29 May 19

Robin Britton
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HAMILTON

By e-mail: rbritton.coast@gmail.com

Dear Robin,

Re: Request for further information under section 92 of the Resource Management Act 1991 for Ponui Aquaculture Ltd/Peter Bull Ltd, Application number: CST60335843

Please find below our responses to questions raised by the s92 request relating to ecology and water quality:

1. The ecological report appears to have some errors with regard to the surveys. Please clarify the year and date for the ecological surveys carried out for seabed bathymetry, water quality, sediment physical and chemical and seabed biological communities in relation to 84ha and 221ha of the proposed mussel farming application.

- The 87-ha area was surveyed on 6 December 2017 not November 2007 as stated in the Executive summary (page 5).
- The additional 134-ha area was surveyed in October 2018 as correctly stated in the Executive summary (page 5).
- Reference to 24th – 26th November 2018 on page 5 section 2 should be 24th – 26th October 2018.

3. Please provide a cumulative effect assessment in relation to all the existing and/or consented mussel farms in Firth of Thames. The ecological report predicts negligible effects. Please provide analysis on studies undertaken to support this claim.

Section 4.1 of the 4Sight ecological assessment includes points that address hydrodynamics, the findings from long-term monitoring of the much larger, Wilson Bay Marine Farming Zone (WMBFZ), and current knowledge of wider-Firth of Thames processes that are relevant to assessing cumulative effects.

In regard to cumulative effects on phytoplankton depletion, "*the Marine Spatial Plan document (Sea Change 2017) reported that from 12 years of monitoring data supported by synoptic surveys, NIWA concluded that no significant depletion of phytoplankton has occurred from mussel farming in the Firth.*"[1] This document drew its conclusions from all available data in the Firth of Thames at the time. Given that the farming density and footprint of the proposed Ponui Island farm is much smaller than that of the WBMFZ, it would be highly unlikely that the Ponui Island farm would significantly deplete phytoplankton in its vicinity.

The nearest mussel farm is over 6 km away, and therefore, it is highly unlikely that the Ponui Island farm would have any detectable effects on the levels of phytoplankton at other marine farms. Furthermore, the Firth of Thames and wider Hauraki Gulf receive substantial quantities of nutrients from their catchments, which fuel phytoplankton growth (e.g., Green and Zeldis

[1] Bone, O., 2019. Ecological assessment of a proposed mussel farm site north-western Firth of Thames. 4Sight Consulting Report prepared for Takutai Ltd. Section 4.1.1, Page 23.

2015).[2] As stated in the 4Sight ecological assessment, "*Broekhuizen et al. (2002) highlighted the important and dominating role of local and wider scale oceanographic influences (e.g. El Niño) on winds, currents, mixing and nutrient supply in the Firth.*"[3] The effects from this are likely to be orders of magnitude greater than the effects from the mussel farm.

Overall, the literature indicates that there is no significant depletion of phytoplankton in response to the combined mussel farming activities in the Firth of Thames.

In regard to cumulative benthic effects, the area of the seafloor that is likely to be affected by mussel farming (i.e., the farm footprint) is well understood in a New Zealand context.[4] Typically, the mussel farm footprint extends from around 50 to 500 m away from the edge of the farm boundary in the direction of the predominant current, depending on the water depth and flushing capacity. The benthic effects are well studied and have been described in the report (e.g., Section 4.1.2) with supporting literature.

A Ministry for Primary Industries report on the ecological effects of aquaculture describes the significance of benthic effects, with regard to mussel farming as follows: *"While benthic effects are one of the most commonly expected changes as a result of shellfish farming, they are typically of minor ecological consequence beyond the boundary of a farm. The severity of benthic effects is typically low to moderate for soft-sediment habitats where there are no particularly sensitive, vulnerable or special benthic communities."*[5]

Thus, for the proposed mussel farming area that is over 6 km from the nearest existing mussel farm, that has a soft-sediment habitat and has no identified vulnerable or special benthic communities, the literature and substantial monitoring carried out to date suggest that effects should have 'minor ecological consequence'.

4. It is noted that the methodology and number of samples used in the first survey and second survey for the expanded survey are inconsistent in terms of some of the methodology. What was the rationale behind the survey design for these and how the sampling design represents the total application area?

