pinkerton on behalf of CRP, 14 October 2014

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- 419. Given the importance of fish commercially as well as their role in the trophic web, the DMC find that the levels of knowledge and scale of impacts are uncertain and that the proposed conditions do not appropriately alleviate this concern. While it may have been possible to address the DMC's concerns about effects on fish through a more appropriate suite of monitoring and response / trigger conditions, the DMC did not go down this path for the reasons outlined in later chapters.
- 420. Other potential effects on fish raised at the hearing appeared to be relatively minor. Noise from the mining operation appears at best to have localised effects on fish and populations would not be threatened. Similarly, entrainment in the dredge and pump system would impact only a negligible proportion of the population.
- 421. Some submitters were concerned about effects on eels. Due to the absence of detailed information on eels presented in the application, submissions or the hearing, the DMC was not able to draw any conclusions on the potential adverse effects on eels. The evidence the DMC did receive suggests however that these are highly unlikely at the population level.

8.6. Marine mammals

8.6.1. The issues

- 422. The potential effects of the proposal on marine mammals, particularly whales, were raised in a number of submissions.
- 423. The Cultural Impact Assessment identified marine mammals as taonga species and the Ngāi Tahu Claims Settlement Act 1998 recognises six marine mammals as taonga species: southern elephant seal, New Zealand fur seals, humpback whales, sperm whales, New Zealand sea lion / Hooker's sea lion and southern right whale. The DMC understands that taonga species schedules in the Ngāi Tahu Claims Settlement Act 1998 are not exhaustive and that not all culturally important species were included. The DMC further understands from the Cultural Impact Assessment that Ngāi Tahu consider all whales taonga.³⁹⁴ In addition to marine mammals being an important aspect of Ngāi Tahu culture, the DMC heard from Mr Ngapora they are also source of economic wellbeing.³⁹⁵

³⁹⁴ Section 4, Cultural Impact Assessment Report, Dyanna Jolly on behalf of Te Runanga o Ngāi Tahu, 2014

³⁹⁵ Statement of Evidence of Kauahi Koroneho Ngapora on behalf of Te Rūnanga o Ngāi Tahu, 11 September 2014

424. The main issues for the DMC related firstly to marine mammal presence and abundance in and around the proposed mining area, and secondly to the effects of the proposed activity on them.

Significance of the proposed consent area to marine mammals

425. The 2013 NIWA report Distribution Patterns of Cetaceans on the Chatham Rise (commonly referred to as the Torres *et al* report during the course of the hearing) provided the basis of information on marine mammals in and around the proposed mining site. This report collated data from two datasets of opportunistic sightings of cetacean species: the Department of Conservation's cetacean sightings data, and a dataset provided by Mr Cawthorn of incidental cetacean sightings by transiting ships. These two datasets provided 137 records of 12 different cetacean species and one species group (beaked whales) sighted between July 1981 and November 2007 within the Chatham Rise study area as seen in *Figure* **10**.³⁹⁶



Figure 10. Distribution of all cetacean sighting locations from DOC and Cawthron datasets within the Chatham Rise study area. (Source: Figure 1-1, Appendix 20 of the EIA, November 2012 (updated April 2013))

426. Although not expressed in the Joint Witness Statement of Experts in the Field of MarineMammals, there was a consensus amongst experts giving evidence on marine mammals that

³⁹⁶ Section 1 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April 2013)

the data was deficient.³⁹⁷ The data available were opportunistic sightings rather than a systematic survey. Dr Childerhouse stated that without systematic survey data on the application area, as well as the wider Chatham Rise, it was difficult to clearly identify which species were likely to be present in the area and, more importantly, the specific significance of the proposed mining area to marine mammals.³⁹⁸ Dr Torres herself acknowledged in her report that the sighting rates were biased due to observational effort and could not be considered representative of actual temporal distribution of cetaceans over the Chatham Rise. The report advised that cautious interpretation of these sightings data was warranted due to a lack of standardized observational effort and the absence of data.³⁹⁹

- 427. From the data available, the twelve species and one species group recorded near the application area were: beaked whales, blue whale, bottlenose dolphin, common dolphin, dusky dolphin, false killer whale, humpback whale, killer whale, minke whale, pilot whale, sei whale, southern right whale and sperm whale.
- 428. The Crown, in its submission, added Ministry for Primary Industries Fisheries Observer Whale Sightings and Chatham Islands Whale Strandings data collected since 1872 to the information known about marine mammals on the Chatham Rise. This data identified twelve additional species to the marine mammals likely to be in and around the application area.⁴⁰⁰ Even so, Dr Childerhouse opined that this data was subject to significant limitations, being:
 - that the sightings were mainly collected by observers on fishing and seismic vessels and, therefore, were biased towards areas where these operations are occurring
 - that the sightings were opportunistic and unlikely to be representative of actual marine mammals present
 - observations from fishing and seismic vessels would be influenced by the nature of their operations and therefore could not be considered representative of the normal situation
 - these records only provided information about where marine mammals have been seen and not about where they had not been seen, as the data set contained no effort data.401

³⁹⁷ Eg Paragraph B, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014; Paragraphs 12 – 13, Evidence of Associate Professor Elisabeth Slooten for Greenpeace New Zealand, KASM, DSCC, 12 September 2014; Paragraph 3, Review by Dr Michael Huber, Mr Miles Yeates and Dr Gareth Taylor (Jacobs) appended to the Statement of Evidence of Michael Edward Huber for the DMC, 12 September 2014

³⁹⁸ Paragraph D, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014

³⁹⁹ Section 1 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April 2013) ⁴⁰⁰ Paragraph 18, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014

⁴⁰¹ Paragraph 19, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014

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- 429. Having acknowledged the limitations of the data, Dr Childerhouse and Mr Cawthorn were agreed that the data sets represented the most comprehensive records currently available.402
- 430. Many of the experts considered that the Chatham Rise supported a high diversity and abundance of marine mammal species due to the relatively high productivity of the Chatham Rise ecosystem and the significant fish stocks it supported.⁴⁰³
- 431. Habitat modelling conducted predicted the Chatham Rise to be an important foraging habitat for southern right whales, particularly along the southern slope, during the summer and autumn months.⁴⁰⁴ The Chatham Rise is also a migration corridor for several species of whales migrating between the northern breeding grounds and feeding grounds in the Southern Ocean.405
- 432. As pointed out by Associate Professor Slooten, marine mammal surveys rather than habitat modelling were needed to determine which species of marine mammals use the Chatham Rise area and how much time they spend there. 406
- 433. The DMC heard from various marine mammal experts that dedicated systematic marine mammal surveys are possible using passive acoustic monitoring, aerial surveys and observers on marine vessels. Mr Cawthorn outlined in his evidence the various limitations to each of the data source techniques.407

⁴⁰² Paragraph 20, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014 and Paragraph 74, Statement of Evidence of Martin William Cawthorn for CRP, 25 August 2014

⁴⁰³ Paragraph 10, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014 and Paragraph 23, Statement of Evidence of Martin William Cawthorn for CRP, 25 August 2014 ⁴⁰⁴ Section 1 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April

²⁰¹³⁾ ⁴⁰⁵ Section 2. 2 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April 2013) ⁴⁰⁶ Paragraph 26, Evidence of Associate Professor Elisabeth Slooten on behalf of Greenpeace, KASM and DSCC, 12

September 2014

⁴⁰⁷ Paragraph 73, Statement of Evidence of Martin William Cawthorn for CRP, 25 August 2014

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Conservation status

- 434. Section 59(d) of the EEZ Act requires the DMC to take into account the importance of protecting the biological diversity and integrity of marine species, ecosystems and processes. Section 59(e) also requires the DMC to take into account the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species.
- 435. Of the recorded marine mammals sighted or stranded relevant to the application area, the DMC understand that a number have a national or international threat classification:⁴⁰⁸
 - southern elephant seal Nationally Critical (NZ status)
 - killer whale Nationally Critical (NZ status)
 - southern right whale Nationally endangered (NZ status)
 - bottlenose dolphin Nationally endangered (NZ status)
 - humpback whale Endangered (IUCN Red List)
 - sei whale Endangered (IUCN Red List)
 - pygmy blue whale Endangered (IUCN Red List)
 - Antarctic blue whale Endangered (IUCN Red List)
 - fin whale Endangered (IUCN Red List)
 - sperm whale Vulnerable (IUCN Red List).

8.6.2. Effects

- 436. Torres et al. (2014) identified the potential impacts on marine mammals from the proposed mining operation as:⁴⁰⁹
 - noise
 - ship strike
 - habitat degradation
 - entanglement
 - pollution.

⁴⁰⁸ Table 1, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014

⁴⁰⁹ Section 3 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April 2013)

Effects of noise

437. The experts agreed that the most significant potential impact on marine mammals was operational noise, and the DMC heard a large amount of evidence on this issue.⁴¹⁰ There were two main questions in order to determine the effects of noise on marine mammals: (i) what is the predicted noise generation by the proposed operation? (ii) at what noise thresholds would there be an adverse effect on marine mammals?



Figure 12. Comparison of marine megafauna hearing ranges with anthropogenic sources. Darker sections of marine mammal hearing ranges indicate peak hearing ranges, range of vocalisations (Johnson 1967, Kastelein et al. 2003, Mellinger et al. 2007, Popov et al. 2007, Houser et al. 2008, Nachtigall et al. 2008, Dawson 1990). Darker sections of anthropogenic sources of noise (red bars) indicate main energy ranges, echo sounders are variable (Götz et al. 2009, Thomsen et al. 2009, CEDA 2011, Robinson et al. 2011). (Source: Figure 1, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014)

⁴¹⁰ Issue 1, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

- 438. The basis for the noise discussion amongst the experts on marine mammals was the JASCO report which modelled sound levels under a fully operational mining scenario. This scenario modelled three individual sources of noise:
 - the dredge under dynamic positioning (point source location at approximate thruster depth for the surrogate vessel *Amundsen Spirit*)
 - an on-board mining plant (a point source at fully loaded hull depth of *Amundsen Spirit*)
 - a point source 25 m above the seafloor representing the dredge pump (scaled using *Sand Falcon* as a proxy).⁴¹¹



Figure 13. Image of dredge concept with location (depth) of sources used in modelled scenarios. (Source: Figure 3 of JASCO report attached to Statement of Evidence of Dr Darlene Ketten for CRP, 7 October 2014)

⁴¹¹ Section 2.1 of the JASCO Chatham Rock Phosphate Underwater Acoustic Modelling report appended to the Statement of Evidence of Dr Darlene Ketten for CRP, 7 October 2014

- 439. The experts in the field of marine mammals agreed that the JASCO model, based on data supplied by Boskalis, provided the best available information regarding sound source characteristics and spread of acoustic pressure levels from proposed operations.⁴¹²
- 440. The outcome of the JASCO model was that the proposed operation would generate RMS⁴¹³ source level of 195.8 dB re 1µPa at 1 m (the DMC notes that all experts accepted this underwater sound metric as appropriate). When fully operational, the 120 dB received level radii (R95 %) was 29 km and the ensonified area was 2,100 km².⁴¹⁴
- 441. There were however some uncertainties and lack of information with the JASCO modelling. The acoustic model did not include riser pipe noise, although noise from the riser pipes was approximated and included in the dredge and subsea pumps' maximum-over-depth planar sound map. The JASCO report considered that the individual contribution of the pipes as a sound source would be less than those of the sources already included in the modelling, and therefore that the inclusion of the pipes would not increase the maximum-over-depth planar sound field of the operation.⁴¹⁵ This was acknowledged by the experts for marine mammals as introducing an element of uncertainty.⁴¹⁶ Mr Humpheson opined it would have been helpful to consider whether the movement of sediment and nodules within the pipe would generate high frequency sound along its entire length of approximately 375 m. He acknowledged that the high frequency sound was only likely to affect the area immediately surrounding the dredge due to rapid attenuation of the high frequencies.⁴¹⁷
- 442. The experts in marine mammals agreed that there was uncertainty about the dredge pump as source levels above 40 kHz were not included in the modelling.⁴¹⁸ The DMC understands from Mr Humpheson that this was due to the unavailability of source data above this frequency range.⁴¹⁹
- 443. The experts in the field of marine mammals agreed that not having data on the ambient noise (including other vessel and animal sound within the predicted ensonified area) introduced another uncertainty regarding the model's application.⁴²⁰ The memorandum prepared by Mr Humpheson explains the importance of this, for example should there be concurrent shipping activity on the Chatham Rise then there would be additional noise. This would likely have the

⁴¹³ RMS = root mean square; or the mean sound pressure over a defined duration, (Ketten EiC, Report, page 8)

⁴¹⁴ Table 7 of the JASCO Chatham Rock Phosphate Underwater Acoustic Modelling report appended to the Statement of Evidence of Dr Darlene Ketten for CRP, 7 October 2014

⁴¹² Issue 1A, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

⁴¹⁵ Section 2.1 of the JASCO Chatham Rock Phosphate Underwater Acoustic Modelling report appended to the Statement of Evidence of Dr Darlene Ketten for CRP, 7 October 2014

⁴¹⁶ Issue 1A, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

⁴¹⁷ Paragraph 10, Summary of Evidence of Darran Humpheson for the Crown, 20 October 2014

⁴¹⁸ Issue 1A, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

⁴¹⁹ Paragraph 9, Summary of Evidence of Darran Humpheson for the Crown, 20 October 2014

⁴²⁰ Issue 1B, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

effect of increasing the overall dB.⁴²¹ From his analysis, Mr Humpheson concluded that the applicant's proposed dredging operations would be dominant compared to the noise of shipping activity, including fishing vessels.⁴²²

- 444. The DMC understands that the effect of noise on marine mammals is complex and can be demonstrated in a range of ways. Dr Childerhouse summarised the potential effects of noise as involving both behavioural changes (eg such as avoiding or leaving an area, affecting communication and / or echolocation or altering behavioural state such as feeding or breeding), and physiological (both temporary and permanent threshold shifts in hearing) for marine mammals at varying distances from the sound source.⁴²³
- 445. Dr Ketten informed the DMC that not only do all sounds not have the same impact across all species, but there can be significant individual variability within species. It is species-specific and is dependent upon both the animal's physiological ability to hear the signal and behavioural dispositions.⁴²⁴
- 446. The experts on marine mammals concluded that the threshold for behavioural responses is likely to occur at received levels between 120 dB and 135 dB re 1 μPa rms. As a level of 120 dB re 1 μPa rms is at or below the sensitivity of toothed whales, the principal concern identified is for baleen whales, which are able to hear those frequencies.⁴²⁵
- 447. It was Dr Ketten's opinion that as Mysticeti (baleen whales) are thought to be migrants and infrequently dive below 200 metres, there was little probability of sufficient numbers of individuals encountering the sound field frequently, at sufficient received levels and for sufficient durations to produce a population level temporary or permanent threshold shift.
- 448. Dr Ketten acknowledged some concern, but to a far lesser degree, for sperm whales because they are a more common resident species and capable of protracted dives at deeper depths. However she noted that they have moderate to poor auditory sensitivity at the relevant operational frequencies. Cumulative effects cannot be ruled out for either sperm whales or mysticetes that are more sensitive to these frequencies, but they were unlikely given that the marine mammals that are most sensitive are migrants, and sperm whales do not typically forage in the vicinity of the proposed operations. All other reported marine mammal species for the Chatham Rise areas either have sufficiently poor or no hearing abilities at the predicted operational frequencies even with repeated exposures, or are rare in the mining application

⁴²¹ Section 3.2, Memorandum from Darran Humpheson: Consideration of Future and Existing Noise Environment on the Chatham Rise, 15 October 2014

⁴²² Paragraph 13, Summary of Evidence of Darran Humpheson for the Crown, 20 October 2014

⁴²³ Paragraph F, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014

⁴²⁴ Lines 27 – 29, page 1509 of the Transcript, 21 October 2014

⁴²⁵ Issue 1D, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

area. Furthermore, given their highly mobile behaviour it was unlikely they would sustain any significant direct, physiological impacts even with frequent encounters.⁴²⁶

- 449. The experts on marine mammals agreed that it was likely that there would be some behavioural effect on some species. Behavioural changes could include altered diving, foraging, pod cohesion, masking of significant acoustic cues (eg communication, echolocation from prey), reproduction, spatial distribution and habitat use.⁴²⁷
- 450. The experts also discussed engine start up. The experts agreed that sudden onset sounds were more likely to cause behavioural change than continuous noise.⁴²⁸ Dr Childerhouse explained that one way to allay that is to undertake 'soft starts', which essentially involved starting noise-generating machinery slowly at a very low sound level before progressively winding them up to full production and maximum noise.⁴²⁹

Loss of habitat and food resources

- 451. The joint conferencing experts on marine mammals agreed that ecological impacts through benthic destruction and impact on prey species was a potential impact, and ranked this second in significance to noise effects. While the Torres *et al* report considered the magnitude of these impacts would be small scale, short-term or unlikely,⁴³⁰ the experts generally agreed that there was insufficient information to confirm the level of significance of this effect.⁴³¹
- 452. Associate Professor Slooten noted that habitat degradation includes direct damage to benthic communities from mining, and indirect impacts caused by the sediment plume.⁴³² Dr Huber noted that sediment plumes associated with discharged wastewater have the potential to disrupt some marine mammal behaviours, including feeding and migration. However, as modelling predicted that sediment plumes would generally be confined to the deepest 50 m of the water column, the primary consideration would be for deep-diving whale species such as sperm whales, pilot whales and beaked whales. Dr Huber concluded that suspended sediment plumes of the concentrations predicted are unlikely to cause impacts on whales and that in any case the

⁴²⁸ Issue 1D, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

⁴²⁶ Page 4 of Appendix A (Assessment of Operational Acoustics and Potential Marine Mammal Impacts for Chatham Rise) of the Statement of Evidence of Dr Darlene Ketten for CRP, 7 October 2014

⁴²⁷ Issue 1D, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

⁴²⁹ Lines 26 – 30, page 1579 of the Transcript, 21 October 2014

⁴³⁰ Section 4.3 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April 2013)

⁴³¹ Lines 14 – 17, page 1489 of the Transcript, 21 October 2014

⁴³² Paragraphs 37 and 38, Evidence of Associate Professor Elisabeth Slooten on behalf of Greenpeace, KASM, and DSCC, 12 September 2014

plumes could be easily avoided. Accordingly such impacts, if they occurred, would be of a small scale.433

Pollution

453. Torres et al identified the main environmental toxins that are currently of concern for populations of marine mammals as persistent organic pollutants (POPs), including PCBs, PBDE's, dioxins and furans. Other pollutants include oil-pollution derived substances, marine debris, metals, sewage-related pathogens, excessive amounts of nutrients causing environmental changes, and radionuclides.⁴³⁴ That report concluded that the impact of pollution on cetaceans was likely to be negligible given their large range, the small-scale nature of this mining proposal, and the probability of an event coinciding with the presence of any animal. The report acknowledged the potential for toxins to bioaccumulate in cetaceans if there was an oil spill or chemical release. 435

Ship strike and entanglement

- 454. The Torres et al report considered that based on the slow travel speed of the dredging vessel while operating (1 m/s), it was unlikely that a collision or harmful interaction with a cetacean would occur, especially with agile species including all odontocetes. While baleen whales are less agile, the report concluded that collision or harmful interaction is again unlikely due to the slow travel speed of the dredging vessel while operating. The report recommended transiting vessels to and from the mining area should take precautions not to strike whales, particularly around the southern edge of the Chatham Rise during summer and autumn when this habitat is important for foraging southern right whales. 436
- 455. The Torres et al report also concluded that entanglement of a cetacean in the lines between vessel and dredge / riser / sinker was unlikely due to (i) the thickness of the lines, and (ii) the lines remaining under tension in order to move the dredge head along the seafloor. Cetaceans would likely be able to perceive the lines visually and if physical contact were made, it was unlikely that an entanglement would occur.437

⁴³³ Paragraph 7 of Annexure B (Assessment of Effects on Marine Mammals from the Chatham Rise Phosphate Limited Marine Consent Application) of the Statement of Evidence of Michael Edward Huber (Marine Mammals), 12 September 2014 Section 3.5 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April 2013)

Section 4.5 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April 2013)

Section 4.1 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated

April 2013) ⁴³⁷ Section 4.4 of Appendix 20 of the EIA, Distribution patterns of cetaceans on the Chatham Rise, November 2012 (updated April 2013)

456. The experts in the field of marine mammals agreed that ship strike and entanglement were sufficiently unlikely that they did not represent a significant concern.⁴³⁸ The DMC heard no evidence to the contrary so accept that ship strike or entanglement of marine mammals is an unlikely effect of the proposal. The DMC also accepts Mr Cawthorn's evidence that the risk of marine mammal strike while the mining vessel is transiting to or from port is little different to the risk posed by fishing vessels operating on the Chatham Rise.⁴³⁹

8.6.3. **Proposed conditions**

- 457. Proposed Condition 17 required reduction of operating speeds when within 300 m of any observed whales and the reporting of any contact with whales to the Department of Conservation. The DMC supports the intent of this proposed condition and understands it to be at the discretion of the master of the vessel to avoid any whales.
- 458. Proposed Condition 18 required that a mitigation zone be visually checked for mammals and that mining commence only after no marine mammals had been observed for at least two hours. The experts in the area of marine mammals agreed on a number of proposed conditions relating to mammals including the distance of a mitigation zone being greater than 200 m (as originally proposed in the conditions) and the period of time for observations. The DMC notes that Proposed Condition 18 reflected the recommendations of the experts in the area of marine mammals in terms of the 1.5 km distance, two hour observation time and the reassessment of the mitigation zone on the basis of measurement of actual sound produced by the mining operation.⁴⁴⁰
- 459. The experts in the area of marine mammals also recommended the use of passive acoustic monitoring to provide range and direction to the vocalising animals. The DMC notes this did not appear in the proposed conditions.⁴⁴¹ Similarly, the suggested requirement for a soft start was not reflected in the proposed conditions.
- 460. The DMC also notes that Proposed Condition 20(a) required that independent and appropriately trained marine mammal observers be placed on-board the vessel in accordance with the draft conditions recommended by the experts in the area of marine mammals.⁴⁴² However, while the experts did not set a minimum duration for the observer on-board the vessel, the DMC notes that Proposed Condition 20(a) limited the need for the trained observer to between one and two years. Thereafter, Proposed Condition 21 required that relevant personnel on the mining vessel undertake appropriate training.

⁴³⁸ Issue 2, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

⁴³⁹ Paragraph 45, Statement of Evidence of Martin William Cawthorn for CRP, 25 August 2014

⁴⁴⁰ Issue 1C, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

⁴⁴¹ Issue 1C, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

⁴⁴² Issue 1C, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

461. The effect of noise on marine mammals was a significant issue during the hearing but the DMC notes that the proposed conditions did not set any noise limits, and instead referred to verification of the JASCO modelling. Proposed Schedule 2B(i) requires measuring the near field and far field of the mining vessel and mining equipment to verify the acoustic modelling results. Monitoring was required no later than one month after mining commences and was to be collected for up to two months while mining was occurring. However the experts in the field of mammals sought more certainty and greater specificity in their agreed recommended conditions. They sought empirical measurements within three months at specified distances of 100 m, 500 m, 1000 m and 2000 m from the planned dredging lane to be measured for at least three dredging passes. The experts specified certain recorded bandwidths, although not all agreed on 200 kHz.⁴⁴³ The proposed conditions did not contain this level of specificity and instead just required verification of the JASCO acoustic model.

8.6.4. **DMC findings**

- 462. The DMC accepts that the information and evidence about marine mammals was based on reported sightings and strandings rather than systematic and specific surveys. Based on the limited information available, the DMC cannot be certain as to the significance of the proposed marine consent area as habitat for marine mammals.
- 463. None of the marine mammal experts concluded that the mining operation would have significant adverse effects at a population level, albeit they differed on individual measures.
- 464. The DMC found operational noise from the proposed mining operation to have the greatest potential impact to marine mammals, but was satisfied that general knowledge about the marine mammal species observed in the wider area of the Chatham Rise, and knowledge about the species-specific behavioural and physiological characteristics and responses (including their auditory ranges), provided sufficient confidence that any effects on individual marine mammals could be managed by a range of conditions, a suite of which were suggested in the final set of proposed conditions tabled by the applicant, including mechanical noise limits, monitoring arrays, vessel speed controls, observers, stop-work separation distances, and reduction of operating speeds.
- 465. The DMC agrees that there is a lack of information regarding the potential effect of the proposal on marine mammals in terms of loss of habitat and food resources, but agrees with Dr Huber that marine mammals should be able to avoid the sediment plume. The DMC also notes that

⁴⁴³ Issue 1A, Joint Statement of Experts in the Field of Marine Mammals, 15 October 2014

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such is the range and mobility of marine mammals that it is unlikely that the proposal would have a significant effect in terms of food sources.

- 466. The DMC agrees with Dr Childerhouse that the risk is not dissimilar to that from other vessel operating in the area.⁴⁴⁴ As such, the DMC does not consider pollution from the proposal to be a significant risk to marine mammals.
- 467. The DMC finds other potential adverse effects such as loss of habitat and food resources, pollution, ship strike and entanglement to be relatively minor, with likely minimal risk to individuals and little or no effect at the population level. Overall, the DMC considers that the suite of conditions based on the applicant's proposals and including marine mammal observers would have addressed the concerns raised by the experts.

8.7. Seabirds

8.7.1. The issues

- 468. The DMC understands from the application and evidence presented that the Chatham Rise is the most important zone for seabirds within the New Zealand region, and has the largest assemblage of seabirds in the world because of the abundance of sea bird prey species on the Chatham Rise. The majority of New Zealand's seabirds could be encountered here at some point over the course of the year, with the possible exception of those species breeding at the Kermadec Islands to the north.⁴⁴⁵ While a very large proportion of New Zealand's seabird species may be found over the Chatham Rise, a smaller proportion of species are known to, or are likely to, use the Chatham Rise area more extensively. This is because they breed close to the Chatham Rise at the Chatham Islands or because they forage over the Chatham Rise from breeding sites further afield.⁴⁴⁶
- 469. Section 59(2)(d) and (e) of the EEZ Act requires the EPA to take into account "the importance of protecting the biological diversity and integrity of marine species, ecosystems, and processes and the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species."
- 470. Dr Thompson stated that four taxa of seabirds likely to be found in the marine consent application area are classified as 'threatened' under New Zealand's threat classification system. Antipodean albatross, Salvin's albatross and magenta petrel (also known as the Chatham Island taiko) have a conservation status of 'nationally critical', and the Chatham petrel has a

⁴⁴⁴ Paragraph 80, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014

⁴⁴⁵ Section 1 of Appendix 21 of the EIA, Seabirds of the Chatham Rise, November 2012 (updated April 2013)

⁴⁴⁶ Section 1 of Appendix 21 of the EIA, Seabirds of the Chatham Rise, November 2012 (updated April 2013)

conservation status of 'nationally vulnerable'.⁴⁴⁷ Mr Taylor also advised that the Chatham Island taiko is critically endangered, with just 20 known breeding pairs, and that recent DOC tracking studies have shown that they forage occasionally over the proposed mining application area.⁴⁴⁸ It is one of the rarest seabirds in the world and is listed in the IUCN Red List Threat Classification as critically endangered.⁴⁴⁹ Mr Bartle and Dr Leigh Bull agreed in their opinion that even low level additional mortality of adults or fledglings of either Chatham Island taiko or Chatham petrel could lead to their early extinction.⁴⁵⁰

471. The DMC understood from Dr Bull that the means through which formal protection is provided for seabirds is via the Wildlife Act 1953.⁴⁵¹

8.7.2. Current situation

- 472. The DMC was told that the applicant's knowledge of seabird occurrence on the Chatham Rise derives mostly from observational data (often collected on an *ad hoc* basis), seabird mortality data from commercial fisheries operations, and data acquired from electronic tracking of individual seabirds. It was common ground that there have been no systematic and quantitative surveys of spatio-temporal seabird occurrence and abundance on the Chatham Rise.⁴⁵²
- 473. It was agreed by the experts involved in the conferencing regarding seabirds, that regardless of gaps in information, the Chatham Rise is an important area for seabirds.⁴⁵³

8.7.3. Effects

- 474. The experts all agreed that the main potential effects on seabirds associated with the proposal were:⁴⁵⁴
 - light attraction resulting in increased probability of collision with wires, cables and vessel structure
 - discharge attraction resulting in increased probability of collision with wires, cables and vessel structure
 - oil pollution
 - sound attraction resulting in increased probability of collision with wires, cables and vessel structure

⁴⁴⁷ Paragraph 21 – 22, Statement of Evidence of Dr David Thompson for CRP, 25 August 2014

⁴⁴⁸ Paragraph C, Statement of Evidence of Graeme Andrew Sydney Taylor for the Crown, 12 September 2014

⁴⁴⁹ Paragraph 19, Statement of Evidence of Graeme Andrew Sydney Taylor for the Crown, 12 September 2014

⁴⁵⁰ Paragraph 144, Evidence of Mr J A (Sandy) Bartle, Royal Forest and Bird Protection Society of New Zealand Incorporated, 12 September 2014

⁴⁵¹ Line 6, page 775 of the Transcript, 3 October 2014

⁴⁵² Paragraph 1, Statement of Evidence of Dr David Thompson for CRP, 25 August 2014

⁴⁵³ Issue 1, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁵⁴ Issue 3, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

- effect of the sediment plume on abundance of vertically migrating prey species of seabirds.
- 475. It was Dr Thompson's opinion that increased sediment in the water column would not affect seabirds through a reduction in foraging efficiency for visual foragers. He concluded this because the sediment modelling indicated that any increase in turbidity would occur at depths in excess of 300 m, which is beyond the foraging range of diving seabirds.⁴⁵⁵ That conclusion was not challenged by any seabird expert. Accordingly the DMC accepts that conclusion and does not consider this effect further. The DMC addresses each of the other identified effects below.
- 476. Dr Thompson gave evidence about the number of birds that were reported killed by commercial fishing activity and returned for autopsy in the seven years up to 2013.⁴⁵⁶ He considered that of current activities occurring on the Chatham Rise, commercial fishing longline and trawl operations have the most effect on seabirds, primarily through direct mortality of birds due to incidental capture by fishing gear.⁴⁵⁷ While the DMC accepts this to be the case, the DMC turned its mind to the question as to whether the proposed mining activity increased the level of risk to seabirds, in terms of both the activity itself and any potential cumulative effect (Section 59(2)(a)(i) of the EEZ Act).

Increased risk of collision

- 477. In terms of increasing the risk of seabird collision with the mining vessel, all the experts involved in conferencing agreed that lighting posed the greatest potential risk.⁴⁵⁸ Nocturnal bird strikes on vessels tend to occur when bright, artificial light sources are used at times of poor visibility, typically during bad weather, often angled outwards or upwards from the vessel, and when the vessel is relatively close to large breeding aggregations of seabirds.⁴⁵⁹
- 478. It was Dr Thompson's opinion that the likelihood of bird strike of taiko and Chatham petrels was low, based on an absence of any strikes being reported.⁴⁶⁰ However Mr Taylor gave evidence as to how DOC uses lights to attract the taiko in order to capture and tag the birds, indicating how attracted to light they are. Storm petrels, prions and other birds are also attracted to the DOC lights, which shine upwards.⁴⁶¹

⁴⁵⁵ Paragraph 28, Statement of Evidence of Dr David Thompson for CRP, 25 August 2014

⁴⁵⁶ Paragraph 24, Statement of Evidence of Dr David Thompson for CRP, 25 August 2014

⁴⁵⁷ Paragraph 24, Statement of Evidence of Dr David Thompson for CRP, 25 August 2014

⁴⁵⁸ Issue 4, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁵⁹ Paragraph 7, Statement of Evidence of Dr David Thompson for CRP, 25 August 2014

⁴⁶⁰ Lines 41 – 46, page 436 of the Transcript, 30 September 2014

⁴⁶¹ Lines 21 – 43 page 469 and lines 36 – 39 page 474 of the Transcript, 30 September 2014

- 479. The applicant proposed the use of green lights on board the mining vessel as a possible mitigation measure. Although none of the bird experts was categorical that green lighting would make a difference, it was noted that they had been effective in the North Sea, although that trial did not include seabirds. The experts agreed that green lights were worth testing to determine whether, and to what extent, this might be an effective approach to reducing the attraction of seabirds to light. The DMC asked whether DOC's capture and tag programme would present an opportunity to trial the green lights and Mr Taylor agreed that this was an option.⁴⁶² However the DMC notes that there was some reservation about the efficacy of a land-based trial. Mr Bartle agreed that a trial was required in advance, which could involve a vessel with green lights, possibly even close to the seabird colonies, to see whether any sea birds fly on board or not⁴⁶³ (although the DMC understood this not to refer to taiko colonies). Dr Bull clarified that, in her opinion, success would be no birds reacting to green lights on land or sea.⁴⁶⁴ The DMC gained the impression from other experts however, that a relative reduction in attractiveness rather than an absolute reduction was more probable.
- 480. Mr Prebble on behalf of the Crown drew the DMC's attention to the lighting requirements for navigational safety under the Maritime Transport Act (Maritime Rules Part 22: Collision Prevention).⁴⁶⁵ The DMC understands that these rules set the minimum night-time lighting profile for vessels (including the distance requirement for visible white lights) and therefore assist in the evaluation of risk of collision by seabirds, although, as noted elsewhere, the DMC was left uncertain as to the applicability of these rules beyond territorial waters. The lighting requirements for workplace safety may also constrain the use of alternative lighting mitigation measures.
- 481. The seabird experts agreed that if green light was not effective or not used, then no mining should occur on nights when birds are most at risk (ie foggy / cloudy nights with no moon present). The experts also agreed that during the known fledging dates for seabirds which breed on the Chatham Islands, night suspension of mining for a 14 day period a week either side of the new moon in May should be required (to protect fledglings of Chatham taiko and Chatham petrel in the critical period when they first depart to sea). The experts supported reducing all unnecessary deck and cabin lighting, covering portholes and windows at night, orientating the deck lights downwards, avoiding upward or horizontal lighting as much as possible and using light intensity reducing technology such as dimmers or timers. ⁴⁶⁶

⁴⁶² Lines 41 – 42, page 474 of the Transcript, 30 September 2014

⁴⁶³ Lines 17 – 19, page 755 of the Transcript, 3 October 2014

⁴⁶⁴ Lines 7 – 8, page 772 of the Transcript, 3 October 2014

⁴⁶⁵ Lines 17 – 46, page 453 of the Transcript, 30 September 2014

⁴⁶⁶ Issue 4, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

- 482. The seabird experts also agreed that discharge from the applicant's vessel (both organic waste from the vessel and benthic material) would increase its attractiveness to seabirds. The experts concluded that this potential effect should be overcome through appropriate design of the vessel, by ensuring that no waste is discharged into the sea and by returning benthic material successfully to the sea floor.467
- 483. One other potential attractant considered by the seabird experts was noise. While the experts agreed that noise could be an attractant, they could not agree on whether low revving diesel engines were less attractive to birds, and therefore whether any measures were required to reduce the risk. Mr Bartle considered that the sort of pumps and generators likely to be used in the dredging operation would pose a potential hazard if they were on deck.⁴⁶⁸ Overall, however, this was considered to be a low risk by the majority of the seabird experts.⁴⁶⁹
- 484. Mr Taylor expressed concern about the size of the vessel potentially increasing the risk of collision by seabirds, compared to typical fishing vessels, due to its greater overall bulk and profile, including wires.⁴⁷⁰ The seabird experts concluded that the risk could be reduced by the vessel design being assessed by a seabird expert to identify design hazards and ways to mitigate the risks.471

Effect on food sources

485. The effect of the sediment plume on the abundance of vertically migrating prey species of seabirds was identified by the seabird experts as a potential effect; but one where there is a high degree of uncertainty due to lack of information.⁴⁷² The DMC understands that vertically migrating marine organisms include a range of small fish, krill and plankton that descend into very deep dark water during the daytime and then at night ascend to feed in the plankton rich waters nearer the surface.⁴⁷³ It follows that if these organisms are significantly affected by the sediment plume, there could be consequential effects on the food source for seabirds. However, there was no agreement between the experts as to how significant that risk is, due to the absence of available and uncontroverted information. The DMC addresses the effects on zooplankton in Chapter 8.4 of this report.

⁴⁶⁷ Issue 5, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁶⁸ Paragraph 197, Evidence of Mr J A (Sandy) Bartle, Royal Forest and Bird Protection Society of New Zealand Incorporated, 12 September 2014
 ⁴⁶⁹ Issue 6, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁷⁰ Lines 1 – 3, page 476 of the Transcript, 30 September 2014

⁴⁷¹ Issue 7, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁷² Issue 9, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

 $^{^{473}}$ Lines 21 – 44, page 471 of the Transcript , 30 September 2014

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Oil

486. It was common ground that oil spill represented a low risk to seabirds although known to clog and damage feathers or be ingested. Mr Taylor considered the risk no different to any other fishing vessel or other boats operating on the Rise, apart from the fact that this would be a larger vessel and therefore likely to have more oil on board.⁴⁷⁴ The DMC agrees.

8.7.4. **Proposed conditions**

- 487. Seabirds were acknowledged in Proposed Schedule 1 as an environmental threshold. If this were exceeded, it would be classed as an "*unexpected adverse impact*" and an adaptive management approach would need to be followed in terms of Proposed Condition 41. Two seabird environmental thresholds were identified in proposed Schedule 1B as:
 - injury or killing of any Chatham Island taiko (*Pterodroma magenta*) or Chatham petrel (*Pterodroma axillaris*)
 - in any calendar month, injury or killing of more than two other seabirds.
- 488. The experts in the field of seabirds identified a number of species that were most at risk, including Chatham Island taiko (Magenta petrel) as critically endangered and Chatham Island petrel as endangered.⁴⁷⁵ Although the seabirds experts identified Chatham Albatross, Southern Buller's albatross (not agreed by all experts), Salvin's albatross and Gibson's albatross as declining populations, these species are considered less at risk. The DMC considers the singling out of the Chatham Island taiko and Chatham petrel as being an environment threshold appropriate given their endangered status. The DMC notes that the Crown expert agreed with the thresholds set out in Proposed Schedule 1 for seabirds.⁴⁷⁶
- 489. Proposed Condition 7 would ensure no food wastes are discharged from the vessel either during mining or transiting to and from the mining site. This proposed condition reflected the recommendations of the experts in the field of seabirds.⁴⁷⁷ The DMC considers this proposed condition appropriate to avoid attracting seabirds to the vessel and therefore reducing the potential for seabird strike or entanglement.
- 490. Proposed Condition 19 outlines all the avoidance measures to reduce the potential impact on seabirds. The DMC notes that most of the proposed conditions recommended by the experts in the area of seabirds were reflected in the proposed conditions, for example minimising lighting on the vessel, covering portholes, and orienting lights downwards.⁴⁷⁸ The experts'

⁴⁷⁴ Lines 20 – 23, page 478 of the Transcript, 30 September 2014

⁴⁷⁵ Issue 10, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁷⁶ Paragraph 11.6, Crown's Closing Submissions, 18 November 2014 (note the submission states 18 October 2014)

⁴⁷⁷ Issue 5, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁷⁸ Issue 4, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

recommendation regarding the use of dimmers and timers and other light intensity reducing technology was not specified in the proposed conditions, although it could arguably be a component of Proposed Condition 19(a)(i). Proposed Condition 19(a)(vi) required minimising the use of vertical wires and objects on the deck, reflecting the recommendations of the experts.⁴⁷⁹ Proposed Condition 19(a)(viii) reducing oil on the deck was also in accordance with the experts' recommendations.⁴⁸⁰

- 491. The DMC notes that the experts recommended that a trial investigating the effectiveness of using green light on a vessel in the Chatham Rise should be undertaken prior to the final build / fitting out of the mining vessel. The experts considered that if the trial was not possible for some reason, green lights should still be installed wherever practical. Although the proposed conditions did not require a trial of green lights, Proposed Condition 19(2)(ii) required maximising the use of green lights.⁴⁸¹
- 492. The experts in the field of seabirds agreed on the need for night suspension of mining for a 14 day period for a week either side of any new moon in May (to protect fledglings of Chatham taiko and Chatham petrel in the critical period when they first depart to sea). This recommended condition was not adopted by the applicant.
- 493. The DMC notes also that the recommended condition regarding the encasing of deck-mounted engines or generators in a housing to reduce noise did not appear in the proposed conditions (although the DMC acknowledges that not all of the experts in the field of seabirds could agree on this proposed condition).⁴⁸² Dr Thompson noted that there was insufficient scientific knowledge in this area and Mr van Raalte indicated that it was most unlikely that above-deck generators would be incorporated in the vessel design.⁴⁸³
- 494. The DMC notes that many of the clauses in Proposed Condition 19 were qualitative rather than quantitative and could be difficult to enforce. The DMC agrees with the EPA's assessment that many of the clauses in Proposed Condition 19(a) would be appropriately addressed in the Lighting Management Plan required by Proposed Condition 19(b).⁴⁸⁴
- 495. The DMC notes that Proposed Condition 20(a) required independent and appropriately trained seabird observers on-board the vessel in accordance with the draft conditions recommended by the experts in the area of seabirds.⁴⁸⁵ The experts considered that a trained seabird observer

⁴⁷⁹ Issue 7, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁸⁰ Issue 8, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁸¹ Issue 4, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁸² Issue 6, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁸³ Issue 6, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁸⁴ EPA Comment of CRP Conditions, 14 November 2014

⁴⁸⁵ Issue 1, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

was required on board for the first year of operation and seasonally dependent thereafter depending on the monitoring results of seabird mortality. The DMC notes that Proposed Condition 20(a) limited the need for the trained observer to between one and two years. Thereafter Proposed Condition 21 required that relevant personnel on the mining vessel undertake appropriate training. The seabird experts considered information gathered from seabird observers was essential for incorporation into any adaptive management response if seabird mortality and / or vessel strike issues arose.⁴⁸⁶ The DMC considers the suite of proposed conditions associated with seabird observers to be generally appropriate.

496. There was some disagreement between the seabird experts regarding the value of undertaking baseline seabird surveys. Drs Bull and Thompson did not consider baseline surveys to be necessary, but thought that the independent observers could collect data on birds around the boat in a systematic way.⁴⁸⁷ The DMC agrees that such surveys, being methodologically quite complex, would require considerable time and effort to be useful and, on the basis of the evidence, did not appear to be warranted.

8.7.5. **DMC findings**

- 497. The Chatham Rise is a nationally and internationally significant marine region for birds because of the diversity and abundance of seabirds using the area. This significance is highlighted by the presence of a number of endemic species that are considered threatened or at risk. The experts on seabirds and the DMC accepted this overall assessment of the importance of the Chatham Rise for seabird populations. The DMC found no compelling evidence that significant direct adverse effects on the seabird population of the Chatham Rise would arise from the proposed mining operation provided that it adhered to an appropriately structured set of conditions.
- 498. With respect to the critically endangered Chatham Island taiko population, it was common ground that any fatality could be a significant issue given their low breeding numbers and especially if, for example, the one male that is responsible apparently for a high proportion of the living offspring was that casualty. However the DMC notes that the probability of such an event is extremely small.
- 499. Overall the DMC considers that most of the conditions proposed by the applicant are consistent with those recommended by the experts in the field of seabirds and would have minimised the potential effect on seabirds despite the qualitative nature of many of the conditions.

