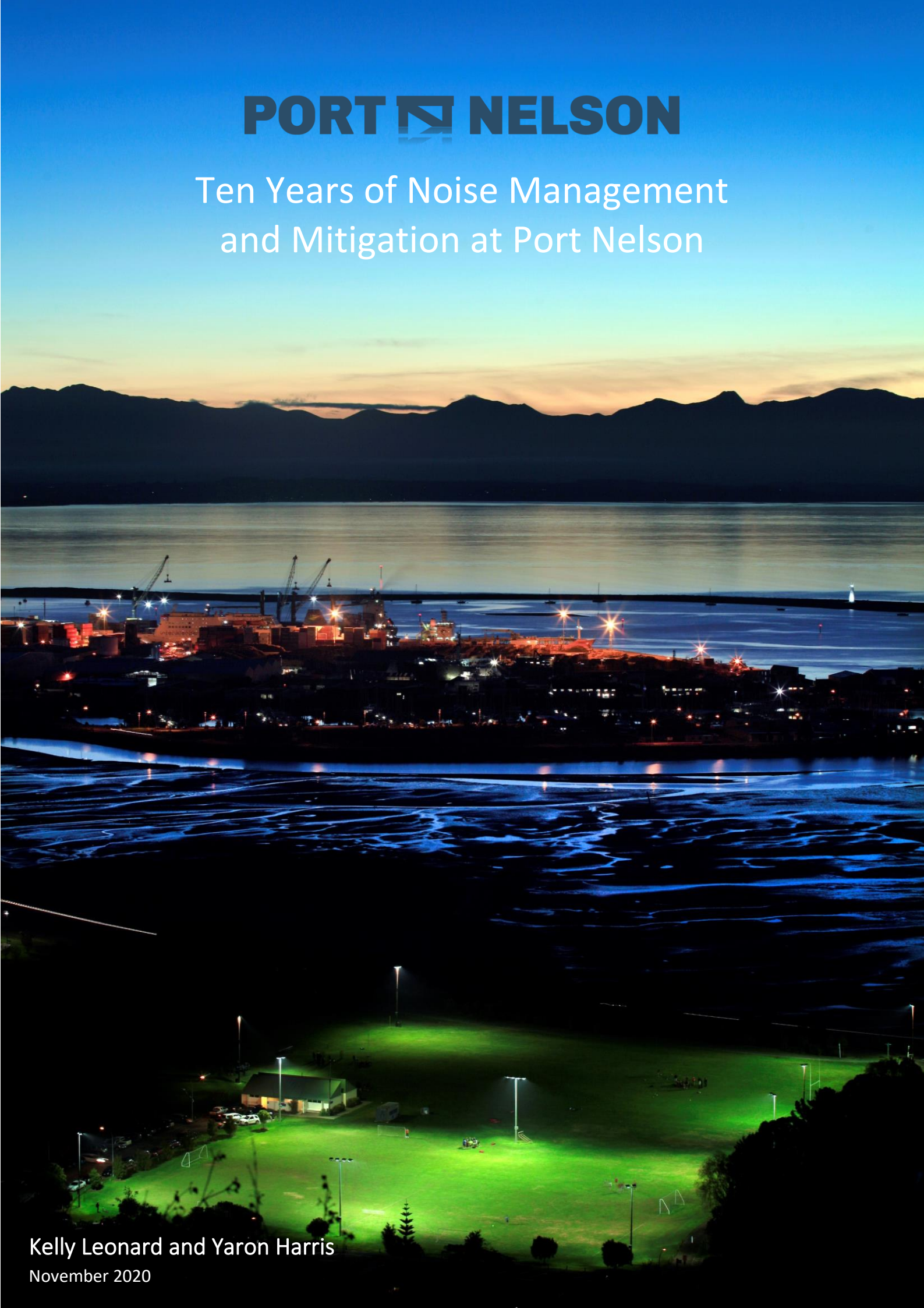
PORT NELSON

# Ten Years of Noise Management and Mitigation at Port Nelson



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PORT NELSON

The Region's Gateway to the World

# Contents

# 1. Introduction

A port has existed in Nelson for over 170 years as critical infrastructure linking the Top of the South region to the rest of New Zealand and the world. Port Nelson is one of New Zealand's oldest Ports, and the city of Nelson grew up around its Port. Port Nelson Limited (PNL) is a facilitator of local industry and is the major gateway for exports from, and imports to the Top of the South region. PNL enables local goods to leave the region directly without the need for a long road trip to other South Island ports. PNL is considered both nationally and regionally significant infrastructure, and operates the largest fishing port in Australasia, the second largest pip fruit export port in New Zealand and provides essential import/export services to the forestry, fishing/fish processing, and wine industries, including in relation to biosecurity. More than 3.3 million tonnes of cargo pass through PNL annually, and since 2016 the volume of cargo has increased by 50% from 2.7 million tonnes (Port Nelson Annual Report 2019). The growth of forestry exports is the main driver for this cargo increase as well as significant growth in the fruit and wine industries.

Exports of Nelson produce started in the 1850s. Supporting works to improve the port and its environs, including wharf construction, dredging, widening shipping channels and the port entrance commenced from 1850. Today the Ports' activities accounts for $2, 260 million of the Nelson, Tasman, Marlborough Region's GDP, this equates to 25%. 22,000 jobs, or 31% in the Nelson-Tasman- Marlborough region have a connection to the Port, and collectively the businesses connected to the Port spend $5.5m per annum, or touch 25-30% of the regional GDP (Berl, 2020).

The 24-hour operation of the Port is vital to the Nelson economy and social well-being of the Top of the South region. Safe access for large vessels into Port Nelson, is tidally restricted. This means large vessel can only enter and exit the Port on the high tide. Vessel schedules are such that ships cannot wait for day time high tides to occur to enter Port Nelson. Consequently at times there are some vessel related operations such as cargo exchange at times can only occur during night-time hours. PNL places a high value on its relationship with its close residential neighbours, the wider community, and it works hard to manage its operations in a way that minimises its noise generation to help maintain its social license to operate.

Noise management at Port Nelson operates under a three-pronged approach, and the rule framework for this is Variation 07/01 within the Nelson Resource Management Plan. The Port Nelson Noise Management Plan details the way the Port operates to minimise its noise outputs to be a good corporate citizen and neighbour. The Port Nelson Noise Mitigation Plan outline the Port's obligations for acoustic treatment of properties affected by Port noise. Port Nelson Limited is accountable to a Noise Liaison Committee (PNLC) on its noise performance. The PNLC is comprised of residents affected by Port noise, Port representatives and an Independent Chair.

Ports bring together a unique set of transport modes and equipment that require large expenditures of energy and are generally large sources of noise. The noise sources of regular concern to PNL and its close residential neighbours are mobile plant, ships at berth, and refrigerated containers, or the hum of the Port, and container 'clangs and bangs', or bangs and crashes that come primarily from container operations. The issue of noise production by ports is shared internationally and is highlighted by the number of recent Port initiatives to reduce noise impacts on residents with proximity to their operations. The intent of this report

is to look at the Ports progress on noise management, and mitigation since noise management practice was implemented at Port Nelson (2008), and the progress through Noise Variation 07/01 became operative up until today. The report also discusses current management approaches and initiatives considered by PNL to continually improve its noise management. The report also considers options for improved management not currently implemented, and whether they could improve noise outcomes at PNL.

## 2. Noise Management at Port Nelson

Noise from Port Nelson is legislatively controlled through Variation 07/01 in the Nelson Resource Management Plan. Variation 07/01 has its foundations in NZS 6809 (New Zealand Standard for Acoustics – Port Noise), and was heard through the Environment Court in 2008, becoming operative in 2012. Variation 07/01 implements a three-pronged approach to noise management at Port Nelson, requiring a Noise Management Plan to be put into effect, detailing how PNL will minimise the noise generated from port operations. Variation 07/01 also requires a Noise Mitigation Plan which details the Port's obligations for acoustic treatment for noise properties deemed affected by port noise. Thirdly, Variation 07/01 requires a Port Noise Liaison Committee (PNLC) to be established, comprising of three members representing the Port, three members appointed and representing the residents affected by port noise, and an independent chair. PNL is required to operate in accordance with Variation 07/01.

PNL has given effect to and has upheld the requirements of The Noise Management Plan as required by the Variation 07/01. Noise management and minimisation is deeply embedded in the operational practices and culture at PNL. PNL is of the opinion that Variation 07/01 has been a successful tool for driving noise minimisation by the Port, and for driving community engagement on port noise through the PNLC, to ensure the Port is accountable and answerable for port noise issues experienced by its close residential neighbours. Like all change initiatives, the early phases provide good wins as the low hanging fruit are plucked, and this was the case when PNL first started to look deeply for ways it can minimise its noise outputs. However subsequent phases require more effort, investment, and progress at this end of the journey is more difficult, often yielding smaller gains.

Variation 07/01 has its origins in Section 16 of the Resource Management Act 1991. The following points from The Commissioners' Recommendation 07/01 - Port Noise Variation (2009) are critical to the function of Variation 07/01.

- "The Variation requires that the Port Operator is responsible for the appropriate management of activities giving rise to noise as well as for the mitigation of the adverse effects of noise in the adjacent residential areas. In other words, whilst there will be a continuing obligation on the Port Operator to minimise the amount of port noise at source, it will now also be required to provide acoustic insulation, and in some cases offer to purchase the most affected houses in order to mitigate the effects of port noise during night-time hours".
- "The intention of this Variation is to substitute a different approach to noise issues from that which is reflected in INr.40. Under this approach, activities that generate noise in the Port Operational

Area are permitted, without there being a noise enforcement line. Rather, a protocol is introduced which has three key elements, a Port Noise Management Plan, a Port Noise Mitigation Plan and a Port Noise Liaison Committee" (Clause 4.4).

