Waikato Expressway: Hamilton Section

Ruakura Interchange
Assessment of Noise Effects
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Ruakura Interchange

Assessment of Noise Effects

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1 Introduction

The New Zealand Transport Agency (the Transport Agency) proposes to alter the existing designation for the Hamilton Section of the Waikato Expressway (Hamilton Section) and obtain additional resource consents from Waikato Regional Council (WRC) in order to construct, operate and maintain the Ruakura Interchange and connecting roads. The Ruakura Interchange was omitted from the recent round of alterations to the designation, whilst the Transport Agency awaited the Board of Inquiry's decision on the Ruakura Development Private Plan Change, by Tainui Group Holdings.

The Hamilton Section is located on the eastern side of the city of Hamilton. The Hamilton Section adjoins the recently completed Ngaruawahia Section to the north, and the existing Tamahere Interchange to the south. It is approximately 22km in length. The route was designated in 2005. Since the route was originally designated, design modifications have occurred. To accommodate those design modifications, alterations to the original designation were required and those alterations were designated in July 2014 (subject to appeal). Those designation alterations affected locations separate from the location for the Ruakura Interchange. In the area of the Ruakura Interchange, the existing designation as originally designated in 2005 still applies.

The Ruakura Structure Plan (RSP) was notified as part of the Hamilton City Proposed District Plan (Proposed District Plan) in December 2012. The RSP (as notified) includes an inland port, freight and logistics hub and other industrial land. The inland port as proposed in the RSP has an intermodal facility so that freight can be transferred to and from road and rail. The RSP also provides for research and innovation activities, and residential areas for an eventual population of approximately 1,800 households, including the development of a neighbourhood centre.

The Transport Agency is now proposing to alter the designations for the Hamilton Section to include a new interchange at Ruakura and encompass associated connecting roads (being the relocated and the existing Ruakura Road). The scope of the designation sought is shown in Figure 1 below.

This report describes the assessment of the noise effects of the proposed designation alterations.
The Resource Management Act 1991 (RMA) requires an assessment of the actual and potential effects on the environment of allowing the activity (s104(1)(a)). It is necessary to identify the effects of the proposed alterations relative to a “baseline” environment. The baseline environment is the current noise environment plus all the activities that are consented to take place. The existing designation for the Hamilton Section of the Waikato Expressway is part of the baseline environment. A Private Plan Change (PPC) has been approved to allow progress of some activities that are within the area encompassed by the RSP. Thus we have considered the PPC as part of the baseline environment. The effect of the PPC on the noise environment is discussed in Section 4.3.

2 Baseline noise environment

The existing designation for the Hamilton Section of the Waikato Expressway is for a road built with noise managed according to the conditions on the designation. This consented activity is part of the baseline noise environment.

Over the full Waikato Expressway Hamilton Section, the existing designation comprises the original designation designated in 2005 with some discrete designation alterations designated in July 2014. Those designation alterations affected locations separate from the location of the proposed Ruakura Interchange and connecting roads. In the area of the designation alterations being currently proposed, the existing designation is as originally designated in 2005.

With regard to road-traffic noise, in essence, the noise conditions on the existing designation require that the road is built with noise levels mitigated to achieve, subject to practicability, the average noise design levels of the Transit New Zealand Noise Guidelines. (The full title of the Transit New Zealand Noise Guidelines is “Transit New Zealand’s Guidelines for the Management of

Figure 1: Diagram of proposed alteration to designation
Road Traffic Noise” contained in Appendix 6 of the 1999 edition of the Planning Policy Manual. We will use the term Noise Guidelines hereafter.)

The average noise design levels of the Noise Guidelines are reproduced here as Table 1 and represented graphically in Figure 2. These show how the allowable noise level increase is related to the “ambient noise level”. Thus, establishment of the existing ambient noise environment is required prior to commencement of any construction activity (excluding site investigations and enabling works). This is identified within the noise conditions on the existing designation and the noise conditions proposed for the proposed designation alterations.

### Table 1: Reproduction of Table 1 Average Noise Design Levels from Page A6:17 of the Noise Guidelines

<table>
<thead>
<tr>
<th>Noise area</th>
<th>Noise descriptor</th>
<th>Ambient noise level (dB)</th>
<th>Average noise design level (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>$L_{Aeq(24h)}$</td>
<td>Less than 43</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>”</td>
<td>43 to 50</td>
<td>Ambient +12</td>
</tr>
<tr>
<td>Medium</td>
<td>”</td>
<td>50 to 59</td>
<td>62</td>
</tr>
<tr>
<td>High</td>
<td>”</td>
<td>59 to 67</td>
<td>Ambient + 3</td>
</tr>
<tr>
<td></td>
<td>”</td>
<td>67 to 70</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>”</td>
<td>More than 70</td>
<td>Ambient</td>
</tr>
</tbody>
</table>

Note that a change in the noise level does not necessarily constitute an impact or effect on the community. The change in noise level may be noticed by the community but simply noticing the change is not an effect either. There is an extensive scientific literature on noise effects. The Noise Guidelines are based on this literature. Research has found that where ambient noise levels are low, people will accept a quite large increase in noise, e.g. 12 dB $L_{Aeq(24h)}$ or even more; where ambient noise levels are high, people will accept only smaller increases in noise, e.g. 3 dB $L_{Aeq(24h)}$; and where ambient noise levels are very high, e.g. 70 dB $L_{Aeq(24h)}$, little or no noise increase will be accepted. The Noise Guidelines represent this research so that compliance with an average noise design level can be taken as having an effect no more than minor.
Typically noise has an effect by interfering with our activities. For example, some noise may make listening to conversations more difficult which creates annoyance or some noise may prevent proper sleep which can then have health impacts. Increases in noise may increase these effects.

Often referred to is work by Theodore Schultz who in the 1970s showed a relationship between noise level and the percentage of the community highly annoyed by noise. While this is a useful guide, care is needed. The relationship was established from people’s response to noise of trains, aircraft, and road-traffic after long-term exposure to the noise and should not be used as a predictor of initial response to changes in noise. Nor should it be inferred that because a percentage of the population is highly annoyed then everyone is annoyed to some degree. In fact research and literature show people’s response to noise is extremely broad and individually subjective. For example, one portion of a population may be highly annoyed by a noise environment that is about 55 dB $L_{Aeq(24h)}$ and a similarly-sized portion of the population will find that same noise environment very satisfactory. Generally the percentage of the population disturbed by noise increases only slowly as the noise level increases.

