

Before the Hearings Commissioners at Christchurch City Council

under: the Resource Management Act 1991

in the matter of: an application by Ryman Healthcare Limited for resource consent to establish and operate a comprehensive care retirement village at 100-104 Park Terrace and 20 Dorset Street, and 78 Park Terrace, Christchurch

between: **Ryman Healthcare Limited**
Applicant

and: **Christchurch City Council**
Consent Authority

Statement of evidence of **Siiri Wilkening** on behalf of Ryman Healthcare Limited

Dated: 6 January 2021

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STATEMENT OF EVIDENCE OF SIIRI WILKENING ON BEHALF OF RYMAN HEALTHCARE LIMITED

INTRODUCTION

- 1 My full name is Siiri Wilkening.
- 2 I am an acoustic engineer employed by Marshall Day Acoustics Limited (*MDA*). I have more than 23 years' experience in acoustic engineering in Germany and New Zealand, specialising in environmental noise control and computer noise modelling. I hold a Master's degree in Environmental Engineering (Land Improvement and Environmental Protection) from the University of Rostock, Germany. I am a full Member of the Acoustical Society of New Zealand, and have been the Society's secretary (2000 to 2008) and treasurer (2012 to now).
- 3 Over the last 22 years, in New Zealand, I have been involved in investigating and reporting on environmental noise and vibration effects for a wide range of projects, including in relation to road, rail, ports, quarries, urban development and construction, industrial and power generation activities and educational facilities.
- 4 I have given evidence at council hearings, the Environment Court, the Arbitration Court and before five Boards of Inquiry. I have also taken part in Environment Court mediations.
- 5 I am familiar with Ryman Healthcare Limited's (*Ryman*) resource consent application to construct and operate a comprehensive care retirement village (*Proposed Village*) at 100-104 Park Terrace and 20 Dorset Street and 78 Park Terrace, Christchurch (*Site*). In this statement of evidence, I describe the parcel of land at 78 Park Terrace as the "Peterborough Site" and the parcel of land at 100 104 Park Terrace and 20 Dorset Street as the "Bishopspark Site". I refer to the Peterborough Site and Bishopspark Site together as the "Sites".
- 6 I conducted a virtual site visit on 14 December 2020 with the assistance of my colleague. I have been unable to complete a site visit in-person due to a family emergency that required me to travel overseas and quarantine requirements.

CODE OF CONDUCT

- 7 Although these proceedings are not before the Environment Court, I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note (2014), and I agree to comply with it as if these proceedings were before the Court. My qualifications as an expert are set out above. This evidence is within my area of expertise, except where I state that I am relying upon the specified evidence of another person. I have not omitted

to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

- 8 My evidence sets out the following:
 - 8.1 An assessment of the noise and vibration effects arising from the construction of the Proposed Village;
 - 8.2 An assessment of the noise and vibration effects arising from the operation of the Proposed Village;
 - 8.3 My responses to the noise and vibration issues raised in submissions on the Proposed Village;
 - 8.4 My response to the noise and vibration issues raised in the Council Officer's Report and particularly the accompanying Environmental Health Report prepared by Ms Isobel Stout, Environmental Health Officer (acknowledging that Ms Yvonne McDonald also makes some general comments regarding construction noise);
 - 8.5 My comments on the draft conditions; and
 - 8.6 My conclusions.

SUMMARY OF EVIDENCE

- 9 I have assessed construction noise and vibration, and operational noise, from the Site.
- 10 I have recommended the use of perimeter and movable site barriers where effective, and the use of low noise construction methodologies such as drilled piling rather than vibratory or impact piling.
- 11 I predict that construction vibration can comply with what I consider are acceptable vibration limits at all times, and that vibration levels will be low throughout the construction duration.
- 12 Construction noise can generally comply with the relevant limits. Some activities have the potential to exceed those limits for brief periods, when high noise works occur in close proximity to multi storey neighbouring buildings that cannot be shielded by barriers. Such exceedances would occur for only a few days for each building as construction of the piles moves along the perimeter. I consider the construction noise effects can be managed in accordance with the best practicable option through preparation and implementation of a Construction Noise and Vibration Management Plan (CNVMP).

- 13 I have assessed operational noise from the Site in relation to site traffic and mechanical plant. I predict that operational noise levels from the Site can comply with the relevant District Plan limits at all times.
- 14 I have reviewed the submissions received in relation to noise and vibration and have responded to all matters raised by submitters.
- 15 I have also reviewed the Council Officer's Report and accompanying Environmental Health Report. Both reports recommend conditions that reflect my assessment.
- 16 I consider that, with appropriate management and design as recommended in my evidence, the Site can be constructed and operated within reasonable noise and vibration levels.

CONSTRUCTION NOISE AND VIBRATION ASSESSMENT

Performance Standards

Noise

- 17 Rule 6.1.6.1.1(P2) of the Christchurch District Plan (*District Plan*) sets out construction noise standards. The rule requires compliance with the noise limits of Tables 2 and 3 of NZS 6803:1999 Acoustics – Construction Noise.
- 18 The Proposed Village has an overall construction period of up to 4 years for both the Peterborough Site and the Bishopspark Site. Accordingly, the long duration noise limits apply. Table 1 below shows the noise limits that apply to the construction of the Proposed Village.

