Synopsis of Community Noise Assessment
Sea-to-Sky Highway Improvement Project
In The Vicinity of
The Eagleridge Overpass and Horseshoe Bay

A. Introduction

As part of the Sea-to-Sky Highway Improvement Project team, Wakefield Acoustics Ltd. have assessed the potential noise impact associated with the project between the west abutment of the Nelson Creek Bridge and Eagleridge Drive as well as the reconfigured Eagleridge overpass. This assessment was carried out to gauge the potential community noise impacts from the operation of the improved highway with the overland route configuration. This summary document provides an overview of the assessment methodology and its conclusions.

The assessment methodology followed the guidelines in the BC Ministry of Transportation document "The Revised Policy For Mitigating The Effects of Traffic Noise From Freeways and Expressways, MoT Nov. 1993." This MoT policy applies to freeways and expressways. The section of Highway 1 from Nelson Creek to Eagleridge Drive may be considered an expressway, hence following this policy is appropriate.

Existing noise levels have been established through seven monitoring stations located at representative locations in this area. These measurements provide a baseline against which any project-related changes in noise levels can be compared. The sites were selected to represent residences most directly exposed to existing highway traffic and relatively free from other noise sources in the community such as heat pumps, pool pumps and residential construction activities. A monitoring station was also established at Gleneagles Elementary School.

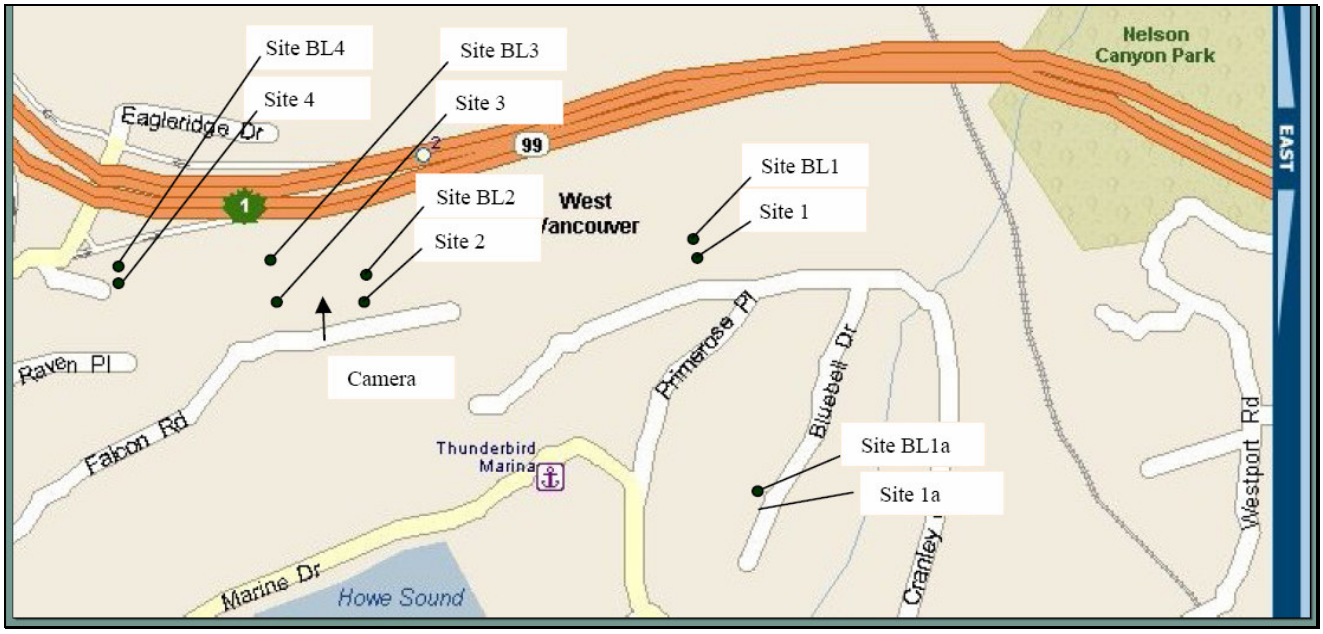
Monitoring was conducted using advanced digital instruments capable of sampling ambient sound levels many times per second, storing the sound level data for analysis at a later date. The noise sampling instruments were set to collect a complete description of the noise environment every fifteen minutes.

