MARSHALL DAY Acoustics

ROLLESTON ACCESS IMPROVEMENTS PROJECT
CONSTRUCTION NOISE & VIBRATION
TECHNICAL REPORT – PACKAGE 1

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Project: **SH1 ROLLESTON IMPROVEMENTS**

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SUMMARY

Marshall Day Acoustics has been engaged to assess construction noise and vibration effects associated with the proposed State Highway 1 (SH1) Rolleston improvements project (The Project). The Project consists of a new roundabout at the intersection of Dunns Crossing and Walkers Road.

We have conducted a construction noise and vibration assessment using best practice guidance and criteria from the following:

- Partially Operative Selwyn District Plan, *Construction noise NOISE-REQ2 and Noise -R4 Vibration Thresholds*
- New Zealand Standard NZS 6803:1999 *Acoustics - Construction Noise*
- German Standard DIN 41503:2016 *Vibrations in buildings – Part 3: Effects on structures*
- British Standard BS 5228-2:2009 *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration*.

Our assessment indicates that some construction activities have the potential to exceed the recommended noise criteria from NZS 6803 when work is occurring close to residential properties – within approximately 60 metres – noting that noise will be of relatively short duration at any single dwelling.

Construction noise effects can be mitigated by various means, such as through the use of temporary site hoardings, the selection of quieter equipment, and effective communication with residents.

Overall, we consider that construction noise and vibration effects are best addressed through the preparation of a Construction Noise and Vibration Management Plan (CNVMP). CNVMPs are typically a Waka Kotahi contractual requirement on all its significant projects.

We discuss the components of a CNVMP in Section 4.0 of this report. Some of the key components are:

- Identification of the most affected houses and other sensitive locations where noise and/or vibration guideline values apply
- Assessment of construction noise and vibration levels
- A procedure for justifying and managing effects from any night-time work
- Staff training/awareness programme
- Procedures for maintaining contact with stakeholders and managing complaints

On this basis, we consider that the Project can be constructed in a manner that ensures construction noise and vibration can either be mitigated or managed as far as practicable so that adverse effects will be reasonable.

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1.0 INTRODUCTION

This report has been prepared by Marshall Day Acoustics (MDA) to inform the Assessment of Effects on the Environment (AEE) for a Notice of Requirement being sought by New Zealand Transport Agency Waka Kotahi (NZTA).

The Project proposes to construct a roundabout at the Dunns Crossing and Walkers Road intersection and associated works to provide roading upgrades that are necessary to respond to both existing transport deficiencies and provide for the forecasted future growth pressures in the area.

This report specifically considers the potential construction noise and vibration effects of the Project and provides recommendations to mitigate these effects.

This report should be read alongside the AEE, which contains further details on the history and context of the Project. The AEE also contains a detailed description of works and the typical construction methodologies that will be used to implement this work.

Operational noise effects associated with the Project are assessed in a separate report.

A glossary of acoustics terminology is provided in Appendix A.

1.1 Project Description

The SH1 Rolleston Access Improvements is one of the transport networks to have been recognized through New Zealand's Upgrade Programme (NZUP) and is intended to respond to both existing transport deficiencies as well as provide for the forecasted future growth pressures in the area.

The project includes a number of safety improvements to intersections along SH1 through Rolleston to reduce deaths and serious injuries and better manage the forecast future growth in traffic volumes. The wider Project, as shown in Appendix B, includes two packages:

- Package 1 - SH1 / Dunns Crossing Road Roundabout and associated works.
- Package 2 - Overpass and balance of the works.

For the purposes of this Report, we will focus on Package 1 which involves the construction of a roundabout (refer to Figure 1) and associated works to support the safe transport movement along SH1, Dunns Crossing and Walkers Roads. The associated works includes the closure of Dunns Crossing Road to SH1 and cycle subway. The cycle subway will provide a safe crossing of the State Highway at the Walkers Road / Dunns Crossing Road roundabout. The subway connects the proposed Burnham Cycleway (along Runners Road) with the Rolleston residential area and provides a walking and cycling connection to the expanding industrial area and shared use paths along Walkers Road and Two Chain Road.

Figure 1: Proposed roundabout SH1 Dunns Crossing/Walkers Road and PPFs within 100 m

1.2 Assessment methodology

The Project implementation will require the use of mobile construction machinery and tools that can generate relatively high of noise levels as the work progresses along the route.

While a detailed construction methodology is unavailable at this stage, we have based our assessment of likely noise emissions on measurements taken at other similar projects.

We have considered the applicable rules in both the Selwyn District Plan and have assessed noise against New Zealand Standard NZS 6803: 1999 *Acoustics - Construction Noise* (NZS 6803) as well as other appropriate guidance.

Our assessment indicates that noise and vibration levels have the potential to exceed the applicable guideline criteria in NZS 6803. However, we consider that adverse effects can be appropriately managed through the implementation of a Construction Noise and Vibration Management Plan (CNVMP).

2.0 NOISE AND VIBRATION CRITERIA

Below we discuss the underlying noise provisions in both the Partially Operative Selwyn District Plan and other relevant published guidance.

2.1 Selwyn District Plan

Under the Partially Operative District Plan (PODP), noise sensitive locations along the extent of the project are located in various zones, including *Medium Density Residential*, *General Industrial, Large Lot Residential* and *Correction Zone.*

The PODP requires construction activities to be assessed against Rule NOISE-R2 which refers to the noise limits in *NOISE-REQ2*. These limits are reproduced in Table 1. Although the Rule does not provide a definition of construction duration, we have assumed the reference relates to the durations specified by New Zealand Standard NZS 6803: 1999 *Acoustics - Construction Noise*. The numerical limits in Table 1 mirror those in NZS 6803. Notably, the commercial and industrial building daytime limit is the same as the residential dwelling "long-term" duration limit, and we have treated both property types as equivalent in our assessment.

Table 1: NOISE-TABLE6 Construction noise limits

Time of week	Time period	Typical duration		Short-term duration		Long-term duration	
		dB L_{Aeq}	L_{AFmax}	dB L_{Aeq}	L_{AFmax}	dB L_{Aeq}	L_{AFmax}
All Residential and Correction Zones							
Weekdays	0630 – 0730	60	75	65	75	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	0730 – 1800	75	90	80	95	70	85
	1800 – 0630	45	75	45	75	45	75
Sundays/public holidays	0730 – 1800	55	85	55	85	55	85
	1800 – 0630	45	75	45	75	45	75
General Industrial Zone							
N/A	0730 – 1800	75	--	80	--	70	--
	1800 – 0730	80	--	85	--	75	--

NZS 6803 definitions of duration:
Typical – Construction work at any one location for more than 14 calendar days but less than 20 weeks
Short-term – Construction work at any one location for up to 14 calendar days
Long-term – Construction work at any one location with a duration exceeding 20 weeks

2.2 Construction Noise Standard – NZS 6803:1999

Current best practice in New Zealand for assessing construction noise is against New Zealand Standard NZS 6803: 1999 *Acoustics – Construction Noise*. Waka Kotahi has also adopted this standard as the appropriate means for managing construction noise effects.

Although not specifically referenced in the PODP noise rules, as we note above, the noise limits in Table 1 mirror those in NZS 6803.

NZS 6803 provides both recommended upper criteria for construction noise and a series of practical steps for managing construction noise on a day-to-day basis. Specifically, it outlines:

- Maximum noise levels for different time periods and durations of work
- Guidance on community consultation and communication
- Strategies for noise control and mitigation

2.3 Vibration Criteria

We have considered the following vibration guidance:

2.3.1 Waka Kotahi guidelines.

Waka Kotahi has issued the "State Highway Construction and Maintenance Noise and Vibration Guide" that address appropriate vibration (and noise) criteria.

