Traffic Noise Guidelines for Low Noise Areas in New Zealand

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Executive Summary

Introduction

The main guidelines applied to traffic noise in New Zealand are the Transit New Zealand Road Traffic Noise Guidelines, published in 1994. These guidelines set allowable increases in noise in relation to the current noise level in the area. For low noise areas the guideline maximum is 55dBA averaged over 24 hours. Typical low noise areas are rural areas, suburban areas away from arterial roads, or areas inside city blocks where the outer row of buildings screen traffic noise. Average noise levels in these areas is often less than 35-40dBA. The guidelines expect that low noise areas are those where the noise level is less than 43dBA expressed as L_{eq} (24 hour). Major bypasses introduce roads into these low noise areas. Often, the effect of the Transit New Zealand guideline level at 55dBA is that residents in low noise areas may be expected to accept noise level increase of 15-20dBA.

In New Zealand if road designations are sought under the Resource Management Act 1991 (reprinted 1994), it is necessary to demonstrate that this level of 55dBA constitutes "reasonable noise".

The intent of this project, carried out between July 1998 and June 2000, was to test a key part of the Transit New Zealand guideline by determining whether the level of 55dBA is found to be acceptable by the majority of the population of a low noise area.

Methodology

The methodology applied was to determine the attitudes and behavioural responses of communities in low noise environments to noise levels of about 55dBA by means of case studies of completed roading projects through low noise areas. This was carried out in three phases.

The first phase addressed initial attitudes in the first 1 to 2 years after a road's completion, and long-term attitudes where the road had been in place for 10 to 15 years. Opinions were gathered by surveys using telephone interviews followed by analysis to establish attitude patterns.

The second phase of the study determined long-term change in behaviour, by indicators such as frequency of property sales, and changes in apparent loss in amenity reflected in changed property values.

The third phase used one of the case studies used to determine long-term response. In this study residents who had moved away from the road but were still within the same town were questioned whether noise had influenced their decision to move.

Selection of Case Studies

The case studies were in areas where the road had been constructed through land which has already been fully developed as a residential subdivision but a corridor had been planned for the road. They were Wairere Drive in Hamilton and Queen Elizabeth Drive in Christchurch for the study of initial responses. The River Road (SH2) in Upper Hutt was used for the second and third stages of the study, and the Napier–Hastings Expressway for the second stage.

Noise Levels

Noise levels for both the initial effects and long-term noise effects were established by a combination of measurement and modelling. Measurements were made over two days for each case study, at houses with a noise environment typical of a group of houses adjacent to the road under study. About 20 measurement locations were selected for each road.

Survey of Community Attitudes

Initial Attitudes

In the first phase of the research, attitudes after 1 to 2 years of completion of a road were first recorded. In response to a general question on their dislikes about the neighbourhood, 15% of the participants answered with no prompting that they particularly disliked traffic noise, 7% disliked traffic in general, 21% had other dislikes about the neighbourhood, and 56% had no particular dislikes.

Results of choosing and ranking up to 6 neighbourhood factors that had the greatest negative impact on the quality of their living indicate that vehicle noise has the greatest negative affect on living in the two neighbourhoods selected.

When residents were asked specifically about their degree of traffic noise annoyance, however, the attitudes were as follows:

10% were highly annoyed; 18% were quite annoyed;
36% were unsure or neutral; 22% were OK;
14% were not at all annoyed.

Long-Term Attitudes

Also as part of the first phase of the research, attitudes of residents after 10 to 15 years of completion of a road were recorded. As in the survey of initial attitudes, general questions asked of residents were on their dislikes about the neighbourhood. With no prompting 16% of the residents said that they disliked traffic noise, and 21% of the residents in this group had no particular dislikes.

Traffic noise was again the factor most often chosen, with 49% of the residents rating traffic noise as having a negative impact on their lives.

When questioned specifically about the degree of annoyance with traffic noise, the attitudes were as follows:

14% were highly annoyed; 21% were quite annoyed;
33% were unsure or neutral; 21% were OK;
11% were not at all annoyed.

Time of day when noise is noticed most, for initial and long-term attitudes

Time of Day	Initial Attitudes		Long-term Attitudes	
	No.	%	No.	%
Not at all	12	8%	9	6.2%
During peak traffic times	53	34%	51	34.9%
Intermittently	12	8%	8	5.5%
Mostly day	17	11%	24	16.4%
Mostly night	44	28%	42	28.8%
Weekends	14	9%	12	8.2%
Seasonal	4	2%	0	0%

Noise impacts on everyday activities, and on thoughts of moving short-term

Impact	Always	Often	Sometimes	Rarely	Never
Disturbed sleep	1 (0.7%)	8 (6%)	19 (14%)	25 (18%)	83 (61%)
Interference with radio/television	0	8 (5.9%)	7 (4.4%)	17 (11.9%)	105 (77.7%)
Interference with conversations	0	2 (1.5%)	14 (10.4%)	16 (11.9%)	103 (76.3%)
Thoughts about moving away	5 (3.6%)	3 (2.2%)	8 (5.8%)	5 (3.6%)	116 (84.7%)

Noise impacts on everyday activities, and on thoughts of moving long-term

Impact	Always	Often	Sometimes	Rarely	Never
Disturbed sleep	5 (4%)	18 (14.3%)	17 (13.5%)	24 (19%)	62 (49.2%)
Interference with television/radio	2 (1.6%)	6 (4.8%)	9 (7.2%)	20 (16%)	88 (70.4%)
Interference with conversations	0	3 (2.4%)	9 (7.3%)	22 (17.9%)	89 (72.4%)
Thoughts about moving away	5 (4%)	7 (5.6%)	5 (4%)	10 (8.1%)	97 (78.2%)

Both initial and long-term attitude study groups were divided into those living below 55dBA and those living above 55dBA. There is a marked increase in the percentage of annoyed and highly annoyed in the subgroup with noise above 55dBA. The difference in attitude is an 8-10% increase in annoyed people, and a 10% increase in highly annoyed people. This increase in highly annoyed people for increasing noise levels than much more rapid than is indicated in the literature.

Property Sales and Values

This second phase of the research was to assess whether an attitudinal response such as annoyance resulted in a quantifiable behavioural response by indicators such as property sales, and changes in apparent loss in amenity reflected in changed property values. This was in part to determine if common objections that a new road would reduce price and saleability of property were borne out by the case studies.

Assessments were made of two sub-sets of property in each of two locations: River Road in Upper Hutt, Wellington, and in the city of Napier. In each location, the two sub-sets comprised similar housing situated parallel to one another, one close to the major road and the other close by but more distant from the major road. The streets were sorted into two subsets with properties ***directly exposed*** to road noise being identified as **"Subset A"** and properties ***not directly exposed*** to road noise identified as **"Subset B"**. The following three methods were used to determine any trend indicating correlation between a property's sale price and its proximity to the road.

1. Direct sales comparison of subset A with subset B.
2. Average sale price of subset A v subset B.
3. Percentage of sales per annum v available housing stock for both subsets A and B.

Upper Hutt Study Area

No clear statistical trends were produced to conclusively prove that properties located within Subset A (the properties closer to the road) sold for a lesser sale price than those in subset B did (properties further from the road). Also the turnover of housing was no higher on average in either subset.

Napier Study Area

The analysis of these properties indicated that no statistical correlation exists between sale prices and proximity to the road. A trend toward housing adjacent to the state highway achieving higher sale prices is apparent, where a superior outlook over reserve land improves the saleability of these properties.

Influence of Road Noise on Initial Decision to Sell

In this third phase of the study, the influence that traffic noise from the new road in the previously quiet area had in the decision to sell the property was determined. Nine houses that sold shortly after the road opened but the residents remained in the same town (Upper Hutt) were located. Results showed that only two of these sold for reasons associated with the noise, and the other sales may have been for improved amenity reasons.

Conclusions

The study of initial attitudes to traffic noise showed that about 10% of the sample population were highly annoyed by traffic noise when the noise level was about 55dBA. A further 15% were quite annoyed.

These percentages of highly annoyed or quite annoyed people are about the same as those for populations exposed to similar noise levels over a number of years, as recorded in the long-term study.

The Transit New Zealand Road Traffic Noise Guideline of 55dBA level for low noise areas assumes the noise effects will be minor because only a small proportion of a population, i.e. less than 10%, will be highly annoyed at this noise level. This study therefore supports the 55dBA level of the Guideline to be the upper limit for low noise areas, provided that it is considered acceptable for a small proportion of the population to be highly annoyed by traffic noise. It also appears that, at this noise level, 25% of the population will have some annoyance, and only 30% will be positive about the noise environment.

Road traffic noise levels on their own at 46-62dBA, as experienced by houses in the survey samples, are not expected to affect the sale price of a house. The general amenity of an area appeared to counteract the effect of road traffic noise on price.

However road traffic noise levels of 53 to 62dBA do appear to encourage people to move out of an area more quickly than from areas less affected by noise, or with noise levels below 55dBA. At least a minority of the sales of houses that occur when traffic noise exposure is increased, will be principally because of noise.

Abstract

A study, carried out in 1998-2000, investigated if a traffic noise level of 55dBA, the level allowed in the 1994 Transit New Zealand Road Traffic Noise Guidelines, was an acceptable limit in New Zealand for areas that previously had low traffic noise. A case study approach was used for four roads, two of which had been open for about 2 years, and two had been open for about 12 years. A sample of residents were surveyed for their attitudes to road traffic noise in comparison to the general amenity of the area. The study also determined if the road traffic noise resulted in lower prices for those houses more exposed to road traffic noise but found that no effect could be isolated from other factors which might also influence price. The study found evidence that exposure to traffic noise can result in more frequent sales, and some of the early sales made soon after the construction of the road can be made principally to avoid the traffic noise.

1. Introduction

The main guidelines applied to traffic noise in New Zealand are the Transit New Zealand Road Traffic Noise Guidelines published in 1994. These guidelines set allowable increases in noise in relation to the current noise level in the area. For low noise areas the guideline maximum is 55dBA averaged over 24 hours. The guidelines expect that low noise areas are those where the noise level is less than 43dBA expressed as L_{eq} (24 hour).

Typical low noise areas are rural areas, suburban areas away from arterial roads, or areas inside city blocks where the outer row of buildings screen traffic noise. Average noise levels in these areas is often less than 35-40dBA. Major bypasses introduce roads into these low noise areas.

Often, the effect of the Transit New Zealand guideline noise level at 55dBA is that residents in low noise areas may be expected to accept noise level increases of 15 to 20dBA. This level of increase would be perceived as more than a tripling of the current noise level.

The value of 55dBA used in the guidelines is taken from a study of population response to transport noise from European cities, and in particular from the study by Shultz (1979). Figure 1.1 illustrates that 55 dBA, based on Schultz's findings, is a threshold below which only a small proportion of the population is highly annoyed by transport noise. Some research on Australian case studies provides indirect support for this value in Australia.

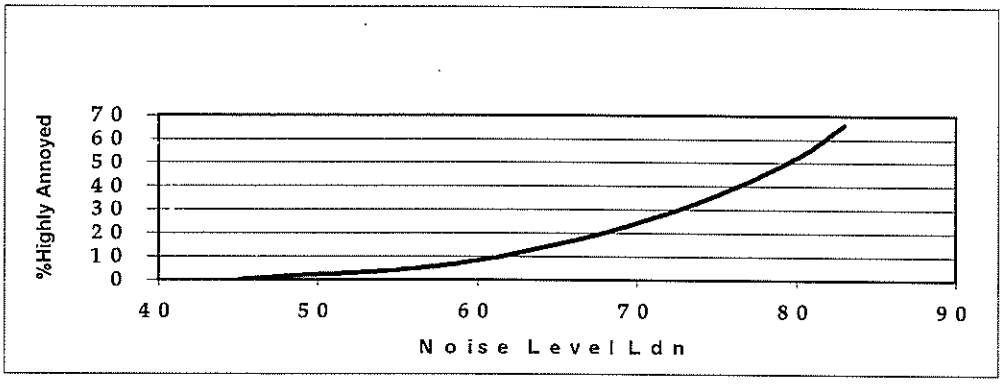


Figure 1.1 % response of people highly annoyed by different increasing noise levels.
(Ldn sound level for day, night: an extra 10dBA is added to night-time levels to allow for the added annoyance.) (based on Schultz 1979)

In New Zealand, road designations sought under the Resource Management Act 1991 (reprinted 1994) have to demonstrate that this level of 55dBA constitutes "reasonable noise". However, this level (55dBA) is significantly greater than that permitted for land use in district plans. In low noise areas, permitted noise from other land use activities would be restricted to between 40 and 45dBA as a 24-hour average. This discrepancy between allowable levels for roading and land use has already been highlighted by roading project opponents at Resource Consent hearings.

