BEFORE THE INDEPENDENT HEARINGS PANEL
OF AUCKLAND COUNCIL

I MUA NGĀ KAIKŌMIHANA MOTUHAKA
I TE TĀMAKI MAKAURAU ROHE

UNDER	the Resource Management Act 1991 ("**RMA**")
AND	
IN THE MATTER	of an application to Auckland Council by Watercare Services Limited ("**Watercare**") for a resource consent to construct, commission, operate and maintain a wastewater tunnel and associated activities in Herne Bay, Auckland ("**Project**")

STATEMENT OF EXPERT EVIDENCE OF SHARON YU-CIN YUNG ON BEHALF OF WATERCARE SERVICES

(NOISE AND VIBRATION)

2 FEBRUARY 2024

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1. EXECUTIVE SUMMARY

1.1 My full name is Sharon Yu-Cin Yung and I am a Senior Acoustic Consultant at Tonkin & Taylor Limited ("**T+T**").

1.2 I am the author of the '*Herne Bay Tunnel – Construction noise and vibration technical assessment report*' dated 28 June 2023 ("**Technical Assessment**" or **"CNVA**") and the draft '*Herne Bay Tunnel – Construction Noise and Vibration Management Plan*' dated 8 September 2023 ("**Draft CNVMP**").

1.3 In my Technical Assessment I assessed the potential noise and vibration effects based on the different construction activities for the Project. These construction activities are described in more detail in the evidence of Mr Bishop.[1] My assessment considered a worst-case scenario for noise and vibration effects at nearby occupied residential dwellings ("**receivers**").

1.4 The potential noise and vibration effects from surface works, activities in the proposed construction support areas ("**CSAs**") and from tunnelling activities were assessed. As described in my evidence, the main sources of noise from these construction activities are secant piling for shaft construction, concrete sawing for open trenching and use of a tunnel boring machine ("**TBM**") to construct the tunnel. Based on my experience, it is in my opinion that the construction methodology reflects the best practicable option to minimise noise and vibration from these types of works.

1.5 With the exception of the two CSAs (at Salisbury Reserve and at 94a-94b Shelly Beach Road), all surface works and tunnelling are within the road reserve and are therefore not required under the Auckland Unitary Plan ("**AUP**") provisions to comply with the construction noise limits provided a CNVMP is provided to Auckland Council ("**Council**"). It does not however remove the requirement to manage noise and vibration levels and to minimise effects. My assessment has identified receivers where potential exceedances of the noise limits in the AUP may occur and recommends measures to ensure these exceedances are managed within the CNVMP.

1.6 The draft CNVMP will be finalised and submitted to the Council as required by Proposed Condition 37 in the Watercare's updated proposed conditions which are appended to the evidence of Ms Drury ("**Proposed Conditions**"). Although the CNVMP includes mitigation measures in the form of

[1] Evidence of Mr Bishop dated 2 February 2024 at section 4.

management and physical requirements to minimise noise and vibration effects, a key feature of the CNVMP is that communication and consultation with the community takes place prior to noisy works commencing. I have found that people are generally more accepting of noise and vibration if they are informed prior to works commencing and know what to expect and when.

1.7 From my experience of observing construction activities, the highest noise levels for this Project will only occur for relatively short periods of time when works are near the surface and or nearest to a receiver, and not throughout the construction programme. During a typical piling day, noise may occur for a couple of hours when physical piling works take place. For the remainder of the time there is minimal noise prior to the commencement of the next pile. Similarly, noise levels will reduce as works progress along the open trench alignment. Longer term construction such as TBM support will generate significantly lower noise level than the worst case presented.

1.8 My assessment of the two CSAs identified that the nearest residential receiver from Shelley Beach Road (CSA2) is over 180m away and noise effects are considered negligible. Since my Technical Assessment was prepared, Watercare has revised the land requirement plan for Salisbury Reserve ("**Revised Plan**"). This Revised Plan is appended to the evidence of Mr Bishop.[2] I have reviewed the Revised Plan, and the site boundary is now 2 - 8m further away from adjoining property boundaries compared to when I assessed the potential effects on these receivers in my Technical Assessment. The Revised Plan means that there is a noise level reduction across all receivers originally identified in my report and compliance with noise limits can be readily achieved.

1.9 For vibration, I identified three properties (1 Marine Parade, 34 Herne Bay Road and 72 Argyle Street) as experiencing construction vibration levels greater than the vibration thresholds of DIN 4150-3 for cosmetic building damage. Structural damage to dwellings and pools is unlikely. I have recommended that these properties have building condition surveys undertaken pre- and post-construction.

1.10 My assessment considered vibration and regenerated noise from the operation of the TBM. I concluded that the effects from tunnelling will be negligible to less than minor at all receivers.

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2 Evidence of Mr Bishop dated 2 February 2024 at Attachment 1.

1.11 I have provided input into the Proposed Conditions relevant to noise and vibration and consider these conditions will ensure that any potential noise and vibration effects are appropriately managed to an acceptable level.

2. INTRODUCTION

Qualifications and Experience

2.1 My full name is Sharon Yu-Cin Yung. I am a Senior Acoustic Consultant at T+T and have held this position since July 2021.

2.2 I have a Diploma in Noise and Vibration control and a Bachelor with Honours in Architectural Studies. I am a member of the Acoustical Society of New Zealand and a Member of the United Kingdom's Institute of Acoustics.

2.3 I have been employed in acoustics since 2013. I have held positions at AECOM (2019-2021) and AURECON (2017-2019) and have worked for the UK Environment Agency (2013-2017), where I was responsible for the regulatory assessment and auditing of industrial noise impact assessments.

2.4 I have undertaken numerous construction noise and vibration assessments across New Zealand for a range of large infrastructure projects, including Auckland's Central Rail Link and Watercare's Central Interceptor ("**CI**") project, specifically for the Point Erin extension project (which was granted consent in September 2023).

Involvement in the Herne Bay Tunnel Project

2.5 I have been engaged by Watercare to assess noise and vibration effects from the construction and operation of the Project. The Project will connect to the CI wastewater conveyance and storage tunnel through a new drop shaft in Point Erin Park.

2.6 I am the author of the Technical Assessment dated 28 June 2023, which accompanied the Assessment of Environmental Effects and consent application for the Project. I also authored the draft CNVMP dated 8 September 2023. This CNVMP remains a draft and will be updated and finalised prior to construction commencing, should consent be granted for the Project.

2.7 I have also assisted in preparing the response to Council's s92 requests insofar as the responses raised matters relating to construction noise and vibration effects from the Project.

2.8 I have undertaken a number of site visits and am familiar with the local area, including the Project's work site and the two CSA areas at Salisbury Reserve (known as "**CSA1**") and 94a-b Shelly Beach Road ("**CSA2**")

Code of conduct

2.9 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the latest Environment Court Practice Note 2023 and that I agree to comply with it. I confirm that I have considered all the material facts that I am aware of that might alter or detract from the opinions that I express, and that this evidence is within my area of expertise, except where I state that I am relying on the evidence of another person.

3. SCOPE OF EVIDENCE

3.1 My evidence assesses the potential construction noise and vibration effects of the Project. I confirm that my assessment contained in this evidence has assessed the Project as a whole, including construction of the tunnel and above-ground works at various shafts along the alignment.

3.2 In this statement of evidence, I will:

(a) Provide an explanation of methodology used in undertaking the noise and vibration assessment of the Project;

(b) Describe the locations for the relevant Project works and wider context of the surrounding area;

(c) Outline the proposed activities to occur, as they are relevant to my assessments;

(d) Summarise my assessment of potential noise and vibration effects on the Herne Bay area and my recommendations to address those effects, as set out in my Technical Assessment and the draft CNVMP;

(e) Respond to matters raised in the Council Officer's section 42A Report for the Project, including commentary on the s92 requests;

(f) Respond to the submissions received on the Project; and

(g) Comment on the Proposed Conditions of consent.