Table 2 provides a summary of the appropriate criteria that consider potential vibration effects on buildings and human response based on the following standards that are commonly adopted in New Zealand:

- Building damage – German Standard DIN 4150-3:2016 *"Structural Vibration – Effects of Vibration on Structures"*.
- Human response – British Standard BS 5228-2:2009 "*Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration"*.

Table 2: Construction vibration criteria

Type	Location	Details	Category A	Category B
Occupied PPFs*	Inside the building	Daytime 0630h – 2000h	1 mm/s ppv	5 mm/s ppv
		Night-time 2000h – 0630h	0.3 mm/s ppv	1 mm/s ppv
Other occupied buildings	Inside the building	Daytime 0630h – 2000h	2 mm/s ppv	5 mm/s ppv
All other buildings	Building foundation	Transient vibration	5 mm/s ppv	BS 5228-2 Table B.2
		Continuous vibration		50% of BS 5228-2 Table B.2

*Protected Premises and Facilities as defined in NZS 6806:2010

The criteria in Table 2 outline a process where construction must be managed to comply with the Category A criteria. However, if measured or predicted vibration levels exceed the Category A criteria, a suitably qualified expert must be engaged to assess and manage construction vibration, with the aim of complying with the Category A criteria as far as practicable.

If the construction vibration exceeds the Category B criteria, construction activity shall only proceed with appropriate monitoring of vibration levels and effects on buildings at risk of exceeding the Category B criteria.

2.3.2 Selwyn District Plan

Under Rule R-14 of the PODP, activities generating vibration must meet thresholds presented in NOISE-TABLE 4, which we understand are derived from German Standard DIN 41503:2016 *Vibrations in buildings – Part 3: Effects on structures*, as shown in Table 3.

Table 3: PODP NOISE-TABLE 4 Vibration Threshold for Structural Damage, PPV (mm/s)

Type of Structure	Short-Term				Long-Term		
	At Foundation, all directions				Floor slab, vertical direction	Topmost Floor, horizontal direction	Floor slab, vertical direction
	1-10Hz	10-50 Hz	50-100 Hz	All	All	All	All
Commercial Activity and Industrial Activity	20	20 to 40	40 to 50	40	20	10	10
Residential Activity	5	5 to 15	15 to 20	15	20	5	10
Sensitive Activity, excluding Residential Activity and Heritage Items	3	3 to 8	8 to 10	8	20	2.5	10

2.4 Discussion

Based on our review of the available criteria, we consider that construction effects should be evaluated against the noise criteria in Table 1 and vibration criteria in Table 2. These criteria will provide for construction phase amenity similar to that anticipated by the underlying PODP permitted activity limits.

These noise and vibration criteria are commonly adopted on Waka Kotahi projects and implemented through a requirement for the contractor to develop a Construction Noise and Vibration Management Plan.

3.0 NOISE AND VIBRATION LEVELS

3.1 Predicted external noise levels and limit setbacks

We have calculated indicative construction noise levels for the receiver locations closest to Dunns Crossing Road roundabout (Figure 2).

Figure 2: Dwellings (highlighted green) within 100 metres of construction activities at Dunns Crossing Road

Table 4 provides indicative sound power levels for construction equipment that would typically be used on a project of this nature. The data is taken from NZS 6803 and previous measurements at construction sites around New Zealand.

Table 4 shows predicted noise levels for each piece of construction equipment at different distances during daytime operations. The selected distances represent the range of typical separation between dwellings and where construction could take place. The predicted levels assume uninterrupted line-of-sight and do not take account of any existing boundary fences or any hoardings that may be erected to control construction noise.

Table 4: Indicative noise levels at 1m from a building façade when equipment is operating 100% of the time and with no effective noise barriers

Equipment	Sound Power Level (dB L_{wA})	Noise Level at distance (dB L_{Aeq})				Daytime Setback (m) required to achieve 70 dB L_{Aeq}
		10 m	25m	50 m	80 m	
Daytime equipment						
Excavator (20T)	103	78	70	63	57	25
Excavator (5T)	102	77	69	62	56	22
Hydro Excavator	112	87	79	72	66	58
Truck	102	77	69	62	56	22
Kerbing Machine	109	84	76	69	63	44
Vibratory Plate Compactor	108	83	75	68	62	40
Pumping Concrete	107	82	74	67	61	36
Truck idling	91	66	58	51	45	6
Milling machine	110	85	77	70	64	48
Plate compactor	108	83	75	68	62	40
Paving machine	103	78	70	63	57	25
Vibratory roller	103	78	70	63	57	25

The construction noise levels in Table 4 show that daytime construction noise may exceed 70 dB L_{Aeq} when the noisiest activities occur within approximately 60 metres of dwellings. We expect this to impact a relatively small number of dwellings along Dunns Crossing Road. At this stage, we do not expect that night-time work will be required.

We consider the most appropriate means of managing potential adverse construction noise effects at these properties, is for the contractor to implement a Construction Noise and Vibration Management Plan (CNVMP) which will set out noise mitigation and communication strategies. We discuss this further in Section 4.0.

NZS 6803 requires that the best practicable option be implemented irrespective of whether compliance is achieved. The CNVMP is the appropriate means of implementing best practical option mitigation strategies over the life of the project.

3.2 Predicted vibration levels and effects

Construction vibration levels would generally be low for all works, with the exception of vibratory rollers and plate compactors (if used). Table 5 provides the nominal set-back distances to achieve the building damage and daytime residential amenity criteria for a range of different types of roller and plate compactors.

These values are based on vibration data from various sources, including measurements conducted by Marshall Day Acoustics across New Zealand. We have used values that are at the higher end of the range to be conservative. In addition, these setback distances include a 100% safety margin to account for different ground types and equipment variation. They are conservative and, in practice, vibration levels will generally be lower at the setback distances given in the table below.

Table 5: Indicative distances to comply with vibration "Category A" criteria

Equipment	Cosmetic Building Damage Setback (m) [1]	Occupied dwellings Setback (m)
	Residential 5 mm/s PPV	Daytime 0630h - 2000h 1mm/s PPV
Drum roller (10-12T vibro function)	14	38
Drum roller (6-8T vibro function)	10	28
Drum roller (3-5T vibro function)	6	18
Plate compactor (450kg)	6	12
Plate Compactor (60-80kg)	2	4

Table 5 indicates that some dwellings close to the works may exceed the "Category A" criteria in depending on the equipment in use.

The CNVMP should identify these setback thresholds and trigger a more detailed consideration of the equipment being used and the potential vibration effects. If required, potential mitigation strategies include alternative means of compaction, such as a static roller and effective communication with affected parties.

4.0 MITIGATION AND MANAGEMENT STRATEGIES

Our assessment indicates that construction activities have the potential to exceed the project noise and vibration criteria. To minimise potential adverse effects, we recommend developing a Construction Noise and Vibration Management Plan (CNMVP) for the project.

The CNVMP should detail consultant and contractor obligations during the project and include:

- applicable noise and vibration criteria
- consent/designation condition requirements
- identification of the most affected properties and other sensitive locations where noise and/or vibration criteria apply

[1] Based on regression analysis of available vibration measurements, plus a 100% safety factor (conservative)

- description of the works, anticipated equipment/processes and durations
- assessment of construction noise and vibration levels
- appropriate mitigation measures to be implemented
- quality program (schedule of inspections, audits and reviews of plan and plan implementation)
- a procedure for justifying and managing effects from any night-time work
- monitoring and reporting requirements
- staff training/awareness program
- procedures for maintaining contact with stakeholders and managing complaints
- contact numbers for key construction staff, staff responsible for assessment and council officers, including at least one Waka Kotahi staff member.

The following sections provide general guidance on several key aspects addressed in the CNVMP.

4.1 Engagement

The most important management tool for construction noise and vibration is consultation and communication.

