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| To: | Kaipara Limited | Date: | 30 March 2020 |
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## Kaipara Limited - Offshore Sand Consent Application - S92 response - Ecology

**Ecology**

1. **The AEE states that underwater noise levels from the proposed dredging are expected to be insignificant. However, neither the AEE or the ecological assessment provide any information on underwater noise levels that are likely to be generated from the proposed extraction. Please provide the noise levels generated from the activity and provide an assessment of effects on marine mammals and fish species from the proposed underwater noise levels.**

An underwater noise assessment was undertaken by Styles Group in 2020 and is included as part of the s92 response.

Kaipara Ltd propose to undertake sand extraction by trailing-suction hopper dredging using a new purpose-built vessel, the William Fraser. The main noise sources associated with the activity will be the drag head making contact with the seafloor, the water jetting and the movement of the sand slurry up the pipe to the hopper. The assessment was based on the loudest operational stage (active dredging), using measured noise level data of the William Fraser.
In order to assess potential noise effects on those species, two data needs were identified:

(1) to understand the existing soundscape; and
(2) to understand the source levels and true propagation coefficients of the William Fraser inside the proposed Extraction Area.

Those data revealed a typical soundscape for an open coastal area (with sounds from fish marine mammals, snapping shrimp, vessels, dredging and weather (wind and waves) generating daily sound pressure levels between 96 and 111 dB re 1 µPa). The average source level of the William Fraser was approximately 168 dB re 1 µPa @ 1m.

Predicted noise emissions from the William Fraser were evaluated in terms of critical distances for which injury (PTS, where hearing sensitivities do not return to normal following noise exposure), temporary threshold shifts (TTS, whereby hearing sensitivities do return to pre-exposure thresholds after a period of time following noise exposure), risk of behavioural effects (as a percentage over range), and auditory masking (whereby noise interferes with a biologically-important signal that marine mammals rely on).

The assessment considers the dredging noise effects on invertebrates, fish and marine mammals. However, given the physical properties of the dredging noise in this case and differing hearing mechanisms between the different groups of animals, the potential noise effects on invertebrates and fishes are not expected to be greater than those predicted for marine mammals. Therefore, the effects modelling was undertaken specifically for marine mammals, with effects on fishes and invertebrates being assumed less than those for the marine mammals. Nine marine mammal species have been identified

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within the Extraction Area, five of which (the more common species) were focused on. Those five were common dolphins, bottlenose dolphins, killer whales, Bryde's whales and NZ fur seals. Of those species, three functional hearing groups where identified: low-frequency (LF) cetaceans, mid-frequency (MF) cetaceans and Otariid pinnipeds (OW).

Audibility of the dredging noise from the William Fraser for marine mammals is calculated to be within 5.6km, beyond which, acoustic disturbance is theoretically not possible.

Injury (PTS) from the sand extraction activities using the William Fraser is not expected to occur at any stage of the dredging within the Extraction Area, for any species. Temporary threshold shifts are also not expected to occur for any species beyond 1m from the William Fraser. These findings are based on the source levels and subsequent exposure levels being below the 2018 NMFS thresholds for PTS and TTS beyond 1m.

Based on the measured ambient sound levels and published hearing thresholds for the species listed above, there is a risk of auditory masking and behavioural effects occurring at a limited range from the William Fraser. There is also a risk of auditory masking for fish; however, the risks are substantially smaller than for the marine mammals. The risk for moderate behavioural responses (defined as those moderate or extensive changes in swimming speeds, direction and/or diving behaviours, cessation of vocalisations for a moderate or extended period, and/or avoidance of the area) was less extensive than low behavioural responses (defined as minor changes in respiration rates, swimming speeds and direction). For example, the 25% probability of a low behavioural response in the delphinids was within 168m compared to 79m for a moderate response. Those ranges drop to 28m and 0m, respectively, for a 50% probability of risk.

The degree of auditory masking (and spatial extent) was highest for fur seals (maximum of 76% reduction in the available listening space within 15m of the William Fraser), followed by bottlenose/common dolphins (maximum 69% LSR), killer whales (68% LSR), then Bryde's whales (66%). The spatial extent of any masking (i.e. greater than 1% LSR) was highest for fur seals, followed by killer whales, bottlenose/common dolphins and then Bryde's whales.

While the underwater noise produced by the William Fraser under normal operation in the southern end of the extraction area, may be faintly heard by marine mammals within the Cape Rodney-Okakari Point Marine Reserve the sound levels are not expected to result in any adverse or behavioural effects within the marine reserve.