3.3 In preparing this evidence, I confirm I have read the following documents:

(a) The section 42A report of Mr Ross, Consultant Planner.

(b) The statements of evidence of Ms Drury, (planning evidence for Watercare), Mr Bishop (construction evidence for Watercare), Mr Shields (transport evidence for Watercare), Mr Thomas (geotechnical evidence for Watercare) and Mr Clarke (structural evidence for Watercare) – all dated 2 February 2024..

(c) The submissions which identify and raise matters related to noise and vibration.

4. METHODOLOGY

4.1 My Technical Assessment relies upon the construction methodology as presented in Mr Bishop's evidence and the transport assessment prepared by Mr Shields.[3] I note that the evidence of Mr Bishop details how some further refinements have been made to the construction methodology after the consent application was submitted to Council. I have reviewed the updated construction methodology and the evidence of Mr Bishop and Mr Shields and confirm that there are no substantive changes to the construction methodology (or traffic movements resulting from this Project) that would alter the conclusions reached in the CNVA and my assessments I now detail in this evidence.

4.2 However, since my CNVA was prepared, I note that there are now only three interception pipelines proposed as part of this Project. The fourth pipeline that was within the road reserves of Wairangi Street, Stack Street and River Terrace has been removed from the application. This removes the potential for noise and vibration effects resulting from construction of this section of pipeline, including the effects on the occupiers at the following 14 residential addresses:

(a) 3, 8 and 10 Wairangi Street;

(b) 3 and 6 River Terrace;

(c) 9, 11 and 15 Cremorne Street; and

(d) 1, 5, 6, 7, 12 and 14 Stack Street.

3 T+T – Herne Bay Tunnel Integrated Transport Assessment (ITA) dated June 2023.

I have therefore updated the number of affected receivers from the CNVA within my evidence.

4.3 As noise and vibration is a technical subject area, in the next two sections I provide an overview of noise and vibration descriptors and metrics.

Overview of noise

4.4 The unit of noise measurement is the decibel ("**dB**"). The A-weighted decibel level ("**dB(A)**"), is used to account for the frequency response of the human ear. The following table (Table 1) provides examples of typical sources of noise and the associated sound level.

Table 1 – example sound levels for common sources of noise

dB(A)	Example
0	Hearing threshold
20	Still night – time outdoors
30	Library
40	Typical office room no talking
50	Heat pump running in living room
60	Conversational speech
70	10 metres from edge of busy urban road
80	10 metres from large diesel truck
90	Lawn mower – petrol
100	Rising a motorbike at 80 kph
110	Rock band at a concert
120	Emergency vehicle siren
140	Threshold of permanent hearing damage

4.5 A sound source can be described in terms of sound power level or sound pressure level. The sound power level is a measure of acoustic energy, while the sound pressure level is what is heard, measured or calculated at a distance from the source. The sound power level of a source will always be higher than the sound pressure level from that source, and the sound pressure level will often specify a distance from the source, eg 65dB(A) at 10m.

4.6 Sound radiates out as pressure waves from a sound source. As a rule of thumb, there will be a 6dB reduction in the level of sound from a source each time the distance doubles. However, the transmission or propagation of sound will also be influenced by air absorption and ground absorption resulting in greater reductions the further away the source is. The effects of screening from terrain and building structures will also influence sound levels. For example, if an object was introduced close to the sound source or the

receiving location such that there was no line of sight then there will be at least a 10dB reduction in sound level. If there is partial line of sight, then the sound level will reduce by approximately 5dB. If there is complete line of sight then there will be no reduction.

4.7 As the decibel is derived from a logarithmic calculation, it is useful to understand how sound levels are described. Every 10dB increase in sound level doubles the perceived sound level. A sound of 70dB is subjectively twice as loud as a sound level of 60dB and a sound level of 80dB is four times louder than a sound level of 60dB. An increase or decrease in sound level of 3dB or more is perceptible. A change in sound level of less than 3dB is not usually discernible. If two noise sources differ by 10dB or more, then the overall sound level is controlled by the higher of the two sources ie there is no decibel contribution from the quieter sound source. This is important when deciding whether to reduce the sound level being generated by all sources or just the loudest.

4.8 When describing unwanted sound, the term noise is used. Both sound level and noise level are interchangeable.

4.9 Various descriptors are used to describe the level of sound experienced. The most common are:

(a) LAeq,t – the A-weighted time-average sound level over a period, t (typically t will be 15 minutes for construction noise); and

(b) LAFmax – the A-weighted maximum sound level in decibels using the fast time response.

Overview of vibration

4.10 Vibration can be measured and described in different ways. When assessing vibration on buildings and the effects on people, the peak particle velocity ("**PPV**") is commonly used, and the unit of vibration velocity is mm/s.

4.11 The effects of vibration on residential building structures varies depending upon the PPV of the vibration and the vibration frequency (see Figure 3 of my evidence). Vibration levels above frequency dependent thresholds may result in minor building damage also known as cosmetic damage ie cracks forming in plastered walls, existing cracks enlarging or partitions becoming detached from load bearing floors. For significant structural damage to occur, the vibration magnitude must be significantly higher if the structure is in good repair. Vibration induced building damage must not be confused with building

damage due to ground settlement. Vibration induced ground settlement is highly unlikely from typical construction activities.[4]

4.12 As people are more sensitive to vibration than building structures, the following table provides guidance on the effects of vibration on people.

Table 2 – vibration effects on people

Vibration level (PPV)	Vibration effect
0.14 mm/s	May be just perceptible in the most sensitive situations
0.3 mm/s	May be just perceptible in residential environments
1.0 mm/s	May cause complaint but can be tolerated if prior warning and explanation has been given to residents
10 mm/s	Likely to be intolerable for any more than very brief exposure to this level in most building environments.

Methodology adopted to predict construction noise and vibration levels

4.13 Figure 1 provides the preliminary alignment of the Project. I describe the activities which will generate noise and vibration and their significance at section 6 my evidence below.

4 This would only occur for dynamic compaction or if there are weak soils which are then liquified due to prolonged vibrations from ground improvement works.

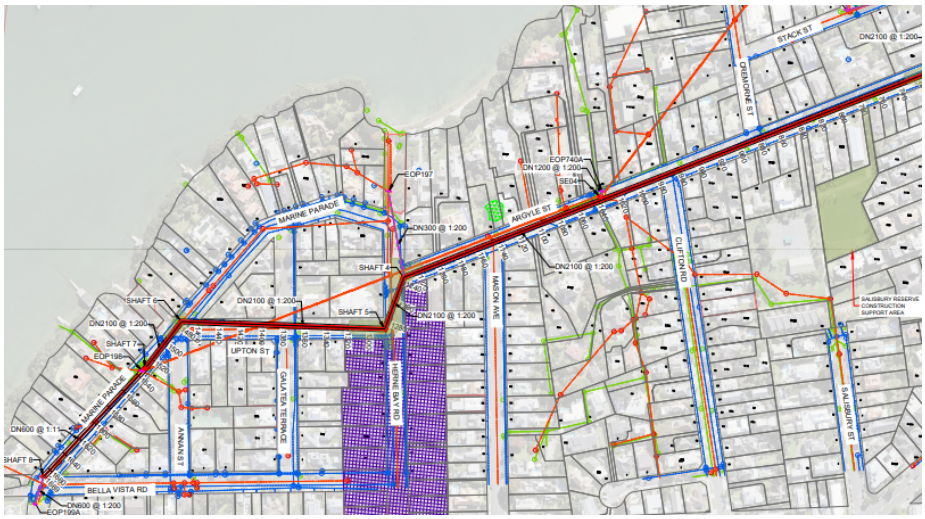

Figure 1 – Herne Bay sewer line

Construction hours

4.14 Noise generating activities will typically occur during standard construction hours between 7am and 6pm Monday to Friday and 8am – 6pm on Saturdays. Site mobilisation and pack down works are proposed to occur 30 minutes before and after these windows. Based on experience at other Watercare sites, works outside of standard hours are typically low noise generating activities for a limited period of time and will comply with the relevant noise limits.