Areas assessed were the Eagleridge Interchange area (Part A in report) and the Horseshoe Bay area (Part B in report).

B. How The Assessment Was Done

Part A (Eagleridge Interchange area) baseline monitoring:

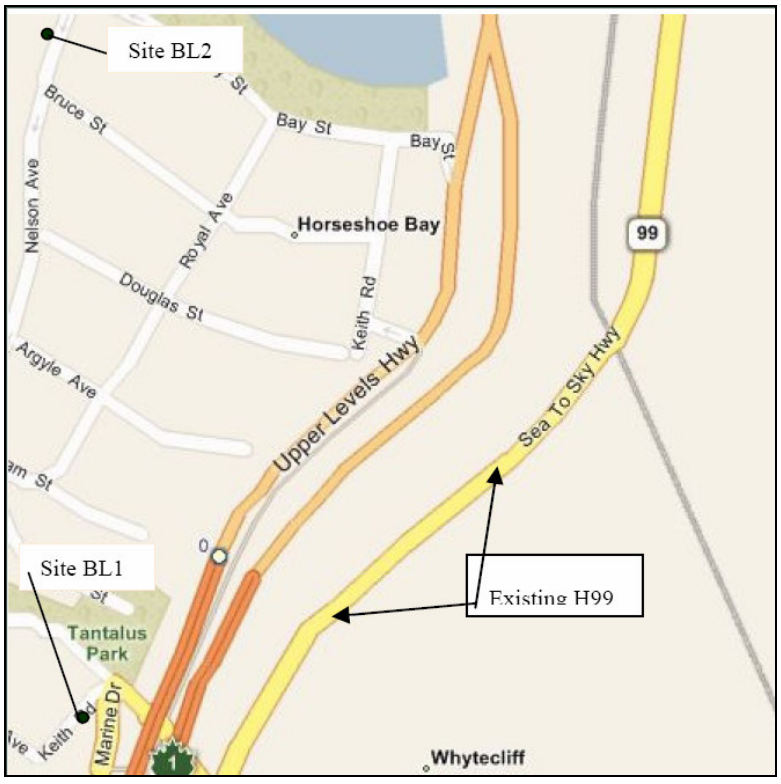
- Baseline monitoring was conducted on December 15, 2005 at four representative locations along Cranley Drive, Falcon Road, and Eagleridge Drive immediately south (waterside) of the highway.
- A fifth monitoring site was added along Bluebell Drive on March 10, 2006.
- Monitoring sites were selected to be representative of residences most directly exposed to existing highway traffic noise and relatively free from the influence of other noise sources in the community.
- Typically, noise levels at locations with a horizontal distance of 40m to 107m from a major highway would be controlled by highway traffic with minor contributions from other sources such as light aircraft, local traffic and activities.
- However in the case of Falcon Road and, to an even greater degree, Cranley and Bluebell Drives, highway noise exposures are greatly reduced due to the shielding provided by the shoulder of the highway above these areas. Therefore the noise exposures are comparable to the existing non-highway related noise levels within these communities.
- After baseline noise readings were taken, noise levels at adjacent residences were projected using an industry recognized noise model. Noise levels were then modeled for the pre-construction existing highway alignment and the post-construction overland alignment. Post construction scenarios included “opening day” and “year 2022”.
- “Year 2022” noise projections included the effects of traffic volume growth.



Noise Monitoring and Modeling Sites Within the Eagleridge Interchange area

Part B (Horseshoe Bay area) baseline noise monitoring

- Baseline monitoring was conducted on March 9 and 10, 2006 at two relevant locations within Horseshoe Bay on the southside (waterside) of Highway 1/99.
- Monitoring sites were selected to be relatively free from the influences of noise sources unrelated to the project from within the community such as direct local traffic.
- One of the monitoring sites was Gleneagles Elementary School on the south (Keith Road) side. The monitoring site was chosen to determine the pre-project ambient noise levels within the school yard.
- The Gleneagles School was closed during the measurements. Had the school been open, ambient noise levels would likely have been somewhat higher than those measured.
- The second location was on Nelson Avenue between Bay and Bruce Streets. This location has line-of-sight to the project approximately 800m to the north and 100m higher in elevation.
- Current noise exposures at these locations are considered to be dominated by local activities, local traffic, BC Ferries movements and occasional aircraft flyovers.