⁴⁸⁶ Issue 1 and 7, Joint Statement of Experts in the Field of Seabirds, 23 September 2014

⁴⁸⁷ Lines 35 – 39, page 788 of the Transcript, 3 October 2014

8.8. Water quality

8.8.1. **Issues**

- 500. The disturbance of seabed sediments by the drag-head and the re-introduction of processed sediments back to the bed via the sinker and diffuser structure were assessed in terms of the potential to alter local water quality and mobilisation of potential contaminants. It was proposed that sediment would be excavated from the seabed using water jets and suction. As Mr Kennedy described in his evidence, the excavation of seabed sediment results in the mixing of seawater in the drag-head with pore water contained in the excavated sediment. It also causes the release of some constituents that were associated with the surfaces of sediment particles, resulting in potential changes in water quality.⁴⁸⁸
- 501. The application of Chatham Rise phosphorite to New Zealand land was also raised by the applicant as having potential benefits to freshwater quality through a reduction in the loss of phosphorus to water.⁴⁸⁹ Submitters however raised potential adverse effects to land and freshwater through the phosphorite application due to its elevated uranium levels relative to other fertilisers currently used in New Zealand. Some submitters⁴⁹⁰ from the Chatham Islands also expressed concerns about effects on surrounding water quality and local fisheries if phosphorite fertiliser was applied to farm land on the islands.⁴⁹¹
- 502. Potential changes in water quality immediately above and at the seabed associated with the release or mobilisation of organic material and trace elements originally associated with seabed sediments was a key water issue at the hearing. In particular:
 - potential for an increase in oxygen demand associated with the discharge of processed sediment and associated organic matter back to the seabed
 - heavy metals, their ability to be taken up and accumulated through the marine food chain (ie biouptake and bioaccumulation) and their toxicity to aquatic life in both the marine and freshwater environment.
- 503. The release of radioactive substances into the marine environment was the focus of considerable attention by a number of parties particularly given the presence of uranium in phosphorite. The human effects of radioactivity are addressed separately in Chapter 8.9.
- 504. Changes in light penetration through the water column due to the presence of a sediment plume were another water quality issue raised by some submitters. While the effects of suspended sediment on water clarity was potentially a water quality issue, the main effect in this instance,

⁴⁸⁸ Paragraph 37, Statement of Evidence of Paul Kennedy for CRP on Sediment and Water Chemistry, 29 August 2014
⁴⁸⁹ Paragraph 13, Opening Submissions for CRP, 25 September 2014

⁴⁹⁰ Eg Mr Cameron

⁴⁹¹ Lines18 – 19, page 198 of the Transcript, 26 September 2014

given the depth at which the discharge would take place, appeared to be the potential for physical effects on marine organisms through the likes of displacement and interference by smothering surfaces and clogging feeding structures. These effects are discussed elsewhere.

- 505. The chemistry of the Chatham Rise sediments and sediment pore water in the vicinity of the mining permit area was assessed from samples collected during surveys. Pore water chemistry was assessed indirectly using an elutriate process. The elutriate process was described to the DMC by Dr Phillips who said the tests are designed to simulate the release of contaminants from a sediment during dredged material disposal and involve the mixing of dredged material with dredging site water and then allowing the mixture to settle. The resulting liquid or elutriate that remained after the sediment has settled was considered to contain the metals and other contaminants that are most bioavailable to organisms ⁴⁹². The applicant's experts used the results of this testing to provide information on the changes in water quality associated with the mixing of sediments and seawater.⁴⁹³
- 506. The elutriate testing undertaken on behalf of the applicant was criticised by several witnesses at the hearing.⁴⁹⁴ The primary criticisms of the technique used were: that the sediment samples used for the elutriate for toxicity testing were three years old and had been frozen, which introduced some uncertainty into the results; and that the water used in the elutriate test was not sourced from the Chatham Rise but rather from the Raglan coast (east coast of the North Island) and at a site en route to the Chatham Islands. Further, the elutriate tests were performed on seabed material that most closely resembles the dredged sediment, rather than the sediment after it had been processed on board and returned to the seabed. The experts involved in the conferencing on toxicology and water quality echoed these concerns. They could not agree on whether the sediment as used in the elutriate test represented the material after it had been processed and returned.⁴⁹⁵ Dr Phillips expressed concern in her evidence that as the elutriate tests were undertaken on seabed material rather than the processed or returned sediment, the results did not represent the bioavailability associated with the processed or returned material. She considered that the 30 minute elutriate tests did not adequately represent the effects on sediment chemical and physical properties that may arise from mining activity or return of the material to above the seabed. 496
- 507. Dr Phillips was also concerned that toxicity was determined only for elutriates derived from surface sediments, whereas the sediment to be mined may consist of any combination of a mix of three layers, namely surface, subsurface and chalk.⁴⁹⁷ From this the DMC understands that

⁴⁹² Line 5 page 794 of the Transcript, 14 October 2014

⁴⁹³ Paragraph 40, Statement of Evidence of Paul Kennedy for CRP on Sediment and Water Chemistry, 29 August 2014
⁴⁹⁴ Eg Dr Ngaire Philips, Dr Louis Tremblay, Associate Professor Peake

⁴⁹⁵ Issue 2, Joint Statement of Experts in the Field of Toxicology and Water Quality, 19 September 2014

⁴⁹⁶ Lines 11 – 25, page 794 of the Transcript, 14 October 2014

⁴⁹⁷ Lines 45 – 2, pages 794 – 5 of the Transcript, 14 October 2014

the samples and results may not be representative of the sediment disturbed and processed by the mining operation. Dr Tremblay expressed similar concern that most of the metals are in the deeper suboxic layers which would be mined. 498

- 508. The experts agreed that, on balance, the appropriateness of the elutriate testing was not a major issue, although there would be value in following this up.⁴⁹⁹ They recommended that the applicant should be required to validate the toxicity tests with fresh sediment samples as a part of a pre-mining sampling programme.
- 509. Associate Professor Peake expressed concern at the lack of baseline data on the quality of the elemental composition of the water column through the proposed mining area. He proposed that in order to measure and assess the effect of a mining activity, the quality of the water must be known before mining commences. He did not consider that the applicant had provided adequate evidence for what that quality was. 500

8.8.2. Release of organic matter and oxygen demand

- 510. Mr Kennedy explained that due to the crushing of organic material by the mining operation and the resulting increase in organic carbon concentrations in the water as a result of the discharge, there may be a corresponding increase in oxygen demand as the material is converted into carbon dioxide. 501
- 511. Mr Kennedy noted that oxygen depletion predicted in the dispersion model was dependent on how much organic carbon was in the sediments. Assessments on behalf of the applicant concluded that if all benthic organisms in the target areas were included in the processed sediment and discharged back to the seabed in the return sediment discharge, carbon accumulation rates on the Rise may temporarily increase by as much as 80 %, but on average much less. However Mr Kennedy thought this scenario was unlikely and concluded that the proposed mining would not produce anoxic conditions in the water column.⁵⁰² He considered that the models were inherently conservative and indicative of worst-case scenarios. In particular, he noted the dilution of the plume outside the immediate mining area was not considered (ie effects would be much less outside the modelled 1.2 km²), and that it was likely that some carbon would be removed from the water column (ie settle out) before it could oxidise.

⁴⁹⁸ Lines 30 – 32, page 837 of the Transcript, 14 October 2014

⁴⁹⁹ Issue 2, Joint Statement of Experts in the Field of Toxicology and Water Quality, 19 September 2014

⁵⁰⁰ Lines 17 – 22, page 822 of the Transcript, 14 October 2014 ⁵⁰¹ Paragraph 63, Statement of Evidence of Paul Cameron Kennedy for CRP on sediment and Chemistry, 29 August 2014

⁵⁰² Section 7.4 of Appendix 11 of the EIA, Review of Sediment Chemistry and Effects of Mining , May 2014

512. Dr Krause challenged these conclusions. He considered it likely that the tailings being deposited would be anoxic and sulphide rich owing to the physical and chemical processes associated with the dredging, transport, processing and return of sediments to the sea floor during the mining operation. 503

Trace elements including heavy metals and their toxicity 8.8.3.

Source of heavy metals

- 513. The DMC heard that both the phosphorite nodules and other seabed sediments of the Chatham Rise contain trace elements including heavy metals, with distributions that differ between sediment types. For example, phosphorite nodules contain elevated phosphorous and uranium levels, while surrounding chalk material contains elevated calcium and barium.⁵⁰⁴ Heavy metals are of particular concern as many are known to exert toxic effects on aquatic organisms when they become soluble and can be available for uptake by organisms either directly through exposure to surrounding water or indirectly through the food chain.
- 514. Due to the separation of the phosphorite nodules from the seabed sediment, and their different eventual receiving environments, the DMC was interested in the trace elements of each and therefore the effects of those trace elements. The nodules would ultimately end up in the terrestrial environment through application of fertiliser, while the rest of the sediment and associated trace elements would be deposited back on the seabed with some remaining in suspension for an extended period of time depending on their particle size and solubility. The DMC addresses each of these in turn.

8.8.4. **Effects of tailings**

515. The DMC heard that during the process of mining, seawater would be mixed with tailings sediment which would cause a release of trace elements and nutrients into the water column.505 A number of submissions expressed concern in regard to trace elements and heavy metals including the effect on the quality and health of organisms and fish, exceedance of ANZECC guidelines and impacts on the food web.506

Major and trace elements

516. The key to understanding the toxicology effects of the tailings from the proposed mining is the element composition of the seabed sediment. Analysis of sediment showed that the different

⁵⁰³ Paragraph 42, Statement of Evidence of Dr Paul Richard Krause for Deepwater Group Limited and Te Rūnanga o Ngāi Tahu, 12 September 2014 ⁵⁰⁴ Paragraph 2, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

⁵⁰⁵ Paragraph 3, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

⁵⁰⁶ Eg submissions from Ngāi Tahu Submission, Hokotehi Moriori Trust, Deep Water Group and KASM.

seabed sediments have different chemical compositions. Elements like chromium and vanadium are enriched in the sand fraction, while elements such as strontium and barium are associated with the silty siliceous and carbonaceous materials in the sediment.507

517. Elutriate samples were examined for the following constituents:

- dissolved ammoniacal-N, nitrate and nitrite-N (and soluble inorganic nitrogen (SIN) as the sum)
- dissolved iron and manganese
- dissolved arsenic, copper, cadmium, chromium, lead, mercury, nickel, uranium and zinc.508
- The DMC heard that abundances of all elements were lower than sediment quality guidelines 518. provided by ANZECC, except cadmium in the elutriate test. 509
- Elutriate testing confirmed that there would be a release of some elements into the water 519. column. The most environmentally significant releases would be inorganic nitrogen, arsenic, cadmium and copper.⁵¹⁰ The experts involved in toxicology and water guality conferencing all agreed that the concentration of metals released or mobilised from the sediments would be critical in assessing the impacts as a result of the mining operation.⁵¹¹

Toxicity effects

- 520. The DMC heard that toxicity testing was undertaken using three species: the amphipod Chaetocorophium c.f. lucasi, the early life stages of the blue mussel (Mytilus galloprovincialis) and a marine bioluminescent bacteria. Mr Kennedy outlined in his evidence the varying responses to the elutriates.512
- 521. Experts such as Dr Phillips and Associate Professor Peake felt that the three species used were not representative of species found at depth in full salinity on the Chatham Rise.⁵¹³ However, the DMC understood that the three species used are fairly standard and allow any toxicity they exhibit to be assessed on a relative basis. The experts agreed that a proposed condition of

⁵⁰⁷ Section 5.6.2, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵⁰⁸ Section 2.2.3, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵⁰⁹ Paragraphs 34 and 44, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August

²⁰¹⁴ ⁵¹⁰ Paragraph 3, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

⁵¹¹ Issue 1, Joint Statement of Experts in the Field of Toxicology and Water Quality, 19 September 2014

⁵¹² Paragraphs 55 – 58. Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

 $^{^{513}}$ Lines 18 – 20, page 795 and Lines 2 – 4, page 823 of the Transcript, 14 October 2014

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consent should be a requirement to undertake research that would help to establish toxicity values based on species that are relevant to the consent area.⁵¹⁴

- 522. Only copper and ammoniacal nitrogen exceeded the conservative ANZECC 99 % protection guidelines, with vanadium maximally 64 % of the guideline value. Together, these data were considered to indicate that only minimal reasonable mixing in the near-field region of the mining discharge outlet would be required to satisfy these toxicity-related thresholds.⁵¹⁵
- 523. The DMC heard from Mr Kennedy that the use of the 99 % protection guideline values was adopted for the Chatham Rise assessment as the Rise can be considered a high value ecosystem.⁵¹⁶ Mr Kennedy considered that based on the toxicity test results, a minimum dilution of 17.5 times would be required to prevent any chronic effects in the biota tested.⁵¹⁷ Mr Kennedy concluded that after 17.5 times dilution, no element for which there is guidance available would be elevated above the ANZECC (2000) 99 % trigger values for the protection of marine species.⁵¹⁸
- 524. Given that the mined benthic area would be devoid of life, it is our understanding that toxicity would be more of an issue for species in the pelagic zone and nearby areas of unmined seabed affected by sedimentation. Dr Phillips confirmed that the level of toxicity would depend on how long the sediment plume remained suspended.⁵¹⁹ Associate Professor Peake concurred that the key parameter was the time the sediment plume takes to disperse, which would determine the extent of exposure of fish that were swimming in that area and therefore exposed to elevated levels.⁵²⁰
- 525. Based on these results, Mr Kennedy considered that a dilution factor of 17.5 would be required to ensure no adverse effects occur as a result of mining. Dilution within the plume close to the discharge would be about 700 times, and towards the outer parts of the plume, dilution would be about 5,000 times or higher within 10 m of the seafloor (350 450 m deep) and greater at shallower depths away from the seabed. Consequently he predicted no toxicological effects would occur as a result of the mining process.⁵²¹
- 526. Dr Phillips expressed concern that toxicity effects and increases in some contaminants were observed with the 24 hour elutriates, which warranted further examination of the potential long

⁵¹⁶ Paragraph 46, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

⁵¹⁴ Issue 3, Joint Statement of Experts in the Field of Toxicology and Water Quality, 19 September 2014

⁵¹⁵ Executive Summary of Appendix A (Chatham Rise sediment elutriates: toxicity and chemistry) of the Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

⁵¹⁷ Paragraph 58, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

⁵¹⁸ Paragraph 62, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

⁵¹⁹ Lines 17 – 19, page 798 of the Transcript, 14 October 2014

⁵²⁰ Lines 15 – 16, page 827 of the Transcript, 14 October 2014

⁵²¹ Paragraph 4, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014
term accumulation of metals in fish in particular given the importance of the Chatham Rise as a commercial and customary fishery.⁵²²

- 527. Mr Kennedy cautioned the DMC that exceedance of an ANZECC (2000) trigger value did not imply an adverse effect. Instead, an exceedance should be a trigger for investigation in relation to the possibility of effects (ie monitor and assess the condition of ecological communities).⁵²³ This caused the DMC some difficulty as it suggested that ANZECC values were therefore not appropriate levels to use as proposed conditions of marine consent. As pointed out by Dr Phillips, exceedance of the ANZECC levels required more investigation. Dr Phillips posed the question: if there was continued exceedance, then what?⁵²⁴
- 528. Associate Professor Peake suggested further research should be undertaken before mining started by measuring the toxicity for the four major commercial species, hoki, ling, orange roughy and warehou, and comparing it with the total possible uranium content in the water at the point of discharge from the discharge pipe.⁵²⁵ He opined that toxicity may be different for the different stages of the lifecycles of these pelagic species and that it could be that the larval stage is more sensitive to uptake than the adult, which would be an added complication.⁵²⁶
- 529. Dr Tremblay acknowledged the challenge of assessing long term potential impacts, particularly as they relate to multigenerational impacts or ecosystem services. He opined that there were significant knowledge gaps particularly in the deep sea environment.⁵²⁷ Although the toxicology tests indicated whether there was an acute effect which is short term ("*basically the organisms going belly-up*"), they would not indicate longer term abilities to reproduce.⁵²⁸
- 530. The experts in this field agreed that there was a lack of information about the sensitivity of sitespecific organisms to dissolved metals in the water column.⁵²⁹ However, they considered that this could be addressed through proposed conditions requiring the applicant to collect baseline information prior to the commencement of mining and to undertake research to establish toxicity thresholds based on species relevant to the proposed marine consent area.

⁵²² Lines 12 – 17, page 796 of the Transcript, 14 October 2014

 ⁵²³ Paragraph 48, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014
 ⁵²⁴ Lines 5 – 9, page 808 of the Transcript, 14 October 2014

⁵²⁵ Lines 31 – 35, page 823 of the Transcript, 14 October 2014

⁵²⁶ Lines 21 – 23, page 825 of the Transcript, 14 October 2014

⁵²⁷ Lines 10 – 16, page 837 of the Transcript, 14 October 2014

⁵²⁸ Lines 38 – 41, page 842 of the Transcript, 14 October 2014

⁵²⁹ Issue 17, Joint Statement of Experts in the Field of Toxicology and Water Quality, 19 September 2014

Uranium

- 531. The issue of uranium was raised in submissions and was discussed at length in the hearing. The DMC heard from Dr Phillips and Associate Professor Peake that there were two effects in the case of uranium: the ecotoxic effect from the chemical perspective, and the effect of the radiation of the uranium and its breakdown products. The two were interrelated.⁵³⁰
- 532. The DMC heard that one of the areas where there is a distinct lack of information is toxicity data for uranium in the marine environment. Dr Phillips outlined the difficulty of making a decision about whether uranium levels are acceptable or not in the absence of guidelines.⁵³¹
- 533. Compared to the Canadian water quality guidelines for the protection of aquatic life: Uranium (2011), at least 50 % of the uranium concentrations measured in elutriate samples were found to be lower than the short-term exposure guidance. The EIA concluded that following a ten-fold dilution, the elutriate concentrations would have been diluted to concentrations at or below the Canadian water quality guidelines for the protection of aquatic life (uranium chronic guidance).⁵³² The DMC notes that this guidance is for freshwater biota and questions its relevance. The applicant's EIA report concluded that as the uranium in the diluted elutriate is likely to be present as carbonate complexes, the risk of chronic toxicity to marine biota was considered remote. The report considered it unlikely that any significant change in the concentration of uranium in fish muscle tissue would occur, due to the dilution of uranium with distance from the discharge, released uranium being present as carbonate complexes, and uptake in fish occurring mainly in bony tissues.⁵³³
- 534. Evolving information was presented to the DMC with regard to uranium concentrations. In the application documents, the plume dispersion model showed that close to the discharge point, increases in seawater uranium concentrations were predicted to be about 10 % of the naturally occurring seawater concentrations. By about 15 km (the edge of the dispersed plume) the relative elevation above the natural concentration was estimated to be about 1 %.⁵³⁴ After revised sediment plume modelling was undertaken, the experts in the field of radioactivity agreed that dilution of uranium (dilution factor 750) to background levels would occur within the near field within 250 m of discharge.⁵³⁵

⁵³⁰ Lines 41 – 44, page 834 of the Transcript, 14 October 2014

⁵³¹ Lines 23 – 24, page 801 of the Transcript, 14 October 2014

⁵³² Section 8 of Appendix E (Review of Uranium in Seawater and its Release from Chatham Rise Sediment) of Appendix 11 of the EIA, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵³³ Section 8 of Appendix E (Review of Uranium in Seawater and its Release from Chatham Rise Sediment) of Appendix 11 of the EIA, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵³⁴ Section 7 of Appendix E (Review of Uranium in Seawater and its Release from Chatham Rise Sediment) of Appendix 11 of the EIA, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵³⁵ Issue 1, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

- 535. While Dr Hermanspahn acknowledged an increased risk factor for the near field (50 m from the point of discharge), he concluded overall that it constituted a low risk due to the exposure is being of only limited duration (being around one day of mining). While uranium was quite soluble in seawater, polonium tended to attach to particulates and would be removed from the plume faster than uranium and settle down into the sediment again. He concluded that the radiological risks to marine biota were small.⁵³⁶
- 536. Although uranium and its potential effects were discussed during the hearing, the DMC understands from Dr Jeffree that Uranium-238 is a 'primordial' radionuclide which decays to produce a series of daughter radionuclides. Among these radioactive elements, there are several which have greater significance for adverse radiological effects on aquatic biota than Uranium-238, being Polonium-210 (Po-210), Radium-226 (Ra-226) and Lead-210 (Pb-210).⁵³⁷ Dr Jeffree considered Thorium-232 (Th-232) and Uranium-235 (U-235) need further consideration and quantitative assessment with regard to their potential for radiological detriment to benthic biota at Chatham Rise.⁵³⁸ The experts in the field of radioactivity all agreed that it would be advisable to establish that levels of radionuclides especially Polonium 210 in the four pelagic fish species of the Chatham Rise would not pose a radiological risk.⁵³⁹
- 537. As identified by Dr Jeffree, there are a number of uncertainties. He suggested that the unconsolidated nature of tailings sediment may result in radionuclides being more easily liberated into the benthic water layer than when they were contained within nodules. Their enhanced water concentrations could then lead to increased radiological exposure of benthic biota through their bioaccumulation. He suggested that it is also possible that very particle-reactive radionuclides would be retained in the suspension layer directly above the benthic sediment, in the very fine colloidal or clay fraction which is not likely to settle between mining cycles, therefore providing an enhanced exposure pathway for benthic filter feeders ingesting such contaminated particles.⁵⁴⁰

 $^{^{\}rm 536}$ Lines 23 – 33, page 877 of the Transcript, 14 October 2014

⁵³⁷ Paragraph 13 of Annexure A (Assessment of Effects of Radioactive Elements on the Marine Environment from the CRP Marine Consent Application) of the Statement of Evidence of Dr Ross Anthony Jeffree, 12 September 2014

⁵³⁸ Paragraph 16 of Annexure A (Assessment of Effects of Radioactive Elements on the Marine Environment from the CRP Marine Consent Application) of the Statement of Evidence of Dr Ross Anthony Jeffree, 12 September 2014

⁵³⁹ Issue 1, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

⁵⁴⁰ Paragraph 53 of Annexure A (Assessment of Effects of Radioactive Elements on the Marine Environment from the CRP Marine Consent Application) of the Statement of Evidence of Dr Ross Anthony Jeffree, 12 September 2014

- 538. The experts in the field of radioactivity agreed that Polonium 210 and other radionuclides have a high affinity for fine sediment. They considered the potential for the increase of radionuclides at the sediment water interface to be of secondary importance as the bulk of the radionuclides reside in the phosphorite and would be removed through the mining process.⁵⁴¹ They recommended that the applicant undertake research to establish a recognised toxicity threshold for uranium in the marine environment.
- 539. Dr Santillo brought to the attention of the DMC the International Atomic Energy Agency as being recognised by Parties to the London Convention and London Protocol as the appropriate body to provide technical advice. He considered that International Atomic Energy Agency Guidelines, including the step-wise approach to consider criteria for *de minimis* exemption and the specific assessment for potential impacts on human health and marine flora and fauna had not so far been applied to the case of the phosphorite deposits on the Chatham Rise.⁵⁴²

Biouptake and bioaccumulation

- 540. The DMC understands that the potential toxicity to the aquatic environment depends on the bioavailability. Mr Kennedy considered the potential for biouptake of arsenic, cadmium and copper and concluded that bioaccumulation of trace elements by fish would be regulated by biological processes. He opined that no biomagnification of any trace element was predicted.⁵⁴³
- 541. As already noted, the experts in the field of toxicology and water quality agreed that there was an absence of baseline data on the bioaccumulation of metals in important customary and commercial fisheries on the Chatham Rise, and that this must be collected before mining is undertaken.⁵⁴⁴
- 542. The applicant's report on uranium stated that uptake of uranium had been demonstrated in both fresh and marine environments. Maximum uptake occurs through feeding and exposure under conditions of lower pH. When higher carbonate conditions occur (and at near neutral pH as occurs in seawater), lower uptake is observed. Uranium does not biomagnify.⁵⁴⁵
- 543. The experts in the field of radioactivity agreed that although radionuclides have the potential to bioaccumulate, the radionuclides of interest do not biomagnify.⁵⁴⁶

⁵⁴¹ Issue 2, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

⁵⁴² Paragraph 22, Evidence of Dr David Santillo on behalf of Greenpeace, KASM, and DSCC, 11 September 20

 ⁵⁴³ Paragraph 88, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014
 ⁵⁴⁴ Issue 5, Joint Statement of Experts in the Field of Toxicology and Water Quality, 19 September 2014

⁵⁴⁵ Section 8 of Appendix E (Review of Uranium in Seawater and its Release from Chatham Rise Sediment) of Appendix 11 of the EIA, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵⁴⁶ Issue 1, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

Cumulative effects

- 544. Mr Kennedy compared the disturbance of the seabed and consequential release of suspended sediment between mining and bottom trawling. He considered that trawling carried out over large areas of the Chatham Rise also results in the release of trace elements and other constituents (nitrogen) to the water column. On a daily basis the releases to the water column are smaller from trawling than mining.⁵⁴⁷ The DMC notes here that Dr Tuck on behalf of the applicant provided the DMC with an estimate of the annual amount of sediment suspended by bottom trawling on the Chatham Rise and compared this figure to that predicted through CRP's mining operation.⁵⁴⁸ However, he did not assess the effects on Chatham Rise water quality.
- 545. Associate Professor Peake refuted the findings of Mr Kennedy, noting that the extent to which the trawling would release sediment would be different from the proposed mining operation. He suggested that the proposed mining operation would disturb a much greater depth of sediment and in the process of filtering it and processing it on board there was the potential for release of more elements from a bound state than it would be from trawling which leaves sediment on the bottom. He stated that with trawling there is only an immediate perturbation just above the seabed with nothing like the same degree of potential mobilisation of the proposed mining operation. ⁵⁴⁹
- 546. Dr Tremblay considered that trawling activities would probably be much more at the oxic level where it is more unlikely that to have remobilisation of metals, whereas mining goes deeper to 50 cm and so the suboxic layers would be suspended, and this is where most of the metals were.⁵⁵⁰

Freshwater quality

- 547. The application of Chatham Rise phosphorite to New Zealand land was also raised by the applicant as having potential benefits to freshwater quality through a reduction in the loss of phosphorus to water.
- 548. The DMC heard that moving from a water soluble phosphate product such as superphosphate to a sparingly soluble phosphorous fertiliser like Chatham rock phosphate would lead to reductions in total phosphorous losses of 0 to 20 %.⁵⁵¹ Based on research, Mr Mackay considered that because the application of a reactive phosphate rock does not result in a sudden short-term rise in readily available phosphorous in the soil or plant, there is a reduction

⁵⁴⁷ Paragraph 90, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014
⁵⁴⁸ Paragraphs 6 and 10, Statement of Evidence of Dr Ian Tuck for CRP, 28 August 2014.

⁵⁴⁹ Lines 10 – 26, page 833 of the Transcript, 14 October 2014

⁵⁵⁰ Lines 28 – 32, page 837 of the Transcript, 14 October 2014

⁵⁵¹ Paragraph 33, Statement of Evidence of Dr Alec Donald Mackay for CRP 28 August 2014

in the potential risk of phosphorous losses in runoff in the weeks following application to receiving environments.⁵⁵² However submitters such as Mr Sandle questioned how the level of runoff for the direct application phosphate compared to superphosphate in the medium and longer term.⁵⁵³

- 549. In its closing statement, the applicant suggested that its product would assist farmers in meeting the requirements of the New Zealand National Policy Statement for Freshwater Management 2014, (which regional councils must give effect to through their regional plans and policy statements under Sections 62(3) and 67(3) of the RMA). The applicant considered that New Zealand National Policy Statement for Freshwater Management 2014 would provide a regulatory 'push' in terms of managing freshwater quality and nutrient runoff in particular that was likely to have some impact on the market's preferences for fertiliser products.⁵⁵⁴
- 550. However, the DMC also noted Dr MacKay's recommendation that a reactive phosphate rock is only used in soil with a pH <6.0 and where there is at least 800 mm annual rainfall.⁵⁵⁵ Mr Sandle estimated the locations within New Zealand that meet the criterion for annual rainfall and suggested that on this basis, the use of direct application fertiliser may be limited.⁵⁵⁶
- 551. The DMC understands that the applicant intended to market the product for direct application for a premium price, but that a proportion would be converted into superphosphate. As the DMC's mandate does not extend to over the use of the end product, the DMC did not consider in detail the differences in the product used for direct application as opposed to being blended for superphosphate, or the potential effects on freshwater quality.

8.8.5. **Proposed conditions**

- 552. Schedule 2 of the proposed conditions required the collection of water samples to determine near seabed water quality prior to the commencement of any mining operations. Parameters to be tested in these samples include organic carbon, nutrients and heavy metals including Polonium 210. It was proposed that elutriate testing of sediments and toxicity testing with the same organisms previously used be repeated, as well as, and if practical, appropriate organisms representative of Chatham Rise species. Testing of trace metal content in key commercial fish on the Chatham Rise was also proposed.
- 553. The DMC considers the applicant's proposed monitoring conditions a step in the right direction regarding the need to characterise the existing water quality character of the consent

⁵⁵² Paragraph 39, Statement of Evidence of Dr Alec Donald Mackay for CRP 28 August 2014

⁵⁵³ Lines 11 – 14, page 1950 of the Transcript, 5 November 2014

⁵⁵⁴ Paragraphs 321 – 323, Closing Legal Submissions for CRP, 19 November 2014

⁵⁵⁵ Paragraph 36, Statement of Evidence of Dr Alec Donald Mackay for CRP 28 August 2014

⁵⁵⁶ Lines 4 – 9, page 1947 of the Transcript, 5 November 2014

application area prior to mining commencing. What they appear to lack however, is any clear feedback into the consequences for mining procedures should the results indicate a water quality or toxicity state of concern.

554. The applicant's proposed adaptive management conditions included unexpected adverse impacts (Proposed Condition 41). This is where the DMC thought that an unexpected water quality result or toxicity test result might potentially result in an alteration to, or at least reconsideration of, the mining operation.

8.8.6. **DMC findings**

- 555. The DMC finds that there are potential adverse water effects associated with the applicant's proposed mining operation. These effects are associated with the mobilisation of trace elements (heavy metals including some with radioactivity) and organic enrichment. While there is some uncertainty around the magnitude of these effects, in general they appear to be localised and relatively minor. The DMC expects an increase in oxygen demand as a result of the tailings discharge, but accepts that this would be localised and short-term in nature given the amount of dilution available.
- 556. While the mobilisation of heavy metals is possible, testing suggests that the concentration levels would not be sufficient to exert toxic effects on marine organisms, particularly after mixing with the surrounding seawater.
- 557. Biomagnification of heavy metals including radioactive elements appears unlikely. The experts in the field of radioactivity all agreed that although radionuclides have the potential to bioaccumulate, the radionuclides of interest do not biomagnify through the food chain.⁵⁵⁷ Monitoring of fish prior to the commencement of mining would in our view benchmark background contamination levels in fish (and other local organisms if necessary) and the DMC considers that conditions could be developed to achieve the necessary level of information.
- 558. The DMC acknowledges that there is some concern surrounding some of the testing procedures used to characterise existing water quality and assess the effects of mining discharges on Chatham Rise water quality, and also the toxicity of tailings discharges on local marine species. It considers however that these concerns could be addressed by additional monitoring and testing prior to mining, as proposed by the experts.
- 559. The DMC did not reach any firm conclusion on the impact on freshwater quality of the application of Chatham Rise phosphorite. There was insufficient information as to the quantities

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⁵⁵⁷ Issue 1, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

of phosphorite fertiliser that would be applied to New Zealand agricultural land, or in what form. In any event, the DMC considers this issue is sufficiently distant from the marine consent, and ultimately not material to our determination. The marine consent process does not provide for controls to be placed on the use made of this kind of end product.

8.9. Human health

8.9.1. The issues

560. Section 59(2)(c) requires the DMC to take into account the effects on human health that may arise from effects on the environment. This is a complex topic as there are many components to it. Due to the separation of the phosphorite nodules from the seabed sediment and their different eventual receiving environments, there are a number of pathways by which human health may be affected. While the phosphorite nodules were intended for use in a terrestrial environment as fertiliser, the discharge of the rest of the sediment would result in a sediment plume and the deposition of waste material on the seabed.

8.9.2. Effects

561. The various ways in which the DMC considered the effects on human health are:

- marine environment through the consumption of seafood
- terrestrial environment through the use of fertiliser and the consumption of plants and animals
- health and safety for workers involved with the processing and handling the end product
- air discharges from the combustion of heavy fuel oil in the engines on the vessels.

Consumption of seafood

562. The chemical makeup and toxicology of the sediment tailings is detailed in Chapter 8.8. There were two main areas of concern in terms of human consumption of seafood, trace elements (including heavy metals) and radioactive substances. During the hearing, not a lot of attention was given to the potential effects on humans through consumption of seafood *per se*; attention was given more to levels of trace elements within the sediment and potential toxicity to marine animals.

- 563. Mr Kennedy opined that in terms of muscle tissue and the possible effects on human health, the only element that is of any significance in fish muscle tissue is mercury.⁵⁵⁸ There was no evidence for the release of mercury during elutriation experiments.⁵⁵⁹
- 564. Mr Kennedy considered no biomagnification of any trace element was predicted and the suitability of fish caught from the Chatham Rise for human consumption would be unaffected by the mining process.⁵⁶⁰ Overall, Mr Kennedy concluded that because the biological uptake of any trace elements released into the water during mining was likely to be insignificant, there would be no risks to human health (from the consumption of fish from the Chatham Rise).⁵⁶¹
- 565. Dr Jeffree considered the most important radionuclide in terms of human exposure for marine organisms is polonium, but opined that there would not be biomagnification through the food chain. While it may transfer from one trophic level to the next, it tends not to get to higher concentrations up the food chain.⁵⁶² As summarised by Dr Jeffree, a plausible transfer pathway from benthos to humans for elevated Po-210 levels is as follows; benthic water / particulates to benthic filter feeders to small javeline fish guild (bentho-pelagic invertebrate feeders) to hake guild (bentho-pelagic predators) + ling guild (benthic predators) to humans.⁵⁶³

Consumption of plants and animals

- 566. Analyses of a sample of phosphorite nodules shows that they are predominantly a mix of carbonate-bearing apatites derived from fluorapatite ($Ca_5(PO_4)_3F$) and hydroxyapatite ($Ca_5(PO_4)_3OH$), meaning that the nodules are particularly elevated in phosphorous (P up to 20 % wt.), calcium and fluoride.⁵⁶⁴ However the DMC heard that the phosphorite nodules from the Chatham Rise have other trace elements. They are notable for low cadmium and lead abundances, and somewhat elevated arsenic (only in finer nodules) and uranium abundances.⁵⁶⁵
- 567. The DMC heard from a number of experts and submitters alike that the Chatham Rise phosphorite nodules have much lower cadmium concentrations than those typically associated with phosphate rock deposits. The DMC heard that the reduced level of cadmium was likely to be a significant selling point for Chatham rock fertiliser.⁵⁶⁶

⁵⁵⁸ Lines 31 – 35, page 944 of the Transcript, 15 October 2014

⁵⁵⁹ Paragraph 76, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

⁵⁶⁰ Paragraph 88, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014

 ⁵⁶¹ Paragraph 121, Statement of Evidence of Paul Cameron Kennedy for CRP on Sediment and Chemistry, 29 August 2014
 ⁵⁶² Lines 24 – 28, page 898 of the Transcript, 14 October 2014

⁵⁶³ Paragraph 43, Annexure A (Assessment of Effects of Radioactive Elements on the Marine Environment from the CRP Marine Consent Application) of the Statement of Evidence of Dr Ross Anthony Jeffree, 12 September 2014

⁵⁶⁴ Section 3.3 of Appendix 11 of the EIA, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵⁶⁵ Section 5.6.1 of Appendix 11 of the EIA, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵⁶⁶ Paragraph 31, Statement of Evidence of Christopher David Castle for CRP, 28 August 2014

- 568. Dr Mackay summarised the difference between Chatham rock and other sources of phosphate. He considered that it has a very low cadmium levels compared to most other rocks, two versus 20 to 30 milligrams per kilogram, but it also has above average levels of uranium so probably twice what you might expect in other rocks.⁵⁶⁷ Other differences include a lower total phosphorus percentage, significant amounts of calcite and lower initial solubility in chemical extracts.⁵⁶⁸
- 569. Previous analyses noted uranium enrichment was limited to phosphorite nodules: in comparison the glauconitic material on the Rise did not have elevated uranium content. In a recent assessment of the radioactivity of the resource, it was found that the maximum radioactivity is nodules samples was 91 kBq/kg.⁵⁶⁹ Consequently none of the material qualified as radioactive under the New Zealand Radiation Protection Act 1965.⁵⁷⁰
- 570. The DMC heard that Chatham Rise phosphorite was found to contain 3 % fluorine in the study of Syers *et al.*, (1987) whereas single superphosphate in comparison contains 1.0 to 1.8 %. The fluorine to phosphorus ratio in superphosphate is between 0.11 and 0.19 whereas direct application of Chatham Rise phosphorite has a ratio of 0.32. This was similar to other phosphate rocks but higher than superphosphate and if used instead of superphosphate would result in higher rates of accumulation of fluorine in soils.⁵⁷¹
- 571. Dr Mackay opined that any unwanted material or element accumulated in the soils did potentially limit future land use opportunities and future potentially market opportunities.⁵⁷² He also considered that as phosphorous fertiliser is essential to the on-going viability of New Zealand pastoral systems and economy, trace amounts of cadmium, uranium and fluorine would continue to accumulate in soils.⁵⁷³
- 572. The DMC heard that this product would offer a low cadmium phosphorous fertiliser option for producers with soils that already have elevated soil cadmium levels and would slow soil cadmium accumulation rates.⁵⁷⁴ Dr Mackay explained that animals to some degree remove cadmium and accumulated it in the kidneys and livers in a pastoral system, but it becomes an issue when farmers swap out of livestock agriculture into say cropping where something is grown for direct human consumption.⁵⁷⁵

⁵⁶⁷ Lines 4 – 9, page 849 of the Transcript, 14 October 2014

⁵⁶⁸ Paragraph 2, Statement of Evidence of Dr Alec Donald Mackay for CRP 28 August 2014

⁵⁶⁹ Kilobecquerel is a unit of measurement for radioactivity

⁵⁷⁰ Section 5.6.1 of Appendix 11 of the EIA, Review of Sediment Chemistry and Effects of Mining, May 2014

⁵⁷¹ Paragraph 51, Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

⁵⁷² Lines 44 – 46, page 852 of the Transcript, 14 October 2014

⁵⁷³ Paragraph 3, Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

⁵⁷⁴ Paragraph 71, Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

⁵⁷⁵ Lines 7 – 11, page 853 of the Transcript, 14 October 2014

- 573. Uranium was discussed by a number of experts during the hearing. Samples of Chatham Rise phosphorite analysed indicated levels of uranium ranging between 27 to 524 mg/kg with a mean of 155 mg/kg.⁵⁷⁶ The DMC heard that currently there are no soil guideline values for uranium in New Zealand.⁵⁷⁷
- 574. The experts in the field of radioactivity agreed that while all phosphorites contain uranium and its decay products, it can accumulate in soils.⁵⁷⁸
- 575. The Crown submission attached the Institute for Environmental Science and Research (ESR) study on the implications of uranium concentrations in Chatham Rise phosphorite. These findings were however challenged by Dr Mackay. The ESR report concludes that the use of Chatham Rise phosphorite as a direct application fertiliser would increase uranium inputs by a factor of eight, while Dr Mackay considered a four-fold increase uranium inputs more realistic based on the levels in current superphosphate produced in New Zealand of around 60 ppm of uranium.⁵⁷⁹ The ESR report concluded that continuous use of Chatham Rise phosphorite as a direct application fertiliser would exceed the Canadian soil uranium guideline of 23 ppm within 40 to 50 years. Dr Mackay considers that this ignores the effect of actions such as treading by livestock, earthworm feeding, mixing and burrowing (eg pedoturbation) which mixes the materials into the upper 7.5 cm root zone of a pasture soil.⁵⁸⁰
- 576. Dr Mackay calculated that it would take 689 years of applying 110 kg per year of Chatham rock phosphate to reach the Canadian soil uranium guideline limit (maximum permissible uranium concentration (MPUC) of 23 mgU/kg from an initial 1 mg U/kg.⁵⁸¹ Furthermore, decreasing the application rates to 40 kg P/ha would take 172 years to reach the MPUC limit, and if 20 % per annum of added uranium in the top soil layer is lost or removed (eg moves beyond 7.5 cm depth in the soil), then it would take 860 and 215 years to reach the MPUC limit for an annual application of 10 and 40 kg P/ha as Chatham rock phosphate, respectively.⁵⁸²
- 577. Dr Bull concluded that as uranium is immobile in soil and not readily removed from soil by plants or animals, uranium accumulation in soils is likely. ⁵⁸³ Based on current application rates, he calculated that the uranium accumulation rates in areas with extensive farming would be around 0.03 mg/kg per year, and up to 0.07 mg/kg per year with intensive farming.⁵⁸⁴

⁵⁷⁶ Table 3 of Appendix 2 (Uranium in Phosphorite) of the Statement of Evidence of Dr David Bull for CRP, 28 August 2014

⁵⁷⁷ Paragraph 50, Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

⁵⁷⁸ Issue 3, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

⁵⁷⁹ Paragraph 75, Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

⁵⁸⁰ Paragraph 76, Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

⁵⁸¹ Paragraph 78, Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

⁵⁸² Paragraph 79, Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

⁵⁸³ Paragraph 47, Statement of Evidence of Dr David Bull for CRP, 28 August 2014

⁵⁸⁴ Paragraph 58, Statement of Evidence of Dr David Bull for CRP, 28 August 2014

- As there are no guidelines for uranium levels in soil, Dr Bull proposed an indicative threshold of 578. 10 mg/kg which includes an uncertainty factor of 50 %. 585 On this basis, he calculated more than 100 years to move from a background of 2 mg/kg to exceed a threshold of 10 mg/kg where Chatham rock phosphate was applied in intensively farmed soils. If uranium accumulated at 0.03 mg/kg per year then the soils would not exceed a threshold of 10 mg/kg for approximately 300 vears.⁵⁸⁶ The DMC notes that Dr Bull's proposed threshold is significantly less than Canadian limits of 23 mg/kg for soil ingestion, inhalation and dermal exposure (toddler), 33 mg/kg to protect the health of grazing mammals, and 500 mg/kg for protection of soil biota.587
- 579. Dr Bull made the point that if Chatham rock phosphate was blended with higher grade material to make superphosphate, that product would have a lower uranium level than Chatham Rise phosphorised lime.588
- 580. From his analyses, Dr Bull opined that uranium in fertilisers derived from Chatham rock phosphate posed little chemical risk to rural residents, people who live on fertilised land. He did however consider that accumulation of uranium in soils should be limited, firstly in order to protect food quality.589
- 581. The DMC heard from Dr Hermanspahn that in determining the radioactive effect of Chatham rock phosphate application to land, he had used the conservative scenario of subsistence farmers living on site and assumed that the person spend 100 % of their time on the land and sources 100 % of their water and food locally.⁵⁹⁰ Dose calculations were performed for age groups of one year olds, ten year olds and adults. The group with the largest risk factor was one year olds living permanently on the converted farmland on a diet sourced completely from the site due to the higher rates of ingestion.⁵⁹¹ On the basis of a guideline level for uranium in soil of 20 mg/kg being adopted, he concluded it would take 275 years in the high application scenario (fertiliser application at 40 kgP/ha per year) and 675 years in the low application scenario (fertiliser application at 10 kgP/ha per year) to reach this limit.⁵⁹² The DMC heard that doses to general public would be restricted to dose from ingestion and equate to about 50 % of the total dose rate for the one year old age group, 25 % of total dose for the ten year old age group and 10 % for adults. 593

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⁵⁸⁵ Paragraph 77, Statement of Evidence of Dr David Bull for CRP, 28 August 2014

⁵⁸⁶ Paragraph 78, Statement of Evidence of Dr David Bull for CRP, 28 August 2014

⁵⁸⁷ Paragraphs 81 – 82, Statement of Evidence of Dr David Bull for CRP, 28 August 2014

⁵⁸⁸ Lines 27 – 34, page 865 of the Transcript, 14 October 2014

⁵⁸⁹ Lines 14 – 19, page 866 of the Transcript, 14 October 2014

⁵⁹⁰ Paragraph 37, Statement of Evidence of Dr Nikolaus Hermanspahn for CRP, 29 August 2014

 ⁵⁹¹ Paragraph 54, Statement of Evidence of Dr Nikolaus Hermanspahn for CRP, 29 August 2014
 ⁵⁹² Paragraph 56, Statement of Evidence of Dr Nikolaus Hermanspahn for CRP, 29 August 2014

⁵⁹³ Paragraph 53, Statement of Evidence of Dr Nikolaus Hermanspahn for CRP, 29 August 2014

582. On this basis, Dr Hermanspahn concluded that uranium was expected to accumulate in agricultural soils, but that the radiological impact would be within acceptable dose limit of 1 mSv per year⁵⁹⁴ for all members of public for more than 250 years of intensive fertiliser application.⁵⁹⁵

Effects on human health through handling

- 583. The initial EPA staff report raised the concern of potential generation of dust from phosphate nodules and exposure of phosphorous pentoxide (P_2O_5) to air and humans during the sorting and packing process onboard and possible effects on human health. Dr Bull pointed out that Materials Safety Data Sheets for phosphorite are readily available from major fertiliser companies (eg Ravensdown 2005). These sheets do not class phosphorite as a hazardous chemical; they may be handled, stored and transported by any person, are not corrosive, have low toxicity and low irritant tendencies. The sheets advise that ventilation and / or personal protection are recommended in conditions where dusts may form.
- 584. Given that phosphorite nodules would not be dried on board the vessel and therefore there would be no dust formation, Dr Bull concluded that the phosphate component of Chatham Rise phosphorite posed a low to negligible occupational health and safety hazard and is controlled through existing health and safety legislation and regulations.⁵⁹⁶ He pointed out that under the Hazardous Substances and New Organisms Act 1996, rock phosphates used as fertilisers are not given a hazardous substance classification. 597
- 585. Similarly the DMC heard from Dr Hermanspahn that the Radiation Protection Act 1965 and the Radiation Protection Regulations 1982 do not apply to the mining or use of Chatham Rise phosphorite as fertiliser, as Chatham Rise phosphorite is not classed as radioactive material.⁵⁹⁸
- 586. The Environment and Conservation Organisations of New Zealand Inc submitted that the risk of a radiological and toxic threat to workers might be "further complicated" if the vessel were flagged to another country.⁵⁹⁹ The DMC requested advice on this matter.
- 587. Maritime New Zealand's response to the EPA stated that Maritime New Zealand was responsible for administering the HSE Act for work on board ships and for ships as a place of work.⁶⁰⁰ Maritime New Zealand referred to Section 3B of the HSE Act. Their opinion concluded that the applicability of the HSE Act would depend on a number of facts such as whether the

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⁵⁹⁴ Radiation levels are generally measured in millisieverts (mSv)

⁵⁹⁵ Paragraph 60, Statement of Evidence of Dr Nikolaus Hermanspahn for CRP, 29 August 2014

⁵⁹⁶ Paragraphs 88 – 89, Statement of Evidence of Dr David Bull for CRP, 28 August 2014

⁵⁹⁷ Lines 34 – 36 page 867 of the Transcript, 14 October 2014

 ⁵⁹⁸ Paragraph 27, Statement of Evidence of Dr Nikolaus Hermanspahn for CRP, 29 August 2014
 ⁵⁹⁹ Paragraph 5.7.5, Submissions by Environment and Conservation Organisations of NZ Inc, 6 November, 2014

⁶⁰⁰ Maritime New Zealand report provided in accordance with Section 44 of the EEZ Act, 18 July 2014

contractual arrangements are governed by New Zealand law and whether the vessel could be required to be registered in New Zealand. The DMC was advised that if the provisions in the Health and Safety and Reform Bill were enacted in their current form (and assuming no change in the mining company's proposed structure) CRP's mining operation with respect to the mining vessel would be regulated.⁶⁰¹ The DMC notes that the Bill is expected to come into force in 2015.

