



MARSHALL DAY
Acoustics 

SALMON FARM RELOCATION
NOISE EFFECTS ASSESSMENT
Rp 001 R01 2016332W | 7 September 2016

Project: **SALMON FARM RELOCATION**

Prepared for: **Ministry for Primary Industries
Private Bag 14
Nelson 7042**

Attention: **Daniel Lees**

Report No.: **Rp 001 R01 2016332W**

Disclaimer

Reports produced by Marshall Day Acoustics Limited are based on a specific scope, conditions and limitations, as agreed between Marshall Day Acoustics and the Client. Information and/or report(s) prepared by Marshall Day Acoustics may not be suitable for uses other than the specific project. No parties other than the Client should use any information and/or report(s) without first conferring with Marshall Day Acoustics.

The advice given herein is for acoustic purposes only. Relevant authorities and experts should be consulted with regard to compliance with regulations or requirements governing areas other than acoustics.

Copyright

The concepts and information contained in this document are the property of Marshall Day Acoustics Limited. Use or copying of this document in whole or in part without the written permission of Marshall Day Acoustics constitutes an infringement of copyright. Information shall not be assigned to a third party without prior consent.

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Draft		For comment	29 July 2016	M Halstead	B Wood
Reviewed	01		7 Sept 2016	M Halstead	B Wood

EXECUTIVE SUMMARY

We have predicted the noise emissions from nine proposed sites for New Zealand King Salmon (NZKS) salmon farms in the Marlborough Sounds, which would be used to assume the capacity of other “low flow” sites in the region should they be shut down.

We have predicted that all of the proposed sites can comply with the noise limits previously accepted during the 2011 NZKS farm expansion by a comfortable margin.

Most farms will not produce significant amounts of noise at dwellings. In the two cases where proposed farms are near to dwellings —Site 82 (Motukina Point) and 47 (Te Weka Bay) — noise effects are predicted to be reasonable provided harvesting and net cleaning activities are avoided during Saturday afternoons, Sundays and public holidays.

Noise produced at night from fixed generators in all cases are predicted to be reasonable, and generally will be at or below the quietest background sound levels experienced at established dwellings.

Noise levels at shorelines are predicted in all cases to be reasonable, and below the 55 dBA L₁₀ limit relating to the protection of recreational activities from salmon farm activities in Plan Change 24.

Some minor positive benefits arise, related to the removal of several of the low flow sites. However, we are not aware of existing significant adverse noise effects related to these sites that would represent a major positive benefit from their removal.

We consider that the noise rules previously applied to NZKS salmon farms are appropriate to control noise emissions from these farms, and with consideration of the issues described above, noise effects from the proposed farms will be adequately addressed (and therefore reasonable).

TABLE OF CONTENTS

1.0	INTRODUCTION	5
2.0	DESCRIPTION OF SITES	5
2.1	Noise Environment	7
2.1.1	Kaitira Survey	7
2.1.2	Ruaomoko Survey	8
2.2	Summary	8
3.0	NOISE STANDARDS	9
4.0	SALMON FARM NOISE EMISSIONS.....	9
4.1	Specific Noise Sources	10
4.1.1	Diesel Generator	10
4.1.2	Feed Dispenser	10
4.1.3	Waterblaster.....	10
4.1.4	Net Lifter	10
4.2	Predicted noise levels from new sites.....	11
5.0	NOISE EFFECTS.....	12
5.1	Noise Effects at new sites	12
5.2	Noise effects at existing sites.....	13
5.2.1	Waihinou Farm	13
5.2.2	Forsyth Farm.....	13
5.2.3	The Crail Bay Farms.....	13
5.2.4	Ruakaka Farm	13
5.2.5	Otanerau Farm	14
5.3	Cumulative Effects.....	14
6.0	RECOMMENDED MITIGATIONS	14
7.0	CONCLUSIONS.....	15

APPENDIX A GLOSSARY OF TERMINOLOGY

APPENDIX B NOISE PREDICTION CONTOURS

1.0 INTRODUCTION

The Ministry for Primary Industries has requested that Marshall Day Acoustics assesses the noise impacts and benefits associated with the relocation of several salmon farm sites related to the New Zealand King Salmon operations in the Marlborough Sounds.

This report describes the noise emissions from the salmon farm sites, presents noise levels predicted for the proposed sites, and discusses the resulting noise effects. The reduction of noise and noise effects resulting from removal of existing sites is also described.

The noise levels from the salmon farming activity, and the ambient noise levels in the Sounds environment has previously been described in Marshall Day Acoustics report Rp001 R03 2011152A, dated 9 August 2011. That 2011 report described the noise effects related to New Zealand King Salmon's proposed expansion of operations at the time. The same salmon farming configurations and methodologies are to be employed at the sites discussed in this report.

2.0 DESCRIPTION OF SITES

The relevant sites in this assessment are the nine locations where new farm sites are being considered, and the six "low flow" sites where farms may be removed, depending on adequate replacement sites being consented.

These sites are illustrated in Figure 1.

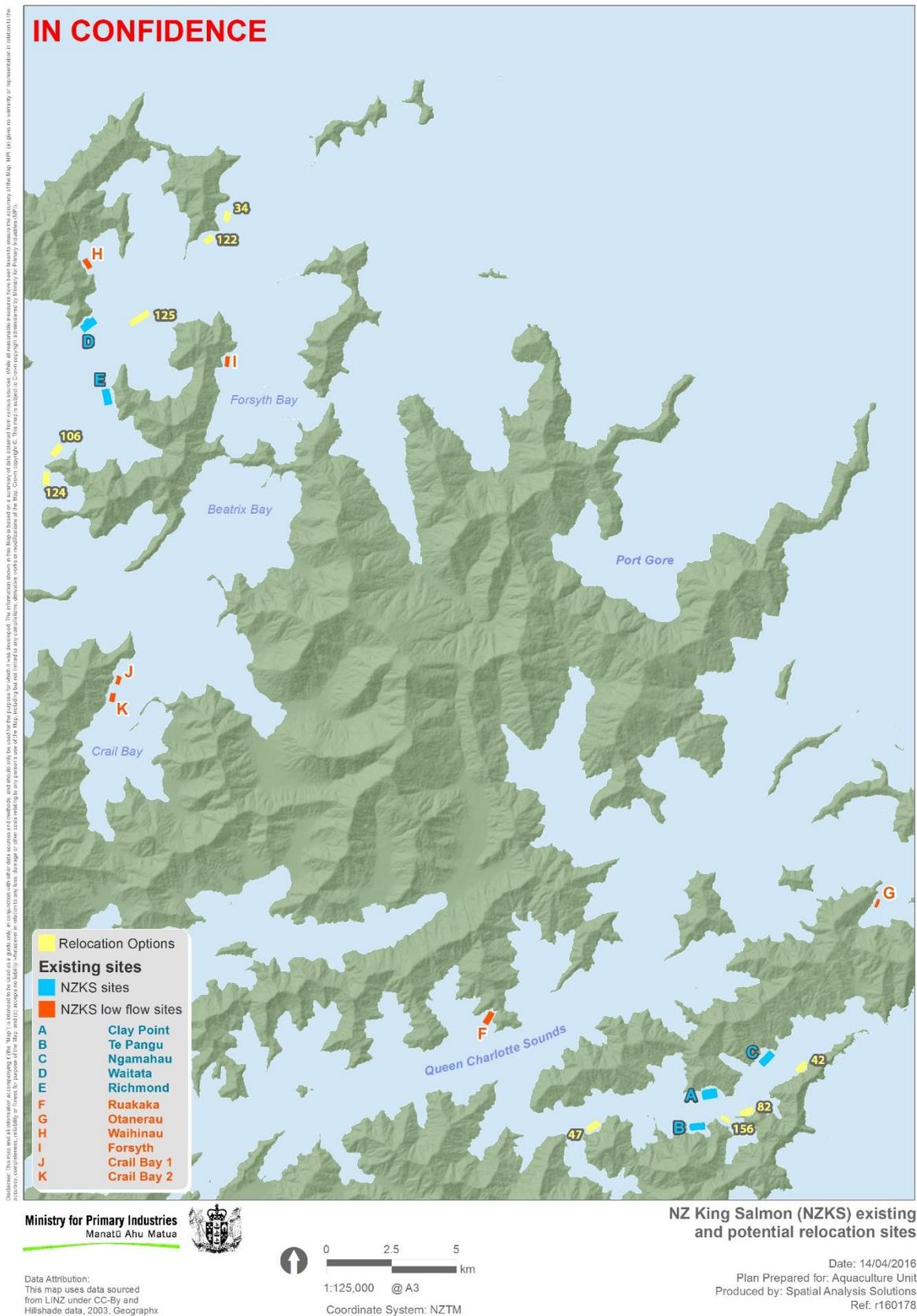


Figure 1 Site Locations

2.1 Noise Environment

The noise environment in the Marlborough Sounds has been measured and assessed during the 2011 NZKS expansion investigation. The identified noise sources included natural sounds and in the case of Tory Channel / Queen Charlotte Sound, shipping activity. These activities have not materially changed since that time, and hence we consider that those noise surveys are still relevant. Details of the relevant assessments from the 2011 report are included in this section as follows.