**2. While it is noted that Section 5.3 of the ecological assessment provides an assessment on the effects of the continuation of sand extraction, this section does not address cumulative ecological effects or cumulative effects on coastal processes. Please provide cumulative effects assessment in relation to the consent and other consents in the area. Please provide analysis on studies undertaken to support this claim if any.**

Sand extraction has the potential to create elevated suspended sediment concentrations, above those which are naturally occurring, immediately around the operational area. However, this effect will not present issues in respect of cumulative ecological effects with any other activities as there are no other activities within the sand extraction area will generate sediment plumes as a result of their ongoing operation.

The only other consented activity in the coastal environment nearby is that of the McCallum Brothers Limited (MBL) sand extraction (ARC28165, ARC28172, ARC28173 & ARC28174). This sand extraction operation is from the near shore area and at its closest 1.2 km inshore from the currently approved Auckland offshore areas. The proposed new Auckland offshore sand extraction area will be at its closest 850 m offshore from the MBL areas. However, currently with only one vessel in operation, capable of sand extraction at this depth the effects will currently only occur from one site at any one time. There are no current plans to operate more than one vessel at a time, within either consented area or to operate vessels in both areas concurrently. Therefore, the effects in each area are separated by distance and by time and will not result in cumulative effects.

From the standpoint of primary production and most other ecological components, it is very difficult to estimate or assess cumulative effects, as most of the effects of the sand extraction operations on the biota are transient in space and time. Operationally it is proposed not to repeatedly extract sand from the same specific area over short time periods of less than six months, thus limiting any cumulative effects of repeated disturbance.

The scallop fishery in the area has been very variable in catch between years, with the most recent plenary report (Hartill & Williams, 2014[1]) showing a declining in catch. Thus the disturbance impact from commercial scallop dredging is not expected to be significant nor contribute greatly to any cumulative effects.

[1] Hartill, B., & Williams, J. R. (2014). Characterisation of the Northland scallop fishery (SCA 1), 1989–90 to 2010–11. New Zealand Fisheries Assessment Report, 26.

**3. The existing extraction tracking methodology covers a track of 10km, 0.7m wide and 0.3m deep. The proposed new method covers 3km, 1.8m, 0.3m deep. Please provide an ecological assessment of the new method.**

The Coastal Carrier dredge vessel which was in operation in the extraction area until October 2019 traversed approximately 10 km to fill a 460m³ hopper with each track approximately 0.7m wide, 0.3m deep and triangular in profile shape. The assessment report was written prior to the commissioning of the William Fraser and as such the dredge path (1.8m width, 0.3m depth) and length (3km) were estimated. The William Fraser was commissioned in October 2019, and underwent sea trails during which it was found that dredge speed needed to be increased from 1.5 kn to 2.5 kn to retain steerage. This resulted dredging traverses of approximately 13 km to fill a 900m³ hopper with each track approximately 1.6m wide, 0.065m deep and more trapezoid in profile shape. The new dredge has an enclosed dredge head reducing the potential for fish entrainment.

The effects to benthic biota will be similar for each dredge method, with the benthic biota disturbed in the path of the dredge head, through either removal, smothering, redistribution or destruction caused by passage through the dredge head, pump, pipe and discharge.

There are however several significant differences between the dredge vessels:

1 **Disturbance**; the William Fraser will collect twice the volume of sand (900 vs 460m³) per dredging event compared with the Coastal Carrier, mean fewer disturbance events per volume of sand extracted. The Coastal Carrier dredge affected approximately 7,000m² for every 460m³ hopper full of sand, it had an efficiency of approximately 32% retention of sand by volume, at an extraction rate of approximately 0.066m³/m² (sand extracted / area effected). The William Fraser affects approximately 24,000m² for every 900m³ hopper full of sand, its efficiency is estimated to be 58% retention of sand by volume, at an extraction rate of approximately 0.038m³/m².

The increased sand retention efficiency means the disturbance time from underwater noise and water quality effects is reduced from about 10.8 hours to about 3.5 hours per 900m³ extracted. The reduced volume per area rate is a function of the dredge profile.

2 **Depth of dredging profile**; the Coastal Carrier dredged sand from up to 300mm bellow seabed surface, the William Fraser has been shown to dredge sediment from only 50 – 80 mm (average 65mm) bellow the seabed surface. With the deeper dredge profile of the Coastal Carrier, almost all the biota in the path was removed and had to pass through the dredge head, pumps, filters and discharge. It had been reported that some of the larger deeper living worms were able to “hold onto” the seabed during the passage of the dredge over them and survive. The reduced dredge profile depth of the William Fraser means that biota buried deeper in the seabed will now not be removed or damaged thus reducing the impacts. The proportion of biota remaining on the seabed following passage of the dredge over an area has as yet not been assessed.