- "The underlying intent of the Variation is that noise issues will be dealt with by the Port conducting its operations in such a way that noise is minimised to the extent which is reasonably practicable. In other words, having regard to the nature and extent of its operations. Explicit in this approach is a theme that the owners of nearby properties accept a level of noise, with the impact of that noise being mitigated in key living parts of their houses by acoustic treatment. It is not intended that there be an enforcement line; that is, a line on the hill depicting a level of received sound, which port noise cannot exceed. In fact, the way the Variation is drafted, there is such an unintentional line in the Variation" (Clause 3.10).
- "The management/mitigation/liaison regime allows flexibility for the Port Operator in its operations, which is a substantial benefit for the wider community. There are existing constraints on the Port operations provided by the fact that the Port is tidal, but further limitations on times of operation (curfews) would be so inconsistent with the established operating methods of shipping lines that there would be a real risk of the Port being bypassed in favour of more flexible ports, necessitating the movement of freight by road or rail at significant cost and risk, particularly to sensitive export cargos such as fruit. In our judgment, the benefits to the Port of the proposal before us are benefits economically and socially to Nelson City and the entire greater Nelson/Tasman region. They are section 5 benefits under the Act that contribute to the sustainable management of natural and physical resources" (Clause 6.22).
- "Because the Variation is intended to deal with the conflicts between the interests of the Port, on one hand, and the interests of residents on the other, it is a key part of the proposal that there is established a Port Noise Liaison Committee comprising representatives of both the Port and of noise affected residents. The Committee is to have certain roles and powers. It is quite clear, and as we gather accepted by all concerned, that the protocol proposed to be set in place by this Variation is founded on a co-operative approach to noise management by the Port Operator, and noise tolerance by the residents. The Port Noise Liaison Committee is at the interface of this readily apparent tension. In our view, the importance of the Committee's role cannot be overstated" (Clause 3.11).

# 3. Performance Against the Port Nelson Noise Mitigation Plan

## 3.1. Progress with Acoustic Treatment

PNL has been working with residents whose properties are affected by port noise, in line with the timeframes prescribed in Variation 07/01, the Port Nelson Noise Mitigation Plan, and as residents approach the Port for acoustic treatment. This has been underway since 2008. To date $800 000 has been spent on mitigation of properties affected by port noise, and this does not include expense incurred because of the requirement to purchase properties in Stage 1. The profile of expenditure since 2008 is shown in Figure 11 below.

*Figure 11 - Port Nelson profile of expenditure associated with the acoustic treatment of properties deemed affected by port noise.*

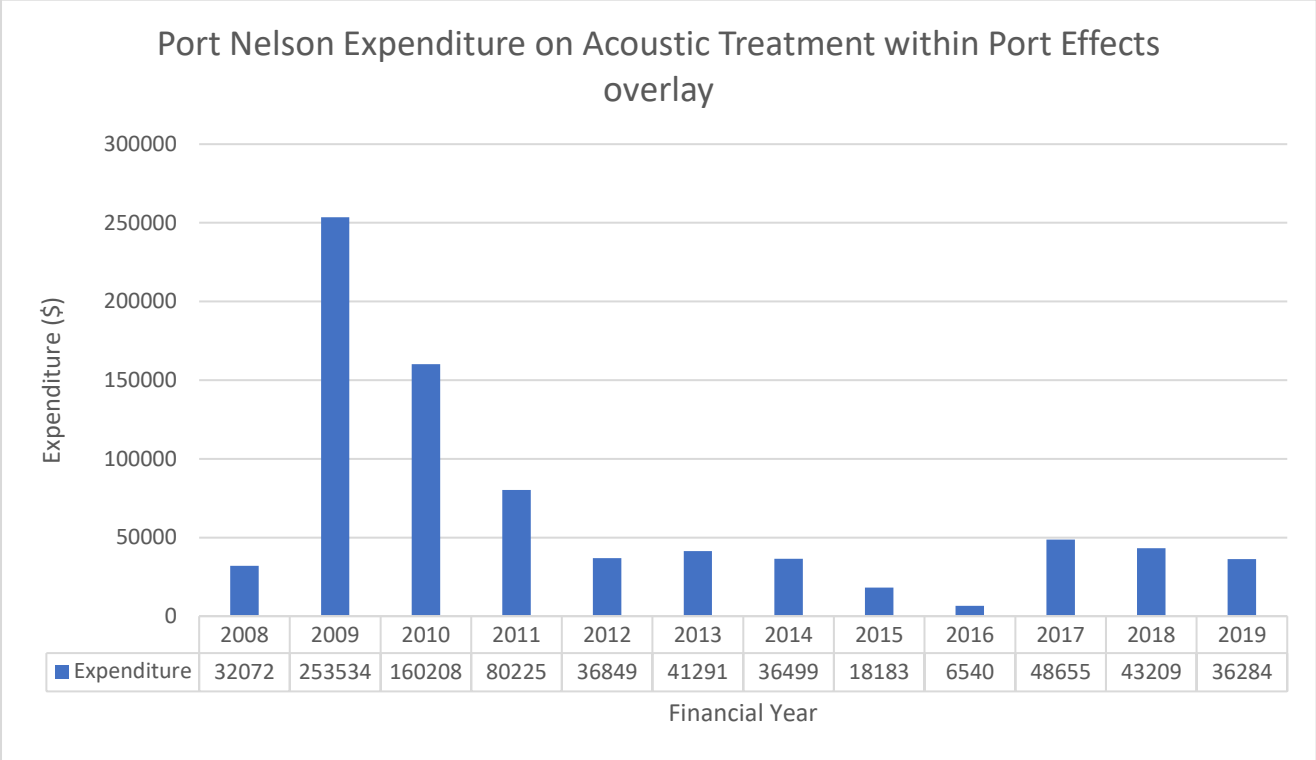



Figure 11 above does not take account of new or altered habitable space within the Port Effects Overlay as the Port does not have an obligation towards this.

### **3.2.** Noise Contours and Updates

The Port Noise Management Plan requires PNL to produce a noise contour map based off a busy 5 day operating scenario showing the area between 55dBA Ldn and 70 dBA Ldn, at 1dBA contour intervals. The residential properties that fall within this zone are the three stages of the Port Effects Overlay and are properties deemed affected by Port Noise. These properties are eligible for acoustic treatment assistance from PNL as prescribed by the Port Nelson Noise Mitigation Plan. It is a requirement of the Port Nelson Noise Mitigation Plan that the contours are reviewed, annually for the first five years then biannually after this. The 2018 Annual Noise Contour Review commissioned by PNL, to meet this requirement recommended changes be made to the boundaries of the Port Effects Overlay. Early in 2019, following a technical peer review of the Contour review, and ground truthing of the modelled Contours this recommendation was submitted to NCC for ratification to give legal effects to the new contour boundaries. At the time of writing Council has not yet ratified the Contours, thus the contour boundaries have not been changed.

# 4. Performance against the Port Nelson Noise Management Plan

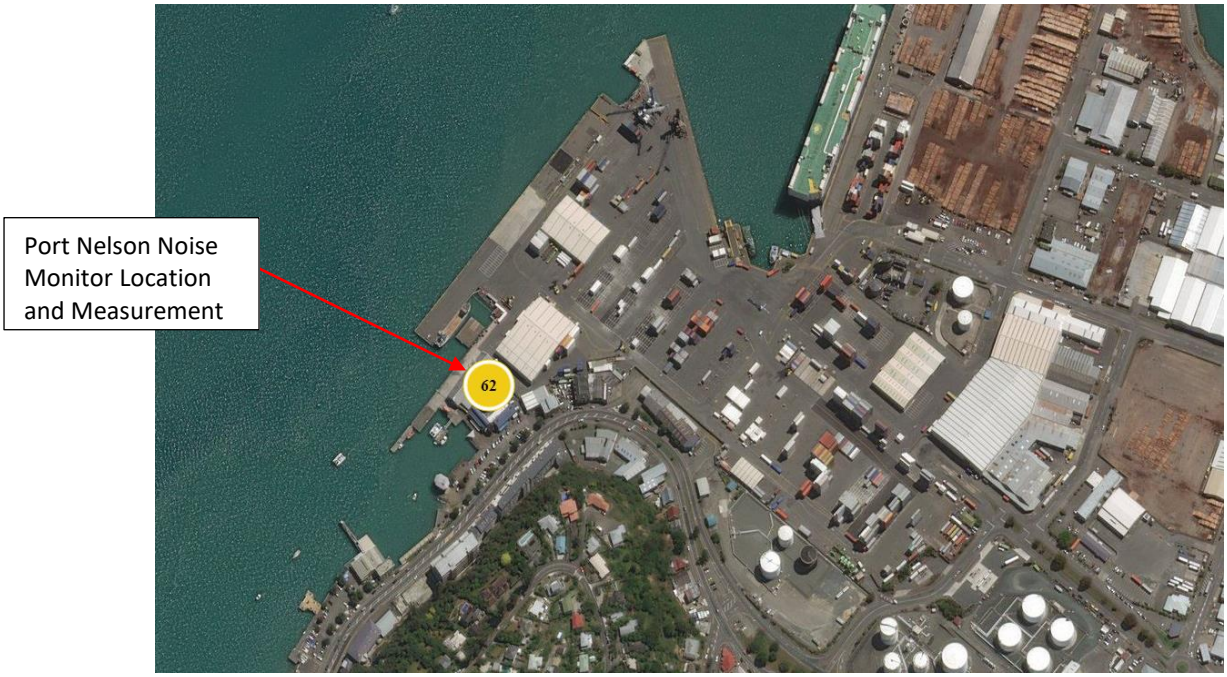
## 4.1. Noise Monitoring at Port Nelson

The trigger values and metrics applied to noise measurement and management at Port Nelson used in The Nosie Management Plan and Noise Mitigation Plan are derived from the New Zealand Standard for Acoustics – Measurement of Environmental Sound (NZS 6801), and the New Zealand Standard for Acoustics – Port Noise Management and Land Use Planning (NZS 6809). The values chosen for implementation in the Noise Management Plan, the validity and appropriateness of these was discussed at length and prescribed by the relevant experts during the hearing on Variation 07/01.