588. Health and safety for workers is also addressed in Chapter 9.10.

Air discharges from the vessel

- 589. As set out in the EIA, MARPOL sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances through MARPOL Appendix 1 Annex VI (Prevention of Air Pollution from Ships). The DMC understands that although New Zealand has not yet ratified the more stringent emission control standards for sulphur oxide, nitrogen oxide and particulate matter, the applicant has undertaken to ensure that its vessel meets all of the requirements of this Annex.⁶⁰²
- 590. The DMC agrees that the sulphur oxide emissions are fuel dependent and the fuel type used by the mining vessel would depend on what fuel is available in New Zealand ports.⁶⁰³

8.9.3. **Proposed conditions**

- 591. Human health is addressed indirectly by the proposed conditions in two different ways; flesh testing of fish and sampling of the chemical composition of phosphorite nodules.
- 592. Proposed Schedule 2A(viii) required muscle testing of hoki and ling prior to mining to determine the concentrations of trace elements and key radionuclides. Proposed Schedule 2B(vii) required a similar exercise to be undertaken after mining commenced after the first, second and fourth year that mining occurred.
- 593. While the reporting was to include a comparison of the data obtained prior to mining commencing, there are no standards or measureable limits outlined in the proposed conditions, not even an indication of what might be an acceptable or unacceptable change in levels of trace metals or radionuclides in commercial fish species. While it might be an interesting exercise and does reflect the recommendations of the experts in the field of toxicology and water quality,⁶⁰⁴

 $^{^{601}}$ Clauses 8 and 9, Health and Safety Reform Bill 2014 (192 – 1)

⁶⁰² Section 4.7.4.6, Marine Consent Application and EIA, May 2014

⁶⁰³ Section 4.7.4.6, Marine Consent Application and EIA, May 2014

⁶⁰⁴ Issue 5, Joint Statement of Experts in the Field of Toxicology and Water Quality, 19 September 2014

the DMC considers this is not a meaningful condition against which a proposal could be assessed for compliance, other than the requirement to provide a comparative report.

- 594. Proposed Schedule 2B(xii) required statistically representative samples to be collected from each shipload of phosphorite nodules to test for levels of major oxides and trace elements. Again, the DMC finds that while this information would be interesting, there are no measureable limits against which the results could be assessed. The DMC finds there is no correlation in the proposed conditions between the results of these samples and the potential effects on human health such as maximum acceptable levels.
- 595. The DMC also notes that cadmium, fluorine and radionuclides (other than uranium and vanadium) are not included in the list of tests to be undertaken.

8.9.4. **DMC findings**

- 596. The DMC was persuaded by Mr Kennedy's evidence that the proposed mining operation posed little risk to humans consuming seafood.
- 597. While Chatham Rise phosphorite generally contains more uranium than current phosphate fertilisers used in New Zealand, it is not classed as a radioactive material.
- 598. The joint statement of experts in the field of radioactivity agreed that radionuclides of interest do not biomagnify (increase in concentration) through the food chain according to reported studies from elsewhere.⁶⁰⁵ Consequently, the DMC finds that the consumption of seafood from the Chatham Rise would pose no greater risk to human health than is currently the case, if mining were to occur.
- 599. Although the issue of uranium content and radioactivity of the eventual product (ie fertiliser) was raised in submissions and the hearing, the issue is significantly distant from the application for marine consent. Furthermore there are no guidelines, and the DMC agrees with the experts in the field of radioactivity that neither the EPA nor the applicant has any control over farm level decisions on the choice of fertiliser, or the amount to apply.⁶⁰⁶
- 600. The DMC notes that the experts in the field of radioactivity all agreed that several decades would elapse based on current rates of application of phosphate fertiliser use, before concentrations of uranium in soil would reach a point triggering the need to develop soil guideline values.⁶⁰⁷

⁶⁰⁵ Issue 1, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

⁶⁰⁶ Issue 3, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

⁶⁰⁷ Issue 3, Joint Statement of Experts in the Field of Radioactivity, 18 September 2014

- 601. With respect to proposed conditions controlling levels of uranium content, the DMC agrees with Dr Bull that while levels of uranium and levels of phosphorous would be useful information, it would be far more useful to know the uranium and phosphorous content of all New Zealand's phosphate fertilisers.⁶⁰⁸ The DMC agrees that a marine consent is not an appropriate mechanism to achieve this.
- 602. With regard to air emissions from the vessel, the DMC considers that these are no different from any other vessel and are most appropriately controlled by the MARPOL standards.

 $^{^{\}rm 608}$ Lines 8 – 22, page 867 of the Transcript, 14 October 2014

9. Effects of Proposal on Existing Interests

9.1. Definition of existing interests

603. In addition to considering the effects of the proposal on the environment, the DMC is required by the EEZ Act to take into account any effects on existing interests of allowing the activity.

604. 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 Claim) Settlement Act 1992:
- (f) a protected customary right or customary marine title recognised under the Marine and Coastal (Takutai Moana) Act 2011.

605. Section 12 of the EEZ Act states:

- In order to recognise and respect the Crowns 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 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 EPA to notify iwi authorities, customary marine title groups, and protected customary rights groups directly of consent applications that may affect them.

606. Under Section 39(1) of the EEZ Act, an applicant's 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;
- 607. Under Section 39(2) of the EEZ Act, 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.

608. Under Section 59(2) of the EEZ Act, 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 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 the 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;

609. 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.

9.2. Identification of existing interests

- 610. The DMC identified the following persons holding existing interests on the basis of the criteria laid down in Section 4 of the Act:
 - Iwi and imi holding fishing quota rights under the Treaty of Waitangi (Fisheries Claim) Act 1992 or customary fishing rights which overlap with the marine consent area, including the Chatham Rise Rohe Moana
 - Te Runanga o Ngāi Tahu (through the Ngāi Tahu Claims Settlement Act)
 - Kaikoura Whale Watch Ltd (as a marine eco-tourism activity)
 - Commercial fishers
 - Persons involved in lawful shipping, navigation and maritime activities.
- 611. The DMC was satisfied that no existing interests arose from the provisions of the EEZ Act relating to an existing marine consent (Section 4(b)); an existing resource consent (Section 4(c)); or a protected customary right or customary marine title recognised under the Marine and Coastal Area (Takutai Moana) Act 2011 (Section 4(f)).

9.3. Pre-hearing meeting of existing interest groups

- 612. A pre-hearing meeting was arranged on 22 September 2014 in order to ascertain the views of existing interest groups representing commercial fishing and various iwi and imi concerns. Of particular interest to the DMC was whether agreement could be reached among all the various groups on the likely effects of the proposal.
- 613. Participants in the meeting agreed on the following statement defining the areas they had in common with the area that would be affected by the proposal (Report of the Pre-Hearing

Meeting, dated 22 September 2014): "The Chatham Rise and its connectivity to the whole marine environment. The marine environment is complex and interconnected and includes the air, the water column and the seabed, and the life within. This will be affected by the whole process of extraction (mining, processing, return of sediment, transport, further processing and end use). This includes an acknowledgement that the effects will be both immediate and will continue to have an effect over time. In some cases the effects will be permanent. Effects will occur outside the marine environment."

614. The report on the meeting⁶⁰⁹ contained an extensive list of matters that existing interest groups wanted the DMC to consider, but noted that it had not been possible in the time available to define those who agreed or disagreed with each issue. It also contained responses to some, but not all, of the questions posed by the DMC. However, many of these matters were covered during the course of the hearing.

9.4. Existing Interests of iwi and imi

9.4.1. Iwi and imi as quota holders

- 615. The DMC was given comprehensive information by Te Ohu Kaimoana Trust in relation to the Treaty of Waitangi (Fisheries Claim) Settlement Act 1992 and its importance to Māori commercial fishing interests.⁶¹⁰
- 616. Commercial and non-commercial fishing rights secured under the Settlement were summed up as follows by Te Ohu Kaimoana Trust Ltd in *Figure 14* and *Figure 15*.

 ⁶⁰⁹ Pages 4 – 7, Report of Pre Hearing Meeting Existing Interests – Commercial Fishing and Cultural Impacts, 22 September 2014
 ⁶¹⁰ Paragraphs 8 – 10, Opening Statement of Kirstin Woods on behalf of Te Ohu Kai Moana Trustee Ltd, 25 September 2014



Figure 14. Commercial and non-commercial fishing rights under Fisheries Settlements (Source: Figure 1, Statement of Evidence of Kirstin Woods on behalf of Te Ohu Kai Moana Ltd, 12 September 2014)



Figure 15. Fisheries Settlement – Flow of benefits (Source: Figure 2, Statement of Evidence of Kirstin Woods on behalf of Te Ohu Kai Moana Ltd, 12 September 2014)

617. Given that the economic interests and concerns of Māori and Moriori quota holders are in many respects the same as the interests of other fishing quota holders engaged in commercial fishing, the DMC has dealt with the commercial interests of iwi and imi quota holders together with commercial fishing interests more generally in Chapter 9.8.

9.4.2. Moriori ki Rekohu (Chatham Islands' Moriori)

- 618. Moriori claims are wide ranging and cover much of the Chatham Rise area. They remain unsettled at this time and are yet to be fully negotiated. Moriori however did accept the partial settlement of their fisheries claims through the acceptance of quota, and are in the business of fishing.
- 619. Mr Solomon, counsel for the Hokotehi Moriori Trust, stated in his submission: "Moriori have historical and contemporary claims to negotiate and settle with the Crown, including claims to the 200 mile EEZ around our Islands. These are matters that the DMC are required to take into account as existing interests when making its decision on the application (Sections 2 and 59 of the EEZ Act 2012)".⁶¹¹
- 620. On the fisheries settlement assets, Mr Solomon stated *"In 2005, after 10 years of advocacy, HMT finally received an allocation of individual transferable quota from Te Ohu Kaimoana. Moriori had argued for the previous 15 years that Rekohu was a special case for allocation and that all quotas held by TOKM within the 200nm zone around Rekohu should be allocated to the islands (show slide). This was because Moriori, more than any other iwi on the mainland, had a greater reliance on our fishery for our livelihood. Moreover, fisheries are the only natural resource of any real economic value that will ever be returned to Rekohu by way of Treaty settlement. Other tribes on the mainland have access to resources that simply not available to Rekohu, for example commercial properties, land, geothermal, rivers, forests and the list goes on*".⁶¹²
- 621. In the end, Te Ohu Kai Moana accepted that Rekohu was a special case for allocation and Moriori, together with Ngāti Mutunga, received a share of the inshore quota and 50 % of the deep-water quota within the 200nm zone.⁶¹³
- 622. Moriori and Ngāti Mutunga also successfully negotiated the establishment of their Chatham Rise "*Rohe Moana*". The Rohe Moana is the result of a memorandum of understanding between the Pā Tangaroa Forum partners and the Ministry of Fisheries.⁶¹⁴ It is based on regulations issued under the Fisheries Act 1993 in accordance with Section 10(c) of the Treaty of Waitangi (Fisheries Claim) Settlement Act 1992 and is therefore "*lawfully established*". The interests that arise in respect of the Rohe Moana (both in the sense of the physical activity of food gathering and in terms of the special relationship between tangata whenua and the Rohe Moana) constitute "*existing interests*" under the EEZ Act.

⁶¹¹ Paragraphs 16 and 17, Opening Representation on behalf of Hokotehi Moriori Trust, 10 November 2014

⁶¹² Lines 1 – 20, page 2115 of the Transcript, 10 November 2014

⁶¹³ Lines 24 – 27, page 2115 of the Transcript, 10 November 2014

⁶¹⁴ Lines 7 – 11, page 2127 of the Transcript, 10 November 2014



This map is intended to be used as a guide only, in conjunction with other data sources and methods, and should only be used for the purpose for which it was developed. Although the information on this map has been prepared with care and in good faith, no guarantee is given that the information is complete, accurate or up-to-date.

Figure 16. Nabis map of Moriori Rohe Moana (red circle) and the the Chatham Rise Benthic Protetion Areas (outlined in black). The proposed mining area falls within the Moriori Rohe Moana. (Source: map from PowerPoint presentation from Hokotehi Moriori Trust, 10 November 2014)

9.4.3. Ngāti Mutunga ki Wharekauri (Chatham Islands)

- 623. Ngāti Mutunga's claims involving the Chatham Rise are wide ranging. They have settled the majority of their fishing claims but are still engaged in negotiating other aspects of their claim with the Crown.
- 624. As Ngāti Mutunga's representative, Mr Kamo, told the DMC "...our Ngāti Mutunga people engaged in a settlement process that was practically forced upon them by the arrival of the Māori Fisheries Act.

We were forced into a settlement, being the first cab of the rank, that saw the bulk, as we are well aware, of our fishing interest given across to this pan-tribal, what we now call Te Ohu Kai Moana entity.

Our people at the time did the best that they could with the limited resource that was available to them in a largely hostile Crown of the day that was practically interested in talking about the relevance or significance of fishing to our island, and indeed we had some of our own Māori people turn up on this island and accuse our whānau here of being greedy for wanting to retain the inshore fishery as a minimum for the use of its own people, both Moriori, Māori and local community as well."615

- 625. The Ngāti Mutunga o Wharekauri Iwi Trust summarised their position as follows:
 - The risk to the applicant is a large amount of upfront capital. The reward is a large profit generated. This is not a problem for the iwi
 - The risk to iwi is as follows:
 - its fishery economic base
 - o its cultural base
 - o its whānau base
 - o its identity
 - Currently the return to the island (and the iwi) if the initiative succeeds, is precisely zero.⁶¹⁶

9.4.4. Ngāti Kahungunu

626. Mr Ngahiwi Tomoana provided the following testimony in evidence of the nature and extent of Ngāti Kahungunu's Treaty settlements relating to its 'Rohe', and the effects of the proposal on them: "Ngāti Kahungunu has worked with other iwi over the last 20 to 30 years or so to achieve fisheries settlement...Ngāti Kahungunu is very susceptible to the fishery because, unlike other iwi, Ngāti Kahungunu have only claimed the fisheries and allowed all hapū to claim the lands. So we feel the impact of any fishing changes, the vagaries of the fishing season, and impacts externally on our fishery.⁶¹⁷

> Ngāti Kahungunu along with Ngāi Tahu and other major fisheries players, work together with the fishing industry to create benthic protected areas to show our corporate citizenship and our Kaitiaki and our sustainability over the fisheries....it (mining) will undo the good intent of the fishing industry in creating those benthic protected areas.⁶¹⁸

> Our contract fishers are Sealord's so with all their boats in that area too we are very concerned that the interruption of fishing would diminish the ability to become better fishers. Hawkes Bay Seafood's as well. We hire 160 workers in the Napier area. Any impact on that fishery itself, because we mainly fish in the area, will have detriment to the economy of our whānau.⁹⁶¹⁹

⁶¹⁵ Lines 9 – 26, page 2183 of the Transcript, 12 November 2014

⁶¹⁶ Section 6, Ngāti Mutunga o Wharekauri Iwi Trust submission, Submission 110139, July 2014

⁶¹⁷ Lines 39 – 45, page 1443 of the Transcript, 21 October 2014

 $^{^{618}}$ Lines 16 – 21, page 1444 of the Transcript, 21 October 2014

⁶¹⁹ Lines 1 – 6, page 1445 of the Transcript, 21 October 2014

9.4.5. Customary (hapū, whānau and iwi / imi) fishing

- 627. The DMC heard evidence from a number of submitters who were directly involved in the business of whānau, hapū and iwi / imi fishing and in many cases had been involved for many generations. These people were particularly concerned about the likely effects of the proposal on price premium. They also expressed their apprehension about the effects of mining on the cultural interests and values that underpinned their tikanga practices and the contribution to their sense of identity of fishing and their other activities at sea.
- 628. On the matter of customary fishing, Mr Tomoana of Ngāti Kahungunu recited the following whakapapa to explain the nature and extent of this relationship based on Ngāti Kahungunu cultural values: "...we see ourselves as Kaitiaki over the whole area (land and sea) based on our whakapapa to Tangaroa (God of the Sea). Ranginui (sky) and Papatūānuku (earth) had 70 offspring, 13 of which are Kaitiaki over the sea and the fishes, and the seabed. Everybody knows Tangaroa, but then there are the Atua (Gods) over the ocean currents, tides, winds, moons. Atua Te Kehu is over whales, Puwhakahara over porpoises and dolphins, Awawaru over shellfish, Te Kahu over sharks, and so on...⁶²⁰
- 629. A valued mahinga kai (food gathering), once common throughout New Zealand but unique to the Chatham Islands and South Island today is titi gathering. Titi (shearwater birds) frequent the Chatham Rise and come ashore on offshore islands to burrow and breed. The gathering of juvenile birds in their burrows is a long-standing practice of local iwi and imi for both consumption and trade with other iwi groups throughout New Zealand and abroad. For some Ngāti Mutunga and Moriori, trading titi forms an important part of their culture and therefore identity. It also supplements whānau incomes in season. Titi gathering rights are protected by law on some offshore islands.

⁶²⁰ Lines 22 - 28, page 1443 of the Transcript, 21 October 2014

9.5. Te Rūnunga o Ngāi Tahu

- 630. In his statements, Mr Christensen counsel for Te Rūnunga o Ngāi Tahu expressed Ngāi Tahu's strong opposition to the application, referring to Ms Bartlett's summary of the five most concerning effects on Ngāi Tahu as follows:⁶²¹
 - "mobile species (including taonga species' within the mining area but outside the Ngāi Tahu takiwā boundary) that form part of Ngāi Tahu fisheries (as described in the Ngāi Tahu Sea Fisheries Report) and that are reliant on benthic habitat and ecosystem function (the mauri of the area as an intact habitat) — mauri indicated by fossil bones and corals of advanced age, alongside the undisturbed state of BPA — 820km² area of destruction impacts mauri, habitat and ecosystem function, affecting mobile species using the area
 - plume effects flowing into the Ngāi Tahu takiwā, directly affecting Ngāi Tahu fisheries (as described in the Ngāi Tahu Sea Fisheries Report) to an uncertain extent
 - commercial quota assets in QMAs crossing the mining footprint, two thirds from Settlement
 - overall fisheries management (QMAs, BPAs, MSC) as the means that the Crown appropriately maintains the health of Ngāi Tahu fisheries and upholds Treaty obligations
 - settlement integrity, including the development right of Ngāi Tahu (as described in the Ngāi Tahu Sea Fisheries Report), and all values and practices associated with Ngāi Tahu fisheries."
- 631. Mr Winchester for the applicant stated that ".... For the avoidance of doubt, CRP accepts that Ngāi Tahu is in a special and different position and it has a range of existing interests, some of which involve cultural interests as a consequence of this specific recognition of those interests through legislation and Treaty settlements. CRP cannot and does not dispute those interests exist. Rather it considers that there is some doubt that those interests are adversely affected by its proposal, and certainly not to the extent claimed".⁶²²
- 632. In his closing statement⁶²³, Mr Christensen for Ngāi Tahu questioned the likely economic benefit of the proposal to New Zealand. He repeated his earlier criticism of the way in which the risks to commercial fishing and marine eco-tourism had been dismissed by the applicant and he argued that more attention should have been paid to the likely impacts of the proposal on Ngāi Tahu's cultural values and rights. In addition he was critical of the applicant's proposal to establish an Environmental Compensation Trust; and suggested that the proposal had to be rejected on the

⁶²¹ Attachment 4, Te Rununga o Ngāi Tahu Closing Statement, 18 November 2014

⁶²² Lines 38 – 45, page 2546 of the Transcript,19 November 2014

⁶²³ Pages 2495 – 2511 of the Transcript, 18 November 2014

basis of continuing uncertainties about its effects on the marine environment and the impact it would have on the Chatham Rise BPA. He summed up: *"The proposal raises serious concerns for Ngāi Tahu in terms of their commercial and cultural interests and the integrity of their settlement with the Crown."*⁶²⁴

- 633. Mr Summerton of Ngāi Tahu, a Director of Okains Long Line Ltd, expressed his concerns about the nature and extent of the proposal's effects, concluding that "Our iwi (Ngāi Tahu) leaders fought hard for the outcome of the Ngāi Tahu Sea Fisheries Report, and achieved a Treaty Fisheries Settlement. The Settlement includes the rights of iwi, and Ngāi Tahu hapū to develop their future Fishing interests."⁶²⁵
- 634. Sections of the Ngāi Tahu Deed of Settlement were referred to by Mr Christensen in his closing statement. He stated "A decision of the Crown cannot lawfully erode the Value of rights or assets of Māori which are either protected under the Treaty of Waitangi, or which comprise part of Treaty Settlements, which were the Crown's final redress for failing to protect and conserve sea fisheries and the historical material and cultural deprivation of Ngāi Tahu Whanui. All of these rights (both tangible and intangible) and assets comprise aspects of the existing interests of Ngāi Tahu as expressed by Te Runanga."⁶²⁶

9.6. Marine ecotourism

- 635. Whale Watch Kaikoura was formed in 1987 as a whānau business on the North–East coast of Te Waipounamu (South Island). The business was based on the nutrient rich currents that converge on the Chatham Rise over a subterranean topography that provides the habitat required by whales and other marine biota from the Chatham Islands to Kaikoura. As the business developed, members of the Hapū of Ngāti Kuri invested in the venture. Some years later the iwi authority for Ngāi Tahu became a major investor in the business.⁶²⁷
- 636. Whales feature prominently in the whakapapa of Ngāi Tahu, Ngāti Kahungunu, Moriori, and Ngāti Mutunga. One of the most common korero pūrākau relates to the ancestor 'Paikea' (whale rider). The relationship between Māori and sea mammals is based on the interaction of Māori over many generations with the sea and their whakapapa to whales and other species of the sea. Submitters from iwi and imi clearly hold significant cultural concerns about the application and how it might affects the taonga species of whales. Concern was also expressed to the DMC

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⁶²⁴ Lines 30 – 32, page 2511 of the Transcript, 18 November 2014

⁶²⁵ Paragraph 39, Statement of Evidence of Greg Summerton, 29 September 2014

⁶²⁶ Paragraph 12a, Statement of Evidence of Mr Stephen Christensen on behalf of Te Rūnanga o Ngāi Tahu, 25 September 2014

⁶²⁷ Page 6, Statement of Evidence of Kauahi Ngaporo on behalf of Kaikoura Whale Watch, 11 September 2014

about the possible economic consequences for marine eco-tourism if the mining operation were to harm or displace marine mammals.

637. In the words of Mr Ngaporo:⁶²⁸ "The Chatham Rock Phosphate proposal has the potential to harm Chatham Rise feeding grounds used by the Kaikoura whales and to impact marine mammals in ways that are not well understood"; and "The whales are dependent on the Chatham Rise ecosystem and we are dependent on the whales. Our destinies are linked."

9.7. Consultation with existing interests

- 638. Although there is no requirement under the EEZ Act for an applicant to consult with existing interests in developing its case for a marine consent, it is clear that in order to understand and address the concerns of existing interest groups, a certain level of consultation is necessary. Moreover, in order to be effective the consultation needs to be undertaken with a degree of sensitivity and care. While this is particularly the case for tangata whenua, it is also important for other stakeholders and interested parties.
- 639. Ms Sanders provided the hearing with a comprehensive account, from the applicant's point of view, of the consultations undertaken by the applicant. She reported that since 2010 it had engaged with key stakeholders such as the fishing industry, iwi and imi, the Chatham Islands community, government agencies, non-governmental organisations and a range of environmental groups.⁶²⁹ This had been by means of meetings, the provision of updates by email and telephone, newsletters, media releases and presentations. Consultants with specialist experience in dealing with Māori had been engaged to assist with the applicant's engagement with iwi and imi. The stated purpose of the consultations was, in Ms Sanders' words, "*to inform and educate interested persons so that they can reach their own conclusions about the project's merits, and to receive feedback about the project, including any concerns, so that we can consider ways to improve the project"*. She went on to note instances where the applicant had refined the design of the proposal and undertaken additional research as a result of the feedback received. She then gave a detailed account of the process follow in respect of key stakeholders.
- 640. Although a number of submitters gave credit for the efforts made by the applicant to engage with stakeholders, the process was the subject of criticism from such groups as the fishing industry, a number of iwi and imi and environmental groups. It was clear that some groups believed that the applicant had not done as much as it should have to provide accurate and timely information on the proposal, answer questions or listen and respond to their concerns.

⁶²⁸ Paragraphs 10 and 13, Statement of Evidence of Kauahi Ngaporo on behalf of Kaikoura Whale Watch, 11 September 2014
⁶²⁹ Paragraph 16, Statement of Evidence of Linda Sanders for CRP, 28 August 2014

- 641. Thus, Ms Tuuta's statement of evidence⁶³⁰ commented that *"The applicant's consultation has been incomplete, insufficient and lacking in integrity in the sharing of information".* Ngāi Tahu's opening statement referred to the applicant's *"lack of understanding of and attention to Māori values."*⁶³¹ The Deepwater Group contested Ms Sanders' account of the applicant's engagement with it in its opening statement.⁶³² In his opening statement, counsel for the Hokotehi Moriori Trust was questioning of the approach taken by the applicant to its engagement with the Chatham Islands community.⁶³³
- 642. Whatever the merits of the approach taken by the applicant to consult with interested parties (and, as indicated above, a number of participants were prepared to acknowledge the efforts it had made) it was evident that the majority of existing interest groups ended up not only opposing the proposal but feeling that their concerns had not been taken sufficiently on board by the applicant.

9.8. Effects on commercial fishing interests

9.8.1. Importance of the Chatham Rise fisheries

- 643. New Zealand's fishing industry is a significant existing interest in the context of this application. Stakeholders include the 57 iwi and imi which hold fishing quotas under the Treaty of Waitangi (Fisheries Claim) Settlement Act 1992. Section 59(2)(h) of the EEZ Act requires the DMC to take into account the nature and effect of other marine management regimes such as the quota management system (QMS).
- 644. The Chatham Rise is one of New Zealand's most productive and important commercial fishing grounds. It is regarded as an unusually rich and diverse ecosystem that includes numerous fish species of commercial importance. Commercial species caught on the Rise include hoki, hake, ling, orange roughy, black and smooth oreos and scampi. Its importance to the fishing industry was described by Dr Helson of Fisheries Inshore New Zealand as follows:⁶³⁴ *"The Chatham Rise fisheries are of national significance and account for over two thirds of New Zealand's total catch of orange roughy and oreos, a third of the total hoki catch, over 40 percent of total catch of scampi and silver warehou and around a quarter of the total ling catch".*

 ⁶³⁰ Page 14, Statement of Evidence of Evelyn Tuuta and Mokopuna Te Moananui a Kiwa Erueti – Newman, 16 September 2014
 ⁶³¹ Paragraph 17, Opening Representation on behalf of Te Rūnunga Ngāi Tahu, 25 September 2014

 ⁶³² Paragraphs 79 – 80, Opening Representation on behalf of the Deepwater Group Limited, 26 September 2014
 ⁶³³ Lines 35 – 38, page 2130 of the Transcript, 10 November 2014

⁶³⁴ Paragraph 12, Statement of Evidence of Statement of Evidence of Dr Jeremy Helson on behalf of the Deepwater Group Limited, 12 September 2014

- 645. Dr Helson went on to note that in 2013 fisheries on the Chatham Rise had produced over \$130 million in export earnings and that Marine Stewardship Council (MSC) certification had been secured for the hoki fishery and was being sought for hake and orange roughy.⁶³⁵
- 646. The DMC heard evidence from numerous witnesses about fish and fishing. This included technical experts, fisheries managers and skippers and experienced local fishermen both from the mainland and from the Chatham Islands.
- 647. Dr O'Driscoll, a witness for the applicant, confirmed that the Chatham Rise was an important area for fish and fisheries, noting that more than 250 fish species had been caught in research trawls on the Chatham Rise at depths ranging from 200m to 800m.⁶³⁶
- 648. The DMC was informed that of the 63 species identified in the prospecting licence area, no important commercial and fish species had more than 10 % of their Chatham Rise estimated biomass (averaged over the past 10 years) within the revised marine consent area.⁶³⁷
- 649. However, Dr O'Driscoll acknowledged that there had been very little commercial catch effort information from within the revised marine consent area since 2003, mainly because of the establishment of the BPA in 2007.⁶³⁸
- 650. Ms Baird noted⁶³⁹ that there was little overlap between the bottom longline ling fishery and the three permit / licence areas.
- 651. Dr Tuck's evidence related to a comparative analysis of sediment suspension arising from demersal trawling and mining and its effect on benthic species. That has been covered elsewhere in this decision in the context of the sediment plume and is not further discussed in this chapter.
- 652. Dr Helson confirmed⁶⁴⁰ that the main deepwater and middle-depth commercial fisheries on the Chatham Rise were:
 - a trawl fishery for hoki and associated species such as silver warehou, hake and ling at depths of 200 to 600 m
 - trawl fisheries for orange roughy and oreos at depths of 700 to 1,000 m

⁶³⁵ Paragraphs 11 – 12, Statement of Evidence of Statement of Evidence of Dr Jeremy Helson on behalf of the Deepwater Group Limited, 12 September 2014

⁶³⁶ Paragraph 1, Statement of Evidence of Richard O'Driscoll for CRP, 28 August 2014

⁶³⁷ Dr O'Driscoll confirmed that there was nothing magical about the 10 % — simply the highest number of 9.9 % rounded up. ⁶³⁸ Paragraph 36, Statement of Evidence of Richard O'Driscoll for CRP, 28 August 2014

⁶³⁹ Slide 4, Summary of Evidence of Susan Jane Baird, 16 October 2014

⁶⁴⁰ Paragraphs 28 – 29 and 69, Statement of Evidence of Dr Jeremy Helson on behalf of the Deepwater Group Limited, 12 September 2014

- a ling longline fishery.
- 653. He added that other commercial species included jack mackerel, alfonsino, scampi, barracouta, squid and groper (hapuku or bass).

9.8.2. Fishermen

- 654. While the evidence of the fishing industry witnesses was highly critical of what it considered deficiencies in the underlying modelling assumptions and conclusions, it did not generally challenge the expert witness' views summarised in the above paragraphs.
- 655. Mr Connolly observed⁶⁴¹ that the hoki fleet rarely trawled above the 400 m isobath in order to avoid the scampi and juvenile hoki, ling, and silver and white warehou, as well as avoiding those areas where ling long liners and scampi trawlers fish.
- 656. Mr Karatea noted⁶⁴² that during his 25 years at sea on the Chatham Rise he had caught crayfish, orange roughy, hapuka, bass, tarakihi, scampi, trumpeter, ling, hoki, blue cod, paddle crabs, jock stewarts, and green bone blue nose.
- 657. Mr Patrick noted⁶⁴³ concern about the juvenile commercial fish (particularly hoki) that congregate in the shallower parts of the Chatham Rise.
- 658. Mr Summerton noted that 78 % of Okains Bay fish, primarily ling and deep sea cod, was caught around the proposed Chatham Rise mining area, and he provided helpful illustrative evidence of the positions and directions of lines set by his activities, and the direction of currents, although the DMC notes that these tended to be on the flanks of the Rise rather than the crest where the proposed mining would take place.

9.8.3. The fishing industry

659. The fishing industry was strongly opposed to the proposal. Groups such as the Deepwater Group, Te Ohu Kai Moana, the Sealord Group, Ngāi Tahu, Ngāti Mutunga and Moriori were unanimously of the view that it posed an unacceptable risk in terms of a reduction in fish stocks from loss of habitat, the potential displacement of certain species of fish and the possible loss of MSC certification. These concerns were echoed by a number of individual submitters and witnesses.

⁶⁴¹ Paragraph 9. Statement of Evidence of Peter Connolly on behalf of the Deepwater Group Limited, 12 September 2014
⁶⁴² Paragraph 51, Statement of Evidence of Turoa Karatea on behalf of Whanua o Evelyn Tuuta and Mokopuna Te Moananui a Kiwa Erueti-Newman, 12 September 2014

⁶⁴³ Paragraphs 14 – 15, Statement of Evidence of Christopher Patrick on behalf of the Deepwater Group Limited, 12 September 2014

- 660. Mr Paulin of the Sealord Group (in which iwi hold a significant interest) explained the importance of the Chatham Rise fisheries and the BPA to his company. He was particularly concerned about the risk of a reduction of productivity and the possible effect of the mining operation on MSC certification. 644
- 661. In his opening statement, Mr Christensen for Ngāi Tahu commented "There are significant limits to the stock assessment modelling, and it is just not possible based on current modelling to estimate the amount of catch that may be displaced nor the cost to the fishing industry generally, and to individual companies such as Okains Bay, of losing decades of acquired knowledge of fish aggregation, spatial / temporal movements and life cycle changes. Displacement of commercial fishing activity and loss of value is likely to arise from the cumulative effects of displacement from multiple mining blocks, wider environmental effects of mining on fish behaviour and consumer concerns about seafood quality."645
- 662. Ms Woods of Te Ohu Kai Moana requested that the application be declined on the grounds that "the proposed benefits do not warrant the risks the activities will create to commercial and noncommercial aspects of the Māori Fisheries Settlement or to the wider fishing industry".⁶⁴⁶ She went on to explain the importance of the Chatham Rise fishery to iwi, noting that the Māori Fisheries settlement was based on the premise that the benefits of the 1992 agreement with the Crown would endure.
- 663. Speaking on behalf of the Deepwater Group, Mr Clement asserted that the proposal had the potential to disrupt the incentives that underpin the successful operation of the QMS,⁶⁴⁷ and was likely to damage the integrity of the Mid Chatham Rise BPA. He warned that the mining operation would increase costs to the fishing industry, reduce the value of quota rights and put at risk the industry's MSC sustainability certification. He saw no possibility of the adverse effects of the proposal being avoided, remedied or mitigated through proposed conditions or the adoption of an adaptive management approach.⁶⁴⁸ He warned that no weight could be attached to the stated intention of the applicant to establish mining exclusion zones in the marine consent area.
- 664. Mr Connolly, a fishing boat operator, gave an account of his first-hand experience on the Chatham Rise, raising questions about the impact of the weather on the viability of the mining operation, the information provided by the applicant's experts on tidal currents and other claims

⁶⁴⁷ Paragraph 8, Statement of Evidence of Ian Thomas (George) Clement for the Deepwater Group Limited, 12 September 2014 ⁶⁴⁸ Paragraph 81, Statement of Evidence of Ian Thomas (George) Clement for the Deepwater Group Limited, 12 September

2014

⁶⁴⁴ Paragraph 27, Statement of Evidence of Colin Douglas Paulin on behalf of the Deepwater Group Limited, 12 September 2014 ⁶⁴⁵ Paragraph 72, Opening Representation on behalf of Te Rūnanga o Ngāi Tahu, 25 September 2014

⁶⁴⁶ Paragraph 15, Opening Statement of Kirstin Woods on behalf of Te Ohu Kai Moana Trustee Ltd, 25 September 2014

made about the distribution of fish, mammal and other marine species on the Rise.⁶⁴⁹ Other individual witnesses involved in the fishing industry as commercial fishers were similarly opposed to the proposal, primarily on the grounds that it was likely to have a detrimental effect on the marine environment, the fisheries on the Chatham Rise and their families' livelihoods.

9.8.4. **The applicant's position**

- 665. The applicant did not disagree about the importance of the Chatham Rise to the fishing industry. It noted that the nutrient-rich waters of the Chatham Rise drove high levels of phytoplankton productivity that supported commercially important populations of demersal and deep water fish. It disagreed however that the mining operation would pose a significant risk to the commercial fishing industry, expressing the view that potential impacts on the fisheries were considered to be of low risk.⁶⁵⁰
- 666. As noted above, the applicant called a number of expert witnesses to refute criticisms that the proposal would impact in any material way on commercial fishery stock levels. The applicant was also strongly critical of the fishing industry for opposing the applicant's mining proposal when they were continuing bottom trawling over significant areas of the Chatham Rise.

9.8.5. Expert conferencing on commercial fishing

- 667. The expert conferencing on commercial fishing agreed⁶⁵¹ on a number of propositions relating to the spatial and temporal overlap between mining and fishing interests on the Chatham Rise. Participants were agreed for example that the Chatham Rise was an important area for commercial fish and fisheries; that only limited fishing had occurred in the consent area in recent years; that the revised consent area represented only a small part of the Chatham Rise; and that if the direct and indirect impacts of mining were restricted to the revised consent area, the effects on commercial fish catch and effort would be small.
- 668. However, there was also agreement that the effects would be larger if the impacts of mining extended beyond the revised consent area and that there was a lack of information on the distribution of some fish species over an annual cycle. The experts concluded that further information would be helpful and suggested that the applicant's proposed conditions and adaptive management regime needed more work.

⁶⁴⁹ Paragraph 6. Statement of Evidence of Peter Connolly on behalf of the Deepwater Group Limited, 12 September 2014

⁶⁵⁰ Summary (page 7), Marine Consent Application and EIA, May 2014

⁶⁵¹ Issue 1, Joint Statement of Experts in the Field of Commercial Fishing, 19 September 2014

669. The conference of experts in the field of economics⁶⁵² took the view that it was not competent to arbitrate between the range of scientific views as to the impact of mining on fish stocks. Participants did however agree that the science indicated that some negative impacts would occur. It could not reach agreement on the probability of the mining affecting the industry's sustainability accreditation standing. The views of individual economics witnesses are outlined in Chapter 11 dealing with the question of economic benefits to New Zealand.

9.9. Sustainability certification

- 670. The fishing industry attached considerable importance to the maintenance of its current MSC certification. It also hoped to secure certification for further species of fish in the near future. The DMC heard testimony about the premium prices that are possible with this certification. It forms part of the industry's strategy to strengthen New Zealand's international reputation for sustainably managed fisheries. The disagreement between the industry and the applicant in this area turns essentially on the question of what, if any, effect the proposed mining activity would have on the industry's MSC certification.
- 671. MSC certification is administered by an international independent non-profit council that assesses a fishery against three core principles: sustainability of exploited stocks (the fishing activity must be at a level which ensures it can continue indefinitely); maintenance of the ecosystem on which the fishery depends (fishing operations must be managed to maintain the structure, productivity, function and diversity of the ecosystem); and effective and responsible management (the fishery must comply with relevant laws and have a management system that is responsive to changing circumstances).
- 672. The Marine Stewardship Council's website lists the key benefits to the fishing industry and fish processors as:
 - existing markets accessed
 - access to new markets
 - livelihoods protected
 - reputation enhanced
 - possible price premiums
 - promotional opportunities.
- 673. The DMC was told that "...New Zealand hoki, which received MSC certification in 2001, was the first major white fishery in the world to be certified. This market advantage provides a premium of \$200 per tonne for hoki block. Once other major whitefish fisheries (especially Alaskan Pollock) gained certification, the financial premium became less important, although the

⁶⁵² Issue 4A – C, Joint Statement of Experts in the Field of Economics, 18 September 2014

reputational benefits ensured New Zealand's certified seafood products were always saleable. For example, during the global financial crisis in 200, the Sealord-produced Argentinean hoki block did not sell for almost12 months. In contrast, Sealord's MSC certified New Zealand hoki continued to sell at good prices right through this period."653

674. The DMC also heard that "New Zealand's fisheries will be less likely to be able to obtain or maintain independent third party sustainability certification such as that provided by the Marine Stewardship Council (MSC) because BPAs help meet the MSC requirement that fisheries do not cause serious or irreversible harm to habitat structure. In the absence of environmental certification, access to premium seafood markets in the European Union, Australia, and the United States will be lost, and the value of New Zealand's seafood exports will be reduced. As a result of the above impacts, deep-water quota owners face increased costs and quota value may decline."654

675. The applicant disputed any effect on the MSC certification. Evidence from Dr Pierre, an experienced MSC auditor, expert assessor and peer reviewer, and expert witness for the DMC, outlined the sort of considerations required by the certification process. She confirmed in response to questioning from the applicant's counsel, Mr Harwood⁶⁵⁵ that she was not aware of any fishery having lost its certification due to third party activity. Mr Harwood provided 656 three examples of fisheries that occur within areas of quite intensive third party activity (including oil and gas production, wind farms, fish farming and commercial shipping) that are either certified or were going through the certification process, being the Norway North-East Arctic and North Sea saithe fisheries, the Louisiana Blue Crab fishery (certified) and the Louisiana Oyster, Dredge, Scraper and Tong fishery. Dr Pierre advised the DMC however that the DMC should treat the concerns regarding the BPA concern issue seriously as it was "one of the more important issues in the broader fisheries context that this process has to consider,"657.

9.10. Maritime and navigation

676. Mining vessels would be subject to the ordinary rules and regulations of working vessels at sea, primarily through the Maritime Transport Act 1994 (MTA) as outlined by Maritime New Zealand in its response to the EPA of 18 July 2014.

