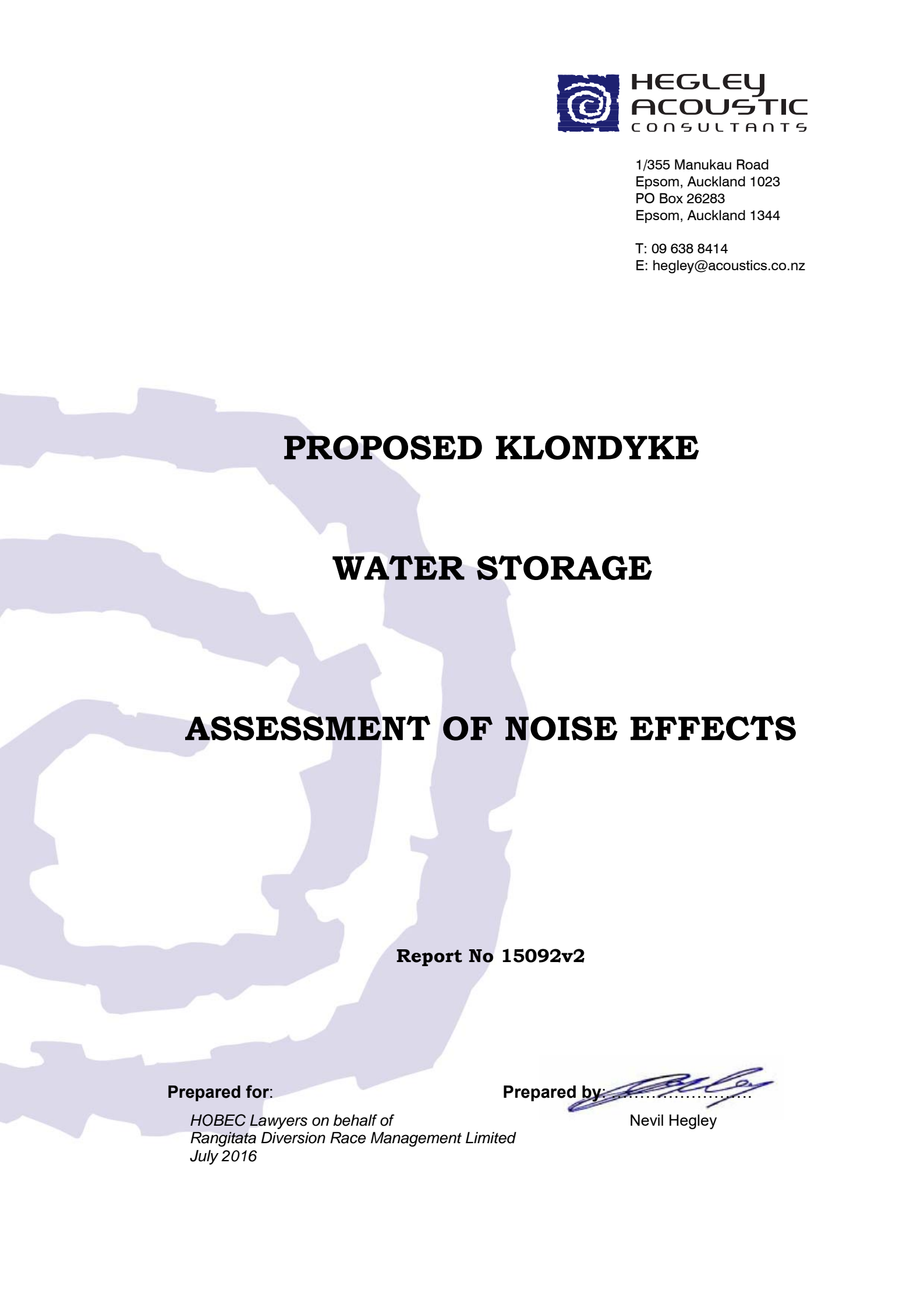




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PROPOSED KLONDYKE WATER STORAGE ASSESSMENT OF NOISE EFFECTS

Report No 15092v2

Prepared for:

*HOBEC Lawyers on behalf of
Rangitata Diversion Race Management Limited
July 2016*

Prepared by:

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EXECUTIVE SUMMARY

The Rangitata Diversion Race (RDR) currently takes water from the Rangitata River and supplies three irrigation schemes, two hydroelectric power stations and Ashburton District Council stockwater between the Klondyke area and Highbank on the Rakaia River. RDR Management Ltd (RDRML) is investigating the feasibility of a water storage facility (approximately 53 million cubic metres of water storage) downstream of the scheme intake in the Klondyke. The outlet flows for the water storage facility may be used for recreation. In that regard outlet flows will be used in a 'standing wave' white water feature. The proposed Klondyke storage facility is formed by a ring of elevated embankments that will allow a maximum reservoir storage elevation of 361m RL.

The proposed work will raise the RDR between the Klondyke intake and the pond and include the installation of a fish screen in the RDR's existing sand trap. Both of these are described in the Engineering Reports prepared by Riley Consultants Limited.

The aim of this report is to consider the noise effects of the construction works and how the site would be operated to ensure this noise is within a reasonable level for the residential neighbours at all times.

As no contract has been awarded for the project at this point typical earthmoving plant expected to be used on site has been assumed. Where there has been any doubt regarding the plant that may be used then larger (and hence noisier) plant has been assumed. The maximum noise will be when the earthmoving plant is operating at the maximum height on the proposed storage pond wall at the closest point to the receiver position. This criterion has been assumed in each direction of the closer dwellings and represents the "worst case" scenario.

Based on field measurements of the type of earthmoving machinery and the concrete batching plant to be used on site, construction noise has been predicted. From these predictions the upper noise level at all of the closer dwellings will be well within the requirements of the NZS 6803:1999 *Acoustics – Construction Noise*. Construction

noise will be within the requirements for a permitted activity in the Rural Zone for the storage facility construction. As a result, the effects of any construction noise will be less than minor in terms of the requirements of the Resource Management Act, and therefore will be acceptable.

Once operating there will not be any noticeable noise from the site to the neighbours.

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1 INTRODUCTION

Rangitata Diversion Race Management Limited (RDRML) is proposing to develop a water storage facility, a white water 'standing wave' kayaking facility, a new fish screen in the RDR's existing sand trap and flood flow take (with some associated canal widening and height increase). The water storage facility and white water course will be constructed on an area formed around the property known as Teradale Farm, which is located between the Rangitata Diversion Race and the Rangitata River and close to the Mayfield Hinds off take. The extent of the construction activity for the water storage facility and white water course are shown on Figure 1. The canal height increase and widening and the construction of the new fish screen occur on the reach RDR between the intake and the proposed water storage facility.

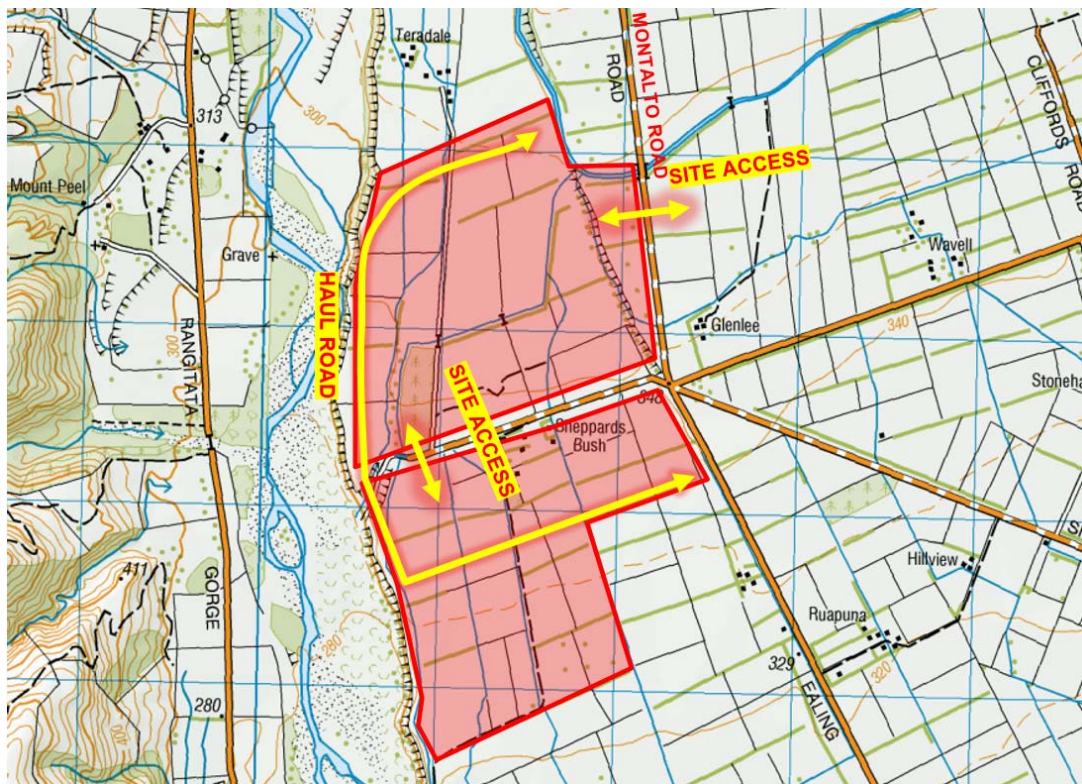


Figure 1. Site Location

This report considers the noise¹ from the proposed work and how the project will be managed to control noise to within a reasonable level for the residents. The noise assessment has been based on the expected equipment to be used for construction and where options are available the larger (noisier) equipment has been adopted in

¹ See Appendix A for a Glossary of Noise Terms used in this report.

the analysis. The noise sources during the storage pond construction will remain within the proposed storage pond site and have been assumed to travel around half of the site for any given stage of the development.

2 DISTRICT PLAN REQUIREMENTS

The site is located in a Rural Zone in the Ashburton District Council Plan and is shown on Figure 2.