Also prescribed by the Port Noise Management Plan is the requirement of PNL to continuously measure noise, and the location for the noise measurements to be done is currently on top of the Holcim cement silo. This was deemed the closest port boundary to the residential area, taking account of container vessel operations which is the primary noise source of concern to PNL's closest residential neighbours. This location was prescribed following recommendations by the experts present in the hearing for Variation 07/01 as the best location to measure noise from the Port, and account for how it is received at the closest residential receptors. In 2019 the question was bought to the PNLC by the Residents' Reps (after being asked by the residents themselves) about where the best location is for measuring port noise. In response to this PNL commissioned an investigation into the best location for the noise monitor. This review was completed by Hegley Acoustics, and it concluded "the location of the noise monitor on the Holcim silo was well chosen, and remains appropriate" (Hegley, 2019).

Figure 1 below is an aerial view of PNL's Noise Monitor on top of the Holcim silo. This shows the closest residential boundary relative to Port Nelson's two container berths, Main Wharf and Brunt Quay.

*Figure 1 – Location of Port Nelson's Noise Monitor*



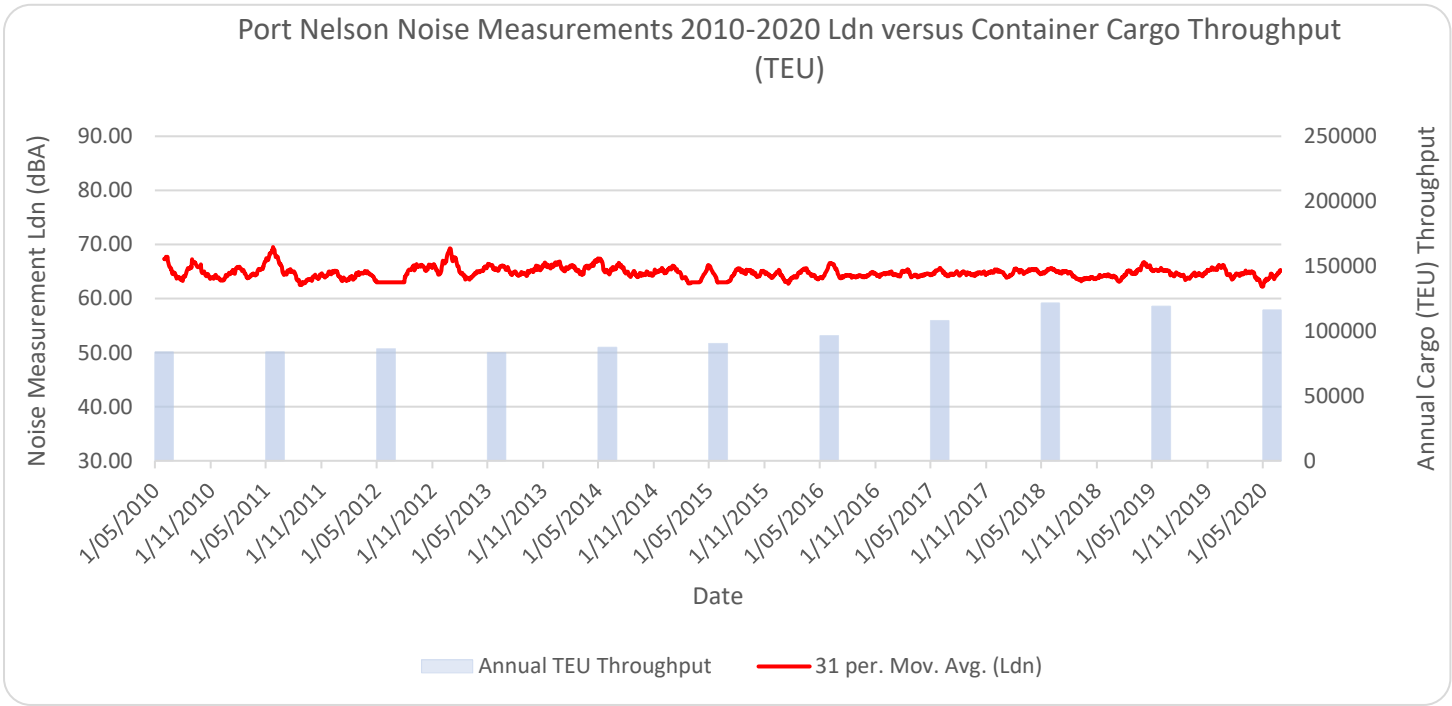
## 4.2. Performance Against the Metrics in the Port Nelson Noise Management Plan

There are several metrics of empirical data through which performance can be measured against the requirements of the Noise Management Plan.

### 4.2.1. **Ldn**

Ldn[1] in colloquial terms is a measure that can be correlated to the 'hum' of the Port. Figure 2 below shows the measured Ldn level (red line) at Port Nelson's noise monitor between 2010 and 2019. Also shown in Figure 2 below is PNL's container cargo throughput over the same period (blue bars). Figure 2 shows a flatter profile (less noise spikes), between 2010 and 2019, and increasing container volumes from 83,800 TEU[2] in 2010 to 119,074 TEU in 2020. The Ldn measurement also includes all noise received to the noise monitor, it does not only measure Port noise. An obvious non port noise source at this location is traffic noise from the highway adjacent to this area of the Port.

*Figure 2 – Measured Noise Ldn at Port Nelson versus Container Cargo Throughput (TEU).*




### 4.2.2. **Significant Noise Events**

Significant Noise Events [3] in colloquial terms are a measure of the clangs and bangs from the Port during night-time hours (2200-0700). The Port Noise Management Plan prescribes a trigger level of 85dBA Lmax

[1] Ldn means the "Day Night Average Sound Level" as defined in NZS6801:1999 and is the night-weighted sound exposure level in A-frequency weighted decibels. (An additional 10 dBA is added to the Leq for the period from 10 pm to 7 am.) It is measured for 24 hours from midday to midday.

[2] TEU is a twenty foot equivalent container unit, this is a measure of container cargo throughput.

[3] Significant noise events are an exceedance of 89dBA Lmax (instantaneous) at Port Nelson's noise monitor (corresponds to 85 dBA LMax at the residential boundary) between 2200 and 0700 that has been verified as being caused by Port Noise.

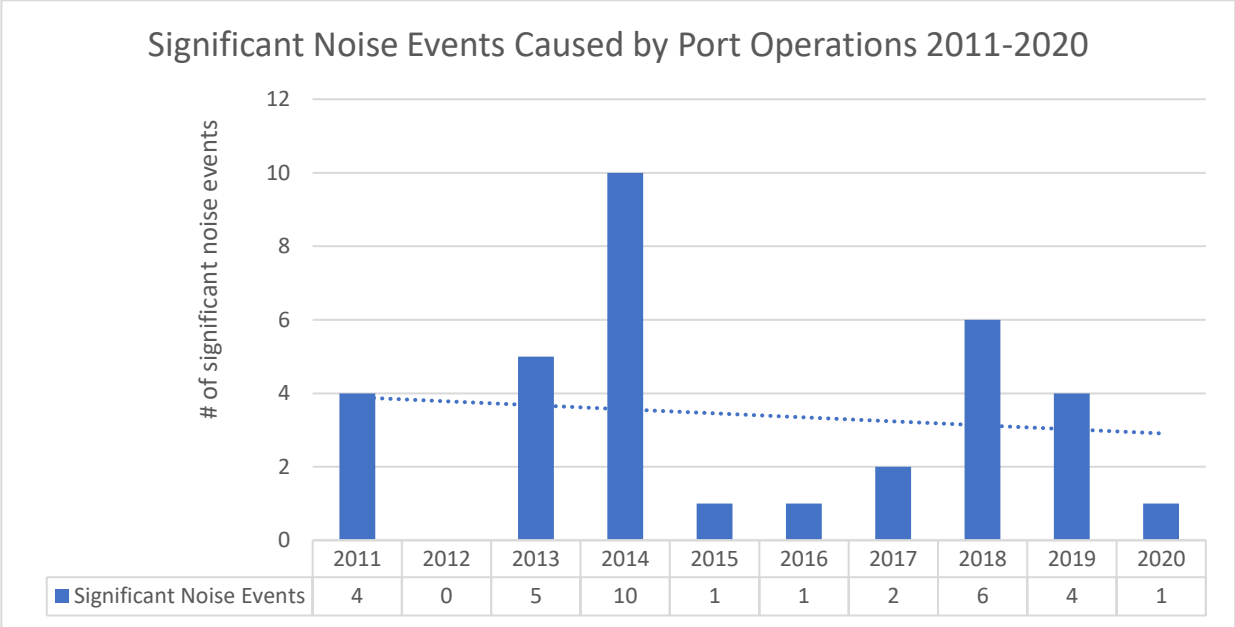
as received at the residential boundary as a 'Significant Noise Event'. This equates to a measured Lmax value at the Holcim silo of 89 dBA Lmax. The 4dBA difference is a function of the distance between the Holcim silo where noise is measured, and the closest residential boundary (IE: the closest residential boundary is further from the Port than the location where noise is measured).

In recognition of the fact that Significant Noise Events are clangs and bangs which may wake residents, the Port Noise Management Plan requires all Significant Noise Events are investigated, including actions which may help prevent exceedances reoccurring, and reported to the PNLC, and Nelson City Council (NCC).