⁶⁵³ Paragraph 59, Statement of Evidence of Ian Thomas (George) Clement for Deepwater Group Limited, 12 September 2014 ⁶⁵⁴ Paragraph 10.3 – 10.4, Statement of Evidence of Ian Thomas (George) Clement for Deepwater Group Limited, 12 September 2014 ⁶⁵⁵ Paragraph 216, Closing Submission for CRP, 19 November 2014

⁶⁵⁶ Paragraphs 219 – 226, Closing Submission for CRP, 19 November 2014

⁶⁵⁷ Lines 19 – 20, Page 1269 of the Transcript, 17 October 2014
- 677. Minimum requirements for matters such as night lighting and navigation would apply as set out in the Maritime Rules for New Zealand Waters made under Part 4 of the MTA. Those rules do not however appear to apply beyond the territorial waters of New Zealand, and the DMC was left uncertain as to whether the same or different would apply in the EEZ (although the DMC presumes that the same would be adopted as best practice even in the absence of any specific requirement, noting that New Zealand is a signatory to the IMO Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS) which apply). Working lights would be at the operator's discretion, tempered by any regulations that may be required by applicable employment regulations (see below) and the observance of informal codes such as the 2013 National Action Plan Seabirds designed to reduce incidental seabird capture and Vessel Management Plans.
- 678. In addition the vessel would be required to comply with the Marine Mammals Protection Act 1978 and the Wildlife Act 1953, the latter particularly relating to seabirds, although Mr Prebble noted⁶⁵⁸ that this function is primarily managed through the relevant provisions of the Fisheries Act 1996.
- 679. Questions arose, particularly from Mr Currie, regarding the implication of Boskalis' vessels being flagged to Cyprus if working in New Zealand's EEZ. The DMC was advised that the Health and Safety Reform Bill, currently before the House (introduced on 10 March 2014) specifically provides for the application of the Health and Safety in Employment Act 1992 to foreign vessels on demise charter to a New Zealand operator and working in the EEZ. That legislation is expected to pass in 2015, although the DMC can make no presumptions regarding either the form or content of any relevant sections prior to passage or the likely structure of the mining company applying for the marine consent.
- 680. Proposed Condition 6 required a Coastal Navigation Warning or other appropriate navigation warning to be promulgated at least one day prior to mining commencing on each mining block. Coastal navigation warnings are issued by the Maritime New Zealand (MNZ) Maritime Operations Centre and cover coastal waters out to a distance of 250 miles from the coast. This would be just a one-off warning, and although it might be sufficient to warn other maritime traffic that mining is about to commence, it would not be a continuous warning that mining is taking place. While the DMC notes the EPA's comments as to whether the one day notification timeframe is in accordance with requirements⁶⁵⁹, it considers that there should be an ongoing method of warning that mining is occurring and that a large vessel would be operating over any given mining block.

⁶⁵⁸ Paragraph 9, Memorandum of counsel for the Crown in response to a question regarding vessel management and fisheries requirements, 14 October 2014 ⁶⁵⁹ Page 3, EPA Comment on CRP Conditions, 14 November 2014

- 681. Proposed Condition 8 required sewage and greywater treatment systems to comply with the Grade A standards as defined in Schedule 6 of the Resource Management (Marine Pollution Regulations) 1998. The DMC considers that this condition would have been appropriate notwithstanding that it does not fall within the EPA's jurisdiction.
- 682. The DMC is satisfied that appropriate controls for the proposed operation could be set under the relevant marine management regimes, and in accordance with best practice. If the concern raised by Mr Currie was not finally addressed through passage of the Health and Safety Reform Bill, then any necessary remedy would be a matter for the government of the day.

9.11. Mid Chatham Rise Benthic Protection Area

683. The fishing industry attaches considerable importance to the maintenance of the Mid Chatham Rise BPA. The fact that some 90 % of the mining permit area overlaps with the BPA is a significant factor in the industry's opposition to this proposal. Because the BPA also has wider significance in terms of New Zealand's international commitments in the field of biodiversity, the DMC has dealt with this issue separately in Chapter 10.

9.12. Rock lobsters and paua

- 684. A number of submitters expressed concern over the possible impact of the proposed mining activities on the various life phases of red rock lobsters (also known as koura, crayfish and *Jasus edwardsii*).
- 685. The DMC heard from Dr MacDiarmid that rock lobster have a number of phases in their life cycle; a long-lived (18 months) and widely dispersed planktonic larval stage (seemingly confined to the upper 200 m of the watercolumn), a post-larval settlement stage that swims inshore to locate suitable settlement habitats, and benthic juvenile and adult phases.⁶⁶⁰ The DMC considered the potential effects of the proposal on all phases of the rock lobster's lifecycle.

⁶⁶⁰ Paragraph 23, Statement of Evidence of Dr Alison MacDiarmid for CRP, 25 August 2014

- 686. Dr MacDiarmid told the DMC that no evidence of rock lobsters occurring on the crest of the Chatham Rise in any of the phosphorite nodule mining licence areas had emerged over 50 years of research. Mr Sykes, representing CRA6 Rock Lobster Industry Association, cautioned however they had not fished there and the research had not been targeted on rock lobster.⁶⁶¹
- 687. The relevant experts identified the three main risks to rock lobster as:
 - interference with the transport of larvae
 - interruption to migration
 - nutrient runoff.
- 688. Dr MacDiarmid told the DMC that juvenile and adult phase red rock lobsters are restricted to depths shallower than 250 m. Given that there is a distance of some 170 km between the eastern end of the permit area and the western extent of the 250 m bathymetric contour around the Chatham Islands, she concluded that it was unlikely that there would be any direct impact from the proposed mining operations on rock lobster populations around the Chatham Islands.⁶⁶²

Interference with the transport of rock lobster larvae

- 689. Potential interference with the transport of larvae to the Chatham Islands was considered by the experts involved in the rock lobster conferencing to be the most significant threat to the Chatham Islands rock lobster fishery.⁶⁶³
- 690. They agreed that significant interference to the transport of larvae to the Chatham Islands would constitute a threat to larval settlement.⁶⁶⁴
- 691. Due to the larvae being entrained in eddy systems to the north of the Chatham Rise, Dr
 MacDiarmid considered that they were highly unlikely to spend time over the crest of the
 Chatham Rise in areas potentially affected by sediment plumes from the mining operation.⁶⁶⁵
- 692. Overall, Dr MacDiarmid concluded that the proposed mining activities were highly unlikely to have any effect on lobster larvae critical to supporting the lobster fishery around the Chatham Islands.⁶⁶⁶

⁶⁶¹ Lines 29 – 33, page 1663 of the Transcript, 22 October 2014

⁶⁶² Paragraph 2, Statement of Evidence of Dr Alison MacDiarmid for CRP, 25 August 2014

⁶⁶³ Issue 1, Joint Witness Statement of Experts in the Field of Rock Lobsters, 16 September 2014

⁶⁶⁴ Issue 1, Joint Witness Statement of Experts in the Field of Rock Lobsters, 16 September 2014

⁶⁶⁵ Paragraph 4, Statement of Evidence of Dr Alison MacDiarmid for CRP, 25 August 2014

⁶⁶⁶ Paragraph 9, Statement of Evidence of Dr Alison MacDiarmid for CRP, 25 August 2014

693. Both Dr MacDiarmid and Mr Sykes agreed that this assessment depended on the accuracy of the sediment plume model and the larval transport settlement model. It was agreed that models have inbuilt uncertainties.⁶⁶⁷

Interruption to rock lobster migration

- 694. The experts also saw potential for migration paths through the proposed mining site and areas affected by the sediment plume and deposition area to be interrupted.⁶⁶⁸ The DMC heard that rock lobster abundance around the Chatham Islands was reliant on the immigration of larger lobsters from deeper water, although there was uncertainty about the depth range and distance of immigration.⁶⁶⁹
- 695. As the mining was proposed at depths greater than 250 m, it was agreed by Dr MacDiarmid and Mr Sykes that the proposal was unlikely to affect adult rock lobster migration.⁶⁷⁰
- 696. The DMC heard from Mr Cameron on the Chatham Islands representing PAUAMAC4 Industry Association Incorporated. He cited his main concerns as being impacts on the coastal ecosystems of the Chatham Islands and risks related to vessels, such as an increased risk of oil spills.⁶⁷¹

Nutrient runoff

697. The experts on rock lobsters discussed the possible impact of nutrient runoff resulting from increased application of rock phosphate fertiliser on the Chatham Islands, if that were to happen. The experts could not agree on whether the effects of any increased use of rock phosphate should be considered as a potential effect of the mining operation. The DMC did not consider that it should be.⁶⁷²

9.13. Proposed conditions

- 698. The establishment of the Environmental Reference Group through Proposed Conditions 47 53 appeared to be the main mechanism put forward by the applicant for addressing the concerns of existing interests. The Group would include:
 - the consent holder
 - a technical specialist in the field of deep-water marine ecology

⁶⁶⁷ Issue 1, Joint Witness Statement of Experts in the Field of Rock Lobsters, 16 September 2014

⁶⁶⁸ Issue 2, Joint Witness Statement of Experts in the Field of Rock Lobsters, 16 September 2014

⁶⁶⁹ Issue 2, Joint Witness Statement of Experts in the Field of Rock Lobsters, 16 September 2014

⁶⁷⁰ Issue 2, Joint Witness Statement of Experts in the Field of Rock Lobsters, 16 September 2014

⁶⁷¹ Lines 40 – 45, pages 2191 – 2192 of the Transcript, 12 November 2014

⁶⁷² Issue 3, Joint Witness Statement of Experts in the Field of Rock Lobsters, 16 September 2014

- a specialist in the field of marine sediments and sediment plume dispersion
- Department of Conservation
- a representative of the deep-water fishing industry
- a delegate from the Chatham Islands
- a non-governmental organisation with an interest in the marine ecosystems of the EEZ
- an iwi / imi representative from the collective of Ngāti Mutunga, Moriori, and Ngāi Tahu.

9.14. DMC findings on existing interests

- 699. The existing interests involved in this application are many and varied. Without exception, the submitters in the process representing existing interests were opposed to it. Although the applicant had made an effort to consult with a wide range of parties with an existing interest, the engagement seemed not to have narrowed the differences to any appreciable extent. The uncertainties surrounding the mining operation were of evident concern to a wide range of existing interest groups, and the proposal was seen as putting their commercial and other interests at risk.
- 700. The evidence presented to the DMC during the hearing, particularly the views of relevant expert groups, did not support the full extent of claims made by existing interest groups as to the likely adverse effects of the mining operation. There were however uncertainties and therefore risks involved in the proposal that had the potential to impact on existing interests.
- 701. For iwi and imi holding fishing quota, there was a concern that adverse effects from the proposed mining operation would reduce the value of their present assets and future development rights as well as undermine important concepts such as Rangatiratanga and Kaitiakitanga. Similar concerns were held in respect of rock lobsters, paua and eels.
- 702. In the area of commercial fishing generally, risks were identified in terms of stock reduction, displacement, product branding and sustainability certification. The DMC considers that a robust set of conditions and appropriate adaptive management regime could significantly lower the probability of an effect to a low level. Fishing interests (including iwi and imi) were nevertheless clear that they should not be required to carry such a residual risk, however small. The DMC acknowledges that the Act requires it to take into account potential effects of low probability that have a high potential impact. On the evidence it heard, the DMC was not persuaded that the potential impact on fishing interest would be more than moderate.

- 703. With regard to marine eco-tourism and specifically Kaikoura Whale Watch Ltd, the marine mammals experts were not in full agreement about the nature and extent of effects of the proposal on marine mammals. There was a degree of uncertainty arising from the fact that evidence of whale sightings was opportunistic and there had been no systematic survey of the distribution or movement of whales on the Chatham Rise. It was generally agreed that the two greatest risks to whales lay in the noise generated by the mining operations and the possibility of collision with mining vessels. Most witnesses seemed to accept however that these risks could be managed through an appropriate set of proposed conditions and a robust adaptive management plan and the DMC agrees. At the same time, it was evident that further research and validation of results would be required to provide certainty about the effects of the proposed mining operation on whales. The DMC accepts this assessment.
- 704. On maritime and navigation issues, the DMC considers that appropriate controls could be set under the relevant marine management regimes. If the concern raised by Mr Currie was not finally addressed through passage of the Health and Safety Reform Bill, then any remedy would be a matter for the government of the day.
- 705. While the effects of the proposal on the Rohe Moana cannot be predicted with any certainty, this is clearly a matter of concern to members of the Pā Tangaroa Forum. The DMC acknowledges their concerns. It understands that no group appreciates being asked to carry risks to its livelihood or way of life without its consent, particularly as there is a spatial overlap between the proposed mining area with the Mid Chatham Rise BPA and the Chatham Islands Rohe Moana.
- 706. On the balance of the information and evidence placed before it, however, the DMC did not feel able to conclude that the mining operation, if the consent were granted and accompanied by a suitable set of conditions, would have had material adverse effects on the Rohe Moana.
- 707. On the evidence and testimony it heard, the DMC judges that the effects of the mining proposal on existing interests generally are unlikely to arise to the extent submitted and are not determinative of the application. However, the DMC acknowledges the concerns of existing interest holders regarding the mining proposal which they see as involving a number of uncertainties and posing risks to their livelihood and wellbeing.

10. Marine Management Regimes

708. Section 59(2)(h) requires the DMC to take into account the nature and effect of other marine management regimes. The regimes considered during this application were those managed by the Ministry for Primary Industries (Fisheries Act, Fisheries (Benthic Protection Areas) Regulations and Biosecurity Act); the Department of Conservation (Marine Mammals Protection Act, Wildlife Act and Code of Conduct on Acoustic Disturbances); Maritime New Zealand (Maritime Transport Act and HSE Act); and the Ministry of Business, Innovation and Employment (Crown Minerals Act). Each of these regimes has a bearing on some aspect of the proposed activity but the DMC considers the only regimes of any material relevance to our assessment are those covered below.

10.1. Fisheries (Benthic Protection Areas) Regulations 2007

- 709. Almost the entire proposed mining operation would take place within the 8,732 km² Mid Chatham Rise BPA.
- 710. Mr Winchester advised⁶⁷³ that the revised marine consent area constituted 55 % of the BPA, and that 92 % of the revised consent area lay within this BPA.⁶⁷⁴ Over the first 15 years mining would take place in 9 % of the revised consent area (ie 450 km²), although the effects would be experienced more widely.
- 711. As noted earlier in this decision, the BPA network was established by the Fisheries (Benthic Protection Areas) Regulations 2007 (the Regulations), regulations promulgated under the Fisheries Act 1996 which came into force on 15 November 2007. This thereby constitutes a marine management regime matter (Section 7(2) of the EEZ Act) that the DMC is required to take into account under Section 59(2)(h) of the EEZ Act.
- 712. The four purposes of New Zealand's 17 BPAs is generally stated in Regulation 3 of the Regulations:

The purposes of these regulations are-

- (a) to establish benthic protection areas within New Zealand's fishery waters
- (b) to set out rules that apply to vessels trawling within the benthic protection areas
- (c) to prohibit the use of a dredge within the benthic protection areas
- (d) to create offences and penalties in relation to any breach of these regulations.

⁶⁷³ Paragraph 166, Opening Submissions for CRP, 25 September 2014

⁶⁷⁴ We note that in the transcript (page 64) these numbers are cited as "roughly 90 %" and "roughly two thirds" respectively

- 713. The Regulations essentially prohibited the use of trawl nets and dredges used primarily for the collection of shellfish within 100 m directly above the seabed in the 17 identified BPAs. Regulation 9 sets the requirements for the use of trawl nets within any BPA above the 100 m upper buffer zone.
- 714. The Regulations contain no explanation or rationale for the particular locations or dimensions of the BPAs, although the DMC heard that reasonable size, representativeness and simplicity of shape were factors in the Minister's direction.
- 715. In its written advice to the DMC, the Ministry for Primary Industries⁶⁷⁵ noted that the BPAs started as a fishing industry proposal to close 17 areas of the EEZ to bottom trawling and shellfish dredging in order to address the adverse effects of fishing deepwater marine habitats and ecosystems. This resulted in an Accord signed with the Minister of Fisheries which subsequently progressed into the Regulations. The Accord acknowledged the adverse effects of these fishing methods and sought to set aside some 30 % of New Zealand fisheries waters. Significantly, that correspondence notes that the Minister of Fisheries agreed that the closure was a significant contribution to meeting Government's legislative obligations regarding the adverse effects of such fishing methods on the aquatic environment. The Ministry also noted that other risks to benthic biodiversity from activities other than fishing (eg mining or drilling) were not prohibited under the Regulations.
- 716. It was common ground that this matter must be addressed. For example, in opening Mr Prebble submitted:⁶⁷⁶ "The impact on the environment within the BPA is a matter that must be considered by the DMC (s 59(2)(d) and (e) of the EEZ Act)."
- 717. Mr Winchester submitted⁶⁷⁷ that the BPAs were not closed to activities other than those specifically prohibited, noting that Parliament could have prohibited applications for other activities either specifically or generally at the time, or regulations to the same effect could have been gazetted subsequently, but were not. Furthermore,⁶⁷⁸ he noted that during the passage of the EEZ Act the Parliamentary Commissioner for the Environment had specifically sought the exclusion of other activities in the BPAs but this was not adopted. Mr Winchester advised caution⁶⁷⁹ regarding the making of judgements on the general policy question of marine protected areas because of the wider policy issues involved. Mr Winchester also observed that the Crown's opening position was one of neutrality with respect to the proposal and that it did

⁶⁷⁵ Ministry for Primary Industries report provided in accordance with Section 44 of the EEZ Act, 18 July 2014

⁶⁷⁶ Paragraph 23, Crown's Opening Submissions, 25 September 2014

⁶⁷⁷ Paragraph 169, Opening Submissions for CRP, 25 September 2014

⁶⁷⁸ Footnote 62 to paragraph 173, Opening Submissions for CRP, 25 September 2014

⁶⁷⁹ Paragraph 12, Opening Submissions for CRP, 25 September 2014

not actively seek protection for the Mid Chatham Rise BPA, although noting⁶⁸⁰ that mining would be inconsistent with the fishing industry and decision-makers intent, and could undermine international recognition as a protected area.

- 718. The DMC was told that the BPAs contribute to New Zealand's targets under the United Nations Convention on Biological Diversity (CBD) 1992 (a matter directly relevant under Section 11 of the EEZ Act). In that regard, the DMC notes Mr Prebble's remarks in his opening statement on behalf of the Crown ⁶⁸¹ that while the existence of the BPA does not preclude a grant of consent: "... mining in the Mid Chatham Rise BPA would be inconsistent with the fishing industry and decision-maker's intent in establishing the BPA network and could undermine international recognition of the area's status as a protected area (which goes towards meeting New Zealand's international obligations arising primarily from the CBD)."
- 719. Furthermore, he repeated that submission in closing⁶⁸², observing that "There are a number of international obligations that New Zealand has which relate to BPAs and which will be relevant to consider should consent be granted."
- 720. And in a footnote to that remark he noted⁶⁸³ "New Zealand has promoted the BPAs as meeting the obligations under CBD on the world stage (IUCN definition for protected areas). This is on the basis the BPA meets both the following criteria in the IUCN definition for a protected area: (1) the primary objective must be conservation; and (2) the management of the area must result in proper conservation from all types of activities that could negatively impact it."
- 721. In answer to a question as to whether granting the application in this particular BPA would have implications for the entire BPA network, and therefore affect New Zealand's obligations under CBD, Mr Prebble was unable to provide a categorical answer⁶⁸⁴ but advised "... all I can say at this point is that if consent were granted I think the Crown would have to undertake a consideration of what was the implications of that more broadly. I don't have an answer for you on that specific point."
- 722. The potential adverse effects in terms of mining activity within the BPA was addressed from two angles:
 - whether the activity of mining is contrary to the purpose and function of the BPA
 - whether the activity of mining in the BPA would adversely affect the MSC certification held (or currently applied for) by the fishing industry.

⁶⁸⁰ Line 45, page 65 of theTranscript, 25 September 2014

⁶⁸¹ Paragraph 28, Crown's Opening Submissions, 25 September 2014

⁶⁸² Paragraph 67, Crown's Closing Submissions, 18 November 2014 (note the submission states 18 October 2014

⁶⁸³ Footnote 72 of paragraph 67, Submissions, 18 November 2014 (note the submission states 18 October 2014

⁶⁸⁴ Lines 10 – 15, page 2492 of the Transcript, 18 November 2014

- 723. The DMC has addressed the MSC matter in Chapter 9.9.
- 724. Turning to the first matter, many parties in opposition submitted that mining in the BPA was essentially an incompatible activity. Rather than cite all those, and for the sake of brevity, the DMC has focused on the evidence of Mr Clement as a proxy for that argument.
- 725. Mr Clement is chief executive of the Deepwater Group and the chairman of Seafood New Zealand Limited, and advised the DMC⁶⁸⁵ that he was the initiator of the BPA concept. He explained that as fishing was the only significant commercial human activity occurring beyond the territorial sea at the time, and marine protection legislation seemed to be stuck, it was decided to use the Fisheries Act to promote the establishment of protected areas beyond the territorial sea, and as trawling and shellfish dredging were only the two activities causing benthic damage, these were the focus of the regulations.
- 726. Mr Clement further explained the basis for the representative series of BPAs ranging from the sub-Antarctic to the subtropics and covering both east and west of New Zealand encompassing the two key geological plates, based on what was then the best available information. While he acknowledged that overall these 17 areas were not commonly trawled or dredged because of their general depth, he denied that this was either intentional and / or self-serving of the industry. In that regard he opined⁶⁸⁶ that the Mid Chatham Rise BPA, while being shallower and therefore within range of these prohibited methods, was a vital component in the network, comprising habitat not well represented elsewhere in the EEZ. Furthermore, he observed that because of the BPA network New Zealand (taking into account other marine protected areas and seamounts) is one of only 28 countries internationally who have met or exceeded the goal of 10 % marine area protection (Mr Clement⁶⁸⁷ gives a figure of 30 %).
- 727. Mr Clement concluded⁶⁸⁸ that "... our global credibility in this regard would be weakened if our MPAs and the BPAs are no longer seen to be provide secure broad scale and representative protection for benthic biodiversity." He stated that "the confidence that the New Zealand and global community might have in the integrity of the BPA network would be jeopardised if mining were to be permitted, regardless of how comparatively small an area (in terms of the whole BPA network) is involved."
- 728. The applicant disputed this line of argument. Its response to this matter, other than the strict legal interpretation given by Mr Winchester, was provided by Mr Wood (who was involved as a consultant to the Deepwater Group in 2006 when the BPAs were being drafted, although not

⁶⁸⁵ Line 30, page 1823 of the Transcript, 4 November 2014

⁶⁸⁶ Line 10, page 1826 of the Transcript, 4 November 2014

⁶⁸⁷ Lines 30 – 33, page 1826 of the Transcript, 4 November 2014

⁶⁸⁸ Lines 20 – 25, page 1827 of the Transcript, 4 November 2014

involved in the industry discussions⁶⁸⁹). His evidence was to the effect that he had made officials aware at the time that winnable minerals existed throughout the proposed BPAs but that they were interested only in fishing-related activities.⁶⁹⁰ Furthermore, he advised that the Mid Chatham Rise BPA was based on Marine Environmental Classification (MEC) Class 63, which comprised an area stretching from the Chatham Islands (and beyond) to the east coast of the South Island, within which the BPA could have been (and could yet be) configured. He included two slides⁶⁹¹ showing, for argument's sake, two additional areas (each) on the Rise in proximity to the BPA which fell within the MEC Class 63 and over which no or little evident trawling effort had taken place according to recent data. The applicant's argument was that through better spatial planning, using a tool such as Zonation, more precisely justified protection areas could be established so that there would be no net loss in effect from the mining but rather a conservation gain. Additionally, a network of proposed exclusion areas had been identified using the Zonation tool within the wider mining licence and proposed prospecting permit areas in which no-mining is proposed because of their high biodiversity value, and for which the applicant offers a "*best endeavours*" condition to secure their longer term protection.

- 729. Ms Appleyard⁶⁹² (and other counsel) responded that regardless of the merits of that proposition, merits that she did not accept, the applicant could not guarantee exclusion areas in perpetuity, neither could the present process achieve any realignment or establishment of new BPAs, indeed the processes for both lay entirely beyond the jurisdiction of the DMC. This point was not disputed.
- 730. Ms Appleyard⁶⁹³ also made reference to the Denniston Plateau / Escarpment Mine case in which the Court accepted the offer of future protection as compensation precisely because two Ministers of the Crown wrote to the Court indicating their willingness to facilitate the formal protection of the Denniston Plateau Protection Area in the event of a grant of consent. That, she opined, was a materially different circumstance to that offered by the applicant and should be distinguished accordingly. In the present instance, there is no evidence before the DMC of any such intent on the part of Government.

10.1.1. Findings

731. The DMC takes the view that mining the seafloor in an area in which a comparable activity is prohibited would be, at the very least, contradictory. Notwithstanding the argument that mining *per se* is not prohibited and is therefore lawful for the purposes of the Regulations, the DMC

⁶⁸⁹ Lines 35 – 30, page 226 of the Transcript, 26 September 2014

⁶⁹⁰ Paragraph 107, Statement of Evidence of Raymond Allen Wood for CRP, 28 August 2014

 ⁶⁹¹ Slides 4 and 5, Benthic Protection Areas and Marine Resources presented with evidence by Raymond Allen Wood, 26
 September 2014
 ⁶⁹² Paragraph 16, Closing Statement on behalf of Deepwater Group Ltd, 18 November 2014; Lines 25 – 32, Pages 143 of the

⁶⁹² Paragraph 16, Closing Statement on behalf of Deepwater Group Ltd, 18 November 2014; Lines 25 – 32, Pages 143 of the Transcript, 26 September 2014; and Lines 45 – 28, pages 2419 – 2420 of the Transcript, 18 November 2014

⁶⁹³ Paragraph 78, Closing Statement on behalf of Deepwater Group Limited, 18 November 2014

finds such a position untenable from a benthic ecology point of view. The net effect, being the destruction of a sizeable benthic area that is protected from an activity similar to mining, is clearly contrary to purpose (a) of the BPA, which is not just to prohibit the specific activities of trawling and dredging but also to protect the benthos.

732. The DMC accepts that the BPAs are creatures of subordinate legislation and, like many such entities, are not set in stone. The Minister clearly has the ability to amend the regulation, and this could be based on updated information received as a result of the sort of Zonation spatial planning tool utilised by the applicant, appropriately ground-truthed for verification, in consultation with relevant stakeholders. As the applicant submitted, such an approach could lead to more refined BPAs. However, and in this Mr Winchester and Ms Appleyard held common ground, this is beyond the DMC's jurisdiction.

- 733. The DMC notes however that evidence was presented that a significant area of potential stony coral dominated habitat exists to the north west of the mining permit and western prospecting permit application areas, predominantly outside but contiguous with the BPA. Without verification that the particular ecological communities of concern are more widely distributed and of an appropriate order of magnitude in abundance, the DMC would find that destroying the existing protected benthic biodiversity would put in question the integrity of the Mid Chatham Rise BPA. A problem for this application, then, is that even if such comparable communities were found beyond the BPA, presumably in areas currently open to fishing (both trawling and longline), their protection could not be guaranteed by any decision of the DMC. Moreover, and despite the applicant's offer of best endeavours, there was no indication from the Crown that such an option was either currently contemplated or would be pursued.
- 734. A related concern of the DMC is the applicant's proposed conditions as drafted appear to set the mining blocks for the first three years in Attachment B with little opportunity to change. This would result in three years of destructive activity in the identified mining blocks, potentially containing unique benthic communities, irrespective of what may or may not be found in the area to the north-west. Verification that the potentially unique ecological communities of concern are more widely distributed and of an appropriate order of magnitude and abundance would need to be established prior to mining commencing.
- 735. Proposed Condition 60 acknowledged the need for a legal mechanism to provide protection for any mining exclusion areas from uses other than mining. The difficulty with this proposed condition is that any legal mechanisms cannot be implemented by the applicant and must rely on the actions of third parties such as Ministry for Primary Industries and the Department of Conservation. As stated in the opening legal submissions for KASM, Greenpeace and DSCC,

this is an entirely different process with entirely different participants.⁶⁹⁴ The DMC understands that this is the primary reason for the use of "*best endeavours*" in the proposed condition; in that the applicant may not have any control over the establishment of protection over the mining exclusion areas other than refraining from mining them. The DMC agrees with the EPA comments that such a condition may not be enforceable.⁶⁹⁵ The DMC considers this proposed condition could not realistically be relied upon to provide protection for mining exclusion areas and does not provide assurance that an alternative BPA would be identified or provided.

736. The DMC concludes that granting consent to this application would effectively negate, and make redundant, one of the purposes and the effect of the Mid Chatham Rise BPA.

10.2. Biosecurity

- 737. Biosecurity issues are likely to occur in association with the arrival of the mining vessel and other vessels such as AUVs into New Zealand waters. Ballast water, vessel biofouling and aquatic equipment are potentially biosecurity risks.
- 738. The application⁶⁹⁶ adequately addressed the question of ballast water (in terms of New Zealand's Import Health Standard for Importing Ballast Water from all Countries) and expressed the applicant's commitment to following New Zealand's obligations under international treaties and agreements. The vessel would re-ballast en route to New Zealand. Once operating in New Zealand, the vessel would ballast at New Zealand ports and discharge the water on the Chatham Rise. This means there would be no ballast biosecurity issue and re-ballasting would not need to occur unless the vessel went overseas (for example, for other mining operations, inspection or dry docking).
- The applicant committed⁶⁹⁷ to managing biofouling in accordance with the Biosecurity Act 1993.
 The vessel's hull would be clean when it arrives in New Zealand and would be kept free of visible biofouling (except for a slime layer).
- 740. The Crown sought that the applicant explicitly addressed the biosecurity risks associated with mining equipment in its biosecurity management plan. The applicant had not done this by the conclusion of the hearing. Underwater equipment such as anchors, chains and components of the mining system including the pump unit, drag-head and riser were seen as biosecurity concerns that needed to be accounted for and managed under the relevant Import Health

⁶⁹⁴ Paragraph 51, Opening Submissions by KASM, Greenpeace and DSCC, 26 September 2014

⁶⁹⁵ Page 16, EPA Comment on CRP Conditions, 14 November 2014

⁶⁹⁶ Paragraphs 107 – 108, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

⁶⁹⁷ Paragraph 109, Statement of Evidence of Gerard van Raalte for CRP, 28 August 2014

Standard (ie Import Health Standard for Used Equipment Associated with Animals or Water, Import Health Standard for Vehicles, Machinery and Tyres).

- 741. The Crown in its closing statement continued to seek a requirement that the biosecurity risks associated with mining equipment be explicitly addressed in the biosecurity management plan and that the voluntary Vessel Biofouling Craft Risk Management Standard (CRMS) be applied from the outset. The Crown acknowledged that the Vessel Biofouling CRMS was voluntary until 2018 and that the jurisdiction of Import Health Standards and CRMSs did not currently extend beyond New Zealand's territorial waters (12 nautical mile limit). The Crown considered that these limitations posed a challenge for managing marine biosecurity risks in the EEZ and that it was desirable to make vessel biofouling management a consent condition.⁶⁹⁸ However the DMC notes that after 2018 and once inside New Zealand's territorial waters, on each return to port, the CRMS would apply.
- 742. Only Proposed Condition 29(e) made reference to biosecurity management of the mining vessel and its equipment, as a component of the standard operating procedures in the Environmental Management and Monitoring Plan (EMMP).
- 743. The DMC understands the Crown's concerns but sees no reason why those issues could not have been addressed in the EMMP. Proposed Condition 32 would require the Chief Executive of the EPA to certify that the EMMP met the requirements of Proposed Conditions 29 or 30, advise the consent holder that amendments were required or advise the consent holder of a timeframe extension for further evaluation of the EMMP, including possible assessment by an external reviewer. The DMC considers that this process would have allowed the concerns raised by the Crown in terms of biosecurity to be addressed.

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⁶⁹⁸ Paragraphs 52 – 53, Crown's Closing Submissions, 18 November 2014 (note the submission states 18 October 2014)

forecast world phosphate price (\$US 108 per tonne) still produced a positive, albeit reduced,

⁷⁰¹ Paragraph 28, Statement of Evidence of Christopher David Castle for CRP, 28 August 2014

747.

Decision on Marine Consent Application - Chatham Rock Phosphate Limited

11. Economic Benefit to New Zealand

11.1. The issues

744. Section 59(2)(f) of the EEZ Act requires the DMC to take into account the economic benefit to New Zealand of allowing the application. In addition Section 10(2) of the EEZ Act provides an economic dimension to the definition of sustainable management, with its reference to enabling people to provide for their economic wellbeing.

11.2. Economic benefit to New Zealand

- 745. The Crown's submission discussed the potential for the mining of phosphorite from the Chatham Rise to increase New Zealand's export earnings, boost employment, support other businesses such as ports and encourage further investment in the mining industry. Quoting from World Bank and other forecasts concerning the global phosphate supply and demand situation, however, the Crown warned that price forecasts needed to be treated with considerable caution given changing market dynamics and recent price volatility.⁶⁹⁹
- 746. Mr Castle for the applicant noted in his evidence that phosphate accounted for some 40 % of the fertiliser used in New Zealand agriculture and horticulture and that all our phosphate was currently imported from Morocco in the form of rock phosphate, most of which is converted to superphosphate by a process known as beneficiation. Statistics New Zealand put the present level of imports of rock phosphate into New Zealand at around 770,000 tonnes per year.⁷⁰⁰ Mr Castle's own view was that the average annual demand in New Zealand was likely to be closer to one million tonnes per year.⁷⁰¹

The applicant produced an analysis from the New Zealand Institute of Economic Research (NZIER) suggesting that, on the basis of the information provided in CRP's prospectus, a

predicted future world phosphate rock price of US\$ 184 per tonne with an assumed exchange rate of US\$ 0.80 to NZ\$ 1.00, the proposed mining activity would boost New Zealand's GDP by some NZ\$ 280 million per year and produce a net welfare gain of NZ\$ 130 million per year.⁷⁰² According to NZIER, some 40 % of this benefit would accrue to New Zealanders not involved

⁶⁹⁹ Paragraph 22, part 1, Submission of The Crown, 10 July 2014

⁷⁰⁰ Page(i) of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014

⁷⁰² Section 6.2 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014

⁷⁰³ Section 5.1.3 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014

estimated welfare benefit to New Zealanders of NZ\$ 110 million per year over the first fifteen years of the proposal.⁷⁰⁴

- 748. Taxes and royalties payable to the Government were initially estimated by NZIER to be of the order of \$46 million per year.⁷⁰⁵ This figure was however subsequently reduced by the applicant to an estimated \$24 million per year.⁷⁰⁶ NZIER estimated the proposal's direct domestic expenditure at NZ\$ 12 million per year for fuel, labour and overheads.⁷⁰⁷ Attention was drawn to the expected environmental benefits of using Chatham rock phosphate on New Zealand farms, such as lower cadmium levels in soils, reduced emissions from shipping and a slower rate of phosphate leaching if the rock phosphate were applied directly rather than in the form of superphosphate.⁷⁰⁸ Other benefits noted by NZIER and the applicant were: modest employment gains; flow-on benefits to ports, port services and the transport sector; security of supply; a measure of import substitution (some 25 % of the estimated annual production of 1.5 million tonnes was projected by the applicant to be sold in New Zealand); and increased export earnings (the remaining 75 % of the proposal's production was expected by the applicant to be exported to Australia and South East Asia).
- 749. On the economic consequences of its effects on the environment, Mr Clough of NZIER argued that the comparatively small size of the mining area (estimated by the applicant to be around 0.5 % of the total area of Chatham Rise above the 1,000 m depth contour), coupled with its distance from land, meant that the mining activities would have a very small environmental footprint.⁷⁰⁹ Mr Clough acknowledged the difficulty of putting a dollar value on the proposal's environmental effects.⁷¹⁰ NZIER believed however that the economic consequences of any environmental effects of the proposal would not outweigh the economic benefits to New Zealand as estimated from the computable general equilibrium (CGE) model.⁷¹¹
- 750. The NZIER report also concluded, on the basis of information supplied by the applicant, that the proposal did not pose a significant risk to New Zealand's fishing industry. In Mr Clough's words, "the commercial values at risk from the CRP mining proposal appear so small as to be negligible".712

⁷⁰⁶ Paragraph 9, Supplementary Statement of Evidence of Evidence of Christopher David Castle for CRP, 7 November 2014

⁷⁰⁴ Paragraph 32, Statement of Evidence of Peter Clough for CRP, 28 August 2014

⁷⁰⁵ Section 4.1.2 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014

⁷⁰⁷ Section 4.1.2 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014 ⁷⁰⁸ Section 4.2 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014 ⁷⁰⁹ Paragraph 35, Statement of Evidence of Peter Clough for CRP, 28 August 2014

⁷¹⁰ Section 2.4 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014 ⁷¹¹ Section 6.2 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014

⁷¹² Lines 36 – 37, page 1023 of the Transcript, 15 October 2014

- In summary, NZIER's assessment was that the proposal should result in a significant overall net 751. benefit for the New Zealand economy.⁷¹³ This view was endorsed by a number of submitters who supported CRP's application.714
- 752. An important caveat entered by NZIER to this positive assessment however was that the proposal needed to be assessed by the applicant as commercially viable and should proceed as planned.⁷¹⁵ On the proposed company structure, the DMC was told that some 50 % of the proposal was likely to be under foreign ownership, that the only significant assets to be owned by CRP were the mining permit and the marine consent; and that the operating assets would be owned and managed by an overseas company.⁷¹⁶ CRP's likely partner in this venture was Boskalis.
- 753. The DMC was told that the applicant planned to negotiate a contract for Boskalis to contractmine the Chatham Rise phosphate rock for at least 15 years if the application for a marine consent was successful.⁷¹⁷ Although no contracts had been finalised at the time of the hearing, Boskalis' expert witnesses confirmed in their evidence that their company had confidence in the applicant's proposal and was strongly committed to it. 718
- 754. Mr Clough described at some length the CGE model used to estimate the likely direct, indirect and induced effects of the applicant's operations on the New Zealand economy. He explained that it was believed this was the most appropriate model to use because it would capture the linkages between the mining sector and the wider economy.⁷¹⁹ He acknowledged that the model had some drawbacks, for example, a number of external factors were outside its scope and it had not previously been used for a mining activity, but noted that had been used by a number of agencies over a range of fields in New Zealand.⁷²⁰
- 755. Dr Nana of Business and Economic Research Limited, who had specialised knowledge of CGE models, affirmed in his evidence that the CGE model was, in his view, well suited to an assessment of the economic impact of a phosphate mining proposal.⁷²¹ His own assessment was that the proposal's impacts would be positive, although relatively small, in terms of both New Zealand's GDP and economic welfare gains.⁷²² He acknowledged however that he had not

⁷¹³ Section 6.2 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014

⁷¹⁴ Section 5, bullet point 1, Analysis of Submissions Report July 2014

⁷¹⁵ Paragraph 2, Statement of Evidence of Peter Clough for CRP, 28 August 2014

⁷¹⁶ Paragraphs 9 – 10, Executive Summary of Evidence of Christopher David Castle for CRP, 26 September 2014

⁷¹⁷ Lines 9 – 11, page 193 of the Transcript, 26 September 2014

⁷¹⁸ Paragraph 96, Statement of Evidence of Sander Steenbrink for CRP, 28 August 2014 and line 38, page 605 of the Transcript, 1 October 2014

¹⁹ Paragraph 21, Statement of Evidence of Peter Clough for CRP, 28 August 2014

⁷²⁰ Page 5, Response to EPA Request for Further Information 28 – 33, Memo from Peter Clough to EPA regarding Further Information Request from EPA, 27 June 2014 (date on EPA website — 1 July 2014) ⁷²¹ Paragraph 14, Statement of Evidence of Dr Ganesh Nana for CRP, 28 August 2014

⁷²² Paragraph 41, Statement of Evidence of Dr Ganesh Nana for CRP, 28 August 2014

verified the data provided to NZIER by the applicant. In his view, the world price of phosphate was a particularly important assumption in terms of influencing the assessment of the proposal's overall economic impact on New Zealand.⁷²³

- 756. Dr Nana expressed the view that an increase in foreign ownership would not affect the estimated GDP increase although it would reduce the welfare benefits of the model⁷²⁴ since more of the economic benefits would flow overseas. Dr Nana noted that environmental and cultural costs were not included in the modelling and that the model was *"agnostic to environmental costs"*.⁷²⁵ Dr Clough confirmed that his assessment had not addressed adverse impacts on cultural values.⁷²⁶
- 757. NZIER's initial analysis was reviewed by the Sapere Research Group, which raised questions about the data used by NZIER and questioned the choice of the CGE model to estimate the economic benefits to New Zealand of this kind of proposal.⁷²⁷ Sapere observed that the results of the modelling did not appear to have been subjected to critical evaluation and testing and questioned whether anyone in New Zealand had the right experience to model the economic effects of undersea mining.⁷²⁸ Querying the decision to assume a market price of US\$ 184 per tonne for the modeling exercise, Mr Murray of Sapere noted that the January 2014 World Bank forecasts of phosphate prices had ranged from US\$ 110 per tonne in 2014 to US\$ 90 per tonne in 2025 and that the world price presently sat at around US\$ 110 per tonne.⁷²⁹ In his opinion, the economic benefits predicted by the CGE model were overly optimistic.⁷³⁰ He did agree however that, regardless of the economic model used, there stood to be a positive impact on the New Zealand economy if the proposal went ahead, and if the key assumptions and forecasts used in CRP's prospectus proved well founded.⁷³¹
- 758. Mr Sundakov, an expert witness called by Ngāi Tahu, was strongly critical of the NZIER assessment. In his view, the net economic effects of the proposal were more likely to be negative than positive.⁷³² He questioned both the data used by NZIER in its modeling and the appropriateness of the CGE model. In his view, a partial equilibrium model would have been more appropriate, and would have given decision-makers more certainty, because of the limited

⁷²³ Paragraph 42, Statement of Evidence of Dr Ganesh Nana for CRP, 28 August 2014

⁷²⁴ Line 10, page 1072 of the Transcript, 15 October 2014

⁷²⁵ Line 5, page 1072 of the Transcript, 15 October 2014

⁷²⁶ Line 10, page 1054 of the Transcript, 15 October 2014

⁷²⁷ Paragraphs 26 and 46 of Annexure B (Review of economic gains expected from Chatham Rock Phosphate mining proposal) of the Statement of Evidence of Kieran O'Neill Murray: Economic Impact, 12 September 2014

⁷²⁸ Paragraph 26 of Annexure B (Review of economic gains expected from CRP mining proposal) of the Statement of Evidence of Kieran O'Neill Murray: Economic Impact, 12 September 2014

⁷²⁹ Paragraph 2 of Annexure B (Review of economic gains expected from Chatham Rock Phosphate mining proposal) of the Statement of Evidence of Kieran O'Neill Murray: Economic Impact, 12 September 2014

⁷³⁰ Lines 19 – 20, page 1138 of the Transcript, 16 October 2014

⁷³¹ Lines 6 – 8, page 1140 of the Transcript, 16 October 2014

⁷³² Paragraph 88, Statement of Evidence of Aleksandr Sundakov on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 11 September 2014

linkages of the project to New Zealand's wider economy.⁷³³ He believed the rock phosphate prices used in the NZIER assessment to be optimistic.734

- 759. Mr Sundakov also questioned whether the potential downside of the proposal had been properly assessed, noting that his own research had led him to the view that the negative effects of the proposal on commercial fisheries and the damage to the natural environment, although uncertain and difficult to quantify, could be very large.⁷³⁵ This was attributable not so much to the possible depletion of fish stocks as to the potential loss of MSC certification and the adverse effect this, and any other reputational damage the proposal might cause, would have on the industry's market access and prices.⁷³⁶ He estimated the potential costs to the fisheries industry to be in the range of NZ\$ 270 million to NZ\$ 1.5 billion per year, noting that Maori stood to be directly affected both as guota owners and as part owners of Sealord.⁷³⁷ (Mr Murray suggested during the hearing that these figures were overstated and that the probabilities of each scenario used by Mr Sundakov needed considerably more work).⁷³⁸ Mr Sundakov's view, in short, was that the benefits of the proposal did not outweigh the potential risks to third parties and the environment.739
- 760. Mr Sundakov's concerns about the possible adverse effects of the proposal on the commercial fishing industry were echoed by a number of submitters and witnesses. The Deepwater Group described the proposal as "fundamentally incompatible with the purpose of the Mid Chatham *Rise BPA*⁷⁴⁰ and expressed concern at the possible impact of the proposal in terms of</sup>disruption to Quota Management System incentives, the integrity of New Zealand's BPA network, its shareholders' interests and consumer perceptions of the sustainability of New Zealand seafood.⁷⁴¹

⁷³³ Paragraph 18, Statement of Evidence of Aleksandr Sundakov on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 11 September 2014

⁷³⁴ Paragraph 32, Statement of Evidence of Aleksandr Sundakov on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 11 September 2014

⁷³⁵ Paragraph 10, Statement of Evidence of Aleksandr Sundakov on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 11 September 2014 ⁷³⁶ Paragraph 51, Statement of Evidence of Aleksandr Sundakov on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group

Limited, 11 September 2014

⁷³⁷ Paragraph 87, Statement of Evidence of Aleksandr Sundakov on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 11 September 2014

⁷³⁸ Line 40, page 1140 of the Transcript, 16 October 2014

⁷³⁹ Paragraph 10, Statement of Evidence of Aleksandr Sundakov on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 11 September 2014

⁷⁴⁰ Paragraph 10, Statement of Evidence of Ian Thomas (George) Clement for the Deepwater Group Limited, 12 September

^{2014 &}lt;sup>741</sup> Paragraphs 71 – 80, Statement of Evidence of Ian Thomas (George) Clement for the Deepwater Group Limited, 12 September 2014

- 761. Mr Summerton saw a range of adverse effects in the proposal, including damage to the Chatham Rise ling spawning areas, the effects of sedimentation and risks to customer perceptions of the New Zealand brand.⁷⁴²
- 762. Ngāi Tahu's opening statement asserted that "*the best available information will confirm that CRP's proposal will deliver small and uncertain economic benefits to New Zealand while destroying or putting at risk unique biodiversity, cultural taonga and highly valuable fishing grounds and spawning areas*".⁷⁴³ As against this, it was generally agreed among fisheries experts that the impact of the proposal on commercial fishing would not be as significant as some submitters feared.⁷⁴⁴
- 763. Pre-hearing conferencing did little to narrow the gaps among expert economic witnesses. There was, for example, continued disagreement about the appropriateness of the CGE model and the data used by NZIER. The experts could not agree on an economic value for the lower cadmium content and slower leaching properties claimed for Chatham rock phosphate or whether greenhouse gas emissions would be reduced or increased by changes in shipping patterns arising from the export of Chatham rock phosphate. Similarly, they could not reach an agreed position on the economic consequences of the proposed mining operation on fish stocks or the possible impact on New Zealand's fishing industry in such areas as sustainability certification and market reputation.⁷⁴⁵ (As indicated above, fisheries experts were generally less concerned about the risks posed by the proposal to the commercial fishing industry than industry and individual submitters). The economic experts remained divided on the probability and economic consequences of adverse environmental effects.⁷⁴⁶
- 764. The differences of view noted in the expert conferencing report were not narrowed to any appreciable extent during the hearing. Questions persisted about the data on which the modelling was based, the appropriateness of the CGE model in this situation and NZIER's apparent dismissal of the possible adverse effects of the proposal on existing interests and the environment as being of little or no significance.
- 765. Mr Ngapora, General Manager of Whale Watch Kaikoura Ltd, expressed concern that the proposed mining operation could have an adverse impact on his company, on Kaikoura's tourism industry (estimated to be worth around \$134 million per year in direct benefits to the Kaikoura community) and on Ngāi Tahu's commercial interests.⁷⁴⁷ He advocated a

⁷⁴² Paragraphs 67 – 106 Amended Statement of Evidence of Greg Summerton on behalf of Te Rūnanga o Ngāi Tahu, 29 September 2014

⁷⁴³ Paragraph 1, Opening Representation on behalf of Te Rūnanga o Ngāi Tahu, 25 September 2014

⁷⁴⁴ Issue 4A, Joint Witness Statement in the field of Economics, 18 September 2014

⁷⁴⁵ Issue 4, Joint Statement of Experts in the Field of Economics, 18 September 2014

⁷⁴⁶ Issue 5, Joint Statement of Experts in the Field of Economics, 18 September 2014

⁷⁴⁷ Paragraph 24, Statement of Evidence of Kauahi Koroneho Ngāpora on behalf of Te Rūnanga o Ngāi Tahu, 11 September 2014

precautionary approach to the proposed mining activity in the absence of robust scientific evidence.