Table 1: NZS 6803 long duration limits

Time of week	Time period	Long-term duration	
Residential receivers			
		dB LAeq	dB LAFmax
Monday to Friday	6.30am – 7.30am	55	75
	7.30am – 6.00pm	70	85
	6.00pm – 8.00pm	65	80
Saturday	7.30am – 6.00pm	70	85
At all other times		45	75
Industrial and commercial receivers			
All days of the year	7.30am – 6.00pm	70	-
	6.00pm – 7.30am	75	-

- 19 The noise limit that applies during the morning shoulder period (6.30am-7.30am) generally prevents noisy construction works

taking place at that time. However, toolbox and safety meetings and similar low noise activities could occur in the morning shoulder period while complying with the noise limit. I have therefore assumed that noisier works will not commence until 7.30am.

- 20 The noise limits apply at 1 m from the most exposed façade of any building surrounding the Site.

Vibration

- 21 The District Plan does not contain vibration limits that apply to construction as a whole. The only reference to vibration is in relation to land repair works in Section 5.4.4.1 and compaction during earthworks in Section 8.9.2.1. These provisions discuss DIN 4150-2:1999 "Structural Vibration – Part 2: Human Exposure to Vibration in Buildings". This standard is not widely used in New Zealand, especially in relation to construction vibration.
- 22 For the assessment of construction vibration, I consider the most widely used standard is DIN 4150-3:1999 "Structural Vibration – Part 3: Effects of Vibration on Structures". This standard sets criteria that ensure that no building damage, including no cosmetic damage such as cracking plaster, is caused by construction vibration. DIN 4150 states "*Experience has shown that if these values are complied with, damage will not occur*". I consider this standard is the most appropriate to use for the purpose of assessing potential vibration effects of the construction of the Proposed Village.
- 23 The relevant limits for dwellings and commercial buildings with residential fitout (e.g. gib lined walls) are set out in Table 2 below.

Table 2: Vibration limits avoiding all building damage

Type of Structure	Short-term vibration				Long-term vibration ¹
	PPV at the foundation at a frequency of			PPV at horizontal plane of highest floor	PPV at horizontal plane of highest floor
	1-10Hz (mm/s)	10-50Hz (mm/s)	50-100Hz (mm/s)	(mm/s)	(mm/s)
Residential	5	5 – 15	15 – 20	15	5

Note:

- 1 Short-term vibration is defined as "vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated". Long-term vibration is defined as all other vibration types not covered by the short-term vibration definition.

- 24 The definition of short and long-term vibration does not relate to the duration of the works, but to the potential for vibration to generate resonance in a neighbouring structure. Therefore, both vibration limits are relevant for the works on the Sites. For instance, drilled piles may cause long-term vibration, while excavator use would cause short-term vibration.

- 25 In addition to the vibration limits relating to the avoidance of building damage, I recommend that potential vibration effects on neighbours' amenity is assessed. Where a vibration level of more than 1 mm/s PPV is predicted from the proposed works, vibration will likely be noticeable and may have some amenity effect. This limit is taken from British Standard BS5228-2:2009 "Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration" and has been applied for other construction sites in New Zealand.

Construction Stages

- 26 The following description of the construction stages for the Proposed Village is based on information provided to me by Ryman's construction team.
- 27 Both Sites have been cleared of previous buildings already, so no above ground demolition is required as part of the construction of the Proposed Village. The ground floor slabs of the previous building need to be removed at the Bishopspark Site, and the existing piles from the previous buildings at the Peterborough Site need to be removed to basement level height.
- 28 The construction of the Proposed Village buildings on both Sites will follow a similar methodology, and will use similar equipment.
- 29 The construction can be divided into the following stages:
- 29.1 Basement construction, including the removal of the ground floor slab (at Bishopspark Site), removal/shortening of the piles (at Peterborough Site), new piling and excavation;
 - 29.2 Building construction and fitout; and
 - 29.3 Landscaping and Site completion.
- 30 I discuss each construction stage in more detail below.

Basement construction

- 31 At the Bishopspark Site, the existing ground floor slabs from the previous buildings will need to be removed. This work will likely be done with a concrete saw and excavator. At the Peterborough Site, the piles of the previous buildings will need to be shortened to basement level, following excavation. This work will likely be done with concrete saws and nibblers (an excavator with a shear attachment).
- 32 The basement extent will be surrounded by bored piles (clutch tubes). The piles will, once installed, form a water impermeable barrier to the basement. The piling duration for the Bishopspark Site will be approximately 80 days, and for the Peterborough Site will be approximately 45 days. Following the installation of the

piles, the basements will be excavated and dewatered. The basement depth will be 4.5 metres.

- 33 The excavation of the basement will be undertaken from ground level down. Accordingly, a 2.4 metre site fence at the Site boundary (where no equivalent barrier already exists) will be effective in shielding the lower floors of all neighbouring buildings from excavation noise. In addition, the excavator can be located away from the boundary and the excavator arm can add distance between the noise source and the neighbouring buildings. These assumptions have been taken into account in the noise modelling discussed below.
- 34 Concrete saws are relatively small items of equipment that can be easily shielded with movable barriers or enclosures where this may be required to achieve compliance with the limits. Therefore, I predict that compliance with the relevant noise limits will be achieved at all times that concrete saws are used.