PNL has been measuring Significant Noise Events since 2011 and Figure 3 below shows the number of Significant Noise Events in each year since 2011. The trendline indicates that the number of significant noise events has trended down since measurements began, and PNL only reported one Significant Noise Event for financial year 2020. Looking ahead to the 2021 financial year, an organisation wide noise KPI for PNL has been implemented. This KPI is for 2 or less operational significant noise events for the year. This was implemented by the Port to recognise the importance of minimising clangs and bangs, the value of our close residential neighbours' sleep, and continuous improvement in port noise management.

In addition to significant noise events the Port also reports on the top three noises that occur between 2200 and 0700 per month, as additional investigations that form part of monthly noise reporting, as required by the Port Noise Management Plan.

*Figure 3 – The number of measured Significant Noise Events between 2011, and 2020.*




## 4.3. Berth Allocation and the Orientation of Vessels at Port Nelson

There are two container berths at Port Nelson, and the Port Noise Management Plan requires the use of Brunt Quay over Main Wharf South whenever this is possible. This is because Brunt Quay is further from the Ports closest residential boundary, thus the resulting noise exposure for close residential neighbours is

less from operations on Brunt Quay than it is from Main Wharf. The length of the berth at Brunt Quay is 196m, and this limits it to receiving container vessels less than 210m LOA[4]. The benefits to using Brunt Quay are not just limited to noise. The container terminal layout is set up to feed Brunt Quay more efficiently than Main Wharf, so there are operational drivers for using Brunt Quay whenever the Port is able, in addition to realising the noise benefits.

Currently vessels that are too long to be safely berthed at Brunt Quay are berthed at Main Wharf South. Shipping trends worldwide mean container vessels are getting larger. Consistent with this trend in Nelson the resulting effect is we have seen an increasing number of container services needing to go to Main Wharf South since the Noise Variation became operative, because of their size. PNL has limited ability to influence the size of vessels calling to Nelson, and Brunt Quay is still used whenever it is possible to do so. Looking ahead once the rebuild of Main Wharf North is complete container vessels that are unable to be accommodated on Brunt Quay, will shift to being berthed at Main Wharf North, instead of Main Wharf South. The advantage of this from a noise perspective is vessels berthed at Main Wharf North are further from the residential boundary than they are at Main Wharf South, and this will reduce noise exposure at the closest residential boundary. The rebuild of Main Wharf North is due to be completed in 2021.

The Port Noise Management Plan also requires the Port to orientate vessels with their generator exhausts or funnels, facing away from the residential area unless the ship is required to be berthed on the opposite side for loading purposes. The purpose of this requirement is to minimise the residents' exposure to low frequency vessel engine noise for the duration a vessel is in Port. This is consistent with best practice in berthing vessels at Port as it results in them having their bows facing in an outbound direction on the wharf. It is rare that vessels cannot be accommodated berthed with an orientation facing away from the residential area, however when this does happen the primary cause of this is, the location of cargo that can't be reached by cranes when the vessel is orientated with their exhausts facing away, and the Noise Management Plan allowed for this in Clause 13.3.i. In most cases this is minimised during the central planning for vessels coming to Nelson, and the avoidance of stowed or loaded cargo in locations where it cannot be reached by PNL's cranes with vessels orientated favourably from a noise perspective. There are very few instances over the previous ten years where vessels have needed to be berthed unfavourably from a noise perspective.

However there has been four occasions in the past ten years where fuel tankers have been berthed inconsistently with this orientation best practice. Three of these occurred in 2019 and were related to the safe navigation of these tankers on an ebbing tide. Specific to the two most recent occasions (out of the three) this occurred as a direct result of the vessel arriving late, and there being insufficient under keel clearance to safely turn the vessel to berth it with its generator facing away from the residential area due to the ebbing tide. The decision around the berthing orientation of these two vessels was not made lightly, and a key consideration was safe vessel navigation and taking account of fuel supply being critical for the normal function of the region dependant on PNL for their fuel supply and Nelson Airport. As a result of complaints about these two occasions NCC issued PNL a Warning Letter alleging PNL had breached this

[4] LOA means length overall

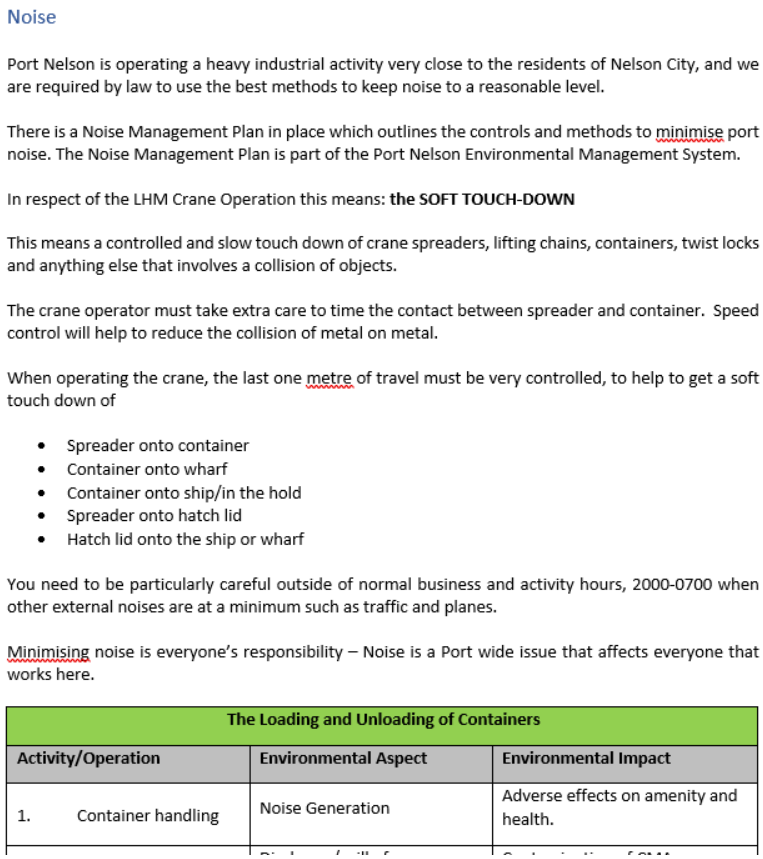
requirement in the Port Nosie Management Plan. PNL disputes the issuing of this letter. To prevent this happening in future PNL has written to the fuel companies advising them that vessels will not be accepted into Nelson if they are running late, and there is insufficient safe under keel clearance to enter the Port and orientate them on the fuel berth (Main Wharf South) with their bow facing out, and generators facing away from the residential area.

### 4.4. Integration of Minimising Noise into Best Practice for Port Operations

A critical element of successful noise minimisation at PNL comes through the integration of noise reducing practices into port operations especially at night and particularly for container operations. All roles that have the potential to cause port noise, especially at night, have been assessed and where there was a better practice that could be implemented to make a meaningful noise reduction this has been done. For port staff in operational roles, training around noise minimisation commences when they read their first learner guide (training manual). The way to carry out certain operations in the optimal way for minimising noise is detailed in the learner guide, and this is the way new staff are trained to complete these tasks. Figures 5 and 6 below are excerpts from the Learner Guides for the roles of a Liebherr Crane Operator, and a Mafi operator, and explain the elements of the roles that contribute to noise and the best practice way to minimise the noise from these functions. PNL has been driving positive change in heavy plant driver behaviour since the noise variation was implemented. Those in these critical functions from a noise perspective have received extensive training on the importance of minimising noise. They also have performance measures specific to noise in the performance and remuneration packages. The days of poor culture around noise minimisation, or disregard for noise minimisation during operations has long passed.

It is important to note the influence of climatic conditions in the transmission of port noise to close residential neighbours. On a warm still night, a cool still night, or where there is an inversion layer present sound travels unconstrained outward from the source, and it is often perceived as louder by residential neighbours in these conditions. This adds another dimension to noise management at PNL.

*Figure 4 – Excerpt from Port Nelson Liebherr Crane Driver Learner Guide*



Noise

Port Nelson is operating a heavy industrial activity very close to the residents of Nelson City, and we are required by law to use the best methods to keep noise to a reasonable level.

There is a Noise Management Plan in place which outlines the controls and methods to minimise port noise. The Noise Management Plan is part of the Port Nelson Environmental Management System.

In respect of the LHM Crane Operation this means: **the SOFT TOUCH-DOWN**

This means a controlled and slow touch down of crane spreaders, lifting chains, containers, twist locks and anything else that involves a collision of objects.

The crane operator must take extra care to time the contact between spreader and container. Speed control will help to reduce the collision of metal on metal.

When operating the crane, the last one metre of travel must be very controlled, to help to get a soft touch down of

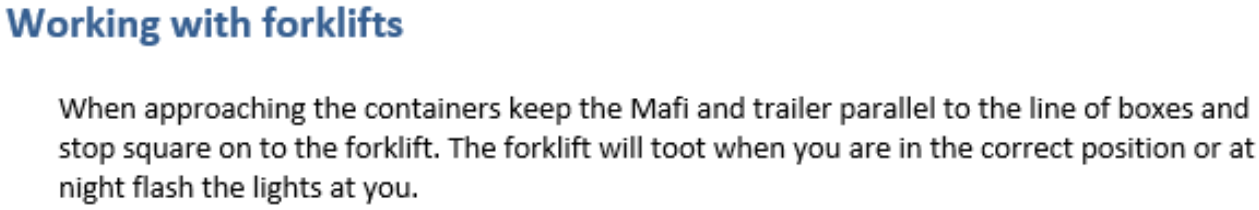
- Spreader onto container
- Container onto wharf
- Container onto ship/in the hold
- Spreader onto hatch lid
- Hatch lid onto the ship or wharf

You need to be particularly careful outside of normal business and activity hours, 2000-0700 when other external noises are at a minimum such as traffic and planes.