2.1.1 Noise environment expected from the existing designation

As noted previously, the existing designation in the area of the proposed Ruakura Interchange and connecting roads is as originally designated in 2005. Some information of the noise environment expected from the existing designation is provided in the acoustic evidence given at the hearing for that designation. The evidence was prepared in July 2002. While the 2002 evidence provides diagrams of noise contours spreading 400 to 500 metres from the carriageway, examining these contours it appears that the modelling should be treated as indicative. However, all the qualifying buildings existing at the time of notification within the modelled area are shown in the diagrams and noise levels for 61 qualifying buildings are reported. The modelling of that time did not include any cross roads or interchanges, only the main Expressway.

The 2002 evidence is given in a form appropriate for a road unlikely to be constructed in twenty years, that is, the noise levels are assessed and the mitigation that would probably be needed outlined, but not developed in detail because, as noted in the evidence, design changes could be expected as the project proceeds through its development stages.

Almost all houses in the route are assigned an average noise design level of 55 dB, the lowest of the range of average noise design levels in the Noise Guidelines. Only close to major roads, such as Ruakura Road, State Highway 26 or Puketaha Road, are higher design noise levels set, which are only 62 dB and therefore do not adequately reflect the noise environment from those major roads.

The assessment of the 2002 evidence is that prior to any mitigation most properties close to the route will have noise levels either within the average noise design levels or their noise levels will exceed the average noise design levels by less than 5 dB. The mitigation considered appropriate was low-noise road surface, either porous asphalt or an asphaltic type, or low barriers of 2.0 to 2.5 metres high. Where more noise reduction of between 5 and 10 dB was required, a combination of low-noise road surface and low barriers was recommended in preference to higher 3.0 to 4.5 metre high barriers as barriers of these heights would probably be visually unacceptable.

It is not clear from the 2002 evidence how these heights recognise that parts of the Expressway design of that time were elevated relative to the surrounding land and whether the barrier heights quoted were related to the land height at the barrier position or the road height. It may have been expected that the barriers could have been placed on the road bed but current road design requirements for Roads of National Significance would expect these barriers to be 10 metres or more back from the road shoulder. However, there was emphasis in the 2002 evidence that the
design was many years from being finalised and more detailed analysis was not practicable at that designation hearing stage.

The 2002 evidence provides noise level predictions for some houses in the area of the proposed Ruakura Interchange and connecting roads, the likely scale of any exceedances of the Noise Guidelines with the route operational, and estimations of the scale of mitigation that would be required to meet the Noise Guidelines.

- Four houses in the area of Percival Road were considered. The Noise Guidelines average noise design level was estimated as 55 dB $L_{Aeq(24h)}$ for each of the four houses and all four houses were estimated to exceed the Noise Guidelines with the route operational. The scale of exceedance was estimated as 2 to 5 dB and the suggested mitigation was porous asphalt road surface or low barriers.

- Four houses in the area of Ruakura Road were considered. The Noise Guidelines average noise design level was estimated as 62 dB $L_{Aeq(24h)}$ for each of the four houses and one house was estimated to exceed the Noise Guidelines with the route operational. The exceedance was estimated as 4 dB and the suggested mitigation was asphaltic concrete road surface or low barriers.

- No houses in the area of Davison Road or Nevada Road were considered.

- Eight houses in the area of the Expressway crossing SH 26 were considered. The Noise Guidelines average noise design level was estimated as 62 dB $L_{Aeq(24h)}$ for all of the houses. Three houses were estimated to exceed the Noise Guidelines with the route operational. The scale of exceedance was estimated as 3 to 6 dB and the suggested mitigation was asphaltic concrete road surface or low barriers.

The baseline noise environment therefore includes the existing designation being operational with noise levels mitigated, if necessary, so that the designation complies with the average noise design levels of the Noise Guidelines with mitigation expectations being low-noise road surfaces and/or barriers up to 2.5 metres high (relative to the road height).

### Methodology

#### 3.1 Modelled noise environments

The assessment is made to the Noise Guidelines which set average noise design levels based on the existing noise environment. The proposed conditions require the existing noise environment to be established prior to the commencement of construction and this will be done with a combination of noise measurements at selected sites within the area and modelling over the whole area. To enable our assessment now we have established an “existing noise environment” using estimations of current traffic volumes. (The traffic volumes prepared and used for the purpose of the current modelling are shown in Appendix A but note these traffic volumes will be updated for establishing the existing noise environment prior to commencement of construction, as required by the proposed conditions.)

Usually the assessment of road-traffic noise levels with a proposed project is performed for a future year ten to twenty years after opening of the project. For other assessments of road-traffic noise levels from the Waikato Expressway Hamilton Section, we have selected 2031 as that “future year”. For the proposed designation alterations, development and implementation of the PPC will be ongoing so that the network surrounding the Ruakura Interchange is predicted to change between
opening and ten to twenty years after opening. Therefore, rather than using 2031, and also with regard to the traffic modelling results available to us, the road-traffic noise levels with the proposed designation alterations were assessed for 2021 and 2041.

In the area of these designation alterations currently proposed the existing designation is as originally designated in 2005. We have obtained the route design as at the time the existing designation was designated. Although the route design has actually evolved between that time and now, as permitted by the designation conditions, we have used the designated route to ensure that no effects are overlooked as could happen if the interim route design changes were assumed as the baseline. Thus for this assessment of the proposed designation alterations, the baseline environment incorporates the designated route design.

The proposed designation alterations include the Ruakura Interchange and there are two design options for that interchange: “the Expressway over Ruakura Road” and “the Expressway under Ruakura Road”. The road-traffic noise levels with each of these design options were assessed.

Therefore, six noise environments were modelled:

- Baseline (designated route) for 2021 and 2041;
- Expressway over Ruakura Road for 2021 and 2041; and
- Expressway under Ruakura Road for 2021 and 2041.