The ambient noise level in the Marlborough Sounds is primarily determined by wind and sea conditions and also intermittently affected by marine vessels, including ferries, commercial fishing and recreational boating activities. Two of the three sites investigated in 2011 are representative of the general areas under consideration for the present relocation of salmon farms – Pelorus Sound (represented by measurements at Kaitira) and the Tory Channel/Queen Charlotte Sound (represented by measurements at Ruaomoko).

2.1.1 Kaitira Survey

The noise logger for this site was located approximately 5 – 7 metres above the Mean Low Water Mark (MLWM) and approximately 8 – 10 metres from the beach adjacent to the proposed Kaitira site. This location was chosen as representative of the ambient noise levels in the Waitata Reach area. A shag rookery is located nearby and this may have influenced the ambient noise levels at times but is unlikely to have had any impact on the background noise level (L_{A90}).

The following graph shows the background noise level (L_{A90}) over the seven-day period along with the measured wind speed at Brothers Island.

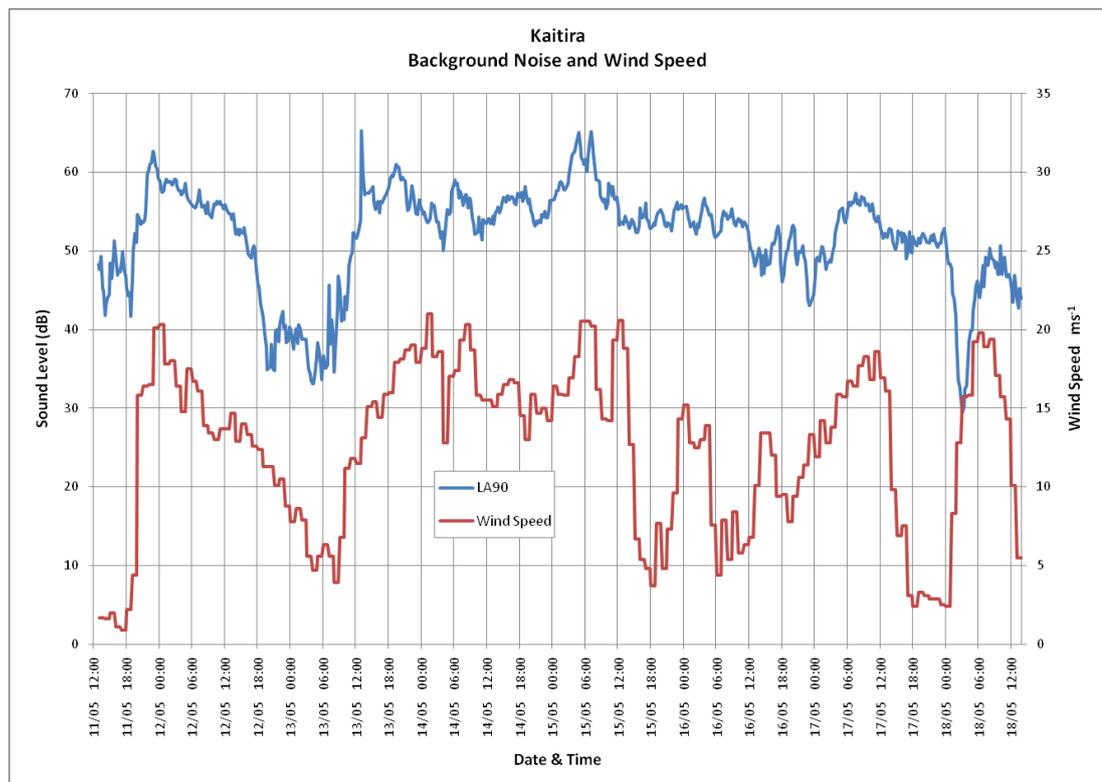


Figure 2 – Kaitira Background Noise Level

The graph shows reasonable correlation with the background noise level and wind speed with significant periods of this measurement affected by the inclement weather. However, two periods during the nights of 12/13 May and the 17/18 May were relatively unaffected and showed the

background noise level dropped down to approximately 35dB LA90. This level is considered a reasonable representation of the quieter background noise levels that occur in this area at times.

2.1.2 Ruaomoko Survey

The noise logger for this site was located approximately 2 metres above the Mean Low Water Mark (MLWM) and approximately 8 – 10 metres from the beach adjacent to the proposed Ruaomoko site. This location was chosen as representative of the ambient noise levels in the Tory Channel/Queen Charlotte Sound area.

The following graph shows the background noise level (LA90) over the seven-day period along with the measured wind speed.

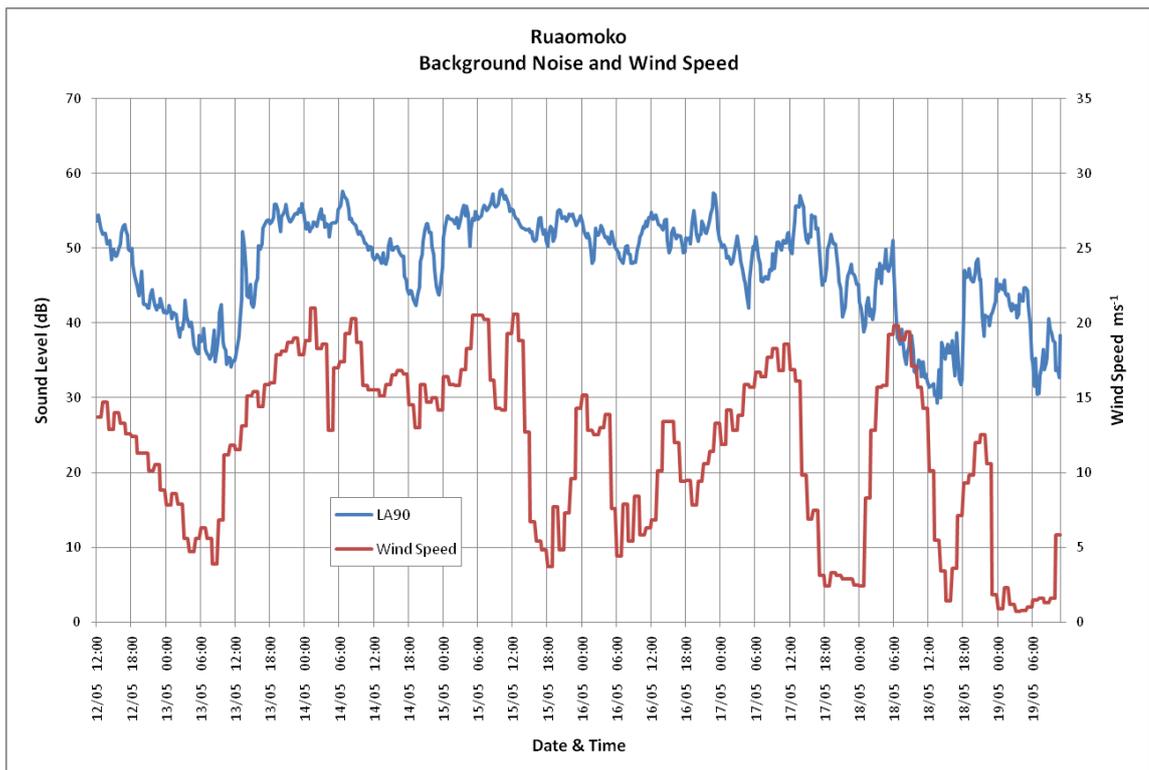


Figure 3 – Ruaomoko Background Noise Level

The graph shows reasonable correlation with the background noise level and wind speed with large periods of this measurement affected by the inclement weather. However, the period during the nights of 12/13 May and the 17/18 May show the background noise level drops down to approximately 35 dB LA90. This level is considered a reasonable representation of the quieter background noise levels that occur in this area at times.