Minimising noise is everyone's responsibility – Noise is a Port wide issue that affects everyone that works here.

| The Loading and Unloading of Containers | | |
|---|---|---|
| **Activity/Operation** | **Environmental Aspect** | **Environmental Impact** |
| 1. Container handling | Noise Generation | Adverse effects on amenity and health. |

*Figure 5 – Excerpt from Port Nelson MAFI Learner Guide.*



## Working with forklifts

When approaching the containers keep the Mafi and trailer parallel to the line of boxes and stop square on to the forklift. The forklift will toot when you are in the correct position or at night flash the lights at you.

### 4.5. Noisy Ships

As required by 13.3 of the Noise Management Plan, PNL keeps a register of noisy ships. Since Noise Variation 07/01 became operative there has been approximately three 'noisy ships' that were regular callers and were the cause of vessel specific noise issues for Port Nelson. In response to each case the PNLC has advised PNL the noise was unacceptable, and to take action. PNL has worked with the shipping lines to compel change in each case, which has resulted in a meaningful decrease to the noise received by its close residential neighbours, especially at night when these vessels are in Port.

In 2015 MSC put on rotation to Nelson two new to Nelson container vessels, the Maria Katharina and Calicanto Bridge. Both vessels were of a suitable length to be berthed at Brunt Quay and could be orientated with their generators facing out to sea. Despite this, for an unknown reason these two vessels

had noisier than usual generators. Their arrival into Nelson would typically be the cause of several noise complaints whilst in Port, especially during night-time hours. These two vessels were noticeably different to the other regular callers and caused a discernible regression in noise performance compared to other vessels. The PNLC advised the Port, on behalf of residents, this was not acceptable, and PNL started to work with the shipping line to resolve the noise issues with these two vessels. Many initiatives were tried by the shipping line to minimise the generator noise from these two vessels whilst in Port, including minimising the load on the vessel generators, running more than one generator to split, and minimise the load, all in an attempt to minimise the noise output. In 2016 the shipping line substituted these two vessels for different ones on the rotation that calls to Nelson, likely due to pressure around unacceptable noise at night.

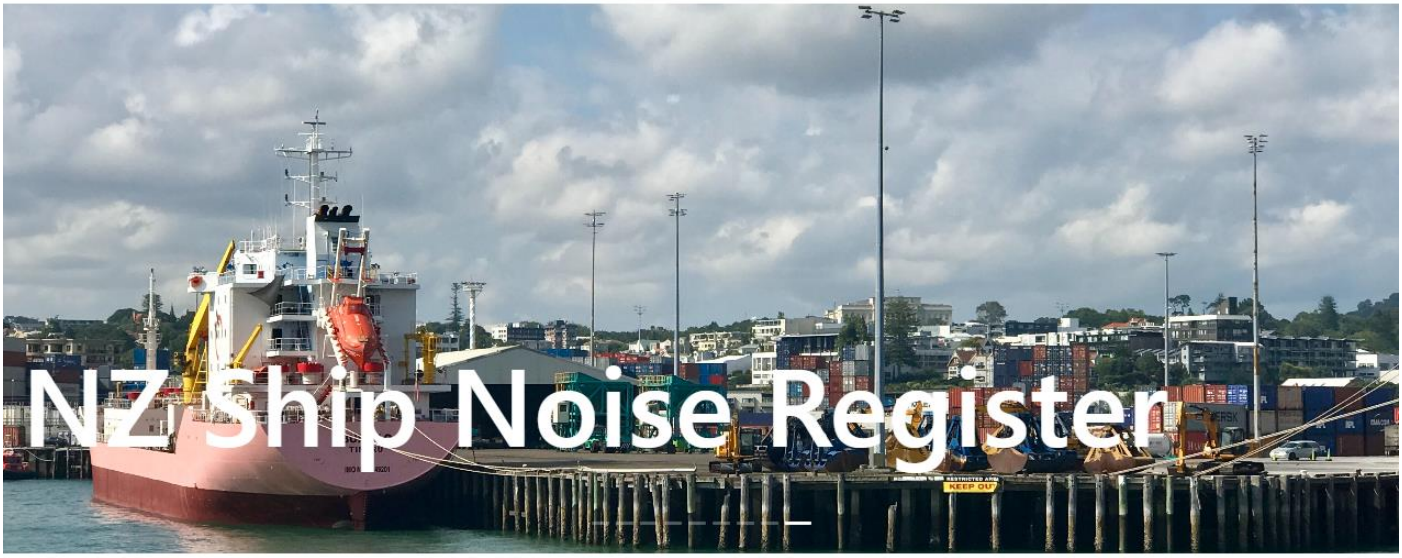
In 2017 Holcim put on regular rotation to Nelson a new vessel to ship cement around New Zealand, The Buffalo. The Buffalo can only be berthed at Main Wharf South because the connection to the cement silo is located here. Cement transfer can only occur whilst the vessel is orientated with its generators facing north (away from the residential area). The arrival of the Buffalo invoked several, and ongoing complaints from PNL's neighbours about the tone and pitch of the pumps when the vessel is discharging cement, both during the day and at night. The Buffalo represented a regression in noise performance with cement transfer, whereby the previous Holcim vessel never presented a noise issue, or was the source of noise complaints in Nelson, even at night. Again on the advice of the PNLC, PNL worked with Holcim to improve the noise performance of this vessel whilst it is transferring cement in Nelson. Representatives from Holcim and PNL also met with residents to hear their concerns directly and update them with progress on the noise issues associated with this vessel. To date this has included the issuing of several warnings about noise by PNL to Holcim, restricting cement discharge to daytime hours only, requiring an investigation into the noise sources on the vessel, and the implementation of noise attenuation to minimise the noise outputs from this vessel. At the time of writing two rounds of noise attenuation have been completed by Holcim, running a different pump whilst in Port has been trialled, and being limited to day time hours appears to have made a meaningful and measurable difference to the noise outputs from this vessel. It now has regular visits to Port Nelson without receiving complaints.

In 2019 a group of Ports', led by Ports of Auckland, contributed to a national noisy ship register for New Zealand along with the expertise of Marshall Day Acoustics. This is a centralised noise database for vessels operating at New Zealand Ports. The foundations for defining a noisy vessel relies on both NEPTUNES's Noise Label and Classification Measurement Protocol[5], as well as measurements of a noisy vessel in Port via a prescribed methodology. NEPTUNES is a Noise Exploration Program To Understand Noise Emitted by Seagoing Ships to which eleven international Ports are a part of. Following characterization to understand noise emitted by seagoing ships NEPTUNES developed a universal measurement protocol that can be applied to various sea vessels in every Port. As its title implies The NZ Ship Noise Register is a list of ships, and information about the key sources of noise are identified, descriptions of the noise issues experienced by the relevant Port are provided, the frequency that noise is an issue has been measured, and the corresponding generator loading at the time of measurement is also detailed. This is a great progression

[5] NEPTUNES https://neptunes.pro/

and collaborations for the collective Ports' to share common information on noisy vessels. This is superior to the requirement for PNL to maintain a register in the Pilots Office as required by the Port Noise Management Plan.

*Figure 6 NZ Ship Noise Register Landing Page*




## 4.6. Port Noise Liaison Committee

The PNLC was established in 2008. Variation 07/01 prescribes the composition of the PNLC as three nominated representatives from Port Nelson, three members appointed by residents living in the port hills residential area, and an independent chairperson. The role of the PNLC is also prescribed by Variation 07/01, to "consider all noise issues arising from port operations, to carry out the functions identified in the Port Nosie Management Plan and any functions identified in Appendix B." The Commissioners Recommendations on Noise Variation 07/01 explains the purpose and function of the PNLC in more detail, more specifically Clause 3.11 of the Commissioners' Recommendations states "The importance of the PNLC's role cannot be overstated."

Residents' Reps are elected to their positions by the PNLC calling for nominations when a vacancy becomes available. If one only one nomination is received for this position the nominee is elected unopposed. In the event more than one nomination is received for the vacant position the PNLC introduces the nominees to residents to inform a postal ballot. The nominee with the most votes is appointed to the position. The term for residents' reps is five years. At the conclusion of the term Committee Members are eligible for re-election.

Both PNL and the PNLC are of the opinion that after ten years Variation 07/01 is working well. PNL has made meaningful inroads to minimising port noise from its operations during the ten-year period since it began implementing the requirements of Variation 07/01 (prior to it becoming operative). This is despite

cargo volumes through Port Nelson more than doubling in this period. Noise Management and the importance of minimising noise, especially during night-time hours is deeply embedded in the decision making and operations at Port Nelson. PNL have also implemented the requirements prescribed in the Port Nelson Noise Mitigation Plan.

Both PNL and the PNLC are of the opinion the PNLC, and in fact the wider requirements of Variation 07/01 function very well. Membership on the PNLC has changed both in residents' reps and PNL reps as availability has changed. The PNLC facilitates an election process for residents to appoint members to their seats on the PNLC. In keeping with the Commissioners' Recommendations on its function under Clause 11.61 all members of the PNLC have done a good job at having the interests of proper promotion of port noise management and mitigation as their focus, as opposed to their own individual pursuits. Both the Residents' Reps and the Independent Chairperson on the PNLC have worked hard to ensure the PNLC functions well, while fostering healthy opinion sharing, and vigorous debate on noise matters where appropriate, for the betterment of noise management. PNL are of the opinion they have met and exceeded the requirements of Variation 07/01 since its implementation and have held up the obligations this imposes. They have taken the advice and recommendations of the PNLC, and value its opinion on progress with noise management, minimisation, and mitigation. It is important to acknowledge the contribution of the volunteer residents' reps on the PNLC, and the efforts they go to represent the residents' on port noise issues, to ensure their point of view is heard and considered in the PNLC forum. Especially in recent times, given emerging noise issues from a recently emerged group of residents.