The location of benthic sampling sites for each survey was determined after they had been surveyed by sonar. Areas that were identified as being typical of the general surroundings and areas that were potentially different in terms of apparent substrate or bottom form were way-pointed during the sonar survey; subsequently, benthic samples were collected at these locations. In the initial survey, additional samples were collected to ensure broad coverage of the survey area. In the expanded survey, due to the evident homogeneity of the substrate in the initial survey area and the larger area to be surveyed, the coordinates of the additional sample locations were randomly generated within three roughly equally sized sections of the survey area: that is for each of three blocks of approximately 45ha. This provided a means to

[2] Green, M., Zeldis, J., 2015. Firth of Thames water quality and ecosystem health. Waikato Regional Council Technical Report TR2015/23 prepared by NIWA.

[3] Bone, O., 2019. Ecological assessment of a proposed mussel farm site north-western Firth of Thames. 4Sight Consulting Report prepared for Takutai Ltd. Section 4.1.1, Page 24.

[4] For example:

Keeley, N.B., Forrest, B.M., Macleod, C.K., 2013. Novel observations of benthic enrichment in contrasting flow regimes with implications for marine farm monitoring and management. Mar. Pollut. Bull. 66, 105–116.

Wilson, P.S., Vopel, K., 2015. Assessing the sulfide footprint of mussel farms with sediment profile imagery: A New Zealand trial. PLoS One 10, 1–16.

[5] Ministry for Primary Industries, 2013. Overview of ecological effects of aquaculture.

randomly determine sample locations for the larger number of samples that needed to be taken and ensure appropriate representative coverage of the overall survey area.

The area of the second survey was 1.5 times larger than that of the first survey. In order to keep the same level of sampling intensity, the number of benthic infauna samples was increased in the second survey by at least 1.5 times. Greater efforts were spent collecting benthic samples than water samples or measurements as the seafloor is most affected by mussel farming activities; furthermore, there is already substantial knowledge regarding the water quality in the Firth of Thames and Hauraki Gulf.

Survey 1 (87 ha):

- 10 benthic infauna samples;
- 6 sediment quality samples;
- 3 water quality samples;
- 2 Secchi disk measurements.
- 2 scallop dredge tows; and
- 1 dive;

Survey 2 (134 ha):

- 15 benthic infauna samples;
- 6 sediment quality samples;
- 6 water quality samples (three locations repeated on incoming + outgoing tide);
- 6 Secchi disk measurements (three locations repeated on incoming + outgoing tide);
- 3 scallop dredge tows; and
- 3 dives.

5. It is noted that SCUBA surveys were conducted to obtain visual description of the seafloor. One single dive for the 84ha and 3 dives for the expanded area. Can you please clarify what was the seafloor area covered under each dive and how does this represent the total application area?

The SCUBA based work was largely a discretionary element if there was available time. Characterisation of the seafloor was conducted using sonar and drawing conclusions by ground truthing the sonar detail using benthic sampling. The purpose of SCUBA surveys was to provide an additional level of validation for the data collected by sonar and grab sampling.

Additionally, SCUBA allowed us to collect several undisturbed samples from well-separated locations within the proposed farm area which helped verify the primary data but also provided a picture of the intensity of the vertical redox potential discontinuity layer, or RPD.

Determining the area of seafloor surveyed by SCUBA is very difficult in moderate currents, low visibility and a largely featureless substrate, as occurs at this location. There are practical aspects in terms of allowable bottom time, safety stops while ascending and inevitable drift off-site during surfacing unless the diver can negotiate back to an anchored safety line. That is not practical in deeper water. As the purpose was to validate the primary methods of sampling (i.e., sonar and benthic grabs), the area of seafloor covered by SCUBA is, in our opinion, not relevant.

6. The ecological report justifies the parameters surveyed stating that they are from the Waikato Reginal Council Guideline. Please provide comparison of methodology and available data from the water quality information collected in the 84ha and expanded surveys in relation to information available from mussel farms manged under WRC. Our understanding from Westpac hearing was unless the water quality/chl- a is monitored 24hrs, the information would not be meaningful. How

was the laboratory detection limit for chl-a determined in the first and second surveys? Did the methodology used in the lab is comparable for the methodology used by Cawthron and others? Please clarify.