Empirically, different biota from different functional groups have different preferences and abilities to live at different depths within the sediments. Predatory species or surface deposit feeders live on the surface of the sediment as they need to move around to find food, some have ability to burry themselves just below the sediment surface and some live at varying depths in burrow they create. While other biota such as filter feeders permanently live buried within the sediment at varying depths, sending up siphon tubes to suck water and food to them. The depths within the sediment at which they live is dependent on the length of siphon they possess. Intertidally cockles (*Austrovenus* sp.) have short siphons and live just below the surface, while wedge shells (*Tellina* sp.) have longer siphons which allow them to live some 10-15 cm below the sediment surface. Polychaete worms and crustacea have similar different functional groupings with a range of within sediment living depths.

Dernie *et al* 2003[2] reported that sediment disturbances to deeper depths (20cm) took longer to recover than areas of shallower (10cm) sediment disturbance.

Therefore, shallow disturbance will not only affect fewer species, but likely result in faster recovery times from the disturbance.

[2] Dernie, K. M., Kaiser, M. J., Richardson, E. A., & Warwick, R. M. (2003). Recovery of soft sediment communities and habitats following physical disturbance. *Journal of Experimental Marine Biology and Ecology*, *285*, 415-434.

## 4. Please provide an assessment of effects on water quality in relation to the proposed extraction.

Water quality testing of the discharges from the William Fraser and the ambient conditions at the extraction site were conducted and reported by Jacobs 2020. To define ambient background natural water quality Jacobs used both water quality monitoring data collected for a short period adjacent to the extraction area and from regular repeated long-term council monitoring sites nearby. Following testing of sediment quality, it was deemed that water quality would be restricted to salinity, temperature, dissolved oxygen, suspended solids and turbidity, as the sediment did not contain contaminants at concentrations high enough for concern. The water quality monitoring at the site was generally lower in concentration than the Goat Island monitoring site for turbidity and suspended solids, while other physical parameters were similar, which was as expected. Background turbidity at the extraction site ranged from 0.14 to 3.11 NTU, averaging 0.31 NTU in May - July 2019. Similarly background suspended solids at the extraction site ranged from 0.47 to 10.46 mg/l, averaging 1.04 mg/l.

During sand extraction operation, the seabed sediment is sucked up through the dredge head (a 1.5 m wide giant vacuum cleaner like head), extraction pipe and discharged into an 8m² screening tray. The water and sediment are passed over and through two screens; a coarse 35mm screen and a fine 2.5mm screen. The coarse shell and other material not passing through the fine screen is then discharged through a pipe which discharges into a moon pool and out under the vessel. The sand passing through the 2.5 mm screen is then discharged into the hopper. Water discharged into the hopper overflows weir boards which discharge into several moon pools and out under the vessel. The oversize discharge contains both shell and sand, and the weir board hopper overflows contain very small amounts of silt and clay sized sediments. The plume created behind the vessel is approximately as wide as the vessel with very little lateral spread visually obvious.

In December 2019 during routine sand extraction operation the turbidity and suspended solids were assessed in the discharge plume created behind the William Fraser. The results showed minor elevations in turbidity (1 – 2 NTU) values and suspended solids (3.5 – 8 mg/l) concentrations in the surface water at the point of discharge that rapidly decline back to ambient ranges of 0.13-0.14 NTU and 2.4-2.9 mg/l by a distance of 250m behind the dredge. The increases in turbidity and suspended solids concentrations are within the range of natural variation recorded as part of the background water quality studies. The suspended solids concentrations and turbidity values found within the plume beyond 250m from the William Fraser were within ranges recorded in the nearby unaffected coastal marine environment. At an operating speed of 2.5 knots this equates to the very weak plume being present at any one location for no more than 3 minutes 15 seconds.

**Comments (not part of s92)**

The monitoring plan and the reports as provided with the current consent only provide for an assessment of the changes in the immediate extraction area and does not allow an understanding of the effects in the adjacent areas. The monitoring plan should be updated to allow an understanding of the effects of the extraction within the entire proposed area of extraction.

The draft EMMP section 5 already provides for monitoring to assess the effects of sand extraction in the entire approved area for sand extraction.

**Geomorphological Monitoring**

1. A multibeam hydrographic survey of the PSEA surveyed as part of any previous PSEAR and the similar (depth) management cells in the two control sites.
2. Single drop camera images will be recorded from:
   a) within each control area management cell;
   b) within each management cell of an ASEA where sand extraction has occurred within the 500,000m³ total which has triggered the monitoring; and
   c) every second cell within the PSEA where sand extraction has not occurred within the 500,000m³ total which has triggered the monitoring.