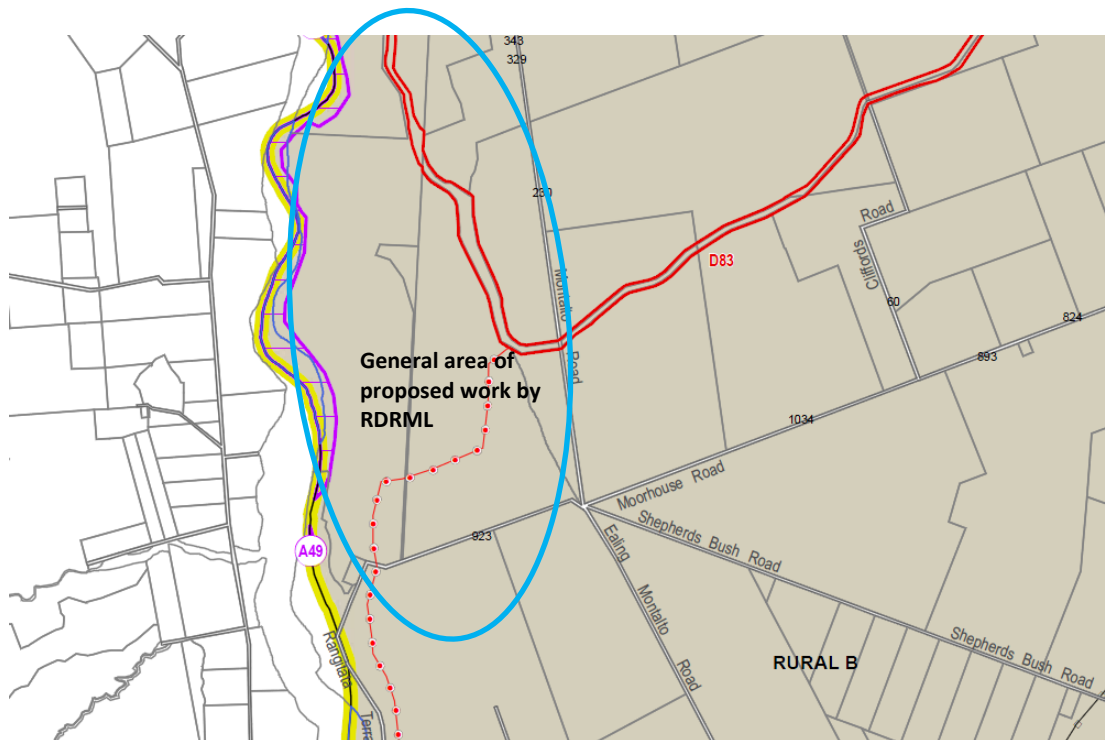


Figure 2. Site Zoning, Ashburton District Plan

Source: District Plan Map R62

As shown on Figure 2 the site is located in a Rural B Zone where Rule 11.8.1 Noise standards for zones sets the following relevant limits:

- a) *The noise level from activities within any other site shall not exceed the limits set out in Table 11-1 below:*

Table 11-1: Noise Limits

	Daytime (0700-2200 inclusive)		Night-time (All other times)	
	<i>L_{Aeq(1hr)}</i>	<i>L_{AF,max}</i>	<i>L_{Aeq(1hr)}</i>	<i>L_{AF,max}</i>
<i>When measured at the notional boundary of any residential unit on an adjoining site zoned:</i>				
<i>Rural A and B</i>	50dB	75dB	40dB	65dB

Notes:

- Where there are buildings close to or on a site boundary, compliance with the noise limits shall be assessed 1 metre from any accessible façade of those buildings.
- Where a fence or other noise control structure is erected on a site boundary, compliance assessment shall consider the effect of such a structure.
- When applying the notional boundary provision, the notional boundary is a line 20 metres from any residential unit on any neighbouring site, as defined in NZS6802:2008 Acoustics-Environmental Noise.
- The daytime noise limits are intended to provide amenity for outdoor activities. Night-time noise limits are intended to allow for sleep amenity.
- The noise rule that is applicable to a site is based on the zoning of the site receiving the noise and not the site that is generating the noise.

For construction work District Plan Rule 11.8.3 Construction Noise states:

- Construction noise shall comply with NZS 6803:1999 Acoustics – Construction Noise.

Table 2 of NZS6803 sets the following noise requirements for construction work

**Recommended Upper Limits for Construction Noise Received
in Residential Zones and Dwellings in Rural Areas**

Time of week	Time period	Typical duration (dBA)		Short term duration		Long term duration	
		<i>L_{eq}</i>	<i>L_{max}</i>	<i>L_{eq}</i>	<i>L_{max}</i>	<i>L_{eq}</i>	<i>L_{max}</i>
Weekdays	0630-0730	60	75	65	80	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	80	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

Where:

- (a) "Short-term" means construction work at any one location for up to 14 calendar days;
- (b) "Typical duration" means construction work at any one location for more than 14 calendar days but less than 20 weeks; and
- (c) "Long-term" means construction work at any one location with a duration exceeding 20 weeks.

Given the size of this project the long term duration noise levels, as set out above, will apply.

Dwellings to the west of the Rangitata River are located in the Timaru District and while the cross boundary noise controls applicable are those as set out in the Ashburton District Council Plan the noise limits of the Timaru District Plan have also been considered. As shown in Figure 3 the land to the west of the Rangitata River is zoned Rural 1 in the Timaru District Plan.

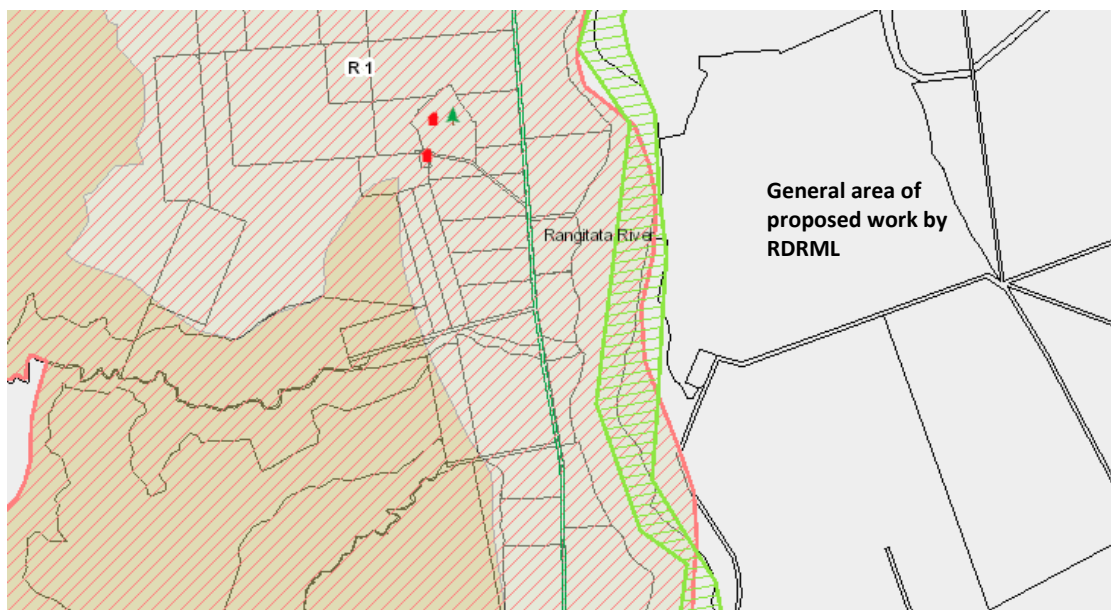


Figure 3. Land Use Zoning, Timaru District Plan

Source: Timaru District Plan

Rule 5.18 of the Timaru District Plan sets the following noise limits for a rural zone:

Noise levels shall not exceed 50dBA L_{10} at the notional boundary of the nearest household unit on any other site between 7.00am and 10.00pm on any day, and 40dBA L_{10} and 70dBA L_{max} at all other times, unless specific noise levels are provided for the activity elsewhere in the District Plan.

General Rule 6.21 requires:

6.21.2.1 MEASUREMENT AND ASSESSMENT OF GENERAL ENVIRONMENTAL NOISE

Except where expressly provided elsewhere in this Plan, noise shall be measured in accordance with the provisions of New Zealand Standard 6801:1991 Measurement of sound and assessed in accordance with the provisions of New Zealand Standard 6802:1991 Assessment of environmental sound.

6.21.2.3 CONSTRUCTION NOISE RULES - ALL ZONES

Construction noise in any zone shall not exceed the recommended limits in and shall be measured and assessed in accordance with the provisions of New Zealand Standard 6803P:1984. The measurement and assessment of noise from construction, maintenance, and demolition work. Discretionary adjustments provided in clause 6.1 of the Standard shall be mandatory within the District.

Except for the L_{max} levels the operation noise rules are the same as set out in the Ashburton District Plan, albeit L_{Aeq} is used in the Ashburton District Plan and L_{10} in the Timaru District Plan. It is noted the L_{max} is not a controlling factor with noise compliance so the issue of any cross boundary differences in the noise control will not cause any problems for either Council. Similarly, the small difference (typically 2dB) between the L_{Aeq} and L_{10} will not have any adverse effect on the noise effects for residents in the Timaru District.

For construction work, the Timaru District Plan adopts the provisions standard NZS6803P:1984 *The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work* while the Ashburton District Plan adopts the more recent version NZS 6803:1999 *Acoustics – Construction Noise*. The use of the 1999 version of NZS6803 is recommended as it removes the ambiguities in the 1984 provisional standard. In this case, compliance with the 1999 version of the standard will ensure compliance with the 1984 provisional standard so is adopted in this report, regardless of any cross boundary effects.

For both the construction and operational noise the requirements of section 16 of the Resource Management Act to adopt the best practicable option to ensure that the emission of noise does not exceed a reasonable level has been as been taken into account. Having considered section 16 of the act, it is concluded that the proposal will not cause unreasonable noise to be emitted.