Shipping activity in the Tory Channel/Queen Charlotte Sound will affect the ambient noise levels but due to their intermittent nature will not affect the background noise level LA90.

2.2 Summary

The following table provides a summary of the typical lowest ambient noise level at each of the two sites.

Table 1 – Background Noise Levels

Site Name	Area/Location	LA90
Kaitira	Pelorus Sound	35 dB
Ruaomoko	Tory Channel/QC Sound	35 dB

3.0 NOISE STANDARDS

The following noise conditions were recommended and accepted at the Board of Inquiry hearing into the 2011 proposed new farms. These limits are directly comparable to the noise limits described in Section 35.1.1 of the Marlborough Sounds Resource Management Plan, as applies to permitted activities, when measured in the general vicinity of the Farms, and 5 decibels more stringent when measured at or within the notional boundaries of established dwellings.

Noise

All marine farming shall be conducted so as to ensure that noise arising from such activities does not exceed the following noise limits when measured no closer than 250m from any marine farm surface structure:

<i>0700 hours – 2200 hours Monday to Friday and 0700 hours – 1200 hours Saturday</i>	<i>55 dBA L₁₀</i>
<i>On any day between 0700 hours and 2200 hours</i>	<i>No L_{max} limit</i>
<i>At all other times including any public holiday</i>	<i>45 dBA L₁₀, and 75 dBA L_{max}</i>

All marine farming shall be conducted so as to ensure that noise arising from such activities does not exceed the following noise limits when measured at the Notional Boundary of dwellings existing at [the date the Plan Change becomes operative]

<i>0700 hours – 2200 hours Monday to Friday and 0700 hours – 1200 hours Saturday</i>	<i>50 dBA L₁₀</i>
<i>On any day between 0700 hours and 2200 hours</i>	<i>No L_{max} limit</i>
<i>At all other times including any public holiday</i>	<i>40 dBA L₁₀, and 75 dBA L_{max}</i>

Noise shall be measured in accordance with NZS 6801:2008. Adjusted levels shall be determined in accordance with NZS 6802:2008. Any construction activities will meet standards specified in NZS 6803:1999.

The following activities shall be exempt from the above noise standard:

- a. Noise generated by navigational aids, safety signals, warning devices, or emergency pressure relief valves;*
- b. Noise generated by emergency work arising from the need to protect life or limb or prevent loss or serious damage to property or minimise or prevent environmental damage; or*
- c. Noise ordinarily generated by the arrival and departure of vessels servicing the marine farm.*

The use of outdoor radios or similar external speakers on the marine farm is prohibited.

4.0 SALMON FARM NOISE EMISSIONS

The noise emissions from new salmon farm activities have been predicted on the basis of the salmon farm equipment noise measured during the 2011 investigation, with the recommended noise mitigations in place that were determined to be reasonable and practicable at that time. Measurements were taken at the Clay Point and Te Pangu Farms during the 2011 investigation.

4.1 Specific Noise Sources

The noise sources which are significant are as follows.

4.1.1 Diesel Generator

A main generator is required to provide power to the accommodation building 24 hours a day, for refrigerators, lighting and general equipment. A diesel generator is typically installed with its own acoustic enclosure and is then located within a generator room in the accommodation building.

Noise measurements of the Clay Point generator were made in May 2011. At this time, the generator room was operating with the external door open to assist with cooling. This is a worst case noise scenario and noise measurements were made inside the room and outside at 3 metres from the door to determine the sound power level of generator noise escaping from the room. The calculated sound power level radiated from the generator room door opening is 93 dBA L_W .

Improvements to the ventilation scheme of the generator room permits a further reduction of generator noise of at least 10 decibels, relative to the unit measured. This is implemented in current farms, and will be part of the new farm design.

4.1.2 Feed Dispenser

The fish are fed with feed pellets which are dispensed by blowing the pellets down a series of long plastic tubes. A compressor provides high pressure bursts of air that push the pellets along the tube at moderately high speed. The pellets are relatively hard and make a noise when they hit the sides of the plastic tubes. The bursts of air last for approximately 4 seconds followed by a 10 second break and then this cycle repeats. The tubes are up to 180 metres long to feed the outer pens. The feed dispenser operates continuously for most of the daytime (9 hours) – seven days a week.

The noise level from the feed dispensing tubes was measured at 2m from the tube at several locations along the tube. The measured noise level has been used to calculate the sound power level of the 'moving point source' that travels down typical 100m long tube. The calculated sound power level of the moving point source is 93 dBA L_W .

The compressor driving the feed dispenser is located in its own room off the generator room and the noise radiated to outside is not significant, due to this enclosure.

4.1.3 Waterblaster

Waterblasters are used to clean the nets underwater. The main drive unit consists of a compressor driven by a diesel engine which blasts water at high pressure through an underwater extension nozzle on to the nets to remove algae growth. The compressor is located in an enclosure. The calculated sound power level radiated from the waterblaster unit is 103 dBA L_W .

Improvements to the enclosure design have permitted a further reduction of waterblaster noise by 5 dB, relative to the units originally measured. This will be implemented at the proposed salmon farms.

4.1.4 Net Lifter

The salmon nets are lifted when required using small motorized net lifters. These units consist of a hydraulic winch powered by a 4hp Honda petrol engine mounted on a portable frame.

The noise level of a typical net lifter was measured at 3 m and the calculated sound power level is 92 dB L_{WA10} . Improvements to the enclosure and silencer design has permitted a reduction of net lifter engine noise by 5 dB. This will be implemented at the proposed salmon farms. A further -5 dB duration correction is applied to account for the intermittent (less than 3 hrs per day total) use of these items.

4.2 Predicted noise levels from new sites

Noise calculations have been carried out based on the above sound power levels for each of the nine proposed salmon farm sites. The noise level was calculated over a sufficient area to identify locations which receive more than 25 dBA L₁₀. Additionally, the noise level was specifically calculated at any identified buildings within this radius. The sound level at the nearest shoreline is determined from the noise contours in each case.

Measurement and assessment at an uninhabited shoreline is somewhat arbitrary as it is unlikely that a person would be present to hear the noise. A listener could just as easily be located in a kayak or fishing boat anywhere around the salmon farm. As the effects of noise reduce with distance it seems reasonable to protect the environment outside a given buffer zone. A nominal distance of 250 metres has been chosen as the closest assessment position.

The calculations have been carried out using the ISO9613-2 sound propagation model. Barrier effects and ground attenuation factors are included in the propagation over land to the most affected dwellings, and the ground attenuation factor inherently accounts for the reflection of sound by the water.

The noise contours produced by the model are presented in Appendix B. In these contours, the noise-making equipment associated with daytime activities are spread across the farm site; only the generator is treated as a fixed noise source. The night-time contours represent the emissions from only the generator operating.

The following table shows the predicted noise levels at each of the proposed salmon farm relocation sites with all equipment operating (including harvesting) during a normal day. The lower value in the range represents the modelled case where the noise-making equipment is spread out across the farm; the upper limit represents the case where all the noise-making equipment is clustered at the part of the farm nearest to the residence.

Note that Site 125 (Waitata Reach) does not have fixed plant, and will be serviced from a vessel which is not considered part of the noise emissions from these sites. However, the noise levels predicted represent noise produced by vessel-based activities. The assessment of noise effects is based on these noise predictions at this site.

“N/A” indicates that the sound level is predicted to be less than 25 dBA L₁₀ at this location.

Table 2 – Predicted Noise Levels (Daytime)

Proposed Salmon Farm Site	Noise Level at Closest Shoreline L _{A10}	Noise Level at most affected Dwelling L _{A10}
34 North Blowhole Pt	36 - 41 dB	N/A
122 Blowhole Point	40 - 45 dB	N/A
125 Waitata Reach	25 - 30 dB	N/A
106 Richmond Bay South	40 - 45 dB	N/A
124 Horseshoe Bay	41 - 46 dB	N/A
42 Tipi Bay	45 - 50 dB	N/A
82 Motukina Point	47 - 52 dB	40 - 45 dB
156 Tio Point	42 – 47 dB	24 – 29 dB
47 Te Weka Bay	45 - 50 dB	40 - 45 dB

The following table shows the predicted noise levels at each of the proposed salmon farm relocation sites with only the generator operating, as would be the case at night. Note that Site 125 (Waitata Reach) will not have a fixed generator and so does not produce noise at night.

