Table 1. Reponses of Childerhouse and MacDiarmid to questions posed in DMC Minute 21

Question #	Question	Response
SC1	The focus for assessing potential impacts to marine mammals has been on cetaceans. However, of all marine mammals documented within the STB and PPA, New Zealand fur seals are the most frequently sighted species. Seals are an indicator species of the health of a fishery, and are also known to be opportunistic exploiters of human activities. Do you think it would be prudent to obtain baseline information about the numbers and health of seals in and around TTR's proposed operations to enable monitoring of any potential changes in their health?	• While it would be useful to have some additional information on seals, given that they are apparently occur in small numbers in the PPA, that the nearest haul out or breeding sites are >75km away, and that the nature of the mining operation means that there are unlikely to be any direct impacts on seals, this should be a low priority.
SC2	Why were no further marine mammal surveys undertaken?	• Childerhouse noted that he had not been asked by TTR to undertake any addition surveys and directed the question to TTR
SC3	Do you accept that the information provided by TTR includes a population survey which is inadequate for the purpose, and some habitat modelling based on anecdotal information (Slooten para 13)? Do you accept that problems include the small size of the area covered and a lack of data on sighting probability? (Slooten para 13)	• The aerial survey by Cawthorn for TTR was not designed to estimate abundance but rather to determine the presence/absence of marine mammals in the PPA and their spatial extent. Therefore, I believe that the Cawthorn survey met its stated purpose and was adequate for the purpose of identifying cetacean occurrence in the area. • Agree that the habitat modelling was based on the incidental sightings data from the public and ships officers, and sightings by MPI fisheries observers • The aerial survey covered the entire PPA and also the waters inshore of the PPA. Obviously, the larger area that the survey covers, the more useful it is likely to be • I agree that there was no data on sighting probability however this survey was not designed to estimate abundance and therefore sighting probability was not required to meet the stated objective. However, it would have been a useful addition to aid in interpretation of the results.
SC4	In para 3 you say "If noise levels of the dredge are comparable to those of shipping as the literature suggests "	• This question appears to be incomplete • As stated in my Evidence, I believe that the likely noise levels from the operation are comparable to shipping noise.
SC5	In para 10 you say that you have not undertaken any field studies	• Childerhouse was not asked to undertake any field studies by TTR. The baseline

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	in relation to this proposal. Why not?	survey was undertaken by Martin Cawthorn Associates and Childerhouse was only asked to review it by TTR and directed the question to TTR.
SC6	Do you accept that noise produced by the mining operations may directly disrupt blue whale foraging, cause blue whales to move out of important feeding areas, interfere with blue whale communication causing loss of feeding or mating opportunities, cause changes in vocal behavior patterns with subsequent energetic consequences, and induce increased physiological stress that compromises blue whale health? (Torres para 9)	• No I do not agree with this very broad statement. • In my primary evidence, I undertake an assessment of potential noise impacts (e.g. Table 2) and conclude that behavioural, rather than physiological effects (e.g. Temporary or Permanent Threshold Shift in hearing) are likely to be of more concern for blue whales. Overall, while the risk of behavioural disturbance is low to moderate, this effect will only be evident in the area immediately around (e.g. ~2km) the operation • Childerhouse also noted that if TTR Condition 12 was accepted, then there is unlikely to be any impacts on blues whales outside the immediate operational area.
SC7	Do you accept that the expected sediment plume from the mining operations may impact the distribution and availability of *N. Australis* (krill), thus reducing the foraging ability and efficiency of blue whales (Torres para 9)?	• Childerhouse noted that he was not an expert on krill and sediment plumes and referred to the information provided in MacDiarmid et al. (2015b) which reported that there should be negligible effects of mining 50 Mt per annum according to standard evaluation criteria. This is principally because the scale of the mined area and the areas of elevated suspended sediment concentrations are small compared to the area used by the populations of these species. Consequently, they are likely to be displaced from, or experience a decrease in prey abundance or availability over a very small part of their distribution. Furthermore, marine mammals are highly mobile and have ample opportunity to avoid the discharge plume. • This issue is also covered by MacDiarmid in her response to questions AM28 and AM29 below
SC8	Do you accept that the STB is an important habitat and foraging area for blue whales?	• Yes. Some parts of the STB are an important habitat and foraging area for blue whales.
SC9	Do you accept that Blue whales have extreme energy demands, and each disturbance to their feeding opportunities and success rate can impact their viability and reproductive capacity. Added noise, habitat impacts, prey disturbance and vessel density in the STB by the mining operation would add physiological and behavioral consequences and burdens to blue whales already living within an impacted and compromised ecosystem? (Torres para 9)	• I don't agree that blue whales have extreme energy demands but rather that they have energy demands consistent with normal biological process such as growth and reproduction. They do require large amounts of krill to eat but are highly adapted to efficiently find, catch, and consume large amounts of krill to meet these needs. • I agree that any disturbance to foraging efficiency could result in negative impacts for blue whales and that any increase in cumulative impacts needs to carefully considered. However, for the reasons provided above for question SC7 the impact of the proposed mining operations on foraging opportunities and