Individuals affected by noise levels higher than the construction noise and vibration criteria should be informed of the proposed works, including timing. Prior to commencing work, notification should be provided to affected households through methods such as letter drops. Furthermore, a contact phone number should be available to residents who may have concerns about the works or require further information.

A communication plan should be developed as required and included as part of the CNVMP.

4.2 Avoidance of unnecessary noise and vibration

An essential part of the CNVMP is training contract staff to be aware of how their actions may generate unnecessary noise and vibration. Examples to be avoided include sounding of horns when a truck is fully laden, using tonal reversing alarms or the forced cleaning of excavator buckets by thumping them on the ground.

Noise and vibration levels can be reduced through site management and protocols, fitting mufflers to trucks, replacement of tonal reversing alarms with broadband reversing alarms and considerate use of machinery.

4.3 Noise Barriers

Placing temporary noise barriers, such as sheets of plywood or construction noise curtains, between dwellings and construction activities can reduce noise levels by up to 10 decibels. While some works can benefit from localised screening (e.g. when using a concrete drill or saw), other activities are linear and cannot be practicably mitigated by barriers.

4.4 Night Work

Night work can cause the greatest disturbance to residents and should generally be avoided. However, a significant amount of state highway upgrading, or maintenance work in urban areas cannot be carried out during daytime hours due to high traffic flows and lack of suitable detours.

Night-time road construction and maintenance works are necessary if:

- Congestion prevents daytime maintenance (information about congestion is available from the NZTA Asset Manager), or

- The window of opportunity for daytime works is too short (this depends on: the nature of the works, i.e. type, duration, safety issues, etc; congestion; site and traffic characteristics), or
- The construction process is continuous (such as some concrete pours).

Before confirming that night work is required, the following should be evaluated:

- What options are available to avoid working at night?
- If there are options, are these technically and economically feasible?

For most night work, enhanced noise and vibration management measures are required, although this depends on the scale of the project and the number of stakeholders potentially affected. Night work in the middle of a residential area requires careful management. A proactive approach is usually the most effective way for a contractor to manage the risk associated with potential noise effects.

The main noise effect of undertaking road construction and maintenance at night is sleep disturbance. Where practicable, works should be programmed so that all noisy activities are undertaken earlier in the night to minimise sleep disturbance as far as practical.

For night works in particular, people tend not to be disturbed by the lower frequency continuous noise from machine engines but do get disturbed by noises such as reversing beepers, whistling, banging tailgates or shouting.

If mitigation of noise from night work requires the installation of temporary barriers or similar, this can reduce the available working time and thus time for this installation and removal must be included in the programming.

In addition to standard good construction and maintenance noise management, when conducting night work it may be necessary to:

- Increase the frequency of communications with stakeholders
- Conduct regular noise and vibration monitoring to ensure adopted noise criteria are achieved

APPENDIX A GLOSSARY OF TERMINOLOGY

Noise	A sound that is unwanted by, or distracting to, the receiver.
dB	Decibel (dB) is the unit of sound level. Expressed as a logarithmic ratio of sound pressure (P) relative to a reference pressure (Pr), where dB = 20 x log(P/Pr).
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) to more closely approximate the frequency bias of the human ear. A-weighting is used in airborne acoustics.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level commonly referred to as the average level. The suffix (t) represents the period, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 "Acoustics - Construction Noise"
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into vertical (up and down vibration), horizontal transverse (side to side) and horizontal longitudinal direction (front to back) components.
PPV	Peak Particle Velocity (PPV) is the measure of the vibration amplitude, zero to maximum, measured in mm/s.
BS 5228:2009	British Standard BS 5228:2009 "Code of practice for noise and vibration control on construction and open sites, Part 1: Noise, Part 2: Vibration"
DIN 4150-3:2016	German Standard DIN 4150-3:2016 "Vibrations in buildings – Part 3: Effects of vibration on structures"

APPENDIX B PACKAGE 1 PROJECT EXTENTS

MARSHALL DAY Acoustics

ROLLESTON ACCESS IMPROVEMENTS PROJECT
OPERATIONAL NOISE TECHNICAL REPORT
PACKAGE 1

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SUMMARY

Marshall Day Acoustics has been engaged to assess the operational traffic noise associated with the proposed Rolleston Access Improvements Project (the Project), which aims to enhance access and efficiency around State Highway 1 in Rolleston. (Construction noise effects are assessed in a separate report).

This report addresses Package One of the Project, which includes a new roundabout at the intersection of Dunns Crossing and Walkers Road.

This report describes the detailed assessment of the Project using New Zealand Standard NZS 6806:2010 *Acoustics - Road-traffic noise - New and altered roads* which represents the best practice approach to assessing traffic noise.

The assessment identified 71 noise sensitive locations (Protected Premises and Facilities, PPFs) within 100 m of the Project and have calculated the likely change in traffic noise levels as result of the Project for a future design year of 2038. The change in noise level as a result of the Project does not trigger the "altered road" criteria set out in NZS 6806, and no specific noise mitigation is required to be considered under the Standard.

For the majority of PPFs there will be no significant change in traffic noise level (less than ±2dB) due to the Project implementation. Approximately 6 PPFs in the vicinity of Dunns Crossing Rd will experience a "just noticeable" to "noticeable" reduction in traffic noise levels which is considered a minor positive effect.

PPFs that are close to the roundabout will experience a change in traffic noise character from one of vehicles traveling at open road speeds, to one of lower speed accelerating and decelerating vehicles. However, the potential effect of the change will be minimal and will diminish over time as people habituate to any change in noise environment.

Overall, we consider the Project will not significantly change the living or sleep amenity for residents and traffic noise effects will be negligible.

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1.0 INTRODUCTION

This report has been prepared by Marshall Day Acoustics (MDA) to inform the Assessment of Effects on the Environment (AEE) for one Notice of Requirement (NoR 1) being sought by New Zealand Transport Agency Waka Kotahi (NZTA).

The Project proposes to construct a roundabout at the Dunns Crossing and Walkers Road intersection and associated works to provide roading upgrades that are necessary to respond to both existing transport deficiencies, as well as provide for the forecasted future growth pressures in the area. This Report will specifically consider the actual and potential effects of the Project at the Pre-implementation and Implementation phases of this project as it related to operational noise effects and recommendations to mitigate effects.

This report should be read alongside the AEE, which contains further details on the history and context of the Project. The AEE also contains a detailed description of works to be authorised within NoR 1, and the typical construction methodologies that will be used to implement this work. These have been reviewed by the author of this Report and have been considered as part of this assessment of operational noise effects. Where a description of an activity is necessary to understand the potential effects, it has been included in this report for clarity.

1.1 Project Description

The SH1 Rolleston Access Improvements is one of the transport networks to have been recognized through New Zealand's Upgrade Programme (NZUP) and is intended to respond to both existing transport deficiencies as well as provide for the forecasted future growth pressures in the area.

The project includes a number of safety improvements to intersections along SH1 through Rolleston to reduce deaths and serious injuries and better manage the forecast future growth in traffic volumes. The wider Project includes two packages:

- Package 1 - SH1 / Dunns Crossing Road Roundabout and associated works.
- Package 2 - Overpass and balance of the works.

For the purposes of this Report, Package 1 will be discussed and involves the construction of a roundabout and associated works to support the safe transport movement along SH1, Dunns Crossing and Walkers Roads. The associated works includes the closure of Dunns Crossing Road to SH1 and cycle subway. The cycle subway will provide for a safe crossing of the State Highway at the Walkers Road / Dunns Crossing Road roundabout. The subway connects the proposed Burnham Cycleway (along Runners Road) with the Rolleston residential area and a walking and cycling connection to the expanding industrial area and shared use paths along Walkers Road and Two Chain Road.