Construction noise levels

4.15 I have predicted construction noise levels for the Project using the software package, SoundPLAN. This noise modelling application is a commercially available tool used for environmental noise calculations. The Herne Bay model that I constructed considers local ground contours, ground absorption, building locations, location of works and associated sound levels using data from similar CI projects and from T+T's library of source level data. Building footprints have been obtained from LINZ and adjusted for the number of floors within each building (assuming 2.8m height per floor with an average height of 8m for double storey buildings). To show the complexity of the Herne Bay model I have provided a 3-D screenshot in **Figure 2** below. The figure shows local terrain features and the varying building heights.

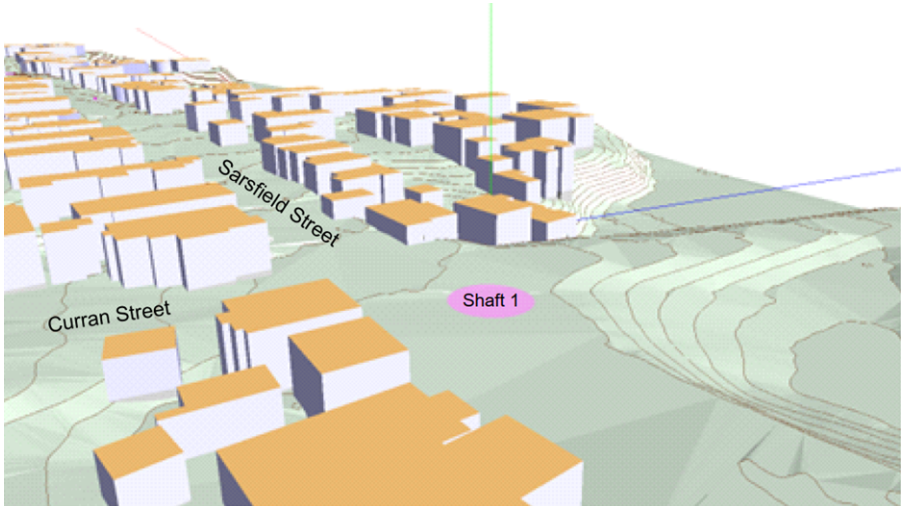

Figure 2 – Example output from Herne Bay noise model (Shaft one shown)

4.16 Construction noise levels have been predicted at all buildings along the proposed tunnel alignment and a combination of façade levels and noise contours have been produced – see Appendices C and D respectively in the CNVA.

Construction vibration levels

4.17 I have predicted vibration levels at residential structures using vibration data from construction activities measured by T+T. This data is derived from PPV levels at a reference distance of 10m. The data has been extrapolated to different distances using standard vibration transmission relationships and known ground attenuation properties in the Herne Bay area. These distances represent the separation between the activity and building (typically defined as the location of the foundation of the building).

4.18 The predicted vibration levels are included at Appendix C of the draft CNVA for surface works, Appendix E for tunnelling and vibration contour maps in Appendix F (surface works) and Appendix G (tunnelling). The tunnelling appendices also include information on regenerated noise levels from the TBM which have been calculated using spatial data.

Assessment under AUP standards

4.19 The noise and vibration levels that I have assessed for the Project were compared against the applicable AUP standards. As the majority of construction works are within the road with the exception of the two CSA, the relevant AUP standards are set out in the following paragraphs of my evidence.

4.20 For construction noise, Rule E25.6.1(3) of the AUP states that:

> The noise from any construction activity must be measured and assessed in accordance with the requirements of New Zealand Standard NZS 6803:1999 Acoustics – Construction noise.

4.21 Rules E25.6.27(1) and E25.6.27(2) respectively contain construction noise limits for activities sensitive to noise (residential receivers) and for any other activity (commercial receivers). As the Project is in a residential area there are no commercial receivers and Rule E25.6.27(2) does not apply. I note that resource consent can be sought and granted to infringe the "limit" in E25.6.27(1) (as it has been in this case), subject to appropriate effects assessments and mitigation.

4.22 As the Project will take more than 20 weeks to construct, the noise limits of Rules E25.6.27(1) and E25.6.27(2) need to be reduced by 5dB (as per E25.6.27(4)). The relevant noise limits are detailed in Table 3 (for works outside the road reserve). These limits apply at 1m from the façade of any building that contains an activity sensitive to noise that is occupied during the works.

Table 3: Construction noise limits for residential dwellings

Time of week	Time period	Noise limit dB	
		L_{Aeq}	L_{Amax}
Weekdays	6:30 am – 7:30 am	55	70
	7:30 am – 6:00 pm	70	85
Saturdays	7:30 am – 6:00 pm	70	85

4.23 With the exception of the two CSAs, all construction works are within the road reserve. Planned works within the road reserve between 7am and 10pm are not required to comply with the construction noise limits of Table 3 where a CNVMP is provided to Council no less than five days prior to the works commencing and the works will take more than 8 hours (Standard E25.6.29(3)(d)). The removal of noise limits for works in the road reserve allows for potentially disruptive works to be completed efficiently to minimise road closures and subsequent disruptions.

4.24 Nevertheless, the noise limits of Table 3 have been adopted for all activities, whether occurring inside or outside the road reserve, for the purposes of s16 and s17 of the RMA, ie duty to avoid unreasonable noise and duty to avoid, remedy or mitigate adverse effects.

4.25 While not explicitly stated in NZS 6803:1999 and the AUP, Council recommends that construction noise is assessed over a 15-minute assessment period which means that short periods of activity will tend to

control the LAeq noise level. This means the worst-case scenarios is assessed over a 15-minute period of the construction activity. In practice construction noise is likely to be lower due to the intermittent nature of construction works.

4.26 The AUP contains rules relating to construction vibration that cover both building damage and amenity limits.[5] AUP Standard E25.6.29(1A) states that vibration from any construction, maintenance and demolition activities in the road must comply with the relevant vibration levels in E25.6.30(1)(a) (DIN 4150-3 limits) and Table E25.6.30.1 (Table 4 amenity limits). However AUP Standard E25.6.29(4A) further notes that the vibration levels specified in Standard E25.6.29(1A)(b) (Table 4 amenity limits) do not apply for planned works in the road with an approved work access permit and a CNVMP is provided to Council no less than five days prior to the work commencing.

4.27 For this Project, Standard E25.6.29(1A)(a) applies to all works in and outside the road (limits contained in DIN 4150-3:1999), and Standard E25.6.29(1A)(b) (Table 4 amenity limits) applies to works outside the road (CSAs).

4.28 AUP E25.6.30(1)(a) states construction and demolition activities must be controlled to ensure any resulting vibration does not exceed the limits set out in *German Industrial Standard DIN 4150-3 (1999): Structural vibration – Part 3 Effects of vibration on structures*,[6] when measured in accordance with that Standard on any structure not on the same site. The relevant guidance limits of DIN 4150-3:1999 are shown graphically in Figure 3. Sensitive buildings are those structures that are particularly sensitive to vibration, for example listed or historic buildings under preservation orders. The 2016 version of DIN 4150-3 has replaced the 1999 version; the vibration thresholds are unchanged.

4.29 Different construction activities will generate vibrations at different frequencies. For example, ground compaction with a vibratory roller will generate vibrations at around 30Hz and vibro piling will result in vibrations around 20 - 30Hz. Vibration frequencies below 10Hz are unlikely from vibration generating construction equipment. The frequency of vibration is therefore important when considering the potential for building damage.