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		thus on energy supplies and reproductive capacity is likely to be negligible. • The STB ecosystem is certainly already impacted by a number of human activities. The degree to which it is compromised is unclear.
SC10	Do you accept that with every increase in anthropogenic activity in the STB region, the risk of vessel strike of a blue whale increases? (Torres para. 33)	• Yes I agree in that adding even one additional vessel will increase the risk of vessel strike. However, the additional amount of expected vessel traffic from the TTR operation is negligible compared with existing traffic levels transiting the region.
SC11	Do you accept that the conservation status and cumulative impacts for Māui dolphin are of serious concern? (Slooten para. 18.1) Do you accept that there is still considerable overlap between Māui dolphins and fisheries in the area, which is likely to be exacerbated by the mining and the sediment plume resulting from the mining.(Slooten 18.1)	• Yes - cumulative impacts are of significant concern for Māui dolphins. • I also agree that there is significant overlap between fisheries and Māui dolphins across most of their range but believe that the inshore waters of the STB are at the limit of the southern range of Māui dolphin and that Māui dolphins are present in extremely low numbers (e.g. Currey et al. (2012) reported that Māui dolphin density was less than 0.0005 Māui dolphin per square nautical mile inshore of the proposed mining area).
SC12	Do you accept that a detailed assessment of the conservation implications of the proposed mining, including cumulative impacts, will be essential in order to provide the DMC with enough information to make a science-based appraisal of the potential impacts of the proposed mining on marine mammals, in particular for Māui dolphins which are already at an extremely high risk of extinction (Slooten 18.1)	• Yes - it is important to carefully consider cumulative impacts of any activity, especially for species at high risk of extinction. • There is sufficient information available presently to make a science based assessment of the scale of the impact of the proposed operations on marine mammals, including Maui dolphins.
SC13	Do you accept that TTR have failed to provide either measurements of the noise made by the proposed mining operation (ships, generator and dredge to be used) or measurements of the background “ambient” noise off Taranaki? (Slooten para. 15)	• Yes - there are no actual measurements of the noise likely to be produced from the mining operation nor of ambient noise for the proposed PPA.
SC14	Why did TTR perform no actual assessment of the ambient noise levels at the mining site? (Torres para 37) rather only of Lyttelton Port for only 15 minutes? Do you accept that the Lyttelton recorded sound is surprisingly high (Slooten para. 15.8)?	• Childerhouse noted that he had not been asked by TTR to undertake ambient noise measurements but that he understood that Hegley had attempted it at the PPA and directed the question to TTR.
SC15	Do you accept that ambient ocean noise is highly site specific, as well as variable temporally? (Torres para 37, Slooten para 15.7))	• Yes - I agree.
SC16	Do you accept that there is no information on local sound propagation conditions that will impact the distance sound will travel (because these local conditions were never measured)	• Yes - I agree.

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	(Torres para 42) And do you accept that sound propagation depends strongly on underwater topography, benthic substrate and water temperature (Slooten para. 15.7)	
SC17	Do you accept that each sound increase contributes to the behavioral and physical consequences to ocean animals, including blue whales (Torres para 49)?	• Not all increases in sound will necessarily lead to an impact on marine mammals. Only those increases that lead to overall levels of noise passing a certain threshold will have a significant effect. This applies to both single and cumulative effects.
SC18	You have not estimated sound levels and frequencies at various distances have you? And do you accept without this information and without marine mammal surveys, you are unable to predict effects on specific marine mammal species at different distances?	• I undertook analysis of estimated sound levels at various distances from the source in Table 2 of my primary evidence. I did not undertake an analysis of the frequency spectra by distance but instead took the conservative approach and assumed that the broadband level was the same for all frequencies (e.g. non-weighting of frequency species impacts). • As noted in my evidence, there are very few species-specific thresholds for noise impacts available and therefore I followed the approach of Southall et al. (2007) who assessed impact by group for low, medium and high frequency cetaceans rather than for specific species as the data is simply not available for 95% of species. • Table 2 of my primary evidence provides estimates of received sound levels at increasing distances from the source and an assessment of the likely impact on marine mammals at that distance based on published criteria for threshold based on Southall et al. (2007).
SC19	Do you accept that the plume will cause impacts on ecosystem productivity through reduced light penetration and subsequent change to the zooplankton community, including *Nyctiphanes australis* (krill), the target prey item of blue whales in the region? (Torres para 51) And do you accept that that with increased sediment in the water column dense patches of *N. australis* – needed by blue whales to survive – may be less numerous, more difficult to detect, and occur in unusual areas that reduce availability to whales (Torres para 51)?	• Childerhouse noted that he was not an expert on krill and sediment plumes and referred to the information provided in MacDiarmid et al. (2015b) which is summarised above under question SC7. • Krill have been found throughout the STB and its distribution is likely to be highly variable within seasons and among years. For this reason, it is reasonable to assume the foraging area for blue whales includes the whole of the STB. On this basis, MacDiarmid et al (2015) concluded that the area of the STB occupied by the plume that may affect krill and therefore blue whales was negligible. • This issue is also covered by MacDiarmid in her response to questions AM28 and AM29 below
SC20	Do you accept that there is an important biomass of N. australis in the STB with an unknown distribution (spatially or seasonally), yet the studies that do exist show increasing abundance toward the proposed mining site, and therefore, habitat disturbance that	• Childerhouse noted that he was not an expert on krill and sediment plumes and referred to the information provided in MacDiarmid et al. (2015b) which is summarised above under question SC7. • I agree that impacts in the foraging area of blue whales should be avoided