Noise Monitoring Sites Within Horseshoe Bay

C. Using Traffic Noise Modeling To Obtain Results

Part A (Eagleridge Interchange area):

Wakefield Acoustics Ltd. uses a state-of-the-art computer model for predicting noise levels in the vicinity of highway interchanges. It uses advances in acoustics and computer technology to improve the accuracy and ease of modeling highway traffic noise.

- After baseline noise readings were taken, noise levels at adjacent residences were projected using the industry recognized noise model. Noise levels were then modeled for the pre-construction existing highway alignment and the post-construction overland alignment. Post construction scenarios included "opening day" and "year 2022".
- "Year 2022" noise projections included the effects of traffic volume growth.

Part B (Horseshoe Bay area)

Wakefield Acoustics Ltd. also uses the Canadian Housing and Mortgage (CMHC) model for predicting noise levels in the vicinity of highways with simpler geometries.

- After baseline noise readings were taken, noise levels at adjacent residences were projected using the CMHC model. Noise levels were then modeled for the pre-construction existing highway alignment and the post-construction overland alignment. Post construction scenarios included "opening day" and "year 2022".
- "Year 2022" noise projections included the effects of traffic volume growth.

D. Assessment Conclusions

Using projected traffic increases expected by 2022, the assessment report has modeled noise impacts upon this expected increase.

- Highway noise exposures are expressed in terms of Leq(24), the 24-hour equivalent sound level. This is a widely-utilized, single-number descriptor of the average sound energy exposure over a 24 hour day used for community noise assessments.
- The noise exposure at Eagleridge Drive site is currently 61.3 dBA. This is expected to decrease slightly (less than 1 dBA) mainly due to the overland route moving a significant volume of traffic away from the area.
- The noise exposures at Falcon Road, Cranley Drive and Bluebell Drive currently range between 37 dBA and 44 dBA. They are expected to increase (1.4 to 3.8 dBA) primarily due to growth in traffic volume, and secondarily due to 150 metre section of highway 1 between Eagleridge Drive and Nelson Creek Bridge having a slightly steeper grade as well as moving slightly closer to the south (waterside).
- The new highway design will preserve or enhance many of the elements which currently provide noise shielding for residences to the south. 690mm high concrete roadside barriers will be relocated to the outside most southerly lanes. Where there the highway is

to be on retaining wall, a higher 810mm high concrete barrier will be used. The rock knoll near the 'Telus' hut will remain.

- The project also requires that the Eagleridge bluff structure to the west of Nelson Creek Bridge be closed in with a retaining wall. This would have the effect of eliminating any noise radiated from the bottom of this structure and hence have some positive effects on noise exposures to the Cranley and Bluebell Drive communities.
- The noise level at the Gleneagles Elementary School is expected to reduce largely due to the relocation of the overland route some 235m to the east, including a 350m long section that will lie behind the prominent hill to the east of the school.
- The noise level at the Nelson Ave. site is conservatively estimated to increase slightly due entirely to project traffic volume growth.

I	II		III	IV	V = IV-III
Site/Address	Measured Baseline 2005		Existing Alignment (2002 Traffic) Leq(24) (dBA)	Proposed S2S Design, (2022 Traffic) Leq(24) (dBA)	Change due to S2S Design and Volume Growth Leq(24) (dBA)
	L_D (L_{90} Range) (dBA)	Duration (hr)			
BL1/ ----- Cranley Dr.	49.5 (42.4-48.5)	5.3	39.5	41.0	1.5
1/ ----- Cranley Dr.	-	-	38.3	40.3	2.0
BL1a/ ----- Bluebell Dr.	53.6 (50.9-56.0)	4.75	44.0	45.4	1.4
1/ ----- Bluebell Dr.	-	-	43.8	45.2	1.4
BL2/ ----- Falcon Rd.	46.9 (40.1-43.3)	6.5	40.3	43.1	2.8
2/ ----- Falcon Rd.	-	-	39.3	43.1	3.8
BL3/ ----- Falcon Rd.	48.8 (40.5-44.8)	5.1	43.2	45.7	2.5
3/ ----- Falcon Rd.	-	-	37.2	40.4	3.2
BL4/ ----- Eagleridge Dr.	64.1/	7.0	61.3	60.7	- 0.6
4/ ----- Eagleridge Drive	-	-	60.1	59.3	- 0.8