The intent of this project, carried out between July 1998 and June 2000, was to test a key part of the Transit New Zealand Guideline by determining whether the level of 55dBA is acceptable to the majority of the population of a low noise area. The study was funded by Transfund New Zealand's research fund.

Objectives

The objectives of this project are:

1. By means of case studies of recent roading projects, demonstrate that the Transit New Zealand Road Traffic Noise Guideline level of 55dBA, taken as the maximum permitted noise level for low noise areas, is viewed by the community as a reasonable level of noise.

2. By this means to provide validation for use for low noise areas in New Zealand, of the Transit New Zealand Road Traffic Noise Guideline.

2. Methodology

2.1 General

The methodology applied was to determine the attitudes and behavioural responses of communities in low noise environments to noise levels of about 55dBA by means of case studies of completed roading projects through low noise areas. The project was carried out in three phases.

The first phase addressed attitudinal responses of both initial attitudes in the first 1 to 2 years after a road was completed, and long-term attitudes after the road had been in place for 10 to 15 years. Two case studies were used for the short-term response and two different case studies for the long-term response. The attitudes were determined by opinion gathered by surveys involving telephone interviews, followed by analysis to establish patterns.

The second phase of the study was to determine long-term change in behaviour. These longer term behaviour effects were determined by indicators such as frequency of property sales, and changes in apparent loss in amenity reflected in changed property values.

In the third phase of the study, residents who had moved away from the road but still were within the same town were questioned whether traffic noise had influenced their decision to move.

2.2 Selection of Case Studies

The type of area selected was where a new road had been constructed through an area that previously had been away from existing roads. The land had already been fully developed as a residential subdivision but a corridor had been planned for the road. This type of area would originally have had a low noise level but would now have noise levels of about 50-60dBA. To ensure an adequate statistical population of affected residents, these bypasses or motorways needed to be at the edge of the urban area.

The case areas selected were:
Napier–Hastings Expressway, Kennedy Road area, Napier
River Road, Upper Hutt
Wairere Drive, Hamilton
Queen Elizabeth II Drive, Christchurch

Wairere Drive and Queen Elizabeth II Drive were only 2 to 3 years old and in both instances the road had been constructed within a planned corridor, through land which has been fully developed as a residential subdivision. These two case studies were used to determine the initial responses to roads. Noise levels obtained in these studies are recorded in Appendices 1 and 2.

The Napier-Hastings Expressway and the Upper Hutt River Road had been completed about 15 and 8 years ago respectively. These two were used to determine the long-term response and the long-term behaviour effects such as house prices and house sales. Noise levels obtained in these studies are recorded in Appendices 5 and 6.

2.3 Noise Levels

Noise levels for both the initial effects and long-term noise effects were established by a combination of measurement and modelling. Measurements were made over two days for each case study. Measurement locations were at houses having a noise environment typical of a group of houses adjacent to the road under study.

About 20 measurement locations were selected for each road. Measurements were made after the survey of opinion to avoid bias of sensitising the population to noise by the apparent investigation of a problem. Noise levels before the road was in place were established by a combination of values stated in the scheme assessment reports, by modelling, and by knowledge of typical noise levels for the particular land use.

Noise levels in the cases selected for studying initial attitudes ranged from 45 to 58dBA. For the case studies of long-term attitudes and property values, noise levels ranged from 48 to 62dBA because these roads had been built under different noise guidelines.

3. Survey of Community Attitudes

3.1 Initial Response to Changed Noise Levels

3.1.1 Procedure

The methodology we used followed that applied in a similar study by Geoplan (1992) on the F3 Freeway north from Sydney, New South Wales.

A letter explaining the purpose of the survey and a sample survey (Appendix 3) were sent to residents living in the designated areas. Occupancies were determined from Local Authority Council records, and those with known phone numbers were contacted to determine their willingness to be interviewed.

From the 394 houses in both the Christchurch and Hamilton locations, 302 could be contacted by phone for the interview (survey form is in Appendix 4). The acceptance rate for interviews was 48%, giving a sample size for the study of 144 houses.

3.1.2 Sampling Method

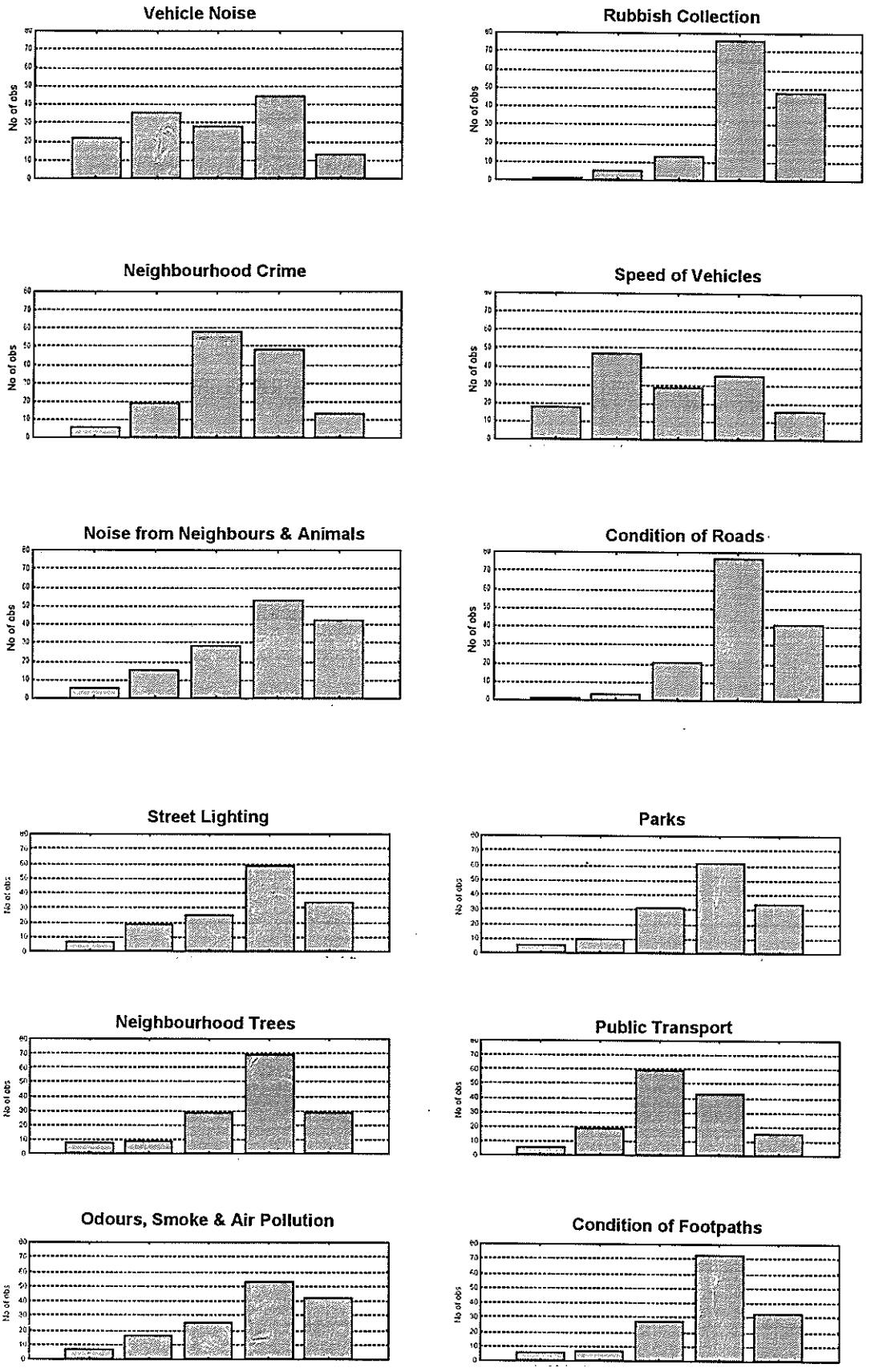
The sampling method employed in the data collection enabled the maximum amount of houses to be surveyed cost effectively. However, this methodology does have some bias in the sample selected. First, because the survey was not compulsory the participants will include people who do not mind doing surveys, have the time to do surveys, or have a particular opinion that they would like to express. We suggest that the data could be skewed by more positive answers than would be typical of the actual population.

Second, the sample we have selected is not fully representative of the neighbourhood population. This eventuated because we did not have access to the phone numbers of residents living in rental accommodation. Therefore the opinions expressed in the survey are mainly from home-owners and long-term residents in the selected areas. People in this group are likely to have stronger opinions that other types of residents.

3.1.3 Findings

To minimise bias, the purpose of the survey was not initially given to the residents. The first question asked of the residents was general, on their dislikes about the neighbourhood. Of the participants, 15% answered with no prompting that they particularly disliked traffic noise, 7% disliked traffic in general, 21% had other dislikes about the neighbourhood, and 56% had no particular dislikes.

Residents were asked to choose and rate up to 6 neighbourhood factors, out of a list of 15 (Appendix 3), that had the greatest negative impact on the quality of their living. The results indicate that vehicle noise has the greatest negative affect on living in the two neighbourhoods selected.



Ranking (columns left to right): Very Unsatisfactory, Unsatisfactory, Unsure/Neutral, Satisfactory, Very Satisfactory

Figure 3.1 Initial attitudes of residents' satisfaction with various (12) neighbourhood characteristics.

Figure 3.1 shows residents' satisfaction ratings on 12 neighbourhood characteristics. For clarity, three neighbourhood characteristics (appearance of houses and gardens, parks, and playgrounds) were not included in this figure. Of note are the bar-graphs for vehicle noise and speed of vehicles which differ in their distribution compared to the other 10 neighbourhood characteristics. These two graphs show that more residents were either "very unsatisfied" or "unsatisfied" with vehicle noise and speed. In general, fewer residents chose to answer "unsure/neutral", "satisfied" or "very satisfied" when responding to questions on vehicle noise and speed.

When residents were asked specifically about their degree of traffic noise annoyance, the responses reflected a normal distribution of answers. Figure 3.2 shows the annoyance ratings, being slightly more skewed to positive responses, than the vehicle noise satisfaction graph in Figure 3.1. This is not unexpected given that people are generally more adverse to expressing strongly negative views, such as "highly annoyed".

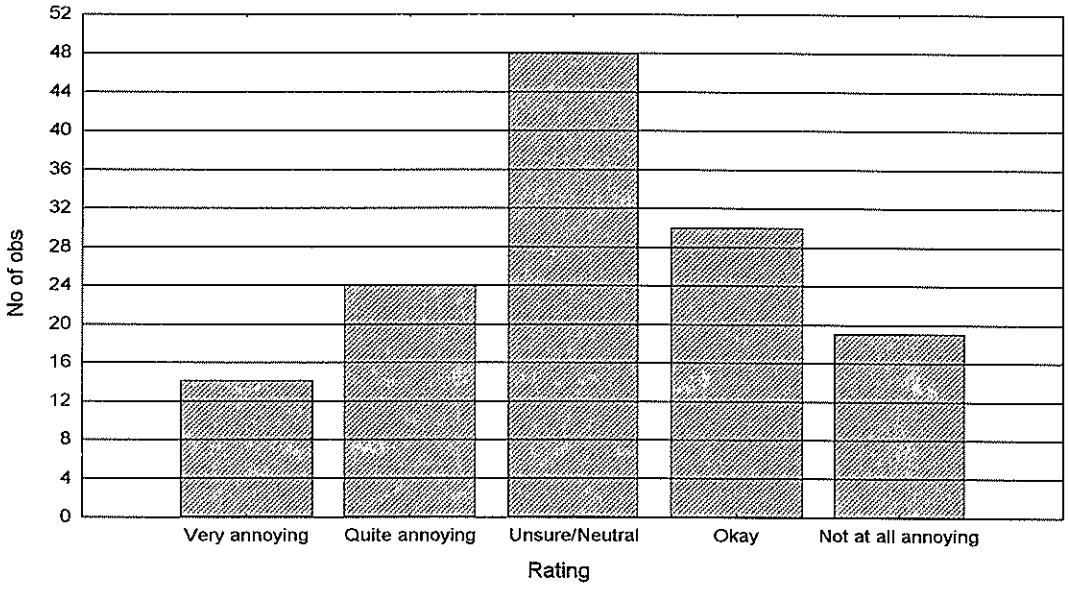


Figure 3.2 Reaction to traffic noise rated in terms of annoyance for initial attitudes.

When the residents were asked specific questions about vehicle noise, they indicated that the main source of traffic noise was from the expressway, and that it was noisier on the side of their house that faced the expressway. Table 3.1 shows that noise was noticed more often during peak periods of traffic and at night.