Figure 4. Location of Proposed Kayaking Course

Figure 5 shows the RDR intake and the section of RDR to be modified, and highlights the location of the proposed fish screen.



Figure 5. Section of RDR to be modified

The earthworks plant expected to be used during the construction of the proposal is set out in Table 1. It is noted that Table 1 will vary from contractor to contractor depending on their preference and availability of plant at the time of construction, so it is given only as an indication of the likely make-up. However, the plant shown in Table 1 represents both the maximum size of plant expected to be used and the maximum amount of plant to be on site at any one time so representing the maximum noise likely to be generated from the site.

The earthworks are likely to be carried out using a combination of scrapers and dozers and/or dump trucks and excavators. The scraper-dozer combination tends to be more economical for haul distances of less than 600m, while the truck-excavator combination tends to be more efficient over longer distances. Whether the contractor uses one or the other or a combination of both, the total number and size of plant will

be similar. For the noise assessment, where there is an option the analysis has been undertaken based on 70% of both options being used. This will provide a good factor of safety with the analysis.

Plant Type	Noise Level (each) L_{WA}	Number on Site
35t Scrapers (Cat 637) and/or 35t Dump Trucks (Cat 769c)	111dB 112dB	Combined total of 21
Dozers (D6) and/or Excavator (Cat 336e)	113dB 110dB	Combined total of 6
Graders (Cat 14)	102dB	6
Water Cart (Cat 725)	112dB	6
Vibrating Roller Compactor (12 t)	107dB	6
Combined Total Plant Number		45

Table 1. Typical Plant Expected on Site

In addition to the earthmoving plant a concrete batching plant may be employed on site. The noise from this plant has been based on field measurements of an existing batching plant that had a sound power level of 115dB L_{WA} . As there are two potential sites where the batching plant may be located, one to the south and one to the east of the pond, both sites have been included in the analysis and this will provide a further factor of safety in the predictions.

4 EXISTING NOISE ENVIRONMENT

The existing noise environment has been assessed based on a series of short term noise measurements during April 2015 for the mid-morning to afternoon period in calm to light winds with fine and mild weather conditions.

The equipment used for the measurements was a Bruel & Kjaer 2250 Hand-held Analyser platform with Sound Level Meter Software BZ 7222, Frequency Analysis Software BZ 7223, Logging Software BZ 7224 and Sound Recording Software BZ 7226. The equipment has been calibrated by the equipment manufacturers and the re-calibration was next due in October 2015. The equipment was field calibrated before and after measurements using a Bruel & Kjaer 4230 calibrator. All measurements were undertaken in accordance with the requirements of NZS6801:2008 *Acoustics – Environmental Noise*.

The noise in the area, at and adjacent to the proposed site, was controlled by farm animals, distant river noise and the effects of wind on the trees. The amount of noise from the Rangitata River was dependent on the distance from the river and will be further controlled by the amount of water flowing.

For the average water flows the river noise does not control the background sound at the dwellings and with minimal wind at ground level and a 2 – 3m/s wind in the tree tops the background sound (L_{A90}) was typically 36dB. This level is expected to drop to approximately 33dB on a still day. As the wind increases the level will rise quickly to 40 – 45dB with a 5 – 6m/s wind blowing.

These levels do not include any effects from farm animals, farm machinery or passing traffic which will vary from time to time. In general, this is a typical rural environment and while the proposed construction works will have an effect on these levels, once operating, there will not be any change to the existing noise environment for the residents.

5 PREDICTED NOISE

From the above the noise effects have been modelled using the Brüel & Kjær Predictor v11.0 programme. This is a powerful environmental noise software package that uses a digital terrain model for the calculations. The calculations have been undertaken in accordance with the requirements of ISO 9613-1/2 Acoustics – Attenuation of Sound during Propagation Outdoors. For this project, a grid varying between 20m – 50m has been adopted in a digital terrain model with the ground contours at 2m intervals. The noise from the earthworks activities has been calculated at each grid point from which the noise contours have been determined. All calculations have been undertaken assuming a positive meteorological effect (which provides a higher level than for neutral conditions) with 0.5 ground absorption, which is considered to be representative of hard ground in the summer and wet ground during the winter. A receiver height of 1.5m has been adopted for the analysis.

In order to predict the noise from the proposed construction at the water storage facility all of the above noise sources have been located at the existing ground level, which is representative of the initial earthworks, and then at the top of the pond wall, which is representative of construction work with the maximum noise exposure to the neighbours. The construction plant was located in the northern part of the site and then in the southern part of the site to represent the closest points where the plant will come to the dwellings in the area.

Construction work for the white water course is further from the closest dwelling and at a lower level than the most exposed pond wall construction so will be below the predicted bund construction at all dwellings. Noise from the canal work, including the fish screen, has been assessed separately for the one dwelling that the canal comes relatively close to.

Figure 6 shows the construction noise contours with the plant operating at the existing ground level in the northern part of the construction site for the white water course and the water storage facility. Figure 7 shows the noise contours with the plant operating in the same area but at the top of the pond wall.