For modelling these six noise environments, we have used traffic volume forecasts prepared in July 2014. Forecast traffic volumes for the designated route have been prepared previously and used in previous noise modelling. However, we have used the traffic volumes from July 2014 as they are from one consistent source/model allowing better comparison of the effects of the proposed designation alterations. (The traffic volumes used are included in the Appendix A to this report.)

The baseline environment and the environments with the proposed route alterations include the surrounding local roads as included in the traffic modelling. These surrounding roads are not part of the proposed designation alterations but traffic volumes using some of the surrounding roads are influenced by the proposed designation alterations.

To facilitate assessment of the effects of the proposed designation alterations, assumptions made for the designated “do-minimum” project were used for the proposed altered “do-minimum” project. For example, the Expressway and all other roads have been sealed with Grade 3/5 two-coat chipseal as a default assumption. This is a noisy road surface and roads may in reality be surfaced with a quieter single-coat chipseal or other road surface. Note that the term “do minimum” is a term with a specific meaning defined in the New Zealand Standard for road-traffic noise, NZS 6806. The term is not used to describe an approach of doing the minimum possible. Rather, it describes the roading network design as it would be without any measures included specifically for noise mitigation purposes.

Appendix A contains details of the noise modelling software, inputs, and methodology.

### 3.2 Proposed conditions

The inaugural New Zealand Standard for road-traffic noise, NZS 6806, was published in 2010. The Transport Agency adopted this Standard for new roading projects. Hamilton City has a draft amendment to their District Plan to also adopt this Standard in place of their existing rules for road-traffic noise. However, NZS 6806 excludes its application to designations that already have existing noise conditions. The original designation for the Waikato Expressway Hamilton Section
has existing noise conditions and so if that designation was not being altered the Noise Guidelines called by the existing noise conditions would still apply.

Alterations to the original designation also need noise conditions. For the designation alterations designated in July 2014 (subject to appeal), it was acknowledged that in comparison to the full route the scale of alterations was small and also that it was preferable that one set of conditions apply to the full route (as far as practicable). It was proposed that those designation alterations were subject to the existing noise conditions on the original designation. The final noise conditions for those designation alterations are more prescriptive than the noise conditions on the original designation but have the same principles and use the same noise criteria of the Noise Guidelines.

For the designation alterations currently proposed, again they are small in scale compared to the full route and it remains preferable that one set of conditions apply to the full route (as far as practicable). Therefore, it is proposed that these designation alterations for the Ruakura Interchange and connecting roads are subject to the same noise conditions as those on the designation alterations designated in July 2014 (subject to appeal).

### 3.3 Assessment

The existing designation is for a road to be built with noise levels mitigated to achieve, subject to practicability, the Noise Guidelines. The proposed altered route design (with the Ruakura Interchange) will also be built with noise mitigated to achieve, subject to practicability, the Noise Guidelines. Therefore, post-mitigation there may be no difference between the noise levels with the proposed designation alterations or the noise levels with the existing designation, but the extent of mitigation to provide those same noise levels might be increased. Increased mitigation might be less practicable or have other impacts compared with the mitigation that would be required for the existing designation. For example, if larger bunds or higher fences are required, these may conflict with good urban design.

- The noise effects of the proposed designation alterations are assessed as road-traffic noise levels that would occur with the proposed altered route design in place and also the mitigation needed to make those noise levels achieve, subject to practicability, the Noise Guidelines.

- The scale of mitigation needed for a road design in the existing designation has been previously estimated. Comparison of that mitigation with the mitigation determined here for the altered route design helps identify effects of the designation alterations even where the noise levels achieved may ultimately be the same.

### 4 Results

In this section, the noise levels and noise level changes are reported to the first decimal place. While it is recognised that this level of precision is higher than what can be reliably measured or perceived, we maintain this level of detail because it avoids some of the anomalies and potential confusion that can arise if the noise levels are rounded to whole numbers only, especially when comparing one modelled situation with another. Using one decimal place, still some noise level changes will appear incorrectly calculated (±0.1 dB $L_{Aeq(24h)}$) but this is a rounding error.

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1 Subject to minor rewording of the noise conditions for clarity on interpretation or current practice
### 4.1 Assessment of the 2021 noise environments

Table 2 shows road-traffic noise levels calculated for the year 2021 for the houses in the area of the proposed designation alterations. (The road-traffic noise levels are presented as graphical contours in Appendix C).

- 56 houses have been identified for noise assessment. The addresses are shown in the first column of the table, in the form of street name then street number. (The addresses are indicated on a plan in Appendix B.)

- Column 2 contains noise levels calculated for the existing noise environment. These are the noise levels used to determine the Noise Guidelines average noise design levels, shown in Column 3.

- Column 4 contains the noise levels calculated for the Baseline (designated route) noise environment in the year 2021. Each of these noise levels have been compared with their Noise Guidelines average noise design level (Column 3). Where the noise level exceeds its average noise design level, the extent of exceedance is shown in Column 5.

- Column 6 contains the noise levels calculated for the noise environment in the year 2021 with the proposed Ruakura Interchange configured with the Expressway going over Ruakura Road. Column 7 shows where (and how much) these noise levels exceed their average noise design level.

- Similarly, Column 8 contains the noise levels calculated for the noise environment in the year 2021 with the proposed Ruakura Interchange configured with the Expressway going under Ruakura Road, and Column 9 shows where (and how much) these noise levels exceed their average noise design level.

Table 2: Road-traffic noise levels (dB \( L_{Aeq(24h)} \) 2 metres above ground level) for houses in the area of the proposed designation alterations calculated for the year 2021