### **4.7.** Noise Complaints, Noise Complainants and Significant Noise Events

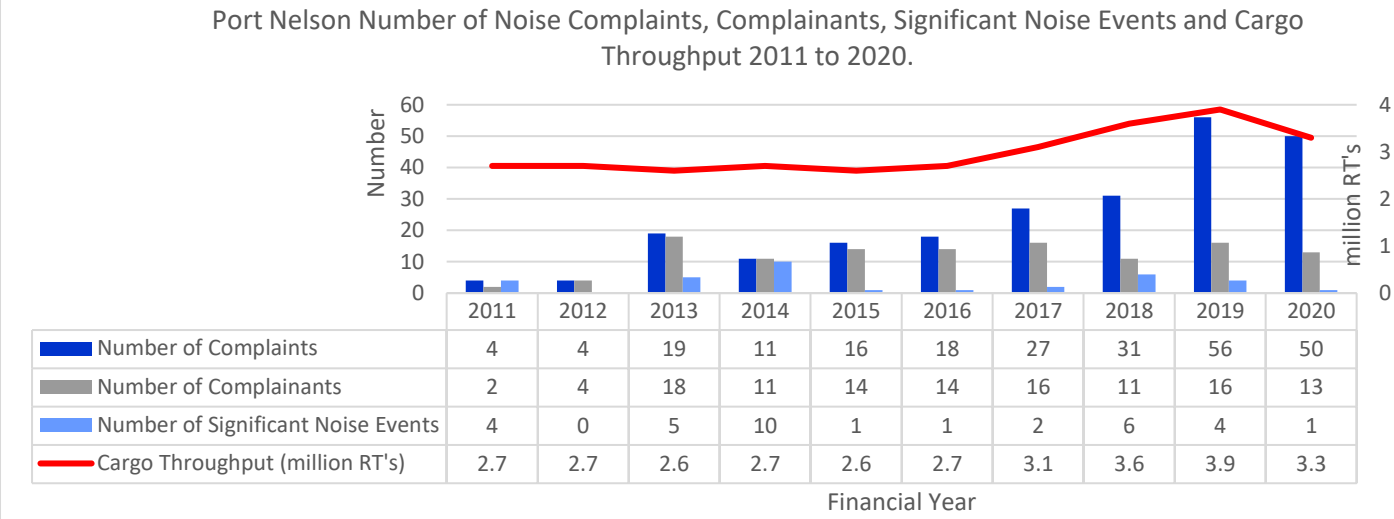
PNL welcomes feedback on port noise directly from residents', particularly if they are unhappy with the port noise they are experiencing. Complaints about port noise can be made via two main mechanisms. Firstly, by phoning the Ports gatehouse which is open 24 hours a day. This is the preferred way to receive noise complaints, as it makes it possible in some situations to make an immediate change to Port operations to minimise the noise of concern. Additionally, there is an online form available on PNL's website[6] where noise complaints can be lodged. However, these are only received by staff during business hours, and like noise complaints made directly to NCC, improving noise outcomes at the time is not possible with retrospective information, limiting these types of complaints to investigations only. Whatever mechanism a complaint is received through, an investigation is carried out, and the complainant is contacted by the Port to follow up and explain the investigation findings where this is possible. Reporting of noise complaints to the PNLC and NCC as prescribed in the Port Noise Management Plan also occurs.

One of the challenges with this noise complaint process is the lack of verification or validation of individual noise complaints. All complaints are treated the same, irrespective of whether they are genuine, or noise monitoring indicates there was a corresponding noisy activity at the Port at the time of concern to the complainant.

[6] https://www.portnelson.co.nz/about-the-port/the-environment/noise-management/online-noise-complaint/

Figure 7 below shows the number of noise complaints, number of noise complainants, the number of significant noise events, and cargo throughput at PNL between 2011 and 2020. The number of complaints and complainants rose in FY 2013, consistent with Variation 07/01 becoming operative. The number of complainants has remained steady since then, with a spike of complaints in 2018. The spike in complaints in 2017 does not correlate to any increase in measured noise or in operational significant noise events.

*Figure 7 Number of Noise Complaints, Complainants, Significant Noise Events and Cargo Throughput between 2011 and 2020.*




| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of Complaints | 4 | 4 | 19 | 11 | 16 | 18 | 27 | 31 | 56 | 50 |
| Number of Complainants | 2 | 4 | 18 | 11 | 14 | 14 | 16 | 11 | 16 | 13 |
| Number of Significant Noise Events | 4 | 0 | 5 | 10 | 1 | 1 | 2 | 6 | 4 | 1 |
| Cargo Throughput (million RT's) | 2.7 | 2.7 | 2.6 | 2.7 | 2.6 | 2.7 | 3.1 | 3.6 | 3.9 | 3.3 |

## 5. Noise Improvement Initiatives Trialled and Implemented at Port Nelson

Below is a list of initiatives researched, considered, tried and where practicable with a noise benefit have been implemented at Port Nelson. These initiatives had the objective of minimising noise production from operations, especially at night. At the time of writing PNL have been actively involved in looking for ways to achieve continuous improvement in noise minimisation since 2008. It is important to acknowledge that at the time of writing the low hanging fruit have been well picked, and now the gains are harder to come by, and the resulting noise benefit is often smaller. However, the challenge is still being actively pursued to ensure PNL continue to deliver improvements in noise minimisation.

### 5.1.1. **Rubber Matting Trial at Main Wharf (Trialled)**

A trial was conducted in 2013 to assess the value of rubber matting underneath containers to deliver a noise benefit when landing containers on the wharf. This trial showed that putting rubber mats under containers did not consistently deliver a measurable noise improvement. This is because a major contributing factor was in fact a different source of noise, the one from the spreader contacting the container, and rubber matting underneath the container did not benefit that source of noise. The heavy-duty rubber matting showed obvious signs of deterioration after ten container moves. Lyttleton Port Company conducted a similar trial and had similar findings. PNL have an additional container noise trial planned for later in 2020 to try new materials, also a hatchlid insert prototype has been developed for trial.

### 5.1.2. Soft Touch Down (Implemented)

The soft touch down procedure was rolled out into all heavy plant in 2013. This involves lowering the speed of the spreader on cranes and container handlers in the last one meter of travel prior to contacting the container or hatchlid they are picking up or placing the hatchlid or container on the wharf or vessel. This ensures the final meter of travel is controlled meaning a soft contact between the metal of the spreader and the container or hatchlid minimising the noise. This is still in place today.

### 5.1.3. Audible Travel Alarms (Implemented)

Following concerns highlighted by residents, traditional travel alarms on plant such as reversing beepers have been phased out progressively at Port Nelson since Variation 07/01 became operative, where this is possible and meets Health and Safety Requirements. There are now many varieties of travel alarms on PNL plant as this technology improves. Some omit a 'whoosh whoosh' or similar sound that can be heard from a short distance away, to warn people in the immediate vicinity of a piece of plant approaching. These are not audible from a long distance away so cannot be heard at a disturbing level at the residential boundary. Another alternative to travel alarms in use at Port Nelson is blue strobe lights to replace reversing beepers at night. Once the headlights are switched on, when reverse is engaged instead of a 'beep beep' being emitted a blue flashing strobe (which is silent) glows. This is particularly useful when reversing forklifts out of containers as the strobe shows outside the doors of the container to warn a passing pedestrian there is a forklift working inside.

### 5.1.4. Plant Maintenance and Procurement for Noise Improvement (Implemented)

Following the implementation of Variation 07/01 noise concerns have become part of the regular service checks done on plant to make sure plant is not noisier than is should be as a result of a fault such as a hole in a muffler or similar. Noise is also an important consideration in the purchase of new plant, both in terms of how much noise it makes, and the potential to retrofit noise insulation. Any optional extra package that can be purchased to minimise noise are. Replacement plant tends to be quieter as part of technology improving, but where possible PNL does look at additional noise insulation, that exceeds the minimum specification. The mobile harbour crane that arrived at Port Nelson in October 2020 will have acoustic insulation fitted in the engine room to help minimise the noise associated whine from the drum of the crane as part of its commissioning.

### 5.1.5. Communication on the Wharf, and Additional Staff in a Hatchman role (Implemented)

There have been many noise improvements delivered through better and different communication methods on the wharf. The implementation of personnel radios has made a significant difference as staff no longer need to yell to communicate. Also the addition to the stevedoring team of a hatchman has contributed meaningful noise reduction. Their sole purpose is to communicate with the crane driver about the position of the spreader respective of the target and provide distance and orientation information to the driver. This is particularly valuable at night when depth perception is difficult, and for blind

movements when the view between the driver and target is obstructed. It is common for a hatchman to count down to the driver the distance from their target. In 2019 a further improvement was added when 2m intervals were painted on tally huts on the wharf to better assist the distance judgement of hatchman. One hatchman is assigned per working crane on each vessel.

#### 5.1.6. **Improved Crane Technology (Implemented)**

As improved technologies have become available, these have been considered for implementation by PNL. The system control computers in PNL's three cranes have been upgraded to improve the soft touch down procedure and control. Cameras have been installed on the end of the boom so drivers have an improved view of their spreader in relation to cargo.

#### 5.1.7. Lashing Bar Removal (Implemented)

The removal of the bars which tie stacks of containers together above deck on a vessel (lashing bars) was a noise highlighted as being of concern to residents. In response PNL developed a modified process and innovative piece of equipment which means these bars can be safely removed without being dropped on the deck of the vessel. This has delivered a meaningful noise benefit.