1.2 Potential Noise Effects from the Project

The key components of the Project considered in this noise assessment are:

- A new roundabout at the intersection of SH1 with Dunns Crossing and Walkers Roads as indicated in Figure 1.
- A range of pavement types including Stone Mastic Asphalt (SMA). Refer Appendix D and E.
- Approximately 71 noise sensitive Protected Premises and Facilities (PPFs) within the urban assessment area – 100 metres from the road.
- Existing noise control bunds and fences along State Highway 1.

Figure 1: Proposed roundabout SH1 Dunns Crossing/Walkers Road and PPFs within 100 m

1.3 Assessment methodology

The Project requires an alteration to the NZTA existing designation, reference NZTA-1. As such, this report considers the potential operational noise effects. (A separate report assesses the potential construction noise effects).

We have considered the underlying noise provisions in both the Partially Operative Selwyn District Plan (PODSP) and New Zealand Standard NZS 6806:2010 *Acoustics - Road-traffic noise - New and altered roads* (NZS 6806).

We assessed the traffic noise levels at sensitive receivers along the Project extent and evaluated how future noise levels will change as a result of the Project. As we describe in the following sections, it was found that the relevant NZS 6806 criteria are not exceeded at any of the assessment locations, and no further noise mitigation is required.

Appendix A includes a glossary of acoustic terminology used in this report.

2.0 NOISE CRITERIA

Below we discuss the relevant criteria for the project.

2.1 Selwyn Partially Operative District Plan

State Highway 1 is designated in the Partially Operative Selwyn District Plan (POSDP). Dwellings within the assessment area are within the Medium Density Residential Zone (MRZ).

The POSDP excludes traffic noise on public roads from complying with the permitted activity standards. This exclusion is noted in NOISE-R1 (Activities not otherwise specified), which states that traffic and rail noise within a land transport corridor does not need to comply with the general rule requirements.

Rule NOISE-R2 requires construction noise to comply with the limits set out in NOISE-REQ2. We assess construction effects in a separate report. Similarly, the construction report assesses vibration generation against the permitted activity standards set out in Rule NOISE-R14.

2.2 NZS 6806:2010

For new projects, NZTA / Waka Kotahi require noise to be assessed using New Zealand Standard NZS 6806:2010 *Acoustics - Road-traffic noise - New and altered roads*. This is the relevant standard for the assessment of road-traffic noise in New Zealand and represents current best practice.

In NZS 6806, noise mitigation is only considered for roading projects that are deemed to have a noticeable noise effect, and any mitigation needs to achieve a noticeable reduction in road-traffic noise.

The Standard provides criteria for existing roads that are being "altered" to determine whether a roading project requires consideration of further noise mitigation. Appendix B summarises the key concepts of NZS 6806.

3.0 NZS 6806 ASSESSMENT METHODOLOGY

The following sections describe how we have applied NZS 6806. The Standard provides a process for identifying noise sensitive locations and for evaluating future traffic noise levels against criteria for "new" and "altered" roads. The current Project is appropriate to consider against the "altered" road criteria.

3.1 We identified 71 protected premises and facilities within 100 m of the project

In urban areas[1], the NZS 6806 altered road criteria apply to all Protected Premises and Facilities (PPFs) within 100 m of the proposed road. PPFs are defined as:

- residential activities
- marae
- overnight medical care
- teaching (and sleeping) in educational facilities
- playgrounds that are part of educational facilities that are within 20m of buildings used for teaching purposes.

Residential accommodation in buildings which are predominantly used for commercial or industrial purposes, garages and ancillary buildings, and premises that are not yet built, unless they have a current building consent, are not considered PPF's under NZS 6806.

[1] *The definition of urban and rural areas specified in NZS 6806 is no longer used by Stats NZ and cannot be applied. For the current noise assessment, the definition of urban and rural areas is as shown on the current "Urban Rural (generalised)" map published by Stats NZ*

We identified 71 PPFs within 100 m of the project based on building platform data obtained from Land Information New Zealand[2]. We note there are a small number of PPFs within the Package 1 assessment area that are not included in this report and are addressed more appropriately as part of the Package 2 assessment.

3.2 We used a design year of 2038 for this assessment

NZS 6806 provides assessment criteria that are to be applied in the "design year". This is defined as *"A point in time that is not less than 10 years but not more than 20 years after the opening of a new road, or the alteration to an altered road, to the public"*. For this Project the design year is 2038.

3.3 The Do-Nothing and Do-Minimum scenarios have different traffic volumes

In order to evaluate potential noise effects, NZS 6806 criteria apply to the following operational scenarios:

- Do-nothing – the existing road layout with the design year (2038) traffic volumes.
- Do-minimum – the proposed road layout with design year (2038) traffic volumes, but without any specific noise mitigation implemented.

3.4 Altered road status is dependent on two criteria

A project is considered an altered road if it meets either of the following criteria:

- Criterion A: where the do-minimum noise environment is ≥ 64 dB $L_{Aeq\ (24\ hour)}$ and the do-minimum noise environment is greater than the do-nothing noise environment by 3 dB or more,
- Criterion B: where the do-minimum noise environment is ≥ 68 dB $L_{Aeq\ (24\ hour)}$ and the do-minimum noise environment is greater than the do-nothing noise environment by 1 dB or more.

4.0 TRAFFIC NOISE LEVEL PREDICTIONS

This section describes how we have assessed the Project against the criteria.

4.1 Information Provided

Our calculations are based on the following files provided by Beca:

- "Existing pavement surfacing" dated 2024-05-30
- "Topographic bund survey" dated 2024-05-57
- Project design "Concept Design Package 1 and 2 Proposed Surface Markup" dated 2024-05-28.
- Average Annual Daily Traffic values for the Do-Nothing and Do-Minimum scenarios.
- 3D terrain data of proposed design in DXF format.

4.2 Modelling Algorithm

In accordance with NZS 6806, traffic noise calculations have been carried out using the *Calculation of Road Traffic Noise (CRTN)* prediction method, implemented in the internationally recognised SoundPLAN environmental noise software (ver 9.0).

Our assessment accounts for multiple factors that affect the propagation of road traffic noise including:

- Road parameters such as road surface, traffic speed, vehicle type and gradient.

[2] *NZ Building Outlines*, *NZ Primary Parcels*, and *NZ Roads Addressing*, Land Information New Zealand (LINZ), obtained 28 May 2024.

- The presence of noise control barriers or other structures (e.g. 1 m high concrete safety barriers to the bridge)
- Ground condition, including absorptive ground such as fields or reflective ground such as concrete or water

Appendix D and E present the modelling parameters used to assess both scenarios in the model.

We measured existing traffic noise levels at various locations within the Project area to verify the noise modelling predictions. The predicted traffic noise levels presented in the following sections are 2 to 3 dB higher (i.e. more conservative) than will be experienced in practice.

4.3 Mitigation

No specific noise mitigation measures have been assessed for this project, other than the noise control bund and fence that we understand are required as a condition of consent for the subdivision adjacent the project.

4.4 Predicted noise levels

Our calculations show that the Project will not trigger the NZS 6806 altered road criteria at any PPF. Therefore, no further noise mitigation is required.

Table 1 (overleaf) presents the predicted noise levels for selected PPFs where the greatest change in noise level will be experienced i.e., at the Dunns Crossing roundabout. Appendix G provides detailed noise data for all 71 PPFs. Appendix F contains noise level contour plots for the Do-Minimum situation.

The analysis indicates that, following implementation of the Project, most dwellings will experience a small decrease in noise levels, with significant reductions at some dwellings of up to approximately 6 dB, due to Dunns Crossing Road moving further away. A few locations on Dunns Crossing Road, will experience small increases, with the largest being a negligible 1.5 dB at 380 Dunns Crossing Road. Notably, none of the NZS 6806 criteria are triggered for any dwellings, indicating that the predicted traffic noise levels remain within acceptable limits.