Building construction and fitout

- 35 Building construction will involve two tower cranes on each of the Sites, trucks and low loaders. The building construction will consist of precast concrete panels that are produced off-site and then assembled on-site. Hand tools and similar smaller equipment will likely also be required. I expect that with appropriate site management, as discussed in paragraphs 54-568, the noise levels from this construction stage can comply with the relevant limits.
- 36 Fitout works are done internally within the Proposed Village buildings, and will not result in high noise levels at neighbouring properties.

Landscaping and Site completion

- 37 Completion of the Proposed Village will involve footpath and driveway construction, and planting. Most of these activities are low noise and vibration generating. The use of plate compactors for footpath construction may generate high noise levels. However, given that the entire Site will have a permanent site fence installed and most paths are away from the boundaries, I expect that these works will comply with the relevant noise limits.

Construction noise assessment

- 38 I consider the basement construction stage will generate the highest noise and vibration levels. I expect all other construction stages will comply with the relevant noise limits for the reasons set out above. Accordingly, I undertook noise modelling for the relevant works associated with the basement construction stage.

Computer noise modelling

- 39 I have predicted noise levels from the highest noise generating equipment expected on both Sites. These are a bored piling rig at

the closest position to the boundaries, and an excavator in relevant locations.

- 40 I prepared a computer noise model in the international software SoundPLAN, which utilises the predictions methods of ISO9613. The model is based on three-dimensional information of the terrain and buildings, and aerial photography.¹ I observed the approximate height of each building surrounding the Sites on Google StreetView, and entered the height and number of floors of each building manually into the model. Each of the noise sources described in paragraph 39 above was placed into the model. The sound power levels for the piling rig and the excavator were taken from British Standard BS5228-1:2009 and confirmed against data measured by MDA.
- 41 The excavator will operate at and below ground level, and therefore, a barrier will provide noise shielding for lower floors.
- 42 I have therefore included a 2.4m barrier surrounding the Site (where there are no effective existing barriers) in the modelling. I discuss the noise barriers later in my evidence.
- 43 The main noise source of the piling rig is the diesel engine, which is at a height of approximately 2 metres. In addition, most receivers around the Site are multi-storey, so noise barriers will not provide effective mitigation for some floors. Nevertheless, I recommend using absorptive noise shields behind the piling rig engines to reduce noise generation and have included them in my predictions in addition to the site barrier.²

Predicted noise levels – Basement construction

- 44 As noted above, the basement construction stage will generate the highest noise and vibration levels. Based on my predictions, only piling has the potential to exceed the daytime noise limit of 70 dB L_{Aeq} at some limited locations and times, as discussed below. The excavation works will comply with the relevant noise limits at all locations and times.

Piling works

- 45 For the Peterborough Site, the piling noise levels are predicted to exceed the 70 dB L_{Aeq} daytime noise limit as follows:

45.1 13 Peterborough Street – 76 dB L_{Aeq} ;

45.2 76 Park Terrace – 74 dB L_{Aeq} .

¹ Obtained from Koordinates.com

² Possible barrier options include the H2 Acoustic Barrier by Echo Barrier.

- 46 For the Bishopspark Site, the piling noise levels are predicted to exceed the 70 dB L_{Aeq} daytime noise limit as follows:
- 46.1 145 Victoria St (commercial) – 77 dB L_{Aeq} ;
- 46.2 110C Park Tce and 131 Victoria St (commercial) – 75 dB L_{Aeq} ;
- 46.3 108 Park Tce – 74 dB L_{Aeq} ;
- 46.4 149 Victoria St (commercial) – 71 dB L_{Aeq} .
- 47 These are the highest predicted noise levels and will generally only be experienced at the higher floor levels of these neighbouring buildings that face the Sites and will not be shielded by the proposed site barrier.
- 48 At all other buildings, I predict the piling works will comply with the relevant noise limit of 70 dB L_{Aeq} .
- 49 The predicted noise levels set out in paragraphs 45-46 will only occur when the piling rig operates immediately outside these buildings. I understand that the piling rig moves at approximately 5 metres per day. Based on this speed, I predict that the highest noise levels will be experienced for no more than four days at each receiver.
- 50 I have prepared a figure showing the highest predicted noise levels for each of the surrounding buildings from the various pile rig locations on the Site. I have attached the figure as **Annex A** to my evidence.
- Excavation works*
- 51 Based on the modelling, I predict the excavation works will comply with the relevant noise limit at all receivers at all times, provided good site management measures are implemented.
- 52 I predict the noise levels from the excavation works will be up to 70 dB L_{Aeq} at the higher floors of buildings overlooking the Site, when works are closest to the buildings. Since the Sites are large, and the excavation works will move around the Site, I expect these highest noise levels from excavation will not extend beyond two to three days per receiver.
- 53 I have prepared a figure showing the highest predicted noise levels for each of the surrounding buildings from the various excavator locations on the Site. I have attached the figure as **Annex B** to my evidence.
- Predicted noise levels - Building construction and fitout***
- 54 I understand that two tower cranes will be used for each of the Sites. I recommend that the tower cranes are located as far away

from neighbouring buildings as practicable. Provided the cranes are well maintained and located away from neighbouring buildings as far as practicable, I consider the noise from building construction will comply with the relevant 70 dB L_{Aeq} noise limit at all neighbouring buildings.