- 766. In the course of its stakeholder consultation programme, the applicant had canvassed various possibilities for improving the economic situation of the Chatham Islands community. Consideration had been given to a range of options, including evaluating the possibility of developing a port in the Chatham Islands and supplying unprocessed rock phosphate to local farmers at cost or lower. Finally, it was instead proposed by the applicant that a Chatham Islands Trust be established to which the applicant would contribute \$200,000 per year (inflation adjusted) for farming activities and a further \$80,000 per year for education opportunities and cultural activities. It was also anticipated that the applicant's proposed Environmental Trust would direct funds towards Chatham Islands conservation proposals. In addition, the applicant offered to support local efforts to obtain a share of the government's royalties, stated its commitment to using Chatham Islands input as much as possible and invited further ideas as to ways in which the Chatham Islands could benefit from the proposal.⁷⁴⁸
- 767. In his opening representation on behalf of the Hokotehi Moriori Trust, Mr Solomon asserted that the proposal had the potential to seriously and adversely impact on the Rekohu (Chatham Islands) economy yet provided negligible benefits to Rekohu.⁷⁴⁹ This sentiment was echoed in the statements made on behalf of Ngāti Mutunga at the session of the hearing held in Chatham Islands. The Chair of the Trust spoke of the uncertainty surrounding the impacts of the proposal and commented *"we don't want to be the guinea pigs"*.⁷⁵⁰ Mr Kamo, Chief Executive of the Trust, questioned the reliability of the modelling used in the proposal and, while acknowledging the efforts made by the applicant to try and develop a partnership with the Chatham Islands community, criticised what he termed the "risk to return ratio" now proposed for Chatham Islanders in the following terms: *"What we are concerned about is that the risk that the iwi here, and in fact the community, has been asked to take on, is a risk to its fishery economic base, its cultural base, its Whānau base and its identity. …And we are concerned that (our identity) could be impacted over time to the extent that whilst the economic loss would be devastating, the cultural loss to our identity would be incalculable."⁷⁵¹*
- 768. The representation made by the Chatham Islands Council affirmed that its position was one of neutrality rather than, as had first been indicated, conditional support. It noted that a number of concerns had been raised about the proposal and that the Council would not support it until answers had been received to the questions it had raised, the concerns it had voiced had been

⁷⁴⁸ Lines 28 – 34, page 2163 of the Transcript, 12 November 2014

⁷⁴⁹ Paragraph 4, Opening Representation on behalf of Hokotehi Moriori Trust, 10 November 2014

⁷⁵⁰ Line 45, Page 2171 of the Transcript, 12 November 2014

⁷⁵¹ Line 5, page 2176 of the Transcript, 12 November 2014

satisfied and a commitment had been made to maximise the economic and social benefits to the Chatham Islands.⁷⁵²

11.3. Proposed conditions

769. Economic benefits are difficult to condition, particularly when they are related to taxes and royalties. Proposed Conditions 54 – 56 would establish an Environmental Compensation Trust for those environmental impacts that could not be avoided, remedied or mitigated. Proposed Conditions 57 – 59 would set up a Chatham Islands Trust to support initiatives that benefited the Chatham Islands community, Ngāti Mutunga and Moriori. The applicant's offer of a bond left open a number of questions such as what would trigger the release of the funds and where the payments would go.

11.4. DMC findings

- 770. The DMC accepts that if the applicant's operating cost forecasts and its other assumptions and projections (for example, concerning the company's structure, the mining operation, the international supply and demand situation, the New Zealand market for direct application phosphate fertiliser, global rock phosphate prices and the NZ\$ exchange rate) were borne out and the proposal were to proceed as planned, there would be some positive economic spinoff to New Zealand. The return to the government from taxes and royalties in that situation was estimated by the applicant to be of the order of \$24 million per year.⁷⁵³ There would be some modest employment gains (primarily an estimated 50 crew positions on the mining vessel) and a positive flow-on economic impact on one or more ports, port engineering services and the transportation sector.
- 771. On the proposal's less quantifiable benefits, while it is not possible to put a figure on security of supply and the environmental benefits claimed for Chatham rock phosphate over imported Moroccan phosphate, these factors could well work to New Zealand's advantage. The DMC was assured that Chatham rock phosphate's higher than average uranium content, while it would over time result in higher levels of accumulation in the soil, was not an immediate problem. Chatham rock phosphate's lower than average cadmium content was seen as an advantage, as were the expected slower leaching rates to the extent that Chatham rock phosphate was used in New Zealand as a direct application fertiliser.
- 772. The applicant confirmed to the DMC that, based on the assessments made by various international agencies, it was confident that there would be a significant export market for its

⁷⁵² Submission from Chatham Islands Council and Statement of Evidence of Alfred Preece on behalf of Chatham Islands Council, 12 November 2014 ⁷⁵³ Section 4.1.2 of Appendix C of the ELA Economic Appendix of Chatham Back Dependents - Input to the ELA March 200

⁷⁵³ Section 4.1.2 of Appendix 6 of the EIA, Economic Assessment of Chatham Rock Phosphate – Input to the EIA, March 2014

phosphorite.⁷⁵⁴ The applicant also drew attention to the improved understanding of New Zealand's marine environment that would flow from its further surveys and research⁷⁵⁵ and its offer to establish a trust fund for environmental research.⁷⁵⁶

- 773. The future world price of phosphate was generally agreed to be of critical importance in any assessment of the proposal's economic impact on New Zealand, and yet it was the subject of strong disagreement among the experts. It seemed to be generally agreed that a price of around US\$ 125 per tonne would constitute a break-even point for the proposal. It was suggested by the applicant that long run contract prices would be more important than spot prices in determining the success of the proposal.757
- 774. The DMC heard a good deal of questioning of the use of the CGE model in assessing the wider economic benefits to New Zealand of this kind of proposal. While the DMC is not in a position to make a definitive finding as to the respective merits of the various economic models available for this kind of assessment, it shares the view expressed by some experts that the results produced by the CGE model were overly optimistic.758
- 775. Notwithstanding Dr Mackay's evidence about the potential for using slow release fertiliser on land with a low, short-term requirement for phosphorous, there remains a question about the extent of the future demand in New Zealand for direct application fertiliser (given that the Chatham rock phosphate would be sold at world market prices) as well as about the global supply and demand situation that would prevail in the years ahead.759
- 776. Finally, the DMC was not persuaded that the NZIER analysis took sufficient account of the proposal's possible adverse impact on existing interests, primarily the commercial fishing industry. Certainly, the applicant's proposal attracted widespread criticism and opposition from such groups as the Deepwater Group, Ngãi Tahu and Kaikoura Whale Watch. It might well be the case, as the applicant argued, that the proposal would not deplete commercial fish stocks to any significant extent, would not result in the loss of MSC certification and would not cause reputational damage that would reduce the value of the industry's exports. These risks, however small, do exist, and in our view the possible economic impacts of the proposal in those areas were deserving of more careful analysis by the applicant. Similarly, the consequences for existing interests of the proposal's adverse impacts on the Chatham Rise environment should have been considered more closely. While such uncertainty surrounds these issues, the overall net economic impact of the proposal cannot be predicted with confidence.

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⁷⁵⁴ Paragraph 20, Statement of Evidence of Christopher David Castle for CRP, 28 August 2014

⁷⁵⁵ Paragraph 220, Opening Submissions for CRP, 25 September 2014

⁷⁵⁶ Section 10.5, Marine Consent Application and EIA, May 2014

⁷⁵⁷ Paragraph 4, Supplementary Statement of evidence of Christopher David Castle for CRP, 7 November 2014

⁷⁵⁸ Lines 19 – 21, page 1138 of the Transcript, 16 October 2014

⁷⁵⁹ Statement of Evidence of Dr Alec Donald Mackay for CRP, 28 August 2014

12. Other Matters

777. Section 59(2)(m) of the EEZ Act requires the DMC to take into account any other matter the EPA considers relevant and reasonably necessary to determine the application.

12.1. The Chatham Islands community

- 778. A session of the hearing was held in Chatham Islands and a number of Chatham Islanders expressed their views in submissions or in representations. The applicant recognised that *"Chatham Islanders have a direct connection to the Chatham Rise and the activities that occur there"*.⁷⁶⁰ The applicant proposed a specific condition establishing a Trust Fund for Chatham Islanders and the Chatham Islands community.
- 779. The views of Ngati Mutunga and the Hokotehi Moriori Trust on the application, in both cases opposed, are described elsewhere in this report. Mr Kamo, CEO of the Ngati Mutunga Trust, commented as follows: *"I'm also wanting to make it clear to the DMC that the idea that nothing should happen in case something bad happens, is generally not the view that's here on the island, the island is well aware that economic development is vital to itself. But it is the level of reassurances required that is currently not being met in the proposal in front of the community at this stage." ⁷⁶¹*
- 780. Individual Chatham Islanders expressed opposition to the proposal. In addition to general concerns about the effects of mining on the Chatham Rise seabed and wider environment, submitters were worried about the risks a mining operation posed for their commercial fishing industries (including paua and rock lobster) and customary fishing activities; the undermining of cultural values and tikanga; the risks and uncertainties surrounding various aspects of the proposal; the likely adverse effects on seabirds and marine mammals; the proposal's perceived incompatibility with the Mid Chatham Rise BPA and Rohe Moana; and ongoing uncertainty as to how, if at all, the Chatham Islands would benefit from the activity.
- 781. In its prepared statement, the Chatham Islands Council commented "The Chatham Islands has a rich fishing industry, however there has been a history of significant exploitation of this resource with very little reinvested in the community. Fishing today remains the mainstay of the island economy."⁷⁶²

⁷⁶⁰ Page 14, Marine Consent Application and EIA Non-technical Summary, May 2014

⁷⁶¹ Line 20 – 25, page 2173 of the Transcript, 12 November 2014

⁷⁶² Paragraph 10, Statement of Evidence of Alfred Preece on behalf of the Chatham Islands Council, 12th November 2014

- 782. The Chatham Islands Council's submission went on to say that the Council needed more information about the likely impact of the proposal and had a number of concerns which would have to be addressed before it could support the application. It accordingly took a neutral position on the proposal. In its words: *"The Councils submission listed a number of concerns which will have to be addressed before it can support this application with the most important being protecting the fishing resource, the marine ecosystem and the economic and social benefit to the Chatham Islands community"*.⁷⁶³
- 783. The following comments convey something of the flavour of the views expressed to the DMC by individual Chatham Island submitters:

"...my main concern, was who is going to pay for it if it stuffs up, and I would like to have a name, somebody to sign a piece of paper saying if there is a problem on the Chatham Islands, we lose our fishery, somebody else is paying for it, not us, because we pay every time." ⁷⁶⁴

"...there is no compensation package offered should there be decimation of the marine environment and the destruction of the Chatham Islands fisheries. No amount of research predictions of what could happen can generate what actually happens The compensation package must cover total loss in its entirety."⁷⁶⁵

12.1.1. Conditions

784. Proposed Conditions 57 – 59 would establish a Chatham Islands Trust in order to support initiatives designed to benefit the Chatham Islands and Chatham Islands community. The Trust would administer \$280,000 per annum (annually adjusted for inflation). Proposed Condition 59 set reasonably clear parameters for the Trust: \$200,000 to fund maintenance and enhancement of farming activities and enhancement of economic development opportunities, while \$80,000 (minus the cost of administering the Trust) to support education opportunities and cultural development initiatives. The DMC understands from Ms Taylor the Chatham Island's Trust evolved out of a commitment made by Chatham Rock as a result of consultation and was not directly linked to any environmental impact.⁷⁶⁶

⁷⁶³ Paragraph 11, Statement of Evidence of Alfred Preece on behalf of the Chatham Islands Council, 12th November 2014

 $^{^{764}}$ Line 34 – 38, page 2199 of the Transcript, 12 November 2014 765 Line 38 – 45, page 2204 of the Transcript, 12 November 2014

⁷⁶⁶ Lines 39 – 42, page 2386 of the Transcript, 18 November 2014

12.1.2. **DMC findings**

785. The DMC acknowledges the importance attached by members of the Chatham Islands community to activities on the Chatham Rise that might affect their livelihood. Most of these concerns are addressed elsewhere in the decision, where the DMC has discussed the risks to the Chatham Rise marine environment and the proposal's potential impact on the commercial fishing industry, the Mid Chatham Rise BPA and the Chatham Rise Rohe Moana. On the basis of the evidence and testimony it heard, the DMC did not find it possible to establish with any certainty just what additional adverse effects the mining project would have had on the interests of the Chatham Islands community. In the particular circumstances of this application, the Chatham Islands community's concerns did not materially influence the DMC's decision. It was not however surprising to the DMC that members and representatives of the Chatham Island community wanted more certain information about the project and did not appreciate being asked to accept the risks it involved, however low, without their consent. It is unfortunate that the differences between the applicant and the Chatham Islands community were not narrowed or resolved through the consultation process at an earlier stage.

12.2. Cultural issues

786. The DMC considered that it should take account of the cultural values and interests of Māori and Moriori. It was encouraged in this by the statement of the applicant that "*CRP recognises* the important spiritual and cultural connection that Māori and Moriori have with their physical environment, and their role as kaitiaki (guardians)."⁷⁶⁷

12.2.1. Report of Ngā Kaihautū Tikanga Taiao

- 787. The EEZ Act provides (under Section 12) for the EPA to receive advice on marine consent applications from its Māori Advisory Committee, Ngā Kaihautū Tikanga Taiao (Ngā Kaihautū) "so that decisions made under this Act may be informed by a Māori perspective". The report was provided in accordance with Section 44 of the EEZ Act. Section 59(3)(c) of the Act requires the DMC to have regard to any advice received from the Māori Advisory Committee.
- 788. Ngā Kaihautū's report on the proposal⁷⁶⁸ gave a comprehensive and informative account of the Māori world view (paradigm), the nature of Māori environmental perspectives and the potential effects of the proposal on Māori interests and values. It described the values that underpin customary and contemporary practice and the principles underpinning Rangatiratanga (selfdetermination) and Kaitiakitanga (sustainable management). It emphasised that the exercise of

⁷⁶⁷ Section 9.3, Marine Consent Application and EIA, May 2014

⁷⁶⁸ Ngā Kaihautū Tikanga Taiao Report — Application from CRP for marine consent to undertake the mining of phosphate nodules in the Chatham Rise, August 2014

these practices is intrinsically tied to Whakapapa (genealogy) and Matauranga Māori (knowledge), which are the foundation stones for the sustainable management of Te Taiao (the environment) and which regulate the interaction of Māori with both the land (Mana Whenua) and the sea (Mana Moana).

- 789. Ngā Kaihautū commented: "Rangatiratanga is linked to the principle of active protection and recognises the rights of Māori to self-determination inherent in both the English and Māori translations of the Treaty of Waitangi (Te Tiriti o Waitangi). The Tribunal has noted in the Ngawha Geothermal Resources Report (1993), that Māori should be protected from the actions of others that impinge on their Rangatiratanga by adversely affecting their continued use or enjoyment of their resources, whether in physical or spiritual terms".⁷⁶⁹
- 790. Ngā Kaihautū registered its ongoing concern at the difficulties faced by Māori in participating fully in the current regulatory regime for applications of this nature. It drew attention to tensions between the Māori view of the environment and the Western approach to development and stressed the importance of observing the principles of the Treaty of Waitangi in considering marine consent applications. It asked that special consideration be given to the principle of active protection and to the impact of the proposed activity on the cultural values of Māori.
- 791. On the implications of the proposal for the environment, Ngā Kaihautū expressed concern at the damage that would be caused to the benthic habitat of the Chatham Rise and the likely effects of increased sedimentation on the wider marine environment. It noted the information gaps and uncertainties surrounding many of the impact assessments, including on marine mammals.
- 792. On the economic impact of the application on Māori, Ngā Kaihautū rehearsed the concerns expressed by a number of submitters on the potential adverse effects of the proposal in the areas of fisheries and eco-tourism. It considered that the economic benefits of the proposal had been overstated and the environmental costs not properly accounted for.

12.2.2. Other parties

793. The applicant contended that cultural concerns, which do not qualify as an existing interest, should not be given undue weight in the decision-making process.⁷⁷⁰ Mr Winchester went on to assert that while social or cultural considerations may be relevant, they deserved less weight except to the extent that they may be captured in defined terms such as existing interest.⁷⁷¹

⁷⁶⁹ Paragraph 11, Ngā Kaihautū Tikanga Taiao Report, 2014

⁷⁷⁰ Paragraph 107, Closing Legal Submissions for CRP, 19 November 2014

⁷⁷¹ Paragraph 56, Closing Legal Submissions for CRP, 19 November 2014

- 794. The DMC accepts that the EEZ Act definition of an existing interest is constrained as outlined in the legal memorandum to the DMC.⁷⁷² However Section 59(2)(m) of the EEZ Act allows the DMC to consider cultural matters if it considers them relevant and reasonably necessary in its determination of the application.
- 795. A feature of the testimony of several Māori quota holders was their strong concern about the impact of the proposal on tikanga and a range of cultural beliefs, interests and values. This was a recurrent theme in the report of the Ngā Kaihautū. It also came through strongly in the eloquent testimony of Mrs Tuuta of Ngāti Mutunga, who stated *"It is of great concern that the mana of my whakapapa has been put at risk by the application of Chatham Rock Phosphate Ltd..... and I have opposed the application."*⁷⁷³
- 796. Similarly strong concern about the impact of the proposal on cultural values and tikanga was expressed by Mr Summerton, a third generation commercial fisher from Ngāi Tahu. He commented *"There will be irreversible impacts on our business, on our values as Kaitiaki, and on the business of our iwi, on our development right, and rights of our iwi, if the application is granted."*⁷⁷⁴
- 797. A lively discussion took place during the hearing as to whether, and if so to what extent, cultural beliefs, values and interests should be taken into account in consideration of the application.
- 798. The applicant took the view⁷⁷⁵ that while cultural matters might be relevant under Section 59(2)(m) as "any other matter that the EPA considers relevant and reasonably necessary to determine the application", they were not an existing interest under paragraph (a) of the Act's definition. In support of this approach, the applicant's counsel noted that the definition of sustainable management in the EEZ (in contrast to that in the Resource Management Act) did not include social or cultural wellbeing and that purely cultural interests fell outside the definition of "*existing interests*" because they could not be considered an activity.⁷⁷⁶ Mr Winchester went on to caution against any double counting of effects.
- 799. At the same time, the applicant did acknowledge the right of interested parties to assert a cultural interest:
 - it accepted that Ngāi Tahu was a special case
 - it noted that it had actively engaged with iwi on the impact of its proposal, including on cultural interests

⁷⁷² Memorandum of Counsel to assist the Decision-making Committee, 12 November 2014

⁷⁷³ Lines 26 – 29, page 1331 of the Transcript, 20 October 2014

⁷⁷⁴ Para 105 Amended Statement of Evidence of Mr Greg Summerton, on behalf of Te Runanga o Ngāi Tahu 29 Sept 2014

⁷⁷⁵ Paragraph 77, Opening Submissions for CRP, 25 September 2014

⁷⁷⁶ Paragraph 78, Opening Submissions for CRP, 25 September 2014

- it cited instances where it had adjusted its application to take those interests into account, and
- it observed that provision had been made for cultural interests to be brought to bear through its proposed Environmental Reference Group, Chatham Islands Trust and Environmental Compensation Trust.⁷⁷⁷
- 800. The applicant in its closing statement considered that it had addressed the cultural concerns associated with the fossilised whale bones by reducing the marine consent area and including any remaining identified areas within mining exclusion areas. The applicant indicated its preparedness to enable cultural interests to be brought to bear on an ongoing basis through its proposed Environmental Reference Group, its Chatham Islands Trust, and the Environmental Compensation Trust.⁷⁷⁸
- 801. On the other hand, a number of submitters argued that their cultural interests were directly relevant to the application whether or not an "*activity*" could be shown to have taken place. For example, Ngāti Mutunga registered its concerns at the impact of the proposal on its cultural values and identity.⁷⁷⁹
- 802. Counsel for Ngāi Tahu criticised the applicant for failing to take sufficient account of the social and cultural impacts of the proposal on Māori and for its lack of attention to Māori values more generally.⁷⁸⁰ He maintained that the mainstream cultural values and rights woven into the settlement of Ngāi Tahu's historical claim were clearly existing interests under the relevant provisions of the EEZ Act. This was also the approach of Ms Bartlett, an expert witness called by Ngāi Tahu, who stressed the significance of Ngāi Tahu's kaitiakitanga role in protecting mauri and its duty to pass the environment on to future generations in a good state. ⁷⁸¹
- 803. Speaking for the Hokotehi Moriori Trust, Mr Solomon commented "The application fails to give effect to the principles of the Treaty of Waitangi in Section 12 of the Act in the following respects; it fails to actively protect Moriori taonga tuku iho; fails to provide for Moriori tchieki, and tchieki is the Moriori dialect for Kaitiaki, responsibilities within our Rohe Moana, and thirdly, fails to provide for the expression of Moriori Rangatiratanga within our Rohe Moana".⁷⁸²

⁷⁷⁷ Paragraph 88 – 89, Opening Submissions for CRP, 25 September 2014

⁷⁷⁸ Paragraph 106, Closing Submissions for CRP, 19 November 2014

⁷⁷⁹ Section 5.3, Ngāti Mutunga o Wharekauri Iwi Trust submission, Submission 110139, July 2014

⁷⁸⁰ Paragraphs 16 – 17, Opening Representation on behalf of Te Rūnanga o Ngāi Tahu, 25 September 2014

⁷⁸¹ Paragraph 62, Statement of Evidence of Deborah Maria Bartlett on behalf of Te Rūnanga o Ngāi Tahu, 12 September 2014

⁷⁸² Lines 5 – 10, page 2110 of the Transcript, 10 November 2014

- 804. In a paper circulated to parties to the hearing on 12 November 2014 counsel assisting the DMC outlined a view on various aspects of the question as to whether cultural values should be taken into account as interests in lawfully established existing activities in this application.⁷⁸³
- 805. After commenting on the complexity of the issue, the paper noted that there was no significant disagreement over whether relevant cultural values could in principle be taken into account under paragraphs (d) and (e) of the Act's definition of existing interests (ie historical and contemporary claim settlements under the Treaty of Waitangi Act 1975).
- 806. On the disagreement over cultural values arising in relation to a fishing activity, ie under paragraph (a) of the Act's definition, the paper concluded that the term 'interests' ought to be read more broadly than had been suggested by the applicant and that an overlap of commercial and cultural interests should not in principle preclude consideration being given to both. It added however that special care needed to be taken in assessing the two different effects in such an overlap situation.
- 807. On cultural interests outside the exercise of kaitiakitanga, the paper suggested that the crux of the issue was the level of engagement or involvement required in order for there to be an existing activity within the meaning of the EEZ Act. It noted that Section 10 of the EEZ Act and its definition of environment was notably less broad than their counterparts in the Resource Management Act but suggested that it would not be inconsistent with the purpose of the Act to allow effects of a purely cultural nature to be taken into account.

12.2.3. DMC findings

- 808. The DMC heard from a number of submitters and from Ngā Kaihautū that the proposal was seen as having an adverse impact on the cultural interests and values of iwi and imi. There is no specific guidance in the EEZ Act as to just how adverse effects of this nature should be assessed and weighed in the consideration of marine consent applications.
- 809. The DMC accepts that the impact of this proposal on the cultural and spiritual values and sense of identity of iwi and imi is a matter of concern and importance to a number of individuals and groups with a direct interest in the application and that it is a matter that the DMC needed to take into account as relevant and reasonably necessary in terms of Section 59(2)(m) of the EEZ Act. While the DMC does not see these matters as determinative in the decision, it does wish to recognise the importance attached to these effects by a large number of submitters and witnesses.

⁷⁸³ Memorandum of Counsel to assist the Decision-making Committee, 12 November 2014

13. The Decision Path

13.1. Information principles

- 810. Section 61 (1) of the EEZ Act requires the DMC to:
 - (a) make full use of its powers to request information from the applicant, obtain advice, and commission a review or report; and
 - (b) base decisions on the best available information; and
 - (c) take into account any uncertainty or inadequacy in the information available.

13.1.1. Full use of powers

811. On the requirement in Section 61(1)(a), the DMC initially had available to it the application itself and six lodgement reports commissioned by the EPA. Requests were then made to the applicant for additional information covering 61 items. All these requests were met. Nine expert reports and an analysis of submissions were commissioned; five reports were sought and obtained from agencies with marine management regime responsibilities; reports on the application were received from EPA staff and Ngā Kaihautū; and joint witness reports were received on the twelve expert conferences and a pre-hearing meeting on Existing Interests arranged by the DMC. Further information was sought and obtained in the course of the hearing, including by extensive questioning of the applicant and other parties and submitters, and by requesting advice from the DMC's legal counsel on aspects of the application and the hearing. The DMC considers that it made full use of its powers to obtain the necessary information and advice on the application.

13.1.2. Best available information

- 812. "Best available information" is defined in Section 61(5) of the Act as "the best information that, in the particular circumstances, is available without unreasonable cost, effort, or time."
- 813. There will always be questions as to how much information could or should have been provided by the applicant in support of a proposal of this kind. There are some areas where it would have been helpful to the DMC to have additional data or earlier access to information provided after the initial application was lodged. This was particularly the case for the area beyond MPL 55549. Bearing in mind the current state of scientific knowledge about the Chatham Rise, the expense involved in conducting surveys in the open sea and the fact that much of the modelling could not be validated *in situ* until mining commenced, however, the DMC is satisfied that the information it received met the definition in the EEZ Act of "*best available information*" in respect of the whole marine consent application area.

- 814. The applicant was also of the view that the information before the DMC was "*best available information*" as defined by the Act.⁷⁸⁴ Mr Winchester noted in his closing statement that there were some areas where witnesses had suggested further information should have been obtained, citing marine mammals is an example. He considered that no further information needed to be gathered at this stage given the absence of risks associated with the subject matter and confirmed that additional data would in any case be gathered at both the pre-mining stage and after mining commenced. Mr Winchester submitted that there was no barrier based on a material inadequacy of information that would prevent the DMC from granting consent.⁷⁸⁵
- 815. The applicant offered to obtain any further information required by the DMC and affirmed that it would support any necessary extension of the decision-making time frame to that end. After examining the material and information before it following the adjournment of the hearing however, the DMC concluded that no further material was required in order for it to determine the outcome of the application, neither would any information that could be made available without unreasonable cost, effort or time materially alter that assessment.

13.1.3. Uncertainty or inadequacy of information

- 816. On the certainty and adequacy of the available information (Section 61 (1) (c)), many submitters and participants in the hearing were of the view that the baseline information provided by the applicant was both uncertain and inadequate and that a considerable amount of additional information was needed about the likely effects of the proposal on both the environment and existing interests.
- 817. Concerns about the uncertainty and inadequacy of information were registered in a number of expert conferencing reports.
 - a) Although it was generally agreed that there was sufficient information to inform decision-making on the mining permit area, the benthic ecology and spatial planning group referred to substantial gaps in knowledge of the hyperbenthic communities on the Chatham Rise, uncertainty about the full degree of biodiversity and missing information about the role of benthic communities in the ecosystem.⁷⁸⁶
 - b) The same report made several references to the uncertainty of information on the impact of mining on benthic communities, the insufficiency of information on changes to the sediment regime and the need to validate sediment plume modelling *in situ*.

⁷⁸⁴ Lines 36 – 39, page 2524 of the Transcript, 19 November 2014

⁷⁸⁵ Lines 40 – 5, pages 2524 – 5 of the Transcript, 19 November 2014

⁷⁸⁶ Issue 2, Joint Witness Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 27 September 2014

- c) The report on commercial fishing⁷⁸⁷ referred to a lack of information on which to base conclusions and the need to obtain better information on such matters as the seasonal distribution and spawning of fish species. That report also drew attention to the need for further work on proposed conditions and the adaptive management plan.
- d) The economics group⁷⁸⁸ noted that the experts had not been able to agree on the sufficiency of evidence to reliably quantify the probability of the indirect impacts of mining on commercial fishing.
- e) Experts on ecosystem effects⁷⁸⁹ reached agreement on a number of issues but noted that the information on habitat effect did not cover all species and that there was a lack of survey data on densities of seabirds and whales on the Chatham Rise.
- f) The joint expert witness statements on impacts on fish⁷⁹⁰ and radioactivity⁷⁹¹ drew attention to information limitations and uncertainties and called for further sampling and research.
- g) Experts on rock lobsters⁷⁹² spoke of the need to ground-truth the sediment plume modeling and a lack of information on larval transport and biophysical processes in the water column.
- h) The seabirds conference report⁷⁹³ referred to imperfect data quality and gaps in the available information.
- Similar references to uncertainty and the need for more information were made in the reports of the expert groups on sediment modelling⁷⁹⁴ and toxicology and water quality.⁷⁹⁵
- 818. Criticisms relating to the uncertainty and inadequacy of information on the application were particularly strong in respect of the broader marine consent area, where fewer surveys had

⁷⁸⁷ Issue 1, Joint Witness Statement of Experts in the Field of Commercial Fishing, 19 September 2014

⁷⁸⁸ Issue 4B, Joint Witness Statement of Experts in the Field of Economics, 18 September 2014

⁷⁸⁹ Joint Witness Statement of Experts in the Ecosystem Effects, 17 September 2014

⁷⁹⁰ Joint Witness Statement of Experts in the Field of Impacts on Fish, 18 September 2014

⁷⁹¹ Joint Witness Statement of Experts in the Field of Radioactivity, 16 September 2014

⁷⁹² Issue 1 – 2, Joint Witness Statement of Experts in the Field of Rock Lobsters, 16 September 2014

⁷⁹³ Joint Witness Statement of Experts in the Field of Seabirds, 29 September 2014

⁷⁹⁴ Joint Witness Statement of Experts in the Field of Sediment Monitoring, 26 September 2014

⁷⁹⁵ Joint Witness Statement of Experts in the Field of Toxicology and Water Quality, 19 September 2014

been conducted, less data was available, no mining plan had been provided and the economic analysis extended to only the first 15 years of mining.

- 819. There was also criticism from submitters that not enough was known about the applicant's company structure (although Boskalis and the applicant expressed confidence that they would be partners in the proposal, no contract had been signed by the conclusion of the hearing); that the technology and equipment planned to be used in the proposal was unproven at the depths envisaged and in the conditions of the Chatham Rise; that too much reliance was being placed on modelling (for example, of the spread and effects of the sediment plume) which had not been validated or ground-truthed in the proposed mining area; that the economic benefits claimed for the proposal were at best arguable; that it had not been shown that the proposed recolonisation experiments in the mined areas were likely to succeed; and that insufficient research had been done into the possible effects of the proposal on the benthic environment and wider marine environment.
- 820. In response, the applicant argued that a significant amount of research had been carried out on the Chatham Rise over a number of years; that it had commissioned a range of expert reports on various aspects of the proposal; and that the expert conferencing reports indicated that the information placed before the DMC constituted an adequate basis on which to make a decision.
- The initial EPA staff report identified a number of gaps and uncertainties in the information 821. provided as at early August 2014 by the applicant.⁷⁹⁶ A supplementary staff report completed in October confirmed that a number of the concerns expressed in the initial report had been eased or removed by the provision of additional information and evidence, including many of the expert conferencing reports. It noted however, that "some uncertainty remains with respect to some of the potential effects on the environment and existing interests from CRP's proposed mining activities¹⁷⁹⁷. It also identified a number of specific areas in which there was a continuing lack of baseline information or a lack of certainty about the potential effects of the proposed activities.798
- 822. The report tabled by the EPA's Ngā Kaihautū⁷⁹⁹ commented that an underlying issue was "...the uncertainty created due to a lack of detailed information regarding the existing environment, the mining approach, contaminants and mining debris, adaptive management, monitoring processes and the environmental impacts of the mining activity on commercial fish species". The report stated that this concern was shared by key affected communities and industry groups.

⁷⁹⁶ EPA Staff Report – Chatham Rock Phosphate Limited Marine Consent Application, August 2014

 ⁷⁹⁷ Paragraph 4.1.15, Supplementary EPA Staff Report, 22 October 2014
 ⁷⁹⁸ Paragraph 4.1.17, Supplementary EPA Staff Report, 22 October 2014

⁷⁹⁹ Paragraph 31, Ngā Kaihautū Tikanga Taiao Report, 2014

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13.1.4. **DMC Comment**

- 823. The DMC recognises that considerable efforts were made by the applicant to provide the necessary baseline information on the marine environment in the consent area and to commission expert modelling and analysis in support of the application. However it is incontestably the case that there remained significant gaps in the data and information provided about the consent area's marine environment as well as uncertainty about the impact of the proposal on existing interests and the environment. This was particularly the case with regard to the wider consent area, where much less information had been assembled by the applicant. As already noted above, the applicant was proposing to collect additional baseline information prior to mining commencing and after the consent was granted.
- 824. The DMC interprets the wording of the legislation to mean that a complete understanding of the environment and absolute certainty about the risks posed by the proposal are not a prerequisite to the granting of a consent. On the other hand, scientific knowledge of the Chatham Rise ecosystem is manifestly incomplete and the DMC does need to have sufficient, and sufficiently certain, information to identify and evaluate the risks involved in a proposal such as this. A good level of baseline information is also necessary in determining the standards, limits, thresholds and triggers for any proposed conditions or adaptive management framework applied to a consent.
- 825. Of particular concern to the DMC are the uncertainties associated with modelling that could not be empirically and *in situ* validated before the commencement of mining, for example in respect of the nature, spread and impact of sedimentation caused by the return to the seabed of waste material (although the DMC acknowledges some internal model validation has occurred). As indicated above, there was a large measure of agreement among experts in a range of fields that more, and more certain, information was needed on which to base assessments of the impact of the proposal on the environment and existing interests, which the DMC found persuasive.
- 826. The DMC's overall conclusion is that the information made available to it on the application, while it met the EEZ Act's definition of best available, was uncertain and in some areas inadequate. The DMC did not take up the offer made by the applicant in its closing statement to provide more information because it judged that the kind of additional information that would have been useful (for example, from further surveys to obtain better baseline information and from model validation tests) could not have been obtained at reasonable cost, effort and time.

827. To favour caution and environment protection would in this case mean that the proposal would be likely to be refused consent. The DMC was therefore required to consider whether taking an adaptive management approach would allow the proposal to proceed. This is addressed in the following chapter.
14. Adaptive Management

14.1. Adaptive management

828. Section 61(3) of the EEZ Act directs that if favouring caution and environmental protection (as directed under Section 61(2) of the Act) means that consent is likely to be refused, then the option of adaptive management must first be contemplated.

829. Adaptive management is defined in Section 64 of the Act 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.
- 830. Further direction is given regarding the imposition of proposed conditions relating to the staging of activities, including the scale, intensity and nature of the activity as well as duration.
- 831. Mr Winchester noted⁸⁰⁰ in his opening legal submissions for the applicant that an adaptive management approach was proposed not because the application raised such uncertainty but because such an approach is a relatively common resource management tool for complex and lengthy proposals, characterised⁸⁰¹ in terms of "*learning by doing*", similar to Ms Rickard's⁸⁰² "*learning as you go*". Mr Winchester submitted⁸⁰³ that lack of detail should not be confused with lack of certainty, and that more detail would not necessarily clarify matters, suggesting that the lens of risk and risk management provided a more appropriate focus. While the DMC maintain that uncertainty has to be addressed, it agrees that adaptive management is a common approach.
- 832. The DMC also agrees that adaptive management is not constrained by Section 61(3). As Mr Winchester noted,⁸⁰⁴ the two examples provided under that section are not exclusive and therefore other approaches to managing risk are available.
- 833. Given the apparent similarities with resource management it was perhaps not surprising that many parties cited and encouraged the DMC to adopt and adhere strictly to the now familiar findings of the Supreme Court in *Sustain Our Sounds v NZ King Salmon* in which King Salmon had proposed three inter-related adaptive management approaches involving staged

⁸⁰⁰ Paragraph 241, Opening Submissions for CRP, 25 September 2014

⁸⁰¹ Paragraph 128, Closing Legal Submissions for CRP, 19 November 2014

⁸⁰² Paragraph 32, Statement of Evidence of Andrea Judith Rickard on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 5 September 2014

⁸⁰³ Paragraph 48, Opening Submissions for CRP, 25 September 2014

⁸⁰⁴ Paragraph 242, Opening Submissions for CRP, 25 September 2014

development, a tiered approach to monitoring, and on-going adaptive management. In that case, and under the Resource Management Act 1991 and its various layers of planning documents, the Court considered whether taking a precautionary approach would preclude adaptive management, and held that this depended on assessing a combination of factors, which it stated as⁸⁰⁵:

- (a) the extent of the environmental risk (including the gravity of the consequences if the risk is realised);
- (b) the importance of the activity (which could in some circumstances be an activity it is hoped would protect the environment);
- (c) the degree of uncertainty; and
- (d) the extent to which an adaptive management approach would sufficiently diminish the risk and the uncertainty.
- 834. In relation to item (d), which it described as the "*vital part of the test*", the Court accepted the Board of Inquiry's finding that there were four factors appropriate to consider when making the assessment, being:⁸⁰⁶
 - (a) there would 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; and
 - (d) effects that might arise can be remedied before they become irreversible.
- 835. Under the EEZ Act the test is arguably dissimilar. It seems evident from the wording of Section 61(3) that an adaptive management approach is not inherently inconsistent with favouring caution and environmental protection, and therefore the particular threshold question addressed by the Court in *King Salmon* may be unnecessary.
- 836. That does not, however, in the DMC's view call into question the Court's findings on the broader question of adaptive management, and effectively, what constitutes good practice. In that regard the DMC finds both the four factors stated by the Court and the further four risk and uncertainty factors adopted from the Board of Inquiry as both appropriate and helpful to its inquiry.

⁸⁰⁵ SC 84/2013 [2014] NZSC 40 At [129].

⁸⁰⁶ SC 84/2013 [2014] NZSC 40 At [133].