“N/A” indicates that the sound level is predicted to be less than 25 dBA L_{A10} at this location.

Table 3 – Predicted Noise Levels (Night-time)

Proposed Salmon Farm Site	Noise Level at Closest Shoreline L_{A10}	Noise Level at most affected Dwelling L_{A10}
34 North Blowhole Pt	28 dB	N/A
122 Blowhole Point	25 dB	N/A
125 Waitata Reach	N/A	N/A
106 Richmond Bay South	28 dB	N/A
124 Horseshoe Bay	31 dB	N/A
42 Tipi Bay	35 dB	N/A
82 Motukina Point	37 dB	24 dB
156 Tio Point	30 dB	N/A
47 Te Weka Bay	31 dB	25 dB

5.0 NOISE EFFECTS

5.1 Noise Effects at New Sites

Most of the proposed new farms are sufficiently removed from existing dwellings that the noise emissions are predicted to produce negligible noise effects on any such dwellings. However at two sites — 82 (Motukina Point) and 47 (Te Weka Bay) — there are dwellings near enough to the proposed farms for noise effects to be considered.

At both of these farms the predicted daytime noise levels are between 40 and 45 dB L_{A10} , depending on the location of the specific net cleaning and harvesting activities within the farms. This noise would generally be masked by wind and sea activity noise, but on calm days it is likely that this noise would be audible, and could be the dominant noise source in the environment. However this noise level is low, and even in the worst case is significantly less than the proposed daytime noise limit of 50 dB L_{A10} at notional boundaries.

The proposed noise limit is more stringent during Saturday afternoons, Sundays and public holidays, as these are times when industrial activities would be less readily tolerated. The daytime activities including net cleaning and harvesting may exceed this limit during these times at these two sites, and should be avoided. This does not preclude daily feeding occurring during these times.

At all sites, the night-time noise emissions relating to the operation of the site generators are well within the recommended noise limits, and in all cases except at site 82 (Motukina Point), are at or below the quietest observed background noise levels due to normal sea and wind activity in the calm state. At site 82 it is possible the generator could be audible to an observer outdoors during calm conditions, but the noise would be intermingled with other natural sounds.

The noise levels produced at the shore and over the water are within the recommended limits, which offer reasonable protection to recreational users of the land and water. The proposed farms are being built to the same specification as those put forward during the 2011 NZKS expansion, and noise

impacts on recreational users were considered and accepted at the same noise levels as is proposed in this case.

The noise effects from site 125 Waitata Reach are considered slightly differently, as all activities are carried out from a vessel, and as such are not directly controlled by the recommended noise limits. We have evaluated these noise emissions on the same basis as for a fixed-plant farm – generally assuming that petrol or diesel powered winches and pumps will be employed, albeit from a mobile platform. The noise emissions from this site are significantly removed from dwellings, and are not predicted to cause adverse noise effects beyond those normally associated with vessels in the area.

5.2 Noise effects at existing sites

The proposal to relocate some of the farming activities has the potential for positive noise effects in areas where existing farming activities will cease. Each of the “low flow” sites are considered in this section in terms of the resulting reduction of noise emissions.

5.2.1 Waihinau Farm

This farm is situated at approximately 400 metres from several identifiable properties, one to the south and several to the northwest. We have not measured emissions from this farm but as it was established prior to the most recently built farms we presume its noise emissions are somewhat higher than the farms which are presently being considered.

The 2011 Marshall Day Acoustics report predicts that the older farms would produce noise levels of 46 dBA L_{10} during daytime, and 33 dBA L_{10} at night-time (when only the generator is operating) at a distance of 400 metres.

In the context of the typical background sound levels we have observed, this operation is likely to be audible at times of quiet seas, but the noise level would generally be considered acceptable. Some perceived benefit to the community may arise from the removal of this farm.

5.2.2 Forsyth Farm

The farm in Forsyth Bay does not appear to be close enough to any dwellings or inhabited properties to cause adverse noise effects, and conversely there would not likely be a significant positive noise effect from its removal.

5.2.3 The Crail Bay Farms

The Crail Bay farms are not currently being farmed. Their design is such that if operating, they would produce noise during daytime hours only. The noise levels predicted for these farms are between 35 and 46 dB L_{A10} during daytime hours, at the nearest bach which is approximately 260 metres from the farm.

This activity is similar to what would be experienced at the Waihinau Farm, and while the noise level is reasonable, the farms removal would eliminate the potential for them to act as one noise source from the environment during times when the sea is calm. Some positive noise effects could be perceived by neighbours to the farm.

5.2.4 Ruakaka Farm

The Ruakaka Farm is approximately 500 metres from the nearest dwelling. At this distance the predicted noise level is approximately 44 dBA L_{10} during daytime and 31 dBA L_{10} during night-time. While the night-time activity is most likely masked at most times by natural noises, the daytime activity would likely be audible, although at a reasonable noise level. As with the Waihinau Farm, its removal may be perceived as a minor benefit to its neighbours.

5.2.5 Otanerau Farm

The Otanerau Farm is approximately 1km from its nearest neighbour. Noise from daytime activities is predicted to be approximately 38 dBA L₁₀, and would be largely masked by sea noise under most circumstances. Night-time noise emissions are expected to be less than the quietest background sound levels under all conditions.

The removal of this farm would not likely have significant noise benefits.

5.3 Cumulative Effects

In several cases (farms 42, 82, 156, and to a lesser extent 125), the proposed new farms are near to existing farms which are intended to carry on operations.

We have examined these cases, and at each site the predicted noise levels from the proposed new farms and the existing farms are at least 10 decibels different from each other at any dwelling. This means that the noise level caused by the nearer farm will not increase as a result of contribution by the more distant farm. Furthermore, it is likely that harvesting equipment would be shared between adjacent farms, such that concurrent activity is unlikely. Although net cleaning may occur at two adjacent farms, the cumulative noise increase that would occur is not significant.

6.0 RECOMMENDED MITIGATIONS

The noise standards described in Section 3.0 of this report have been previously considered, and provide a reasonable degree of protection from adverse noise effects. The farms proposed in this application are predicted to comply with these standards, provided:

1. That the farms are constructed in similar fashion to those established as part of the 2011 NZKS expansion, including the use of silencers on net lifters and water blaster pumps, and silenced ventilation to the generator housings as previously recommended.
2. That net cleaning and harvesting activities at sites 82 and 47 are avoided during Saturday afternoons, Sundays, and public holidays.
3. That the general recommendations of avoiding outdoor radios or similar external speakers on the marine farm are followed.

7.0 CONCLUSIONS

We have predicted the noise emissions from nine proposed sites for NZKS salmon farms in the Marlborough Sounds, which would be used to assume the capacity of other “low flow” sites in the region.

Calculations show that all of the proposed sites can comply with the noise limits previously accepted during the 2011 NZKS farm expansion by a comfortable margin.

It is predicted that most farms will not produce significant noise at dwellings. In the two cases where proposed farms are near to dwellings —Site 82 (Motukina Point) and 47 (Te Weka Bay) — noise effects will be reasonable provided harvesting and net cleaning activities are avoided during Saturday afternoons, Sundays and public holidays.

Noise produced at night from fixed generators is predicted in all cases to be reasonable, and generally to be at or below the quietest background sound levels experienced at established dwellings.

Noise levels at shorelines are predicted in all cases to be reasonable, and below the 55 dBA limit relating to the protection of recreational activities from salmon farm activities in Plan Change 24.