5.0 ASSESSMENT OF TRAFFIC NOISE EFFECTS

Below we discuss the potential adverse effects from the project in terms of the change in noise level and character.

5.1 There will be negligible change in noise level at PPFs

For the majority of PPFs there will be no significant change in traffic noise levels (less than ±2dB) as a result of the Project implementation. Approximately 6 PPFs in the vicinity of Dunns Crossing Rd will experience a small reduction in traffic noise levels, which is considered a minor to moderate positive effect. The PPFs with the greatest change in noise level are presented in Table 1.

Table 1: Predicted future traffic noise levels

Address	Predicted noise level, dB $L_{Aeq\ (24hr)}$		Change because of Project, dB	Criteria triggered?
	Do-nothing	Do-minimum		
PPFs closest to Dunns Crossing Roundabout				
15 Fountain Place	63.4	63.3	-0.1	No
17 Fountain Place	62.7	62.4	-0.3	No
406 Dunns Crossing Road	68.8	65.1	-3.7	No
404 Dunns Crossing Road	68.8	64.3	-4.5	No
402 Dunns Crossing Road	68	62.7	-5.3	No

Address	Predicted noise level, dB $L_{Aeq\ (24hr)}$		Change because of Project, dB	Criteria triggered?
	Do-nothing	Do-minimum		
400 Dunns Crossing Road	67.5	61.9	-5.6	No
398 Dunns Crossing Road	67.3	61.6	-5.7	No
1 Newman Road	67.2	61.4	-5.8	No
392 Dunns Crossing Road	66.7	63	-3.7	No
390 Dunns Crossing Road	66.1	64.4	-1.7	No
388 Dunns Crossing Road	66	65.3	-0.7	No
376 Dunns Crossing Road	59.3	59.3	0	No
380 Dunns Crossing Road	56	57.5	1.5	No
382 Dunns Crossing Road	63.6	64.2	0.6	No

5.2 The roundabout may change the character of the traffic noise

Our assessment of traffic noise is generally quantitative, relating to the noise level received in the future and the change in noise level experienced due to the Project. However, it is acknowledged there are also several qualitative aspects that affect how people perceive the acoustic effects of a Project.

Whilst noise levels for most PPFs are expected to be similar with and without the Project, PPFs that are close to the roundabout will experience a change in character from one of vehicles traveling at open road speeds, to one of lower speed accelerating and decelerating vehicles. The change can be most noticeable for heavy vehicles.

Good design can reduce the change in noise level or character. For instance, engine braking by traffic, and especially trucks, can be reduced if road design clearly indicates a drop in speed environment enabling truck drivers to pre-empt the speed reduction.

In practice, we anticipate the comparatively high traffic flows on SH1 compared with Walkers and Dunns Crossing Road will mean that most traffic can pass through the roundabout without significant braking or acceleration.

In our experience, dwelling occupants gradually habituate over time, i.e. “getting used to” the change and level in noise environment. Any change in environment due to the introduction reconfiguration of an intersection, may cause initial disturbance to people. However, over time, people become accustomed to the sound (both level and location), pay less attention to it and the response will diminish.

5.3 Health and amenity effects that might be experienced as a result of noise levels

Over the last approximately 20 years, many of the subdivisions in Rolleston adjacent to the State Highway have been developed to protect residents against traffic noise. This has typically been achieved through a combination of a 3-metre-high noise control bund/fence along the State Highway boundary, setbacks and planning controls to require appropriate constructions for dwellings.

Over time traffic noise levels will increase such that noise levels at dwellings closest to the State Highway will experience noise levels in the order of 60 to 65 dB $L_{Aeq(24h)}$, irrespective of whether the Project proceeds. To give this some context, the World Health Organisation (WHO) has identified that noise levels above 50 dB L_{Aeq}[1] may cause adverse health effects.

[1] The 2018 WHO guidelines recommend an external road traffic noise level of 53 dB L_{den}. This converts to approximately 50 dB $L_{Aeq(24h)}$

Whilst our assessment shows a reduction in traffic noise levels for some, most dwellings' noise level will largely remain unchanged. In broad terms, external noise will be above the WHO recommended level of 50 dB L_{Aeq} but, through the planning controls that have been implemented by Selwyn District Council, internal noise levels within dwellings will be much lower and will provide appropriate internal living and sleeping amenity.

APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (24 h) would represent a period of 24 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
NZS 6801:2008	New Zealand Standard NZS 6801:2008 *"Acoustics – Measurement of environmental sound"*
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics – Environmental Noise"*
NZS 6806:2010	New Zealand Standard NZS 6806:2010 *"Acoustics - Road-traffic noise - New and altered roads"*
Design-Year	A point in time not less than 10 years but not more than 20 years after the opening of the Project to the public.
Do-nothing Scenario	The situation at Design Year assuming no alterations are made to the existing road.
Do-minimum Scenario	The situation at Design Year assuming the Project is constructed, but excluding no specific noise mitigation measures such as noise control barriers or low noise road surfaces.

APPENDIX B NEW ZEALAND ROAD TRAFFIC NOISE STANDARD NZS 6806:2010

NZS6806:2010 "Acoustics – Road-traffic noise – New and altered roads" has recently been developed and was issued as a full New Zealand Standard in April 2010. This is the first New Zealand road-traffic noise standard and was developed by an independent multidisciplinary committee of Standards New Zealand.

The Standard is intended for all road-traffic noise assessments both from State highways, and local roads in circumstances where the traffic is within the thresholds of the Standard.

The Standard is an extensive and complex document; therefore, it is only practicable to present the key concepts for the purposes of this report.

The Standard uses the noise measurement index ($L_{Aeq(24h)}$) and the concept of a "design year" (the year for which the assessment is undertaken) at least ten years after opening of a project.

B1 Assessment positions

The Standard specifies a list of types of protected premises and facilities (PPFs), which are assessed in accordance with the provisions of the Standard. In addition to premises such as dwellings and educational facilities, NZS6806 extends its protection to other premises such as marae, hospitals which contain in-patient facilities, motels and hotels in residential zones and playgrounds within 20 metres of educational facilities.

The assessment position for existing buildings is at any façade. Commercial and business uses are not considered to be PPFs and are therefore excluded from the assessment as they are not considered to be noise sensitive.

NZS 6806 stipulates that, in an urban area, all protected premises and facilities within 100 metres of the alignment shall be assessed, and excludes locations outside this area.

B2 Noise criteria

The noise criteria of the Standard are not based on existing ambient noise levels, but are dependent on traffic volume and distinguish between new and altered roads. There are three levels of criteria (A, B and C) as set out in the table below.

Table 2: Noise criteria

Category	Altered Roads	New Roads with a predicted traffic volume >75,000 AADT at the design year	New Roads with a predicted traffic volume of 2,000 to 75,000 AADT at the design year
	dB $L_{Aeq(24h)}$	dB $L_{Aeq(24h)}$	dB $L_{Aeq(24h)}$
A (primary external noise criterion)	64	64	57
B (secondary external noise criterion)	67	67	64
C (internal noise criterion)	40	40	40

The criteria to be used depend on the application of the best practicable option (BPO) test, with the A criterion being met or bettered if this is consistent with the BPO, the B criterion being met or bettered if criterion A is not achievable with the BPO, and criterion C being achieved with the adoption of the BPO, if criterion B is not achievable with the BPO.

The Category C criterion is an internal design criterion for habitable rooms; however, while not specifically stated in NZS6806, it is assumed that the internal criterion applies to all noise sensitive rooms in protected premises and facilities, including teaching areas and in-patient care rooms where patients sleep.