- 55 It may be necessary to deliver the cranes either at night or on a weekend to avoid traffic disruption. The Sunday and night-time noise limits are significantly lower than normal construction noise limits. It is unlikely that such deliveries could comply with these limits. However, this noise will be infrequent and for a short duration. I consider that any effects from this delivery noise can be managed by communication and consultation with neighbours.
- 56 Trucks and low loaders will be required to deliver the precast panels. I expect that these deliveries will occur during daytime Monday to Saturday. I predict the noise levels from these deliveries will comply with the relevant noise limits at all times.
- 57 Hand tools will be used during the construction of the buildings. These are generally small and can be shielded to reduce noise levels to neighbouring sites. Provided there is considerate use of these plant items, I predict that compliance with the daytime noise limits can be achieved at all times.
- 58 As discussed above, building fitout works do not include any high noise inducing activities, and will comply with the relevant noise limits at all times.

Predicted noise levels – Landscaping and site completion

- 59 As discussed above, building fitout and landscaping and site completion do not include any high noise inducing activities, and will comply with the relevant noise limits at all times.

Construction noise levels and responses

- 60 People react to construction noise irrespective of compliance with the relevant noise limits being achieved. Generally, the construction noise limits allow for noise levels outside a building that are higher than would be appropriate for ongoing noise. When construction is reaching these levels, people may not want to spend time outside.
- 61 Because of this reaction, people would generally experience construction noise inside a building, with doors and windows closed. A typical New Zealand building achieves a noise level reduction of at least 20 to 25 decibels, therefore, a noise limit of 70 dB L_{Aeq} will translate to an internal noise level around 45 to 50 dB L_{Aeq} . I consider internal noise levels up to 55 dB L_{Aeq} can be accepted for limited periods in office environments. Depending on the internal noise level, in a residential environment, people may react by turning the TV or radio up or moving to a quieter part of the house.

- 62 The highest noise levels I have predicted are up to 76 dB L_{Aeq} at a dwelling and 77 dB L_{Aeq} at commercial premises. These external noise levels would equate to internal noise levels of approximately 51 to 57 dB L_{Aeq} . For the brief periods when such high noise levels may occur, it is likely that people will seek respite by moving to a part of the building away from the Proposed Village works. However, as noted in paragraphs 45-46 above, I predict highest noise levels for only about four days per building, before the piling rig has to be moved to a new location and is at a distance that means compliance with the limits is expected to be achieved.
- 63 Overall, for most of the four year construction duration on both Sites together, noise levels in buildings adjacent to the Site will not adversely affect residential or commercial activities. There will be some amenity effects on neighbouring properties for a very short period during the basement piling works.
- 64 I discuss mitigation of the noise effects from the Proposed Village construction works below.

Construction vibration assessment

Predicted vibration levels

- 65 I have predicted vibration levels from the construction of the Proposed Village based on vibration surveys previously undertaken by MDA across different ground conditions, and vibration levels set out in the relevant standards as referenced in paragraph 22. The predictions include a 100% safety margin, i.e. the "safe distance" predicted is doubled to ensure a conservative approach.
- 66 Bored piling causes very little vibration. I consider the amenity limit of 1 mm/s PPV is able to be achieved at distances of 3 to 4 metres, and the building damage limit will be complied with at distances of less than 1 metre. Based on the Proposed Village drawings, there are no neighbouring buildings within those distances. I therefore predict that the bored piling works will comply with the recommended amenity and building damage vibration limits at both Sites.
- 67 Excavation can cause vibration exceeding the 1 mm/s PPV amenity limit at 10 to 15 metres in uninterrupted ground. However, the pile wall will have been installed around the Sites' perimeters prior to excavation commencing, and it will form an effective vibration barrier. I therefore predict that the amenity vibration limit will be generally complied with during excavation works at both Sites. The building damage limit would be complied with at 4 metres distance in uninterrupted ground, and therefore compliance can be achieved at both Sites at all times.
- 68 For all other construction works, I predict that vibration levels will be less than 1 mm/s PPV.

Construction vibration levels and responses

- 69 As discussed above, I predict that the vast majority of works will produce vibration levels less than 1 mm/s PPV. This is a low level of vibration that, while perceptible, should not cause undue disturbance.
- 70 Vibration levels at 1 mm/s PPV in residential environments are likely to cause complaint but can be accepted if prior warning and explanation has been given to residents. As discussed above, I do not expect a vibration level of 1 mm/s PPV will be reached for most neighbouring buildings of the Sites. Overall, I consider that vibration from the Proposed Village works will be reasonable in a residential context.