5 There are no sources of potential vibration post-construction.

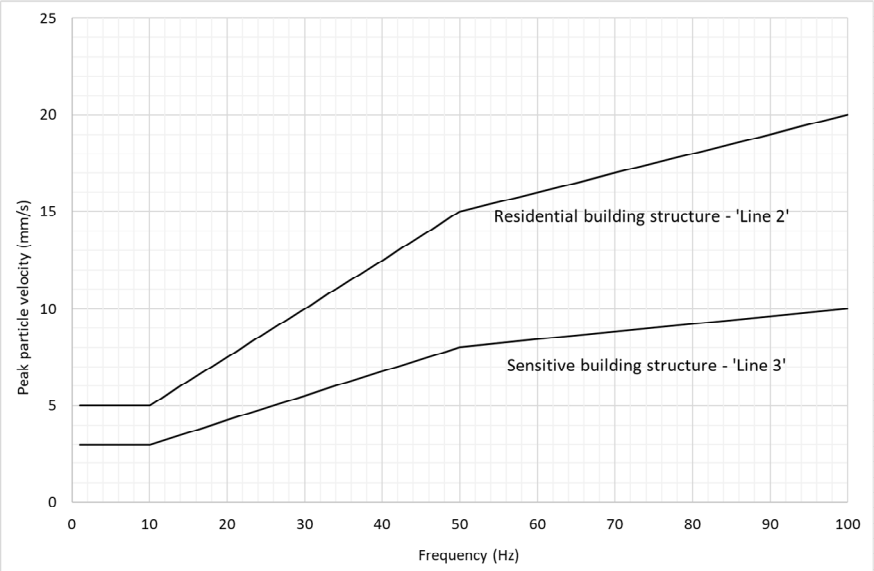

Figure 3 – DIN 4150-3 limits

4.30 DIN 4150-3 limits are set to reduce the likelihood of damage to the serviceability of the building. The serviceability is considered reduced if for example, cracks form in plastered surfaces of walls and existing cracks are enlarged (also known as cosmetic damage as explained in paragraph [4.10] to [4.12] of my evidence). Exceeding the DIN 4150-3 limits does not necessarily result in cosmetic damage, and these effects are not considered to be damaging to the structural integrity of a building. As mentioned in Section 3.3.1 of the CNVA, structural damage is unlikely to occur in residential structures at vibration levels below 50mm/s PPV.

4.31 The AUP amenity vibration limits (Rule E 25.6.30(1)(b) applicable for the two CSAs) are reproduced in Table 4.

Table 4: Table E25.6.30.1 vibration limits in buildings (amenity values)

Receiver	Period	PPV mm/s
Occupied activity sensitive to noise	Night-time 10 pm to 7 am	0.3
	Daytime 7 am to 10 pm	2.0
Other occupied buildings	At all times	2.0

4.32 If the vibration amenity levels in Table E25.6.30.1 are exceeded then Rule E25.6.30(1)(b) allows vibration levels up to 5mm/s PPV being received between 7am and 6pm for no more than three days (for the project duration) provided that building occupants within 50m are advised at least three days prior to works commencing.

4.33 Tunnelling between shafts will be undertaken using a TBM. When the TBM is operating there is the potential for effects to be experienced within buildings,

specifically regenerated noise from vibrations in the ground. There is no regenerated noise limit in the AUP.

4.34 A regenerated noise level of 35dB LAeq(15min) has been adopted for the Project and represents a level at which low levels of annoyance may occur inside residential buildings.[7] This noise level has been implemented for other CI projects and represents a suitable assessment criterion for regenerated noise, including the potential effects on sleep quality. As the TBM is scheduled to operate during standard construction hours the criterion represents a conservative noise limit for assessing the potential effects irrespective of the hours when the TBM is likely to operate.

5. EXISTING ENVIRONMENT

5.1 The Project is located within Herne Bay, a predominantly residential suburb on the western fringe of the Auckland City Centre. Public open space in the Project area is present at Salisbury Reserve and Point Erin Park. Ponsonby School is located at 50 Curran Street, approximately 65m to the south of the proposed trunk sewer line. There are existing buildings between the school and nearest construction site (Shaft One) which help screen the school buildings (existing built form) from construction noise.

5.2 Residential receivers (buildings structures that are dwellings with occupants) are situated around all construction work areas of the Project. The majority of receivers are two storey high buildings, with a number of apartment blocks and three storey high buildings. A map of nearby properties that may potentially be affected by noise and/or vibration from the construction works along the road reserve are provided in Appendix B Figure 1 of the CNVA and listed in Appendix C Table 1 of the CNVA. The table identifies receivers located within an 80m radius of each shaft location and their associated distance from the nearest surface construction area. Buildings further than 80m away have not been assessed as there will be substantial noise screening from the intervening buildings.

5.3 With the removal of the fourth interception pipeline (within road reserves of Wairangi Street, Stack Street and River Terrace - EOP1019), 16 receivers,[8] as identified in paragraph [4.2] of my evidence, can be removed from the assessment as they are no longer predicted to experience noise or vibration levels above the Project's criteria from other construction activities. I have

7 World Health Organisation Guidelines for Community Noise (1999).

8 3 Wairangi Street and 11 Cremorne Street each have two buildings.

updated the number of affected receivers from the CNVA within my evidence. An updated total of 149 residential receivers (originally 165) was identified.

5.4 The main sources of existing noise are vehicles on local roads and noise generated by residential activities, which includes use of lawnmowers and DIY. Noise from traffic on State Highway 1 is audible on the eastern side of the Project area. Local ambient noise levels at the front of properties vary between 55 and 65dB during standard construction hours depending upon the level of traffic activity/time of day.

6. PROPOSED ACTIVITIES

6.1 The construction process is described in detail in the documents supporting the application, and in the updated construction methodology prepared by Mr Bishop and the traffic evidence of Mr Shields. Therefore, I do not go into detail here apart from to highlight the activities which have the potential to generate potentially measurable noise and vibration. As with any infrastructure Project, I expect that the construction methodology is likely to be refined prior to physical works commencing. However, I understand that any post-consent refinements can only "improve" on the noise and vibration levels presented in the CNVA (ie those refinements cannot result in an increase in effects).

6.2 Once operational, there will be no noise experienced at any of the receivers as the source of noise will be constrained within the confines of the tunnel. I have therefore only considered construction activities and their potential to generate noise and/or vibration.

6.3 The construction activities that I consider have the ability to generate noise and vibration effects include:

(a) **Secant piling** – the main noise source will be the secant piling rig as piles are drilled with an auger around the perimeter of each shaft. Secondary noise sources include the pouring of concrete and use of a crane when lowering pile cages. Unlike other forms of piling this is a low noise and vibration activity and does not produce impulsive noise like driven piling. Noise is only generated when the plant is operating. A source of noise is if the auger is shaken to remove the soil – this can create a couple of seconds of ‘clanking’ type noise. When the shafts are constructed, the noise will not be continuous and from experience on similar projects noise will only be generated for periods of 15 - 30 minutes at a time. As there will be no driven piling, minimal levels of vibration will be generated such that

cosmetic damage to structures is unlikely at distances greater than 5m.

(b) **Interception shaft construction –** a bored piling rig and vibro piling rig will be used to construct the interception shafts. The main source of noise will be the bored piling rig and the main vibration source will be the use of the vibro pile rig. The bored pile is used to drill the interception shafts and has similar characteristics and magnitudes of noise as secant piling. Only one pile is required per interception shaft. The vibro pile rig will be used for placing a temporary steel casing into the drilled interception shafts to stabilise the shaft. The use of the vibro pile rig is typically short in duration of 5 - 15 minutes at a time. The use of the vibro pile rig may generate vibration levels that could result in minor cosmetic damage at around 5m.