<table>
<thead>
<tr>
<th>Address (Street name then number)</th>
<th>Existing Noise Guidelines average noise design level</th>
<th>2021 Baseline (designated route)</th>
<th>2021 Ruakura Interchange with Expressway over</th>
<th>2021 Ruakura Interchange with Expressway under</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Noise level</td>
<td>Design level exceedance</td>
<td>Noise level</td>
<td>Design level exceedance</td>
</tr>
<tr>
<td>Chelmsford 2A</td>
<td>46.5</td>
<td>58.5</td>
<td>56.2</td>
<td>54.6</td>
</tr>
<tr>
<td>Davison 11</td>
<td>55.7</td>
<td>62.0</td>
<td>54.7</td>
<td>58.3</td>
</tr>
<tr>
<td>Davison 27</td>
<td>49.4</td>
<td>61.4</td>
<td>52.6</td>
<td>54.1</td>
</tr>
<tr>
<td>Davison 55</td>
<td>49.3</td>
<td>61.3</td>
<td>55.0</td>
<td>55.1</td>
</tr>
<tr>
<td>Davison 67</td>
<td>45.8</td>
<td>57.8</td>
<td>54.9</td>
<td>54.0</td>
</tr>
<tr>
<td>Davison 67b</td>
<td>47.5</td>
<td>59.5</td>
<td>54.6</td>
<td>53.7</td>
</tr>
<tr>
<td>Davison 77</td>
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<td>56.8</td>
<td>56.2</td>
</tr>
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<td>45.6</td>
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<td>56.5</td>
<td>55.2</td>
</tr>
<tr>
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<td>46.5</td>
<td>58.5</td>
<td>58.2</td>
<td>57.5</td>
</tr>
<tr>
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<td>60.3</td>
<td>3.3</td>
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<tr>
<td>Lissette 6</td>
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<td>65.2</td>
<td>65.1</td>
<td>65.6</td>
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<td>59.9</td>
<td>57.0</td>
<td>54.9</td>
</tr>
<tr>
<td>Address (Street name then number)</td>
<td>2021 Baseline (designated route)</td>
<td>2021 Ruakura Interchange with Expressway over</td>
<td>2021 Ruakura Interchange with Expressway under</td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------------------------</td>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Existing Noise Guidelines average noise design level</td>
<td>Noise level</td>
<td>Design level exceedance</td>
<td>Noise level</td>
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<tr>
<td>Nevada 70a</td>
<td>45.6</td>
<td>57.6</td>
<td>57.9</td>
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<td>55.8</td>
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<td>Nevada 74</td>
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<td></td>
</tr>
<tr>
<td>Ryburn 37</td>
<td>53.2</td>
<td>62.0</td>
<td>60.0</td>
<td></td>
</tr>
<tr>
<td>Ryburn 45</td>
<td>53.5</td>
<td>62.0</td>
<td>61.8</td>
<td></td>
</tr>
<tr>
<td>Ryburn 53a</td>
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<td>65.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Ryburn 55</td>
<td>58.6</td>
<td>62.0</td>
<td>67.4</td>
<td>5.4</td>
</tr>
<tr>
<td>Ryburn 63</td>
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<td>62.0</td>
<td>69.6</td>
<td>7.6</td>
</tr>
<tr>
<td>Ryburn 72</td>
<td>52.4</td>
<td>62.0</td>
<td>63.9</td>
<td>1.9</td>
</tr>
<tr>
<td>Southsea 70</td>
<td>46.5</td>
<td>58.5</td>
<td>56.1</td>
<td></td>
</tr>
<tr>
<td>Vaile 3</td>
<td>63.2</td>
<td>66.2</td>
<td>61.1</td>
<td></td>
</tr>
</tbody>
</table>

Column 5 shows where the Baseline (designated route) noise level exceeds its average noise design level. The presence and scale of these exceedances have been already identified in previous noise.
assessments (though perhaps not numerically equal to those identified here due to differences in details of the modelling inputs). Noise mitigation for these exceedances has been given preliminary assessment. It has been found and agreed that the noise effects of the Baseline (designated route) are reasonable or can be made reasonable with practicable mitigation measures.

Therefore, we have considered the effects of the proposed designation alterations by reading across the rows in Table 2 and particularly comparing Columns 5, 7, and 9. The Noise Guidelines are structured such that where there is no exceedance of the average noise design level, it can be taken that there is no effect, even if there is a noise level change. Where there are exceedances, overall both the presence and scale of exceedances are almost equivalent across the three columns. This indicates to us that the effects of the proposed designation alterations are comparable with the effects of the Baseline (designated route) which have been agreed.

A section of Ruakura Road is included within the proposed designation alterations. Though the road-traffic noise levels for houses adjacent to this section of Ruakura Road do change between the Baseline (designated route) and the proposed routes, the total noise levels do not exceed the Noise Guidelines and so the noise level changes can be considered as having no more than minor effect, if any.

The proposed designation alterations have little effect for houses on Davison Road; possibly a small noise level decrease but this would have very slight or negligible effect. The proposed designation alterations do not introduce effects to houses in the area of Nevada Road. Any other noise level changes caused by the proposed designation alterations tend to occur where there are no noise-sensitive receivers.

We acknowledge some large exceedances, such as for 134C Percival Road, 55 Ryburn Road, and 63 Ryburn Road; and note the scale of the exceedances is consistent between the three 2021 noise environments. These exceedances and others in Columns 5, 7, and 9 highlight the area of Percival Road and Ryburn Road, which is consistent with the 2002 evidence for the designation, discussed in Section 2.1.1, though the scale of the exceedances is now identified is larger than that previously identified. It is considered this is due to detail of the current modelling being greater than that practicable for the modelling for the 2002 evidence.

For each exceedance we have considered the Baseline (designated route) and the proposed routes for differences that could adversely affect the practicability of mitigation of that exceedance. We find no substantive difference. Our consideration included:

- Where a section of lower-noise road surface is an option for noise mitigation, that section would have equivalent effect given equivalent implementation for the Baseline (designated route) or the proposed routes.

- Local to the proposed Ruakura Interchange, the configuration of the Expressway over Ruakura Road raises the Expressway level relative to the Baseline (designated route); or the configuration of the Expressway under Ruakura Road raises Ruakura Road over the Expressway. Such elevation differences could adversely affect the practicability of any barriers intended for noise mitigation; but there are no houses with exceedances requiring barriers which could be affected by these elevation differences.

- For houses in the area of Percival Road and Ryburn Road, mitigation options may include barriers. Alterations to the elevation of the Expressway adjacent to this area could influence noise mitigation-effectiveness of barriers, and we understand that such alterations have occurred relative to the design of the route at the time of the original designation. However, such elevation alterations in this area are unrelated to the proposed designation alterations and
so not included in this noise assessment but will, as required by the conditions on the existing
designation, be considered within the future noise assessment of the whole route.