Mitigation and Management

- 71 I recommend that a CNVMP is prepared and implemented to manage the potential noise and vibration effects of the construction works. The CNVMP will include details on the noise and vibration limits, construction staging, methodology and equipment, predicted noise and vibration levels, and details of the mitigation measures to be employed on the Site. It will also include procedures for communication, consultation and complaints responses. In my opinion, ongoing communication with neighbours is one of the most important and effective management measures in relation to noise and vibration effects.
- 72 I also recommend that the following mitigation measures are implemented. These measures will ensure the best practicable option is adopted so that noise does not exceed a reasonable level.

Temporary noise barriers

- 73 I recommend the use of temporary barriers around the perimeter of the Sites. The panels of these barriers should be constructed from materials with a minimum surface mass of 6.5 kg/m². Suitable panels include 12 mm plywood or the following proprietary 'noise curtains':
- 73.1 Duraflex 'Noise Control Barrier - Performance Series';
- 73.2 Soundex 'Acoustic Curtain - Performance Series'; or
- 73.3 Flexshield 'Sonic Curtain with 4 kg/m² mass loaded vinyl backing'; or
- 73.4 Echo Barrier H2 Acoustic Barrier (6 kg/m²).
- 74 Alternative noise barriers should be approved by a suitably qualified acoustic specialist because some proprietary noise curtains have insufficient surface mass for general use.

- 75 I consider the panels should be a minimum height of 2.4 m. The panels should be abutted or overlapped to provide a continuous screen without gaps at the bottom or sides of the panels.
- 76 I also consider the panels should be positioned as close as practicable to the noisy construction activity to block the line-of-sight between the activity and noise sensitive receivers. Where the panels are positioned on the Site boundary, additional local barriers should be considered near the activity to ensure effective mitigation for sensitive receivers on upper floor levels of neighbouring buildings. Such temporary noise barriers may be used for the piling rig engine (refer paragraph 43), concrete saws (refer paragraph 34) and other smaller equipment around the site.

Permanent fences

- 77 Ryman proposes to construct permanent boundary fences for the Proposed Village. These fences could be installed early during the construction period to provide noise mitigation. In order to reduce operational noise levels from the Site (discussed later in my evidence), these fences must be constructed from materials with a minimum surface mass of 10 kg/m², such as 18 mm plywood or equivalent.

Site management

- 78 I recommend the following good site management practices in order to manage noise and vibration levels:
- 78.1 Excavator operators undertake an induction where they are trained on good practice site noise mitigation measures such as setting the bucket down carefully and not hitting the ground or the pile wall;
- 78.2 All equipment that will be used on the Site for an extended period, has broadband warning devices rather than tonal reversing alarms. Many construction sites have already updated their equipment to remove tonal reversing or mobility alarms. The reduced noise levels and tonality will reduce annoyance of neighbours; and
- 78.3 Equipment is placed in the most appropriate location to reduce noise levels, where practicable. This would include the placement of the tower cranes as much as practicable in the centre of the Sites, and excavators are located away from the boundary to provide extra distance to neighbouring buildings.

Consultation and communication

- 79 I recommend that neighbours are informed of the potential for vibration inducing works that will likely be noticeable in a residential setting, such as excavation works and piling. The communication should include comment that people can feel

vibration at a magnitude below that necessary to cause any (including superficial) damage to buildings.

- 80 Communication with affected neighbours should also be undertaken prior to infrequent events such as night-time crane deliveries, and prior to commencement of identified high noise activities such as piling.
- 81 The consultation and communication would establish if there are neighbours with particular sensitivities that could practicably be responded to, and establish a good working relationship with neighbours.

Conclusion

- 82 Overall, I consider that with appropriate site management and mitigation, the construction works at both Sites can be undertaken in general compliance with the relevant noise and vibration limits and will not cause unreasonable noise and vibration effects.

OPERATIONAL NOISE ASSESSMENT

Performance Standards

- 83 Rule 6.1.5.2.2 of the District Plan sets out the relevant operational noise standards.
- 84 The noise limits at any Category 3 residential sites are 55 dB L_{Aeq} and 85 dB L_{Amax} from 7am to 11pm, and 45 dB L_{Aeq} and 75 dB L_{Amax} from 11pm to 7am. The noise limits at any Category 2 Victoria Street sites (adjacent to the Bishopspark Site) are 55 dB L_{Aeq} and 85 dB L_{Amax} from 7am to 11pm, and 50 dB L_{Aeq} and 75 dB L_{Amax} from 11pm to 7am.

Noise generating activities on site

- 85 Operational noise from the Proposed Village will include:

85.1 Mechanical plant;

85.2 Noise emissions from on-site vehicle movements; and

85.3 Rubbish collection points.

Mechanical plant

- 86 I understand the mechanical plant for the Sites will likely involve roof mounted units for outdoor air conditioning units for the residential units, the pool pump for the indoor swimming pool and the emergency generators for each of the Sites, which will be located in the basement. Air conditioning has the potential to operate 24 hours per day, 7 days per week. Therefore, the design will need to ensure that the most stringent (night-time) noise criterion of 45 dB L_{Aeq} is complied with.

