Wakefield (Acoustics)

Our File: 08-1327-1
July 17, 2009

MEMORANDUM

Consulting
Acoustical
Engineers

Wakefield Acoustics Ltd.
301-2250 Oak Bay Ave
Victoria, B.C. Canada
V8R 1G5
Tel: 250-370-9302
Fax: 250-370-9309
Email: nonoise@shaw.ca

To: **James Bay Neighbourhood Association**
c/o Marg Gardiner

Faxed:	No
E-mailed:	Yes
Mailed:	No
Couriered:	No

From: **Duane Marriner, P. Eng.**

Re: **James Bay Neighborhood Association – Noise Monitoring**

Introduction:

Wakefield Acoustics was retained to monitor the general transportation noise over two typical weekdays at two representative locations in the James Bay neighborhood. The purpose of this monitoring was to provide a basis for characterizing transportation noise during the 2009 tourist season for future reference.

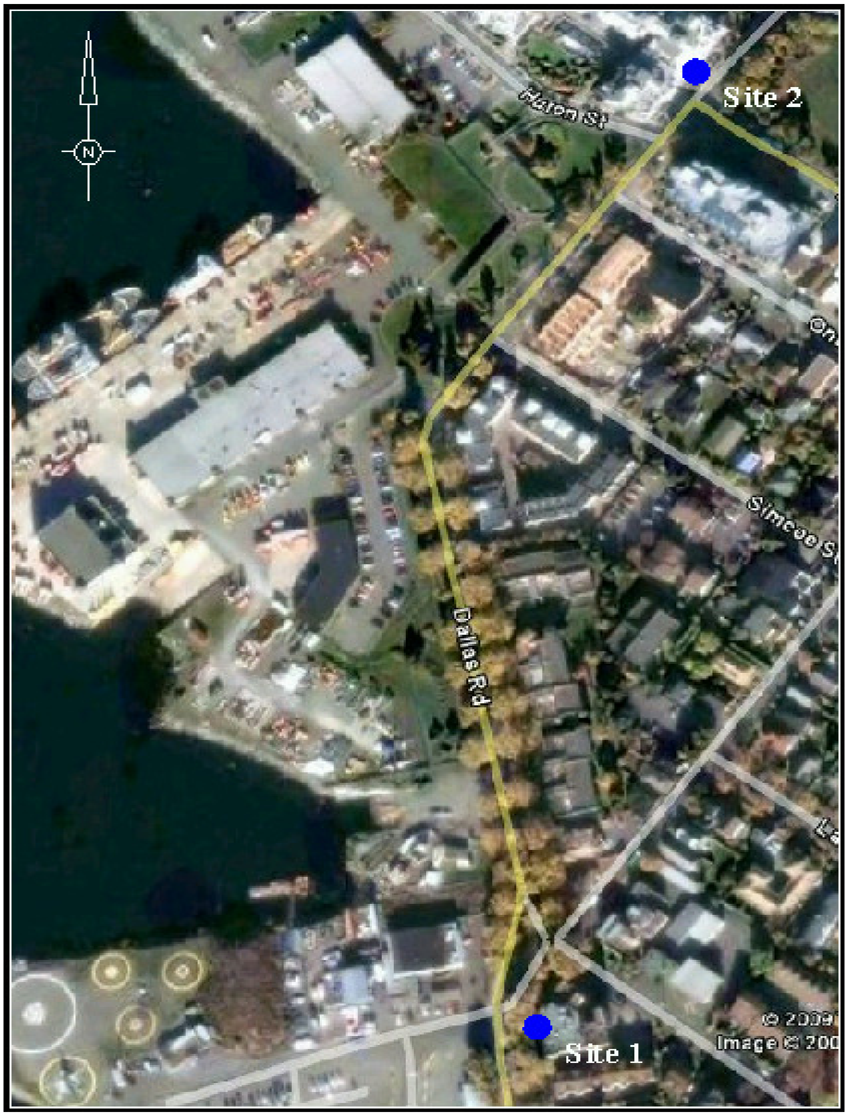
Methodology:

Times and Locations:

On the morning of June 9, 2009, the undersigned visited the Dolphins and Shoal Point condominiums of James Bay to establish two long-term (48-hour) noise-monitoring locations in consultation with the James Bay Neighborhood Association. There were no cruise ships at the Ogden Point berths for the first 22 hours of noise monitoring. Three cruise ships were to arrive on the second day. The monitoring sites were to be representative of the residents that would be the most exposed to tourist transportation noise. Two locations were chosen:

- Site 1 along the western side of the outdoor patio of Suite #2, The Dolphins, 104 Dallas Road
- Site 2 on the southeastern side of the outdoor balcony of Suite 428, Shoal Point, 21 Dallas Road

The locations are shown on the following Site Map.



Site Map: James Bay Neighborhood from Site 1 near the Erie Street at Dallas Road intersection to Site 2 near the Ogden Point entrance driveway.

While continuous unattended noise monitoring was underway at Sites 1 and 2, attended monitoring was also conducted to note the times of the major noise events and their noise levels. This was done for an hour at each location on June 10 and 11 during the mid-afternoon. Table 1 summarizes the unattended and attended monitoring schedules.

Table 1: Summary of James Bay Monitoring Sites, Dates and Times, June 9 - 11, 2009

Site Number	Address/Location	Start	Stop	Type
1	Suite #2 The Dolphins	10:09 Hours June 9	Midnight	Unattended
		Midnight	10:09 Hours June 10	Unattended
		10:09 Hours June 10	16:00 Hours June 10	Unattended
		16:00 Hours June 10	17:00 Hours June 10	Attended
		17:00 Hours June 10	20:11 Hours June 10	Unattended
		20:11 Hours June 10	Midnight	Unattended
		Midnight	16:28 Hours June 11	Unattended
		16:28 Hours June 11	17:30 Hours June 11	Attended
2	Suite #428 Shoal Point	9:38 Hours June 9	Midnight	Unattended
		Midnight	9:38 Hours June 10	Unattended
		9:38 Hours June 10	15:11 Hours June 10	Unattended
		15:11 Hours June 10	15:43 Hours June 10	Attended
		15:43 Hours June 10	17:39 Hours June 10	Unattended
		17:39 Hours June 10	Midnight	Unattended
		Midnight	15:10 Hours June 11	Unattended
		15:10 Hours June 11	16:11 Hours June 11	Attended
		16:11 Hours June 11	17:47 Hours June 11	Unattended

In the table the lighter shaded (green) cells denote the start times of the six charts presented in the results section below, the darker shaded (red) cells denote the stop times of same.

Noise Monitoring Equipment and Procedures

Continuous ambient[1] noise monitoring was conducted using two Larson-Davis Model 820 Community Noise Analyzers, with one instrument located at each residential location. These digital instruments comply with ANSI S1.4 [1983] standards for Type 1 Sound Level Meters and are capable of sampling the ambient sound level many times per second and storing the resulting sound level data for subsequent analysis and display. Using their "Interval Mode", these instruments were set to collect a complete statistical description of the noise environment every minute. For each one minute interval, these instruments store the *equivalent sound level*, or L_{eq}[2], and the maximum sound level, or L_{max}, expressed in units of A-weighted decibels, or dBA (see Appendix A). Statistical noise level descriptors, or "Exceedance Levels", notably L_{90}, were also collected in each interval. The L_{90} represents the sound levels that were exceeded 90% of the time and is considered a measure of the background sound level that exists during the quietest periods. In addition, the Model 820's also logged the L_{eq}(5 sec) and L_{max}(5 sec) expressing a more detailed noise level history in 5 second intervals.

[1] Ambient noise includes all sources of noise in the environment including primarily engine and exhaust noise of motorcycles and scooters, light, medium and heavy vehicles. In addition, ambient noise includes noise from helicopter, seaplanes and other harbor activities.

[2] The L_{eq} may be used to derive the related L_{dn} or day-night equivalent noise level which is similar to the L_{eq} except that a 10 dBA penalty is applied to the nighttime hours from 22:00 to 0700 hours (see Appendix A).