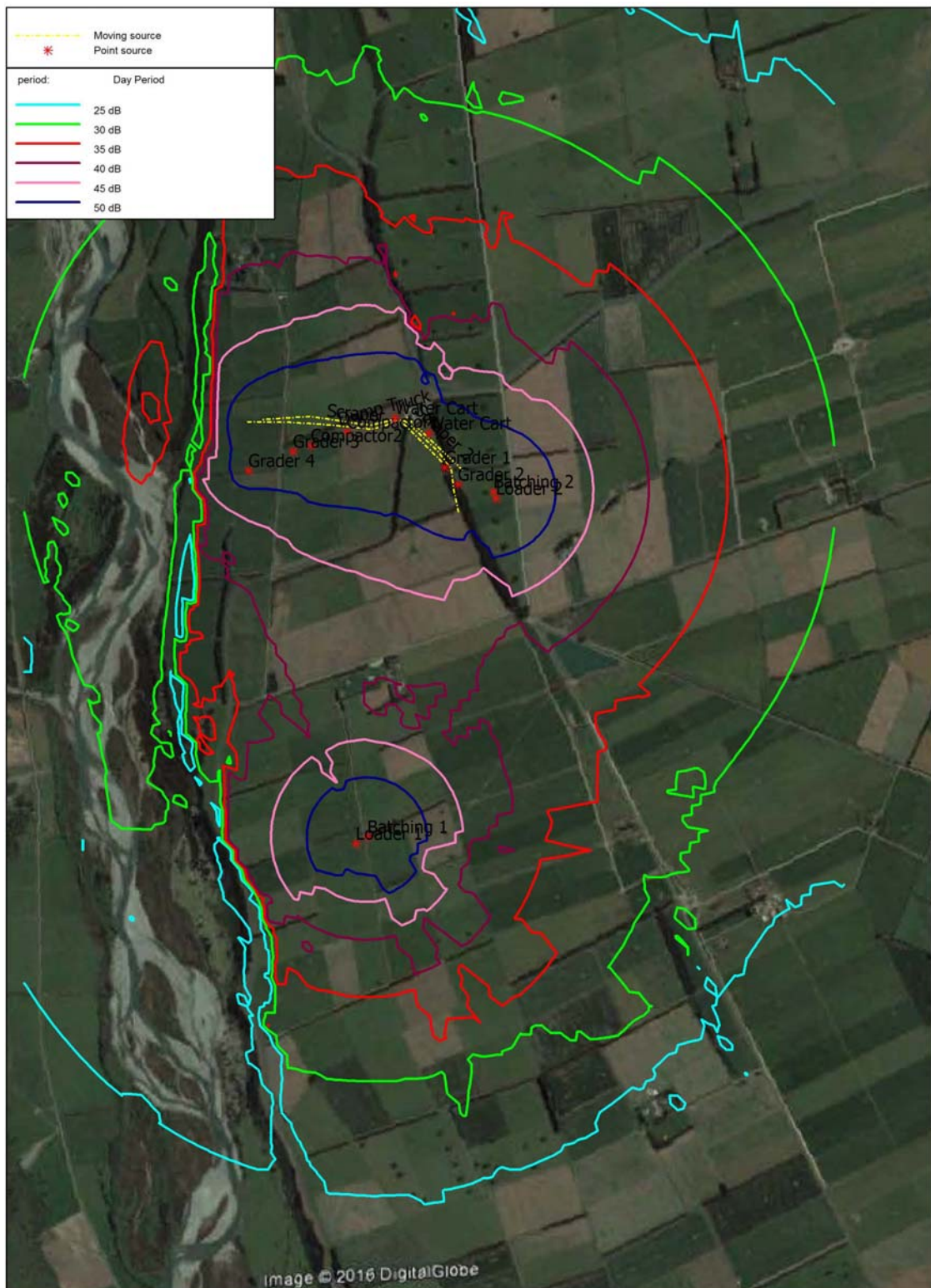


Figure 6 . Bund Construction at Ground Level to the North, dB L_{Aeq}

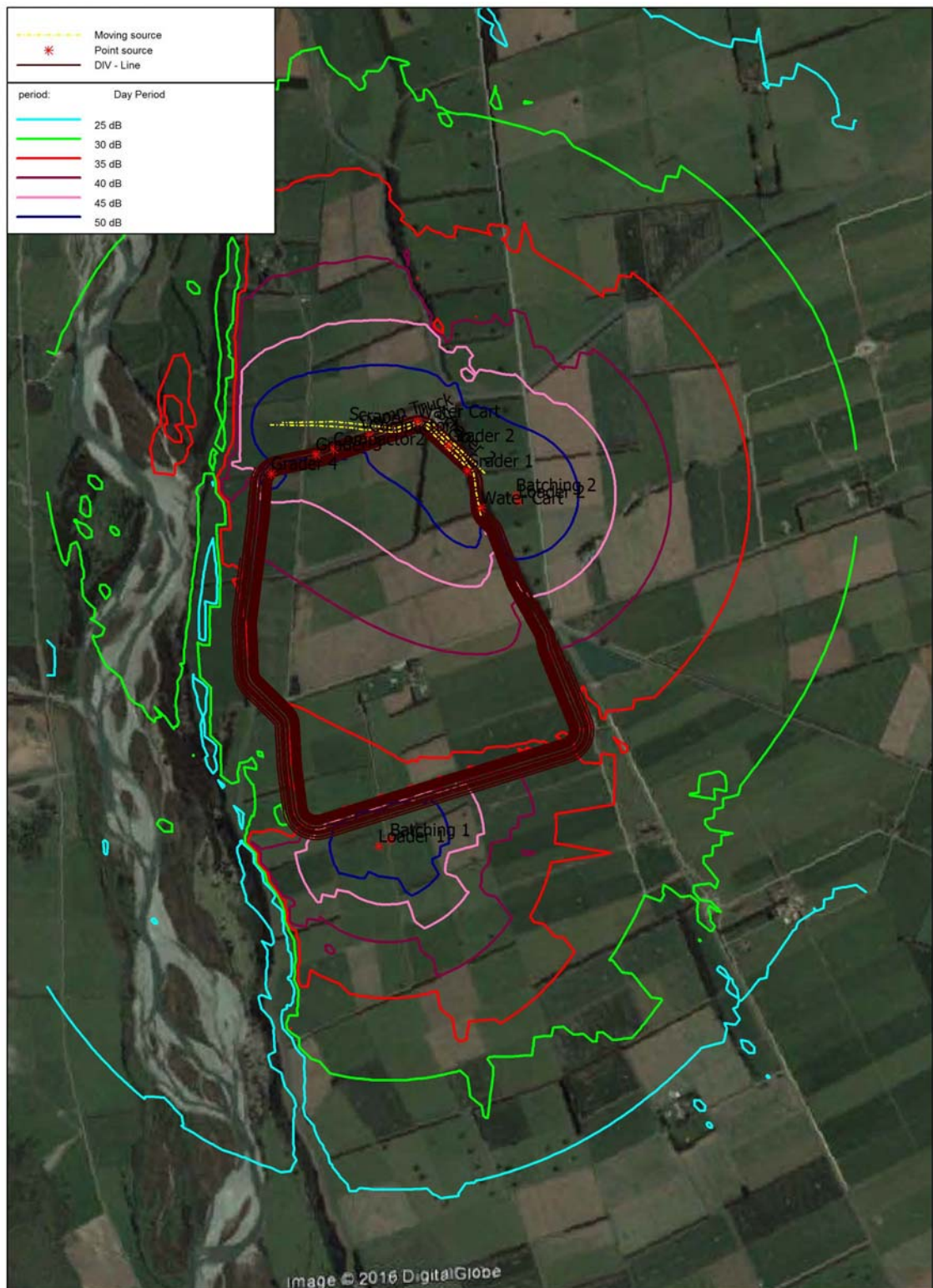


Figure 7. Bund Construction at the Top of the Bund to the North, dB L_{Aeq}

Figure 8 shows the noise contours with the construction plant operating at the existing ground level in the southern part of the site

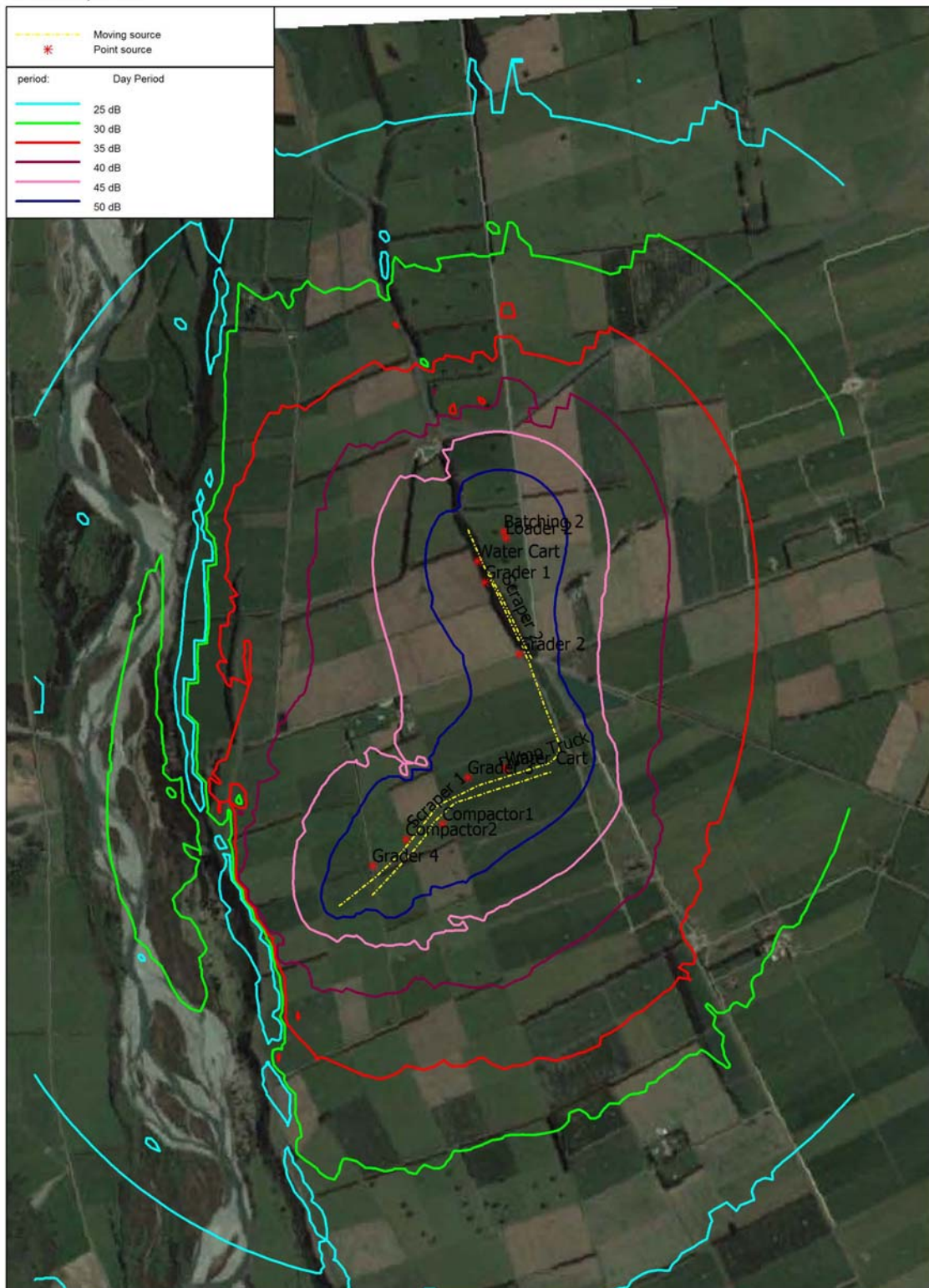


Figure 8. Bund Construction at Ground Level to the South, dB L_{Aeq}

Figure 9 shows the noise contours for southern part of the site with the plant operating at the top of the bund so the construction activities are at the maximum exposure to the neighbours.

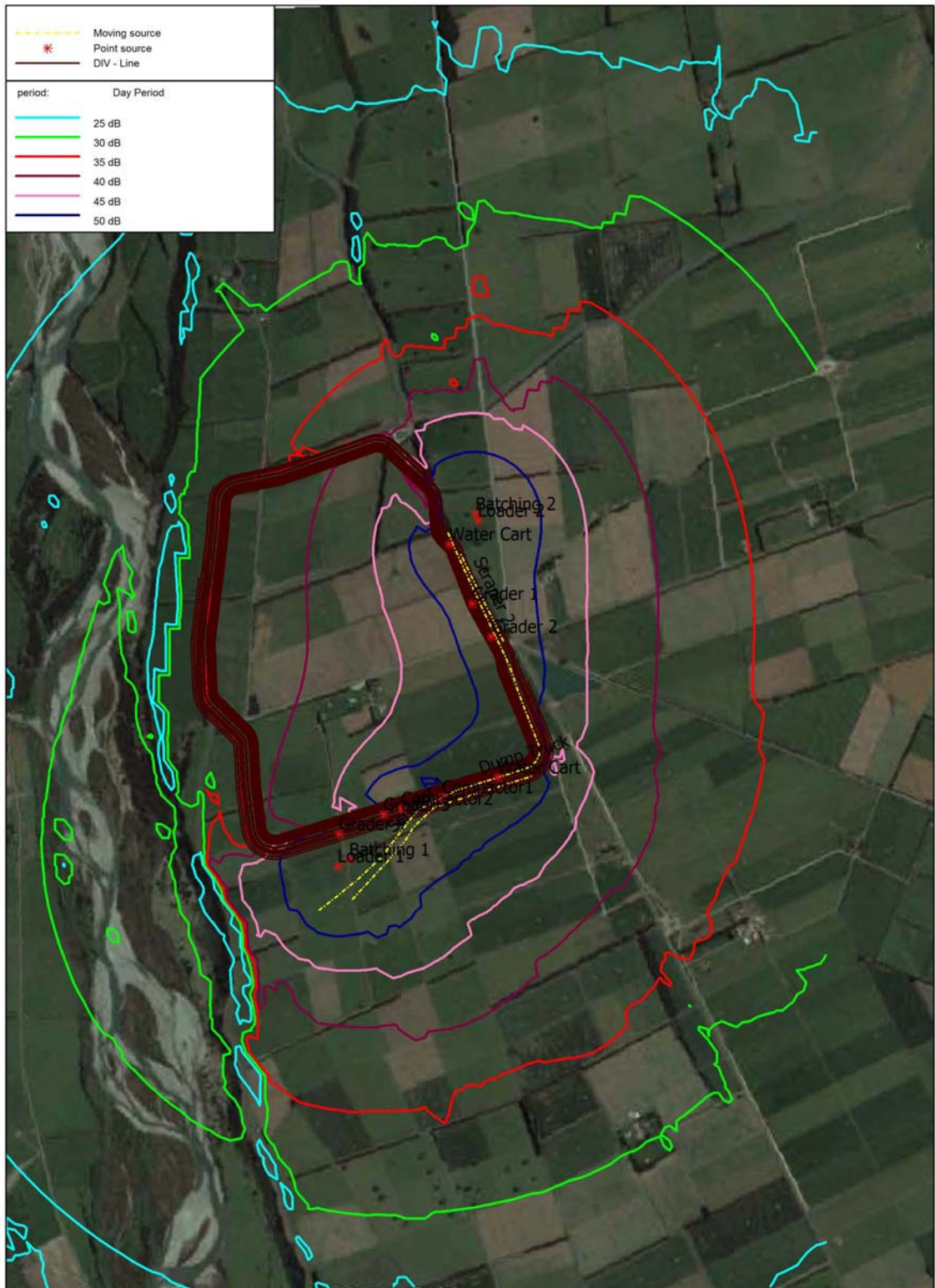


Figure 9. Bund Construction at the Top of the Bund to the South, dB L_{Aeq}

In addition to the noise contours the noise has been predicted at the notional boundary of each of the closer dwellings as shown on Figure 10. The results are set out in Table 2.