(c) **Cutting and breaking of paved surfaces** – to facilitate below ground structures – trenched pipelines and shafts, paved surfaces will be cut using concrete saws and then broken using either excavators fitted with percussive breakers or simply by lifting and breaking the asphalt surfaces into smaller pieces. These activities are relatively short in duration and will not occur continuously. Of all the construction activities that will take place, use of concrete saws will generate the highest sounds levels but only for short periods – eg typically 5 - 20 minutes at a time. Use of a breaker attachment on an excavator and ground compaction may generate vibration levels that could result in minor cosmetic damage at around 5m.

(d) **Tunnelling using a TBM** – once lowered in the thrust shafts there will be negligible noise created by the TBM. There will be surface noise from removal of the soil from the shaft. Depending on the type of TBM this may involve a pump to remove slurry or use of a crane to remove muck buckets. Noise generated by the TBM will only occur during standard construction hours. However, the TBM may be operated outside of standard hours for emergency purposes, for example if the TBM gets stuck or maintenance is required. The TBM will operate at a depth of between 3m and 17m below ground surface level with the shallowest depths between Shafts Six and Seven. Both ground vibration and regenerated noise from operation of the TBM has been calculated based on the geology of the area and the corresponding ground attenuation parameters.

(e) **Surface works** – open trenching will use excavators, and similar plant to remove/install material and small cranes to lower the pipelines. Pavement surfaces will be reinstated and will require compaction of fill and paving plant. All of these plant are relatively low noise and are typical of plant used for underground utility infrastructure works.

(f) **Heavy commercial vehicle movements** – noise will be generated by trucks driving to and from the work sites and manoeuvring within the CSAs. There are no noise standards for vehicles moving on roads controlled by Auckland Council or Auckland Transport. When construction vehicles operate within the work sites and when moving with the CSAs the Project's construction noise limits will be used to manage potential noise effects.

(g) **Miscellaneous plant** - dewatering plant for the shafts are likely to operate continuously. These pumps can be acoustically shielded/treated such that noise levels of less than 50dB can be expected at a distance of 10m from the operating unit. Hydro excavators will be required to operate when locating underground services. Hydrovacs will generate high noise levels (greater than 80dB at 10m) but will only operate when required.

6.4 Two CSAs are required for the Project; Salisbury Reserve (CSA1) for small stockpile and general support activities and at 94a - b Shelly Beach Road (CSA2) to support noisier activities such as secant piling support and main stockpiling. Mr Bishop's evidence provides details of each CSAs use and a revised land use plan for CSA1.[9] The CSA proposed at Salisbury Reserve has residential properties on all sides. Both sites will be fully fenced with site hoarding, which will provide noise screening to ground floor locations but not first floor locations. Main amenity areas typically located on the ground floor during the daytime will be screened from CSA activities by the site hoarding, providing a beneficial noise reduction.

6.5 CSA2 is located over 90m from the nearest receiver (Point Erin Swimming Pool) and over 180m from the nearest residential receiver. The distance alone mitigates noise associated with activities at this site.

6.6 I understand that this Project will be coordinated with the proposed CI extension at Point Erin to ensure construction works are scheduled so that at

9 Evidence of Mr Bishop dated 2 February 2024 at [4.17] – [4.28] and Attachment 1.

any given time, cumulative impacts from both projects are minimised. The CNVA[10] has however considered a worst-case scenario for cumulative impacts. I concluded that while there may be overlaps of both projects, any cumulative effects of noise can be managed and are likely to be negligible or less than minor.

6.7 The noise and vibration assessment has been based on data collected from similar projects and a construction methodology that has been supplied by a contractor. Noise modelling has used the commercially available SoundPLAN software and appropriate input data has been used (building locations, and, ground and building elevations). Based on this information I have a high degree of confidence in the accuracy of the noise level predictions. Vibration levels at different distances have been calculated using known ground attenuation relationships for the local area. Vibration levels are presented as a range as I acknowledge that there is a greater uncertainty when predicting vibration compared to noise. Nevertheless, I consider that the presented vibration levels are sufficiently conservative that when works take place, vibration levels are likely to be lower. A requirement of the draft CNVMP is that noise and vibration monitoring is undertaken to validate any assumptions and if appropriate, make any corrective actions, eg updated calculations.

7. CONSTRUCTION NOISE AND VIBRATIONS ASSESSMENT

7.1 In the CNVA and s92 responses I predicted and assessed noise and vibration compliance and potential effects from construction activities. My assessment looks at the construction works in three distinct parts:[11] surface works (shaft construction and open trenching),[12] construction support areas (at Salisbury Reserve and Shelly Beach Road)[13] and tunnelling (from Point Erin Park to Marine Parade).[14]

7.2 All surface works will be undertaken in the road reserve therefore there are no AUP limits which restrict noise generated by these works. Vibration on the other hand has to be managed such that vibration levels do not exceed the building damage limits of DIN 4150-3.

7.3 Although there are no AUP noise limits for surface works, this does not remove the contractor's responsibility to manage and mitigate potential adverse noise

10 CNVA Section 5.3.3.
11 CNVA Section 5.1.
12 CNVA Section 5.3.
13 CNVA Section 5.4.
14 CNVA Section 5.5.

effects. As planned noisy works will only be undertaken during standard construction hours the effects of construction noise have been assessed against possible disturbance of normal daytime residential activities. Therefore, the Project has adopted the noise limits of Table 3 of my evidence for all works irrespective of whether they occur inside or outside the road reserve.

7.4 My assessment of the CSA predicted noise levels assumes activities (ie truck movements for CSA1) take place along the boundary of the sites. This is the closest distance between the site activities and receivers, providing a worst case scenario. In reality, truck movements and activities will take place further in the site itself, increasing the actual distance and noise levels will likely be lower than presented.

Surface Works Noise Assessment

7.5 All shaft construction works are proposed to occur within the road reserve and 41 receivers[15] will experience noise during secant piling works greater the Project's 70dB LAeq limit. Noise levels during construction of the shafts will not be continuous and will vary as piling works move away from the closest point to each receiver. From my experience of observing construction activity, the highest noise levels will only occur for a relatively short period of time and intermittently during the works.

7.6 Six receivers (46 Argyle Street, 45 Argyle Street, 91 Sarsfield Street, 96 Sarsfield Street, 98 Sarsfield Street and 34 Herne Bay Road) are predicted to exceed 80dB LAeq with a maximum noise level of 84dB LAeq predicted at 46 Argyle Street, which is located less than 15m from piling works. Noise levels will vary during construction of the shafts (dependent on size and depth of shaft) and will not be at the maximum levels (indicating closest location to works) throughout the works.

7.7 It is estimated that a maximum duration of 112 days is required to construct the larger main shafts and 30 — 50 days for the smaller interception shafts.[16] Noisy works will not occur continuously throughout these periods and noise levels will reduce as works move around the work sites and away from the closest point to each receiver. From my experience of piling works for example, the highest noise levels are likely to occur for 1 - 2 days in total and thereafter noise levels will reduce as the location of activities change. During a typical piling day, noise may occur for a couple of hours when physical piling

15 CNVA Section 6.1.2.1 and Appendix C.

16 CNVA Table 2.2.

works take place. For the remainder of the time there is minimal noise prior to the commencement of the next pile.

7.8 Due to the height of the properties in Herne Bay (predominantly two storeys) noise from piling cannot be as effectively mitigated as for one storey properties, as 6m high barriers would be needed. Temporary noise barriers this high would be impracticable to construct and maintain. Therefore, management of piling noise via the Project's CNVMP will be required.

7.9 Open trenching and/or horizontal directional drilling ("**HDD**") is proposed for shallower pipe connections between the main shafts and local connection points. It has not been possible to use the less noisy HDD activity everywhere due to shallow depths of connections, geology and practicability.