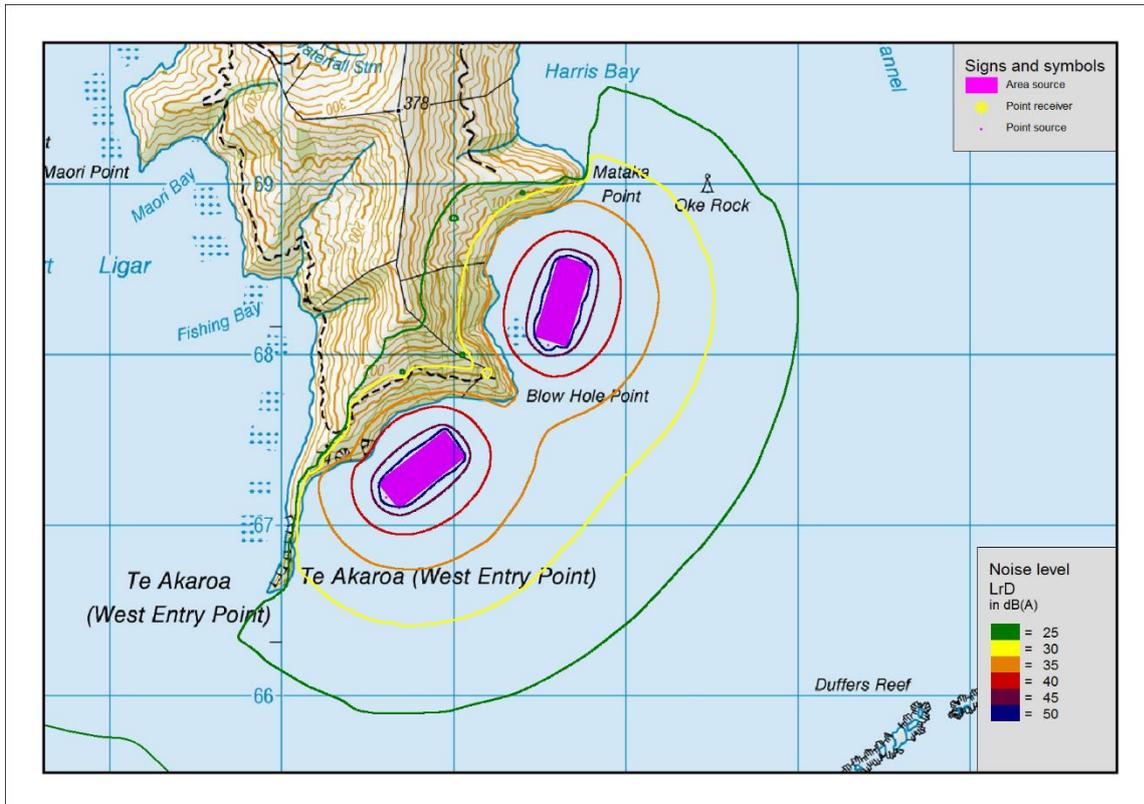
Some minor positive benefits existing related to the removal of several of the low flow sites, however we are not aware of significant adverse noise effects related to these sites that would represent a major positive benefit from their removal.

We consider that the noise rules previously applied to NZKS salmon farms are appropriate to control noise emissions from these farms, and with consideration of the issues described above, noise effects from the proposed farms will be adequately addressed.

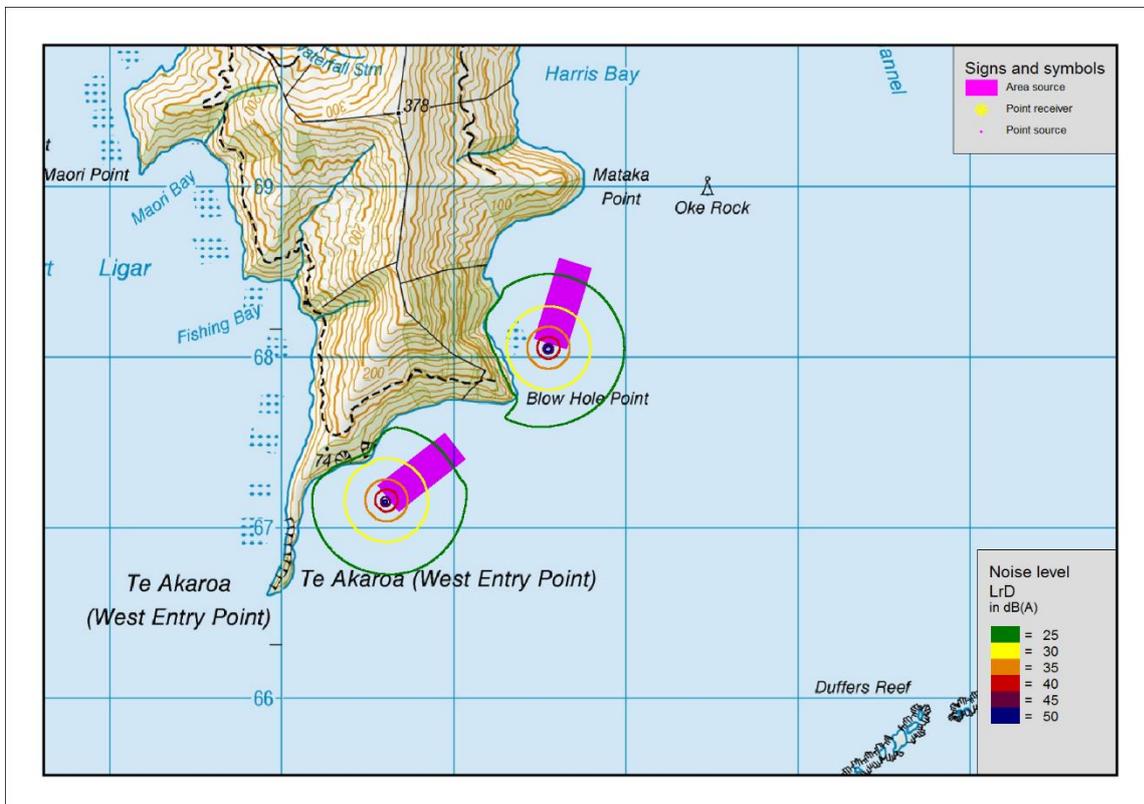
APPENDIX A GLOSSARY OF TERMINOLOGY

SPL or L_p	<p><u>Sound Pressure Level</u> A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.</p>
SWL or L_w	<p><u>Sound Power Level</u> A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.</p>
dB	<p><u>Decibel</u> The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of $P_r=20 \mu$Pa i.e. $dB = 20 \times \log(P/P_r)$</p>
dBA	<p>The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.</p>
A-weighting	<p>The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.</p>
$L_{A95}(t)$	<p>The A-weighted noise level equalled or exceeded for 95% of the measurement period. This is commonly referred to as the background noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.</p>
$L_{A90}(t)$	<p>The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.</p>
$L_{A10}(t)$	<p>The A-weighted noise level equalled or exceeded for 10% of the measurement period. This is commonly referred to as the average maximum noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.</p>
L_{Amax}	<p>The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.</p>