The 40 dB $L_{Aeq(24h)}$ criterion is required to be achieved by the adoption of the BPO, for habitable rooms which would otherwise receive internal noise levels greater than 45 dB $L_{Aeq(24h)}$, i.e. a minimum noise level reduction of five decibels is required to be achieved.

B3 Limitations of the Standard

Section 1.3 of the Standard lists the limitations of the Standard. Of particular relevance to this Project are items (b) and (c) which state that;

> *This Standard does not apply to:*
>
> *(b) New and altered roads predicted to carry less than 2000 AADT at the design year;*
>
> *(c) Alterations to existing roads that are not altered roads as defined in this Standard;*[3]

B4 Noise assessment scenarios

NZS6806 provides for several operational scenarios to be assessed and compared. These include:

- The existing noise environment which, for altered roads, consists of the current road layout and traffic volume, and, for new roads, consists of the current ambient noise level;
- A future Do-minimum scenario, which represents circumstances at the design year where a Project has been implemented without any specific noise mitigation. This means that the choice of road surface material is independent from its noise generating characteristics and the only barriers included are solid safety barriers, which are required for reasons other than noise mitigation.
- Several future mitigation options, which consist of scenarios whereby mitigation is designed specifically to reduce noise levels in order to achieve compliance with the relevant noise criteria and fulfil the BPO test.

[3] NZS 6806:2010 Acoustics – Road-traffic noise – New and altered roads, Section 1.3.1

APPENDIX C PACKAGE 1 PROJECT EXTENTS

APPENDIX D 'DO-NOTHING' SITUATION NOISE MODELLING INPUT PARAMETERS

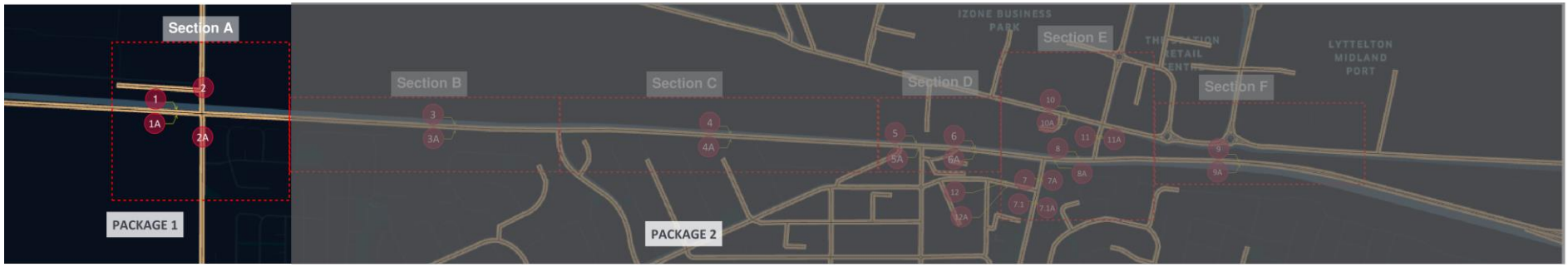


Table 3: Assessment parameters Do Nothing

Section	Item	Description	Vehicles per hour (Vph)	Heavy Vehicles (HV%)	Surface type	Surface correction	Speed limit Km/h
A	1	SH1 (West-East) to Walkers Rd	10522	10	Grade 3/5 Chipseal	6	100
	1a	SH1 (East-West) to Walkers Rd	10130	10	Grade 3/5 Chipseal	6	100
	2	Two Chain Rd to SH1 (Walkers Rd) to SH1	5433	8	Grade 3/5 Chipseal	6	100
	2a	Newman Road to SH1(Dunns Crossing Rd)	5433	8	Grade 4/6 Chipseal	6	50
B	3	SH1 (West-East) Walkers Road to Rolleston Drive	11594	10	Grade 2/4 Chipseal	6	100
	3a	SH1 (East-West) Rolleston Drive to Walkers Road (SH1)	11591	10	Grade 3/5 Chipseal	6	100
C	4	SH1 (West-East) Rolleston Drive to Tennyson St	11290	11	Grade 3/5 Chipseal	6	80
	4a	SH1 (East-West) Rolleston Drive to Tennyson St	10536	12	Grade 3/5 Chipseal	6	80
D	5	SH1 (West-East) Rolleston Drive to Tennyson St	11260	11	Grade 3/5 Chipseal	6	80
	5a	SH1 (East-West) Rolleston Drive to Tennyson St	10441	12	Grade 3/5 Chipseal	6	80
	6	SH1 (West-East) Tennyson St to Rolleston Drive North	12919	10	Grade 3/5 Chipseal	6	80
	6a	SH1 (East-West) Tennyson St to Rolleston Drive North	14703	9	Grade 3/5 Chipseal	6	80
E	7	Rolleston Drive North to SH1 (North-South)	9580	4	DG10	0	50

Section	Item	Description	Vehicles per hour (Vph)	Heavy Vehicles (HV%)	Surface type	Surface correction	Speed limit Km/h
	7a	Rolleston Drive North to SH1 (South-North)	13030	4	DG10	0	50
	7.1	Rolleston Drive North to SH1 (North-South)	9028	4	DG10	0	50
	7.1a	Rolleston Drive North to SH1 (South-North)	7937	4	DG10	0	50
	8	Rolleston drive to Hoskyns (West-East)	23616	8	SMA10	0	80
	8a	Rolleston drive to Hoskyns (East-West)	22017	8	SMA10	0	80
	10	George Holmes to Hoskins Rd (E-W) Jones Road	5090	17	DG10	0	50
	10A	George Holmes to Hoskins Rd(West-East)Jones Road	3058	20	DG10	0	50
	11	Jones Road to SH1 (Hoskyns road (North-South)	11912	11	SMA10	0	50
	11a	Jones Road to SH1 (Hoskyns road S-N)	10385	11	SMA10	0	50
	12	Kidman St (West-East)	6272	3	DG10	0	50
	12a	Kidman St (East-West)	1625	5	DG10	0	50
F	9	Hoskyns Rd to Christchurch (West-East)	19634	12	SMA10	0	100
	9a	Hoskyns Rd to Christchurch (East-West)	19827	12	EPA10	-1	100