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	impacts prey availability for blue whales in this area should be considered and avoided? (Torres para 53)	wherever possible.
SC21	Do you accept that in conclusion, "it is naive to think that a 35 year mining project within the STB region will not impact this population of blue whales, through elevated noise within their frequency range, habitat displacement, vessel impacts, and prey disturbance." (Torres para 58). And do you accept that the absence of credible, scientifically robust data on background noise and the noise produced by the mining operation mean that it is not possible to determine the impact of the noise from the proposed mining operation on marine mammals, nor to develop conditions relating to noise (Slooten 15.9)	• I do not believe that there will be any significant impact on blue whales from any of these issues for the following reasons: a. TTR condition 12 will limit noise from the operation to levels that minimise any impact on blue whales b. While the possibility of habitat displacement exists, if it occurs it is likely to only be around the immediate area (e.g. within 2km) of the operational activity which represents only a very small part of the total foraging area of blue whales in the region, and c. There is unlikely to be significant prey disturbance, and if it does occur, it is likely to only be around the immediate area (e.g. within 2km) of the operational activity which represents only a very small part of the total foraging area of blue whales in the region. • Information on noise and ambient levels are not required for an assessment of impact as Condition 12 sets a maximum allowable level of noise from the operation. Therefore, the operation must comply with this condition and no louder noise will be permitted. The noise level specified in Condition 12 has been set to minimise impacts on marine mammals based on published international studies (e.g. Southall et al. (2007).
AM27	In paragraph 107 (d) on Māui's dolphins you are relying on modelling, correct? Not on surveys? Why were no surveys undertaken? Does your conclusion stand that "mining 50 Mt per annum is likely to have negligible effects on this species" if one Māui's dolphin is killed or displaced or reproduction is affected by mining?	• Yes, the assessment relies on modelling the distribution of Hector's and Māui dolphins based on incidental sightings by the public, ships officers and MPI observer sightings. • A survey by Martin Cawthorn Associates Ltd (2013) was undertaken. • My understanding is that Māui is a sub-species (i.e. very closely related to southern populations called Hectors dolphin). If a single Māui dolphin was killed through displacement or changes in the availability of abundance of prey then my assessment of risk to this population would increase. However, given the available information about Māui distribution and its use of turbid water the likelihood of a death from the mining activities is very unlikely.
AM28	In paragraph 107 (a) you discuss blue whales. Do you accept Dr Torres findings that the STB is an important habitat and foraging area for blue whales? (Torres para 9)	• Yes, I cite Torres in MacDiarmid et al. (2015).
AM29	Do you accept that the mining may affect *Nyctiphanes australis* (krill) and therefore blue whales? (Torres para 9)	• This issue is also addressed in question SC7 and SC9 above. • Krill have been found throughout the STB and its distribution is likely to be

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		highly variable within seasons and among years. For this reason, it is reasonable to assume the foraging area for blue whales includes the whole of the STB. On this basis, MacDiarmid et al (2015) concluded that the area of the STB occupied by the plume that may affect krill and therefore blue whales was negligible.
AM30	Is your finding of negligible impacts affected if one blue whale was known to forage in the "in the vicinity of the proposed mining areas"?	• My assessment assumed that blue whales forage over the whole of the STB, including the PPA, thus my assessment would not alter if a single blue whale was observed to forage in the area affected by mining. The natural variability in the availability of krill in the area is known and expected and is likely to have a much bigger impact on where blue whales forage than the impact of the proposed mining.
AM31	At paragraph 108 f you discuss cumulative impacts. Do you accept that noise can be a cumulative impact? Why did you not measure it?	• Yes - I agree noise can be an impact. • NIWA was not commissioned by TTR to undertake assessments of underwater noise. This question is best addressed to TTR.
AM32	How about other disruption by ship activities? You do not discuss ocean acidification. Can this be a cumulative impact?	• The likelihood of vessel strikes can be mitigated by reductions in vessels speeds. • For vessel noise see responses by Dr Childerhouse above. • Other possible vessel activities that could cause disruption to marine mammals (e.g. rubbish, discharges, oil spills) are addressed by other TTR witnesses. • I discuss the potential impacts of ocean acidification and cumulative impacts in paragraphs 108-110 of my evidence.