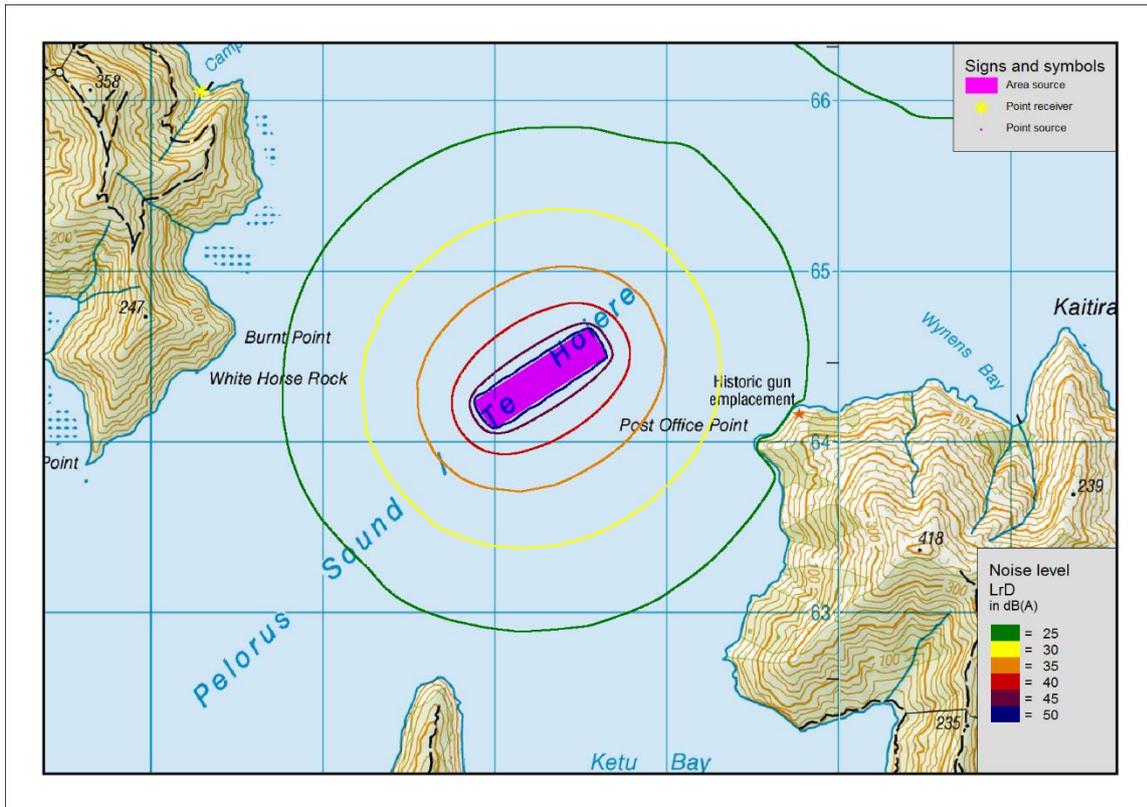
APPENDIX B NOISE PREDICTION CONTOURS



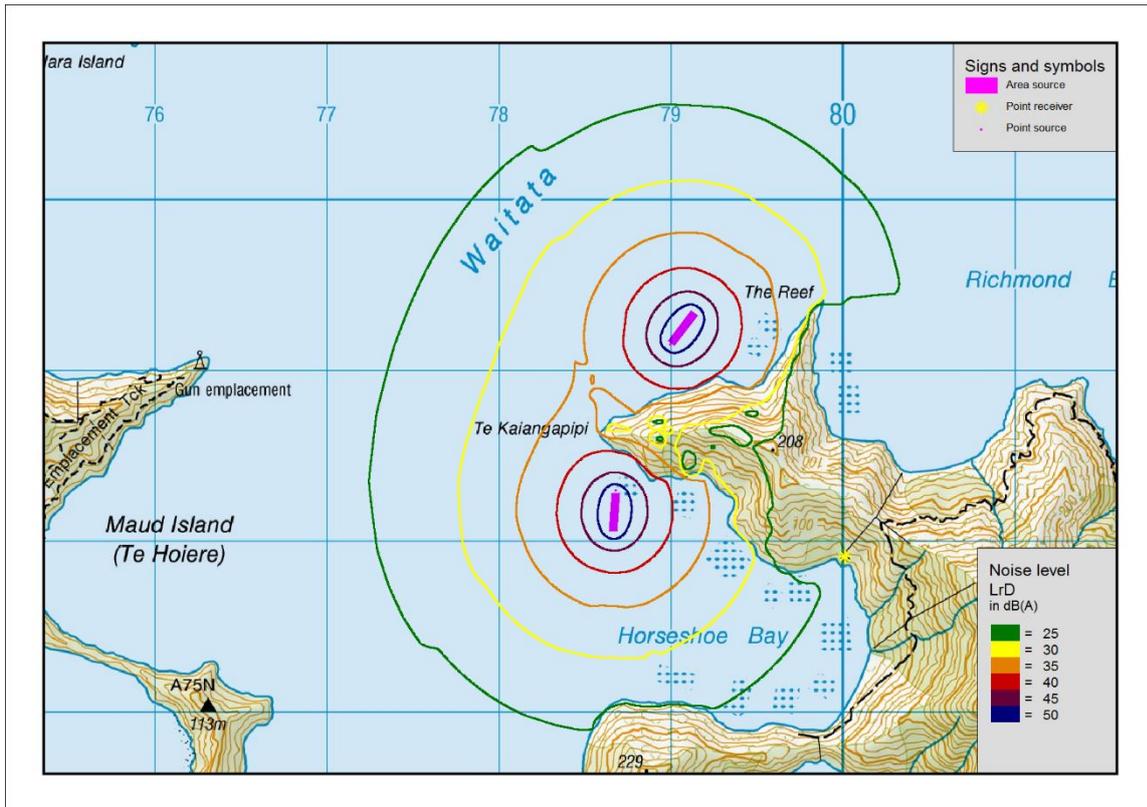
Site 34 – North Blowhole Pt and Site 122 – Blowhole Point, Daytime



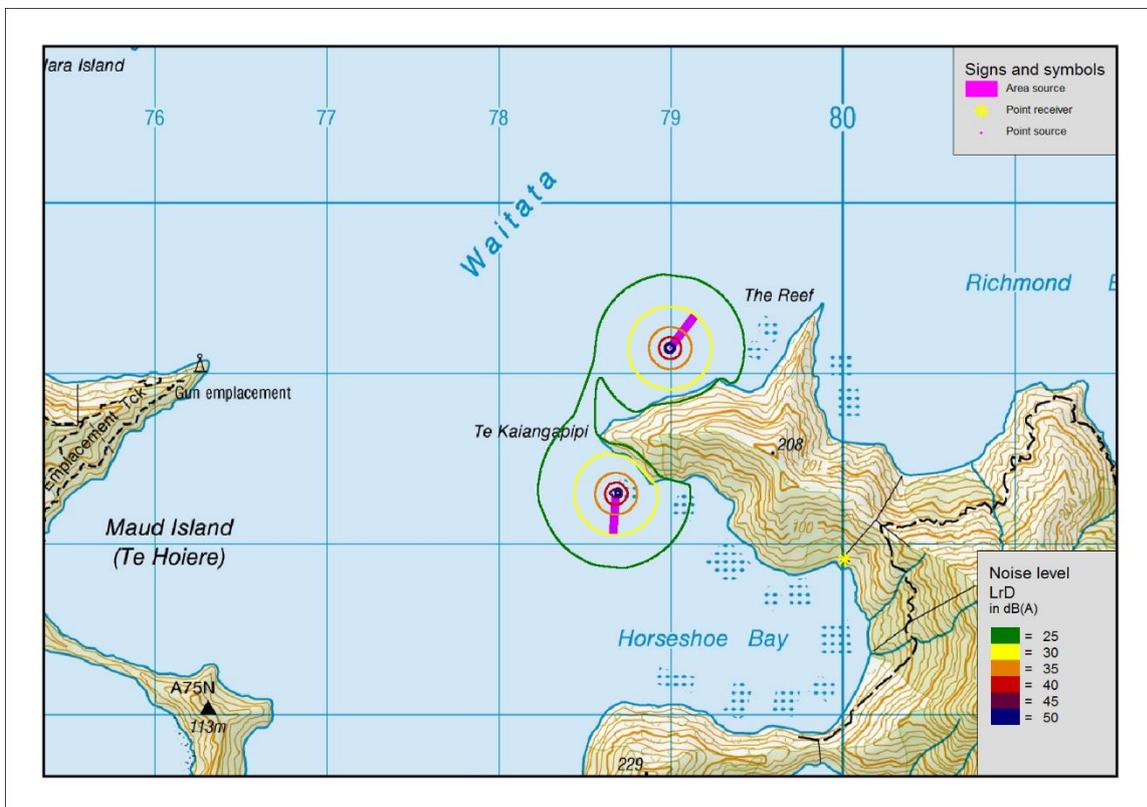
34 North Blowhole Pt and 122 Blowhole Point, Night-Time