Chlorophyll-a is measured in the water as a proxy for phytoplankton. Discrete water samples provide a snapshot of water quality at the time of sampling. They are useful for indicating ball-park concentrations at the time of sampling but should be interpreted in the wider context of long-term measurements, of which there are many for the Firth of Thames.

To the best of my knowledge, the Wilson Bay Marine Farming Zone Areas A and B both sampled water column chlorophyll-a on a monthly basis for at least 5–10 years; note that their monitoring plans are not publicly available. Most other smaller mussel farms in the Waikato region are not required to conduct monthly water quality sampling. There are two water quality buoys in the Firth of Thames and Hauraki Gulf that measure high-frequency chlorophyll-a, one owned by Waikato Regional Council and the other by NIWA. The high-frequency chlorophyll-a measurements show clearly how chlorophyll-a concentrations vary widely during the course of a day (e.g., Greeen and Zeldis, 2015) and can provide context for the discrete water quality samples.

Extraction of chlorophyll-a was carried out in the same manner for both analytical methods – the difference was the detector used to measure the concentration (spectrometry vs. fluorometry). Chlorophyll-a concentrations from both surveys were analysed using a 90% acetone extraction and then detected using either a spectrometer or fluorometer, the latter being more sensitive but the former still being accurate. National Environmental Monitoring Standards (NEMS) for coastal waters[6] recommend a 90% acetone extraction and measurement by fluorometry.

7. Based on the results in Table 3, 4 & 5, chl-a is relatively low compared to other studies. How reliable is this information based on the laboratory methodology used and if you consider this as an indicator for phytoplankton, is the site suitable? Do these low chl-a concentration have implications for the site's suitability for mussel farms?

All chlorophyll-a measurements were conducted by Hill Laboratories and, therefore, follow approved methodologies and undergo rigorous quality checks. We have no reason to doubt the validity of the results.

Chlorophyll-a concentrations vary temporally and spatially. The Firth of Thames and wider Hauraki Gulf receive elevated levels of nutrients from their catchments, which fuel phytoplankton growth. Based on the current knowledge of nutrient levels in the Firth of Thames, it is unlikely that any location in the Firth of Thames would have insufficient phytoplankton levels to support the growth of mussels in a farming zone of this size.

8. Based on the results in Table 3, 4 & 5, will you be able to explain how the nutrient levels (mainly nitrogen and phosphorous) in the water quality, limits the phytoplankton /chl-a level at the proposed site?

Water quality in the Firth of Thames and Hauraki Gulf, including nutrient levels, is well known and well reported. In such a well-flushed environment, nutrient levels will change quickly and be influenced by the wider Firth of Thames and Hauraki Gulf depending on the tide. Growth of phytoplankton is based on a number of factors, including light and temperature, and is not always correlated with nutrient concentrations.

[6] http://www.nems.org.nz/documents/water-quality-part-4-coastal-waters

Furthermore, nutrient levels in the Firth of Thames have been shown to be increasing over time.[7] This indicates there should be sufficient (and most likely, excess) nutrients to sustain phytoplankton populations that are appropriate for mussel farming.

9. Did either the scallop dredge survey or dives undertaken indicate presence of horse mussels or green lipped mussels or shells in the proposed area?

No.

10. If consent were to be granted, Council would be seeking environmental monitoring conditions similar to those included on the resource consent for the Western Consortium (a copy is attached). Please consider these conditions in relation to the current proposal and provide modification or suggestion on how they could be amended for the current proposal.

Unless there is good reason not to, we propose monitoring as accepted for the Westpac Mussels farms (Waitoetoe and Rangipakihi) in the Firth of Thames; that is, an approach based on the framework described in Waikato Regional Council Technical Report 2015/40.[8] This approach focuses on monitoring enrichment of the seabed underlying the farm with organic matter (benthic organic enrichment). Benthic organic enrichment is the primary potential ecological effect from mussel farming and is associated with the deposition of faecal wastes and other biological material that may drop from the farming structures.

To monitor benthic organic enrichment, sediment samples are collected from representative locations within the farming area and at nearby reference locations and measured for total free sulphides, sediment organic matter content, and redox potential. The in-farm results are then compared to the reference location results to determine the extent of organic enrichment within the farming area.