APPENDIX E 'DO-MINIMUM' SITUATION NOISE MODELLING INPUT PARAMETERS

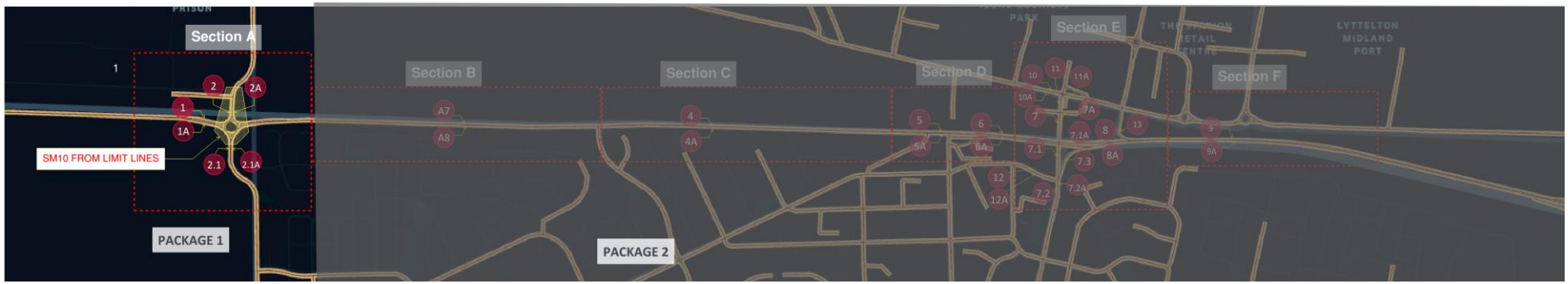


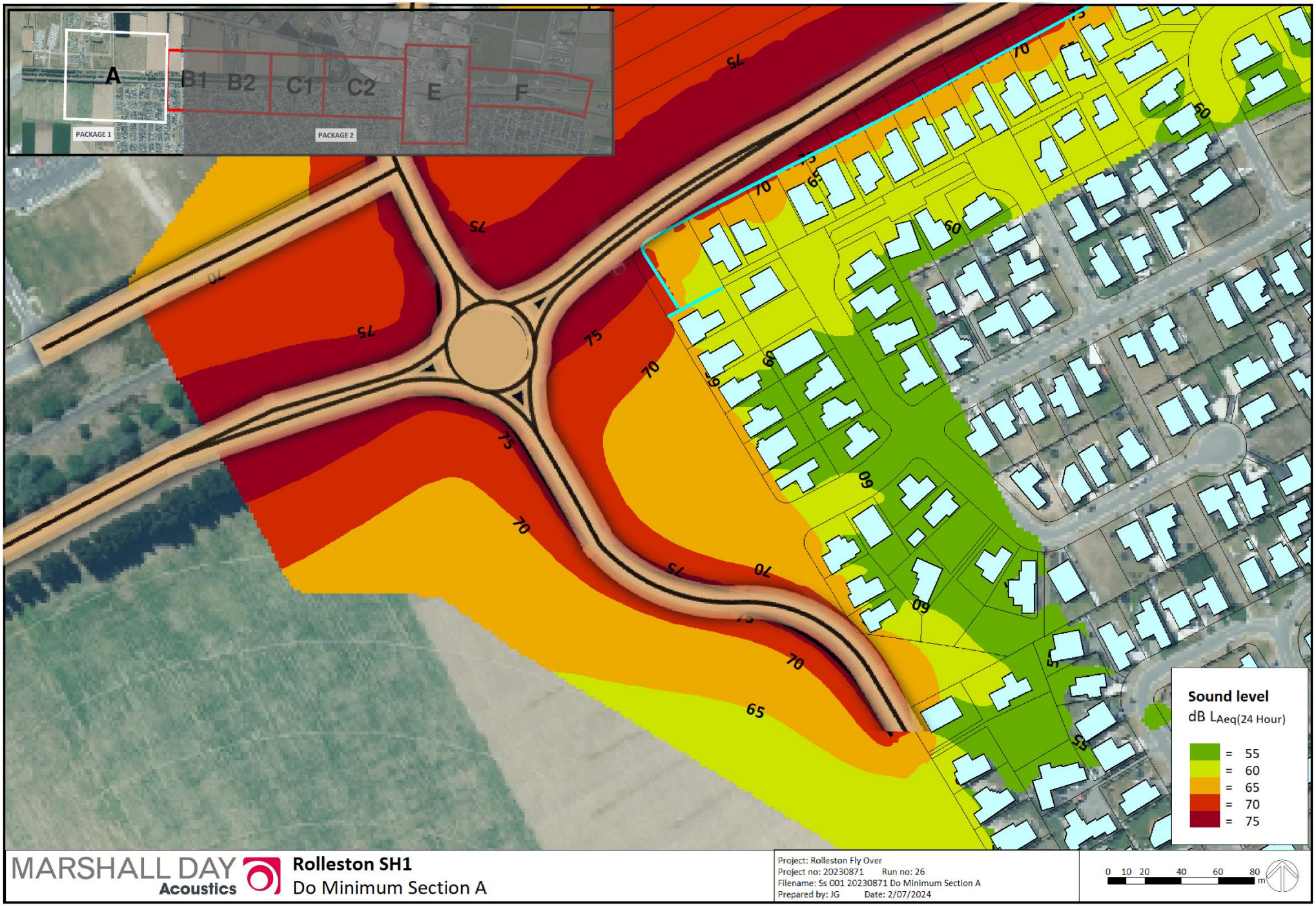
Table 4: Assessment parameters Do Minimum

Section	Item	Description	Vehicles per hour (Vph)	Heavy Vehicles (HV%)	Surface type	Surface correction	Speed limit Km/h
A	1	SH1 (West-East) to Walkers Rd	10527	10	Grade 3/5 Chipseal	6	100
	1A	SH1 (East-West) to Walkers Rd	10298	10	Grade 3/5 Chipseal	6	100
	2	Two Chain Rd to SH1 (Walkers Rd) to SH1	2646	10	SMA10	0	100
	2A	SH1 to Two Chain Rd (Walkers Rd)	1606	12	SMA10	0	100
	2.1	Lowes Road to SH1(Dunns Crossing Rd)	3267	5	Grade 4/6 Chipseal	6	50
	2.1A	Lowes Road to SH1(Dunns Crossing Rd)	4864	3	Grade 4/6 Chipseal	6	50
B	3	SH1 (West-East) Walkers to Rolleston Drive	8455	13	Grade 2/4 Chipseal	6	100
	3A	SH1 (East-West) Walkers to Rolleston Drive	10905	11	Grade 3/5 Chipseal	6	100
C	4	SH1 (West-East)Rolleston Drive to Tennyson St	8399	13	Grade 3/5 Chipseal	6	80
	4A	SH1 (East-West) Rolleston Drive to Tennyson St	10517	11	Grade 3/5 Chipseal	6	80
D	5	SH1 (West-East) Rolleston Drive to Tennyson St	8388	13	Grade 3/5 Chipseal	6	80
	5A	SH1 (East-West) Rolleston Drive to Tennyson St	13248	10	Grade 3/5 Chipseal	6	80

Section	Item	Description	Vehicles per hour (Vph)	Heavy Vehicles (HV%)	Surface type	Surface correction	Speed limit Km/h
	6	SH1 (West-East) Tennyson St to Rolleston Drive	8386	13	PA10	6	80
	6A	SH1 (East-West) Tennyson St to Rolleston Drive	11624	10	SMA10	6	80
E	7	Rolleston Drive Bridge (North-South)	16740	5	SMA10	0	50
	7A	Rolleston Drive Bridge (North-South)	7835	3	SMA10	0	50
	7.1	Rolleston Drive to SH1 (North-South)	10396	4	SMA10	0	80
	7.1A	Rolleston Drive to SH1 (North-South)	12031	4	SMA10	0	80
	7.2	Rolleston Drive to SH1 (North-South)	10396	4	SMA10	0	60
	7.2A	Rolleston Drive to SH1 (North-South)	12031	4	SMA10	0	60
	7.3	SH1 to Rolleston Drive (East-West)	5642	5	SMA10	0	50
	8	Rolleston drive to Hoskyns (West-East)	8360	13	PA10	0	80
	8A	Rolleston drive to Hoskyns (East-West)	9110	6	SMA10	0	80
	10	George Holmes to Hoskyns Rd (East-West) Jones Road	6198	13	DG10	0	50
	10A	George Holmes to Hoskyns Rd (West-East)Jones Road	4798	16	DG10	0	50
	11	New Road Up bridge (North-South)	16734	5	DG10	0	50
	11A	New Road Up bridge (South-North)	7841	5	DG10	0	50
	12	Kidman St (West-East)	6900	7	DG10	0	50
	12A	Kidman St (East-West)	1942	4	DG10	0	50
	13	Jones Road to SH1 (Hoskyns road South-North)	11248	11	SMA10	0	50
F	9	Hoskyns Rd to Christchurch (West-East)	19607	12	PA10	0	100
	9A	Hoskyns Rd to Christchurch (East-West)	20774	8	SMA10	-1	100

APPENDIX F DO MINIMUM NOISE LEVEL CONTOURS

(following pages)