- 837. Mr Currie, for KASM, Greenpeace and DSCC, submitted⁸⁰⁷ that the DMC could not apply adaptive management conditions in the hope that these would ameliorate problems in time; problems that are currently on the table rather than those that may arise and are not presently identified. While the DMC generally agrees with the import of that proposition, it does not hold necessarily in all circumstances. That essentially, is why staging is a reasonably fundamental aspect of adaptive management. It recognises that certain effects may arise and be addressed at a future time; and puts in place objectives, thresholds, responses, triggers, limits, standards, restart parameters, and so on, precisely to allow that decision point to be deferred to a future time but within the ambit of the consent granted.
- 838. In closing submissions a number of counsel⁸⁰⁸ addressed the overlap between precaution and caution as those matters relate to adaptive management. Without needing to rehearse their particular submissions, it is sufficient to record that all agreed whatever line might be drawn between the two concepts had little practical import, and, for all intents and purposes, the DMC might (and, the DMC understood, should) read those constructs interchangeably. Mr Prebble, for example, referred the DMC to relevant sections of various reports, advice and speeches provided during the passage of the EEZ Bill and concluded⁸⁰⁹ *"Given the adoption of the precautionary approach under both the RMA and the Fisheries Act 1996 and the parallels between both of those and the EEZ Act, as well as the parliamentary debate, it seems a reasonable conclusion that favouring caution and environmental protection effectively amounts to incorporation of the precautionary approach into the EEZ Act."*
- 839. While Mr Winchester also addressed this question, the DMC did not understand him to take a materially different view.
- 840. Mr Anderson submitted in closing that before an adaptive management approach can be adopted it is necessary that the adverse effects are identified and can be remedied, and certainly before they might become irreversible. Furthermore he contended⁸¹⁰ that there needed to be sufficient certainty that unanticipated effects can be managed when they arise, although it is in the nature of unanticipated effects that the effects are not certain.
- 841. The DMC notes that in *King Salmon* the Court referred (paragraph 114) to a line of Environment Court decisions involving adaptive management observing that *"The Court said that it should not put an applicant in a position of anticipating and researching all hypotheses before making*

⁸⁰⁷ Paragraph 77, Opening Submissions by KASM, Greenpeace and DSCC, 26 September 2014

⁸⁰⁸ Mr Currie; Ms Appleyard, Mr Anderson and Mr Prebble

⁸⁰⁹ Paragraph 66, Crown's Closing Submissions, 18 November 2014 (note the submission states 18 October 2014)

⁸¹⁰ Paragraph 34, Closing Submissions on behalf of the Royal Forest and Bird Protection Society of New Zealand Incorporated, 18 November 2013

an application."

- 842. The Court noted that the issue of sufficiently diminishing risk and uncertainty (about which Mr Winchester made a particular point in both opening and closing) depends on the extent to which risk and uncertainty remains and the gravity of the consequences if the risk is realised. Mr Winchester repeatedly stressed⁸¹¹ that context is important and the lens of risk management is the proper tool.
- 843. Finally the DMC notes that the Court did not, in our understanding, propose that its approach was intended to cover all instances where an adaptive management approach might be under consideration. The Court explicitly qualified its findings with the phrase "*at least in this case*". ⁸¹² In that regard the DMC is mindful of the fact that the proposed activity is intended in the open ocean, at depth and in an environment about which there exists significant uncertainty of knowledge and consequence.
- 844. Ms Rickard made similar observations in her supplementary evidence,⁸¹³ acknowledging that uncertainty is not, by that fact alone, "*bad*" and that sustainable management requires provision for innovation and new practice. The critical issue for her in adaptive management, on which there was no evident disagreement, is clear objectives and the progressive circularity of the feedback loop process.⁸¹⁴
- 845. The DMC accepts the argument that the issue is not about uncertainty *per se* but about what is an acceptable and appropriate level of risk in the gap between certainty and uncertainty. That gap is never likely to close entirely for a proposal of this scale in the environment in which it is proposed. Closing the gap to an acceptable risk-tolerance point is, however, critical to the granting of consent under the EEZ Act.
- 846. In line with that reasoning, the DMC considers that steps to establish empirically the predictions made and conclusions drawn from the various modelling exercises undertaken by the applicant are a legitimate part of an adaptive management approach. Indeed, this is clearly intended by Section 63 of the EEZ Act.
- 847. The DMC therefore considered whether a three-stage adaptive management approach,
 incorporating a data gathering stage ahead of actual mining by way of a condition precedent,
 would be practicable. In other words, as part of an adaptive management proposed consent

⁸¹¹ For example, paragraph 25, Closing Legal Submissions for CRP, 19 November 2014

⁸¹² For example, in paragraph 133 of that decision

⁸¹³ Paragraph 15, Supplementary Statement of Evidence of Andrea Judith Rickard on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 16 November 2014

⁸¹⁴ Paragraph 37, Statement of Evidence of Andrea Judith Rickard on behalf of Te Rūnanga o Ngāi Tahu and Deepwater Group Limited, 5 September 2014

condition, imposing a requirement to collect sufficient field data to confirm the habitat predictions that emerge from the Zonation spatial planning model prior to any operational mining. This would be required in order to demonstrate the existence beyond the mining application area of significant comparable stony coral-dependent benthic communities in sufficient abundance and density, presumably unaffected by recent trawling or dredging activities, such that the loss of those same communities through mining might be said to be acceptable.

- 848. The reason this would constitute a no-mining stage is because it seems to the DMC unwise to allow benthic destruction while the communities in question are considered potentially unique. If this were disproven, a trial mining stage to validate the plume model (in terms of direction, decay, sedimentation and suspended sediment characteristics) over a three block, one-year period (for example) could be authorised. Only then, and provided any adjustments to the modelling arising from those results concluded that the adverse effects were the same as or less than the current predictions, would full operational mining be permitted. The first two stages would therefore each contain a go / no-go trigger, which could effectively terminate the consent if the field evidence is sufficiently contrary to prediction.
- 849. In passing, the DMC notes that information gained from stage one of the above option would also likely be of considerable assistance to the Director-General of Conservation in determining CRP's application under the Wildlife Act 1953 for permission to destroy a Schedule 7A animal, being Cnidaria / Anthozoa (corals and sea anemones) / Stony corals, all species in the order Scleractinia.
- 850. Towards the end of the hearing, the DMC invited parties to the application to comment on a staged approach as outlined in Section 64 of the EEZ Act. In his closing statement, legal counsel for the applicant stated in relation to a staged approach or trial run: "given the economics of this project, is simply never going to fly for the applicant because the upfront investment is too great to take a risk of a trial run and the quid pro quo of that, in terms of Chatham Rock's view of the evidence, is that a trial run isn't necessary based on risks and effects".⁸¹⁵
- 851. The DMC also invited parties to the application to comment on the option of a partial approval as provided for in Section 62 of the EEZ Act, noting that considerably more information and evidence had been received on the proposed activities in mining area MPL 55549 than for mining in the wider consent application area. The applicant responded "*that is obviously not Chatham Rock's preference but it would take the view that a consent which enabled it to mine*

⁸¹⁵ Line 45, page 2594 of the Transcript, 19 November 2014

and do so in accordance with at least its current business plan is better than none."⁸¹⁶ Parties opposing the application were resistant to the idea of even a partial approval.

14.2. DMC Findings

- 852. The DMC finds that an adaptive management approach would not resolve the primary question of the adverse effect on the benthic environment without considerable pre-mining research and model validation *in situ*, which the applicant informed the DMC was not a viable option.
- 853. The DMC gave careful consideration to the option of partial approval. Its conclusion is that the destructive impact of mining on the area in MPL 55549, coupled with the potential adverse effects on the wider marine environment, ruled out such a partial approval.

⁸¹⁶ Lines 5 – 9, page 2595 of the Transcript, 19 November 2014

15. Consideration of the Application and Decision

- In this chapter the DMC considers the proposed activities against the decision-making matters to be taken into account under Section 59 of the EEZ Act, cross checks its findings for consistency with the purpose of the EEZ Act and give its decision.
- 855. This chapter is a summary of the key conclusions reached by the DMC and is not intended to be an exhaustive analysis against the EEZ Act's provisions. For that latter purpose, the entire decision document is relevant. However, it is intended to satisfy the principal requirement of Section 69 of the EEZ Act regarding the reasons for the DMC's decision in the sense that the matters summarised are those that the DMC considers determinative of that decision.

15.1. Section 59(2)(a) effects on the environment

- 856. Section 59(2)(a) requires the DMC to take into account any effects on the environment of allowing the activity, including cumulative effects and effects that occur in New Zealand or in the waters above and beyond the continental shelf beyond the outer limits of the EEZ.
- 857. The most significant adverse effect would be that caused by the extractive part of the mining operation itself. This would result in the physical removal of phosphorite nodules and associated surface sediment along with all benthic biota living within and on the seabed over an area of between 450 km² (15 year consent) and 1050 km² (35 year consent) to a depth of up to 0.5 m. This would include the epifauna communities described by Dr Rowden which are dominated by the stony coral *G. dumosa* and are potentially unique to the central crest of the Chatham Rise⁸¹⁷ and which the DMC concludes are rare and vulnerable ecosystems which merit protection.
- 858. In addition to the removal of habitat and mortality of benthic biota, the benthic communities surrounding the worked mining block would be impacted by deposition of the returned sediment discharged from the mining vessel.⁸¹⁸ That deposition (at a depth of 1 mm) is modelled to extend at least 10 km beyond the consent area sought after 15 years of mining, 1 mm being a reasonable precautionary threshold for potentially adverse effects on sensitive benthic organisms as identified by Dr Hewitt and broadly agreed.⁸¹⁹

⁸¹⁷ Issue 1, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014
⁸¹⁸ Paragraph 75, Statement of Evidence of Paul Cameron Kennedy for CRP on Environmental Impacts (updated), 29 August 2014 (amended 14 November 2014)

⁸¹⁹ Line 44 – 45, page 727 of the Transcript and lines 40 – 41 page 728 of the Transcript, 3 October 2014

- 859. The mining would result in a long term change in habitat from a mixed phosphorite nodule / soft sediment habitat to a graded soft sediment habitat.⁸²⁰ Restoration of the area to its original state is not expected as stony coral and other sessile organisms found in the marine consent area are dependent on hard substrate for settlement.⁸²¹ Re-establishment of communities following mining is uncertain and at best would take decades. Moreover the re-established communities would be based on soft sediment rather than hard coral.⁸²²
- 860. The spatial and temporal extent of the indirect impacts of mining are, however, uncertain as the modelling has yet to be verified *in situ*.
- Almost the entire proposed mining operation would take place within the 8,732 km² Mid
 Chatham Rise BPA, which is discussed below under Section 59(2)(h). The DMC concludes that
 the environmental protection afforded by that mechanism would then be rendered redundant.
- 862. The DMC recognises that cumulative effects in conjunction with fishing industry activities across the Chatham Rise might eventuate, but the DMC is unable to conclude from the evidence received that they would necessarily arise or, if they did, what their magnitude and significance would be.
- 863. On the effects that might occur in New Zealand arising from the application of mined phosphorite, the DMC found that there was uncertainty as to the extent and nature of its use in New Zealand and, given its distance from the marine consent, this issue was not material to the DMC's decision.
- 864. The DMC concludes that there would be significant and permanent adverse effects on the existing benthic environment. The DMC considers this is a significant factor amongst all the matters that it is required to take into account.

15.2. Section 59(2)(a) effects on existing interests

865. Section 59(2)(a) of the EEZ Act requires the DMC to consider any effects on existing interests of allowing the activity, including cumulative effects and 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.

⁸²¹ Issue 1, Joint Statement of Experts in the Field of Benthic Ecology and Spatial Planning, 16 and 27 September 2014

⁸²⁰ Paragraph 76, Statement of Evidence of Paul Cameron Kennedy for CRP on Environmental Impacts (updated), 29 August 2014 (amended 14 November 2014)

⁸²² Pages 2002 – 2003 of the Transcript, 6 November 2014

- 866. Existing interests identified in connection with this application were the interests of: iwi and imi holding fishing quota rights under the Treaty of Waitangi (Fisheries Claim) Settlement Act 1992; Ngāi Tahu; marine eco-tourism operators; commercial fishing operators; and marine traffic operators.
- 867. The DMC found it difficult to establish with any certainty just how and to what extent the interests of these groups might be affected by the mining operation. The concerns raised by existing interests holders frequently centred on the accuracy of the various models being used by the applicant to predict effects, for example, in the assessments of fish stocks and the dispersal of sediment. If those models were to prove accurate, or to fall within reasonable bounds, then the proposal would be unlikely to have significant effects on the interests of existing interests groups.
- 868. There was little agreement between the applicant and commercial fishing interests as to the level of risk that the mining operation represented in terms of stock reduction, displacement or product branding and sustainability certification. Concerns were also held by those with rights to the Chatham Rise Rohe Moana and those representing customary fishing interests. The relevant expert group however agreed that the risks posed to commercial fishing were not as serious as the industry claimed. The DMC accepts this view.
- 869. The DMC acknowledges the views expressed to it that the proposal risked undermining Treaty of Waitangi settlement provisions such as the development right and the value of Treaty settlement–based fish quotas. However the general view of fisheries experts, and Dr Pierre with respect to MSC certification, was that the adverse effects of the proposal would not be as serious as was suggested by the industry. At the same time, the DMC understands the concern expressed by virtually all existing interest groups at the prospect of being forced to carry risks to their livelihood and wellbeing, however small, without their consent.
- 870. On the likely effects on marine eco-tourism activities, the DMC concludes that the proposal would pose only a low risk to mammals on the Chatham Rise and that a suitable set of conditions could have been developed to address that risk.
- 871. On the customary fishing rights of Māori and Moriori, including within the Rohe Moana, the DMC was unable to establish on the basis of the evidence provided to it that the proposal would have any significant impact. It acknowledges however the levels of concern and apprehension expressed to it by the relevant groups.
- 872. The transiting of the general area by shipping is a matter that may occur periodically but is not affected by the proposed mining activity to any extent greater than might currently be

experienced with the fishing fleet and could, in the DMC's view, be readily managed through standard maritime notice requirements.

873. Overall, the DMC concludes that the effects on existing interests that it needs to take into account are principally the effects on fishing interests, which are of low probability and potentially moderate impact. Such effects are not determinative of the application and, relative to some of the other factors that the DMC must take into account, are of limited weight in the overall assessment.

15.3. Section 59(2)(b) Effects of other activities undertaken in the application area

- 874. Section 59(2)(b) requires the DMC to take into account the effects on the environment or existing interest of other activities undertaken in the area covered by the application or in its vicinity, including the effects of activities that are not regulated under the EEZ Act; and 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. The DMC interprets this provision to be aimed at ensuring marine consent decisions take into account the potential for cumulative effects to arise out of the combination of effects of the proposed activity and effects of other activities already undertaken in the area or vicinity of the proposal. The only other activity presently undertaken on a material scale in the area covered by the application or in its vicinity is commercial fishing and so the DMC's consideration under Section 59(2)(b) focuses on that.
- 875. As there is limited, if any, spatial overlap of fishing and the proposed mining (although noting that longlining is permitted within the BPA), the applicant did not consider it necessary to assess the combined effect of both activities on the Chatham Rise. The DMC was provided with a comparison of trawling scale and intensity by Mr Tuck⁸²³ and is satisfied that the mining activity would take place in a considerably smaller area than the fishing activity, but with greater intensity.
- 876. The DMC agrees there is limited spatial overlap between fishing and the proposed mining and concludes that there are unlikely to be any adverse effects of other activities undertaken in the area material to the outcome of this application.

⁸²³ Paragraphs 6 and 10, Statement of Evidence of Dr Ian Tuck for CRP, 28 August 2014

15.4. Section 59(2)(c) Effects on human health

- 877. Section 59(2)(c) requires the DMC to take into account the effects on human health that may arise from effects on the environment.
- 878. Two main areas of health concern were raised in terms of the human consumption of seafood; trace elements (including heavy metals) and radioactive substances. It was common ground that there would be no biomagnification of trace elements either in particular species or through the food chain because the biological uptake of any trace elements released into the water column as a result of mining was likely to be insignificant.
- 879. The most important radionuclide in terms of human exposure from marine organisms was polonium. However, it was generally agreed that it would not biomagnify through the food chain because, even though it may transfer from one trophic level to the next, polonium tends not to get to higher concentration levels up the food chain.⁸²⁴
- Regarding the health and safety of workers on the mining vessel, the DMC understands that phosphorite is not classed as a hazardous substance, is not corrosive and has low toxicity and irritant tendencies. It may accordingly be handled, stored and transported by any person.
 Similarly, Chatham Rise phosphate rock is not classed as a radioactive material.⁸²⁵
- 881. On the matter of air quality, Boskalis confirmed that the operation would adhere to international laws and standards (specifically MARPOL) as well as comply with any additional requirements under New Zealand law. A proposal specific environment and management plan would be drafted and agreed before the start of mining, outlining all proposal rules and standards applying to oily water, hazardous substances, wastewater, garbage (solid waste) emissions to air, ballasting and hull bio-fouling.
- 882. The DMC concludes that there are unlikely to be any significant adverse effects on human health arising from effects of the proposal on the environment.

15.5. Section 59(2)(d) Protecting biological diversity and integrity

883. Section 59(2)(d) requires the DMC to take into account the importance of protecting the biological diversity and integrity of marine species, ecosystems and processes. Biological diversity is defined in Section 4(2) of the EEZ Act to have the same meaning as in the RMA,

⁸²⁴ Lines 24 – 28, page 898 of the Transcript, 14 October 2014

⁸²⁵ Paragraph 27, Statement of Evidence of Dr Nikolaus Hermanspahn for CRP, 29 August 2014

which is "the variability among living organisms, and the ecological complexes of which they are a part, including diversity within species, between species, and of ecosystems".

- 884. Communities with a high abundance of *G. dumosa* were acknowledged by the applicant to be habitat forming communities which to date have not been found outside the marine consent area. *G. dumosa* as a species is not endemic to Chatham Rise (it is found elsewhere in the EEZ) but it is protected under the Wildlife Act 1953. However an application for authority to kill *G. dumosa* was made to the Director-General of Conservation and the DMC heard that it is formally on hold pending the DMC's decision on the present application. Experts agreed that communities with a high abundance of the stony coral met the definition of a 'sensitive environment' under EEZ regulations.⁸²⁶
- 885. The question arose during the hearing as to the difference in meaning between 'ecosystems' and 'communities'. Neither is defined in the EEZ Act. Dr Rowden's view was "So people will call a coral reef an ecosystem, whereas I might say that a coral reef is really a community". ⁸²⁷ The DMC's conclusion is that the words could be used interchangeably.
- 886. The phosphorite nodule habitat is considered unique in New Zealand's EEZ⁸²⁸. In addition Dr Rowden described the Chatham Rise "as one of the most obvious and distinct ecosystems we have in the EEZ and it is one of the most productive."⁸²⁹
- 887. The DMC was persuaded that communities dominated by *G. dumosa* (among others) in the mining area fall within the scope of Section 59(2)(d) and notes that the applicant reached a similar conclusion.⁸³⁰ The extractive activity would not protect those communities. The DMC considers this is a significant factor amongst all the matters that it is required to take into account.

15.6. Section 59(2)(e) Protecting rare and vulnerable ecosystems

888. Section 59(2)(e) requires the DMC to take into account the importance of protecting rare and vulnerable ecosystems and the habitats of threatened species. The EEZ Act does not define 'rare and vulnerable ecosystems'.

⁸²⁶ Issue 1, Joint Witness statement on Benthic Ecology and Spatial Planning, 16 and 27 September 2014

⁸²⁷ Line 30, page 2014 of the Transcript, 6 November 2014:

⁸²⁸ Section 6.3.4.3 of the Marine consent applicant and EIA, May 2014

⁸²⁹ Lines 39 – 41, page 2032 of the Transcript, 6 November 2014

⁸³⁰ Paragraph 152, Closing Legal Submissions for CRP, 19 November 2014

- 889. While a number of the marine mammals species recorded in the general application area have a national or international threat classification,⁸³¹ the DMC was persuaded that the mining consent area did not constitute a particularly significant habitat for those species.
- 890. Dr Thompson stated that four taxa of seabirds likely to be found in the marine consent application area were classified as 'threatened' under New Zealand's threat classification system. The Antipodean albatross, Salvin's albatross and magenta petrel (also known as the Chatham Island taiko) have a conservation status of 'nationally critical', and Chatham petrel has a conservation status of 'nationally vulnerable'.⁸³² Mr Taylor confirmed that the Chatham Island taiko was critically endangered, with just 20 known breeding pairs, and that recent DOC tracking studies showed that they forage occasionally over the proposed mining application area.⁸³³ However, while the Chatham Rise could be considered part of those species' habitat for foraging purposes, the DMC was persuaded that neither the mining operation nor its effects would constitute a material risk.
- 891. Mr Winchester submitted that 'ecosystem' in the context of Section 59(2)(e) referred to the Chatham Rise ecosystem rather than the particular *G. dumosa* dominated areas, which in his view were better described as 'communities'.⁸³⁴ In support of this submission, Mr Winchester cited the Joint Statement of Experts on Benthic Ecology and the agreement that the Chatham Rise was one of the most productive ecosystems within New Zealand's EEZ.
- 892. The DMC finds that interpretation unnecessarily restrictive, noting that the reason the Joint Statement of Experts concluded as it did was because the scale on which the relevant evidence was provided was at the scale of the wider Chatham Rise.
- 893. Mr Winchester also argued that the potentially unique communities of *G. dumosa* did not appear to fall with the scope of Section 59(2)(e) because they were neither *"rare or vulnerable ecosystems"* nor *"habitats of any threatened species"*.⁸³⁵ However it was Dr Rowden's opinion that the coral based communities could be said to be a vulnerable marine ecosystems according to the definition used by the FAO.⁸³⁶ The FAO International Guideline for Management of Deep-sea Fisheries in the High Seas defines a vulnerable marine ecosystem as ecosystems that are *"rare or unique, functionally significant, fragile, slow to recover and structurally complex."* The DMC finds that the communities dominated by *G. dumosa* are highly likely to meet this definition.

⁸³¹ Table 1, Statement of Evidence of Simon John Childerhouse for the Crown, 17 September 2014

⁸³² Paragraph 21 – 22, Statement of Evidence of Dr David Thompson for CRP, 25 August 2014

⁸³³ Paragraph C, Statement of Evidence of Graeme Andrew Sydney Taylor for the Crown, 12 September 2014

⁸³⁴ Paragraph 154–155, Closing Legal Submissions for CRP, 19 November 2014

⁸³⁵ Paragraph 157, Closing Legal Submissions for CRP, 19 November 2014

⁸³⁶ Lines 35 – 5, pages 2012 – 2013 of the Transcript, 6 November 2014

- 894. While the DMC notes Dr Rowden's comment that in the deep sea rarity could simply be a sampling artefact,⁸³⁷ the DMC attributes some weight to the fact that *G. dumosa* is a species that is afforded absolute protection under the Wildlife Act.
- 895. The high density of *G. dumosa* forming communities in the mine permit area is strongly correlated with the presence of phosphorite nodules. These nodules also occur in high density in the mine permit area, hence the applicant's focus on this area of the Chatham Rise. The DMC accepts the evidence of Drs Rowden and Berkenbusch that the communities dominated by *G. dumosa* are potentially unique, and in the absence of any strong evidence on the presence or abundance of such communities beyond the mining permit area (and given the requirement to favour caution and environmental protection), the DMC finds it more than likely that such communities are rare. That, in combination with their vulnerability, signifies that the DMC must take into account the importance of protecting those communities. The DMC concludes that the potentially unique communities of *G. dumosa* in the mining areas are rare and vulnerable ecosystems which merit protection. The DMC considers this a significant factor amongst all the matters that it is required to take into account.

15.7. Section 59(2)(f) Economic benefit to New Zealand

- 896. Section 59(2)(f) requires the DMC to take into account the economic benefit to New Zealand of allowing the application.
- 897. The DMC accepts that the proposed mining operation, if it were to proceed as currently planned and if the various assumptions and forecasts on which NZIER based its modelling are borne out, would have some economic benefits for New Zealand. Among the specific benefits the proposal might generate are the taxes and royalties payable to the government, modest employment gains, and flow-on benefits at the chosen port or ports and in the transport sector. The availability of direct application Chatham rock phosphate in New Zealand would also hold out some advantages.
- 898. The assumptions and forecasts used by NZIER and therefore the credibility of the figures produced by the CGE economic model however remained in dispute. The DMC considers that the potential economic benefit to New Zealand was overstated in the application, although it does not accept the most pessimistic of the expert opinions.
- 899. The DMC concludes that the proposal would be unlikely to generate more than a modest economic benefit to New Zealand and that the quantum and distribution of that benefit remains

⁸³⁷ Lines 7–10, page 2014 of the Transcript, 6 November 2014

uncertain. The DMC observes that economic benefit to New Zealand is one of the few criteria in Section 59(2) that focuses on the benefits, as opposed to the environmental costs, of a marine consent proposal. Having found that the economic benefit to New Zealand of this proposal is unlikely to be more than modest, the DMC must weigh that alongside the significant and permanent adverse effects on the benthic environment and other potential environmental adverse effects of the project.

15.8. Section 59(2)(g) Efficient use and development of natural resources

- 900. Section 59(2)(g) requires the DMC to take into account the efficient use and development of natural resources.
- 901. In its opening submission, the Crown outlined the Government's position on the contribution of mining to New Zealand's economy and drew attention to the potential of the mineral and marine assets in the EEZ to generate wealth for New Zealanders. It affirmed that the Government wished to encourage the environmentally responsible efficient development and use of the country's diverse energy and mineral resources.⁸³⁸
- 902. This matter was addressed by the applicant solely with respect to the mining of phosphorite nodules. In that regard the DMC notes no reasonably comparable application or operation was put before the DMC against which the efficiency of the applicant's proposed use and development could be assessed. The DMC also received no compelling evidence that the proposal was not an efficient use and development of the phosphorite resource. The DMC also accepts that if the product found its way into the market for direct application, rather than as a superphosphate blend, this would represent efficient use and development.
- 903. A caveat to this conclusion is that the EEZ Act defines natural resources to also include seabed, subsoil, water and all forms of organisms (whether native to New Zealand or introduced). The proposal could not be said to be an efficient use and development of those "*residual*" natural resources.
- 904. The DMC concludes that this aspect of Section 59(2) is of limited relevance to the overall determination of the application.

⁸³⁸ Paragraphs 10 – 15, The Crown's Opening Representation, 25 September 2014

15.9. Section 59(2)(h) Nature and effect of other marine management regimes

- 905. The DMC considers the only marine management regime, the nature and effect of which is material to our assessment, is the Fisheries (Benthic Protection Areas) Regulation and the resultant Mid Chatham Rise Benthic Protection Area. There is little doubt that mining the seafloor in an area in which the only other significant and potentially destructive activity (bottom trawling) is prohibited is, at the very least, contradictory, and that the resultant effect of mining 1050 km² of the seabed over 35 years would negate the effect that the Mid Chatham Rise BPA has had for protecting that benthic environment. What effect that might have on the BPA network as a whole, and what response, if any, might be required of government was left unanswered at the hearing.
- 906. The DMC concludes that there would be a significant adverse effect on the Fisheries (Benthic Protection Areas) Regulations with respect to the Mid Chatham Rise BPA and that one of the purposes and the effect of the BPA would be undermined if the application were granted. The DMC considers this is a significant factor amongst all the matters that it is required to take into account.

15.10. Section 59(2)(i) Best practice

907. Section 59(2)(i) requires the DMC to take into account best practice in relation to an industry or activity. While the Boskalis representatives told the DMC the technology and practices involved in this proposal were well understood and that Boskalis is a leader in the industry, the proposed mining method and equipment to be used on the Chatham Rise has not been used at similar depths anywhere in the world. The DMC understands that globally marine mining is an industry in its gestation⁸³⁹ and that guidance on best practice for deep-sea mining is therefore limited. However, Boskalis stated that the operation on board the vessel would adhere to international laws and standards (specifically MARPOL), as well as the additional requirements that follow from New Zealand law. In addition Mr Ross-Watt for Ngāi Tahu identified a number of good practice codes and guidelines that might be appropriate, for example the International Marine Minerals Society's Code for Environmental Management of Marine Mining (IMMC), the Noumea Convention, the London Protocol and the Mining Code issued by the International Seabed Authority.⁸⁴⁰

⁸³⁹ Page 8, M.Beggs submission 109926

⁸⁴⁰ Paragraph 15, Statement of Evidence of Mr Tara Ross-Watt on behalf of Te Rūnanga o Ngāi Tahu, 11 September 2014

908. The DMC concludes that regardless of the present uncertainty about what might constitute best practice for this operation (a matter that would inevitably and necessarily evolve over a 35 year consent duration) conditions could be developed, including explicit review conditions, that would ensure best practice was implemented, maintained and amended appropriately throughout any consent duration.

15.11. Section 59(2)(j) Imposing conditions to avoid, remedy or mitigate adverse effects

- 909. Section 59(2)(j) of the Act requires the DMC to take into account the extent to which imposing conditions under Section 63 might avoid, remedy, or mitigate the adverse effects of the activity.
- 910. The DMC has discussed the matter of conditions proposed throughout this decision. The DMC notes that the applicant accepted that there were no avoidance, remediation or mitigation measures that could be applied to the direct loss of benthic communities within and alongside the mining block. It did however propose conditions and measures which it believed would contribute to protecting specific benthic habitats beyond the mining blocks and providing opportunities for habitat enhancement elsewhere within the wider application area.
- 911. As discussed, the DMC does not accept that the proposed mining exclusion areas could be considered compensation for the damage from mining because if they are within the BPA then these areas are already protected from disturbance from bottom trawling and shellfish dredging. If they are not within the BPA, then the DMC could have no certainty that the areas would be protected from any activity other than the present application.
- 912. The DMC also notes that the mining exclusion areas, as proposed, did not appear to encompass habitat that is suitable for potentially unique epifaunal communities and at least one infaunal community.⁸⁴¹
- 913. Similarly the DMC cannot accept the proposed recolonisation trials with introduced substrate as any form of positive mitigation because the likelihood of success at any reasonable scale remains uncertain at best.
- 914. The applicant also offered an environmental package to help address the adverse effects of mining. This included an Environmental Compensation Trust Fund, the funding of an Environmental Reference Group and the establishment of a Chatham Islands Trust Fund.

⁸⁴¹ Lines 1 – 5, page 2032 of the Transcript, 6 November 2014

- 915. The DMC notes that these are not mitigation measures because they do not directly relate to any particular adverse effect of the mining. Rather, they are an indirect offset, the logic and rationale (including the quantum proposed) of which was not clearly evident.
- 916. The DMC concludes that conditions could be refined to address many of the matters discussed throughout this decision. However, no avoidance, remediation or mitigation measures could be applied to the direct loss of benthic communities within and alongside the mining block. This is seen by the DMC as a significant matter.

15.12. Section 59(2)(k) Relevant regulations

917. Section 59(2)(k) requires the DMC to take into account any relevant regulations. The DMC has discussed marine management regimes above. No other relevant regulations were brought to its attention.

15.13. Section 59(2)(I) Any other applicable law

918. Section 59(2)(I) requires the DMC to take into account any other applicable law. The DMC has considered other applicable laws along with marine management regimes. No other relevant applicable law was brought to the DMC's attention.

15.14. Section 59(2)(m) Any other matter the EPA considers relevant and reasonably necessary to determine the application.

- 919. Section 59(2)(m) requires the DMC to take into account any other matter considered relevant and reasonably necessary to determine the application.
- 920. The DMC considered that Māori and Moriori cultural values and Chatham Islands community concerns fell into this category.
- 921. The DMC is mindful of the risk of double counting where there is an overlap of effects. The DMC was unable to establish with certainty just what additional adverse effects the mining proposal would have had on the Chatham Island community beyond the effects accounted for elsewhere in this decision. It accepts that the impact of this proposal on the cultural and spiritual values and sense of identity of iwi and imi is a matter of concern and importance to a number of individuals and groups with a direct interest in the application and that it is a matter that the DMC needed to take into account. While these matters were not determinative in the decision,

the DMC does wish to recognise their importance to a large number of submitters and witnesses.

15.15. Conclusion

- 922. This chapter has summarised the key conclusions of the DMC's consideration of the proposal against the matters that the DMC must take into account in accordance with Section 59 of the EEZ Act and favouring caution and environmental protection as required by Section 61(2).
- 923. The DMC concludes that there would be significant and permanent adverse effects on the existing benthic environment. The most significant adverse effect would be the physical removal of phosphorite nodules and associated surface sediment along with all benthic biota living within and on the seabed over an area of up to 1050 km² over 35 years, to a depth of up to 0.5 m. This would include communities which are dominated by the stony coral *G. dumosa* and are potentially unique to the central crest of the Chatham Rise, and which the DMC concludes are part of rare and vulnerable ecosystems which merit protection. In addition to the removal of habitat and the mortality of benthic biota, the benthic communities surrounding the worked mining block would be impacted by deposition of the returned sediment discharged from the mining vessel. That deposition (at a depth of 1 mm) is modelled to extend at least 10 km beyond the consent area sought after 15 years of mining. The mining would result in a long term change in habitat from a mixed phosphorite nodule/soft sediment habitat to a graded soft sediment habitat.
- 924. The DMC concludes that the project was unlikely to generate more than a modest economic benefit to New Zealand and that the quantum and distribution of that benefit were uncertain. As against this, there would be significant and permanent adverse effects on the benthic environment and other potential environmental adverse effects. The DMC finds the economic benefits of the proposal to New Zealand to be insubstantial relative to potential adverse environmental effects of the proposal.
- 925. The DMC also concludes that the proposal would have a significant adverse effect on the Fisheries (Benthic Protection Areas) Regulations with respect to the Mid Chatham Rise Benthic Protection Area, and that at least one of the purposes and the effect of the BPA would be undermined if the application were granted.
- 926. Taking these matters into account, and favouring caution and environmental protection (in light of the uncertainties and inadequacy inherent in the information), the DMC concludes that consent for the proposal must be refused unless there were some way in which an adaptive

management regime could overcome its concerns or the outcome were somehow contrary to the purpose of the EEZ Act.

- 927. The DMC has considered the adaptive management approach offered by the applicant and finds that it would not address its fundamental concerns such as the need to validate the habitat predictions of the Zonation model in advance of mining, and to validate the sediment modelling *in situ* through a limited preliminary mining trial. However, an adaptive management approach designed to address those concerns would render the project unviable for the applicant, and could not be imposed without frustrating the consent.
- 928. The DMC has also considered whether the conclusion it reached, guided by the specific decision-making criteria, the information principles, and in particular the requirement to favour caution and environmental protection, is in keeping with the express purpose of the EEZ Act. Unlike the RMA, the detailed machinery provisions for guiding the DMC's decision are not subservient to the legislative purpose. It is still however relevant to consider in the round whether the decision is consistent with the EEZ Act's purpose. Similar to the RMA, the purpose of the EEZ Act balances a number of potentially competing factors whose relevant weight depends on the facts of the application being considered.
- 929. In this instance, the DMC is convinced that the proposal would create significant and permanent adverse effects on the environment which are incapable of being avoided, remedied or mitigated, and that this aspect of sustainable management is of paramount concern in this instance. The DMC finds nothing in the purpose of the Act that suggests it is inappropriate for it to be guided by that concern, particularly when the requirement to favour caution and environmental protection has been invoked.

15.16. Decision

930. The DMC's decision is to refuse the application by Chatham Rock Phosphate Limited for a marine consent to mine phosphorite on the Chatham Rise.

Mr Neil Walter (Chalr)

Neingen

Dr Nicola Crauford (EPA Board Member)

Mr David Hill

Mr Lennie Johns

10 February 2015

Dr Greg Ryder

Appendix 1: Procedural History

- On 14 May 2014 Chatham Rock Phosphate Limited (CRP) submitted an application under Section 38 of the EEZ Act for a marine consent to mine phosphate nodules on the crest of the Chatham Rise for a period of 35 years.
- Six lodgement reviews of the application were commissioned by the EPA. CRP was informed on 28 May 2014 that the application had been reviewed and would not be returned as incomplete under Section 41 of the EEZ Act.
- 3. On 16 May 2014 the Environmental Protection Authority (EPA) appointed the following persons to be a committee to consider the marine consent application lodged by CRP:
 - Mr Neil Walter (Chair)
 - Dr Nicola Crauford
 - Mr David Hill
 - Mr Lennie Johns
 - Dr Gregory Ryder
- On 9 June 2014 the EPA requested the applicant to provide 44 items of further information under Section 42 of the Act. Responses to all the requests were provided by the applicant between 27 June and 2 September 2014.
- 5. In accordance with Section 45 of the Act, the application was notified to: Government Ministers with responsibilities that may be affected by the application; Maritime New Zealand; iwi authorities; customary marine title groups; protected customary rights groups; and other groups and persons with interests that may be affected by the application, including regional councils.
- 6. The application was publicly notified on 12 June 2014. A total of 1,037 parties were served a copy of the public notice, including ten Government Ministers, Maritime New Zealand, 98 iwi authorities and a range of parties considered to have an existing interest (including Chatham Island groups, commercial fishers, the Deepwater Group, Seafood New Zealand, the Department of Conservation and Environment Canterbury). The public notification included an invitation to make submissions.
- 7. The closing date for submissions on the application was 10 July 2014. A total of 294 submissions were received, with 75 submitters indicating that they wished to present their submissions in person at the hearing. The submissions came mainly from within New Zealand, with the highest number being received from Wellington, the Waikato, Auckland, Taranaki, Canterbury, Otago and the Chatham Islands, in that order. 24 submissions came from overseas.

- Of the 294 submissions received, 97 (33 %) supported the proposal either in full or in part; 194 (66 %) opposed it either in full or in part; two were neutral; and one submitter did not state a clear position. Eight submissions were not in the prescribed form but were accepted by the DMC. Seven late submissions were also accepted by the DMC.
- On 27 June advice on relevant marine management regimes was sought from the Ministry for Primary Industries; WorkSafe New Zealand; the Department of Conservation; Maritime New Zealand; and New Zealand Petroleum and Minerals.
- 10. On 17 and 25 July 2014 the applicant was requested to provide additional items of information.
 All but one of the requests was responded to by 29 August 2014, with the outstanding matter being addressed in evidence at the hearing.
- 11. Nine independent reviews of sections of the application were commissioned by the EPA and the DMC. An initial EPA staff report on the application was issued in August 2014, and a supplementary report in October 2014. The EPA was also commissioned in November 2014 to provide comment on the conditions and adaptive management regime proposed by CRP. The EPA's Māori Advisory Committee, Ngā Kaihautū Tikanga Taiao, submitted a report on the application on 4 August 2014.
- On 1 August 2014 CRP informed the EPA of the removal of the eastern block (prospecting permit PP 55967) from its application. This left an application area of 5,207 km², including the mining permit area MPL 55549.
- On 4 August 2014, the DMC issued a Minute deferring the commencement of the hearing by 15 working days (to 25 September 2014) in order to give the applicant more time to respond to its further information requests.
- 14. Formal notice of the hearing was issued on 28 August 2014. Earlier minutes had indicated sessions of the hearing would be held in Hamilton and the Chatham Islands as well as Wellington. Detailed hearing procedures were posted on the EPA website and notified to intending participants.
- 15. 35 statements of evidence were lodged by the applicant, and 41 by submitters, including supplementary and updated statements. A further nine statements of evidence were filed by experts commissioned by the DMC.

- 16. The DMC's Minute of 22 August extended the time limit for the filing of the applicant's and submitters' evidence.
- 17. Twelve expert conferences were arranged, on the subjects of: Benthic Ecology and Spatial Planning; Commercial Fishing; Economics; Ecosystem Effects; Impacts on Fish; Marine Mammals; Radioactivity; Rock lobsters; Seabirds; Sediment modelling; Toxicology and Water Quality; and proposed conditions. A pre-hearing meeting also took place on Existing Interests.
- 18. The hearing began in Wellington on 25 September 2014. In all there were 26 days of hearing, including two days in Hamilton and one in the Chatham Islands. 48 submitters were heard. The hearing was adjourned on 19 November 2014 and formally closed by the DMC on 12 December 2014.
- 19. Overall the DMC issued twenty two Minutes.
- 20. The DMC completed its deliberations and issued its decision on 10 February 2014.