Table 3.1 Time of day when noise is noticed most.

Time Period	No. of Obs	%
Not at all	12	8%
During peak traffic times	53	34%
Intermittently	12	8%
Mostly day	17	11%
Mostly night	44	28%
Weekends	14	9%
Seasonal	4	2%

A slight positive correlation of 0.31 was found in the raw scores between actual noise levels and annoyance. Further analysis found a statistically significant difference in annoyance occurred at the 0.05 p-level between those living in areas with noise above 55dBA and under 55dBA ($p = 0.0001$). There was also a statistically significant difference in satisfaction between these groups ($p = 0.005$).

An analysis on the change in noise levels, before and after the expressway was built, was also conducted relative to residents' satisfaction levels. Change in noise levels allocated to one of four groups:

1. no change in noise or decreased levels of noise;
2. an increase up to 5dBA,
3. an increase between 5 and 10dBA, and
4. an increase of 10dBA or more.

No statistically significant difference in satisfaction ratings was recorded between these groups at the 95% confidence level. However in the no change/decreased noise levels group, more people rated as "satisfied" with noise levels, and in the group living in areas which had had an increase of more than 10dBA people rated as "unsatisfied" more often.

Table 3.2 provides information on the degree to which noise impacts on everyday activities. Respondents were asked how often noise disturbed or interfered with these activities. They were also asked how often they had thought about moving away on account of the traffic noise.

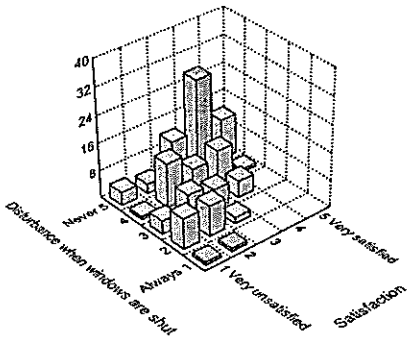
Table 3.2 Noise and its impacts on everyday activities, and on thoughts of moving.

Impact	Always	Often	Sometimes	Rarely	Never
Disturbed sleep	1 (0.7%)	8 (6%)	19 (14%)	25 (18%)	83 (61%)
Interference with radio/television	0	8 (5.9%)	7 (4.4%)	17 (11.9%)	105 (77.7%)
Interference with conversations	0	2 (1.5%)	14 (10.4%)	16 (11.9%)	103 (76.3%)
Thoughts about moving away	5 (3.6%)	3 (2.2%)	8 (5.8%)	5 (3.6%)	116 (84.7%)

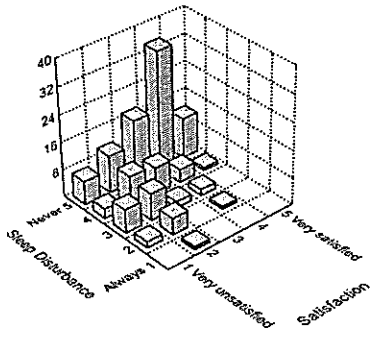
Figures 3.3a, b, c show that those who are often disturbed by sleep, and those who have thought about moving away, are more likely to be unsatisfied with noise levels.

Figure 3.3 The relationship between satisfaction levels and degrees of disturbance from road traffic noise, from the survey of initial attitudes.

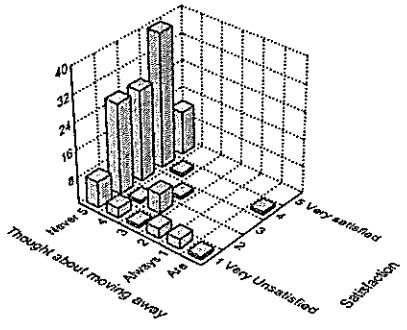
a. Degree of disturbance caused by noise, when windows are shut.



b. Degree of sleep disturbance caused by noise.



c. Thoughts about moving away because of noise.



Other variables that were found to influence satisfaction and annoyance levels with noise were the perceived noisiness of internal activities in the house, education level, whether the person owned the house, and the presence of children. However none of these variables were found to be statistically significant.

The noise levels assessed for each of the roading systems studied are shown in Appendices 1 and 2.

3.2 Long-Term Response to Changed Noise Levels

3.2.1 Procedure and Sampling Method

The same survey procedure, and sampling method that were used for the initial surveys were used for the long-term surveys.

From the 313 houses in both the Upper Hutt and Napier locations, 239 could be contacted by phone for the interview. The acceptance rate for interviews was 52%, giving a sample size for the study of 125 houses.

3.2.2 Findings

As in the first phase of the survey, initial questions asked of residents were on their dislikes about the neighbourhood. With no prompting 16% of the residents said that they disliked traffic noise. This percentage is very similar to the 15% obtained in the short-term noise survey, but only 21% of the residents in this group had no particular dislikes.

Residents were asked to choose and rate up to 6 neighbourhood factors that had the greatest negative impact on the quality of their living. Traffic noise was the factor most often chosen, with 49% of the residents rated traffic noise as having a negative impact on their lives.

Figure 3.4 shows residents' satisfaction ratings for different neighbourhood characteristics. Three neighbourhood characteristics (appearance of houses and gardens, train and aeroplane noise, and playgrounds) were removed from this figure so that the graphs could be easily compared. As in the initial survey the two graphs for vehicle noise and speed of vehicles differ in their distribution in comparison to the graphs of the other 10 neighbourhood characteristics. These two graphs show that more residents were unsatisfied with vehicle noise and speed. In general, fewer residents chose to answer "unsure/neutral", "satisfied" or "very satisfied" for vehicle noise and speed.

Questions asked of the residents about traffic noise produced the same findings as in the short-term survey. Figure 3.5 shows that residents' ratings of annoyance are normally distributed. In contrast to the vehicle noise satisfaction graph in Figure 3.4, this demonstrates again that respondents are hesitant to express strongly negative views.

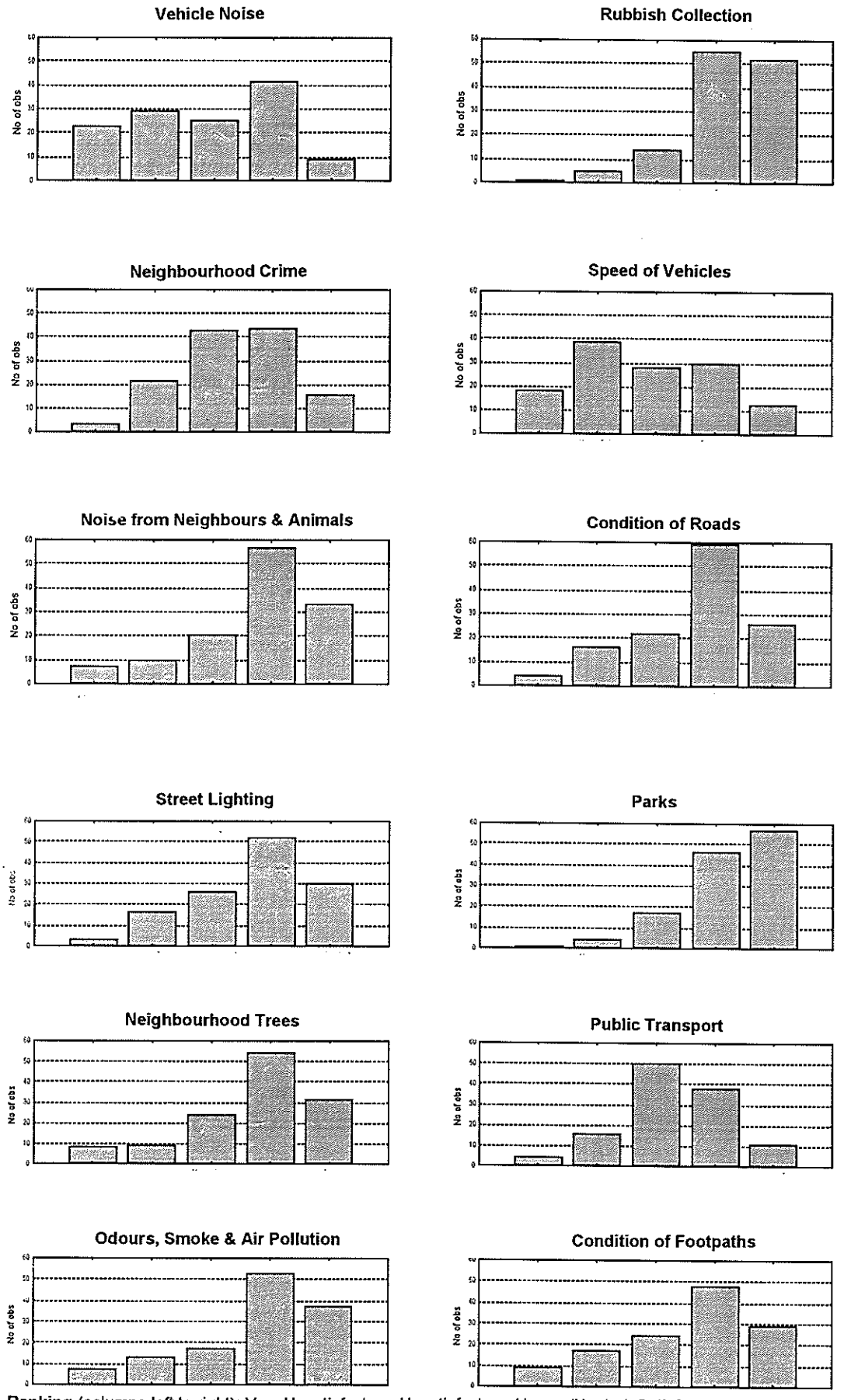


Figure 3.4 Long-term attitudes of residents' satisfaction with various (12) neighbourhood characteristics.

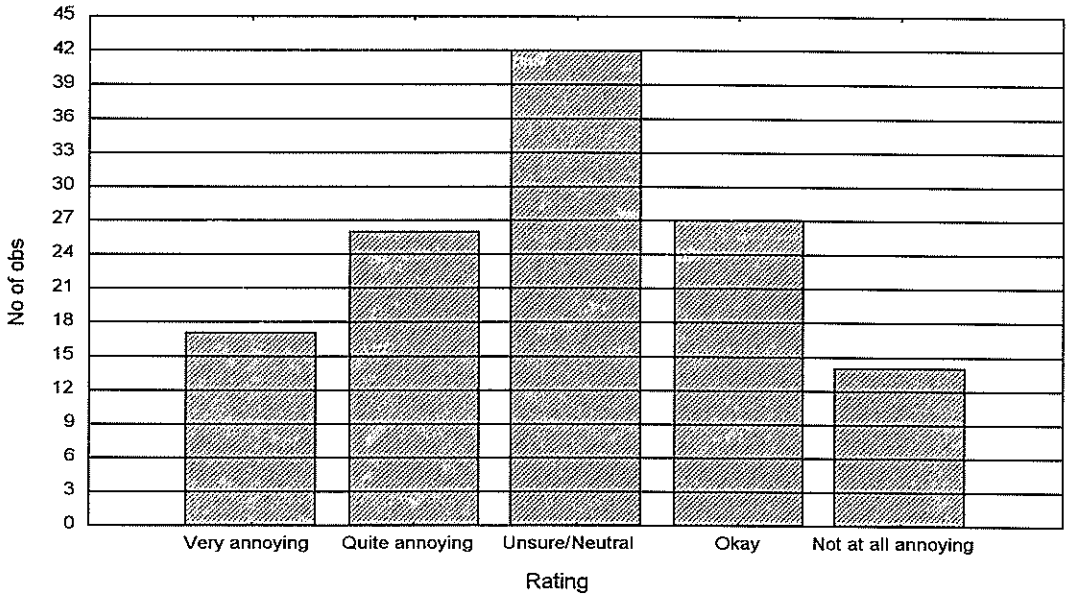


Figure 3.5 Reaction to traffic noise rated in terms of annoyance for long-term attitudes.

A slight positive correlation of 0.23 was found in the raw scores between actual noise levels and satisfaction. Further analysis found a statistically significant difference in satisfaction at the 0.05 p-level between those living in areas with traffic noise above 55dBA and that under 55dBA ($p = 0.009$). Figure 3.6 shows these differences.

However, note that more observations are in the graph representing opinions of people living in areas with noise over 55dBA. Residents there are more likely to rate noise as unsatisfactory.

The graph representing residents living with noise below 55dBA has a relatively low number of observations at the negative end of the scale; and the greater proportion of these residents were "satisfied" with the noise levels.