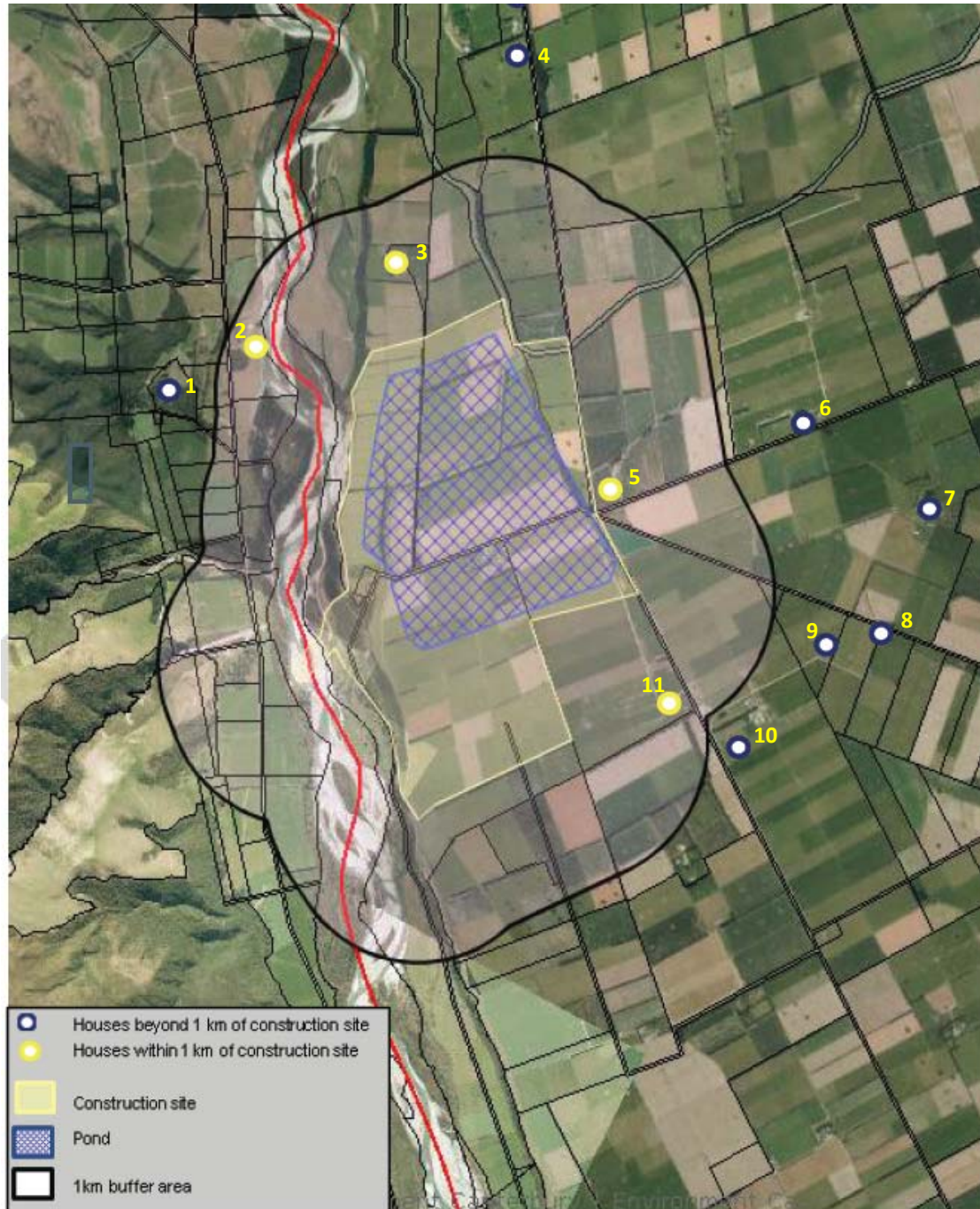


Figure 10. Location of Spot Noise Predictions

Source: BCHF Air Discharge Report

Site*	Figure 6	Figure 7	Figure 8	Figure 9
1	16	16	18	19
2	30	30	25	25
3	42	41	32	29
4	4	3	1	1
5	47	47	50	51
6	31	31	32	33
7	18	19	19	22
8	12	13	12	15
9	2	2	6	2
10	26	26	31	34
11	34	34	42	43

* See Figure 10 for the location of each site

Table 2. Predicted Pond Construction Noise Levels (dB L_{Aeq})

As shown on Figures 6 – 9 and Table 2 the highest noise level at 1m from the façade of any dwelling in the area is 51dB L_{Aeq} . This is well within the level of 70dB L_{Aeq} as required by NZS 6803:1999 Acoustics – Construction Noise. Although the construction of the proposed pond is classed as construction work the levels for the closer neighbours do, in fact, fall within the requirement of 50dB L_{Aeq} as set out in Rule 11.8.1 of the District Plan for an ongoing permitted activity when taking into account the averaging provisions of NZS6802, which is not permitted by the construction standard NZS6803, and the assessment point for operational noise being the notional boundary of the dwellings. Based on field measurements undertaken of the type of construction equipment to be used at this site, by complying with the L_{Aeq} level the L_{AFmax} level will also be complied with.

There are two areas where dwellings are relatively close to the proposed canal upgrade, one approximately 1km south of Bridge 3 and a group of dwellings adjacent to the Bridge 3 site as shown on Figure 11.

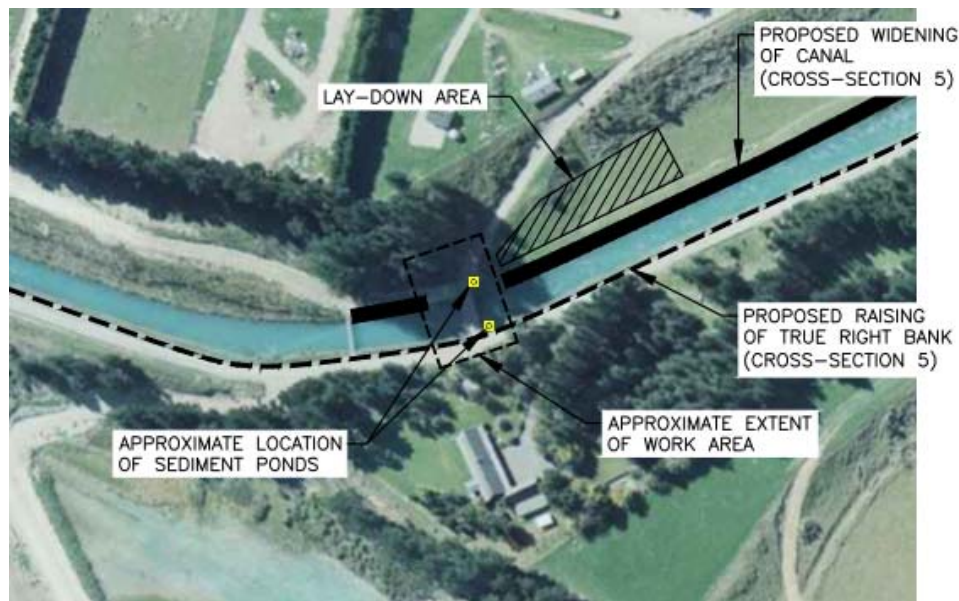


Figure 11. Bridge 3

Source: Riley Consultants Drawing 11835/2-3

The canal upgrade will be undertaken using truck and trailers and an excavator, such as a Cat 320D, which has a measured sound power (L_{WA}) of 105dB. For the bridge construction the main noise is expected to be a drill for the piles and a concrete truck. Based on measurements of drilling piles this work will have a sound power of 105dB (generated mainly from the clearing of the drill). The concrete truck discharging the concrete has a measured sound power of 106dB.

For the dwelling to the south of Bridge 3 the earthworks construction noise will be up to 57dB L_{Aeq} as the work passes at its closest point to the dwelling.

For the dwellings adjacent to the Bridge 3 site the noise from the canal upgrade will be up to 66dB L_{Aeq} .

The proposal is sheet piles will be driven around the abutments for Bridge 3 to isolate them from the canal water to provide a dry working area. These piles will be installed using a vibro-hammer. Field measurements of an 80t crane with a power pack and a 5t vibro hammer gave measured levels of between 74 – 76dB L_{Aeq} at 20m, the exact level being dependent on the side of the piling that was measured, the sides being quieter than the front and back.