- 87 In my experience, mechanical plant can be designed to comply with the applicable noise limits. Design measures to ensure compliance may include:
- 87.1 Locating plant away from property boundaries;
 - 87.2 Selecting low-noise plant options;
 - 87.3 Incorporating other mitigation measures such as barriers and enclosures; and
 - 87.4 Imposing load controls at night.
- 88 The emergency generator will be well shielded in the basement, and any test runs will be undertaken during the daytime, Monday to Friday only. I consider that the location of the emergency generators is appropriate to ensure there are no adverse noise effects on neighbouring sites.

On-site vehicle movements

- 89 The driveways of both Sites are adjacent to residential boundaries. Since the car parking will be in the basement, the driveways will descend quickly to a lower level. The proposed boundary fence around the Sites' perimeters will provide effective shielding for any neighbouring sites, especially once the driveway is lower than the natural ground level.
- 90 I understand that written approval has been obtained from the residents at 90 Park Terrace, which abuts the driveway into the Bishopspark Site. There is no further dwelling in the vicinity of this Site's driveway, and therefore I have not addressed vehicle noise in relation to the Bishopspark Site further.
- 91 I have predicted the noise levels from vehicles on site for the most exposed neighbouring dwellings for the Peterborough Site. These are 76 Park Terrace and 18 Salisbury Street.
- 92 Adjacent to the Park Terrace entrance, visitor parking is allowed for along the boundary with 76 Park Terrace. This area will be well shielded by the proposed boundary fence. Accordingly, I consider the noise level will comply with the most stringent night-time limit of 45 dB L_{Aeq} .
- 93 The driveway beside 18 Salisbury Street exits the basement carpark. Based on the proposed 77 car parks in the basement, and assuming that during night-time no more than 10% of those vehicles may leave or enter the carpark, I predict a noise level of 43 dB $L_{Aeq(1h)}$. This noise level complies with the most stringent night-time limit of 45 dB L_{Aeq} .

Rubbish collection

- 94 Rubbish collections have the potential to cause annoyance, particularly if they occur at night-time. The most likely location for rubbish bins will be in the basement carpark.
- 95 Given the shielding provided by the site boundary fences, and the infrequent nature of rubbish collection (no more than once per day and likely less), I consider that the resultant noise levels will comply with the relevant noise limits.
- 96 However, in order to reduce potential annoyance, I recommend that no tonal reversing alarm is used on the trucks, and that refuse collection is limited to daytime hours only (i.e. between 7am and 11pm).

Conclusion

- 97 Overall, I predict that the Sites can operate in full compliance with the relevant operational noise limits.

RESPONSE TO SUBMISSIONS

- 98 I have reviewed all of the submissions, and noted the following noise and vibration issues raised by submitters:
- 98.1 General construction noise and vibration concerns;
 - 98.2 Construction hours;
 - 98.3 Management of construction noise and vibration, such as an offer of temporary relocation;
 - 98.4 The preparation of a CNVMP;
 - 98.5 The use of Westwood Terrace for construction traffic;
 - 98.6 Sheet piling;
 - 98.7 Noise from rubbish disposal areas;
 - 98.8 Vehicle noise from driveways; and
 - 98.9 Noise from the swimming pool and pump.
- 99 I address each of these issues below.

General construction noise and vibration effects

- 100 A number of submitters³ have raised concerns about general construction noise and vibration, which I have addressed in the body of my evidence.
- 101 V Zanetti of 1/28 Salisbury Street is concerned that some 330 piles will be required to be removed as part of the construction of the basement car parking at the Peterborough Site.
- 102 I understand that the existing piles will be retained and upgraded to allow for the construction of the new basement carpark. The top of the piles may need to be cut down to basement level, using concrete saws and nibblers. These works will be below ground height, and can be shielded with barriers, as discussed earlier.
- 103 The pile wall around the Site perimeter will be installed prior to any excavation works, and I therefore expect construction vibration from the construction works once the wall is in place will be low (albeit perceptible).
- 104 I have addressed the construction noise levels in my evidence above, and reiterate that with appropriate site management, noise levels from excavation can comply with the relevant noise limits.

Construction hours to manage noise/vibration impacts

- 105 B Watson of 23B Salisbury Street seeks a reduction in construction hours to reduce noise and vibration effects.
- 106 The overall duration of works is dependent on the daily work hours available. Therefore, these two aspects need to be weighed against each other. Reducing the construction hours (e.g. by not providing for any work on Saturdays or reducing daily construction hours) may result in an increase in the overall construction duration, with associated adverse effects.
- 107 As discussed in the body of my evidence, while the overall construction period is approximately four years, noise generating works will only occur for a portion of the construction period. I therefore do not support more limited construction hours based on noise effects.

Management of construction noise and vibration, such as an offer of temporary relocation

- 108 D and A McLean and the owners of 18 Salisbury Street are concerned about construction noise and vibration impacts on their tenants and seek an option for temporary relocation to manage effects.

³ Including D. & L. Worthington of 76 Park Terrace; ICON; the owners of 1-8/18 Salisbury Street; and S. O'Connor of 12/28 Salisbury Street.