Generally the practicability of potential noise mitigation measures needs to consider the presence
or interactions with other noise mitigation measures and the number and extent of houses affected.
It is difficult (and may be misleading) to fully assess potential noise mitigation measures for the
proposed designation alterations in isolation from noise mitigation measures for the whole route.
However, we can make comment on the factors affecting potential noise mitigation measures.

- Where an exceedance is in the order of 3 dB or more, such as for some Ryburn Road houses,
  lower-noise road surfaces would likely be the first potential noise mitigation measure
  considered. Where an exceedance is smaller, a barrier would likely be the first potential noise
  mitigation measure considered, unless that exceedance may be incidentally addressed by a
  lower-noise road surface being otherwise considered. A combination of lower-noise road
  surface and barrier could be considered.

- Where an isolated house has an exceedance, for instance 87 Davison Street potentially, a
  barrier might be more practicable. Where a cluster of houses have exceedances, for instance
  Percival Road and Ryburn Road houses, a section of lower-noise road surface may become
  more practicable.

- Other non-noise effects of potential noise mitigation measures are also considered. Sometimes
  lower-noise road surfaces are preferred where barriers would create negative visual effects, or
  negative social effects through segregation, or interfere with stormwater management.
  Sometimes a lower-noise road surface may not meet the engineering requirements of the road
  surface.

Consideration of these factors is consistent between the Baseline (designated route) and the
proposed routes.

By this assessment of the 2021 noise environments, we conclude that for both the existing
designation and the proposed designation alterations, the Noise Guidelines can be achieved,
subject to practicable, and the extent of mitigation is similar.

We have considered the effects of the two Ruakura Interchange configuration options by
comparing Column 7 with Column 9. Overall both the presence and scale of exceedances are almost
equivalent across the two columns. This indicates to us that, in terms of noise effects, the proposed
designation alterations can be made without requiring the configuration to be defined. The
Ruakura Interchange configuration with the Expressway under Ruakura Road generates slightly
lower noise levels for houses in the area. 87 Davison Road is the only house where the effect of the
noise level difference might be more than negligible; and even for 87 Davison Road the effect would
be no more than minor in terms of the total noise level or the noise mitigation that would be
recommended.

### 4.2 Assessment of the 2041 noise environments

Table 3 follows the format of Table 2 but the noise levels for the Baseline (designated route) noise
environment and for the noise environments with the proposed designation alterations are now
calculated for the year 2041 (rather than 2021).

(The road-traffic noise levels are presented as graphical contours in Appendix C. The addresses are
indicated on a plan in Appendix B.)
Table 3: Road-traffic noise levels (dB $L_{Aeq(24h)}$ 2 metres above ground level) for houses in the area of the proposed designation alterations for assessment for the year 2041

<table>
<thead>
<tr>
<th>Address (Street name then number)</th>
<th>Existing Noise Guidelines average noise design level (2041 Baseline (designated route))</th>
<th>2041 Ruakura Interchange with Expressway over 2041 Ruakura Interchange with Expressway under</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chelmsford 2A</td>
<td>46.5 58.5 56.2</td>
<td>55.6 54.4</td>
</tr>
<tr>
<td>Davison 11</td>
<td>55.7 62.0 55.6</td>
<td>57.9 57.8</td>
</tr>
<tr>
<td>Davison 27</td>
<td>49.4 61.4 52.9</td>
<td>54.3 53.7</td>
</tr>
<tr>
<td>Davison 55</td>
<td>49.3 61.3 55.1</td>
<td>55.7 54.0</td>
</tr>
<tr>
<td>Davison 67</td>
<td>45.8 57.8 54.8</td>
<td>54.9 53.4</td>
</tr>
<tr>
<td>Davison 67b</td>
<td>47.5 59.5 54.5</td>
<td>54.4 53.2</td>
</tr>
<tr>
<td>Davison 77</td>
<td>47.6 59.6 56.7</td>
<td>57.1 54.8</td>
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<tr>
<td>Davison 79</td>
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<td>56.2 54.7</td>
</tr>
<tr>
<td>Davison 81</td>
<td>46.5 58.5 58.1</td>
<td>58.6 0.1                                                                         55.9</td>
</tr>
<tr>
<td>Davison 87</td>
<td>45.0 57.0 60.2 3.2</td>
<td>60.5 3.5                                                                         58.2 1.2</td>
</tr>
<tr>
<td>Lissette 6</td>
<td>62.2 65.2 64.4</td>
<td>65.1 65.1</td>
</tr>
<tr>
<td>Nevada 70</td>
<td>47.9 59.9 57.0</td>
<td>56.0 55.0</td>
</tr>
<tr>
<td>Nevada 70a</td>
<td>45.6 57.6 57.8 0.2</td>
<td>57.0 55.5</td>
</tr>
<tr>
<td>Nevada 70b</td>
<td>45.5 57.5 57.8 0.3</td>
<td>57.1 55.7</td>
</tr>
<tr>
<td>Nevada 72</td>
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<td>56.4 54.9</td>
</tr>
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<tr>
<td>Nevada 73</td>
<td>45.1 57.1 55.7</td>
<td>55.8 54.3</td>
</tr>
<tr>
<td>Nevada 74</td>
<td>45.4 57.4 56.8</td>
<td>56.8 55.2</td>
</tr>
<tr>
<td>Nevada 75</td>
<td>45.3 57.3 56.2</td>
<td>56.3 54.7</td>
</tr>
<tr>
<td>Percival 134B</td>
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<td>66.5 4.5                                                                         66.4 4.4</td>
</tr>
<tr>
<td>Percival 134C</td>
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<td>64.9 6.8                                                                         64.7 6.6</td>
</tr>
<tr>
<td>Percival 164</td>
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<td>64.7 2.7                                                                         64.7 2.7</td>
</tr>
<tr>
<td>Percival 166</td>
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<td>63.4 1.4                                                                         63.3 1.3</td>
</tr>
<tr>
<td>Ruakura 303</td>
<td>64.9 67.9 65.6</td>
<td>59.1 58.1</td>
</tr>
<tr>
<td>Ruakura 313</td>
<td>65.6 68.6 66.3</td>
<td>60.5 59.5</td>
</tr>
<tr>
<td>Ruakura 316</td>
<td>63.9 66.9 64.9</td>
<td>60.9 59.5</td>
</tr>
<tr>
<td>Ruakura 318</td>
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<td>63.1 61.4</td>
</tr>
<tr>
<td>Ruakura 352</td>
<td>63.0 66.0 66.0 0.0</td>
<td>65.1 64.3</td>
</tr>
<tr>
<td>Ruakura 363</td>
<td>61.2 64.2 63.9</td>
<td>62.9 62.2</td>
</tr>
<tr>
<td>Ruakura 410</td>
<td>60.4 63.4 59.8</td>
<td>58.9 58.5</td>
</tr>
<tr>
<td>Ruakura 414</td>
<td>56.4 62.0 56.6</td>
<td>56.9 56.5</td>
</tr>
<tr>
<td>Ruakura 415</td>
<td>66.9 69.9 62.7</td>
<td>62.8 62.7</td>
</tr>
<tr>
<td>Ruakura 449</td>
<td>62.2 65.2 59.0</td>
<td>59.4 59.2</td>
</tr>
<tr>
<td>Ruakura 495</td>
<td>64.8 67.8 60.0</td>
<td>62.4 62.3</td>
</tr>
<tr>
<td>Ruakura 501</td>
<td>54.7 62.0 54.2</td>
<td>57.1 56.9</td>
</tr>
<tr>
<td>Ruakura 560</td>
<td>51.1 62.0 53.0</td>
<td>54.8 54.4</td>
</tr>
<tr>
<td>Ruakura 566</td>
<td>52.5 62.0 53.7</td>
<td>55.7 55.4</td>
</tr>
<tr>
<td>Ruakura 576</td>
<td>54.5 62.0 54.9</td>
<td>57.1 57.0</td>
</tr>
</tbody>
</table>
The 2041 results (Table 3) are consistent with the 2021 results (Table 2). The findings and discussion of the 2021 results (following Table 2) can be applied also to assessment of the 2041 noise environments. Therefore, assessment of the 2041 noise environment indicates that for both the existing designation and the proposed designation alterations, the Noise Guidelines can be achieved, subject to practicability, and the extent of mitigation is similar.