The design will use standard rotary bored piles potentially using driven (vibro-hammer) steel casings and this method is assumed for the purposes of the construction methodology although other methods (including driven steel 'H' piles, continuous flight auger, or other such pile installation methods) could be adopted. Field measurements of a Geax EK110 multi-purpose piling rig and an EK90 Drilling Rig gave sound power levels of up to 105dB L_{WA} .

If driving sheet piles the noise at the closest dwelling, which is to the south west of the bridge site, will be up to 72dB L_{Aeq} when assuming the highest noise from the piling. For the drilling of piles the highest noise at the closest dwelling will be 67dB L_{Aeq} . During the concrete pouring noise at the closest dwelling will be up to 66dB L_{Aeq} . These levels are all well within the 75dB L_{Aeq} requirement of NZS6803 for this work and hence the effects reasonable. As a guide, a reduction of 10dB is an apparent halving of the perceived noise level. By complying with L_{Aeq} levels the maximum level (L_{Amax}) will also be complied with.

The fish screens are located some 2km from the closest dwelling so neither the construction of the screens or the operation of the fish screens will be heard at the closest dwelling.

6 TRAFFIC NOISE

Noise from traffic generated by the proposed facility has been assessed. There are no traffic noise requirements in the District Plan or any other legislation with respect to traffic noise related to the proposed facility. The only guideline is NZS 6806:2010 *Acoustics- Road-traffic Noise - New and Altered Roads* and as the title of suggests this Standard sets design criteria for new and altered roads, not a change to the traffic flow due to any given activity.

However, if this Standard is considered the lowest level set is 57dB $L_{Aeq(24hr)}$ as measured at the dwelling façade for a new road with a traffic volume of 2,000 to 75,000 AADT. However, the Standard also states that it does not apply to new and altered roads predicted to carry less than 2,000 AADT at the design year.

The traffic flows have been adopted from the traffic engineer's Transportation Assessment Report with only the roads within the immediate proximity of the storage facility considered in the noise assessment. The existing traffic flows are:

Road	Location	Average Daily Traffic (vpd)
Ealing Montalto Road	South of Baxters Road	120
Moorhouse Road	West of Mayfield Klondyke Road	90
Moorhouse Road	East of Shepherds Bush Road	60
Shepherds Bush Road	West of Arundel Rakaia Gorge Rd	25

Table 3. Existing Traffic Flows

The additional traffic has been predicted by the traffic engineer for both the 3 and 5 year construction options. As there is more traffic each day for the three year scenario (and hence more noise) only this option has been considered in the noise assessment. That is, a conservative (highest) effect of traffic noise has been assessed. As a guide, there will be a 4 - 5dB reduction in the traffic noise should the 5 year construction period be adopted.

Materials	Transport Mode	Project Average (vehicle movements per day)	Project Peak (vehicle movements per day)
Rock riprap delivery	Truck and trailer	94	142
Concrete delivery	Truck	16	92
Fuel delivery	Truck	2	6
Synthetic liner delivery	Truck and trailer	34	70
Total		146	310

Table 4. Estimated Daily Heavy Traffic Movements (3 year programme)

Based on these traffic flows the total number of vehicles per day remains well below 2,000vpd for the roads near the proposed storage facility so, in terms of the requirements of NZSS6806 the traffic noise will be well within a reasonable level. However, there will be a large increase in the existing traffic flow during the construction period and as such the noise from individual vehicles will be heard by those residents living close to the road.

As shown on Figure 12 the main routes are along Moorhouse Road and Ealing Montalto Road.

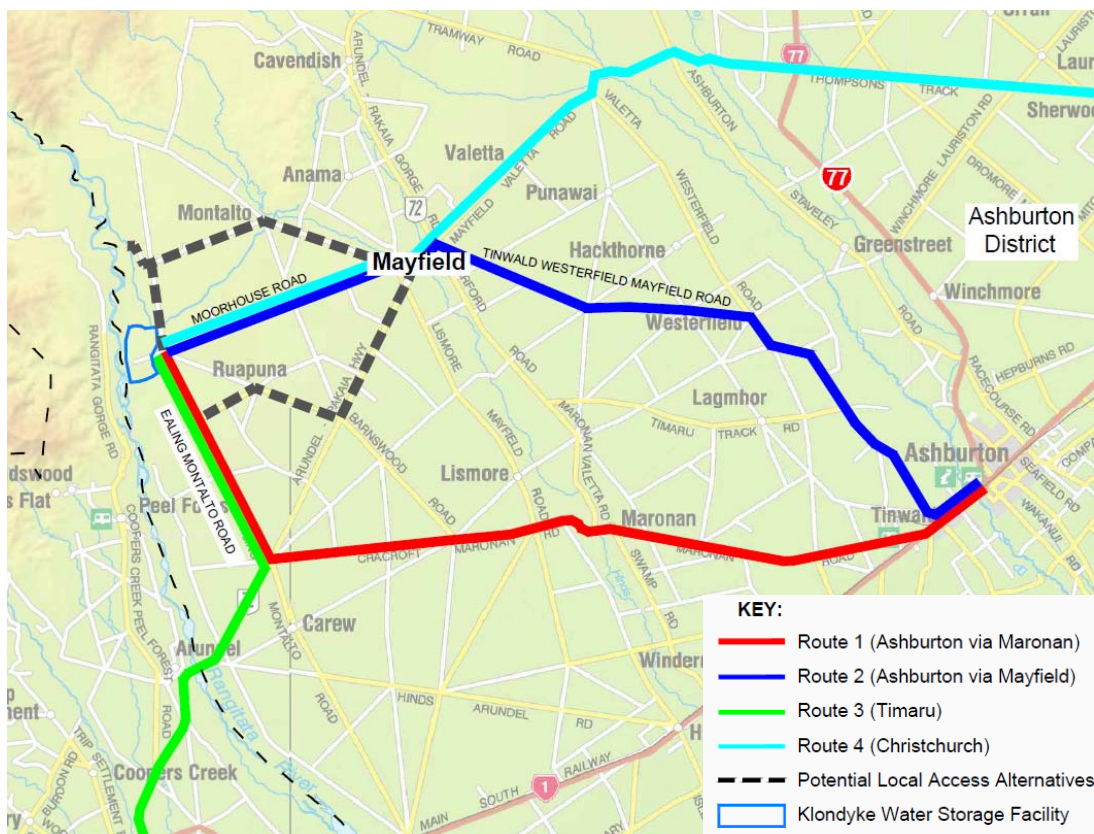


Figure 12. Primary Transport Routes

Source: TDG Dwg 13256_C2A

There are approximately six dwellings within 6km of the proposed storage facility varying from 20m to 550m from the road. Even with the maximum number of trucks on Moorhouse Road the noise at the closest house (20m from the road) will be below 47 - 49dB $L_{Aeq(24hr)}$. As set out above, the noise from individual trucks will be clearly audible and there will be more events than occur at the moment. However, the noise will be well below the level normally considered reasonable from traffic, and other than any potential of a concrete pour extending into the night time period there will not be any additional vehicle movements at night time. Any truck noise will only occur for short periods for the duration of the construction work.

The closest house on Ealing Montalto Road that is within 6km of the site is approximately 65m from the road. Although there is the potential of more traffic on Ealing Montalto Road than Moorhouse Road, due to potential truck movements to Timaru, the closest house is well clear of the road so the resulting noise will be approximately 44 – 45dB $L_{Aeq(24hr)}$ and well within a reasonable level. As for the houses on Moorhouse Road the construction traffic noise will not occur at night time and the truck noise will only occur for the duration of the construction period.

Once operational, and with the exception of any additional recreational traffic generated by the kayaking course, there will be an insignificant change in the existing traffic noise and as such no change to the existing traffic noise for the neighbours.

7 CONCLUSIONS

Field measurements of the noise from earthmoving machinery and the concrete batching plant have been undertaken at existing construction sites. From these measurements the noise to the environment has been predicted at the closer existing dwellings to reflect the upper level of noise ever likely to be experienced by the neighbours. For much of the time the equipment will be further from the neighbours and hence there will be less noise at the receiver positions. However, to ensure there will be compliance with the predicted noise levels the noisiest scenarios have been modelled.

During the construction of the storage facility and assuming the maximum plant will be operating at the maximum height on the pond wall, the noise level will not be above 43dB L_{Aeq} and generally below 35dB. The District Plan sets a level of 70dB L_{Aeq} for construction noise and 50dB L_{Aeq} for any ongoing permitted activity. At these levels the noise effects from the construction of the storage facility will be less than minor and for much of the time will be at or below the existing background sound in the area. While the construction work will be heard at times it will be within a reasonable level and will not have an adverse effect on the existing noise environment. Similarly, when taking into account the distances from the construction works to the closer residences, there will not be any vibration effect beyond the site boundary.

Construction of the kayaking course will be quieter for the residents than construction work on the storage facility itself so there will not be any adverse noise effects from this phase of the construction work.

During the upgrading of the canal construction the equipment will be within approximately 35m of the closest dwellings so in this case, and for the short period it will take for the canal works to pass, the noise will be up to 57dB L_{Aeq} . Although the noise from this work will be clearly audible the level will be well within the 75dB limit of NZS6803. When taking into account the expected noise level of up to 57dB and the duration of the work (2 - 3 weeks) the noise will be well within a reasonable level for

the residents. Vibration from this work is not expected to be noticeable so there will not be any effects on the residents from vibration during the canal reconstruction.

Any piling that may be required for the bridges is clear of noise sensitive activities and will not cause any noise or vibration problems for the neighbours. Bridge 3 is the closest to any dwelling and to further minimise any noise or vibration issues at these dwellings it is currently proposed to drilling these piles. As a result, both noise and vibration from piling will be well within the design criteria and there will not be any adverse effects for the closest neighbours.

There will not be any noticeable noise from either the construction or subsequent use of the fish screens for the closet residential neighbour.