The only variable that was found to influence a person's satisfaction with noise was the perceived noisiness of internal activities inside the person's own home. Those people with quiet homes were less likely to be unsatisfied. People who were unsatisfied and annoyed were more likely to want to move and more likely to have sleeping difficulties. However, these relationships were not found to be statistically significant.

Figure 3.6 The difference between satisfaction ratings above and below the level of 55dBA.

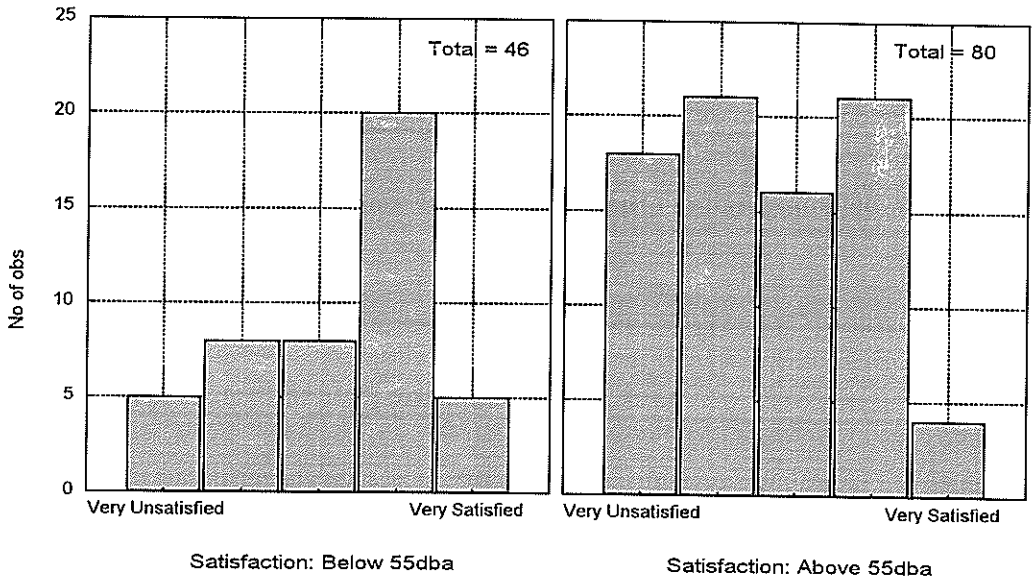


Table 3.3 shows that noise was noticed more often at peak traffic times and at night, and Table 3.4 provides information on how often noise disturbed everyday activities and how often the residents thought about moving away on account of the traffic noise.

Table 3.3 Time of day when noise is most likely to be noticed.

Time Period	No. of Obs	%
Not at all	9	6.2%
During peak traffic times	51	34.9%
Intermittently	8	5.5%
Mostly Day	24	16.4%
Mostly night	42	28.8%
Weekends	12	8.2%
Seasonal	0	

Table 3.4 Noise and its impacts on everyday activities, and on thoughts of moving.

Impact	Always	Often	Sometimes	Rarely	Never
Disturbed sleep	5 (4%)	18 (14.3%)	17 (13.5%)	24 (19%)	62 (49.2%)
Interference with television/radio	2 (1.6%)	6 (4.8%)	9 (7.2%)	20 (16%)	88 (70.4%)
Interference with conversations	0	3 (2.4%)	9 (7.3%)	22 (17.9%)	89 (72.4%)
Thoughts about moving away	5 (4%)	7 (5.6%)	5 (4%)	10 (8.1%)	97 (78.2%)

3.3 Comparisons of Effects of Short-Term & Long-Term Noise

The data from the two short- and long-term studies were combined. The mean actual noise value for the short-term survey sites was 54dBA, and for the long-term survey sites it was 56dBA. The long-term sites did not have as much variation in noise values.

The findings from the two surveys were then combined. Again, significant differences were found for satisfaction ($p = 0.0001$) and annoyance levels ($p = 0.000015$) for those residents living in areas with noise above and below 55dBA. No differences in satisfaction and annoyance levels were found between the resident groups who participated in the short- and long-term surveys. Therefore, residents who had been subject to noise recently and residents who have been living with noise for longer, both rated their reactions to traffic noise similarly in terms of satisfaction and annoyance.

We also investigated the effect that length of tenancy could have on the residents' satisfaction or annoyance levels, but found no significant trends in the data. Figure 3.7 summarises the findings. It shows that those living in areas where noise is under 55dBA have positively skewed responses to the satisfaction question. Those living in areas where the noise is over 55dBA are more likely to be dissatisfied. The differences in satisfaction between those having lived in short- and long-term noisy conditions are minimal. However, there is a slight tendency for those who have lived in an area for a short period of time to be less satisfied with noise. Presumably, people grow used to traffic noise over time, or they develop strategies to minimise its disruption to everyday life.

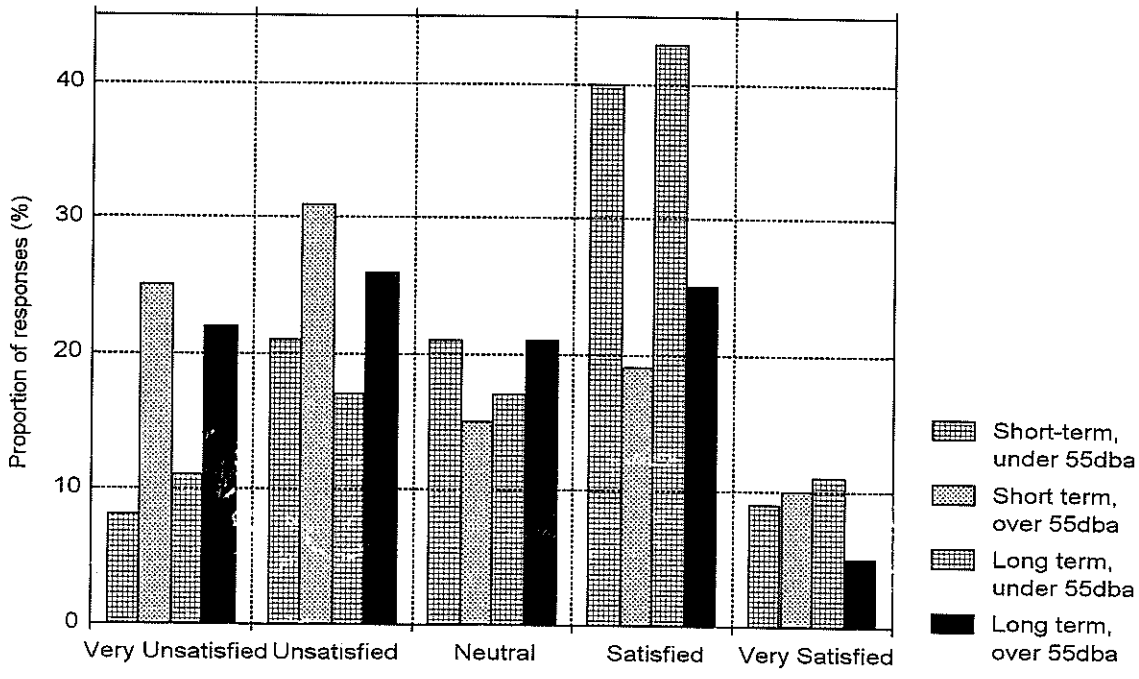


Figure 3.7 Satisfaction ratings of residents living with noise above and below 55dBA for short and long periods of time.

4. Property Sales & Values

4.1 Introduction

The purpose of this component of the research was to assess whether an attitudinal response, such as annoyance, resulted in a quantifiable behavioural response. This was done by examining indicators such as property sales, and changes in apparent loss in amenity reflected in changed property values. In part this was to determine whether the common objection that a new road would reduce price and saleability of property, would be borne out by the case studies.

4.2 Literature Review

A literature study was undertaken to review how such assessments had been approached before. A number of case studies with similar objectives to this one were found in the international context (see section 7, References). They ranged in time from the 1970s through to 1996. First we reviewed whether an acceptable level of road noise had been established, below which property value and saleability was not affected. Next we compared our proposed methodology with the methods applied by other researchers, to validate or vary our approach as appropriate.

Although the findings of the study were not conclusive, a number were of relevance to the subject. One was the difficulty in developing a completely robust research approach, given the many variables impacting on the research in any location. Some researchers noted that features such as the type of land development surrounding the road segment, traffic volumes on the roadway, and operating conditions, all contributed to the impact of road noise pollution on nearby residents. For instance, regarding traffic volumes, the marginal noise of a motor vehicle travelling on a busy road is relatively minor compared with the same vehicle travelling on a low traffic-volume road.

In terms of a noise level identified as being "acceptable" to an urban community, variations were found between the studies. In the United States (US) many Federal Agencies have adopted an Ldn (day-night sound level) of 65dBA as a threshold above which land is considered incompatible for residential use (Haling & Cohen 1996). US studies carried out in the 1970s estimated that background noise in a typical urban neighbourhood was roughly 55 Ldn and that housing prices decreased by 0.2% to 0.6% (average of 0.4%) per one Ldn unit increase (Haling & Cohen 1996). Hall et al (1978) concluded, with respect to property in the US, that differences in house prices were clearly related to high levels of noise from highway traffic. However the "high" level of noise recorded in that study was over 73dBA or higher, and they concluded that levels of 60 and 65dBA had been shown to annoy residents but did not affect house prices.

Overall, the studies showed that the effect of highway noise on the price of housing varied with each location. They also showed that the reduction in house price did not occur in a linear fashion dependent on level of noise. Many other factors impacted on the findings and often these were difficult to quantify. However it seems relatively conclusive, from the international research carried out, that noise deemed as high will impact on sale price. The definition of high, as outlined above, will depend on the locality's characteristics and on other factors. However a level of about 65dBA and below generally should not impact sale price or the saleability of the property. At levels about 75dBA and above, property values should begin to decline because of the noise pollution factor.

4.3 Methodology

To assess sales and property values, assessments were made of two subsets of property in each of two locations: at River Road in Upper Hutt, Wellington, and in the city of Napier. In these locations, the two subsets comprised similar housing situated parallel to one another, one close to the major road and the other parallel but more distant from the major road.

The issue to determine was whether the subsets located closer to the road sold for less than their counter-parts situated further from the road, and whether those properties closer to the road sold more frequently. An affirmative finding in either case might indicate that the road noise was detrimentally impacting on the value of the property or on the quality of life of the residents.

Recorded in the literature was a method using two subsets of similar types of property, one of which is located close to the road in question and another at a defined distance from the road (and thus experiencing less noise), and similar housing types. If these conditions can be met, sale comparisons can be made to determine any variations based on the proximity to the road.

Some researchers also carried out forms of multiple regression analysis on the sub-sets of property data, to isolate the noise variable. However the general finding that noise and property value are not related in a linear fashion, i.e. there are always unique variables at different locations impacting on the findings, meant that further analysis beyond the simple hedonic price comparison approach, as proposed here, would suffice. Indeed Hall et al. (1978) commented that, where the site selection of the subsets had produced good comparable housing, then an analysis of the variance of the selling prices would be sufficient to reach valid conclusions.

For this study, three methods were adopted to determine any trends that would indicate a direct correlation between a property's sale price and its proximity to the road. They are:

- Direct sales comparison of subset A v subset B,
- Average sale price of subset A v subset B,
- Percentage of sales per annum v available housing stock.

From a historical sales database, we searched all sales that took place within all streets of the selected case site, during the period January 1994 to September 1999. The streets were sorted into two subsets with properties **directly exposed** to road noise being identified as **"Subset A"**; and properties removed and **not directly exposed** to road noise identified as **"Subset B"**.

4.3.1 Direct Sales Comparison of Subset A v Subset B

We identified at least one sale for most streets every year from 1994 to 1999, within subset A (directly exposed). Each of these sales was analysed and assessed for its quality, floor area, land area, other buildings, landscaping and general appeal. Using our professional judgement we made allowances for positive and detrimental features. By making these allowances and deducting or adding them to the sale price of each property, we were able to arrive at a residual value for each sale. This method adjusts differences for each property and makes a direct comparison of properties more relevant.

The next step was to directly compare each subset A sale with the selected relevant subset B sales. By dividing the subset A sale by a subset B sale, we determined a positive or negative percentage as the variance between the sales. The percentages have been averaged for each sample, for each year. The assumption was made that sales occurring within a calendar year have been directly compared with each other. Therefore property market value fluctuations have been determined as occurring on a yearly basis.

4.3.2 Average Sale Price of Subset A v Subset B

This approach involved utilising the entire sales data available for all streets included in the Upper Hutt and Napier studies. The total sale value has been adopted as the basis of this approach and the sales have subsequently been sorted by the year in which they occurred. On this basis we have directly compared total subset A sales v total subset B sales.