Results of the computer model for Baseline (Existing Configuration, 2002) and Future (Proposed S2S Design and 2022 Traffic) Conditions, Modeled Noise Levels Expressed in Leq (24) in units of dBA

I Site/Address	II Measured Baseline 2005		III Modeled Baseline (Existing Alignment, 2002 Traffic) L_{eq}(1 hr pm peak)/ L_{eq}(24) (dBA)	IV Modeled (Proposed S2S Design, 2022 Traffic) L_{eq}(1 hr pm peak)/ L_{eq}(24) (dBA)	V = IV-III Change due to S2S Design and Volume Growth (dBA)
	L_{eq}(1 hour)/L_D	Duration (hour)			
BL1/ ----- Marine Drive. (Gleneagles School)	58.8/-	1	61.0/-	56.7/-	-4.3
BL2/ ----- Nelson Avenue	-/57.3	5.3	-/~49.0	-/ ~50.6	1.6

Results of CMHC Modeling for Baseline (Existing Configuration, 2002 Traffic) and Future (Proposed S2S Design and 2022 Traffic) Conditions, Modeled Noise Levels Expressed in Leq(1 hr pm peak) and Leq(24) dBA in units of dBA

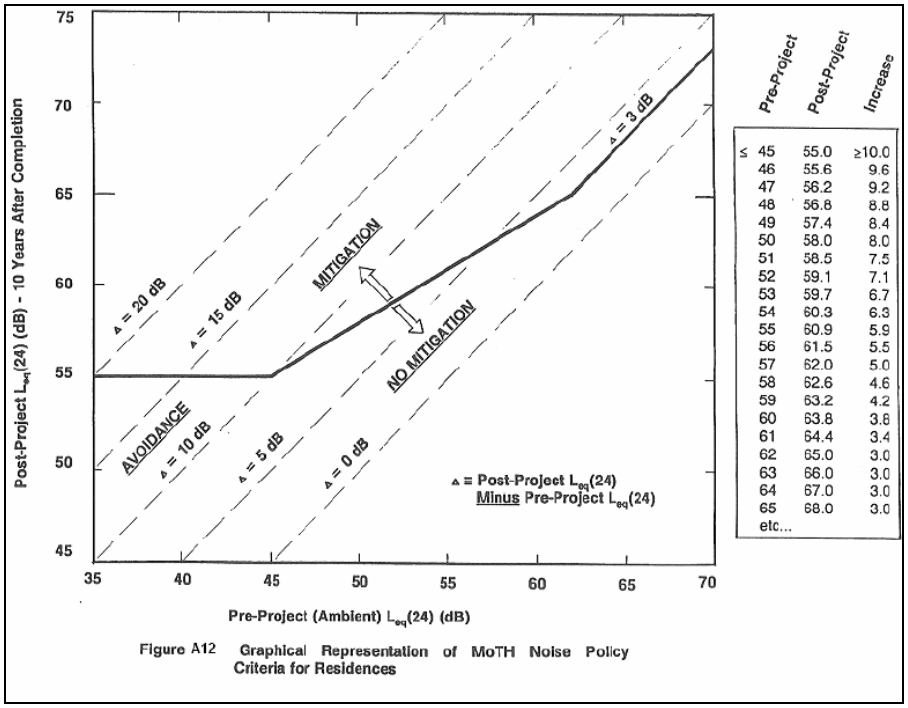
E. B.C. Ministry Of Transportation Noise Policy (1993)

Assessing the Eligibility of Long-term Highway Traffic Noise Impacts for Mitigation Consideration Under the B.C. MoT s Revised Noise Policy of 1993

In November 1993, the Environment Branch of the B.C. MoT (at that time Ministry of Transportation and Highways) adopted a Revised Policy for Mitigating the Effects of Traffic Noise from Freeways and Expressways. This policy features a sliding scale of maximum noise level increases expressed in terms of $L_{eq}(24)$ - that are permitted to accompany new or upgraded freeway or expressway projects before mitigation measures must be considered. This approach is based on the consideration that a given project-related increase in $L_{eq}(24)$ for example 5 dBA - will have a larger impact when it occurs in a residential area that is already quite noisy than it will in an area where baseline noise levels are much lower. The MoT noise policy criteria, which dictate where mitigation measures will be considered, may be stated as follows.