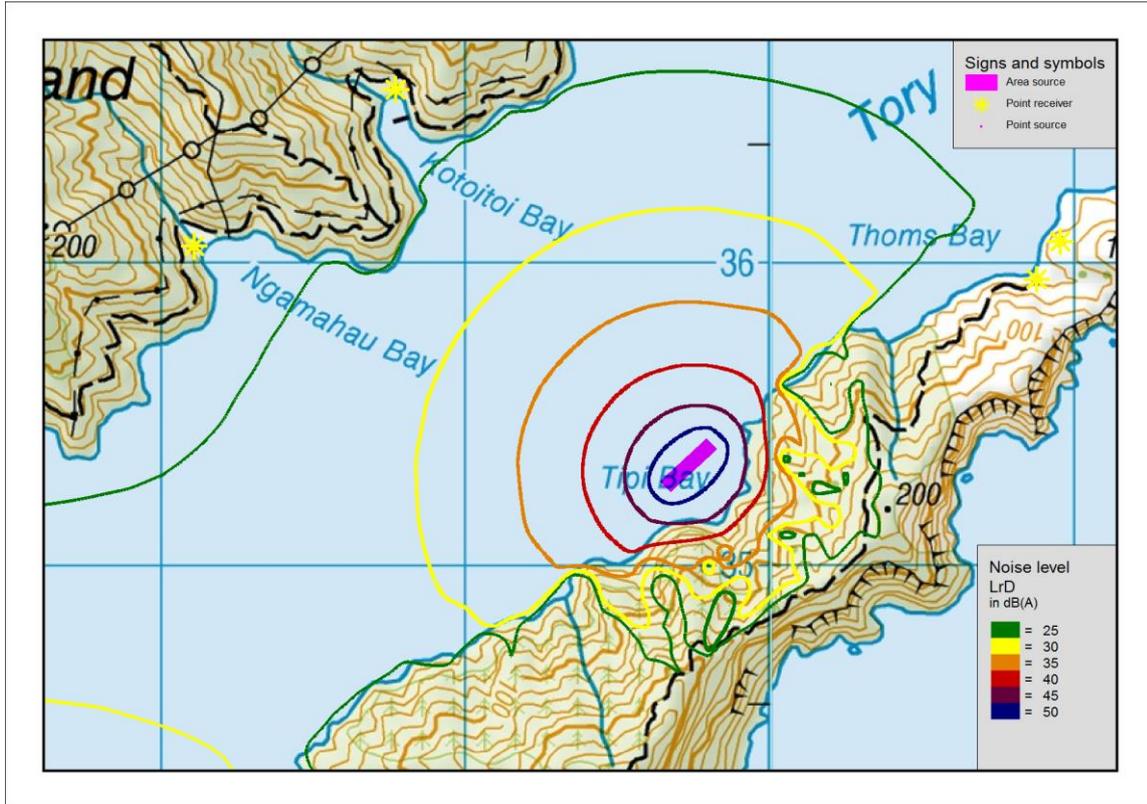
Site 125 – Waitata Reach, Daytime



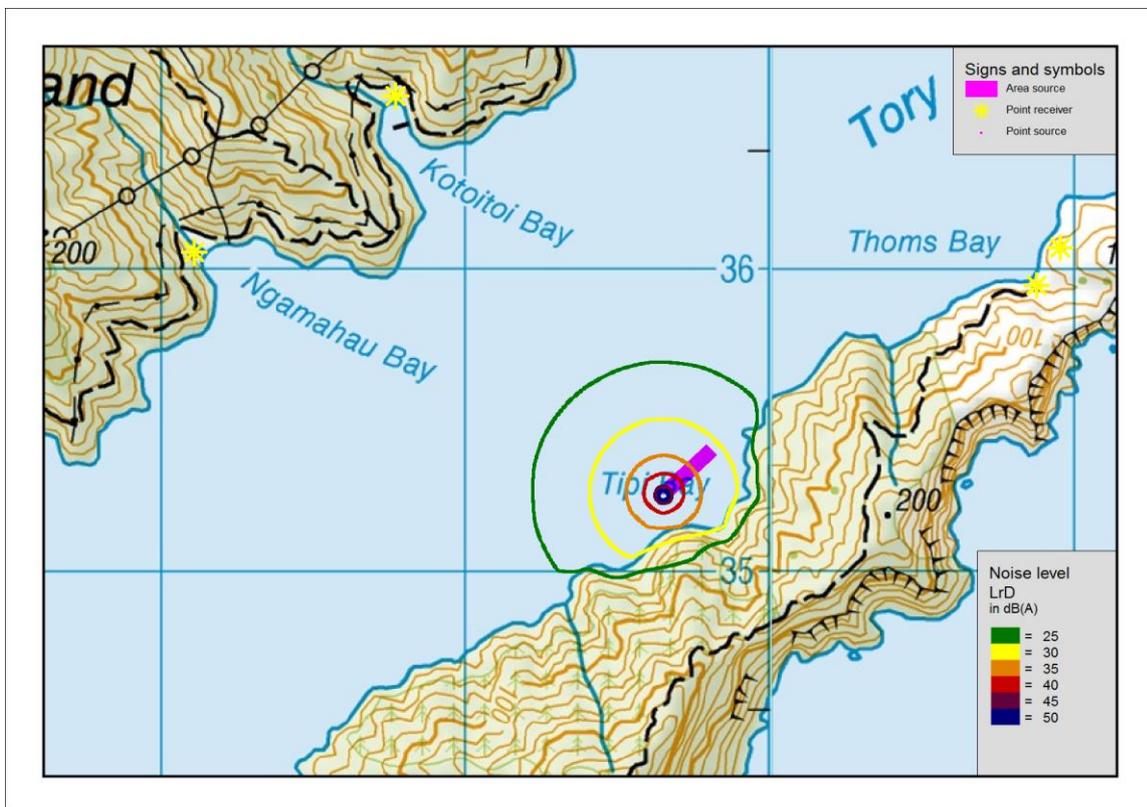
Site 106 – Richmond Bay South and Site 124 – Horseshoe Bay, Daytime



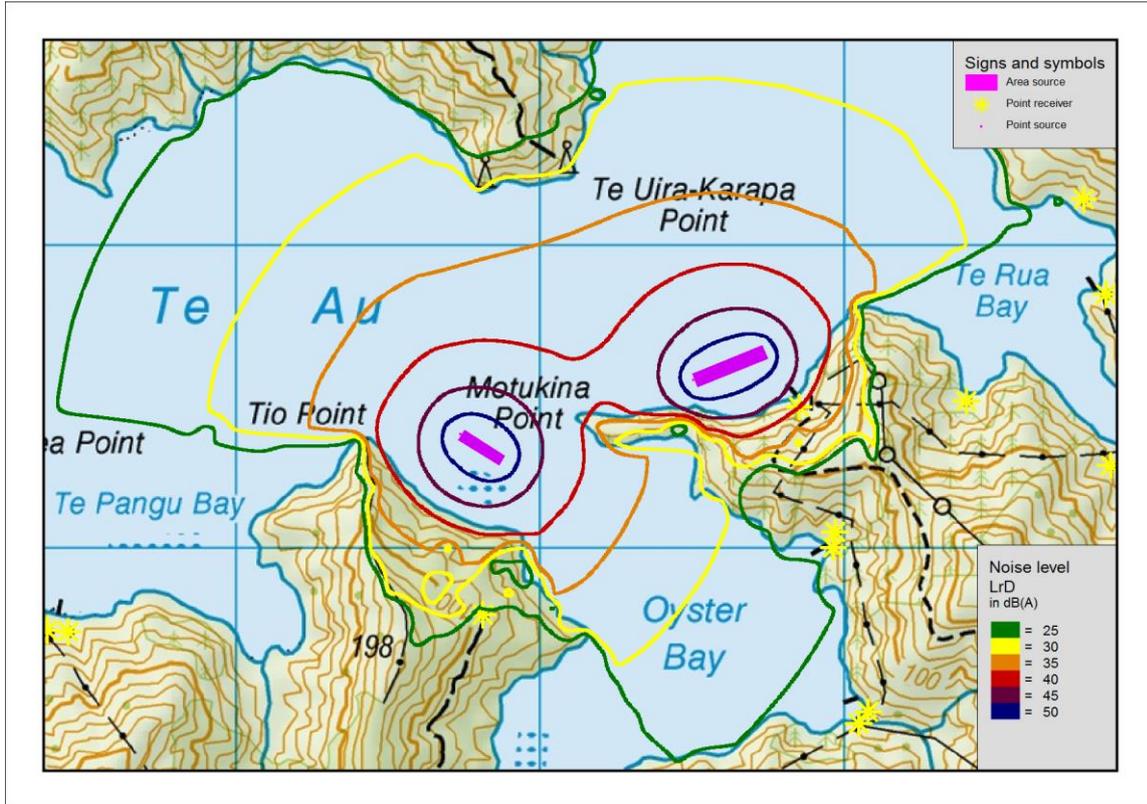
Site 106 – Richmond Bay South and Site 124 – Horseshoe Bay, Night-Time