Appendix 2: List of Presenters Who Appeared at the Hearing

Day 1— 25 September 2014

Basin Reserve, Wellington

Mr James Winchester on behalf of Chatham Rock Phosphate Ltd (CRP) — opening representation Mr Jeremy Prebble and Ms Eleanor Jamieson on behalf of The Crown — opening representation Mr Stephen Christensen on behalf of Te Runanga o Ngāi Tahu — opening representation Ms Kirsty Woods on behalf of Te Ohu Kai Moana Trustee Ltd — opening representation

Day 2 — 26 September 2014

Basin Reserve, Wellington

Mr James Winchester on behalf of CRP

Mr Duncan Currie on behalf of Greenpeace, KASM, and DSCC — opening representation

Ms Jo Appleyard on behalf of Deepwater Group Limited — opening representation

Mr Peter Anderson on behalf of the Royal Forest and Bird Protection Society of New Zealand Incorporated — opening representation

Mr Rob Enwright on behalf of Environmental Defence Society — opening representation

Ms Nicola de Wit on behalf of Environmental Defence Society - opening representation

Mr Chris Castle representing CRP — evidence on company structure and background

Dr Robin Falconer appearing for CRP - evidence on project genesis and history

Mr Ray Wood appearing for CRP — evidence on research programme, monitoring, spatial planning

Day 3 — 29 September 2014

Basin Reserve, Wellington

Ms Linda Sanders appearing for CRP — evidence on consultation and communication

Mr Stephen Christensen on behalf of Te Rūnunga o Ngāi Tahu

Mr Maui Solomon on behalf of Hokotehi Moriori Trust

Ms Ruby Haazen on behalf of Greenpeace, KASM, and DSCC

Dr Katrin Burkenbusch appearing for Ngāi Tahu, Deepwater Group, Ngāti Kahungunu and Te Ohu Kaimoana (Ngāi Tahu et al.) — evidence on benthic ecology

Mr Duncan Currie on behalf of Greenpeace, KASM, and DSCC

Mr James Winchester on behalf of CRP

Mr Dan Govier appearing for Te Runuga o Ngāi Tahu — evidence on benthic monitoring and compliance

Day 4 — 30 September 2014

Basin Reserve, Wellington Mr Jeremy Prebble on behalf of the Crown Dr Thomas Hourigan appearing for the Crown — evidence on benthic issues Mr James Winchester on behalf of CRP Mr Duncan Currie on behalf of Greenpeace, KASM, and DSCC Dr John Leathwick appearing for the Crown — evidence on Zonation / marine spatial planning Professor Les Watling appearing for Greenpeace, KASM, and DSCC — evidence on benthic ecology Dr David Thompson appearing for CRP — evidence on seabirds Mr Peter Anderson on behalf of Royal Forest and Bird Protection Society of New Zealand incorporated Mr Jeremy Prebble on behalf of the Crown — evidence on seabirds Ms Eleanor Jamieson on behalf of the Crown

Day 5 — 1 October 2014

Basin Reserve, Wellington

Mr James Winchester on behalf of CRP

Dr Jeremy Spearman appearing for CRP — evidence on sediment plume modelling

Mr Stephen Christensen on behalf of Te Rūnunga o Ngāi Tahu

Mr Jeremy Prebble on behalf of the Crown

- Ms Eleanor Jamieson on behalf of the Crown
- Mr Duncan Currie on behalf of Greenpeace, KASM, and DSCC

Mr Sander Steenbrink appearing for CRP — evidence on project background, project examples and capability

Ms Jamie Lescinski appearing for CRP - evidence on sediment plume

Mr Gerard van Raalte appearing for CRP - evidence on mining techniques and methodology

Mr Dougal Greer appearing for the DMC - evidence on sediment modelling

Mr Morgan Slyfield on behalf of the DMC

Dr Scott Nodder appearing for CRP — evidence on sedimentology

Day 6 — 2 October 2014

Basin Reserve, Wellington Ms Eleanor Jamieson on behalf of the Crown Dr Peter Longdill appearing for the Crown — evidence on sediment and the plume Ms Ruby Haazen on behalf of Greenpeace, KASM, and DSCC Mr James Winchester on behalf of CRP Dr Diane Jones appearing for CRP — Noise and acoustics Mr Ben Williams appearing for Deepwater Group Mr Jeremy Prebble on behalf of the Crown Emeritus Professor Arthur Popper appearing for CRP — evidence on noise Dr lan Tuck appearing for CRP — evidence on effect of trawling on the seabed Dr Alison McDiarmid appearing for CRP — evidence on rock lobsters

Day 7 — 3 October 2014

Basin Reserve, Wellington Mr James Winchester on behalf of CRP Dr Judith Hewitt appearing for CRP — evidence on benthic Communities Ms Ruby Haazen on behalf of Greenpeace, KASM, and DSCC Mr Jeremy Prebble on behalf of the Crown Mr Peter Anderson on behalf of Royal Forest and Bird Protection Society of New Zealand Incorporated Mr Sandy Bartle appearing for Royal Forest and Bird Protection Society of New Zealand Incorporated evidence on seabirds and ecological effects Mr Morgan Slyfield on behalf of the DMC Dr Leigh Bull appearing for the DMC — evidence on seabirds

Mr Hamish Harwood on behalf of CRP

Day 8 — 14 October 2014

Basin Reserve, Wellington

Mr Stephen Christensen on behalf of Te Rūnunga o Ngāi Tahu

Dr Ngaire Phillips appearing for Te Rūnunga o Ngāi Tahu — evidence on ecotoxicology

Mr James Winchester on behalf of CRP

Mr Duncan Currie on behalf of Greenpeace, KASM, and DSCC

Associate Professor Barrie Peake appearing for Greenpeace, KASM,, DSCC and EDS — evidence on marine chemistry

Mr Hamish Harwood on behalf of CRP

Mr Morgan Slyfield on behalf of the DMC

Dr Louis Tremblay appearing for the DMC — evidence on marine ecotoxicology

Dr Alec McKay appearing for CRP - evidence on agriculture and nutrients

Dr David Bull appearing for CRP - evidence on trace element accumulation in soils

Dr Nikolaus Hermanspahn appearing for CRP - evidence on uranium and radioactivity

Dr Ross Jeffree appearing for DMC - evidence on radionuclides in the marine environment

Dr David Santillo appearing for Greenpeace, KASM, DSCC and EDS - evidence on radioactive materials

Day 9 — 15 October 2014

Basin Reserve, Wellington

Mr James Winchester on behalf of CRP

Mr Paul Kennedy appearing for CRP - evidence on sediment and water quality

- Mr Duncan Currie on behalf of Greenpeace, KASM, and DSCC
- Mr Stephen Christensen on behalf of Te Rūnunga o Ngāi Tahu
- Mr James Winchester on behalf of CRP
- Dr Matt Pinkerton appearing for CRP evidence on trophic model
- Mr Jeremy Prebble on behalf of the Crown
- Dr Beth Fulton appearing for the Crown evidence on ecosystem effects
- Mr Peter Clough appearing for CRP evidence on economics
- Ms Jo Appleyard on behalf of Deepwater Group Limited
- Dr Ganesh Nana appearing for CRP evidence on economics modelling

Day 10 — 16 October 2014

Basin Reserve, Wellington

Mr Stephen Christensen on behalf of Te Rūnunga o Ngāi Tahu

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Decision on Marine Consent Application - Chatham Rock Phosphate Limited

Mr Alexsandr Sundakov appearing for Deepwater Group, Ngāi Tahu, Ngāti Kahungunu and Te Ohu Kaimoana — evidence on economics

Mr James Winchester on behalf of CRP

Mr Morgan Slyfield on behalf of the DMC

Mr Keiran Murray appearing for the DMC - evidence on economics

Dr Richard O'Driscoll appearing for CRP - evidence on commercial fish and fisheries

Ms Jo Appleyard on behalf of Deep Water Group

Ms Susan Baird appearing for CRP — evidence on ling fisheries

Day 11 — 17 October 2014

Basin Reserve, Wellington

Ms Jo Appleyard on behalf of Deep Water Group

Dr Jeremy Helson appearing for Deepwater Group, Ngāi Tahu, Ngāti Kahungunu, Te Ohu Kaimoana and Fisheries Inshore New Zealand — evidence on fish stock

Mr James Winchester on behalf of CRP

Dr David Middleton appearing for Deepwater Group, Ngāi Tahu, Ngāti Kahungunu, Te Ohu Kaimoana and Fisheries Inshore New Zealand — evidence on fish stock

Mr Hamish Harwood on behalf of CRP

Mr Alistair Dunn appearing for CRP - evidence on fish stocks

Ms Amy Hill appearing for Deepwater Group, Ngāi Tahu, Ngāti Kahungunu, Te Ohu Kaimoana and Fisheries Inshore New Zealand

Mr Morgan Slyfield on behalf of the DMC

Dr Johanna Pierre appearing for the DMC — evidence on commercial fishing

Day 12 — 20 October 2014

Basin Reserve, Wellington

Dr Nick Roskruge appearing for Ngā Kaihautū Tikanga Taiao

Ms Evelyn Tuuta appearing for herself — representation

Mr Turoa Karatea appearing for Evelyn Tuuta - representation

Mr Te Moananui a Kiwa Erueti-Newman appearing for Evelyn Tuuta - representation

Mr Greg Summerton appearing for Ngāi Tahu — evidence on long lining fisherman

Mr James Winchester on behalf of CRP

Mr Kauahi Koroneho Ngāpora appearing for Whale Watch Kaikoura — evidence on Kaikoura whale watch

Mr Hamish Harwood on behalf of CRP

Mr Rodney Tribe appearing for Ngāi Tahu Seafoods — evidence

Ms Maria Bartlett appearing for Ngāi Tahu — evidence on existing interests

Ms Kirsty Woods appearing for Te Ohu kai Moana Trustee Ltd — representation on existing interests fisheries

Mr Laws Lawson appearing for Te Ohu kai Moana Trustee Ltd — representation on existing interests fisheries

Day 13 - 21 October 2014

Basin Reserve, Wellington

Mr Ngahiwi Tomoana appearing for Ngāti Kahungunu Iwi Incorporated — representation

Mr Duncan Currie on behalf of KASM, Greenpeace and DSCC

Associate Professor Liz Slooten appearing for KASM, Greenpeace and DSCC — evidence on marine mammals

Mr James Winchester on behalf of CRP

Mr Stephen Christensen on behalf of Te Rūnunga o Ngāi Tahu

Mr Tara Ross Watt appearing for Deepwater Group, Ngāi Tahu, Ngāti Kahungunu, Te Ohu Kaimoana — evidence on marine mammals and marine management regimes

Mr Duncan Currie on behalf of KASM, Greenpeace and DSCC

Dr Darlene Ketten appearing for CRP - evidence on effects of noise on marine mammals

Mr Jeremy Prebble on behalf of the Crown

Dr Simon Childerhouse appearing for the Crown - evidence on marine mammals

Mr Hamish Harwood on behalf of CRP

Mr Martin Cawthorn appearing for CRP — evidence on marine mammals

Ms Eleanor Jamieson on behalf of the Crown

Day 14 — 22 October 2014

Basin Reserve, Wellington

Mr Jeremy Prebble on behalf of the Crown

Mr Darran Humpheson appearing for the Crown - evidence on effects of noise on marine mammals

Mr Duncan Currie on behalf of KASM, Greenpeace and DSCC

Mr James Winchester on behalf of CRP

Mr Morgan Slyfield on behalf of the DMC

Dr Mike Huber appearing for the DMC — evidence on impacts on fish and mammals

Ms Ruby Haazen on behalf of KASM, Greenpeace and DSCC

Ms Eleanor Jamieson on behalf of the Crown

Mr Stephen Christensen on behalf of Te Rūnunga o Ngāi Tahu

Mr Darryl Sykes appearing for CRA6 Rock Lobster Industry Association — evidence on rock lobster fisheries management

Day 15 — 23 October 2014

Basin Reserve, Wellington

Mr Robert Goodden representing himself — representation

Mr Mac Beggs representing himself - representation

Mr Gareth Hughes representing the Green Party of Aotearoa - representation

Day 16 — 29 October 2014

Kingsgate Convention Centre, Hamilton Mr Ray Wood on behalf of CRP Ms Ruby Haazen on behalf of KASM, Greenpeace and DSCC — opening representation Mr Phil McCabe representing himself — representation Mr John Paul Martin representing himself — representation Ms June Penn representing herself — representation Ms Vera van der Voorden representing herself — representation Ms Nora van der Voorden representing herself — representation Ms Vera van der Voorden representing herself — representation Ms Vera van der Voorden representing herself — representation Ms Vera van der Voorden representing herself — representation Ms June Penn representing himself — representation Mr Paul Havemann representing himself — representation Ms June Penn representing Felipe Bonfanti de Barros — representation Ms Denise Davis representing herself — representation Mr Apirana Daymond representing herself — representation

Day 17 — 30 October 2014

Kingsgate Convention Centre, Hamilton Ms Nicole Hancock representing herself — representation Ms Tui Allan representing herself — representation Ms June Penn representing Linda Silvester — representation Ms June Penn representing herself — representation Ms Christine Rose representing herself — representation

Day 18 — 3 November 2014

Basin Reserve, Wellington Mr James Winchester on behalf of CRP Mr Richard Johnson representing the EPA Mr Simon Lamping representing the EPA Ms Amy Hill on behalf of Deepwater Group, Ngāi Tahu, Ngāti Kahungunu, Te Ohu Kaimoana and Fisheries Inshore New Zealand Ms Gemma Couzens representing the EPA Dr David Weller representing the EPA Mr Manu Graham representing the EPA

Mr Jeremy Prebble on behalf of the Crown

Day 19 — 4 November 2014

Basin Reserve, Wellington Mr John Lawson representing himself — representation Ms Jo Appleyard on behalf of Deepwater Group and Sanford Limited Mr George Clement appearing for the Deepwater Group — evidence Mr James Winchester on behalf of CRP Mr Hamish Harwood appearing for CRP Mr Doug Paulin appearing for Deepwater Group — evidence on fisheries Mr Peter Connolly appearing for Deepwater Group — evidence on fisheries Mr Darryn Shaw appearing for Sanford Ltd — evidence on existing Interests Mr Shane Walls appearing for Deepwater Group — evidence on fisheries Mr Chris Patrick appearing for Deepwater Group — evidence on fisheries Mr Andrew Smith appearing for Deepwater Group — evidence on fisheries

Day 20 — 5 November 2014

Basin Reserve, Wellington Mr Brian Sandle representing himself — representation Mr Joseph Hassell representing himself — representation

Day 21 — 6 November 2014

Basin Reserve, Wellington

Mr Campbell McKenzie appearing for CRP - evidence on phosphate mining and mining permits / licences

Mr Stephen Christiansen on behalf of Te Rūnunga o Ngāi Tahu

Ms Jo Appleyard on behalf of Deepwater Group

Mr James Winchester on behalf of CRP

Dr Ashley Rowden appearing for CRP — evidence on benthic communities, habitat modelling, recolonisation and spatial planning

Ms Ruby Haazen on behalf of KASM, Deepsea Conservation Coalition and Greenpeace

Ms Eleanor Jamieson on behalf of the Crown

Dr Paul Krause appearing for Deepwater Group, Ngāi Tahu, Ngāti Kahungunu and Te Ohu Kaimoana — evidence on impacts on fish

Mr Michael Page appearing for CRP - evidence on impacts of sediment plume on fish and fish eggs

Mr Jeremy Prebble on behalf of the Crown

Mr Barry Weeber and Catherine Wallace representing Environment and Conservation Organisations of New Zealand Inc — representation

Day 22 — 10 November 2014

Basin Reserve, Wellington

Mr Maui Solomon representing Hokitehi Trust - representation

Ms Ruby Haazen on behalf of KASM, Deepsea Conservation Coalition and Greenpeace

Dr Marie Brown appearing for Environmental Defence Society - evidence on proposed conditions

Day 23 — 12 November 2014

The Den, Chatham Islands

Ms Linda Sanders representing CRP

Mr Gary Cameron representing PauaMAC4 Industry Association Inc - representation

Ms Paula Paige and Mr Ward Kamo representing Ngāti Mutunga o Wharekauri Iwi Trust — representation

Mr Chris Castle representing CRP

Mr Jeff Clarke representing the Chatham Islands Council - representation

Mr Gary Cameron representing PauaMAC4 Industry Association Inc - representation

Mr Phillip Ross Christiansen representing himself - representation

Mr Jack Daymond representing himself - representation

Mr Jeff Clarke representing CRA 6 Rock Lobster Industry Association Inc - representation

Mr Ian Maxwell representing himself — representation

Day 24 — 17 November 2014

Basin Reserve, Wellington

Mr James Winchester on behalf of CRP

Mr Paul Kennedy appearing for CRP — evidence on assessment of environmental impact

Mr Duncan Currie on behalf of KASM, Deepsea Conservation Coalition and Greenpeace

Mr Stephen Christensen on behalf of Te Runanga o Ngāi Tahu

Mr Jeremy Prebble on behalf of the Crown

Ms Andrea Rickard appearing for Ngāi Tahu et al.— evidence on proposed conditions Mr Christopher Rendall appearing for the Crown — evidence on proposed conditions Mr Urs Signer representing himself — representation

Day 25 — 18 November 2014

Basin Reserve, Wellington

Mr James Winchester on behalf of CRP

Ms Carmen Taylor appearing for CRP - evidence on proposed conditions

Mr Stephen Christensen on behalf of Te Rūnunga o Ngāi Tahu - closing statement

Mr Duncan Currie on behalf of KASM, Deepsea Conservation Coalition and Greenpeace — closing statement

Ms Nicola de Wit on behalf of EDS - closing statement

Ms Jo Appleyard on behalf of the Deepwater Group - closing statement

Mr Peter Anderson on behalf of Forest and Bird - closing statement

Mr Jeremy Prebble on behalf of the Crown — closing statement

Day 26 — 19 November 2014

Basin Reserve, Wellington

Mr James Winchester on behalf of CRP - closing statement

Mr Hamish Harwood on behalf of CRP - closing statement
Decision on Marine Consent Application – Chatham Rock Phosphate Limited

Appendix 3: CRP Proposed Conditions

Proposed Marine Consent Conditions

Purpose

To mine phosphorite from the Chatham Rise seabed and undertake associated surveying and monitoring, for a term of 35 years, subject to the following conditions:

Definitions	
Chief Executive	The Chief Executive of the Environmental Protection Authority (or his or her designate appointed in writing).
EEZ Act	Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012.
EMMP	Environmental Management and Monitoring Plan.
EPA	Environmental Protection Authority, the consent authority for this marine consent under the EEZ Act.
ERG	Environmental Reference Group. A group established in accordance with the conditions of this consent. The purpose of the ERG is to provide independent and objective advice to both the Consent Holder and the Chief Executive in relation to all relevant matters covered by the conditions of this consent.
mining and mining activities	means the extraction of phosphorite nodules from the seabed by the mining vessel.
mining block	the areas, generally 5 by 2 km in dimension, that have been or are to be mined.
unexpected adverse impact	an adverse impact, after the application of avoidance, remediation and mitigation measures, which is beyond the scope and significance of those outlined in the marine consent application and associated EIA.

Explanatory Notes

- (i) A number of the conditions in this marine consent rely upon a certification process which is to be carried out by the Chief Executive. The criteria to be used for the certification process are whether the intent and purpose of the condition is being met. For most of the certification conditions, the intent and purpose of the conditions are generally descriptive rather than prescriptive. In recognition of this approach, in all instances where a certification process is proposed, the condition provides the Chief Executive with the opportunity to seek expert advice from appropriate external reviewers and / or experts. This approach has been utilised as an alternative to a prescriptive peer review process.
- (ii) In addition to complying with the conditions of this marine consent, granted under the EEZ Act, the Consent Holder must also ensure that it complies with the requirements of other relevant New Zealand statutes and Regulations. At the time that this marine consent was granted, this

includes, but is not limited to, the Biosecurity Act 1993, <u>the Crown Minerals Act 1991</u>, the Marine Mammals Protection Act 1978, the Maritime Transport Act 1994 and associated Rules, and the Wildlife Act 1953. Specific documentation, required under New Zealand statutes or Regulations, that is relevant to environmental management aspects of the Consent Holder's activities include: the approved International Oil Pollution Prevention Certificate for the mining vessel; the approved Shipboard Oil Pollution Emergency Plan for the mining vessel; a biosecurity clearance approval for the mining vessel upon first entry into New Zealand waters; the approved certificate for the environmental liability (marine oil spill) insurance held for the mining vessel; and, any permit under the Wildlife Act 1953 to take coral.

Mining Operations in Accordance with Application and Consent

1. The Consent Holder must undertake all activities in general accordance with the marine consent application, consisting of Volumes One and Two, entitled "Chatham Rock Phosphate Limited – Proposed Mining Operation – Marine Consent Application and Environmental Impact Assessment" submitted to EPA in May 2014, although subject to the subsequent information provided to the EPA as part of the processing of the marine consent application which has resulted in modifications to the proposal and which have been accommodated within these conditions.

Where there is inconsistency or ambiguity between the marine consent application (including the associated EIA) documents listed in this condition and the conditions of this consent, these conditions prevail.

- 2. The Consent Holder must ensure that all personnel and contractors undertaking work and tasks authorised by this consent are made aware of the conditions of this consent and that all personnel and contractors undertake their operations to ensure compliance with those conditions.
- 3. At all times, a copy of all plans and management plans required in accordance with the conditions of this consent, including a copy of this marine consent, must be readily available at the Consent Holder's offices and on the vessel undertaking the mining operations and related activities.

Notices of Commencement – Monitoring and Mining

- 4. At least one calendar month prior to the initial commencement of the proposed monitoring outlined in Schedule 2A, the Consent Holder must advise the Chief Executive, in writing, of the proposed monitoring commencement date.
- 5. At least six calendar months prior to mining activities, the Consent Holder must advise the Chief Executive, in writing, of the proposed mining commencement date.

Mining Operations and Mining Vessel – Restrictions and Controls

6. The Consent Holder must ensure that a Coastal Navigation Warning, or other appropriate navigation warning, is promulgated at least one day prior mining commencing on each mining block. The purpose of this notice or warning is to advise other marine traffic, including fishing vessels, of the presence of the mining vessel and associated mining equipment within the area being mined.

- 7. The Consent Holder <u>mustshall</u> ensure that no food wastes are discharged from the mining vessel while mining or in transit to and from port. Food waste is to only be disposed of at appropriate facilities once the vessel returns to port. Food wastes, food products, and any biological material retained with the phosphorite nodules, are to be stored on the vessel in a manner that cannot be readily accessed by seabirds.
 - 8. The sewage and greywater treatment system on the mining vessel must comply with the Grade A standard for wastewater treatment as defined in Schedule 6 of the Resource Management (Marine Pollution Regulations) 1998.
 - 9. At all times, the Consent Holder, in order to carry out its mining operations in accordance with this consent, must only:
 - (a) operate one mining vessel at any one time; and
 - (b) mine 30 km² of seabed per year, averaged over the current year and the previous 4 years of mining, while mining is occurring and no more than 35 km² in any 12 month period; and
 - (c) mine within a mining block with a single pass only of the drag-head.
 - 10. During the first 5 years of mining operations, mining may only occur in a 820 km² area, located on the crest of the Chatham Rise, within the Consent Holder's mining permitarea marked (MP) 55549 on the map in Attachment A.

After the first 5 years of mining and provided the adaptive management requirements of Condition 40 have been met, the Consent Holder may also undertake mining operations<u>outside</u> <u>MP 55549</u>, in the remainder of the marine consent area, as shown on the map in Attachment A. in the following areas on the crest of the Chatham Rise, but only if the Consent Holder has obtained the relevant mining permits pursuant to the Crown Minerals Act 1991 (or any different resource access approval if this legislation is replaced):

that area of 2,886 km² associated with the minerals prospecting licence (MPL) 50270, which excludes the 1,019 km² relinquished by the Consent Holder and the 820 km² associated with MP 55549 located in the western end of MPL 50270; and

that area of 1,501 km² associated with the Consent Holder's application for a prospecting permit (PP) 55971 adjoining and located to the west of MPL 50270.

The locations of these areas are shown in the figure in Attachment A to this consent.

Advice Note: The Consent Holder will also need to obtain and hold any other authorisations required under New Zealand.

- 11. During the first 3 years of mining operations, the Consent Holder must only carry out mining within the mining blocks identified in Attachment B of this consent. These mining blocks are:
 - (a) sufficiently separated such that sedimentation impacts between the mining blocks are minimised in any given year; and
 - (b) sufficiently removed from the areas predicted to have benthic communities with high biodiversity values, including but not limited to communities characterised by significant

densities of the cold water coral *Goniocorella dumosa*, so as to minimise potential adverse impacts from sedimentation and total suspended solids.

Advice Note:

- (i) The mining restriction provided for by part (b) of this condition, enables the Consent Holder to firstly ground-truth the modelling upon which the initial identification of the mining exclusion zones are based and if need be, as provided for by Condition 14(b), identify amended or additional mining exclusion zones. Also, during this time the monitoring of the actual impacts from total suspended solids and sedimentation on benthic communities, as outlined in Schedule 2, will occur.
- (ii) Attachment B identifies fifteen mining blocks. The mining blocks to be mined during the first 12 months of mining, including a reserve block, are identified in the attachment. For the second and third years of mining, the Consent Holder may choose to mine any six of the twelve remaining mining blocks that on-going exploration surveys identify as containing the most phosphorite. The annual Mine Plan for the second and third years of mining, as required by Conditions 25 to 28, will identify the mining blocks, including reserve blocks, to be mined in the coming year.
- 12. The Consent Holder must ensure that the material returned to the seabed from the mining vessel is:
 - (a) released at a height of 10 m above the seabed, on average, per mining block;
 - (b) released within or alongside the mining block that is being mined by the mining vessel; and
 - (c) released, at all times, through a diffuser or similar technology which ensures that the material is discharged at low outflow velocities (as close to zero, relative to the seabed) to minimise plume development.

The Consent Holder must implement and maintain a monitoring and record system that confirms the height at which the processed material from the mining vessel is released to the seabed and to calculate the discharge velocity by measuring the rate at which the material enters the sinker, and the mining vessel speed and the properties of the diffuser being utilised. At a minimum, monitoring shall ensure that appropriate data are collected, for these two key parameters, with at least thirty data points being collected during each hour that the sediment is being released. The Consent Holder must provide a record of this monitoring to the Chief Executive within 5 workings days of receiving a request for the data from the Chief Executive. The Consent Holder must also report on compliance with this condition in the report required by Conditions 38 and 39.

- 13. The Consent Holder may only carry out mining in areas where the sediment composition in the area to be mined has been determined by sample collection and particle size distribution analysis to confirm that the return of processed material from the mining vessel to the seabed will comply with the environmental thresholds outlined in Schedule 1. Sediment sample collection must consist of at least 40 representative cores per mining block.
- 14. The Consent Holder must ensure that mining does not occur in the following areas:

- (a) the mining exclusion areas identified in the figure in Attachment C to this consent, including a 1,700 m buffer strip that extends around the mining exclusion areas;
- (b) any amended or additional mining exclusion areas identified by the Consent Holder as a result of research undertaken prior to commencement of any mining operations as outlined in Schedule 2 or further prospecting activities, including areas of significant coral thickets, significant marine biodiversity and areas of cultural significance. Amended or new mining exclusion areas must provide for no decrease in the total coverage and biodiversity value of the mining exclusion areas within the areas covered by this consent. Any amended or additional mining exclusion areas that are identified are to be advised in writing to the Chief Executive for reviewcertification, including possible assessment by an appropriate external reviewer. Within one month of receiving this assessment, the Chief Executive must either certify that the proposed amended or additional mining exclusion areas meet the requirements of this condition, request-require amendments and / or request-advise the Consent Holder of a timeframe extension for further evaluation. Upon receiving certification for the amended or additional mining exclusion area, these areas are to be identified in a revised figure contained in Attachment C of this consent; and
- (c) areas of igneous or metamorphic basement rock outcrops, at the seabed, greater than 2 km^2 in extent.

<u>Advice Note</u>: Condition 60 provides a best endeavours approach for the Consent Holder to advocate and support for striving to ensure protection mechanisms from a range of activities, not just mining, for the exclusion areas identified under parts (a) and (b) of this condition.

- 15. If, after the first five years of mining, the Consent Holder is able to commence mining outside of MP 55549 and within MPL 50270 during the months of August and September, which are the months associated with ling spawning, the Consent Holder must restrict its mining operations to the area west of longitude 180°.
- 16. If a ship wreck or evidence of the site of a ship wreck, where the wreck occurred before 1900, is identified at any time within any proposed mining block to be mined, the mining block associated with the wreck must not be mined by the Consent Holder. Within 24 hours of discovering any such site, the Consent Holder must notify the Chief Executive, ERG and Heritage New Zealand of the find. The site of any such wreck may only be mined if clearance is received from Heritage New Zealand and the Chief Executive.

<u>Advice Note:</u> The identification of any such wrecks or sites does not preclude the Consent Holder from moving its mining operations to another mining block, provided the new mining block is identified in the Mine Plan required by Conditions 25 to 28.

Environmental Management – Marine Mammals and Seabirds

17. The Consent Holder must ensure that at all times the personnel on the mining vessel, and any support or monitoring vessels, are informed and aware of their obligations under the Marine Mammals Protection Act 1978 and Part 3 of the Marine Mammals Protection Regulations 1992 or any legislation or regulation that replaces these requirements. This includes, but is not limited to, ensuring that:

- (a) the masters of all vessels associated with the mining operations reduce speed to a safe minimum within 300 m of, and take all practical steps to avoid, any whales which may be observed; and
- (b) reporting, <u>within 5 working days</u>immediately to the Department of Conservation, any marine mammal strikes, injuries or deaths.
- 18. On every occasion that the mining vessel returns to the mining location from port and is in place to recommence mining activities, prior to mining recommencing, the Consent Holder must ensure that a mitigation zone extending from the mining vessel in all directions is visually checked. If marine mammals are observed within this zone, then mining operations must not commence. The Consent Holder may only commence mining operations once no marine mammals have been observed within this defined zone for a period of at least two hours. The mitigation zone, subject to ocean conditions enabling the zone to be visually checked, is:
 - (a) 1.5 km until and unless the results of the noise monitoring confirm that noise from the mining vessel and mining equipment is at or below the noise levels used in the acoustic modelling;
 - (b) a reduced zone having been certified by the Chief Executive following an assessment of the noise monitoring and any associated considerations (whether the noise levels are at or below the noise levels used in the noise modelling), including, if required, possible assessment and advice to the Chief Executive by an appropriate external reviewer.

<u>Advice Note:</u> The reference for the 'acoustic modelling' is - McPherson C, Wladichuk J, Schlesinger A 2014. Chatham Rock Phosphate Underwater Acoustic Modelling. JASCO Document 00874, Version 1.0. Technical report by JASCO Applied Sciences for Chatham Rock Phosphate.

- 19. (a) Subject to ensuring that all vessel health and safety requirements are complied with, the Consent Holder must ensure that, at a minimum, the following seabird impact avoidance measures are implemented on the mining vessel:
 - (i) use of lighting on the mining vessel is minimised;
 - (ii) where possible, the utilisation of green light sources is maximised;
 - (iii) deck lighting is shielded and / or faces downwards_to minimise horizontal light emission;
 - (iv) lighting that is not needed at night is turned off;
 - (v) vessel portholes and windows are to be fitted with black-out blinds, and the use of these blinds is to be maximised, to reduce the potential for unnecessary light emissions;
 - (vi) the use of vertical wires and objects on the deck is minimised_or such structures, if required, are designed to minimise any potential bird strike impacts;
 - (vii) maximise the use of low reflective paints on the mining vessel to minimise the potential for reflected light; and

- (viii) ensure that the vessel deck and other surfaces are as free as practicable of oil and other substances that have the potential to adversely affect the functionality of seabird feathers.; and
- (b) Within one month of completion of the design of components of the mining vessel that might impact on seabirds, namely vessel lighting and deck structures, the Consent Holder must forward to the Chief Executive for review the Lighting Management Plan, including a vessel lighting assessment, for the vessel. The purpose of the Lighting Management Plan is to ensure compliance with the requirements of part (a) of this condition and that potential impacts on seabirds are minimised. Within one month of receiving the Lighting Management Plan, the Chief Executive must either-certify that the Lighting Management Plan:
 - (i) <u>certify that the Lighting Management Plan</u> meets the requirements of this condition; or
 - (ii) advise the Consent Holder that amendments are required; and / or
 - (iii) request a timeframe extension for further evaluation of advise the Consent Holder that the time for evaluation the Lighting Management Plan has been extended and when that evaluation will be complete. including possible assessment by an appropriately qualified and experienced external reviewer.

Prior to making a decision about whether or not to certify the Lighting Management Plan, the Chief Executive may seek an assessment of the Lighting Management Plan by an appropriately qualified and experienced external reviewer. If the Chief Executive requests amendments and / or a time extension in accordance with parts (ii) and (iii) of this condition, these steps must occur simultaneously.

If the Chief Executive advises_that amendments are required in accordance with this condition, the Chief Executive must advise the Consent Holder within 10 working days of receipt of the revised Lighting Management Plan, or at a later time advised by the Chief Executive, whether it is certified or not. If the Chief Executive does not advise the Consent Holder within the timeframes specified within this condition, the Lighting Management Plan is deemed to be certified by the Chief Executive.

- 20. (a) For at least the first year of mining operations and for no more than two years of mining operations, the Consent Holder must ensure that independent and appropriately trained seabird and marine mammal observers are on the mining vessel while the mining vessel is at sea. These independent observers will be responsible for observing and recording the presence of seabirds and marine mammals in and around the mining vessel and the nature of interactions with the mining vessel, if any.
 - (b) No earlier than one year after the commencement of mining operations, the Consent Holder may submit to the Chief Executive for review, a report, prepared by appropriately qualified seabird and marine mammal experts, based on the observations of marine mammals and seabirds collected in accordance with part (a) of this condition, assessing the ongoing risk to seabirds and marine mammals from the mining operations. If the report identifies that the ongoing risk is low and that in the expert's opinion the independent observers are no longer required to carry out the role outlined in part (a) of this condition, then within one month of receiving the report, the Chief Executive

may accept, or decline, the recommendations of the report, or request a timeframe extension for further evaluation of the assessment including possible assessment by an external reviewer. If the Chief Executive accepts the recommendations of the report, the Consent Holder may cease using independent observers in accordance with this condition.

- 21. Once the independent and appropriately trained seabird and marine mammal observers are no longer required in accordance with Condition 20, the Consent Holder must ensure that relevant personnel on the mining vessel undertake appropriate training, in conjunction with the relevant regulatory authority, in the identification, recording and reporting of the presence of marine mammals and seabird species in and around the mining vessel. These trained personnel will be primarily responsible for continuing to observe and record the presence of seabirds and marine mammals in and around the mining vessel and the nature of interactions with the mining vessel, if any.
- 22. The Consent Holder must also ensure that all personnel undertaking work at sea are provided with a marine mammal and seabird species identification guide to help ensure accurate species identification. All personnel are to be instructed to report any relevant sightings to the trained observers.
- 23. The Consent Holder must record and maintain a log of all strikes of seabirds that occur on the mining vessel, including photographs (whole body and at least two head shots), date, time, weather conditions, species (where known) and whether the bird was dead or released alive. If they are able to be safely recovered, dead birds are to be bagged, labelled, frozen and provided to the Department of Conservation when the mining vessel next returns to port.
- 24. The Consent Holder must record and maintain a log of all sightings of marine mammals, including location, species and number of animals. Annually, on 31 October, the Consent Holder shall provide a copy of this log to the Chief Executive and the Department of Conservation.

Mine Plan

25. At least three calendar months prior to mining activities commencing, the Consent Holder must forward to the Chief Executive a Mine Plan. The purpose of the Mine Plan is to describe the operational mining activities, including vessel operations, which are to take place in the coming calendar year.

The Mine Plan must provide, at least, the following information:

- (a) confirmation of the mining method to be utilised, including but not limited to, the seabed mining method, the separation method and the method used to return the processed material from the mining vessel to the seabed;
- (b) management and maintenance requirements for key components of the mining operations;
- (c) the location of the areas that are not to be mined (identified by latitude and longitude and associated maps), or which are not to be mined during specific time periods, in accordance with Conditions 14 and 15 of this consent;

- (d) the location of the mining blocks to be mined over the next 12 months (identified by latitude and longitude and associated maps), including identification of a reserve mining block/s;
- (e) identification of the predicted extent of sediment deposition associated with the return to the seabed of the processed material from the mining vessel, including the implications of the known sediment composition of the mining blocks as determined by sampling;
- (f) restrictions, if any, that will apply to navigation while mining is occurring;
- (g) contingency procedures to prevent and deal with unusual events, including but not limited to, extreme weather events and equipment failure; and
- (h) other actions necessary to comply with the conditions of this consent and any other relevant regulatory or legislative requirements including any relevant environmental management requirements arising out of the EMMP required by Conditions 29 or 30 of this consent.
- 26. No later than 31 October of each year while mining operations continue, the Consent Holder must update the Mine Plan and forward the updated Mine Plan to the Chief Executive. The updated Mine Plan is to provide the information identified in Condition 25 above for the following calendar year, and at least the following additional information:
 - (a) confirmation of the areas mined in the previous 12 month period (identified by latitude and longitude and associated maps);
 - (b) the volume of material retained and transferred to port in the previous 12 month period; and
 - (c) any changes to the mining method utilised or mine plan approach as a result of:
 - (i) any adaptive management approaches that have been implemented in accordance with Condition 41;
 - (ii) an assessment of all relevant environmental and monitoring data that has been gathered by the Consent Holder; and
 - (iii) any environmental management considerations identified as a result of the EMMP's audit and review procedures (as required by Condition 29).
- 27. Within one month of receiving the Mine Plan from the Consent Holder in accordance with Conditions 25 or 26, the Chief Executive must either certify that the Mine Plan meets the requirements of Conditions 25 or 26, advise the Consent Holder that amendments are required and / or request a timeframe extension for further evaluation Mine Plan including possible assessment by an external reviewer. If the Chief Executive advises that amendments are required in accordance with this condition, the Chief Executive must advise the Consent Holder within 10 working days of receipt of the revised Mine Plan, or at a later time advised by the Chief Executive, whether it is certified or not. If the Chief Executive does not advise the Consent Holder within the timeframes specified within this condition, the Mine Plan is deemed to be certified by the Chief Executive.

28. The Consent Holder must ensure that mining operations are undertaken at all times in accordance with the certified Mine Plan.

Environmental Management and Monitoring Plan (EMMP)

- 29. At least three calendar months prior to the commencement of mining activities, the Consent Holder must forward to the Chief Executive an EMMP. The purpose of the EMMP is to provide a management and operational framework which continually guides and informs measures and management approaches, to ensure compliance with the conditions of this consent and in accordance with the avoid, remedy or mitigate hierarchy for the prevention or management of any adverse impacts associated with the Consent Holder's mining operations. The EMMP must include, but not be limited to:
 - (a) the Consent Holder's environmental policy;
 - (b) the purpose of and objectives for the EMMP;
 - (c) a list of key personnel and points of contact, including but not limited to personnel with specific environmental management responsibilities under the conditions of the consent and the EMMP;
 - (d) management procedures including, but not limited to, continued identification of potential environmental impacts, assessment of relevant legal requirements, development of an environmental programme for the management of environmental impacts, identification of roles and responsibilities, environmental and operations training requirements, internal and external communication, documentation and document control, the management of and response to environmental incidents, <u>contingency planning</u>, audit and review;
 - (e) standard operating procedures, as they relate to potential environmental impacts. These procedures must include, but not be limited to, biosecurity management of the mining vessel and all mining equipment in water, potential interaction with wildlife including marine mammals, waste management (solid and liquid), vessel lighting and the management of interactions with seabirds, vessel and other operational noise, equipment loss at sea, hazardous substances management, mining operations, dealing with any spillages including of oil and hazardous substances and generally minimising potential environmental impacts associated with mining;
 - (f) monitoring procedures required to implement the monitoring programme, including the monitoring described in Schedule 2 and Conditions 12, 13, 23 and 24 of this consent. Monitoring procedures must include, but not be limited to, the monitoring objectives, monitoring requirements and associated roles and responsibilities, calibration and repair requirements for the equipment, processes for monitoring compliance reviews and audits, non-conformance and corrective actions and control of monitoring records; and
 - (g) other procedures or actions necessary to comply with all of the conditions of this consent and any other relevant regulatory or legislative requirements.

The Consent Holder may prepare separate, but subsidiary to the EMMP, management plans to comply with this condition.

<u>Advice Note:</u> Within the marine consent application, the Consent Holder identified at least 2 separate but subsidiary management plans. These are the Lighting Management Plan, now specifically required by Condition 19 of this consent, and the Solid Waste Management Plan.

- 30. The Consent Holder must audit and review the EMMP as follows:
 - (a) at a minimum, no later than 30 September of each year while mining operations continue;
 - (b) if an environmental threshold identified is Schedule 1 is exceeded or an unexpected adverse impact triggers the adaptive management process outlined in Condition 41; and
 - (c) if an environmental incident has occurred, or a complaint has been received, that has triggered the need to advise the Chief Executive in accordance with Condition 42 of this consent.
- 31. The Consent Holder must provide the Chief Executive with a copy of the EMMP within one month and no later than 31 October of it being reviewed and updated in accordance with Condition 30.
- 32. Within 1 month of receiving the EMMP from the Consent Holder in accordance with Conditions 29 or 30, the Chief Executive must either certify that the EMMP meets the requirements of Conditions 29 or 30, advise the Consent Holder that amendments are required and / or request advise the Consent Holder of a timeframe extension for further evaluation of the EMMP including possible assessment by an external reviewer. If the Chief Executive advises that amendments are required in accordance with this condition, the Chief Executive must advise the Consent Holder within 10 working days of receipt of the revised EMMP, or at a later time advised by the Chief Executive, whether it is certified or not. If the Chief Executive does not advise the Consent Holder within the timeframes specified within this condition, the EMMP is deemed to be certified by the Chief Executive.
- 33. At all times, the Consent Holder must ensure that all operations are undertaken in accordance with the requirements of the certified EMMP, including any subsidiary management plans which includes the Lighting Management Plan.

Monitoring

- 34. The Consent Holder must implement and carry out the monitoring programme described in Schedule 2.
- <u>35.</u> At least one month prior to any component/s of the monitoring described in Schedule 2 commencing, the Consent Holder must forward to the Chief Executive for <u>review_certification</u> a detailed methodology for the monitoring that is to be carried out. Within 10 working days of receiving the methodology, the Chief Executive must either certify that the methodology is appropriate for the monitoring that is to be carried out, advise the Consent Holder that amendments are required and / or <u>request advise the Consent Holder of</u> a timeframe extension for further evaluation of the methodology for the monitoring that is to be carried out.

Prior to making a decision about whether or not to certify the methodology for the monitoring, the Chief Executive may seek an assessment of the methodology by an appropriately qualified and experienced external reviewer., including possible assessment by an external reviewer. If the Chief Executive advises that amendments are required, the Chief Executive must advise the Consent Holder within 5 working days of receipt of the revised methodology, or at a later <u>time advised by the Chief Executive</u>, whether it is certified or not. If the Chief Executive does not advise the Consent Holder within the timeframes specified within this condition, the methodology for the component of the monitoring to which it applies is deemed to be certified by the Chief Executive.

Advice Note: It is anticipated that these monitoring methodologies, once mining activities commence and the EMMP is prepared, will form part of the monitoring procedures required by Condition 29(f) of this consent.

35.36. Once mining operations have commenced, irrespective of any reporting requirements in relation to monitoring, the Consent Holder must ensure that it has in place procedures that ensures that all monitoring data are routinely reviewed and assessed in terms of compliance with the conditions of this consent.

Advice Note: This procedure/s is to be included in the EMMP.

36.<u>37.</u> The Consent Holder must ensure that the reporting requirements for the monitoring programme, as described in Schedule 2, are complied with. The Consent Holder must provide copies of all monitoring reports to the Chief Executive and to the ERG.

Reporting

- 37.38. No later than 30 April and 31 October during the first two years of mining operations, and thereafter no later than 31 October of each year, the Consent Holder must forward a report to the Chief Executive and the ERG.
- <u>38.39.</u> The report must include, but not necessarily be limited to, the following:
 - (a) assess compliance with the conditions of this consent and provide detailed explanations of any non-compliance and measures taken accordingly to remedy these;
 - (b) provide an appropriate record of the ERG meetings;
 - (c) analyse and summarise the results of monitoring undertaken in accordance with the conditions of this consent (as described in Conditions 12, 13, 23 and 24 and Schedule 2), and, if appropriate, make recommendations in relation to monitoring programme changes;
 - (d) report on the observed marine mammals and seabird sightings in and around the mining vessel, and a copy of the sighting logs;
 - (e) summarise and analyse incidents or complaints receiving during the reporting period;
 - (f) provide an overview of the funds held by the Trusts established in accordance with Condition 54 and 57, the activities funded by the Trust and the outcomes or results arising from this funding;
 - (g) provide an overview of other deliverables provided to the Chief Executive in accordance with the conditions of this consent. This includes, but is not limited to, whether any adaptive management process assessments have been or have been initiated, the Mine Plan, the EMMP and any other subordinate management plans; and

(h) detail any other issues considered important and relevant by the Consent Holder.

Adaptive Management Approach – Staged Mining

- 39.40. After the first five years of mining operations, the Consent Holder may undertake mining activity within areas outside of mining permit 55549 specified in Condition 10, provided the Consent Holder meets the following requirements:
 - (a) that an adaptive management response, as described in Condition 41, either:
 - (i) has not been triggered, as a result of an exceedance of an environmental threshold identified within Schedule 1, within the past 2 years; or
 - (ii) if an environmental threshold has been exceeded and a response has been triggered, then a successful adaptive management solution has been implemented that has ensured that the environmental threshold/s have not been exceeded over the preceding 12 months.
 - (b) in relation to a proposed additional area to be mined, the following prospecting activities, as outlined in Schedule 2C, have been completed:
 - (i) bathymetry has been confirmed;
 - (ii) sampling of the physical characteristics of the seabed has been carried out; and
 - (iii) sampling (defined as epibenthic photography and infaunal sampling) of the benthic ecology has been carried out.
 - (c) in addition to (a) and (b) above, the Consent Holder has performed additional plume modelling studies for the proposed additional mining area based on oceanographic (including current meter) data collected for the proposed mining area, and that the monitoring data which is relevant to the plume modelling and collected in accordance with Schedule 2 of this consent have been used to calibrate and validate the model. This includes confirming that the environmental thresholds identified in Schedule 1 will continue to be complied with.
 - (d) the Consent Holder has:
 - (i) from the information gathered in accordance with part (b) of this condition, identified additional areas that cannot be mined in accordance with Condition 14;
 - (ii) in accordance with Condition 47, provided the Environmental Reference Group (ERG) with the opportunity to evaluate and provide feedback to both the Consent Holder and the Chief Executive on the information gathered in accordance with this condition and all monitoring data collected and assessed in accordance with the conditions of this consent; and
 - (iii) been granted a mining permit in accordance with the provisions of the Crown Minerals Act 1991_(or any different resource access approval if this legislation is replaced).

- (e) Provided a report to the Chief Executive on the location and nature of the additional mining area as well as compliance with the requirements of this condition.
- (f) Within three months of the receipt of the report provided in accordance with part (e), the Chief Executive must provide certification to the Consent Holder, in writing, as to whether this condition has been complied with. <u>The Chief Executive may advise the Consent Holder of a timeframe extension for further evaluation of the report, including possible assessment by an appropriately qualified and experienced external reviewer.</u> Upon receipt of certification from the Chief Executive that this condition has been complied with, the Consent Holder may commence mining in the additional mining area.

Adaptive Management Approach – Unexpected Adverse Impacts

- 40.41. In circumstances where an environmental threshold identified in Schedule 1 has been exceeded or an unexpected adverse impact associated with the mining operation is identified by the Consent Holder and / or another party as a result of activities authorised by this consent, the Consent Holder must:
 - (a) as soon as practicable and no later than 5 working days of becoming aware of the <u>exceedance of the environmental threshold identified in Schedule 1 or an unexpected</u> adverse impact, advise the Chief Executive in writing;
 - (b) the Consent Holder may continue mining unless the Chief Executive determines that the adverse impact is significant and gives the Consent Holder express instruction in writing to cease until such time a solution can be put in place that ensures that the unexpected adverse impact can be avoided, remedied or minimised;
 - (c) within 1 month of advising the Chief Executive, unless a timeframe extension is requested by the Consent Holder, complete an assessment of adaptive management approaches that can be implemented that will avoid, remedy or minimise the exceedance of the environmental threshold identified in Schedule 1 or an unexpected adverse impact. The assessment must include consideration of relevant environmental and monitoring data. If a solution is identified, the assessment must identify the timeframe for implementation. This assessment must be provided to the Chief Executive for reviewcertification. Within one month of receiving this assessment, the Chief Executive may either certify that the proposed solution meets the requirements of this condition, request amendments and / or advise the Consent Holder of request a timeframe extension for further evaluation of the assessment including possible assessment by an appropriately qualified and experienced external reviewer; and
 - (d) subject to receiving certification from the Chief Executive to proceed with the proposed solution, the Consent Holder must ensure that if an adaptive management approach is to be implemented, it must be implemented in accordance with the timeframe identified in the assessment required by part (c) of this condition.