Mitigation measures will be considered on an MoT freeway or expressway project, and carried out if found feasible, cost-effective and widely supported by the affected residents, if and where, ten years after project completion, the predicted total (project plus baseline) community noise level, expressed in terms of $L_{eq}(24)$, is: Between 55 and 65 dBA, and exceeds the corresponding pre-project (baseline) noise level by an amount which varies from 10 dBA at a pre-project level of 45 dBA, to 3 dBA at a pre-project level of 62 dBA, or 65 dBA or more and exceeds the corresponding pre-project level by at least 3 dBA.

A graphical depiction of the MoT noise policy criteria is provided in Figure A12.
To be considered cost-effective under the MoT policy, mitigation measures generally need to be able to provide a predicted noise reduction of 5 dBA or more at front row, ground floor noise receiver locations and have an installed cost of not more than about $15,000 (in 1993 dollars) per effectively-protected residence. Final rulings as to whether such mitigation is practical and cost-effective in a given project situation are made by MoT project management.



Graphical Representation of MoT Noise Policy Criteria for Residences

Note that unless the Highway is not a freeway or expressway, the MoT highway noise impact mitigation policy does not automatically apply. However, the policy is being adopted as more than a guideline and all of the stipulations will be adhered to.
The MoT policy also contains noise exposure criteria for educational facilities. This is based on the traffic noise levels created inside exposed classrooms. Mitigation measures are to be considered *where it is projected that, ten years after project completion, daytime (8:30 to 15:30) traffic noise levels inside classrooms will exceed, the L_{eq} (1 hr) 47 dBA and will have increased by 3 dB or more above the pro-project levels.*

F. Some Facts On Community Noise Fundamentals And Descriptors

What is Sound and How is it Made?

Vibrating surfaces such as engine housings, drumheads or loudspeakers and rapidly moving fluids such as in jet engine exhausts, produce minute fluctuations in atmospheric, or air, pressure. These pressure fluctuations spread out from the source in the form of expanding pressure waves in the air, much as a water wave on a pond spreads out from the point where a pebble has been dropped their intensity steadily decreasing with distance from the source. Our ears, acting like microphones, sense these air pressure fluctuations and our brain interprets them as sound.

The Sound Pressure Level or "Decibel" Scale

The ear is capable of sensing sound, or "hearing", over an enormous range of intensities - from the faintest rustling of leaves to the roar of a nearby jet aircraft. The jet may produce sound that is one million times more intense than the rustling of leaves. Therefore, similar to the "Richter" scale which compresses the entire range of earthquake magnitudes into a 1 to 10 scale, the "Sound Pressure Level or "Decibel" scale was developed to represent the even greater range of audible sound intensities within a compressed, or "logarithmic", scale. Within this scale, a Sound Pressure Level (SPL) of 0 decibels (dB) represents the threshold of hearing in the ear's most sensitive frequency range, while the thresholds of tickling or painful sensations in the ear occur at 120 to 130 dB. The accompanying poster shows the Sound Pressure Levels, or more commonly "sound levels", typically created by a variety of common sources in the community. Roughly speaking, each 10 dB increase in sound level corresponds to a doubling of subjective loudness.

How is Sound Measured?

Sound is measured with instruments called "Sound Level Meters" which consist of a microphone in conjunction with an electronic amplifier, a display meter and commonly today, a digital memory for logging sound level data over time. These meters are calibrated before each use.

The Frequency or "Pitch" Sensitivity of the Ear - A-weighted Decibels

The normal range of sound frequencies audible to the young, healthy ear is from 20 cycles per second, or Hertz (Hz.) to about 20,000 Hz. The ear is much more sensitive to mid and higher frequencies (particularly the 500 to 4000 Hz, range) than to lower frequencies. To approximate the ear's frequency sensitivity, Sound Level Meters contain electronic weighting networks, the most widely used and appropriate for typical measurements in the community being the "A-weighting". Sound levels measured with this weighting in effect are called A-weighted sound levels and their unit of measurement is the A-weighted decibel, or “dBA".

What is Noise?

Noise is commonly referred to as unwanted sound, because it interferes with human activities and/or creates annoyance. The judging of sound as noise is then, to a substantial degree, a personal or subjective matter since it depends on the situation, the activities engaged in as well as individual attitudes and sensitivity.