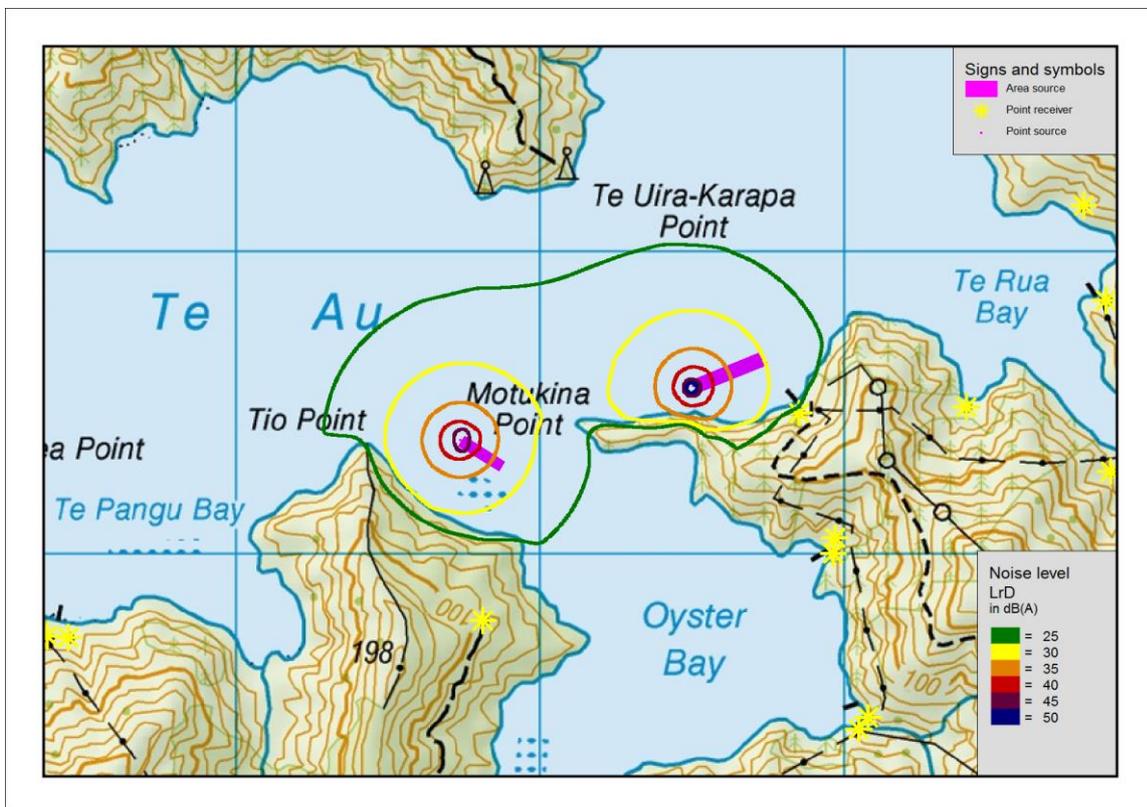
Site 42 – Tipi Bay, Daytime



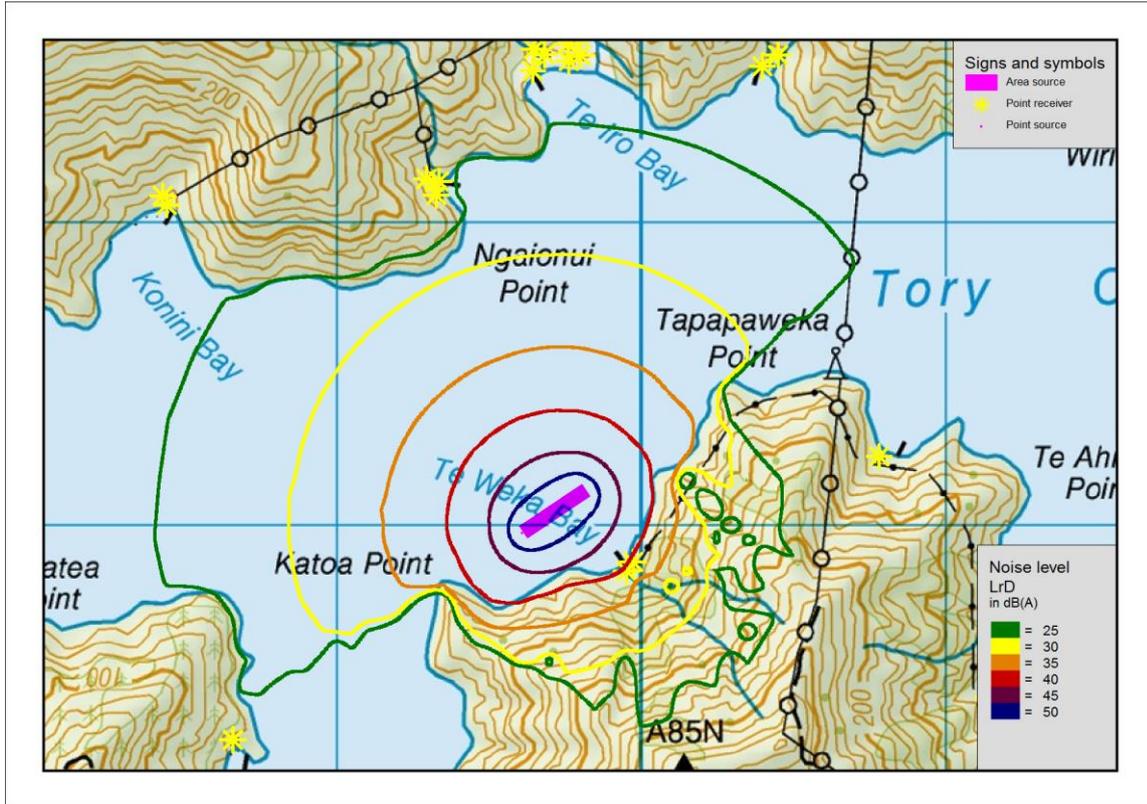
Site 42 – Tipi Bay, Night-Time



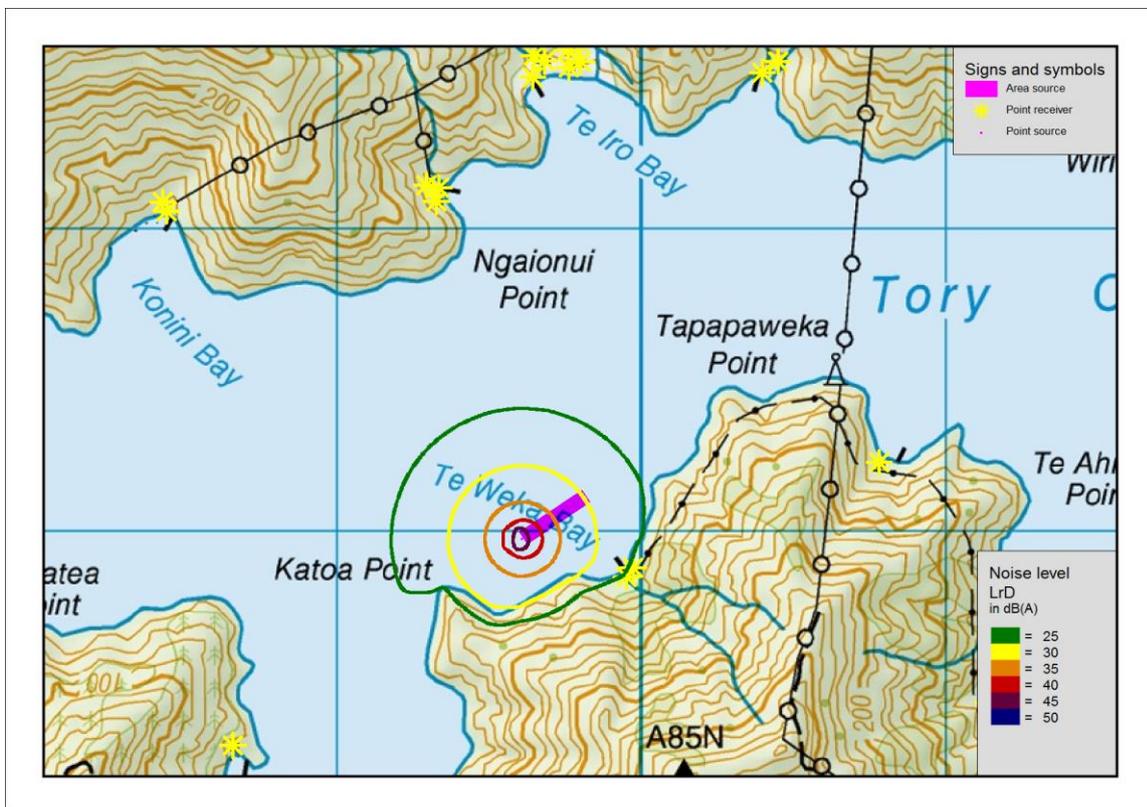
Site 82 – Motukina Point and Site 156 – Tio Point, Daytime



Site 82 – Motukina Point and Site 156 – Tio Point, Night-Time



Site 47 – Te Weka Bay, Daytime



Site 47 – Te Weka Bay, Night-Time