4.3.3 Percentage of Sales per Annum v Available Housing Stock

This approach provides an indication of the frequency of turnover of housing stock within the two study regions. Data on the number of possible sales that occurred between 1994 and 1995 were collected, this figure was divided by the housing stock available within that particular subset, and subset A was graphed against subset B for both regions.

4.4 Upper Hutt Region

4.4.1 Introduction

Upper Hutt is situated in the northern Hutt Valley, approximately 33 kilometres north of central Wellington City. The high volume roadway identified for the purpose of this study, the River Road, is the main arterial road carrying traffic through the Hutt Valley. It is effectively a continuation of the Hutt Motorway in the south, extending through to Te Marua and across the Rimutaka Range in the north.

Following a preliminary selection of streets for our Upper Hutt survey, a site visit was made. The streets suitable for the study are predominantly developed with residential housing, and are easily separated into two distinct subsets. One subset (A) includes properties directly exposed to road noise and they are in the following streets:

Longfellow Street	**Riverbank Road**
Hazel Street	**Jupiter Crescent**
Hudson Avenue	**Kea Grove**
Clouston Park Road	**Mary Crescent**

After visiting the site we excluded Jupiter Crescent because it is primarily developed for industrial use and so does not compare to the others. We added McLeod Street in its place, because it incorporated residential property and its situation comfortably fitted the study.

The second subset (B) included properties set back from River Road, and they are in the following streets:

Shakespeare Avenue	**Oak Street**
Davis Crescent	**Kowhai Avenue**
Maher Street	**Cecil Street**
Redwood Street	**Benge Crescent**
Victoria Street	**Rosina Street**

4.4.2 Location Description

The properties that were the focus of the Upper Hutt survey are primarily residential housing developed c.1950 through to the 1960s, with a small amount of development taking place during the intervening years to the present day. The housing tended to be a modest New Zealand style, with construction generally of timber frame, and of a style typical of larger housing developments of the era.

The locality could be described as providing a pleasant established environment in most cases, and housing in general is well maintained with the exception of a small number of properties. The land area attributed to each property on average comprised sites of approximately 600m^2. Housing tends to sell in the mid-price bracket when compared to other housing located in the Upper Hutt area, typically in the range of $100,000 to $130,000. The area is popular with first-home buyers and family groups because of the lower price level, spacious sections, and close proximity to amenities.

The locality is well serviced, having five schools nearby, the Upper Hutt shopping centre, with a full array of shops including supermarket within one kilometre, an abundance of parks, a community sports centre, churches, and a public bus route that is within half a kilometre of all properties.

4.4.3 Micro-location Description

Although most of the housing is similar, with all properties enjoying a comparable type environment, a few key features were noted within the following properties:

Kea Grove - this cul de sac street is located directly adjacent to River Road and is predominantly developed with lower quality, ex-state style, housing. Housing would be described as inferior to that in the other streets in the sample. Also housing was most likely state-owned and, as a consequence, had been tenanted rather than owner-occupied in the past.

Riverbank Road – this street forms part of a short cut from River Road via Pine Avenue to the main shopping area for Upper Hutt. As a consequence high levels of traffic were noted on this thoroughfare. Although this traffic is a detrimental factor, properties in this street tend to have a pleasant outlook over Riverbank Park. A mixture of housing stock exists on this street, with development generally having taken place at different times rather than in the 1950s and 60s as elsewhere in the suburb.

McLeod Street – as noted earlier, McLeod Street was added because of its location adjacent to River Road and its similar housing stock. However this street, although being well established and tree-lined, appeared to carry a high volume of traffic which potentially reduces its desirability somewhat.

Allowance has been made for these inherent differences between the above streets, and for any differences that they possess when carrying out our analysis.

4.4.4 Direct Sales Comparison Approach

The analysis below shows, for each net sale in subset A, the average **net sale** for subset B, and the percentage variance between the two subsets each year for five samples.

Analysis of sales

Year	Net Sale Subset A	Average Net Sale Subset B	% Variance
Sample 1	*Longfellow v Shakespeare*		
1995	$102,700	$87,000	+18.0%
1996	$99,500	$102,500	+2.3%
1997	$93,500	$92,750	+0.8%
1998	$145,000	$131,436	+10.31%
Sample 2	*Riverbank, Hudson, Hazel v Elm, Kowhai, Victoria and Oak*		
1994	$100,500	$108,923	- 7.78%
1995	$76,500	$92,300	-17.12%
1996	$109,000	$111,833	- 2.3%
1997	$91,700	$103,010	-10.98%
1998	$93,500	$116,000	-20.00%
Sample 3	*Mary, Kea v Davis, Maher, Redwood*		
1994	$90,000	$82,000	+9.75%
1995	$77,000	$92,300	+16.6%
1996	$83,500	$111,833	-25.34%
1999	$144,000	$103,010	-39.80%

Analysis of sales *(continued)*

Sample 4 *McLeod v Redwood*

1996	$116,500	$105,675	+10.24%
1997	$131,000	$ 95977	+36.49%
1999	$179,600	$121636	+47.65%

Sample 5 *Clouston Park v Benge, Rosina, Cecil*

1995	$91,500	$77,648	+17.83%
1996	$99,000	$103,090	+ 4.0%
1997	$86,000	$90,700	- 5.2%
1998	$106,500	$112,400	- 5.3%
1999	$119,000	$122,000	- 2.5%

The following table summarises the average yearly variation across all five samples over the years 1994 to 1999.

Percentage annual net sales for Subsets A v B

Year	% net sales
1994	–1.94%
1995	+8.82%
1996	–3.14%
1997	+5.20%
1998	–8.33%
1999	–1.78%

This analysis illustrates, first, that there is no correlation between the sales value of properties in subset A v subset B.

Second, the annual net sales percentage indicates that the variation in sale value has fluctuated markedly over a 6-year period. However the fluctuation has been no greater than plus or minus 10%. As a whole there has been an even spread indicating a less than 0.25% variation between the subsets over the years 1994 to 1999.

The scatter-graph of Figure 4.1 gives a further indication that there is no clear correlation between sales within subset A and subset B over the years 1994 to 1999. The comparable properties pertaining to each of the subjects are scattered around the value of 1, which is the line of direct comparison.

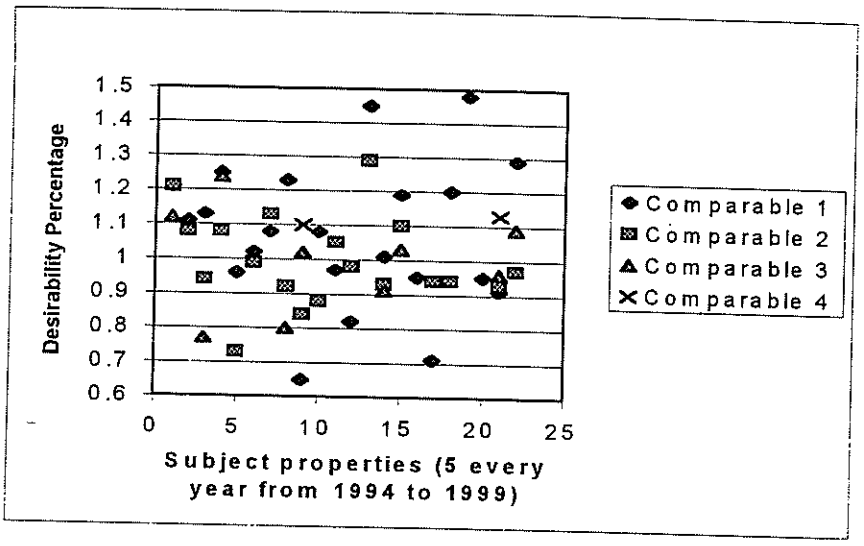


Figure 4.1 Desirability correlation between properties alongside, and those away from River Road, Upper Hutt, between 1994-1999.

4.4.5 Average Sale Price of Subset A v Subset B

Due to the large volume of sales the average sale prices for subsets A and B were plotted against each other on Figure 4.2.

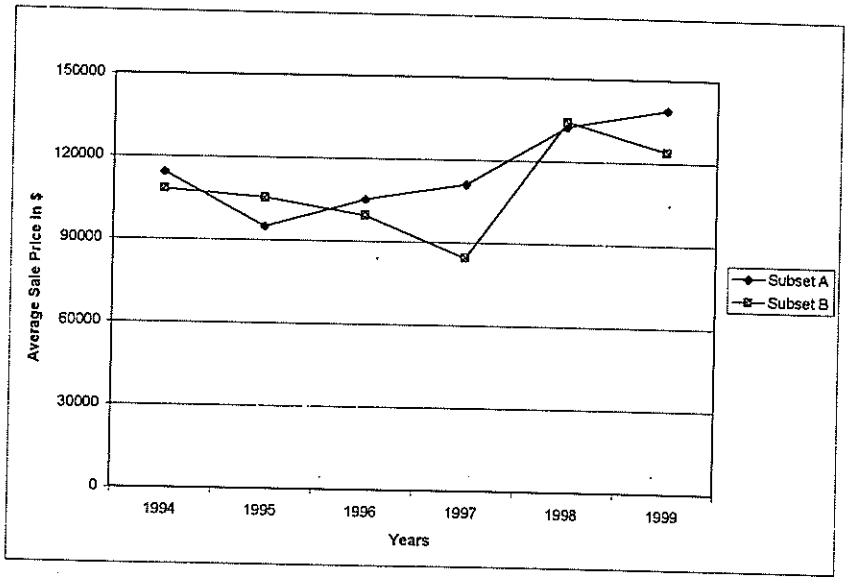


Figure 4.2 Average sale prices for properties alongside, and those away from River Road, Upper Hutt, between 1994-1999.

As would be expected, a noticeable increase in sale price occurs for the years from 1994 through to 1999. However there is no direct correlation between the subsets.

4.4.6 Percentage of Sales per Annum v Available Housing Stock

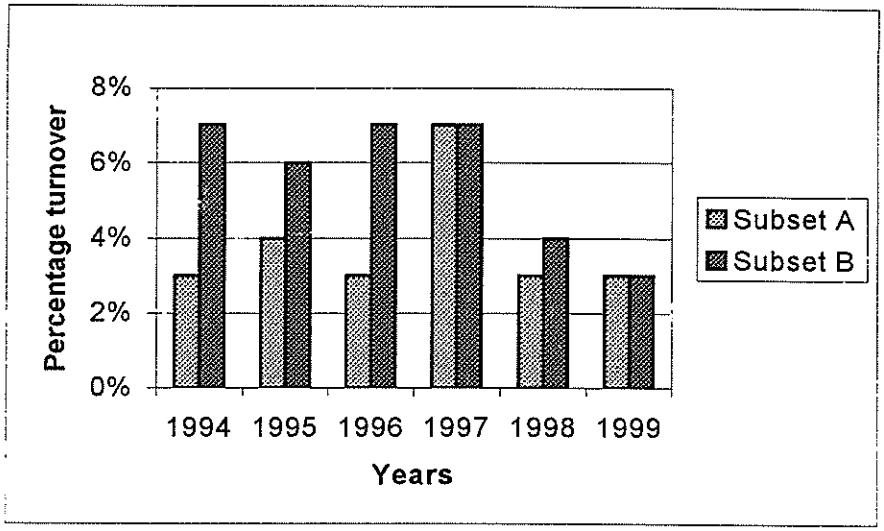


Figure 4.3 Percentage of properties sold of total sales in subsets A and B, Upper Hutt, for years 1994-1999.

This graph shows that the percentage turnover indicated by subset A is no higher than the turnover for subset B, and in many instances housing in subset B appears to have sold more frequently than that in subset A. This could indicate that people, once settled into a home located in subset A area, are no more likely to sell their home because of road noise than subset B home owners.

4.5 Napier Region

4.5.1 Introduction

Napier is located on the central East Coast of New Zealand's North Island in the province of Hawke's Bay. The high volume roadway identified for the purpose of this study is part of State Highway (SH) 50, that connects Napier with the western side of Hastings. It carries a high volume of traffic daily and from our perception, road noise was greater in this location than in the Upper Hutt study.

The streets selected to be the focus of this Napier survey are predominantly developed with residential housing. The streets are easily separated into two distinct subsets. Subset A includes properties directly exposed to road noise located in the following streets:

Clarence Cox Crescent (part)
Downing Street
Titoki Crescent (part)
Atherfold Street (part)
Hamlin Place

The second subset B included those properties set back from SH50. These properties were located in:

Bill Hercock Street
Clarence Cox Crescent (part)
Magdalen Crescent
Konini Crescent
Atherfold Crescent (part)
Titoki Crescent (part)

Some streets that are quite long are in both subsets because one part is close to the road then curves away. For this reason sales of properties located in the same street were categorised according to their road noise exposure into the appropriate subset.