4.3 Potential of cumulative noise effects

This section is intended as informative commentary as we are aware of concerns about the "cumulative effect" on the environment of the PPC, the East Coast Main Trunk Line, and the Waikato Expressway Hamilton Section. The "Ruakura Structure Plan – Logistics Zone: Assessment of Acoustic Effects" includes discussion of the potential of cumulative noise effects.

With regard to the proposed designation alterations, the noise modelling undertaken for this noise assessment used as inputs traffic volumes obtained from traffic modelling of future years. The traffic modelling takes into account the PPC and its influence on traffic demands, origins, and destinations. Noise from use of the PPC land is not included in the road-traffic noise modelling. Noise from any land use is also not included in the road-traffic noise model, and neither is the East Coast Main Trunk Line. This is normal practice. If the additional noise sources were included, the ambient noise levels, upon which Noise Guidelines average noise design levels are based, may be higher and as a consequence the average noise design levels would be higher. Therefore, excluding these additional noise sources is a conservative approach. The "Ruakura Structure Plan – Logistics Zone: Assessment of Acoustic Effects" included some noise modelling of the environment with the PPC, the East Coast Main Trunk Line, and the Waikato Expressway Hamilton Section (without the Ruakura Interchange).

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2 Prepared in June 2013 by Marshall Day Acoustics, report number Rp 02 00 2013211A
Some basic noise concepts are relevant to considering the potential for cumulative noise effects and may assist some people in understanding how adding noise sources into a noise environment will be experienced.

Noise is generally considered to be unwanted sound, but we could use the terms interchangeably. Noise or sound is measured in the unit decibel (dB). A dB is a logarithm of the ratio of the pressure of the sound measured to a reference pressure. The pressure range between the quietest sounds that people can hear and the loudest sounds is very large and logarithms make this range more manageable.

As a logarithmic unit, when one noise source is added together with an identical noise source, the total noise level is an increase of only 3 decibels above the noise level of one of the noise sources. By example:

- Adding two identical noise sources: 60 dB + 60 dB = 63.0 dB;
- Adding three identical noise sources: 60 dB + 60 dB + 60 dB = 64.8 dB;
- Adding four identical noise sources: 60 dB + 60 dB + 60 dB + 60 dB = 66.0 dB;
- Adding five identical noise sources: 60 dB + 60 dB + 60 dB + 60 dB + 60 dB = 67.8 dB.

It is generally accepted that a change in noise level of 3 dB is considered “noticeable” to most people. A noise level change of 10 dB is generally accepted as being experienced as a doubling of noise for most people.

The example additions above also show that if a lower noise level is added to a higher noise level, the total noise level will be little changed above the higher noise level. By example:

- 65 dB + 50 dB = 65.1 dB;
- 55 dB + 50 dB = 56.2 dB.

There are noise performance standards for activities on the PPC land near to the proposed designation alterations. Noise received from activities in the Ruakura Logistics and Ruakura Industrial Park Area shall not exceed 55 dB $L_{Aeq(15\text{min})}$ between 7:00 am and 8:00 pm; 50 dB $L_{Aeq(15\text{min})}$ between 8:00 pm and 11:00 pm; and 40 dB $L_{Aeq(15\text{min})}$ between 11:00 pm and 7:00 am.3

There will be some houses for which the Waikato Expressway Hamilton Section Project provides the dominant noise source; however any noise effects from the Project will be effectively mitigated. Where the Project is the dominant noise source, adding the noise allowable from the Logistics Zone will cause little change to the total noise level.

Cumulative noise effects are not expected to be unreasonable, but another element that should be noted as potentially affecting the experience of the cumulative noise environment for people. When traffic volumes are high, road-traffic noise can be of a continuous nature; and when traffic volumes are low, the road-traffic noise may be heard as separated events. Trains are usually heard as separated events, though the passing of a long train may raise noise levels for a minute or two. It is expected that the Logistics Zone may have some continuous background noise sources, such as refrigeration units, and that noise from activities within the Logistics Zone may fluctuate in nature depending on the machinery operating and activities being undertaken. People may be able to discern these different noise types and identify different noise sources, but this is not considered as an effect.