#### 5.1.8. Preference for Daytime Operations (Implemented)

PNL takes all reasonable steps to avoid working at night, for several reasons, including consideration of night-time noise, and the value of sleep for our close neighbours. In addition to this it is better for our staff from a fatigue management and well-being perspective, and there are additional staff costs during night time hours, therefore a clear financial incentive to avoid night time operations. However Port Nelson is a tidal Port, some vessels only have the required under keel clearance to enter and exit the Port on the high tide, and their schedules typically require them to leave on the next high tide. Vessel schedules need to be kept and so this means vessel operations need to happen between the high tides, including at night-time when necessary.

#### 5.1.9. Vessel Planning (Implemented)

A key component of noise minimisation associated with vessel planning is minimising the number of moves needed to complete a vessel, this in turn reduces the hours required to complete operations on vessel. Especially discharge, load, reload containers (containers that need to be unloaded to reach cargo underneath them not destined for Nelson, that are then reloaded), and the number of hatchlid moves. There are corresponding financial drivers to support this initiative.

#### 5.1.10. Reefer Positioning and Orientation (Implemented)

Refrigerated Containers (Reefers) are located at Port Nelson on specific container grids due to their need to be pluged in. The hum of the motors when they are running has been noted at times to be a noise concern for the Ports neighbours, particularly during the peak fruit season. To help minimise the noise from reefer units the Port keeps a row of containers in the grids closest to the road whenever possible to help screen this noise. The grid closest to the residential boundary also has their power points located in a position where the container motor faces north when these are plugged in.

#### 5.1.11. Location of operations, relocation of log operations to be further from residential area (Implemented)

In recent years infrastructure development at Port Nelson has had the objective of making efficient use of land and consolidating cargo types. Additionally, there has also been a noise management objective and noise benefits for the Ports residential neighbours. Log operations have been permanently withdrawn from the former logyard bound by Low, Carkeek and Vickerman St's and this has been replaced by Warehousing. These log operations now take place on Rogers St, to the north which took this operation further away from the residential area and delivered a meaningful noise reduction. Due to increased availability of land on Rogers St we are also seeing reducing and infrequent use of the Nelmac log yard. Once the final stages of the log yard upgrade are complete, we anticipate the Nelmac Yard will no longer be used for log operations.

#### 5.1.12. Noise Workshops with Operational Staff (Implemented)

PNL regularly engages with operational staff on noise through operational and foreman's meetings. From time to time it also takes the opportunity to have dedicated workshop sessions focussed on noise management, to draw ideas and initiatives from those who work in the operations. This is to ensure the Port is continuously improving its noise management practices and to see if those who most actively participate in minimising noise have any new ways that can be tried to improve noise performance. The most recent round of workshops was held in 2020.

#### 5.1.13. Painting Hatchlid Holes (Implemented)

One of the simplest but most beneficial ideas that came from one of the internal noise workshops was to paint the hatchlid holes white. Picking up hatchlids is one of the most difficult movements for a crane driver, it is also one of the riskier movements from a noise generation perspective as the steel spreader contacts the equivalent of a thirty tonne steel drum. Painting the hatchlid holes white was a really simple idea that vastly improved the visibility of the small holes for the crane driver and helped minimise the risk of accidentally missing them with the spreader and creating noise from the spreader contacting the hatchlid.

#### 5.1.14. Crane Driver Training and Crane Simulator (Implemented)

In 2018 PNL purchased a technology leading crane simulator to improve its crane driver training prior to trainee's working a vessel. This means PNL crane drivers reach a higher calibre in terms of capability before they get alongside a vessel. In terms of noise minimisation their skills are more developed on smoothly and quietly moving cargo before they physically work on a vessel. They can undertake simulator training at night and can complete assessments on the simulator also. PNL has always invested in developing and ensuring their crane drivers are highly skilled. Noise is one of the factors that contributes towards assigning a competency grade to a driver's skill level, and this impacts their remuneration. The high skill level of the PNL crane drivers around noise management is always evidenced on the rare occasion where we have out of town crane drivers working at Port Nelson, and this inevitably leads to noise complaints.

#### 5.1.15. Location of Cranes at the southern end of Main Wharf (Implemented)

In March 2020 at a meeting between a group of residents from the Port Effects Overlay and PNLC this group of residents asked if PNL could operate the newest crane at the southern end of Main Wharf as that is closer to the residential boundary. Their thinking around this was the newer crane was quieter. The Port took this request into account and whenever it can from an operational perspective it places the newer of the cranes on the wharf at the southern end.

#### 5.1.16. Main Wharf North Rebuild (Implemented)

The rebuild of a 100m section of Main Wharf that had reached the end of its usable life commenced in 2019. It is scheduled to be completed in 2021. From a noise minimisation perspective once completed this will see container operations currently undertaken at Main Wharf South relocated to Main Wharf North. On average all containers exchanged on Main Wharf will be further from the residential boundary.

### 5.2. Other Noise Improvement Initiatives Under Investigation

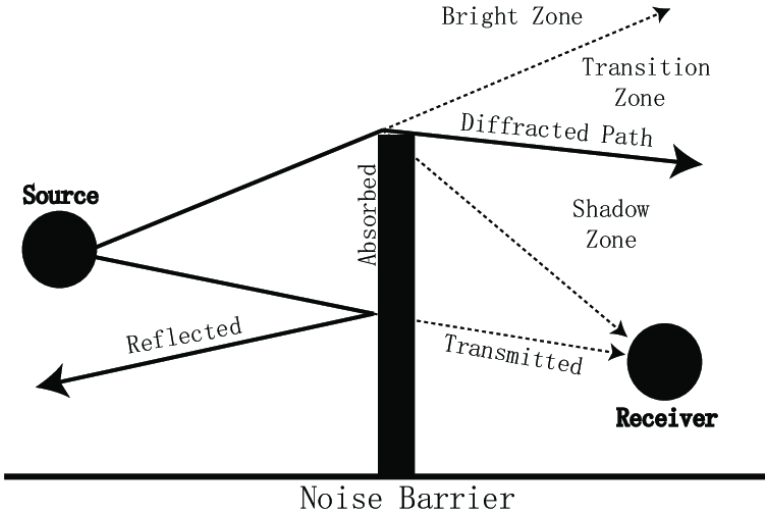
#### 5.2.1. Acoustic Barriers for Operational and Reefer Noise

This approach requires a physical barrier to be placed in between the noise source and the receiver with to goal of absorbing and deflecting noise to lower to overall effect as shown in Figure 9 below. The context for consideration of this option is that PNL's reefer tower structures, or boundary fences between noise sources of concern have been considered for fixing acoustic barriers to. Fixing acoustic barriers to the reefer towers is unlikely to be practical as it would require a close seal between the containers and the towers. This isn't possible from an operational perspective when container stacks are constantly changing and container handlers need to access them. Operationally this would mean disruptions to configure the barriers for each container movement, and the barriers would be susceptible to frequent damage. Besides

the question of practicality, Hegley's noise model indicates that the largest noise contribution is from the low frequency end of the spectrum of which typical acoustic barriers are less effective at attenuating.

Fixing acoustic barriers to the boundary fences between operations of noise concern and the residential area also presents challenges. Firstly to be effective as shown in Figure 8 below the line of sight needs to be disrupted between the source of the noise and the receivers. This would result in an immensely high, and likely unsightly fence on the Ports boundary causing disrupted views for the residents, and some rigorous engineering solutions to cope with the wind loadings for a structure of this type.

*Figure 8 – Diagram of How an Acoustic Barrier Works.*

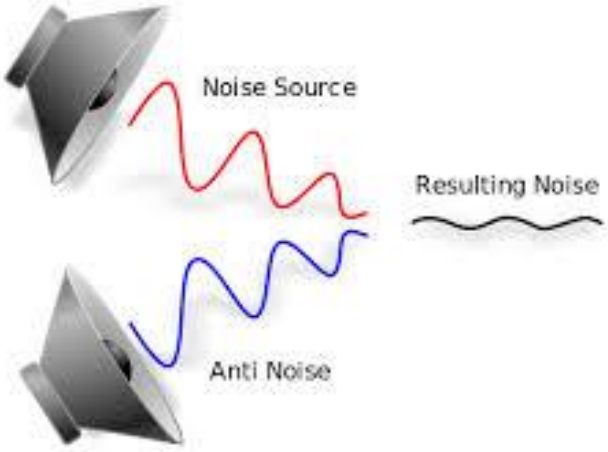



### 5.2.2. Phase Cancellation

Phase Cancellation requires an inversion of the target sound profile to be projected at the noise source. This effectively cancels the sound being generated between the source and the receiver, a simplified diagram is shown in Figure 9 below. As the sound profile of the reefer generator is relatively constant, an initial test setup would be greatly simplified from a theoretical system (Kwon et.al, 2016). The only component of the setup would be the speakers/subwoofers to output the sound profile. Operationally this would be more practical than acoustic barriers to trial without interruption of the stacking and plugging in of reefers. The hanging of speakers/cables and an available electricity supply means little infrastructure modification would be necessary. However everything in this part of the operational area is susceptible to frequent damage.

As phase cancellation is more effective at attenuating the lower frequency noise and a test case could be implemented with less operational disruption, this is the preferred option for further investigation.

*Figure 9 – Diagram Showing Active Noise Control*




### 5.2.3. Improved Noise Monitoring Technology

Under consideration currently is the technological advances in noise monitoring technology and its application at Port Nelson. This includes whether or not additional monitoring sites are needed, getting real time noise feedback to operational staff, triangulation of noise sources and imaging, noise sensors on plant and equipment. This project will commence in 2021.