4.5.2 Location Description

The properties that were the focus of the Napier survey are primarily residential housing developed c.1960s through to the 1980s, with a small amount of development taking place during the intervening years to the present day. Housing tended to be of an average New Zealand style, typical of the period of development. Construction is generally of timber frame with most of similar quality and of a style typical of subdivisions established by private company housing developments.

In general the locality could be described as providing a pleasant established environment. Housing was mostly well maintained with the exception of a small number of properties. The land area attributed to each property on average comprised sites of approximately 650m^2. Housing in this locality tends to sell in the mid- to upper-price bracket compared to other housing in the Napier area, with sales typically in the range of $110,000 to $165,000. This area is popular with first-home buyers and family groups because of the modern standard of accommodation in the most part, an affordable price level of housing, spacious sections and the close proximity to amenities.

The locality is well serviced, having four schools nearby, the Clarence Cox shopping centre with a full array of shops including a mini-market and several other convenience stores. The location is well serviced with public parks and reserves, churches, and a public bus route on Kennedy Road that is within half a kilometre of all properties.

4.5.3 Micro-location Description

Most of the housing is similar, with all properties enjoying a comparable environment. However a few key features are described as follows:

Bill Hercock Street - the southern end of this street contains properties of an average to poor quality with little to no section layout. Large electrical transmission lines enter Napier City about here and many properties are affected by this detrimental feature. We are of the opinion that transmission lines over, or near to, a home greatly affects a property's saleability and market value. Allowance for the presence of these power lines has been made when carrying out an analysis of these affected properties.

Titoki Avenue - although directly exposed to road noise, this street provided a pleasant outlook over a reserve containing a small stream. Properties in this street appeared established and well maintained.

Hamlin Place - the outlook here was also established and housing quality tended to be of a slightly higher standard.

A judgement allowance for these benefits and detrimental features as they affected each property was made when carrying out the analysis.

4.5.4 Direct Sales Comparison Approach

Our findings in relation to this method of analysis can be briefly summarised for 4 samples as follows:

Analysis of sales

Year	Net Sale Subset A	Average Net Sale Subset B	% Variance
Sample 1	*Titoki v Titoki, Konini*		
1995	$124,000	$138,177	-10.30%
1996	$146,000	$141,116	+ 3.40%
1998	$122,000	$93 175	+30.93%
Sample 2	*Downing v Magdalen*		
1994	$98,500	$99,206	- 0.08%
1995	$114,000	$99,806	+14.22%
1996	$102,000	$107,080	- 4.75%
1997	$104,000	$105,077	+ 1.11%
1998	$109,500	$95,433	+14.74%
Sample 3	*Clarence Cox v Bill Hercock*		
1994	$102,000	$100,000	+2.0%
1995	$102,000	$90,000	+13.33%
1996	$96,000	$103,000	-6.80%
1997	$95,500	$106,000	-10.00%
1998	$83,000	$89,800	-9.20%
1999	$115,000	$104,630	+9.90%
Sample 4	*Atherfold and Hamlin v Atherfold*		
1994	$89,000	$99,950	-10.96%
1995	$127,000	$123,051	+ 3.20%
1996	$104,000	$90,700	- 5.2%
1997	$128,500	$112,400	- 5.3%
1998	$123,000	$123,500	- 0.04%

The following table summarises the average yearly variation across all four samples for the years 1994-1999.

Percentage annual net sales for Subsets A v B

1994	+3.10%
1995	+5.11%
1996	-3.33%
1997	-4.73%
1998	+9.10%
1999	+9.90%

This analysis illustrates, first, that properties directly exposed to road noise on average are selling for higher sale prices than those sheltered from the road noise. This may be related to the more pleasant outlook obtained from properties looking over the reserve. Very little consistent correlation is apparent between the sales value of properties in subset A v subset B. Second, the annual net sales percentage indicates that the variation in sale value has fluctuated markedly over a 6-year period. However the fluctuation has been no greater than plus or minus 10%. As a whole, the spread has been even indicating an approximate variation of +3% between subset A and subset B, over the years 1994 to 1999.

The scatter-graph of Figure 4.4 gives a further indication that no clear correlation exists between sales within subset A and subset B over the years 1994 to 1999. The comparable properties pertaining to each of the subjects are scattered around the statistical value of 1, which is the line of direct comparison.

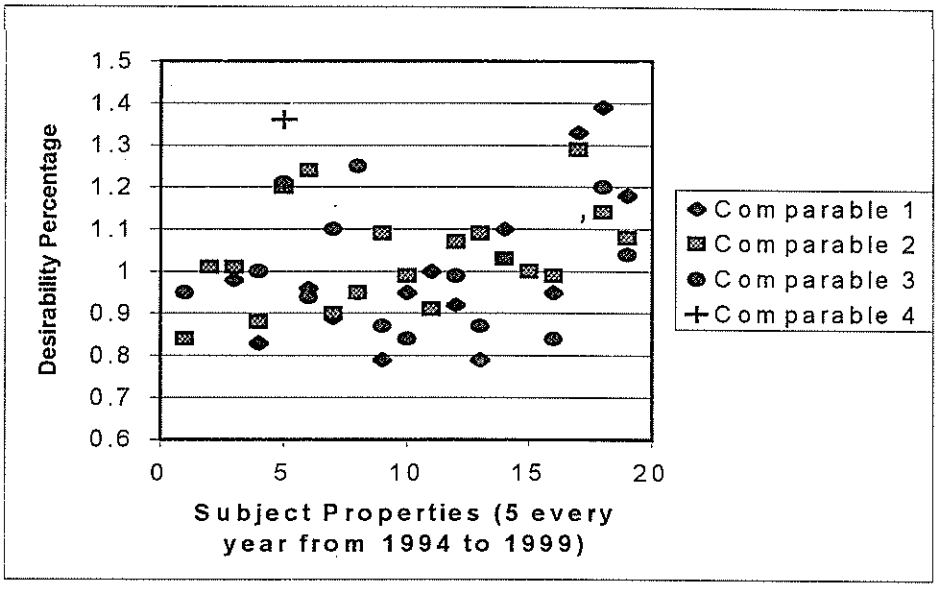


Figure 4.4 Desirability correlation between properties alongside, and those away from, the SH50 Expressway in Napier, for years 1994-1999.

4.5.5 Average Sale Price of Subset A v Subset B

As the volume of sales was large, this information was plotted in Figure 4.5 as a graph.

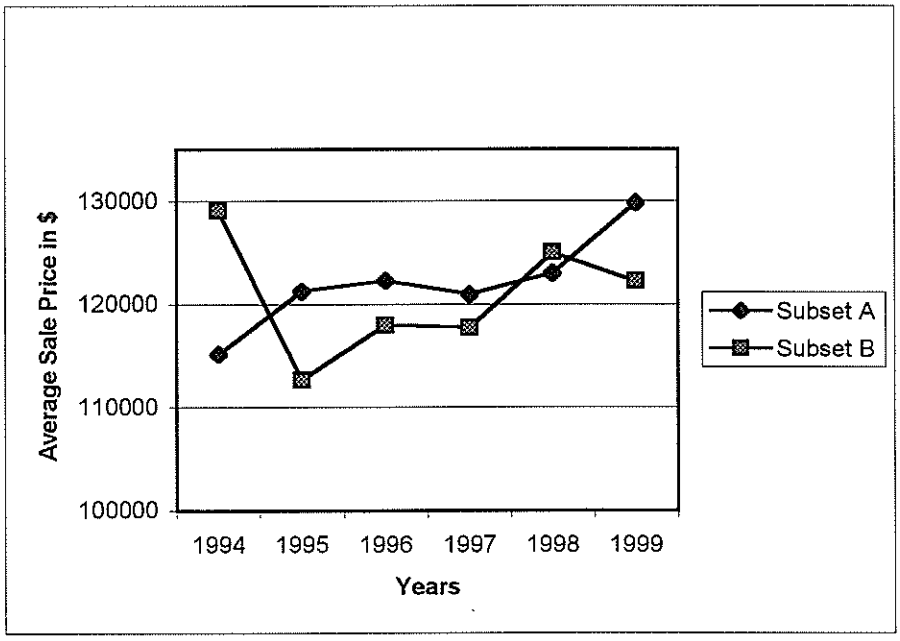


Figure 4.5 Average sale prices for properties in subsets A and B, alongside the SH50 expressway in Napier study area, for years 1994-1999.

As would be expected, there is a noticeable trend in the increase in sale price for the years from 1994 through to 1999. However the trend is towards subset A selling for greater sales values than subset B. This trend is consistent with our view that the open outlook more than compensates for road noise.

4.5.6 Percentage of Sales per Annum v Available Housing Stock

Figure 4.6 shows the results.

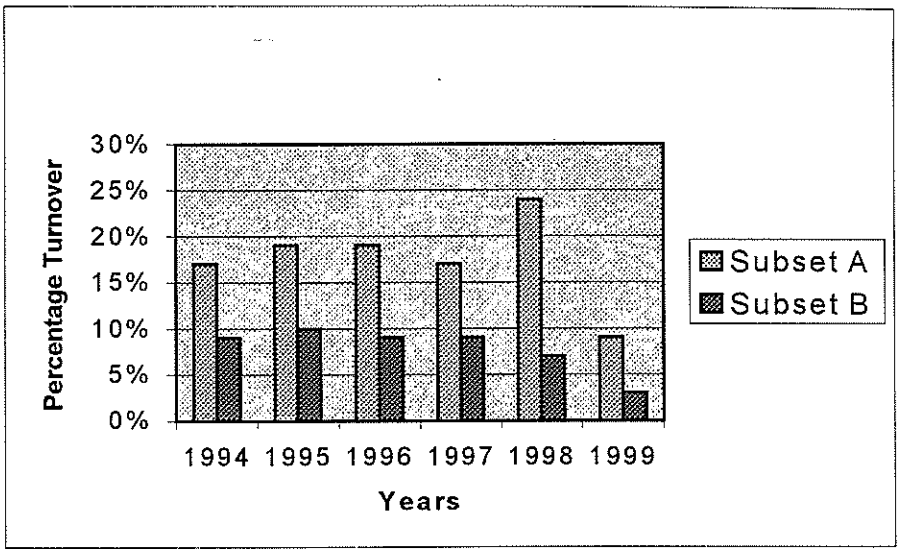


Figure 4.6 Percentage of properties sold of total sales in subsets A and B, Napier area, for years 1994-1999.

In all instances housing in subset A appears to have sold more frequently than that in subset B, and the turnover of housing directly exposed to SH50 is considerably greater than those sheltered from expressway noise. The results strongly suggest that road noise is a factor encouraging housing turnover, although as indicated in Section 4.5.5, outlook enables greater sales values to be obtained.

4.6 Discussion

The literature review indicated that a number of variables would impact the value and turnover of residential property, and that sale price and noise were often not related in a linear way. The typical criteria applied by a purchaser when selecting a property supports this point. Clearly a prospective purchaser will view a number of homes that are available for sale when looking to purchase. The options are many, but often they will be limited by their income, which determines their price range. In addition, the location of a property may be important to them, and this is influenced by many extraneous factors. Assuming that a purchaser has decided on a location and price range, they will view the houses available in the selected area.

Having decided on a location and an affordable price range, a prospective purchaser will generally view properties within these parameters and they will identify a selected number of properties that best meet their requirements. They will then view the properties and make a choice as to the property that best suits.

This process is a trade-off and comes down to personal taste, based on information known and also on certain assumptions. For example a property affected by a detrimental feature will be compared to a similar property that is not affected by the same detrimental feature. A price adjustment may be made to compensate. If this is the case, a home with other positive features such as a larger floor area, better quality or with a pleasant outlook may sell for the same price as a less attractive home with no detrimental features. In the assumptions made, a purchaser may consider that road noise will be less than what is experienced once the property is purchased and occupied.

Assuming a willing buyer–willing seller, the sale price will most likely be determined by a value for money assessment, and by what the purchaser perceives as meeting their requirements. After a period of living in a property located next to a noisy road, the new owner will either become used to the traffic noise and learn to ignore it, and/or accept it. Alternatively the noise will become increasingly annoying, prompting the new owner to become dissatisfied and look to relocate to another area.

These factors appear to highlight that buying a residential property is a matter of "trade-offs". The affect of road noise is just one of many issues affecting a purchaser's decision to buy, and later to remain or sell.