3 The Board of Inquiry’s Draft Report and Decision for the Ruakura Development Plan Change released on 5 August 2014
5 Assessment of construction noise effects

The construction noise effects associated with the original designation and the designation alterations designated in July 2014 (subject to appeal) have been assessed and a condition set on requiring a Construction Management Plan including the procedures, methods and measures to be applied to address compliance with NZS 6803, the New Zealand Standard for construction noise. NZS 6803 outlines requirements for a Construction Noise Management Plan. The conclusion about the existing designation is that, provided a Construction Noise Management Plan is appropriately prepared and implemented, construction noise effects of the existing designation will be reasonable.

Construction activities and effects associated with the proposed designation alterations will be of the same nature as associated with construction of the existing designation. Separation distances between the construction activity and nearby receivers for the proposed designation alterations are expected to be no shorter than separation distances for the existing designation. For both the existing designation and the proposed designation alterations, the construction activities on the local roads to join the project to the local road network are moderate forms of construction activity and while some will be close to noise-sensitive receivers (such as houses), appropriate management of noise and construction timing can ensure effects will be less than minor.

Therefore, it is proposed that the designation alterations for the Ruakura Interchange and connecting roads are subject to the same conditions relating to construction noise as those on the designation alterations designated in July 2014 (subject to appeal).

Principal points from the assessment of construction noise associated with the existing designation, and applicable also to construction noise associated with the proposed designation alterations, are:

- NZS 6803 provides some “recommended” construction noise upper limits to assist in formulating project-specific construction noise upper limits. Most road construction activity readily complies with these recommended construction noise upper limits where there is more than 40 to 60 metres separation between the main construction activity and the receiver. For both the majority of the existing designation and these proposed designation alterations, the construction activities are expected to match typical road construction activities and the majority of construction activity will be more than 40 to 60 metres from houses.

- Typical for a roading construction project is that construction activities will likely be spread out at various points along the project, so at any one time construction activities will be simultaneously be occurring over the total project length. Though there may be a number of items of plant or machinery operating throughout the project area, at any time a single noise-sensitive receiver is likely only in close proximity to typical three to four (but occasionally more) items of plant or machinery.

- Where there are several items of plant or machinery working together, they are usually spread over the immediate work area. This dispersal tends to reduce the noise level of the combination of plant or machinery compared to if they were all working clustered closely together.

- Though the total Project construction period may be long, for a single noise-sensitive receiver, the construction activity will appear intermittent. There will be periods of construction activity followed by quieter periods to allow, for example, construction in other areas, for fill to settle, or for concrete to strengthen.
In many instances where noise-sensitive receivers are nearest to the existing designation or the proposed designation alterations, the Project is altering existing roads and so construction activity will be of a nature akin to typical road maintenance activities of resurfacing and minor realignment.

Overall the proposed designation alterations result in only small to moderate changes in separation distance between the construction activity and nearby receivers compared with separation distances with the existing designation. Therefore it is expected that the ability for construction noise effects associated with the proposed designation alterations to be reasonable is little changed from the ability of the existing designation, and the periods or extents for which alternate noise management methods may need to be used will also be similar. Therefore we conclude that provided a Construction Noise Management Plan is appropriately prepared and implemented, construction noise effects of the proposed designation alterations will be reasonable.

5.1 Construction Noise Management Plan

The Transport Agency offers guidance on management of construction noise, such as the “State Highway Construction and Maintenance Noise and Vibration Guide”⁴. NZS 6803 also provides guidance. Expectations from these sources of the minimum requirements for a Construction Noise Management Plan include:

- Description of the works, anticipated equipment processes/durations;
- Identification of the noise-sensitive receivers likely most affected by construction noise of specific construction activities;
- “Construction noise upper limits” determined with regard to the receiving noise environment and including daily/weekly scheduling considerations, and with regard to any specific consent/designation requirements, and this may also take into account where particular noise-sensitive receivers are recently subject to other construction noise sources;
- Assessment of likely construction noise levels and scheduling, with appropriate noise mitigation measures to be implemented;
- Establishing a monitoring regime which targets both the more noisy activities and their potential occurrences near noise-sensitive locations;
- Staff training/awareness programme;
- Procedures for maintaining contact with stakeholders, including informing them when noisy activities may occur and providing summary reports of monitoring and investigations of any noise complaints;
- Process for managing noise complaints; and
- Contact telephone numbers for key construction staff, staff responsible for noise assessment and Council offices, plus a single point of contact for immediate advice of concerns about noisy activities.

The Construction Noise Management Plan will outline management practices to accompany construction activities with noise levels within the “construction noise upper limits”. While the constructor is expected to make practicable efforts to comply with the construction noise upper

limits recommended for a project, NZS 6803 recognises there may still be occasions where, even with application of the best practicable options for noise avoidance or mitigation, the construction activity does not comply with the recommended construction noise upper limits. Therefore the Construction Noise Management Plan will also outline more intense and/or additional management practices that will be used for those activities which are expected to exceed the construction noise limits.

6 Conclusions

This noise assessment is not for the whole Waikato Expressway Hamilton Section designation but only for the proposed designation alterations to accommodate a Ruakura Interchange and connecting roads. The proposed designation alterations were assessed for two configurations of the Ruakura Interchange with the Expressway over Ruakura Road and the Ruakura Interchange with the Expressway under Ruakura Road.

We based this noise assessment on identifying effects of the proposed designation alterations over and above the effects already anticipated by the existing designation. It is proposed that these designation alterations for the Ruakura Interchange and connecting roads are subject to the same conditions relating to noise as those on the designation alterations designated in July 2014 (subject to appeal). The nature of the designation alterations for the Ruakura Interchange are very similar to the nature of the designation alterations designated in July 2014 and therefore we recommend the noise conditions as reviewed then applied to those designation alterations are applied without modification on these designation alterations for the Ruakura Interchange. We used those noise conditions to frame this noise assessment.

With regard to road-traffic noise, the assessment undertaken is sufficient for us to conclude that for both the designated route and the proposed designation alterations, the Noise Guidelines can be achieved, subject to practicability, and the extent of mitigation is similar. Therefore the noise effects of the proposed designation alterations compared with the noise effects of the Baseline (designated route) are considered no more than minor and generally less than minor for most nearby noise-sensitive receivers. If the proposed designation alterations are granted, the best practicable option for mitigation will be finalised in following stages of detailed design.