There are no traffic noise limits in the District Plan or any other legislation that is applicable to this application. If the lowest limit that is set out in NZS 6806:2010 *Acoustics- Road-traffic Noise - New and Altered Roads* is adopted, the noise level will be well within a reasonable limit. Taking this into account and that the construction work will only occur for the duration of the project, and other than any potential concrete pours extending into the night time period, there will not be any change to the night time noise, traffic noise will be reasonable and will not cause an adverse effect for the neighbours.

When considering the above and the requirements of the Resource Management Act, the development proposed by RDRML can be managed so the noise effects will be less than minor and therefore acceptable and there will not be any adverse effects for the neighbours.

* * *

Appendix A

Guide to Noise Terms

The following sets out an explanation of the acoustic terms that will be referred to throughout this report. The aim is not to necessarily provide technical definitions, but to enable a basic understanding of what is meant.

The setting of specific noise levels to control any adverse effects does not necessarily mean that noise will not be heard. Audibility depends on the level of a sound, the loudness of the background sound and any special frequency composition or characteristics that a sound may have.

Research suggests that a small number of people (approximately 10%) will find any noise not of their own making unacceptable. Conversely, there are approximately 25% of the population that are essentially immune to any noise. Neither of these two extremes is normally designed for. In establishing the appropriate noise levels the aim is to try and represent the typical expected community reaction, this will generally be approximately 90% of the people.

In order to reflect community response to noise it is necessary to establish a measure that reflects our attitude to the sounds that we hear. Due to the variability of many sounds (level, tone, duration, intrusiveness above the existing sound, etc) no single descriptor will totally describe the potential community reaction to a sound. For this reason there are a number of terms that need to be understood.

dB

The basic unit to quantify a sound is the decibel. When A-weighted (such as L_{Aeq}) the sound level, or dB, is a good environmental noise descriptor because of the similarity between A-weighting and the frequency response of the human ear at moderate sound levels. It can also be measured easily. However, it provides no indication of tonal frequency components or unusual frequency distributions of sound that may be the cause of annoyance. Where appropriate, this must be assessed separately.

We can hear a change in sound pressure that varies from 1 (taken as the threshold of hearing) through to 1,000,000,000,000 (taken as the threshold of pain). In order to bring these numbers to a more manageable size a logarithmic scale is normally adopted. This reduces the above values to 0 and 12 respectively. The decibel is then described as 10 times the logarithm of the ratio of the pressure level of interest, to a reference pressure level. Thus the scale becomes 0 to 120dBA.

Some typical subjective changes in noise levels are:

A change of 3dB is just perceptible
 A change of 5dB is clearly perceptible
 A change of 10dB is twice (or half) as loud

Because we use a logarithmic scale care must be taken when adding sound levels. Two equal noise sources raise the level of one source by 3dB. It takes 10 equal noise sources to raise the level of one source by 10dB. ie $60\text{dB} + 60\text{dB} = 63\text{dB}$ and $60\text{dB} \times 10 = 70\text{dB}$.

Maximum Sound Level ($L_{A\text{max}}$)

This unit equates to the highest (maximum) sound level for a defined measurement period. It is adopted in NZS6802:2008 Acoustics – Environmental Noise, mainly as a method of protecting sleep.

L_{A10}

The sound level which is equalled or exceeded for 10% of the measurement time. This level is adopted in NZS6802:1991 Assessment of Environmental Sound to measure intrusive sound. This level may be considered as the average maximum sound level.

Background Sound L_{A90}

The sound level which is equalled or exceeded for 90% of the measurement time. This level is adopted in NZS6802:2008 Acoustics – Environmental Noise to measure the background sound. This level may be considered as the average minimum

sound level and is the component of sound that subjectively is perceived as continuously present.

Equivalent Sound Level (L_{eq} , L_{Aeq})

The L_{Aeq} may be considered as the continuous steady noise level that would have the same total A-weighted acoustic energy as a fluctuating noise over the same time period.

Ambient Sound

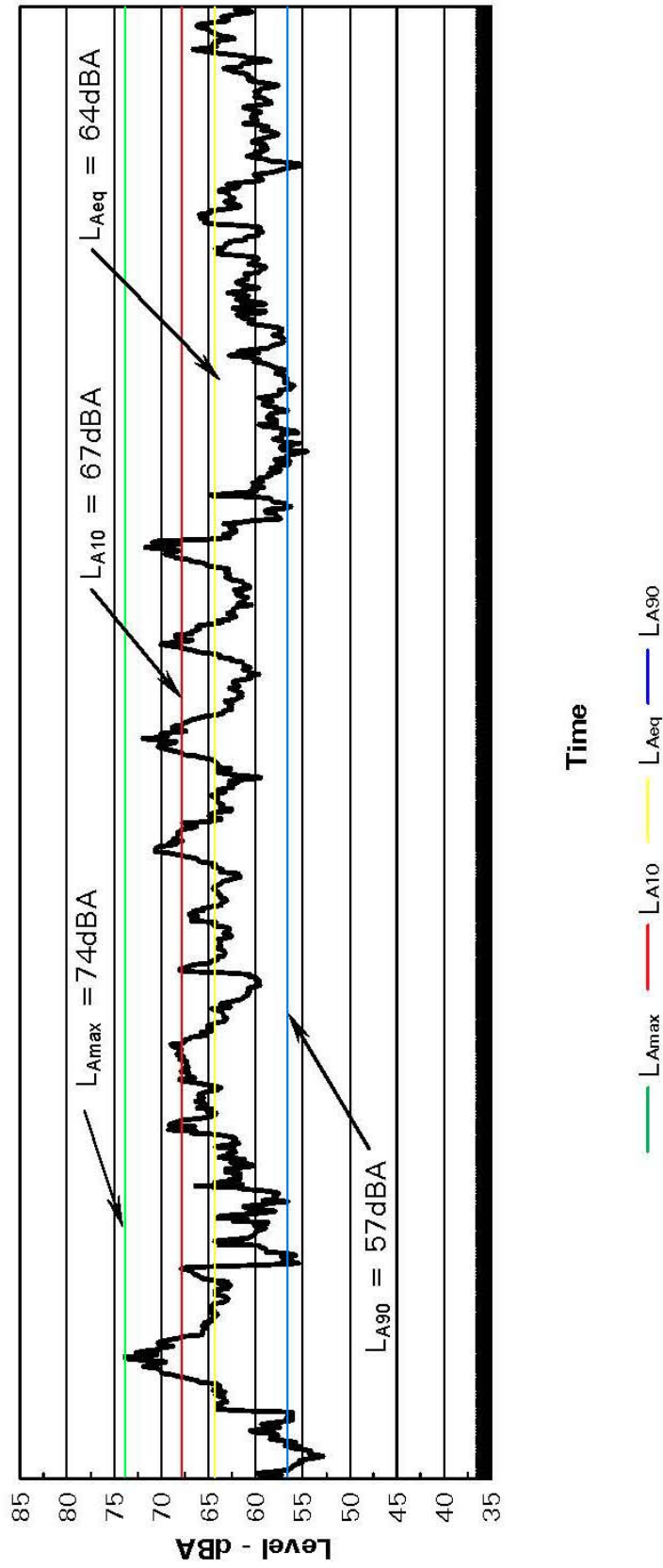
The ambient sound is normally used to describe the total noise environment. The ambient sound is often measured as the 24 hour L_{Aeq} , which is an average value over the 24 hour period. Shorter times are often used, such as the daytime period

Notional Boundary

The notional boundary is defined as a line 20 metres from the facade of any rural dwelling or the legal boundary where this is closer to the dwelling.

Figure A1 shows a noise trace with the relationship of L_{Amax} , L_{A10} , L_{A90} and L_{Aeq} values when including all events over the 15 minute measurement period and Figure A2 some typical noise levels.

* * *



L_{Amax} is the maximum noise level
 L_{A10} is the noise level that is equalled or exceeded for 10% of the measurement period
 L_{A90} is the noise level that is equalled or exceeded for 90% of the measurement period
 L_{Aeq} is the noise level that contains the same energy as the time varying noise