4.6.1 Upper Hutt Study

No clear statistical trends were produced to conclusively prove that properties located within subset A (the properties closer to the road) sold for a lesser sale price than did those in subset B. Additionally the turnover of housing was no higher on average in either subset. A reasonable conclusion is that, in relation to this location, the noise emanating from the River Road has neither detrimentally impacted the value of residential property, nor has it motivated purchasers to sell more often or more quickly.

4.6.2 Napier Study

Analysis of these properties indicated that no statistical correlation exists between sale prices and proximity to the road. In fact a trend shows housing adjacent to SH50 achieving higher sale prices. Based on our observations, the superior outlook over reserve land appears to improve the saleability of these properties. Turnover of the properties however does show a trend suggesting that housing exposed directly to road noise sells more frequently than properties further away.

During our visit to the area our perception was that the noise being generated from the road was more noticeable than that from the River Road, Upper Hutt. Road noise may be a factor motivating purchasers to sell their properties after purchase, although the outlook in many instances provides compensation and may contribute to the initial decision to purchase. If the outlook had been less appealing then sale values may have been reduced. The fact that the turnover is higher in property adjacent to the expressway indicates that the outlook, while providing compensation initially, becomes out-weighed by the road noise in the medium to long term.

5. Influence of Traffic Noise on Property Sales

This third phase of the research was based on sales data for houses sold between 1986 and 1990 at the River Road study site, that had been found using the "Quotable Value" database. The previous titles for the properties were then found using information kept at Land Transfer Office, Land Information New Zealand. A number of houses could be located that had previous ownership details and had been sold during this period in the River Road area. From the titles found, 19 residents were possibly still residing in Upper Hutt and contact details for 10 of these residents could be found. (We assumed that people who moved to areas outside Upper Hutt were moving for reasons that would be independent of noise.)

Of these residents nine could be contacted by telephone. The purpose of the call was explained to the past residents, and they were asked why they had moved houses, and to discuss their response if necessary. At the conclusion of this discussion, the respondents were told that the purpose of the call was to determine, specifically, if noise had been a factor in their decision to move. Following this they were asked to comment on the noise they had experienced while living in River Road, and the influence it had on the decision to sell their house. All responses were recorded. As the survey only involved two main questions, we were able to obtain 100% participation.

The results of the questioning showed that 3 houses had been sold for personal reasons, 3 had been sold to upgrade to another house, 2 had been sold for reasons associated with the noise, and 1 house had been sold because the owner wanted to move closer to the city centre.

6. Conclusions

The study of initial attitudes to traffic noise, i.e. one to two years after the road was in place, showed that about 10% of the sample population was very annoyed by traffic noise when the noise level was about 55dBA. A further 15% were quite annoyed. These percentages of very annoyed or quite annoyed people are about the same as those for populations exposed to similar noise levels over a number of years, as recorded in the long-term study.

The Transit New Zealand Road Traffic Noise Guideline of 55dBA level for low noise areas assumes that noise effects will be minor because only a small proportion of a population, i.e. less than 10%, will be highly annoyed at this noise level. This study therefore supports the 55dBA level in the Transit New Zealand Road Traffic Noise Guidelines to be the upper limit for low noise areas, provided that it is considered acceptable for a small proportion of the population to be highly annoyed by traffic noise. It also appears that, at this noise level, 25% of the population will have some annoyance, and only 30% will be positive about the noise environment.

Road traffic noise on its own at levels of 46-62dBA, as experienced by houses in the survey samples, is not expected to affect the sale price of a house. The general amenity of an area appeared to counteract the effect of road traffic noise on price.

However road traffic noise levels of 53 to 62dBA do appear to encourage people to move out of an area more quickly than from areas less affected by noise, or with noise levels below 55 dBA. At least a minority of the sales of houses that occur when traffic noise exposure is increased will be principally because of noise.

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Schedule of Appendices

Appendix 1 Noise Levels near Wairere Drive, Hamilton

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level before construction Leq (24 h) dBA
Frost Place			
3		53	51
8		53	52
Camden Place			
2		55	53
3		53	52
9		51	46
10		53	46
11		51	46
14		53	46
22		53	44
Highland Drive			
19		55	53
20		55	53
21		53	51
23		51	49
25		51	48
26		52	44
28		52	44
Cullimore Street			
18		55	53
48		55	53
64		55	53
68		51	50
Matipo Crescent			
3		53	52
5		53	52
7		52	51
11	Front Rear	49 46	48 44
33		50	44
37		51	44
39A		49	45
Chestnut Place			
5		49	48
6	Ground Floor 1st Storey	54 55	53 54
8		53	52
10		51	49

Notes:

1. All measured are corrected for the facade position.
2. "Front" and "rear" values are shown separately if there is a difference.

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level befpre construction Leq (24 h) dBA
Cherrywood Street			
7		47	45
8		47	45
10		46	44
16		55	44
18		50	44
20		55	43
21		43	42
22		55	43
24		54	41
27		49	46
28		53	42
32		51	42
36		49	42
38		50	43
40		50	43
Ashley Street			
2		56	44
108		56	43
14		46	42
20	Front Rear	49 46	47 43
22	Front Rear	49 46	47 43
24	Rear	57	42
28	Front Rear	49 46	47 43
40		57	43
42		57	43
48		53	43
52		49	47
56		47	45
Totara Drive			
15		58	56
19		57	56
22		54	51
24		54	51
26		54	52
28		55	52
69		56	55
71		57	55

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level before construction Leq (24 h) dBA
Morrow Avenue			
4		48	47
6		46	45
12		45	44
16		47	47
18b		55	45
20b		55	45
26		55	44
30		47	47
44		46	45
46		55	43
62		46	46
66		54	44
70		46	46
72		54	44
74		47	45
76		54	44
Brough Place			
6		53	53

Appendix 2 Noise Levels near QEII Drive, Christchurch

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level before construction Leq (24 h) dBA
Autumn Place			
15		53	51
23	Front	52	47
	Rear	55	
27	Front	52	47
	Rear	55	
Grimseys Road			
21		56	50
25		60	63
42		64	61
42a		64	61
44		64	61
Ramore Place			
20		51	54
23		51	54
25b		53	54
25c		56	55
25d		56	55
Sheraton Place			
5	Front	53	50
	Rear	57	
	Upper storey rear	64	
9	Front	53	50
	Rear	57	
11	Front	53	49
	Rear	57	
15	Front	53	49
	Rear	57	
16		53	48
17b	Front	53	48
	Rear	57	
18, 18b		53	48
21	Front	53	48
	Rear	57	
Te Maru Place			
22		53	51
25a		53	51
29		53	51
31a		53	51
31b	Front	53	51
	Rear	50	

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level before construction Leq (24 h) dBA
Sarabande Ave			
20		57	48
24a		58	48
24b	Front	58	48
	Rear	62	
25		57	48
26	Front	58	48
	Rear	62	
34	Front	58	48
	Rear	62	
35		58	48
37		58	48
38	Front	58	48
	Rear	62	
41		58	48
42	Front	58	48
	Rear	62	
43		58	48
45		58	49
47		58	49
61		58	50
63		58	50
Winters Road			
224		54	51
236		54	51
280		54	54

Appendix 3 Letter and Sample Survey sent to Potential Survey Participants

Cover Letter

9 November 1998

Dear Resident,

We are interested in your perspectives about what it is like to live in ..... In the next few weeks, we will be conducting interviews with residents in your neighbourhood to see what people think about living in ..... We are only interviewing in a few neighbourhoods, and have selected ..... because of concerns that some residents have expressed. It is important that you participate in this interview so that we can get a balanced and representative view of the concerns in your neighbourhood. The information you provide will help make your neighbourhood and other neighbourhoods better to live in.

We will be ringing you in the next couple of weeks to see if you are interested in participating in the survey and to organise a suitable time for us to conduct the interview. The interview will take about ½ hour of your time. It will consist of easy questions about your neighbourhood. We have included some of the questions, with this letter, so that you will know what to expect.

Please accept this 'scratchy' as a token of our appreciation for the time that you will use. Good luck!

In the event that you do not hear from us before the 23rd of November (we may not have your phone number), and you wish to be interviewed please contact me. You can do this by ringing me collect on 04 568 3118, extension 767. To ring collect dial 010 to get an operator, and tell the operator the number.

Yours sincerely,

T. Jane Mitchell
Researcher / Analyst
Email: Jane.Mitchell@opus.co.nz

Sample Only

Upper Hutt Household Study

Opus International Consultants

Central Laboratories is one office within the company - Opus International Consultants. We are located in Lower Hutt. The work we do at Opus includes architecture, construction, environmental planning, mechanical and electrical engineering, power engineering, property management, roading, and aspects of city and town planning.

We will be ringing you within the next week to see if you would like to participate in an interview.
This example survey is to give you an idea of the type of questions you should expect. We will also be asking some personal questions, such as your age, and occupation. These questions are to determine if any groups of people perceive their neighbourhood differently.
You may answer the questions in the example survey if you wish. They may help you to answer the questions more easily when we ask them to you over the phone.
Confidentiality Assurance

All questions we ask in the survey are strictly confidential.

This means that no one other than the few staff working on this project and yourself will see your answers. We will only use the information you give for the purposes of the project. None of the information you provide will be associated with your name or specific details about where you live.

This part of the survey/interview asks for your opinions. It is not a test and there are no right or wrong answers. The best answer is your own personal opinion. Please follow the steps outlined below.

1 Read through the list below

We have listed some neighbourhood factors that may or may not affect you. All of these factors are things that can be changed about a neighbourhood.

2 Select the 5 neighbourhood factors that you think have the **greatest negative** affect on the quality of your current living situation. Place a tick next to them in the column titled 'most affect'.

3 Please **rate** the **5 factors chosen** in order. Start with '1' for the factor you are most displeased with. '2' for the next most displeasing, then '3' for the next most displeasing factor and so on. Put your answers in the column titles 'rating'.

Greatest affect	**Rating**	**Neighbourhood factors**
_____	_____	Vehicle noise
_____	_____	Train/ aeroplane etc, related noise
_____	_____	Street lighting
_____	_____	Speed of vehicles
_____	_____	Rubbish collection
_____	_____	Public transport
_____	_____	The presence of playgrounds
_____	_____	The presence of parks
_____	_____	Odours, smoke, air pollution
_____	_____	Noise from neighbours and animals
_____	_____	The presence of neighbourhood trees
_____	_____	Neighbourhood crime
_____	_____	Condition of roads
_____	_____	Condition of footpaths
_____	_____	Appearance of houses and gardens

Please rate the following neighbourhood factors in terms of your level of satisfaction with them in your neighbourhood. Please circle your choice.

For example....

Friendliness of neighbours.
If you consider this to be "satisfactory" you should circle the satisfactory option.

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

---

Now, over to you....

1. Appearance of houses and gardens

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

2. Condition of footpaths

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

3. Condition of roads

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

4. Neighbourhood crime

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

5. Neighbourhood trees

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

6. Noise from neighbours and animals

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

7. Odours, smoke, air pollution

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

8. Parks

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

9. Playgrounds

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

10. Public Transport

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

11. Rubbish collection

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

12. Speed of Vehicles

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

13. Street Lighting

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

14. Train/aeroplane noise

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

15. Vehicle noise

Very Unsatisfactory Unsatisfactory Unsure/Neutral Satisfactory Very Satisfactory

You will also be given the opportunity to comment further on any of the matters that have been raised, please feel free to make notes in the space below.

.....
.....
.....
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.....
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Appendix 4 Household Survey Form

HOUSEHOLD SURVEY

Opus International Consultants

Interviewer:

_____

House Address:

_____

Area:

_____

Do you have any particular dislikes about the area in which you live?
Prompt - do you ever complain to yourself or other people about anything to do with the neighbourhood?

DO NOT READ Traffic Noise ☐1
Traffic ☐2

Other.....3
.....
.....

I am going to read out a list of neighbourhood factors. Can you tell me which has the greatest negative affect on the quality of your current living situation?
See card 1.
OFFER TO REREAD IF NECESSARY
Which has the next greatest negative affect on the quality of your current living situation?
READ THOSE LEFT, ETC., UNTIL ALL HAVE BEEN RANKED.

LIST NUMBER:.....Worst effect
(You do not need to fill in all spaces if they have no particular dislikes)
1.....
2.....
3.....
4.....
5.....
6.....

Are there any neighbourhood factors that we have not mentioned that you would have rated worse than (the one you chose first).
( ) YOU CAN INSERT FIRST CHOICE HERE IF YOU WISH.

1.....

2.....

Now we require you to rate some neighbourhood factors in terms of your level of satisfaction with them.
You will rate them on a scale of 1 – 5.
(STATE THAT THEY CAN SCRIBBLE THIS DOWN ON A BIT OF PAPER IF THEY WISH, TO MAKE IT EASIER FOR THEM TO REMEMBER)
1 being very unsatisfactory and 5 being very satisfactory. 3 is either unsure or neutral.