Advice Note:

(i) If the proposed adaptive management approach entails modifications to any of the key elements of the mining vessel or associated components, such as the drag-head,

separation plant or the material return, then it is acknowledged that it may take some time to implement the proposed management approach.

(ii) If an adaptive management solution is not identified by part (c) of this condition, Condition 74 provides the Chief Executive with the opportunity to review the term of the marine consent and / or the conditions of this consent.

Environmental Incidents

41.42. The Consent Holder must maintain and keep a register of all environmental incidents, including but not limited to exceedances of the environmental thresholds identified in Schedule 1, that are associated with activities authorised by this consent. Upon becoming aware of any environmental incident, the Consent Holder must record:

- (a) the date, time and duration of incident and / or when the incident was identified;
- (b) the location of the mining vessel, and the nature of mining operations taking place, at the time that the incident occurred;
- (c) the cause or likely cause of the incident and any factors, such as weather conditions, that may have influenced its severity;
- (d) the nature and timing of any measures implemented by the Consent Holder to remedy or mitigate any adverse effects, if any, associated with the event or incident;
- (e) the steps to be taken in future to prevent the recurrence of similar events or incidents; and
- (f) any other relevant information.

All of the above actions are to be recorded on the register. <u>A copy of this register must be held</u> on the mining vessel at all times and is to be provided to the Chief Executive upon request. If the incident relates to an exceedance of the environmental thresholds identified in Schedule 1, then the Consent Holder must follow the process outlined in Condition 41 of this consent while also ensuring that the register and associated records required by this condition are maintained in relation to the incident.

42.<u>43.</u> In circumstances where an incident, other than an incident associated with an exceedance of environmental threshold, <u>has or</u> is likely to result in a non-compliance with the conditions of this consent, then the Consent Holder must advise the Chief Executive, as soon as practicable and no later than 5 working days after the Consent Holder becomes aware of the incident. In circumstances where the Chief Executive has been advised of an environment incident under this condition then the Consent Holder must, within 5 working days of completing the investigation required by Conditions 42(c) to (f), provide a copy of the investigation to the Chief Executive.

Complaints

43.44. The Consent Holder must establish and publicise its dedicated communication methods, which provides for 24 hours a day coverage, for receipt of environmental complaints arising from the Consent Holder's mining operations. The dedicated communication methods must also be advised, in writing, to the Chief Executive and the ERG.

- 44.45. The Consent Holder must maintain and keep a register of all environmental complaints, as part of its environmental incident register required by Condition 42, associated with activities authorised by this consent. Upon becoming aware of any environmental complaint, the Consent Holder must record:
 - (a) the date, time and duration of the event associated with the complaint;
 - (b) the nature of the complaint, the time at which it was received, and if the complainant is willing to provide the information, the complainant's name, contact details and their location and the time of the event or incident;
 - (c) the location of the mining vessel, and the nature of mining operations taking place, at the time that the event occurred;
 - (d) the cause or likely cause of the event and any factors, such as weather conditions, that may have influenced its severity;
 - (e) the nature and timing of any measures implemented by the Consent Holder to remedy or mitigate any adverse effects, if any, associated with the event;
 - (f) the steps to be taken in future to prevent the recurrence of similar events; and
 - (g) any other relevant information.

All of the above actions are to be recorded on the register. <u>A copy of this register must be held</u> on the mining vessel at all times and is to be provided to the Chief Executive upon request.

45.46. In circumstances where a complaint is associated with an event that <u>has or</u> is likelty to result in a non-compliance with the conditions of this consent, then the Consent Holder must advise the Chief Executive, as soon as practicable and no later 5 working days after the complaint is received. In circumstances where the Chief Executive has been advised of a complaint under this condition then the Consent Holder must, within 5 working days of completing the investigation required by Conditions 42(c) to (f), provide a copy of the investigation to the Chief Executive.

Environmental Reference Group (ERG)

- 46.47. At least three calendar months prior to mining activities commencing in accordance with this consent, the Consent Holder must establish an ERG. The brief for the ERG must include, but not be limited to:
 - receive all data and reports, including but not limited to the monitoring outlined in Schedule 2, prepared in accordance with this consent, as well as other relevant research that is part of the adaptive management approach described within the conditions of this consent;
 - (b) consider the impacts on the Chatham Rise marine environment of the Consent Holder's mining activities;
 - (c) identify and discuss appropriate measures, or management actions, to address issues identified or to remedy or mitigate unexpected adverse impacts for the Consent Holder to consider, including consideration of proposed adaptive management approaches; and

(d) other matters relevant to the environmental management and performance of the Consent Holder's mining activities.

The ERG are to consider these matters at regular meetings, as required by the Condition 50 of this consent.

47.48. In establishing the ERG in accordance with Condition 47, the Consent Holder must invite representatives from the following organisations and experts with appropriate qualifications or experience or both to join the ERG. The organisations and experts include, but are not limited to:

- (a) one representative from CRP, as the Consent Holder;
- (b) a suitably qualified technical specialist in the field of deep-water marine ecology;
- (c) a suitably qualified specialist in the field of marine sediments and sediment plume dispersion;
- (d) a nominated representative from nominated by the Department of Conservation;
- (e) a representative nominated by the deep-water fishing industry;
- (f) a representative from the Chatham Islands community;
- (g) a representative from an environmental non-government organisation with an interest in the marine ecosystems of the EEZ; and
- (h) an Iwi / Imi representative from the collective of Ngati Mutunga o Wharekauri, Moriori, and Te Runanga o Ngai Tahu.

Additional members may also be co-opted onto the ERG, either temporarily or permanently, to ensure that the ERG has the requisite skills to deliver on the brief described in Condition 47.

<u>Advice Note:</u> To provide for an ERG that is both effective and efficient, it is acknowledged that the Consent Holder may generally seek to restrict the ERG membership to no more than 12 individuals.

48.49. Without limiting the ability of the ERG to set its own procedures, including meetings as and when considered necessary by the ERG, the Consent Holder must provide reasonable administrative, logistical and financial support to facilitate the function of the ERG, including the provision of an independent facilitator to chair ERG meetings.

49.50. The Consent Holder must provide for meetings of the ERG to occur at the following frequency:

- (a) at least twice a year during the first two years of mining operations; and
- (b) after the first two years of mining, at least annually.
- 50.51. The Consent Holder must ensure that all ERG members are advised of meeting dates and location in a timely manner, and no later than one calendar month in advance of the meeting.
- 51.52. The Consent Holder must ensure that all information, including data and reports, that are to be discussed at ERG meetings are provided in a timely manner, and no later than 10 working days in advance of the meeting.

52.53. The Consent Holder must ensure that a record of the ERG meetings is forwarded to the Chief Executive within one month of meetings being held.

Environmental Compensation Trust

- 53.54. The Consent Holder, through the establishment of a Trust, must provide environmental compensation for those areas of its environmental impacts that cannot be avoided, remedied or mitigated. The Trust is to be established before the commencement of mining. Trustees are to be appointed at the Consent Holder's discretion but must include:
 - (a) one representative from CRP, as the Consent Holder;
 - (b) one nominated representative nominated by from the Department of Conservation;
 - (c) a suitably qualified deep-water marine scientist;
 - (d) one representative from Iwi / Imi from the collective of Ngati Mutunga o Wharekauri, Moriori, and Te Runanga o Ngai Tahu; and
 - (e) one representative from an environmental non-government organisation with an interest in the marine ecosystems of the EEZ.
- 54.55. The purpose of the Trust is to administer annual funding, to be settled on the Trust by the Consent Holder, of \$350,000 per annum (annually adjusted for inflation). The first annual settlement must occur on or before the first day that mining takes place and subsequent annual settlements must occur on the anniversary of the first settlement for each year that mining takes place.
- 55.56. The objectives of the Trust, with priority for funding allocation given to objective (a), are:
 - (a) to advance environmental and biodiversity enhancement in the marine environment of the Chatham Rise, and on or around the Chatham Islands; and
 - (b) to support scientific research of the Chatham Rise, in particular geographic areas and biological communities relevant to the Consent Holder's mining operations.

Chatham Islands Trust

- 56.57. The Consent Holder, through the establishment of a Trust, will support initiatives designed to benefit the Chatham Islands and Chatham Islands community, Ngāti Mutunga o Wharekauri and Moriori. The Trust is to be established before the commencement of mining. Trustees are to be appointed at the Consent Holder's discretion but must include:
 - (a) one representative from CRP, as the Consent Holder;
 - (b) at least one representatives from Hokotehi Moriori and at least one representative from Ngati Mutunga o Wharekauri; and
 - (c) at least two representatives from the Chatham Islands community.
- **57.58.** The purpose of the Trust is to administer annual funding, to be settled on the Trust by the Consent Holder, of \$280,000 per annum (annually adjusted for inflation). The first annual settlement must occur on or before the first day that mining takes place and subsequent annual

settlements must occur on the anniversary of the first settlement for each year that mining takes place.

58.59. Priorities for funding, and the objectives of the Trust, are:

- (a) Annually, the Trustees are to allocate up to \$200,000 (annually adjusted for inflation) to the following objectives, with priority for funding allocation given to objective (i). The objectives are:
 - (i) to provide for, initially through investigation and then through implementation, maintenance and enhancement of Chatham Islands farming activities; and
 - (ii) to provide for the enhancement of economic development opportunities on the Chatham Islands.
- (b) Annually, the Trustees are to allocate the remainder of the funds held by the Trust (less the costs of administering the Trust) to the following objectives, with priority for funding allocation given to objective (i). The objectives are:
 - to support education opportunities, through grants or scholarships, for Chatham Islanders, with a particular focus, where possible, on education related to the marine environment, offshore mining operations and vessel operations;
 - to support cultural development initiatives, through education grants and scholarships or through other means, that support the unique cultural needs of Ngati Mutunga o Wharekauri and Moriori, including any initiatives relating to Ngati Mutanga o Wharekauri and Moriori cultural relationship with the marine environment; and
 - (iii) to support other community activities on the Chatham Islands.

Protection of Mining Exclusion Areas

- 59.60. Prior to undertaking and if necessary following commencement of mining operations under this consent, the Consent Holder must:
 - (a) In consultation with the Ministry of Business, Innovation and Employment NZ Petroleum & Minerals, the Department of Conservation, the Ministry for Primary Industries and other interested parties, use best endeavours to establish a legal mechanism to protect the areas referred to in Condition 14(a) and (b), and other areas outside of the marine consent area but identified from the marine spatial planning exercise undertaken by the Consent Holder, from future mining operations and any other activities that would disturb the seabed ; and
 - (b) Upon either:
 - (i) the legal mechanism being established; or
 - (ii) best endeavours being exhausted,

the Consent Holder must provide evidence to the Chief Executive, for the purposes of certification in accordance with the requirements of this condition, of a satisfactory legal mechanism being established or best endeavours discussions being exhausted.

<u>Advice Note:</u> This condition is a proffered condition intended to further protect the mining exclusion areas. It is in addition to the legal protection that is to be sought under Condition 14(a) and (b).

Bond

- 60.61. Pursuant to section 65 of the EEZ Act, prior to mining activities commencing on the Chatham Rise, the Consent Holder must make provision for the maintenance of a bond in favour of the EPA for the purposes of:
 - (a) remediating any long-term unexpected adverse impacts that might arise as the result of the Consent Holder's mining operations; and
 - (b) monitoring the long-term adverse impacts associated with:
 - the loss of benthic habitat as a result of seabed removal as part of the mining operations, including but not limited to the effectiveness of hard-substrate recolonisation areas established by the Consent Holder;
 - the extent of sedimentation deposition, and associated impacts on the benthic environment, as a result of the return of processed material to the seabed from the mining vessel;
- 61.62. The quantum of the bond must be sufficient to cover the estimated costs (including any contingency necessary), and any further sum the Chief Executive considers necessary, associated with the activities outlined in Condition 61 above.
- 62.63. The bond must be in a form certified by the Chief Executive in accordance with the requirements of these bond conditions, and be on the terms and conditions required by the Chief Executive.
- 63.64. The bond must be guaranteed by a guarantor acceptable to the Chief Executive. The guarantor must bind itself to pay for the carrying out and completion of any bond in the event of any default of the Consent Holder, or any occurrence of adverse impact requiring remedy.
- 64.65. Subject to the Chief Executive receiving notice of the Consent Holder's intention to commence mining in accordance with Condition 5, the amount of the bond must be fixed by the the Chief Executive 3 months prior to mining activities commencing on the Chatham Rise and every fifth anniversary thereafter by the Chief Executive. The amount of the bond must be advised in writing to the Consent holder at least one month prior to the review date.
- **65.**<u>66.</u> Should the Consent Holder not agree with the amount of the bond fixed by the the Chief Executive, then the matter must be referred to arbitration in accordance with the provisions of the Arbitration Act 1996. Arbitration must be commenced by written notices by the Consent Holder to the Chief Executive advising that the amount of the bond is disputed, such notice to be given by the Consent Holder within two weeks of notification of the bond. If parties cannot agree upon an arbitrator within a week of receiving the notice from the Consent Holder, then an arbitrator must be appointed by the Arbitrators' and Mediators' Institute of New Zealand Incorporated. Such arbitrator must give an award in writing within 30 days after his or her appointment, unless the Consent Holder and the Chief Executive agree that time may be extended. The parties must bear their own costs in connection with the arbitration. In all other

respects, the provisions of the Arbitration Act 1996 apply. Pending the outcome of that arbitration, the existing bond, if in place, must continue in force.

66.67. If the amount of the bond to be provided by the Consent Holder is greater than the sum secured by the current bond, then within one month of the Consent Holder being given written notice of the new amount to be secured by the bond, the Consent Holder and the guarantor must execute and lodge with the Chief Executive a variation of the existing bond or a new bond for the amount fixed on review by the Chief Executive. Activities authorised by this consent may not be undertaken if the variation of the existing bond or new bond is not provided in accordance with this condition.

67.68. The bond is to be released no more than 10 years after:

- (a) the expiry, surrender, lapsing or cancellation of this consent; or
- (b) the Consent Holder has advised the Chief Executive that all mining activities authorised by this consent have ceased and will not be resumed.

Dispute ResolutionMediation

- 68.69. In the event of any dispute, disagreement or inaction arising from any Chief Executive certification / approvals required by the conditions of this consent, or the implementation of monitoring required by the conditions, that cannot be resolved by the Consent Holder and the Chief Executive within a timeframe of not more than three months, either party may give notice of the intention to engage an independent and appropriately qualified dispute resolutionmediation expert to determine-mediate the matter. The notice must be in writing and must identify the matter to be determined-mediated and reasons that the parties do not agree.
- 69.70. Within one week of giving notice, if the parties cannot agree on a mutually acceptable dispute resolutionmediation expert to determine the matter, then an expert is to be appointed by the Arbitrators' and Mediators' Institute of New Zealand Incorporated.
- 70.71. The appointed dispute resolution mediation expert is to determine facilitate the mediation of the matter before him or her within 30 days of being appointed, unless the Consent Holder and the Chief Executive agree that time may be extended. In determining the matter, the appointed dispute resolution expert is entitled to seek further information and hear from the parties as he or she sees fit.

Advice Note: The dispute resolution process provided for in this condition does not prejudice any party's rights to take enforcement action in relation to the conditions of this consent.

Non-lapsing and Non-cancellation of Marine Consent

71.72. This consent will not lapse until a date 10 years from the grant of the consent. For the avoidance of doubt, during the first 10 years following the grant of this consent, this consent is not liable to cancellation pursuant to section 86 of the EEZ Act.

Marine Consent Review

72.73. The Chief Executive may, within two months of the second anniversary of the grant of this marine consent, and every five years thereafter, serve notice to the Consent Holder, in accordance with sections 76 and 77 of the EEZ Act, of its intention to review either the duration

and / or the conditions of this marine consent for the purposes described in section 76(1) of the EEZ Act.

73.74. At any time, if an adaptive management approach, in accordance with Condition 41, has not been considered to be achievable by the Consent Holder following completion of an assessment carried out in accordance with these conditions, the Chief Executive may serve notice to the Consent Holder, in accordance sections 76 and 77 of the EEZ Act, of its intention to review either the duration and / or the conditions of this marine consent.

Schedule 1 – Environmental Thresholds

If the following environmental thresholds are exceeded the Consent Holder is then required to follow the process provided for by the 'Adaptive Management Approach – Unexpected Adverse Impacts' condition (Condition 41).

Ref.	Parameter / Impact	Purpose	Trigger	Determined by / at	Confirmation mechanism (if applicable)
1A	Total suspended solids (TSS)	To confirm that the TSS levels of the plume generated by the mining operations are in accord with those predicted by the numerical models and to ensure that the impacts on ecological values in the water column, beyond the area of predicted adverse impact from the plume, are no greater than predicted.	50 mg/L (Note: The verification of this trigger will be determined based on turbidity. The correlation between turbidity and total suspended solids will be determined through monitoring to be carried out prior to mining commencing – refer to Schedule 2).	At a point 5 km or greater away from the edge of the mining block being mined OR at a point 50 m or greater above the seabed at any location	 If the results of monitoring, as described in Schedule 2, exceeds the threshold on any occasion, the Consent Holder must: (a) within no more than 48 hours carry out an additional round of monitoring while mining operations are occurring; and (b) if the results of the second round of monitoring exceeds the threshold, carry out two further rounds of monitoring, no more than 48 hours apart, when mining operations next occur; and (c) if the results of additional rounds of monitoring also exceed the threshold, then the adaptive management process outlined in Condition 41 is to be followed.
18	Seabirds	To ensure that adverse impacts on seabirds as a result of contact with equipment on the mining vessel are	Injury or killing of any Chatham Island taiko (<i>Pterodroma</i> <i>magenta</i>) or Chatham petrel (<i>Pterodroma</i> <i>axillaris</i>) by mining	As required by Condition 23, the Consent Holder must ensure that all bird strike events are logged and other specific activities followed.	Not applicable.

Ref.	Parameter / Impact	Purpose	Trigger	Determined by / at	Confirmation mechanism (if applicable)
		avoided.	operations.		
			In any calendar month, injury or killing of more than 2 other seabirds.		
1C	Sedimentation	To confirm that the extent of sediment deposition generated by the mining operations is in accord with that predicted by the numerical models and to ensure that the impacts on ecological values on the seabed, beyond the area of predicted adverse impact from sedimentation, are no greater than expected.	No observed adverse impacts on benthic organisms beyond the distance predicted for 1 mm sedimentation from the mining of one mining block.	At a point no more than 7 km from the edge of a mined mining block.	As determined by examination and assessment of the qualitative seabed images and seabed samples by an appropriately qualified expert, and as collected in accordance with the 'ecological impacts outside of the mining area' as described in Schedule 2.

The environmental thresholds identified in the above table may be amended (reduced or increased), removed or new thresholds added through a replacement Schedule. This reflects an adaptive management approach in terms of the utilisation of environmental thresholds throughout the term of the marine consent. At all times the environmental thresholds are to be set at a level that is consistent with ensuring

the extent of adverse impacts recognised by this consent are not exceeded and / or continuing to minimise adverse impacts associated with mining.

The process to be followed before a replacement Schedule forms part of this consent is:

- (a) The Consent Holder is to prepare a proposed replacement Schedule and an associated report, supported by relevant scientific and / or operational evidence, outlining the reasons for the proposed amendments.
- (b) The Consent Holder is to provide the ERG with an opportunity to review and comment on the proposed replacement Schedule.
- (c) Once tThe Consent Holder and ERG have agreed that replacement Schedule is appropriate, the replacement Schedule is to be provided the proposed replacement Schedule to the Chief Executive for certification review.
- (d) Within one month of receiving the replacement Schedule, the Chief Executive must either certify that the replacement Schedule contains environmental thresholds that continue to reflect appropriate thresholds that reflect the nature of the Consent Holder's ongoing mining operations, request require amendments and / or request advise the Consent Holder of a timeframe extension for further evaluation. At any time prior to making a decision about whether or not to certify a proposed replacement Schedule, the Chief Executive may request an assessment by an appropriately qualified which may include possible assessment by an external reviewer.
- (e) Within five working days of certifying the replacement Schedule, the Chief Executive must ensure that the consent contains the replacement Schedule (including the date at which the Schedule comes into effect).

Schedule 2 - Monitoring

Advice Note: The following schedule described the monitoring required by Conditions 34 and 40. There are also a range of conditions that specifically describe additional monitoring requirements that have not been included in this schedule (Conditions 12, 13, 23 and 24) as this monitoring is required to continue, with any possible amendment, while mining is taking place in accordance with this marine consent.

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting	
2A - Prior to commencement of any mining operations						
i	Water quality	To obtain and analyse water samples to determine the near seabed water quality.	Collection of water samples from 10 m above the seabed from three locations, one in MP 55549 and two non-mining locations at least 50 km away from MP 55549. At each location, on the occasion that the sample is being collected, measurements of salinity, temperature and dissolved oxygen will be collected from the surface to the seabed at appropriate intervals to identify vertical variation within the water column for these parameters. Five samples, collected every 500 m along a 2 km long transect, will be collected at each location. Total of 15 samples. Samples will be analysed for the following parameters: - total suspended solids and turbidity; - particulate and dissolved organic carbon;	Two rounds of monitoring, at least six months apart, are to be carried out prior to mining commencing, within sufficient time to meet the identified reporting requirements.	As part of a pre- mining report to be provided to the Chief Executive at least three months before mining commences.	

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
			 ammoniacal nitrogen; dissolved reactive phosphorus; and arsenic, chromium, copper, lead, mercury, nickel, uranium, vanadium and zinc. Three samples from each sampling location (9 samples in total) will be collected an analysed to determine polonium 210 content. 		
ii	Water quality and oceanographic (fixed landers) (Note – as described in Schedule 2B below, this monitoring will be continued once mining commences)	To continuously measure seabed turbidity and other physical properties of the marine environment at selected fixed sites in the marine consent area.	Monitoring to be carried out using fixed landers with appropriate monitoring equipment. Up to 4 landers are to be deployed at any one time, with 3 located adjacent to area to be mined in the first year and 1 located in an area unaffected by mining (i.e., the latter is to be an area utilised as a reference for mining ecological or water quality impact assessment). The lander at the reference site and one of the other landers will include instruments to monitor turbidity, current speed and direction. The other 2 landers will monitor turbidity only. The monitoring instruments will be capable of providing detailed information about the lower 50 m of the water column.	Monitoring to commence at least 18 months before mining commences. This provides for at least 12 months of data to be assessed within the pre- mining report. Data will be downloaded at least every 6 months.	As part of a pre- mining report to be provided to the Chief Executive at least three months before mining commences.
iii	Bathymetry in MP	To complete the basemap	To undertake a survey that will	To be completed at least	As part of a pre-

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
	55549 - completion	for resource development and environmental assessment by ensuring that the bathymetry for the whole of the mining permit area is collected.	complete the multi-beam swath bathymetry mapping of MP 55549. <u>Bathymetry survey margin of error</u> <u>must not exceed ±5 m vertically and</u> ±10 m horizontally.	three months before mining commences and in sufficient time to meet the identified reporting requirements.	mining report to be provided to the Chief Executive at least three months before mining commences.
iv	Benthic community modelling ground- truthing (Zonation)	To collect seabed images and samples to confirm the modelling of benthic habitats and communities that underlies the identification of areas with high biodiversity.	Surveys will use AUVs or similar technology to collect photographs of the seabed and corers to collect samples of the seabed sediments that will be analysed to determine benthic habitats and communities in the same manner as previous surveys. The results will be integrated with existing data to update the predicted distribution of areas with high biodiversity value, especially those containing stony corals.	The survey and analysis is to be completed at least three months before mining commences.	A report to be provided to Chief Executive at least three months before mining commences. The report is to recommend any amended or additional mining exclusions areas that meet the purpose of Condition 14(b), and which require certification in accordance with that condition.
v	Elutriate testing	To repeat the elutriate testing previously carried out using fresh sediment samples.	Elutriate testing of three sediment samples collected from MP 55549.	One testing round only. Testing to be completed at least 6 months before mining commences.	A report to be provided to the Chief Executive at least three months before mining

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
					commences. Report is to compare results to those reported in Appendix 11 of the application.
vi	Toxicity testing	To repeat the toxicity testing previously carried out using fresh sediment samples.	From sediment samples collected from MP 55549, repeat the toxicity testing on the same organisms utilised in the 2014 toxicity testing carried out by NIWA. In addition, if practical, also include testing on appropriate organisms representative of Chatham Rise species.	One testing round only. Testing to be completed at least 6 months before mining commences.	A report to be provided to the Chief Executive at least three months before mining commences. Report is to compare results to those reported by NIWA in 2014.
vii	Turbidity profile / equipment trial	To measure the turbidity, and other physical parameters of the marine environment, using the equipment to be used in subsequent plume monitoring.	Within and adjacent to the proposed first mining block to be mined, survey the water column using an AUV, or similar equipment. The principle purpose of this monitoring is to determine the effectiveness of the equipment to gather turbidity data (and other data) within the plume once mining commences. Determine the turbidity profile within and adjacent to the area surveyed.	One successful monitoring round only. This monitoring / testing round to be completed at least 6 months before mining commences.	As part of a pre- mining report to be provided to the Chief Executive at least three months before mining commences.
viii	Trace elements in	To determine the	Species to be monitored are ling and	At least two rounds of	As part of a pre-

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
	key commercial fish on the Chatham Rise.	concentrations of trace elements and key radionuclides in fish muscle tissue (i.e., the edible flesh) on the Chatham Rise before mining commences.	 hoki. Fish are to be obtained from commercial long-line or trawl operations that have caught fish from areas: 3 'mining locations' which are located within 50 km of MP 55549; and 3 reference locations which are located more than 100 km from MP 55549. Eight fish, of each species, are to be collected from each site. The length and weight of each fish is to be recorded. Muscle tissue from each individual fish is to be removed and homogenised for laboratory analysis. Analysis of the muscle tissue must include: from all fish at each site, trace elements, including arsenic, nickel, uranium and vanadium; and from five fish collected from each site, polonium 210. 	monitoring are to be carried out prior to mining commencing, within sufficient time to meet the identified reporting requirements.	mining report to be provided to the Chief Executive at least three months before mining commences.
ix	Ambient sedimentation rates (fixed landers)	To determine the natural sedimentation rate in the marine consent area.	Install a sediment trap on the at least one lander established at the a reference site as part of the water quality and oceanographic monitoring described above.	Monitoring to commence at least 18 months before mining commences. This provides for at least 12 months of data to be	As part of a pre- mining report to be provided to the Chief Executive at least three months

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
				assessed within the baseline report. The sediment in the sediment trap is to be recorded at least every 6 months (at the same time that the data is downloaded from the lander).	before mining commences.
2B - D	uring mining operati	ons			
i	Sound from the mining vessel and equipment	To measure the sound of the mining vessel and mining equipment, in both the near field and far field, to verify the acoustic modelling results (McPherson et. al 2014 – refer to Condition 18).	Monitoring to be carried out using at least one lander equipped with instruments capable of recording sound levels in the appropriate frequency range at distances necessary to measure the near and far field sound levels of the vessel and mining equipment.	Monitoring is to commence no later than one month after mining commences. Monitoring data is to be collected for up to two months while mining is occurring.	A separate report is to be provided to the Chief Executive within two months of all of the monitoring data having been collected. The report is to assess whether the actual sound generated by the activity is within the range predicted in the acoustic modelling carried out prior to mining commencing.
ii	Water quality and oceanographic	To continuously measure seabed turbidity and other	Monitoring to be carried out using fixed landers with appropriate	Continuously while	Summary to be provided in

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
	(fixed landers) (Note – continuation of the pre-mining monitoring described in Schedule 2A above)	physical properties of the marine environment at selected fixed sites in the marine consent area.	monitoring equipment. Up toAt least 4 landers are to be deployed at any one time, with <u>at</u> <u>least 3</u> located adjacent to mining blocks and <u>at least 1</u> located in an area unaffected by mining (i.e., the latter is to be an area utilised as a reference for mining ecological or water quality impact assessment). These landers may be relocated as mining progresses. The lander/ <u>s</u> at the reference site and <u>at least</u> one of the other landers will include instruments to monitor turbidity, current speed and direction. The other two landers will monitor turbidity only. The monitoring instruments will be capable of providing detailed information about the lower 50 m of the water column.	mining is occurring. Data will be downloaded at least every 6 months.	report required by Conditions 38 and 39.
111	Plume extent	To confirm that the turbidity levels of the plume generated by the mining operations are in accord with those predicted by the numerical models and to ensure that the impacts on ecological values in the water column, beyond the area of predicted adverse	Profile (track and map) the sediment plume, while mining is occurring, using an AUV or similar equipment, within and adjacent to the mining block being mined. The AUV, or similar equipment, will measure turbidity levels continuously during its surveys.	Profiling must occur on at least two occasions while the first mining block is being mined, and on at least one occasion for each of the mining blocks mined during the remainder of the first 12 months. After the first 12 months of mining, and	Summary to be provided in report required by Conditions 38 and 39.

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
		impact from the plume, are no greater than predicted.		dependent on the results of the first 12 months of monitoring, the frequency of this monitoring can be reduced to up to two occasions each year during the second through to the fifth years of mining, and thereafter to at least one occasion each year while mining continues.	
iv	Sediment composition and chemistry	To routinely determine the composition of the seabed material to confirm that seabed chemistry is with the bounds described in Appendix 11 of the marine consent application.	 Analysis of cores collected as part of monitoring programme to include: where visual redox differences are observed, Eh readings every 10 cm up to at least 30 cm; and, vertical cross-sections to be photographed immediately. At least five samples are to be collected for each mining block from the samples collected in accordance with Condition 13. Sample analysis must include: particle size distribution; examination for total organic carbon and carbonate; and trace element analysis for arsenic, cadmium, chromium, copper, lead, mercury, nickel, uranium, vanadium and zinc. 	Core and sample analysis to be ongoing while mining is occurring. Polonium 210 analysis to occur no later than during the first 6 months of monitoring.	Summary to be provided in report required by Conditions 38 and 39. Reporting to include comparison with the range described in Appendix 11 of the marine consent application, including identification of samples that fall outside of that range.

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
			Analysis of three sediment samples, collected from within MP 55549 and the reference locations, to be analysed for polonium 210.		
v	Disposal of processed material from the mining vessel	To routinely estimate the composition of the material disposed from the mining vessel.	 Samples to be collected on the mining vessel at a location where processing has been completed. 24 hour composite samples to be collected. All samples are to be analysed for the following parameters: total suspended solids and turbidity; particulate and dissolved organic carbon; ammoniacal nitrogen; dissolved reactive phosphorus; and dissolved and total metals / metalloids for arsenic, chromium, copper, lead, mercury, nickel, uranium, vanadium and zinc. 	During the first 12 months of mining, a sample is to be collected during every 24 hour period that mining occurs. After the first 12 months of mining, the frequency of this monitoring shall be reduced to at least once during each mining cycle.	Annual summary to be provided in report required by Conditions 38 and 39.
vi	Ecological impacts outside of mining area	To confirm that the extent of sediment deposition generated by the mining operations is in accord with that predicted by the numerical models and to ensure that the impacts on ecological values on the seabed, beyond the area of predicted adverse	Monitoring locations must include 3 regional reference sites that will not be impacted by mining within MP 55549 or by other activities. The other monitoring locations are from blocks 1 and 2 mined in the first year of mining, and blocks 4 and 5 in the second year of mining. Monitoring transects, at least 8 km in length, will be established at each	The monitoring of the reference sites and block 1 transects must take place within 3 months of completion of mining block 1. Subsequent monitoring must take place as follows: - within 9 months of	Annual summary to be provided in report required by Conditions 38 and 39.

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
		impact from sedimentation are no greater than predicted.	monitoring location. At each monitoring location, one transect will be aligned with the predicted plume direction and another transect perpendicular to the predicted plume direction. Photograph of the seabed will be taken at regular intervals along each transects. These images will be analysed to provide quantitative information on the distribution and condition of benthic epifauna. At points 1,000, 3,000, 5,000, 7,000 m and at the end of each transect, sufficient images and seabed samples will be collected to enable an assessment (qualitative) of the nature and condition of benthic epifaunal and infaunal communities.	 the completion of block 1. This monitoring round will include the transects from block 2. within 15 months of the completion of block 1. In addition, the same monitoring frequency as that applied to blocks 1 and 2 is to be applied to blocks 4 and 5. The survey plan to be followed after the first two years of mining will be determined following an assessment of the monitoring carried out on blocks 1, 2, 4 and 5. 	
vii	Trace elements in key commercial fish on the Chatham Rise	To determine the concentrations of trace elements and key radionuclides in fish muscle tissue (i.e., the edible flesh) on the Chatham Rise after mining commences.	 Species to be monitored are ling and hoki. Fish are to be obtained from commercial long-line or trawl operations that have caught fish from areas: 3 'mining locations' which are located within 50 km of MP 55549; and 3 reference locations which are located more than 100 km from MP 55549. Eight fish, of each species, are to be 	A round of monitoring is to be undertaken after the first, second and fourth year that mining has occurred. The timing of this monitoring is to be consistent with the timing of the rounds of 'trace elements in key commercial fish on the Chatham Rise'	Summary, including comparison with the data collected prior to mining commencing, to be provided in report required by Conditions 38 and 39 in the years that
Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
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			 collected from each site. The length and weight of each fish is to be recorded. Muscle tissue from each individual fish is to be removed and homogenised for laboratory analysis. Analysis of the muscle tissue must include: from all fish at each site, trace elements, including arsenic, nickel, uranium and vanadium; and from five fish collected from each site, polonium 210. 	monitoring that took place prior to mining commencing.	monitoring has occurred.
viii	Recolonisation	To provide long term information on the recolonisation of the mined blocks.	The transects established for monitoring of the 'ecological impacts outside of mining area' will be extended into and across blocks 1, 2, 4 and 5. Photographs of the seabed will be taken at regular intervals along each transect. These images will be analysed to provide quantitative information on the distribution and condition of epifauna. At points 200 and 500 m inside the edge of the mining block, sufficient images and seabed samples will be collected to enable an assessment (qualitative) of the nature and condition of the epifaunal and	The same as monitoring of the 'ecological impacts outside of mining area'	The same as monitoring of the 'ecological impacts outside of mining area'

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
			infaunal communities present.		
ix	Hard substrate trials	To assess the viability and value of the placement of hard material to provide added hard substrate habitat, thereby possibly enhancing biodiversity value within and adjacent to the mined areas.	 Initial trials are to be carried out in the following areas: in an area close to coral-dominated communities and predicted to be suitable habitat for coral-dominated communities but where no such communities have developed due to a lack of hard substrate; and, within an area that has been mined, but only once deposited sediment has consolidated. Hard substrate is to be placed on the seabed at the above areas in discrete patches, at increasing distances from potential colonising sources. Once in place, sufficient photographs (using an AUV or similar equipmen) are to be taken of the trial areas to enable a record of the change in the epifauna community to be determined. 	Monitoring to occur within 12 months, and thereafter at 2, 3, 5 and 10 years of the hard substrate being placed on the seabed.	Summary, including assessment of effectiveness of the trial, to be provided in report required by Conditions 38 and 39 in the years that monitoring has occurred.
X	Sedimentation rates (fixed landers)	To determine the ongoing sedimentation rate in the marine consent area once mining operations commence.	Maintenance of the sediment trap already installed on the lander, as part of the monitoring programme carried out prior to mining commencing, established at the reference site as part of the water quality and oceanographic monitoring described above.	Continuously while mining is occurring. The sediment in the sediment trap is to be recorded at least every 6 months (at the same time that the data is downloaded from the	Annual summary to be provided in report required by Conditions 38 and 39.

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
				lander).	
xi	Organic matter retains on mining vessel	To provide ongoing information about the amount and composition of organic material retained on the 80 mm screens within the on- board sediment processing system (and thus not returned to the seabed).	Maintenance of a log recording the nature of material held on the 80 mm screen storage bin. A digital photographic record of the storage bin is to be taken at the same time.	For the first 12 months of mining, this monitoring is to be carried out daily during mining operations. After the first 12 months of mining, the frequency of this monitoring shall reduced to at least once during each mining cycle.	Annual summary to be provided in report required by Conditions 38 and 39.
xii	Phosphorite nodule composition	To routinely determine the composition of the mined phosphorite nodules to provide information on the resource / chemical composition in relation to its use as a fertiliser.	Statistically representative sample to be collected from each shipload of nodules. Nodule analysis must include major oxides (iron, calcium, potassium, sulfur, phosphorus, silicon, aluminium, magnesium and sodium) and trace elements (arsenic, chromium, copper, lead, nickel, uranium, vanadium and zinc).	Sample collected from each shipload. Ongoing while mining is occurring.	Annual summary of nodule composition to be provided in report required by Conditions 38 and 39.
2C - T	o meet surveying req	uirements of the staged ada	ptive management approach (Conditio	n 40)	
i	Bathymetry	To complete the basemap for resource development and environmental assessment by ensuring that the bathymetry is collected in the areas that the Consent Holder is proposing to carry out	To undertake surveys, that will complete the multi-beam swath bathymetry mapping of the proposed additional mining area (i.e., outside of MP 55549). <u>Bathymetry survey margin of error</u> <u>must not exceed ±5 m vertically and</u> ±10 m horizontally.	To be completed in sufficient time such that relevant information can be provided in the report to be prepared in accordance with Condition 40(e).	A report prepared in accordance with Condition 40(e). <u>The reporting</u> <u>requirements in</u> <u>relation to the</u>

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
		mining, outside of MP 55549, in accordance with Condition 40.			<u>Schedule 2C(ii)</u> <u>monitoring is to</u> <u>include</u>
II	Seabed composition	To collect regionally representative seabed samples to identify sediment physical properties and chemistry in the areas that the Consent Holder is proposing to carry out mining, outside of MP 55549, in accordance with Condition 40.	Analyse the seabed samples to determine particle size distribution, and their major oxide and trace element chemistry.		comparison with the range described in Appendix 11 of the marine consent application, including identification of samples that fall outside of that
iii	Benthic ecology	To collect representative seabed images and samples to confirm the nature and character of benthic habitats and communities in the areas that the Consent Holder is proposing to carry out mining, outside of MP 55549, in accordance with Condition 40.	Surveys will use AUVs or similar technology to collect photographs of the seabed and corers to collect samples of the seabed sediments that will be analysed to determine benthic habitats and communities in the same manner as the previous surveys carried out within MP 55549.		range. Where concentrations fall outside of that range, that reporting is to include measures by which mining will be adjusted (as appropriate) in reflection of those concentrations
iv	Oceanographic	To collect physical oceanographic information to enable the calibration and validation of the plume modelling within the area that the Consent Holder is	At least one lander equipped with instruments comparable with those at the regional reference site will be required within the area that the Consent Holder is proposing to undertake mining.	At least 12 months of oceanographic data are to be collected. Data are to be collected in sufficient time such that it can be utilised in the calibration and	<u>concentrations.</u>

Ref.	Parameter	Objective/s	Requirement	Timing and Frequency	Reporting
		proposing to carry out		validation of the plume	
		mining, outside of MP		modelling, as it applies	
		55549, in accordance with		to the new area of	
		Condition 40.		mining, and the results	
				be provided in the	
				report to be prepared in	
				accordance with	
				Condition 40(e).	

The monitoring identified in the above table may be amended (reduced or increased), removed or new monitoring requirements added through a replacement Schedule. This reflects an adaptive management approach in terms of the role that monitoring will play throughout the term of the marine consent.

The process to be followed before a replacement Schedule forms part of this consent is:

- (a) The Consent Holder is to prepare a proposed replacement Schedule and an associated report, supported by relevant scientific and / or operational evidence, outlining the reasons for the proposed amendments.
- (b) The Consent Holder is to provide the ERG with an opportunity to review and comment on the proposed replacement Schedule.
- (c) Once-<u>T</u>the Consent Holder and <u>ERG have agreed that replacement Schedule is appropriate, the replacement Schedule is to be provided the proposed replacement Schedule to the Chief Executive for <u>certificationreview</u>.</u>
- (d) Within one month of receiving the replacement Schedule, the Chief Executive must either certify that the replacement Schedule contains a monitoring programme that will <u>continue to</u> identify the nature of the actual impacts on the environment associated with the Consent Holder's mining operations, <u>request_require_amendments</u> and / or <u>request_advise the Consent Holder of a</u> timeframe extension for further evaluation. At any time prior to making a decision about whether or not to certify a proposed replacement, the <u>Chief Executive may request an assessment by an appropriately qualified</u> which may include possible assessment by an external reviewer.
- (e) Within five working days of certifying the replacement Schedule, the Chief Executive must ensure that the consent contains the replacement Schedule (including the date at which the Schedule comes into effect).

Attachment A – Marine Consent Area





Attachment B – Mining blocks during the first three years of mining

Attachment C – Mining Exclusion Areas



Appendix 4: Expert Conference Participants

Commercial fishing – 19 September 2014

- Dr Richard O'Driscoll
- **Dr** David Middleton
- Dr Jeremy Helson
- Dr Johanna Pierre
- Mr Alistair Dunn

Radioactivity – 18 September 2014

- Dr Nikolaus Hermanspahn
- Dr Ross Jeffree
- Dr David Bull
- Dr Alec McKay
- Dr Barrie Peake

Rock Lobsters – 16 September 2014

Dr Alison MacDiarmid

Mr Daryl Sykes

Economics – 18 September 2014

Mr Peter Clough

- Dr Ganesh Nana
- Mr Kieran Murray
- Mr Alex Sundakov
- Dr Johanna Pierre (attended for Issue 4A-C)

Sediment modelling – 26 September 2014

Ms Jamie Lescinski

Dr Jeremy Spearman

Dr Scott Nodder

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Decision on Marine Consent Application – Chatham Rock Phosphate Limited

Dr Peter Longdill

Mr Dougal Greer

Benthic Ecology and Spatial Planning – 16 and 27 September 2014

Dr Judith Hewitt

Dr Les Watling

Dr Thomas Hourigan

Mr Dan Govier

Dr Katrin Berkenbusch

Dr Carolyn Lundquist

Dr John Leathwick

Dr Ashley Rowden (did not attend the second meeting on 27 September 2014 and therefore did not sign the Joint Statement of Experts)

Toxicology and Water Quality – 19 September 2014

Dr Ngaire Phillips

Dr Louis Tremblay

Dr Barrie Peake

Mr Paul Kennedy

Seabirds – 23 September 2014

Dr David Thompson

Mr Graeme Taylor

Dr Leigh Bull

Mr Sandy Bartle

Impacts on Fish – 18 September 2014

Dr Ian Tuck

Dr Mike Huber

Dr Paul R. Krause

Dr Diane Jones

Decision on Marine Consent Application – Chatham Rock Phosphate Limited

Dr Ian Tuck

Emeritus Professor Arthur N. Popper

Mr Michael Page

Mr Paul Kennedy

Ecosystem Effects – 17 September 2014

Dr Matt Pinkerton

Dr Beth Fulton

Mr Sandy Bartle

Mr Paul Kennedy

Marine Mammals – 15 October 2014

Associate Professor Liz Slooten

- Dr Simon Childerhouse
- Dr Michael Huber
- Mr Darran Humpheson
- Dr Darlene Ketten
- Mr Tara Ross-Watt
- Mr Martin Cawthorn

Conditions - 3 and 24 October 2014

Dr Marie Brown

- Ms Andrea Rickard
- Ms Carmen Taylor
- Mr Chris Rendall
- Mr Tara Ross-Watt
- Mr Sam Du Fresne (Observer EPA)
- Ms Gemma Couzens (Observer EPA)

Decision on Marine Consent Application – Chatham Rock Phosphate Limited



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