Figure A1

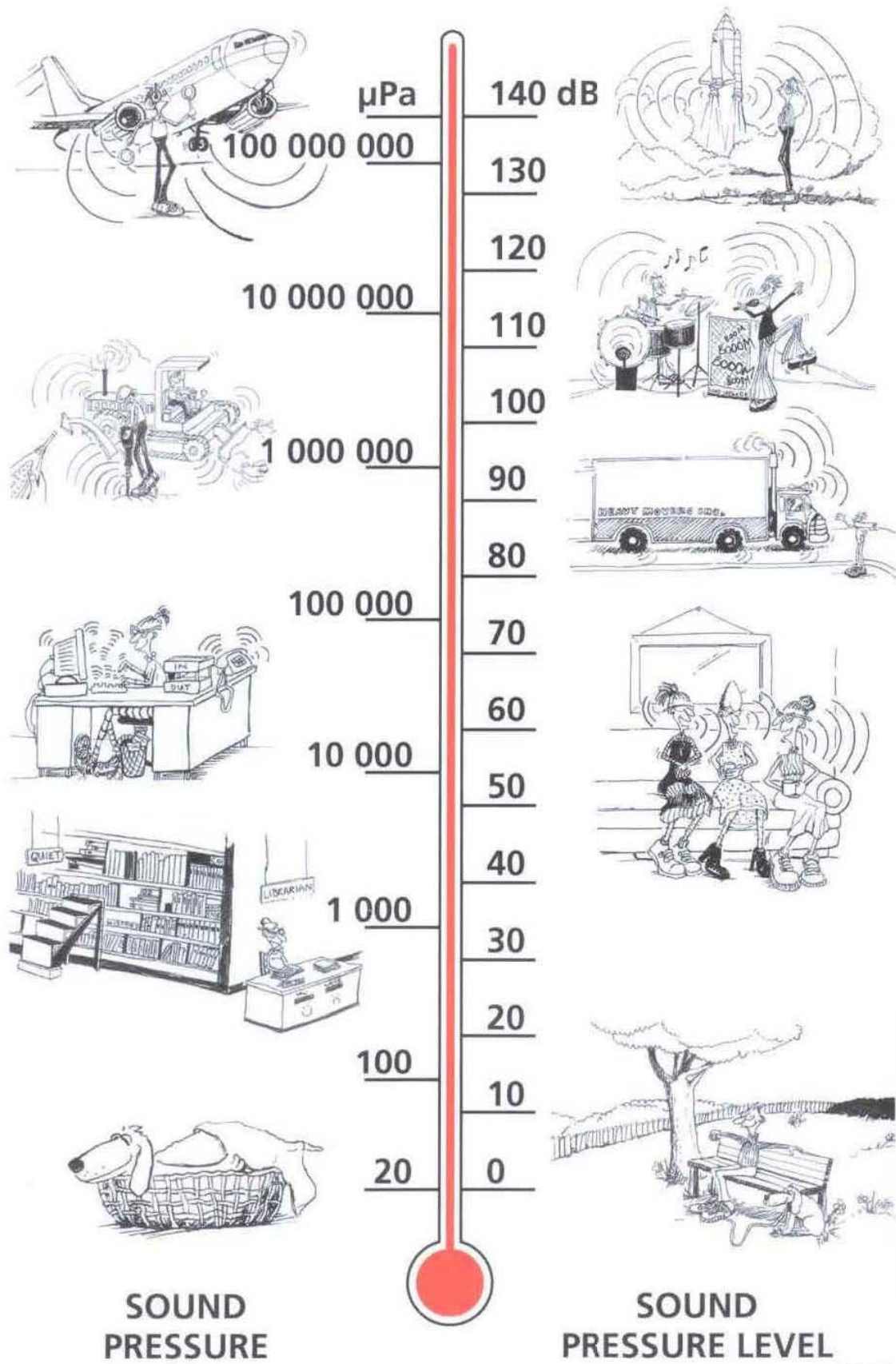


Figure A2

Appendix B

Marshal Day Review

Marshal Day Acoustics (MDA) have reviewed version 1 of this report and version 2 as set out above has included the response to those comments were appropriate. The following sets out the points raised by MDA (in italics) followed by a summary of the response to those points.

As the Report is a draft, it may be beneficial to address some general formatting matters ahead of the final version to ease interpretation. In particular: noise contour plots could usefully show dwellings; moving source paths could be more clearly denoted on these plots; and the dwellings in Figure 11 could be numbered in accordance with the sites in Table 2.

The figures have been modified to show the moving sources in yellow.

Figure 11 relates construction noise at Bridge 3, more than 5km north of the proposed construction work on the water storage area. Table 2 relates to work undertaken on the preparation of the water storage area so the two areas are sufficiently far apart that it is considered they should be reported separately as they relate to a different group of residents. However, the noise effects are reported in the same section of the report so easily identified by the affected residents.

Dwellings at locations 1 and 2 in Figure 10 are within the Timaru District. The Report does not discuss operational noise received here in the context of noise standards in the Timaru District Plan, nor establish any differences in the assessment of construction noise compared to the Ashburton District.

The Ashburton District Plan is the relevant control but a discussion of the Timaru District Plan has been included in the noise assessment. It is noted the noise requirements of both District Plans are similar.

The Report does not discuss the application of NZS 6803:1999 in detail. The Standard provides desirable upper limits of construction noise, which apply at 1 metre from the façade of a building. The Standard also states that “the best practicable options should always be adopted to ensure that the emission of noise from the site is minimized”.

The assessment point and reference to the requirement of section 16 of the Resource Management Act has been added to the report. Construction noise is well within the requirements of NZS6803 and this reflects the fact the best practicable options to minimise noise have been adopted, such as selecting relatively quiet piling methods.

Operational (post construction) noise is not discussed or assessed in detail. We note that the Ashburton District Plan noise standards also apply at the site boundary, in addition to the notional boundary assessment included in the Report. Although this is more of a technical point, it may or may not affect the overall status of the activity.

There is little post construction noise and any such noise will be well within the District Plan noise requirements for a permitted activity.

Table 11-1 of Rule 11.8.1 requires the assessment to be undertaken “at the notional boundary of any residential unit on an adjoining site zoned Rural A and B”. This has been done. The rule goes on to define the notional boundary as a line 20 metres from any residential unit on any neighbouring site, as defined in NZS6802:2008 Acoustics-Environmental Noise

Specific details of ambient noise measurements are not provided. It is best practice to report at least basic details of the survey (i.e. date, time, location, equipment, etc.), in general accordance with NZS 6801:2008, referred to in Rule 11.7.1.a of the Ashburton District Plan.

The report has been updated to satisfy this request.

In Section 5, the ground absorption used in the calculations is described as “representative of typical farm land”. In our experience, inland areas of Canterbury typically are best represented by hard ground conditions, especially in the summer when we assume most construction will occur. We are uncertain what absorption coefficient has been used in the Report.

There is no research available to provide specific guidance on ground absorption in NZ although typically a ground absorption of 0.7 has been used by MDA and others throughout the country for projects such as wind farms where similar ground conditions are experienced and that absorption is considered appropriate. In this case ground absorption of 0.5 was adopted to provide a factor of safety. Changing

this absorption factor by as much as 100% will only alter the result by 1 – 2dB for the closer houses with a slightly higher difference as the distance to the receiver increases although the noise received decreases as the distance increases. There is a greater variation with the changing meteorological effects and for that reason a relatively high positive meteorological factor has been included in the analysis to provide a factor of safety with the calculations.

Details of the construction programme and phasing are not provided, although it is suggested that the white water facility will be constructed after bunds.

This is not a noise issue as even if the work was concurrent there would be insignificant cumulative effects.

The discussion on pg. 19 does not match the predicted construction noise levels in Table 2. The text refers to a highest noise level of 43dB L_{Aeq} , whilst the Table indicates a maximum value of 51dB L_{Aeq} . We presume this is a typing error, but note that it alters the subsequent conclusion that noise levels “fall within the requirement of 50dB L_{Aeq} set out in Rule 11.8.1 of the District Plan”.

There was a typo in the numbers and this has been corrected in the report. However, there appears to be a misunderstanding when adopting the District Plan operation noise limits. NZS6803 (the construction standard) does not permit averaging although clause 6.4.1 of NZS6802:2008 states “If a sound is not present all of the time it is likely to create lesser annoyance than the same sound if it were continuously present. In this Standard, an adjustment to representative sound levels of up to 5dB shall be used to take this into account.” It is noted that no averaging is permitted at night time. For the proposed work, which will only occur during the daytime, averaging will provide for a minimum of 1 – 2dB reduction to the measured level (as given in Table 2), the exact reduction being dependent on the final times the work will be undertaken.

No information is provided on traffic numbers associated with the white water facility, once operational. It is also unclear from the Report alone whether this activity forms part of this consent application. Information on the anticipated number of vehicle movements, access route and resultant noise levels would be necessary to assess any potential noise effects.

Traffic flows for this project are so low (less than 100 vehicle movements per day as set out in the Traffic Engineer's report) that there will not be any adverse traffic noise effects for the residents. This vehicle flow is too low to calculate a meaningful noise level. However, it is acknowledged the noise from individual vehicles will be heard.

Section 6 acknowledges that NZS 6806:2010 does not apply either to existing roads or those with less than 2,000 vehicles (AADT). However, traffic noise is then assessed against a noise limit given in this Standard. We consider that use of this Standard is inappropriate.

In particular, use of the $L_{Aeq(24hr)}$ parameter is not a reliable measure of noise effects relating to this project. Given that no traffic movements (construction or operational) are expected at night, averaging daily noise levels to a 24-hour parameter means that they appear artificially low. 24-hour noise levels are also not directly comparable to commonly used guidance on noise (e.g. District Plan noise standards, WHO guidelines, NZS 6802:2008 and NZS 6803:1999). For daytime noise, we would typically utilise a 1-hour L_{eq} for these reasons.

It is agreed that NZS6806 is inappropriate to adopt when assessing very low traffic flows. It is also considered to be inappropriate to adopt a $L_{Aeq(1hr)}$ value in this case for the same reasons. All that can be said is that traffic noise will be well with a reasonable level for the residents.

We have a number of concerns around the dwellings shown in Figure 11 (adjacent to "Bridge 3"):

- a) Piling will occur close to these dwellings, yet the methodology is not discussed in detail.*
- b) The Report generally asserts that "by complying with the L_{Aeq} levels the L_{Amax} will also be complied with", yet no information or assessment is provided. Whilst we generally agree for typical construction noise sources, this may not be the case for the piling, depending on the method used.*
- c) Similarly, in the Conclusions section, the discussion of vibration effects is introduced. Again, this is likely not a significant issue for general construction activities, but some piling methods may cause high vibration levels in this area.*
- d) Some infrequent night-time activity (e.g. concrete pours) is mentioned in the Report. The low night-time noise limits could mean that this activity does not comply at this time. This is particularly so for dwellings close to Bridge 3 if night-time pours are anticipated at this site.*

The report has been updated to include piling at Bridge 3.

Field measurements have shown that for the proposed construction work (including the type of piling proposed) if the L_{Aeq} is complied with the L_{Amax} will also be complied with. This is the advantage of using L_{Aeq} rather than L_{10} (as adopted in NZS6803P:1984) as the short duration effects of L_{Amax} are included in the L_{Aeq} measurement.

Vibration effects have been monitored at an existing site close to the type of piling proposed and shown to comply with the requirement of Standard DIN 4150-3 (1999): Structural Vibration – Part 3 Effects of Vibration on Structures with a good factor of safety. The distance to the closest dwelling in this case is more than three times greater than monitored in the above case. No vibration issues are expected for any of the proposed construction works.

No contract for the work has been let at this stage so the likelihood of any night time work is an unknown. In the event there is night time work proposed this will be dealt via a noise management plan. This will include implementing noise control techniques, adopting the best practicable option (as set out in NZS6803), working with neighbours, timing of the work and any other options that may be available when the issues are known.

* * *