7.10 For open trenching, 65 receivers (originally 80 receivers in CNVA[17]) are predicted to exceed 70dB LAeq. Four receivers (originally six receivers) (22 Marine Parade, 49 Marine Parade, 32 Sentinel Road and 34 Sentinel Road) are less than 10m from the nearest works and are predicted to experience noise levels above 85dB LAeq, with a maximum noise level of 87dB LAeq at 22 Marine Parade (originally 92dB LAeq at 8 Wairangi Street). Maximum noise levels may only occur for a relatively short period of 3 to 4 days and intermittently within the total duration of the works. Due to the height of the receivers, barriers will not provide effective screening at first floors.

7.11 The highest predicted noise level for HDD is 74dB LAeq at 96 and 98 Sarsfield Street. Four receivers (originally five receivers) are expected to experience levels above 70dB LAeq. Noise levels below 75dB are considered acceptable for the limited duration of works and effects will be reasonable and less than minor in magnitude.

7.12 An improvement to the number of affected receivers can be seen due to the removal of the fourth interception pipeline. Nearby receivers along Stack Street and Wallace Street will also experience reduced construction noise durations due to this change.

Construction Support Area noise

7.13 The CSAs will be used for site offices, storage of materials, plant and equipment. Currently, only CSA2 (Shelley Beach Road) will be used for secant piling support — pile cages will be stored and prepared at the CSA prior to installation within the pile bores at each shaft. At CSA2, noise effects

17 Numbers reduced due to the removal of the fourth pipeline as mentioned in paragraph [4.2] of my evidence.

are considered to be negligible due to the spatial distance to the nearest residential receiver (over 180m).

7.14 Since my CNVA was prepared, the CSA1 (Salisbury Reserve) area has been refined by Mr Bishop and a Revised Plan has been provided within his evidence at Attachment 1. I have identified that the revised site boundary proposed has moved away from the adjoining property boundaries by a minimum of 2m (up to 8m). My revised predictions indicate noise levels are reduced and can meet the noise limit of 70dB LAeq at all receivers with 2m site hoarding in place. The revised predictions are presented in Table 5 for the most affected receivers.

Table 5: Revised noise level predictions for CSA Salisbury Reserve

Address	**Distance from compound site boundary (m)**	**Predicted noise level at first floor level (LAeq, dB)**	**Predicted noise levels at ground floor level with screening (LAeq, dB)**
14 Argyle Street ^	7	72	64
4/40 Wallace Street	9	70	62
6 Argyle Street ^	9	70	62

^ one storey building (no first floor)

Traffic noise

7.15 In the CNVA I assessed and predicted the noise effects from construction traffic based on the anticipated numbers of vehicles movements (trucks and light vehicles) and the traffic routes. I relied on the assessment from Mr Shields in relation to anticipated vehicle movement and numbers.

7.16 I predicted less than a 1dB increase in road-traffic noise level due to the contribution to existing traffic flows by the Project. This is a negligible increase. Mr Shields has identified that there may be traffic generated outside of standard construction hours, especially when moving the TBM. In my experience, the movement of TBM transport is slow moving in nature and generates lower noise levels with careful handling. Resulting noise effects are likely to be minor and only for the periods that they occur. As such the noise

effects from out of hours movements will and can be managed by the CNVMP, ie by consulting with occupiers of nearby buildings.

Construction Vibration Assessment

7.17 Based on conservative assumptions, only three buildings (originally four in the CNVA – effects at 8 Wairangi Street have been removed[18]) have been identified as experiencing vibration levels greater than the vibration thresholds of DIN 4150-3 (listed in Table 6 below). At these levels, very minor cosmetic damage could occur, but structural damage is highly unlikely (refer to paragraphs [4.29] and [4.30]). From my involvement on projects for Kainga Ora's land development within Auckland, I have never encountered structural damage from vibration levels monitored significantly above the DIN 4150-3 limits with management controls in place.

7.18 For open trenching, a likely worst-case assessment has been undertaken based on an excavator with breaker attachment and hard ground geology. In the case of 1 Marine Parade, rather than open trenching being required, HDD is currently the preferred approach at this location. At the two historic properties, works associated with secant piling have been assumed.

7.19 At all of these properties, I have recommended that building condition surveys be undertaken and I describe what this process involves in paragraph [8.6].

Table 6: Predicted vibration levels

Address	Activity	Closest distance	PPV	DIN 4150-3 Limit
1 Marine Parade	HDD	~ 1 m	> 10 mm/s	5 mm/s
34 Herne Bay Road*	Shaft 5	~ 6 m	4 - 5 mm/s	3 mm/s
72 Argyle Street*	Shaft 4	~ 8 m	3 - 4 mm/s	3 mm/s

Note * - Historical / Sensitive

Tunnelling assessment

7.20 Operation of the TBM will generate ground vibration. The tunnel is located entirely below ground at depths typically between 9 and 17m for the majority of the alignment and reaches its shallowest points of 3m around Shaft Seven

18 Refer to paragraph [4.2] of this evidence.

and interception shaft SE04. The closest receiver (98 Sarsfield Street) is located approximately 4m horizontal distance from the tunnel near Shaft Two. A vibration level of around 1mm/s PPV is predicted, while this level of vibration may be perceived by building occupier it is well below the established thresholds known to cause minor cosmetic damage to buildings and other structures.

7.21 Regenerated noise within rooms may be audible within approximately 18m of the TBM and 99 buildings have been identified as experiencing a daytime noise level greater than 35dB LAeq. This criterion value is normally used to assess the potential for sleep disturbance effects if a TBM were to operate at night. In my assessment I concluded that noise from operation of the TBM is unlikely to be noticeable and hence cause little to no disturbance for normal daytime residential activities.

7.22 As the TBM will advance at 7 to 10m per day, maximum vibration and regenerated noise levels are likely be experienced for 1 to 2 days per receiver. I consider that the effects of tunnelling to be negligible to less than minor at all receivers.

8. MANAGEMENT AND MITIGATION OF CONSTRUCTION NOISE AND VIBRATION

8.1 The following measures are proposed to manage the potential effects of construction noise and vibration throughout the duration of the work:

(a) Implementation of an Auckland Council certified CNVMP (see discussion below).[19]

(b) Implementation of an Auckland Council certified Communications Plan.[20]

(c) A 1.8 – 2.0m high solid hoarding to be located around the perimeter of the CSA-1 at Salisbury Reserve. Stock piling activities are limited to the CSA-2 Shelley Beach Road.

(d) Construction of pile cages should only take place at CSA-2 Shelly Beach Road.

19 Proposed Condition 38.

20 Proposed Condition 6.

(e) Temporary noise barriers constructed from noise blankets are to be used around small plant such as HDD rigs and concrete sawing where practicable.

(f) Communication and consultation with the community shall be undertaken prior to works and as detailed in paragraph [8.4] of my evidence.

(g) Building survey to be undertaken as detailed in paragraph [8.5] and [8.6] of my evidence.

(h) Noise and vibration monitoring to be undertaken at the start of high noise and vibration activities to validate any assumptions, for justifiable complaints and properties identified in Table 6 (paragraph [8.7]).

I agree that these remedies will mitigate and avoid unnecessary noise and vibration impacts at receivers under the Best Practicable Option ("**BPO**").

Draft CNVMP

8.2 A draft CNVMP has been prepared and this management plan will be finalised by Watercare and its contractor prior to works commencing.

8.3 The purpose of the CNVMP is to identify best practice management and BPO for physical controls to avoid, remedy or mitigate any adverse noise and vibration effects. The draft CNVMP is based on the construction methodology adopted for my CNVA. For the reasons I have already explained, even if there is a slight change in the methodology it is unlikely that noise and/or vibration levels will change such that the effects of the Project need to be reassessed or enhanced mitigation implemented.