A
B1
B2
C1
C2
E
F
PACKAGE 1
PACKAGE 2
75
70
65
60
55
Sound level
dB LAeq(24 Hour)
= 55
= 60
= 65
= 70
= 75
MARSHALL DAY Acoustics
Rolleston SH1
Do Minimum Section A
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Filename: Ss 001 20230871 Do Minimum Section A
Prepared by: JG Date: 2/07/2024
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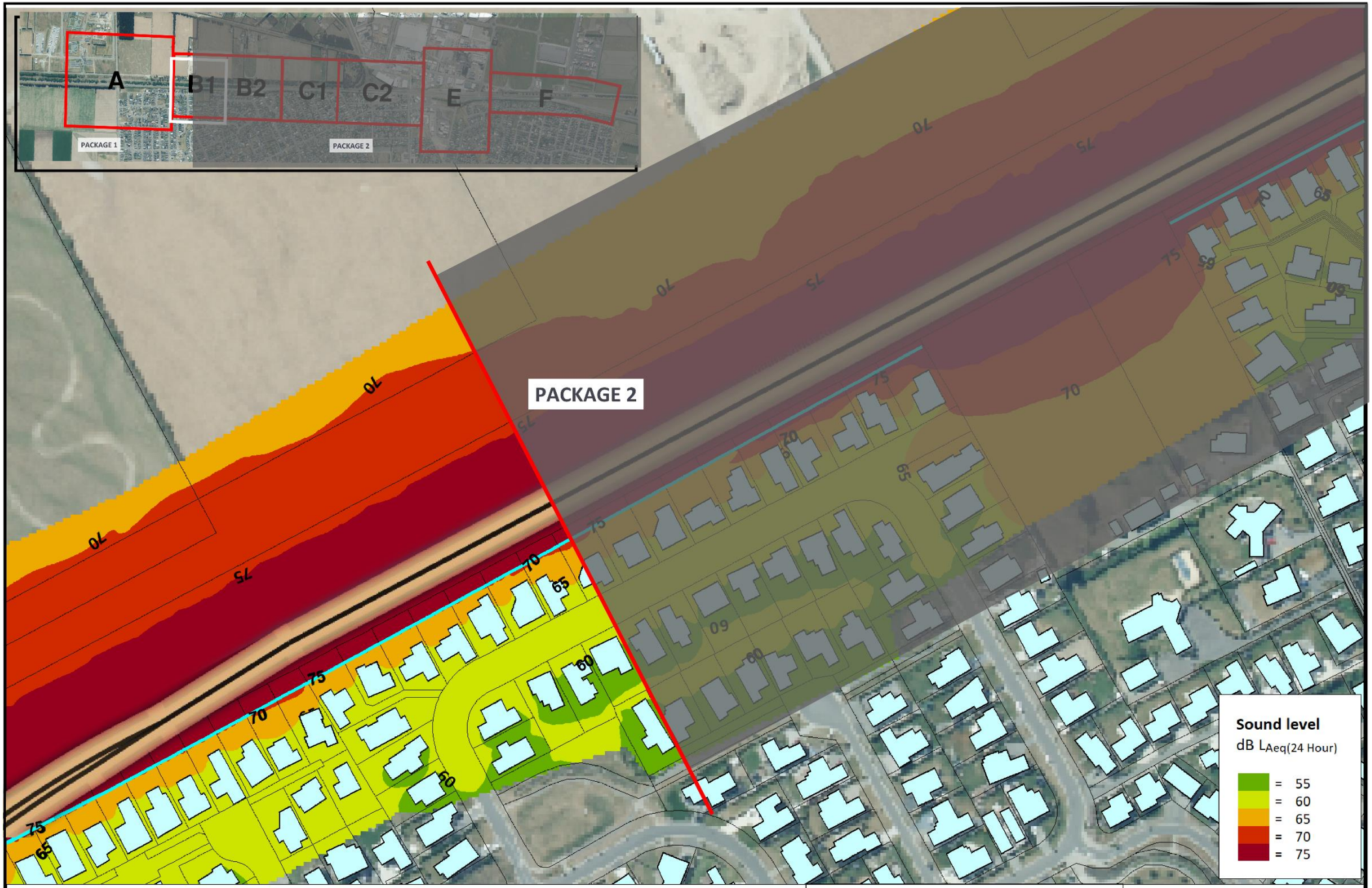

MARSHALL DAY Acoustics

Rolleston SH1

Do Minimum Section B1

Project: Rolleston Fly Over
Project no: 20230871 Run no: 26
Filename: Ss 002 20230871 Do Minimum Section B
Prepared by: JG Date: 1/07/2024

0 10 20 40 60 80 m

APPENDIX G DO-NOTHING AND DO-MINIMUM NOISE LEVELS FOR PACKAGE 1 PPFS

PPF	Do Nothing (2038) LAeq(24h)	Do Minimum (2038) LAeq(24h)
1 Fountain Place	55.5	54.2
1 Newman Road	67.2	61.4
2 Fountain Place	55.2	54.4
2 Goodland Place	56.3	55.6
2 Newman Road	66.7	63
3 Fountain Place	55.2	54.7
3 Newman Road	55.5	54.2
4 Fountain Place	56.2	55.5
4 Goodland Place	54.8	54.2
4 Newman Road	58.8	57.8
5 Fountain Place	55.6	54.7
6 Fountain Place	56.6	55.8
6 Joy Place	58	57.5
6 Newman Road	56.3	55.6
7 Fountain Place	58	57.4
7 Joy Place	58.3	57.8
7 Newman Road	55.2	54.4
8 Fountain Place	58.8	58.2
8 Goodland Place	54.8	55.3
8 Joy Place	58.8	58.4
9 Joy Place	58.9	58.3
10 Fountain Place	58.8	58.2
10 Joy Place	58.9	58.5
11 Fountain Place	62.9	62.7
11 Rhyolite Court	57.3	56.7
12 Fountain Place	62.4	62.1
12 Goodland Place	54.6	54.1
12 Joy Place	62.5	62.1
13 Fountain Place	62.7	62.4
14 Fountain Place	63	62.8
14 Goodland Place	53.7	53.1
14 Joy Place	61.6	61.2
15 Fountain Place	63.4	63.3
15 Joy Place	62.1	61.7
16 Fountain Place	62.9	62.6
16 Joy Place	62.2	61.8
17 Fountain Place	62.7	62.4
18 Fountain Place	62.4	62.1
43 Lignite Drive	59.4	58.9
45 Lignite Drive	59.2	58.7
47 Bethany Road	60.1	59.7
47 Lignite Drive	59.3	58.8
51 Lignite Drive	56.6	56.1
53 Bethany Road	60.2	59.7
55 Bethany Road	51.7	51
57 Bethany Road	52.8	52.8

PPF	Do Nothing (2038) LAeq(24h)	Do Minimum (2038) LAeq(24h)
58 Lignite Drive	64.6	64.2
59 Bethany Road	53.4	53.4
60 Lignite Drive	64.6	64.2
62 Lignite Drive	63.9	63.6
64 Lignite Drive	63.3	62.9
66 Lignite Drive	63.2	62.9
68 Lignite Drive	63	62.7
70 Lignite Drive	62.5	62.1
72 Lignite Drive	59.6	59.2
74 Lignite Drive	58.1	57.6
76 Lignite Drive	57.1	56.5
370 Dunns Crossing Road	57.2	57.5
372 Dunns Crossing Road	56.7	57.5
374 Dunns Crossing Road	56.8	57.5
376 Dunns Crossing Road	58.7	59.3
380 Dunns Crossing Road	56	57.5
382 Dunns Crossing Road	63.6	64.2
388 Dunns Crossing Road	66	65.3
390 Dunns Crossing Road	66.1	64.4
392 Dunns Crossing Road	66.7	63
398 Dunns Crossing Road	67.3	61.6
400 Dunns Crossing Road	67.5	61.9
402 Dunns Crossing Road	68	62.7
404 Dunns Crossing Road	68.8	64.3
406 Dunns Crossing Road	68.8	65.1