(Don't forget to check to answers with people if they answer with numbers)

(a) Appearance of houses and gardens
(Put neutral if not applicable)
Very Unsatisfactory 1. ☐
Unsatisfactory 2. ☐
Unsure/Neutral 3. ☐
Satisfactory 4. ☐
Very Satisfactory 5. ☐

(b) Condition of footpaths .....
(c) Condition of roads .....
(d) Neighbourhood crime ...
(e) Neighbourhood trees .....
(f) Noise from neighbours and animals .....
(g) Odours, smoke, air pollution .....
(h) Parks .....
(i) Playgrounds .....
(j) Public transport .....
(k) Rubbish collection .....
(l) Speed of vehicles .....
(m) Street lighting .....
(n) Train/aeroplane noise .....
(o) Vehicle noise .....

What sort of noises do you notice most around your neighbourhood?
DO NOT READ
Traffic ☐1
Neighbours ☐2
Aeroplanes ☐2
Animals ☐2
Other.....2
.....
....
.....

How would you rate traffic noise if 1 was very annoying and 5 was not at all annoying. 3 is the mid point.
YOU SHOULD USE THE SAME SCALE AS USED BEFORE.
.....

When do you notice the traffic noise around your neigbourhood most?
DO NOT READ

Not at all	☐0
During peak traffic times	☐1
Intermittently	☐2
Mostly day	☐3
Mostly night	☐4
Weekends	☐5
Seasonal	☐6

.....7

How often does traffic noise disturb you when your windows are shut?
Rate on a scale of 1 = Always, 5=Never. .....

How often does traffic noise disturb your sleep?
1=Always, 5=Never .....

How often do you have trouble hearing the radio or television because of the traffic noise?
1=Always, 5=Never .....

How often does the traffic noise interfere with conversation made in the house?
1=Always, 5=Never .....

Have you ever thought about moving away on account of the traffic noise?
1=Always, 5=Never **(or N/A)** .....

Now I would like to ask you some questions about yourself. They will help to determine if any particular groups of people view things differently to other groups of people.

Participant Information

1. What gender are you? **(Do not ask, you should be able to tell)**

Female	☐1
Male	☐2
A couple	☐3

2. What is your age?

(State age categories if you think that this will be a sensitive question)

< 18	☐1
19-29	☐2
30-44	☐3
45-64	☐4
65+	☐5

What is your highest or best qualification?
Prompts – education, work experience, courses etc.
DO NOT READ

Before School Certificate	☐1
With School Certificate	☐2
University Entrance, Bursary	☐3
Trade certificate	☐4
Undergraduate work/degree, or polytech diploma	☐5
Post graduate work/degree	☐6
Other.....	7

What is your Occupation?
DO NOT READ

Clerical/ Office worker	☐ 1
Domestic Duties	☐ 2
Labourer	☐ 3
Manager	☐ 4
Professional	☐ 5
Salesperson/ Retail	☐ 6
Student	☐ 7
Trades-person	☐ 8
Unemployed	☐ 9
Retired	☐10
Other.....	...11

.....
.

Make a note if they work in Transport or at the Council

.....
.....

How many children live in this house? **(Under 18)** .....
What are their ages?
.....
You do not have to answer this next question.
At what times of the day are you normally home?

Before 9am and after 5pm, and during the weekends	☐1
At home for most of the day and night	☐2
At home for most of the day only	☐3
At home at irregular hours	☐4

(Explanation: We ask it because we would like to be able to compare people who are home at different times. i.e. someone who is home more often may have stronger opinions.)
If they all ready stated unemployed - tick: 'Don't work.'

Do you work?

Shifts (Irregular hours)	☐1
Nights	☐2
9:00am – 5:00pm, Monday to Friday	☐3
Don't work	☐4
Other 5	

ONLY READ IF THEY WORK AWAY FROM HOME N/A ☐
(code - blank)
In general, compared to other work places how noisy would you say your work is?
DON'T READ BUT CLARIFY USING SCALE IF NECESSARY

Much noisier	☐1
Quite noisy	☐2
Average/ don't know	☐3
Not as noisy	☐4
Very quiet	☐5

In general, compared to other homes, how noisy do you think your home is?
DON'T READ BUT CLARIFY USING SCALE IF NECESSARY

Much noisier	☐1
Quite noisy	☐2
Average/ don't know	☐3
Not as noisy	☐4
Very quiet	☐5

<u>Home ownership and dwelling characteristics</u>
Do you pay rent or board to live in this house?

Yes	☐1
No	☐2

How long have you lived in this house? **DO NOT READ**

<1 yr	☐1
1-3 yrs	☐2
4-9 yrs	☐3
10-20 yrs	☐4
21-35 yrs	☐5
36+ yrs	☐6

How many stories/levels does the house have? .....

What is your house is made from?

Brick	☐1
Brick Veneer	☐2
Fibre Board	☐3
Stone	☐4
Wood	☐5
Concrete/Plaster	☐6
Other.....7	

Do you think that there is a side of your house that is noisier than the other sides?

Yes ☐1
No ☐2

IF YES

Which side is this?

.....

Prompt - does it face a street or a neighbouring house.

IF STREET

Which street?

.....

IF NEIGHBOURING HOUSE

Which side of the house is it with respect to your street ?

(USE MAPS TO HELP YOU).

.....
.....
.....

IF THEY GIVE A SIDE, WORD QUESTIONS WITH REFERENCE TO THAT PARTICULAR SIDE OF THE HOUSE. IF NOT, WORD THEM GENERALLY.

Are your windows double or single glazed (on that side of the house)?

Prompt -the number of sheets of glass over the window

Single ☐1
Double ☐2
Don't know ☐3

What is the proportion of windows/walls you have (on the noisier side of the house)?

Mainly windows ☐1
Half windows ☐2
Quarter windows ☐3
Small windows ☐4
No windows ☐5

How are your windows covered (on that side of the house)?

(Tick more than one box if necessary)

They are not covered ☐1

(Clarify if they state "Drapes")

Netting ☐2
Light curtaining ☐3
Heavy curtaining ☐4
Blinds ☐5

(On the noisier side of your house) what is the garden like?

There are a lot of big trees and a dense garden ☐1
There are a lot of bigger trees however the garden is not very dense ☐2
The garden is dense but there are few large trees ☐3
There is not much in the way of a garden ☐4
There is no garden ☐5

(On the noisier side of the house) how big are the fences?

There is a high solid fence on the noisier sides of the house ☐1
There is a high fence, however it is not very solid ☐2
There is a small fence ☐3
There is no fence ☐4

ASK THIS QUESTION ONLY IF THEY SPECIFIED A SIDE N/A ☐
(code - blank)

Please indicate what type of rooms are on the noisiest side of the house, and how many of these rooms there are on the noisiest side of the house.

Bedroom/s ..... ☐1
Living Room/ Family room ..... ☐2
Kitchen/Dining area ..... ☐3
Bathroom Laundry ..... ☐4
Garage ..... ☐5
Other.....6

ASK ONLY IF ONE OF THE ROOMS IS A BEDROOM

N/A ☐ (code - blank)

Do you sleep in any of the rooms on the noisier side of the house?

Yes ☐1
No ☐2

What is the positioning of the house with respect to the road?

READ OUT OPTIONS

The house is above the road ☐1
The house is slightly above the road ☐2
The house is at the same level as the road ☐3
The house is slightly below the road ☐4
The house is below the road ☐5

Now I have asked you a lot of questions without giving you the chance to give your own personal opinions. Would you like to say anything further?

.....
.....
.....
.....
.....
.....
.....
.....
.....

Appendix 5 Noise levels near River Road, Upper Hutt

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level before construction Leq (24 h) dBA
Moehau Grove			
1	Front (Holdsworth)	53	53
9	Front	48-52	42
	Rear	48-50	<43
Bailey Grove			
	Rear	48	<43
Holdsworth Avenue			
79	Front	53	53
	Rear	48	43
89	Front	53	53
	Rear	48	43
97	Intersection	61	59
Longfellow Street			
10	Rear	58-60	<43
20	Front	51	46
22	Rear	60	43
30	Rear	53	43
32	mid	53	
62	Front	53	50
	Rear	49-50	<43
76	Front	50-51	50
90	Front	48	48
92	Rear	55-58	45
Mary Crescent			
20	Front	44-50	44
	Rear	44	44
Kea Grove			
7	Rear	50	<43
	Front	50	48
McLeod Street			
9-11	Front	57	58
28-34	Front	55	54
	Rear	56	46
68	Front	57	57
	Rear	54	45
94	Front	57	57
	Rear	50	45
Gibbons Street			
103,106	Front	60	55
Riverbank Road			
28	Front	62	59
Pine Avenue			
92	Front	62	59
Poplar Grove			
12-13	Rear	58	<43

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level before construction Leq (24 h) dBA
Willow Grove			
10-11	Rear	58	<43
Hudson Avenue			
29	Front	51	46
	Rear	56	46
47	Front	51	49
	Rear	51	<43
Clouston Park Road			
9-13	Front	57-58	52
	Rear	61	<43
55	Front	56	52
	Rear	58	50
107	Rear	60-63	<43
120	Rear	58-59	<43

Appendix 6 Noise Levels near Napier-Hastings Expressway

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level before construction Leq (24 h) dBA
Titoki Crescent			
7	Front	53	48
13	Front	56	48
17	Front	51	48
19	Front	51	48
22	Front	51	48
23	Front	56	48
24	Front	54	48
27	Front	56	48
Downing Avenue			
18	Front	53	
	Rear	59	48
20	Front	53	
	Rear	59	48
30	Front	53	
	Rear	59	48
32	Front	53	
	Rear	59	48
40	Front	53	
	Rear	59	48
43	Front	53	
	Rear	59	48
46	Front	53	
	Rear	57	46
60	Front	53	
	Rear	59	48
Clarence Cox Crescent			
60	Front	53	
	Rear	57	48
72	Front	53	
	Rear	57	46
80	Front	53	
	Rear	57	46
82	Front	53	
	Rear	57	46
84	Front	56	
	Rear	62	48
86	Front	56	
	Rear	62	48
88	Front	56	
	Rear	62	48
90	Front	56	
	Rear	62	48
96	Front	56	
	Rear	62	48

House Address	Position	Current Work Levels Leq (24 h) dBA	Noise level before construction Leq (24 h) dBA
Clarence Cox Crescent (continued)			
104	Front	56	
	Rear	62	48
106	Front	56	
	Rear	62	48
110	Front	56	
	Rear	62	48
Kel Tremain Place			
8	Rear	51	53
8a	Rear	51	53
Atherfold Crescent			
16	Front	60	48
24	Front	60	48
48	Front	60	48
74	Front	60	48
Hamlin Place			
6	Front	56	46
8	Front	56	46
Alan Styles Place			
3	Front	57	48
5	Front	57	48
11	Front	57	48
Tiffen Place			
3	Front	54	
	Rear	54	

Appendix 7 Interview Schedule for Surveys with Residents who have moved house

Interview Guide

Part A – Introduction
(1 minute)

Note: In the introduction the interviewer must not mention that the interview is to do with Transfund or traffic noise.

Introduction to yourself and Opus.

Position the interview as talking to people about property and the reasons people decide to move house.

"The information we obtain will help our client improve living environments in urban areas."

Assure confidentiality (i.e. our professional code of ethics and only collective responses will be reported back to the client.

Ask the respondent if they last lived in the address required.

"We have been interviewing people who have moved from one particular area, to find out why they moved from there. From property records we have found that a ....., once lived in ..... Is this person you?"

If No – Thank and close

If Yes – *"Would you mind if we asked you a couple of questions about why you moved from this house?"*

Explain how the interview will be run and the length of the interview (approx. 10 minutes).

Part B – Reasons for moving house
(2 minutes)

Note: The following questions are to be asked in order, and questioning can be stopped when it is obvious where traffic noise is ranked in terms of its influence on the decision to move houses. Or when the last question has been asked.

Probe: for clarification.

Ask respondents what their reasons were for moving

Clarify if there was one particular reason for moving, and rank the other reasons in terms of how much they influenced the decision to move.

Probes

Ask them if there was anything that they did not like about where they were living.

Ask them what they were looking for when they bought the new house.

Ask respondents to compare their current home with the last home, and tell us what is better and worse about the new home.

Part C – Closing
(2 minutes)

Thank the interviewee for their time and explain the purpose of the call. Tell them that the work is being done for Transfund, in order to find out what level of traffic noise is acceptable in an urban living environment.

Ask the respondent if they have anything further to say and then thank them again.