Communication and consultation

8.4 In my opinion, communication and consultation is the primary management practice for construction noise and vibration. With prior notification of when noisy works are likely to occur and the reasons for the works, people are more likely to be more accepting when works occur. Watercare has an established communications procedure and this will be documented in the Project's Communications Plan (required to be prepared by Proposed Condition 6). At a minimum, the following will be implemented and will form part of the CNVMP:

(a) Written communication to all building occupiers within 100m of the shaft sites at least 5 days prior to works commencing.

(b) Public site signage with contact details for the Project's communication liaison officer.

(c) Regular project updates.

(d) If any night works are anticipated then building occupiers within 100m of the works will be advised at least 5 days prior to the works commencing.

(e) If there are any complaints then a comprehensive investigation will be undertaken.

Building condition surveys

8.5 Building condition surveys will be offered to the owners of properties predicted to experience PPV levels greater than the lower DIN 4150-3 limits of 5mm/s for residential, and the two properties which are predicted to experience vibration over the 3mm/s DIN threshold for historic/sensitive building types (ie those properties in Table 6).

8.6 A building condition survey involves a suitably qualified and experienced person to visually inspect the building and any external structures such as retaining walls, concrete slabs and in ground pools to check for serviceability and signs of damage. Damage is defined as any cosmetic cracking of plasterboard internal linings, especially around door and window openings, hairline cracks on concrete surfaces, cracking along grout lines on tiled surfaces and any similar features on external surfaces. Observations are made by taking photographs and measuring the dimensions of any cosmetic damage. The opening and closing of doors and windows are also checked to assess vertical alignments. No invasive observations are made, ie within wall linings or below floor level structures such as pile supports. At the end of works a similar survey is undertaken of the same features and any change in the condition of the features is noted. If appropriate, remedial work will be undertaken by Watercare.

8.7 The magnitudes of the vibration levels I have calculated are worst case and are not sufficient to cause any other form of building damage such as structural failure of supporting structures. If damage were to occur, minor expansion of existing cracks may be likely. However, the main cause of cracking arises from expansion/contraction caused by temperature changes or changes in ground water as a result of seasonal changes and following

prolonged rain and/or drought. Mr Thomas in his evidence discusses the effects of dewatering and ground settlement on the buildings.[21]

8.8 Noise and vibration monitoring will be undertaken at the start of high noise and vibration activities to validate any assumptions used in my noise assessment, and when triggered by a justifiable complaint. Monitoring of vibration is recommended at the properties identified in Table 6 to demonstrate that vibration levels are being managed.

9. RESPONSE TO COUNCIL OFFICER'S REPORT

9.1 There have been three s92 requests from Council. All three matters were very minor and did not affect the assessment of noise and vibration effects.[22]

9.2 I have reviewed the section 42A report and the Council's specialist memo which relates to construction noise and vibration matters. Except in relation to Salisbury Reserve which I address below, I have no specific comments on the contents of the report or specialist memo. I note that the Council's specialist agrees with the predictions and effects assessments in the CNVA and considers that, subject to the proposed mitigation, the noise and vibration levels for the predicted durations are considered to be reasonable.

9.3 As set out on page 36 of the section 42A report, the proposed CSA at Salisbury Reserve will result in noise and vibration levels slightly (2dB) above the noise limit for an extended period of time compared to the rest of the Project. My assessment and the Council reports acknowledge that with the proposed mitigation, the predicted levels will not result in unreasonable adverse effects. However, as I have described above, since notification of the Application, Watercare has further refined its land use requirement at Salisbury Reserve. The Refined Plan is included in the evidence of Mr Bishop. I have provided a reassessment of noise effect for this in paragraph [7.14] of my evidence and have concluded a reduction to overall noise levels at all adjacent residential receivers. The predicted noise levels based on the revised plan for Salisbury Reserve can comply with the noise limit of 70dB LAeq at all receivers with site hoarding in place.

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21 Evidence of Mr Thomas dated 2 February 2024 at section 12.

22 These matters were 1- Document revision number of the CNVA required updating, 2- CNVMP description of tunnelling to be consistent with the CNVA' description (duration of tunnelling) and 3 – whether the CNVA needed updating having reviewed the submissions (outcome - no revision was required).

10. RESPONSE TO SUBMISSIONS

10.1 I have read the submissions received on the Project that express concerns relating to construction noise and/or vibration effects. I address each of these submissions individually below.

Herne Bay Residents' Association

10.2 The Herne Bay Residents Association's submission seeks that the Project's CNVMP must have community input.

10.3 The purpose of the CNVMP is to identify those activities which are likely to generate noise and vibration that requires management in order to mitigate and minimise any adverse effects. The CNVMP will also outline community consultation with surrounding affected residents in relation to the noise and vibration aspects of the Project. The CNVMP will be certified by Auckland Council prior to works commencing.

10.4 The Herne Bay Residents Association has not indicated what 'community input' involves and based on my experience, it would be highly unusual for a residents' association to be involved in the finalisation of a CNVMP. In my opinion it is unnecessary step and I do not recommend any amendments to the conditions of consent in response to this submission point.

Salisbury Reserve Residents' Group and 44 Wallace Street

10.5 The Salisbury Reserve Residents' Group and the owner of 44 Wallace Street raise concerns regarding the noise that will be generated from heavy construction vehicles accessing Salisbury Reserve. They consider that this will undermine the amenity provided by the relatively low ambient noise levels that are characteristic of the residential location.

10.6 As stated in Mr Bishop's evidence, Sailsbury Reserve (CSA1) is intended to be used for immediate support with main site offices, worker welfare facilities, storage of tools and small materials with staff parking.[23] These activities on site are typically not noisy and will be further shielded by the site boundary fence. Large construction truck movements will be concentrated at CSA2.

10.7 Mr Shield's evidence states there will be an increase of four to six vehicles movements per hour (during the 12 hour day) with construction traffic along the residential streets west and east of Salisbury Reserve.[24] This is a traffic

23 Evidence of Mr Bishop dated 2 February 2024 at [4.19].

24 Evidence of Mr Shields dated 2 February 2024 at [7.7].

movement increase of 2% - 13% due to construction. A change in traffic volume date by +25% or -25% only results in 1 dB change in predicted noise levels, which would be imperceptible.

10.8 Additional traffic will access the site during standard construction hours and activities on site will be managed via the CNVMP to minimise noise effects. Best practice management such as imposing speed limits, avoiding high engine revs and turning off engines when idling will be included. As such, I consider noise contribution from the additional traffic movements due to CSA1 to be negligible.

10.9 In my opinion heavy vehicle movements to and from CSA1 may be distinguishable from regular traffic but there will not be a significant increase to the current ambient noise levels.

37 Herne Bay

10.10 Ms Fong expresses concern regarding the potential for vibration induced damage to the building and outdoor structures (retaining walls and pools), from construction of the Project, specifically construction of EOP197 and Shaft Four.

10.11 The property is ~30m from EOP197 and ~40m from Shaft Four. Vibration levels of less than 2mm/s may occur during HDD activities and below 1mm/s during shaft construction. These activities will not be continuous and will not result in vibration induced damage to any structures at the property. In my opinion, there is no technical basis to monitor vibration or to conduct building condition surveys, as the potential for vibration effects at this property is negligible only.

99 Sarsfield Street

10.12 Marcus David and Yvonne Robinson have raised concerns regarding the potential for vibration to affect the building, swimming pool and garden improvements on the property.

10.13 At this property, it is predicted that there will be 2 to 3mm/s PPV during Interceptor shaft SE03 construction. These levels apply at the dwelling house and other structures. Vibration is predicted to be below building damage criteria and lower still at the swimming pool. As such, in my opinion there is no technical basis to monitor vibration or conduct building condition surveys at this property.