- 109 I have predicted that the front building at 18 Salisbury Street may receive noise levels up to 77dB L_{Aeq} when piling works are undertaken at the closest point to this boundary. However, as noted above, the duration for such noise levels would be a matter of days, before the piling rig has moved on along the boundary.
- 110 I have recommended the use of a CNVMP, which would include processes for consultation and communication with neighbours. If these processes indicate any significant adverse effects arising from the noise levels due to neighbours' circumstances, management options may be discussed. However, I do not generally recommend temporary relocation as a matter of course because it requires uprooting people from their home.
- 111 Therefore, I consider it is appropriate for the option of temporary relocation to be investigated at the time the CNVMP is implemented, if necessary.

Preparation of the CNVMP

- 112 G Dewe of 23D Salisbury Street seeks that a CNVMP is prepared and submitted prior to completion of the hearing.
- 113 CNVMPs are documents that, in order to be effective and usable, require detailed information as to the construction programme and stages. While a draft CNVMP could be provided at this stage of the project, most of the necessary construction methodology details are generally completed after consenting and therefore the draft CNVMP could have limited utility. Nevertheless, the proposed approach to manage construction noise and vibration was described in the draft CNVMP submitted to Council on 17 November 2020 in response to a further information request. The conditions of consent will require a CNVMP to be prepared based on the final construction methodology.
- 114 Annex E2 of NZS6803 contains the common content of CNVMPs. I recommend that the conditions reference this section of the standard to ensure that the CNVMP meets the relevant information requirements.
- 115 The owners of 1-8/18 Salisbury Street also request that a CNVMP is prepared. I agree that a CNMVP will be the most effective way of managing construction noise and vibration in a proactive and detailed manner as discussed in the body of my evidence.

Use of Westwood Terrace during construction

- 116 R Begg of 6/17 Salisbury Street is concerned that the use of Westwood Terrace during construction would cause noise and vibration.
- 117 I understand that Ryman have confirmed that no access via Westwood Terrace is required during the construction period.

Sheet piling

- 118 The owners of 1-8/18 Salisbury Street are concerned that sheet piling may lead to vibration.
- 119 I note that no sheet piling is proposed around the Site. Piles will be installed with an auger, which will greatly reduce vibration (and noise). I understand this construction method has been deliberately chosen to reduce adverse noise and vibration effects on neighbouring buildings.

Noise from rubbish disposal

- 120 Centro Roydvale Ltd of 155 Victoria Street is concerned about noise impacts from the placement of rubbish disposals. I have discussed this issue at paragraphs 94-96 in the body of my evidence above.

Vehicle noise from the driveways

- 121 D and L Worthington of 76 Park Terrace, are concerned about noise from vehicles on the southern driveway of the Peterborough Site.
- 122 I have discussed this matter at paragraphs 89-93 in the body of my evidence above. I consider that, with the boundary fence in place, noise from vehicles will readily comply with the operational noise limit at this neighbouring site. The southern driveway also provides adjacent visitors parking, which adds extra distance between the driveway and the dwelling at 76 Park Terrace.

Noise from the swimming pool and pump

- 123 The Dorset Street Flat Owners Group of 2 to 16 Dorset Street, and Dr J Roper-Lindsay of 4A, 6, 12 and 16 Dorset Street are located immediately to the north of the Bishopspark Site. These residents are concerned about noise from the swimming pool and associated pool pump.
- 124 The swimming pool will be inside the building, and a fence will be installed around the Site perimeter. These factors will doubly shield the neighbours from any noise from the indoor pool.
- 125 The pool pump is part of the mechanical plant that will be installed on the Site, and will be designed to comply with the relevant noise limits. This compliance is generally achieved through common measures such as locating outlets away from the boundary, isolating the pump from surrounding ground, installing attenuators on outlets where required and choosing a pump with a suitable sound level.

RESPONSE TO COUNCIL OFFICER'S REPORT

- 126 I have reviewed the Council Officer's report and accompanying Environmental Health Report, as they pertain to noise and vibration. Both the Council Officers reach the same conclusion as

me that construction noise and vibration can be appropriately managed through a CNVMP and that operational noise from the Site will not cause adverse effects on neighbouring sites.

- 127 The Environmental Health Report notes that the main noise sources from the Proposed Village will be from construction, operation and external fixed plant (once the Site is operational). I concur with this finding and have addressed each of these aspects in my evidence.
- 128 The Environmental Health Report also recommends a report be provided to prove that acoustic insulation to address road traffic noise on the surrounding collector roads will meet Rule 6.1.7.2.1 of the District Plan (proposed condition 67). Based on the existing ambient noise levels that I observed during my virtual Site visit, I consider that compliance with the acoustic insulation provisions will be achieved using standard construction methodologies and materials. I agree that a report setting out the insulation provisions will ensure that appropriate measures will be implemented to achieve compliance.

DRAFT CONDITIONS

- 129 I have reviewed the recommended conditions of consent attached to the Council Officer's Report. Condition 18 reflects Ryman's draft conditions and my recommendations in relation to the use of a CNVMP to manage construction noise and vibration. The content of the CNVMP is based on the details set out in Annex E2 of NZS6803:1999 and will appropriately include communication and complaints procedures, amongst other things.
- 130 I agree with the proposed Draft conditions without amendments.