## 6. International Research in Port Noise Management

Port Noise is a common challenge for Ports worldwide, especially those with close city and residential boundaries. Extensive website research leaves us of the opinion the most effective projects initiated to tackle port noise in the international port space have been:

- Noise Management in European Ports (NoMEPorts)
- *Pentathlon – Ports of Stockholm, Helsinki, Tallinn, Turku and Naantali – together*, alias PENTA
- Green Cruise Ports
- Noise Exploration Program to Understand Noise Emitted by Seagoing Ships 2018 - (NEPTUNES)

NoMEPorts (2005 - 2008) This produced a Best Practice Guide (BPG) for the measuring and mitigating noise originating from port side activities. The BPG documents the methods for collection of noise data, scientific simulations to predict noise levels and broadly discusses solutions to the identified noise sources.

PENTA (2011 - 2013) This projects purpose was to explore and develop strategies for the challenges that face several Baltic ports. A report was dedicated to noise and discusses the different ways each of the ports handled the issue and includes several suggested measures for mitigating it.

Green Cruise Port (2016 - 2019) This project involved 20 European partner ports and aimed to assist in creating environmentally friendly cruise port infrastructure. A report conducted by this initiative focussed on noise and the resulting mitigation measures are included in Table 1.

NEPTUNES (2018 - ongoing) Is an International initiative aimed at reducing noise from vessels and has produced several BPGs to assist in achieving this.
A high-level view of the solutions mentioned in these reports is presented in Table 1.

*Table 1 – Port Noise Mitigation Measures of International Significance tried in other Ports.*

| Mitigation Measures | | |
|---|---|---|
| **Operational Changes** | **Equipment Modification** | **Infrastructure Changes** |
| Berthing allocation based on noise | Spreader guidance systems | Noise barriers |
| Berthing direction based on noise | Electrification of vehicles/equipment | Onshore power supply |
| Staff noise training & awareness | Exhaust Silencers vehicles/equipment | Ramp design changes |
| Environmentally differentiated fees/costs | Insulation of impacts between acoustically hard materials | - |

While a somewhat standard format for noise monitoring and identification is possible for all ports to adopt, actual mitigation measures that work for some ports will not work for others. The reasons for this are extensive and are briefly discussed with respect to PNL in Section 4.

## 7. A specific look at Stockholm

Ports of Stockholm were/are participants in NEPTUNES, NoMEPorts and PENTA. Outcomes from adopting these project's protocols has resulted in Ports of Stockholm implementing all the measures shown in Table 1 excluding noise barriers.

Recently Ports of Stockholm have declared their intention of installing on-shore power supplies for cruise ships at berth (Pospiech, 2020). No response from a Ports of Stockholm contact was received to confirm this, however PNL will continue to seek comment on their noise management efforts.

## 8. A specific look into Noise Management at Glebe Island and White Bay

The Port Authority of New South Wales recently came up with a draft noise management framework comprising of a Port Noise Policy, a Vessel Noise Guideline, Landside Noise Guideline, and a Noise Standard specifically for Glebe Island and White Bay operations. This was drafted with the intent to:

- manage, changes in interpretation in Port Noise Management Requirements.
- introduce transparency, to allow the Port Authority to manage port noise as a whole (holistically) not by individual Port operations.
- to negotiate previous noise guidelines which were not well suited to Ports.
- to create certainty for the community and regulators.
- to have noise limits for visiting vessels and landside activities with consequences for exceeding these.
- to have noise mapping and to have planning controls for new developments and goals for long term reduction in vessel noise.

The foundations from which this originated was ambiguity and gaps around what was appropriate for the Port and community in terms of port noise, which were the appropriate regulations or standards and what those were. This is a stark contrast to Port Nelson whereby the rules and regulations are clearly prescribed in Variation 07/01 and the Port Nelson Noise Management Plan, which was derived from the New Zealand Standard for Port Noise (NZS 6809).

The Draft Vessel Noise Operating Protocol (at berth) is a framework for the Port Authority to measure and enforce trigger levels with ship operators and occupiers. It prescribes a scale of responses the Port Authority will take if a vessel breaches the trigger levels in the protocol. Depending on the severity, and the number of times a vessel breaches the trigger levels the actions include the requirement to provide a Noise Management Plan, daylight hour restrictions, and in the most severe cases declining vessels from entering the Port. As part of the protocol development shore power was considered. It was dismissed due to the lack of vessels that had the ability to plug into shore power visiting the Port, and because it does not remove all the noise. Noise from reefer/cargo, vessel air conditioning, and requirements of the accommodation block on the vessel are still powered via shore power.

The Draft Landside Noise Guideline is controlled by the EPA Noise Policy for Industry (2017), and it is acknowledged this is not well suited to Ports. The Draft Landside Precinct Criteria intends to set the ultimate overall noise level for landside activities that could be produced by the Port. At the time of writing the maximum permissible noise levels for landside users had not been set. The Draft Landside Noise Guideline does go into and map the sensitive receivers to Port noise and the planning controls that exist for developers on these sites. It also goes into the acoustic treatment measures in close residential areas by the Port Authority. In a similar approach to Port Nelson there is internal noise standards prescribed. These are 35dBA in sleeping areas and 40dBA for other internal habitable spaces during the daytime. These have been written into the development standards for future residential plans for close residential neighbours in respective areas.

The Draft Noise Standard summarises the key requirements of the Port Noise Policy, Vessel Noise Guideline, Landside Noise Guideline, and Noise Attenuation Measures. This lacks the specific detail

contained in each plan and is the overarching document piecing together each component of Port Nosie Management at Glebe Island and White Bay.

There are several key differences between operations in New South Whales and Port Nelson. Glebe Islnad and White's Bay are not tidal Ports, and do not have their noise management approach prescribed through existing legislation. It is also worth noting these provisions are still in draft with their final versions pending.

## 9. How Port Nelson Measures Up

The Noise Variation 07/01 became fully operative in 2012 and requires PNL to implement a Port Noise Management Plan, a Port Noise Mitigation Plan and a Port Noise Liaison Committee as a management and mitigation approach for port noise. As a result, several mitigation measures have been implemented that have been explored as part of international best practice to reduce noise, and there are several other methods under investigation. Table 2 below displays the key solutions from some of the European initiatives and their implementation status at PNL.

Table 2 - *Port Noise Mitigation Measures of International Significance tried in other Ports and their status at Port Nelson.*

| Mitigation Measures | | |
|---|---|---|
| **Operational Changes** | **Equipment Modification** | **Infrastructure Changes** |
| Berthing allocation based on noise | Spreader guidance systems | Noise barriers |
| Berthing direction based on noise | Electrification of vehicles/equipment | Onshore power supply |
| Staff noise training & awareness | Exhaust Silencers vehicles/equipment | Ramp design changes |
| Environmentally differentiated fees/costs | Insulation of impacts between acoustically hard materials | |
| Electric equipment, heavy plant upgrades to minimise noise (silencing kits), spreader guidance system. | | |

Green = Implemented/partially implemented
Orange = Being Investigated
Red = Discarded at present

While consideration of noise barriers has not been completely discarded as their large-scale implementation to blanket noise control would require the loss of 'line of sight' between affected residents and the noise source. Due to the elevation difference between typical noise sources at PNL and the receivers, their ability to provide beneficial noise attenuation without prohibitive costs, and

engineering inputs and a large reduction of resident's visual amenity, it is unlikely they are a practicable solution in the case of Port Nelson.

With regards to onshore power supply for berthed vessels, at current usage levels this would not be possible without upgrades in capacity to the Nelson electrical grid. As these upgrades are outside of PNL operational control this measure has been discarded at present.

Ramp redesign has not been implemented as PNL does not regularly use its roll-on-roll-off (RORO) ramp and it is therefore not considered a relevant source of noise.

Environmentally differentiated fees have been implemented as part of NEPTUNES which PNL is a participant in. The Environmental Ship Index (ESI) which PNL subscribes to is expanding its criteria to include noise performance.

## 10. Further Research

Besides the investigations underway in Table 2, Active Noise Control (ANC) is being explored as an option for attenuation of noise. Expanding on the principle used in noise cancelling headphones which specifically targets the noise in question and inverts its frequency to cancel its effect. The application of this at a large scale is only recently being explored (Nahyun Kwon, Moonseo Park, & Hyun-Soo Lee, 2016) and requires further investigation to understand its effectiveness and practicality at PNL.

PNL is considering improved noise monitoring technology, this would improve the identification and accuracy of sound measurement at Port Nelson. This would automate the task and discard irrelevant noise not produced by the port and therefore better target mitigation measures. This has already been implemented at Port of Otago to good effect.

## 11. Conclusions

It is important to PNL to be a good neighbour and corporate citizen. PNL is very conscious of its noise effects, has taken its responsibilities to minimise noise, especially at night seriously, and has made good progress and implemented changes to its operations to reduce its noise outputs. Noise is deeply engrained in PNL's business operation and decision making.

Additionally, PNL has taken the obligations prescribed by Variation 07/01 seriously, and it has invested significantly in meeting those. PNL is of the opinion that Variation 07/01 has been a successful tool for driving change to improve Port noise effects on its close neighbours and for driving community engagement on port noise through the PNLC, to ensure the Port is accountable and answerable for port noise issues experienced by its residential neighbours.

Like all change initiatives, the early phases provide good wins as the low hanging fruit are plucked, and this was the case when PNL first started to look deeply for ways it can minimise its noise outputs. However subsequent initiatives require more effort, investment, and progress at this end of the journey is more difficult, often resulting in less significant gains.

Some of the initiatives described in the report are put forward by various European ports and it would be reasonable to consider them the leaders in Port Noise Management. In comparison to these ports, PNL is applying similar methodology to current best practice standards and is innovating with its own investigations to achieve fewer undesirable noise effects on its neighbours.

Is it the PNLC's opinion the Noise Variation and current approach works well. Together the PNLC, PNL and Residents affected by Port noise work collaboratively towards improved noise management outcomes. Both PNL and the PNLC welcome ideas from the public on better noise management solutions.

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