We conclude that provided a Construction Noise Management Plan is appropriately prepared and implemented, in accordance with NZS 6803 and the Transport Agency’s guidance on management of construction noise, construction noise effects of the existing designation will be reasonable. At times during the construction period, some noise-sensitive receivers may be adversely affected by construction noise levels. However, management of these events can ensure the overall effect is no more than minor.
## Appendix A: Modelling details and traffic volumes

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modelling and assessment</td>
</tr>
<tr>
<td>Review</td>
</tr>
</tbody>
</table>

### “Existing noise environment”

The proposed designation conditions require establishment of the existing noise environment prior to commencement of construction. That noise environment will likely be established through noise measurements and noise modelling. Note that for any modelled project, the realism of the noise model strongly depends on the completeness and intricacy of its inputs. Operational road-traffic noise modelling is usually based on annual average daily traffic rates, neutral environmental conditions that neither enhance nor limit propagation of the noise, and usually with no account of extraneous noise sources such as industrial noise or aircraft or activity in the area. Noise measurements should also be considered not necessarily fully representative of the noise environment but should be used only as a “snapshot” of the noise environment as it specifically occurred during the noise measurement period.

### Design years

2021 and 2041

### Noise model

NZS 6806: 2010 gives good guidance on the process and particulars expected of road-traffic noise assessments and noise modelling, more explicit and detailed than contained in the Noise Guidelines. All road-traffic noise modelling for this assessment has been in line with NZS 6806: 2010 and the Noise Guidelines. The modelling techniques used are well established in New Zealand. The model used is based on the Calculation of Road Traffic Noise (CRTN) model. The CRTN model was developed in the United Kingdom more than thirty years ago. Research in New Zealand has validated the model as appropriate in New Zealand so long as some New Zealand-specific adjustments are applied. $^5$

Calibration and validation have extensively established the reliability of noise modelling for assessing changes in noise levels, including New Zealand-specific calibration and validation. $^6$

While the match of modelled noise levels to measured noise levels is usually 1 to 2 dB $L_{Aeq}(24h)$, it is important to note:

### Noise modelling software

The noise modelling software used is SoundPLAN version 7.3 with current updates. SoundPLAN fully takes into account the effects of terrain and buildings in the propagation of noise from the road-traffic into the surrounding environment. SoundPLAN calculates the noise level over the entire calculation area that may contribute noise to a particular calculation point. SoundPLAN calculates noise at spaced points over a defined grid so as to produce noise contours, as included in this report. While these noise contours interpolate noise


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Ruakura Interchange

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Opus International Consultants Ltd
In addition, SoundPLAN calculates noise at specifically selected points. This is useful, for example, to identify the most exposed part of a façade on a building of interest and the noise level at that position.

**Traffic and layout**

In the modelling of the altered project (and the designated project), the NZS 6806: 2010 definition of the do-minimum design is used. This is “the project implemented including safety barriers and other structures (which may have an incidental noise mitigating effect)” but without “any measures undertaken for the sole purpose of reducing noise.” The do-minimum Project design is the Project without any noise-specific mitigation. While the Noise Guidelines do not specifically use this “do-minimum” design, it is implied by the process of assessing the noise of the project, comparing these noise levels to the average noise design levels and mitigating the project noise levels where necessary to achieve the average noise design levels.

**Traffic speeds**

Traffic speeds were advised as 80 km/h on the existing Ruakura Road between Silverdale Road and SH 26; 80 km/h on SH 26; 60 km/h on the relocated Ruakura Road west of the Expressway; 80 km/h on the relocated Ruakura Road east of the Expressway; and 100 km/h on the Expressway.

(10.07.2014 Mike Meister, Opus International Consultants)

On other roads, traffic speeds are taken as the current signposted speed limit.

**Road gradient**

Road gradient was calculated by the SoundPLAN software based on the imported vertical road alignment and/or the imported terrain data.

**Road surface**

For the current ambient situation, roads have been modelled as sealed with Grade 3/5 two-coat chipseal as a default assumption, although these roads may in reality be sealed with a quieter single-coat chipseal or other road surface. For the designated project and altered project, the expressway and all other roads have been sealed with Grade 3/5 two-coat chipseal as a default assumption. This is a noisy road surface and roads may in reality be sealed with a quieter single-coat chipseal or other road surface.

**Road layout, horizontal and vertical alignment**

Provided in July 2014 via dxf files that were directly imported into the SoundPLAN software.

(11.07.2014 Nelson Turvey and Ray Rui Guo, Opus International Consultants)

**Terrain data**

Topography for the area within approximately 300+ metres of the Project was provided as contours lines at 1 metre intervals via a dxf file that was directed imported into the SoundPLAN software.

**Buildings**

Buildings were identified via aerial photographs and input into the SoundPLAN software.

**Assessment positions**

Throughout this assessment, noise levels are calculated at a height of 2.0 metres above ground level. 1.7.2 of NZS 6806 states the assessment position should be 1.2 to 1.5 metres above each floor level of interest in the building of the Protected Premise or Facility. 2.0 metres is conservative compared to 1.2 or 1.5 metres and allows for building floor height to be constructed above ground height.
Ruakura Interchange

Traffic Flows
Baseline (Daily, HCV)
Baseline (Daily, RCV)
Scheme (Daily, HCV)
Scheme (Daily, RCV)

Ruakura Interchange
Opus International Consultants Ltd

Date: 2 July 2014

2041 TRAFFIC FLOW PREDICTION
Appendix B: Addresses
Appendix C: Noise environments
(Calculated for 2 metres above ground level)

Existing environment

2021 Baseline (designated route) environment
(Calculated for 2 metres above ground level)

**2021 Ruakura Interchange with Expressway over**

![Map of Ruakura Interchange with Expressway over]

**2021 Ruakura Interchange with Expressway under**

![Map of Ruakura Interchange with Expressway under]
(Calculated for 2 metres above ground level)

**2041 Baseline (designated route) environment**

**2041 Ruakura Interchange with Expressway over**
(Calculated for 2 metres above ground level)

**2041 Ruakura Interchange with Expressway under**

![Map showing noise levels at Ruakura Interchange with Expressway under.](image-url)