2 Stack Street

Noise

10.14 The owner of 2 Stack Street[25] (Malcolm Legget) raises concerns regarding the potential for significant construction noise at the property, which may disrupt the enjoyment of their home during construction.

10.15 Noise will be intermittent during shaft construction, which is programmed to take ~70 working days maximum. Worst case noise levels of around 76dB LAeq are predicted when piling takes place nearest the property. Noise will not be continuous throughout the programmed works and will only be for a small portion of the day when works are underway. Piling noise will reduce as works move away from this closest point.

10.16 For all other activities associated with the construction of Shaft Two, noise levels will be around 60dB or less. While there may be occasions when there will be some disturbance duration piling works this will occur for a short period of the day. An external level of 76dB would equate to approximately 50dB indoors with windows and doors closed, which is a level that would not affect residential amenity for the short periods when piling takes place.

10.17 The owners of this property will be consulted and provided with details when works are planned which is proposed to be a requirement of the final CNVMP.[26] Overall, I consider the potential effects on this submitter to be minor and do not recommend any changes to the Project as a result of this submission.

Vibration

10.18 The owner of 2 Stack Street also considers that it is unclear from the AEE and accompanying technical reports how much vibration will result during the construction of Shafts Two and Three.

10.19 Vibration is predicted to be ~1- 2mm/s PPV when Shaft Two is constructed, which is below the relevant criteria for building damage. Vibration levels during construction of Shaft Three will be less than 1mm/s PPV.

10.20 As such, in my opinion, there is no technical basis to monitor vibration or conduct building condition surveys at this property.

25 Identified as 54 Wallace Street in the CNVA.

26 Proposed Condition 38.

92, 94, 96, 98 Sarsfield Street

Vibration

10.21 The owners of the properties at 92, 94, 96 and 98 Sarsfield Street collectively raise concerns regarding the potential for construction vibration to adversely affect the building on the corner of Sarsfield and Wallace Streets. I am aware that the relevant building is 97 years old, with clay brick and cavity wall construction. However, I do not consider it to be a construction type that is particularly sensitive to damage as in my experience brick and mortar structures are generally more resistive to small vibrations than wooden structures.

10.22 During construction of Shaft Two, vibration levels are predicted to vary between 1 and 3mm/s PPV. It is possible that vibration levels at 98 Sarsfield Street may reach 4mm/s at the nearest point to the works. These vibration levels are below the building damage thresholds of DIN 4150-3.

10.23 In my opinion, there is no technical basis to monitor vibration or conduct building condition surveys at this property. However, following the s92 requests, I note that a structural survey has been undertaken at these properties (including 51 Wallace Street) as presented in Mr Clarke's evidence. Mr Clarke has identified the predicted vibration levels will not affect the structural stability of these buildings, but notes there is the potential for cosmetic damage to result.[27] Watercare is offering pre- and post-condition surveys to the owners of the properties and the CNVMP will be updated to include these properties for survey.

Noise

10.24 Some of these submitters have also expressed concern in relation to construction noise impacts at the property.[28] The submitters note that the building is two-storey, and so they consider the noise will be far worse than that for a single-storey structure.

10.25 As I have described the Herne Bay noise model included the number of assumed floors at paragraph [4.15] in my evidence. Therefore, the calculated noise levels reflect the number of storeys at the property. Worst case external noise levels at these properties are predicted to range from 70 to 83dB depending upon the proximity to the piling works during shaft construction.

27 Evidence of Mr Clarke dated 2 February 2024 at [1.4] - [1.5].

28 Submission from Paul Vujcich of 96 Sarsfield Street, Herne Bay; Submission from Alastair McLaren of 92 Sarsfield Street, Herne Bay;

Noise will not be continuous and only occur for short periods of the day. These levels would equate to approximately 45 to 58dB indoors with windows and doors closed. Noise levels at the upper end of this range may affect residential amenity for the short periods when piling takes place. The owners of these properties will be consulted and provided with details when works are planned, which is a requirement of the CNVMP.

10.26 98 Sarsfield Street is the closest to the piling works and predicted to experience noise and vibration levels at the higher end of the range stated above. Additional communication and consultation will be implemented to understand the occupancy status of the property for mitigating potential effects during occupancy. This will be managed via the CNVMP.

10.27 Overall, I consider the potential noise effects on these submitters to be minor and can be managed via the CNVMP. I do not recommend any changes to the Project as a result of the submissions from these landowners.

9 Argyle Street

10.28 The owner of 9 Argyle Street (Gary Lane) opposes the use of Salisbury Reserve (CSA1) as a construction support area and considers, based on the CNVA, that compliance with the relevant noise standards of the AUP will not be achieved. In particular, the submitter considers that the Salisbury Reserve area is a staging area only, rather than a location that construction is actually taking place. As such, the submitter alleges that the more restrictive zone-based noise standard in rule E25.6.18 should be used.

10.29 The CSA1 is a temporary construction site and the construction noise standards of the AUP apply. At 9 Argyle Street, a maximum predicted noise level of 70dB is predicted from construction of Shaft Three. Noise from the CSA will be much lower at this property (50 - 55dB when activities take place). There will be no significant loss of residential amenity at this property due to the works.

33 Wallace Street

10.30 The owner of 33 Wallace Street (Rowena Joan Roberts) expresses concern regarding the potential for damage to their property arising from construction of the Project. I assume that the submitter is concerned with the potential for vibration effects to cause damage to the property.

10.31 Vibration from the nearest works (Shaft Three) will be less than 1mm/s PPV and building damage due to vibration is highly unlikely.

51 Wallace Street

10.32 The owner of 51 Wallace Street (Helene Brownlee) also expresses concern regarding the potential for damage to that property arising from vibration effects during construction of the Project. The property is part of the 92, 94, 96, 98 Sarsfield Street building.

10.33 It is possible that vibration levels at 51 Wallace Street may reach 4mm/s when piling works take place closest to the property. These vibration levels are below the building damage thresholds of DIN 4150-3. This is also supported by the evidence of Mr Clarke, who has concluded that there is the potential for cosmetic damage to result from the predicted settlement levels (not from vibration).[29]

10.34 In my opinion there is no technical basis to monitor vibration or conduct building condition surveys at this property. However, a structural survey was carried out at 51 Wallace along with 92, 94, 96, 98 Sarsfield Street, in response to the s92 request by Mr Clarke. As noted in paragraph [10.23] of my evidence, Watercare has offered pre- and post-condition surveys for this property and this will be updated within the CNVMP.

11. CONDITIONS

11.1 Proposed Conditions of consent are appended to the planning evidence of Ms Drury. I have provided input into these proposed conditions relevant to noise and vibration, which are detailed below. I consider that these conditions and those which relate to the hours of working are appropriate to manage the effects from construction noise and vibration.

29 Evidence of Mr Clarke dated 2 February 2024 at [1.4] - [1.5].

11.2 I note the following for the proposed conditions of consent found in attachment 5 of the s42a report:

(a) Condition 41 to 43 relates to Activity Specific Construction Noise and Vibration Management Plan ("**ASCNVMP**"). In my opinion, it is more efficient to include the activity specific predicted noise levels and identified receivers within the CNVMP itself without the need to replicate sections within a separate document. A section within the CNVMP will achieve the same result. As currently drafted, the Proposed Conditions would not prevent this approach.

(b) Condition 44 relates to vibration limits at specified addresses. With the removal of the fourth pipeline, effects are no longer applicable for 8 Wairangi Street. This address does not need to be included.

12. CONCLUSION

12.1 In my opinion the construction works associated with this Project are routine activities for large scale infrastructure works. I consider that any construction noise and vibration effects can be appropriately managed and mitigated through the implementation of the CNVMP. I therefore consider that the resource consents being sought by Watercare for the Project should be approved.

Sharon Yu-Cin Yung
2 February 2024