**Sediment Texture**

1. Seabed Ponar grab samples of sediment will be collected from:
   a) One location within each control area management cell;
   b) One location within each management cell of an ASEA where sand extraction has occurred within the 500,000m³ total which has triggered the monitoring; and
   c) One location from every second cell within the PSEA where sand extraction has not occurred within the 500,000m³ total which has triggered the monitoring.

**Biological Monitoring**

1. Seabed Ponar grab samples of sediment will be collected from:
   a) One location within each control area management cell;
   b) One location within each management cell of an ASEA where sand extraction has occurred within the 500,000m³ total which has triggered the monitoring; and
   c) One location from every second cell within the PSEA where sand extraction has not occurred within the 500,000m³ total which has triggered the monitoring.

The text above shows it allows for differences in the intensity of sampling with greater sampling in those areas which have had sand extraction, but still requires sampling albeit at a lower intensity in those areas adjacent within the approved area which have not had sand extraction (highlighted).

Biogenic Sand Production

Beca, in their s92 response, has commented on Biogenic Sand Production. - I provide further comment on this.
There are several ways in which to calculate biogenic shell production, the most accurate is by direct measurement of biota population biomass and using biota growth rates to calculate biogenic production. However, this involves a considerable amount of survey work along with a considerable understanding of the biota with the population, and is rarely done or possible without significant assumptions. An alternative is to use a sediment budget equation with a number of knowns and unknowns in terms of inputs and losses from a sediment system. The equation must balance, and biogenic production as an unknown is assumed be a value to balance the sediment budget.

Hilton (1990) quantified the carbonate content of surficial sediments south of Te Arai Point. In the fine, very well sorted sands of the upper shoreface, Hilton reported the carbonate was only 2-5% of the total sample in depths less than 25m, however this increased to 20-30% in the area between the 25 – 30m chart datum depth contours. Hilton determined that the carbonates consisted mostly of fragments of benthic macrofauna of molluscan origin. Based on the benthic biota data collected in the embayment since 1990 (ASR, 2003, 2006, Bioresearches, 1993, 2011, 2016, 2017, 2019a,b, Grace 1991, 2005) this has not changed with molluscs still dominating the biota.

Hilton (1990), by integrating data from trawls, was able to estimate the total mass of live shell material in the surficial seabed sediments (the top 10-15 cm in this case). He reported an average concentration of shell of 97g/m$^2$ for the embayment inshore of the depth of closure (25m).

Hilton (1990) assumed that for a shellfish species of a 10-year life expectancy, 10% of the population would die every year and the shell becomes part of the biogenic sand. This assumes a constant population size, and that recruitment and mortality were constant, which they are generally not. It also appears that he assumed all shellfish had a similar life span, which is also not a valid assumption. His assumptions were based on the information available in 1990, greater information on life span is now available but the population size, mortality and recruitment are still not well understood. Based on these assumptions, he calculated that the existing weight of shell material, 5,300 tonnes, would increase to 73,000,000 tonnes after 100 years. Unfortunately this calculation was incorrect. Hilton mistakenly added the dead shell material back to the live shell material each year for a compounding recalculation of dead shell production over the 100-year time frame. This process grossly overestimated the production of dead shell material over time. Based on his assumptions the live shellfish population was not expected to change year to year therefore the production should be the same each year. Even if the shellfish population varied in size between years the expected dead shell production would not approach the tonnage Hilton calculated. Correcting Hiltons dead shell production calculation overtime, results in an annual shell material production of 530 tonnes, translating to 482m$^3$/year assuming shell material has a density of 1.1Mg/m$^3$. Hume *et al.* (1999) suggests these values cover half the bay and should be doubled to a corrected value of 964m$^3$/year, which is considerably less than that Hilton reported in 1990 of 900,000m$^3$/year.

The NIWA sand study (Hume *et al*., 1999) considered Hilton's original shell production value of 900,000m$^3$/year erroneous and suggested biogenic sand production was less than 12,000m$^3$/year based on a sediment budget. Barnett in his 2005 environment court evidence suggested it should be near

90,000$m^3$/year. Neither of the these estimates of Barnett or NIWA were based on biological science. Hilton's (1990) corrected estimate of 964$m^3$/year is based on actual biological production but was subject to invalid assumptions which could have resulted in greater production. None of the studies have measured annual variation in production or the effects of long-term ecological changes such as species loss, on production.

We support the conclusion of Beca, that the offshore sand consent extraction area is beyond the depth of closure and that biogenic sand production is of less importance than for areas within the depth of closure. The biota monitoring to date is still in agreement with Hiltons finding that shell based carbonate increases in percentage in the area between 25 and 30m depth.

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