12. The ecology report refers to a map (Figure 6B) in relation to marine mammal sightings/records. Can you please provide this map as it is not attached.

The referenced figure is from the Hauraki Gulf Forum State of our Gulf 2014 report and should have read Figure 6-43.[9] This can be found on page 144 of the report and is also attached to this response.

13. The ecological report simply relying on Biosecurity Management Plan (BMP) and lack an assessment on marine pest/biosecurity effects. Please provide this.

We acknowledge that Biosecurity is an important element of farm management; however, we do not want to commit to a detailed protocol around this at this point but accept and suggest that an appropriately worded condition can be formulated that requires a BMP to be signed off by Council before the farm is developed. We think that this approach will provide the required flexibility such that the BMP will capture the current initiatives the industry is promulgating, such as the A+ Sustainable Aquaculture Management Framework.

The A+ framework was developed by Aquaculture New Zealand and provides guidance for a range of aquaculture management issues, including biosecurity. The biosecurity-related objective in the framework is: "*Farming activities do not cause an unacceptable biosecurity risk*".

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[7] Green, M., Zeldis, J., 2015. Firth of Thames water quality and ecosystem health. Waikato Regional Council Technical Report TR TR2015/23 prepared by NIWA.

[8] Keeley, N., Cornelison, C., Knight, B., Forrest, B., Taylor, D., 2015. Monitoring framework for the Waikato coastal marine area: Report 3 – Seabed and water column monitoring and standards. Waikato Regional Council Technical Report 2015/40 prepared by Cawthron Institute. 56 p.

[9] Hauraki Gulf Forum, 2014. State of our Gulf 2014: Hauraki Gulf – Tīkapa Moana/ Te Moananui a Toi State of the Environment Report 2014. Hauraki Gulf Forum Report.

The is achieved through best practice biosecurity management, including prevention, surveillance, and reporting.

15. The applicant has provided a depth average current data for the site. This does not enable us to assess the different water flow directions and rates within the water column. We would like this to understand the nutrient flow through the proposed farm and the possible dispersal of any bottom accumulation. Please provide current data through the water column, especially if there are distinct different flows between the surface and bottom water bodies.

We don't believe that such a detailed analysis of the water column is warranted in an open hydrodynamic setting like this. The data collected confirmed that the proposed location is exposed to relatively strong currents, which flow in a largely predictable direction. Residual currents are also expected, which will vary depending on the strength and direction of the wind and tidal phase. The combination of these effects creates a well-mixed location. It is known that the severity of seabed effects decreases as flushing increases (e.g., with increased water currents).[10]

17. It is understood that the Mussel Reef Restoration Trust has a consent for restoring mussel beds around Ponui Island. The consent expires in 2043. Can you clarify whether your proposal will affect the use of this consent holder.

My understanding is that the Mussel Reef Restoration Trust deposits large quantities of mussels on the seabed so that they might colonise the area. The proposed farming area would not prevent this; in fact, mussels falling off the lines provide hard structure on the sea floor, which may provide additional habitat for mussel larvae and other organisms to settle and grow.

From email correspondence on 27 May 2019 with Dr Carina Sim-Smith, who is involved with the restoration project, I understand that the two areas the Mussel Reef Restoration Trust have a consent for are: 1) South of Ponui Island (south of Motunau Bay) and 2) East of Ponui Island (east of the narrowest part of the island). Dr Sim-Smith also said that *"in general, we would deploy mussels at depths between 5 and 20 m."* The westernmost boundary is approximately 4.5 km east of Ponui Island and in ~21-24 m water depth. Based on this information, the proposed spat farm location would be outside of the location where the trust would deposit mussels.

I also note that the predominant northwest/southeast direction of currents in the area means that water that has passed through the proposed farm in either direction is most unlikely to interact with that area to the west.

Kind Regards,

Dr Pete Wilson
Senior Coastal Scientist
4Sight Consulting Ltd

[10] Forrest, B., Cornelisen, C., 2015. Monitoring framework for the Waikato coastal marine area: Report 2 – Regional aquaculture monitoring priorities and guidance. Waikato Regional Council Technical Report TR2015/39 prepared by Cawthron Institute.