CONCLUSIONS

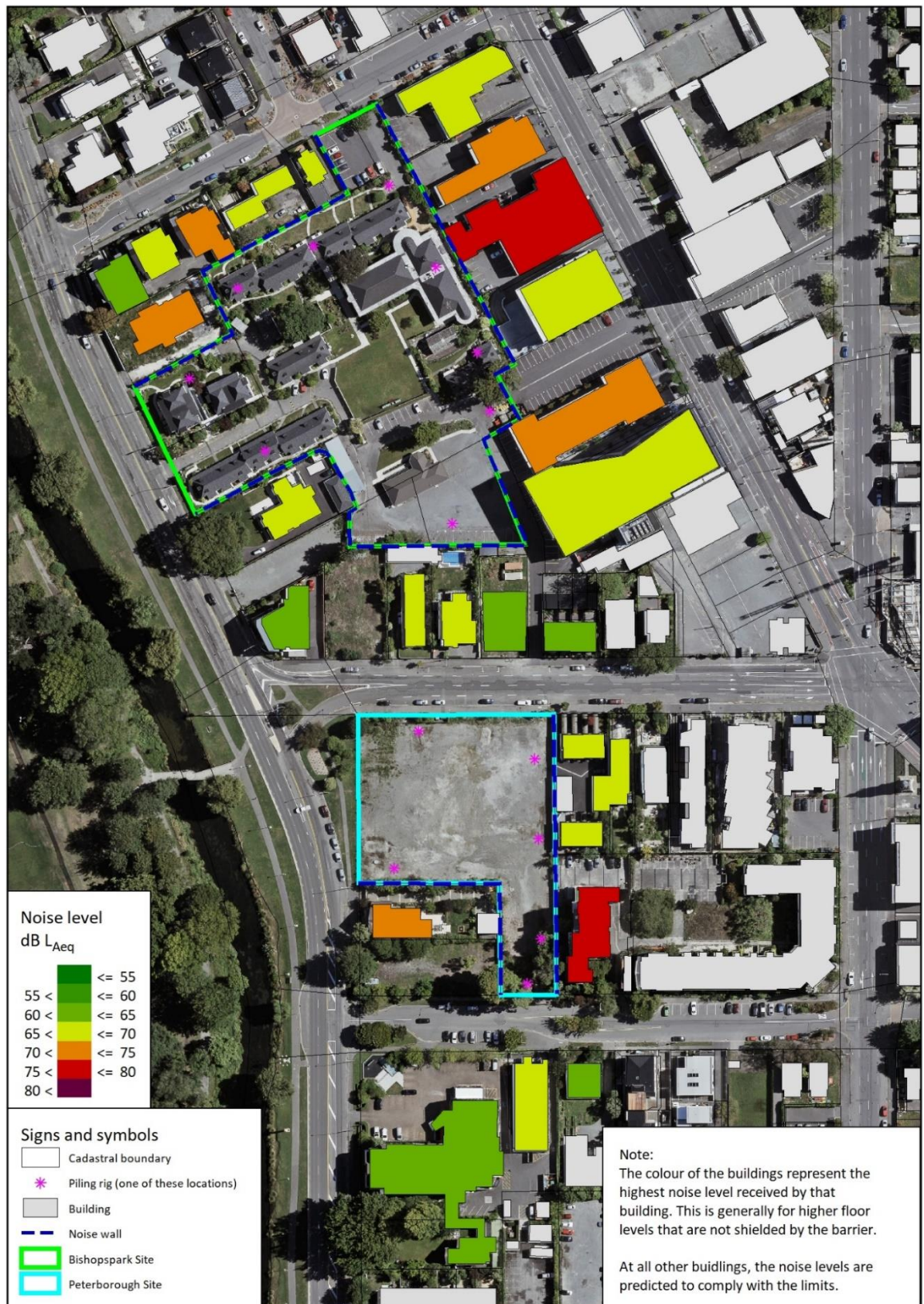
- 131 I have assessed construction noise and vibration and operational noise from the Proposed Village at the Bishopspark and Peterborough Sites at Park Terrace, Christchurch.
- 132 With appropriate on site management, the use of localised and perimeter barriers and appropriate choice of equipment and construction methodologies, I consider construction noise and vibration can generally be managed to comply with the relevant noise and vibration limits. Some limited exceedances of the noise limits for short periods may occur when high noise works occur in close proximity to neighbouring multi-storey buildings, which cannot be shielded by barriers.
- 133 I recommend the use of a CNVMP to manage and mitigate construction noise and vibration emissions from the Site. The CNVMP will include details regarding communication with affected neighbours, survey requirements, and specify best practicable

option mitigation and management measures in addition to general site measures.

- 134 I predict that operational noise from the Site, both from vehicles travelling on the Site and external mechanical plant, can comply with the relevant District Plan noise limits.
- 135 The recommended conditions in the Council Officer's Report reflect my assessment recommendations.
- 136 Overall, I consider that the Site can be constructed and operated within reasonable noise and vibration levels.

Siiri Wilkening
6 January 2021

ANNEX A – PREDICTED MAXIMUM NOISE LEVELS FROM VARIOUS PILING RIG LOCATIONS AT NEIGHBOURING BUILDINGS



ANNEX B – PREDICTED HIGHEST NOISE LEVELS FROM VARIOUS EXCAVATOR LOCATIONS AT NEIGHBOURING BUILDINGS