The sound level meters were field-calibrated before and after each 24-hour monitoring period using a precision acoustical calibrator – a Larson-Davis Model CA200. The memory units of the instruments were downloaded to a portable computer at the approximate end of each 24- hour period. The instruments were mounted on tripods 1.6 m above patio or deck level in secure locations.

Weather Conditions during Noise Monitoring

The weather conditions in James Bay from June 9 to 11, 2009, summarized in Table 2, were favorable for noise monitoring.

Table 2:
Summary of Weather Conditions along the James Bay Waterfront, June 9 to 11, 2009

Date	Temperature High/Mean/Low (Degrees Celsius)	Wind Speed (kmph)/Direction	Precipitation
June 9	10.4/14.4/18.5	Light in morning increasing to 20 knots from SW in afternoon	Nil
June 10	11.0/15.9/20.9	Same	Nil
June 11	10.9/15.2/19.4	Same	Nil

Traffic Conditions during Noise Monitoring

Tour bus traffic over the two afternoon monitoring sessions was seen to be consistent, that is, the same number of buses were counted over the one hour attended monitoring sessions. Both counting sessions were carried out on days when cruise ships were in port.

Seaplane and Helijet flights arrivals and departure times may have varied from day to day over the monitoring session, however, scheduled transit bus movements would have been the same for the three midweek days.

During attended monitoring an event log was prepared listing the dominant transportation noise events. The event log noted a description of the transportation noise source, a representative time of day of the noise event in hh:mm:ss format and the highest[3] L_{max} apparently[4] generated by the noise event.

[3] For example, in the case of a seaplane departure, the *representative* time of day noted in the event log corresponded to the start of the takeoff run. However the highest noise level of the departure would have typically occurred 10 to 15 seconds later just after the seaplane lifts off the surface of the water. In the case of tour bus passbys, the representative timing point for the event corresponded to the approximate midpoint of the bus passby. The highest noise level however may have occurred before or after the midpoint timing point. Moreover all L_{max}(5 sec) noise levels noted in the event log may have occurred at any time within a five second interval. In general the highest noise levels noted in the event log occurred around the time of the noted noise event but may be influenced by other overlapping noise events in some cases.

The major transportation noise contributors were:

- Seaplanes
- Tour buses and transit buses
- Diesel pick up trucks
- Commercial heavy vehicles
- Helijet (Site 1 only)
- Heavy motorcycles

Other modes of transportation included rental scooters, light and medium vehicles however, these lesser noise events were not recorded on the event log.

Results:

"One Minute" Noise Level Histories

The relevant L_{eq}'s and L_{dn}'s are summarized in Table 3. The noise level histories for unattended continuous long-term noise monitoring are provided in Figures 1 to 6. The L_{eq}'s and L_{dn}'s are inscribed on the figures for reference.

Table 3: Transportation Noise Levels on James Bay Water Front Summer, 2009

Site #	Address/Location	Dates	Duration hrs	L_{eq} (dBA)	L_{dn} (dBA)	Comment
1	Suite #2 The Dolphins	June 9 to 10	24	60.5	63.6	Cruise Ship arrived on 22nd hour of 24 - hour monitoring period
		June 10 to 11	6.9	63.4	-	Numerous cruise ship arrivals and departures throughout monitoring period
		June 10 to 11	24	63.7	65.6	Numerous cruise ship arrivals and departures throughout monitoring period
2	Suite 428 Shoal Point	June 9 to 10	24	59.3	61.0	Cruise Ship arrived on 22nd hour of 24-hour monitoring
		June 10 to 11	7.3	63.8	-	Numerous cruise ship arrivals and departures throughout monitoring period
		June 10 to 11	23.7	61.5	63.6	Numerous cruise ship arrivals and departures throughout monitoring period

[4] In some cases noise levels from two or more transportation noise sources may overlap. These cases are also noted in the events log.

Figure 1:

James Bay Neighborhood Association, Unattended Monitoring
Site 1 - Suite #2 Dophins, 104 Dallas Road, June 9 to 10, 2009
(Noise Levels in 1 minute Intervals)

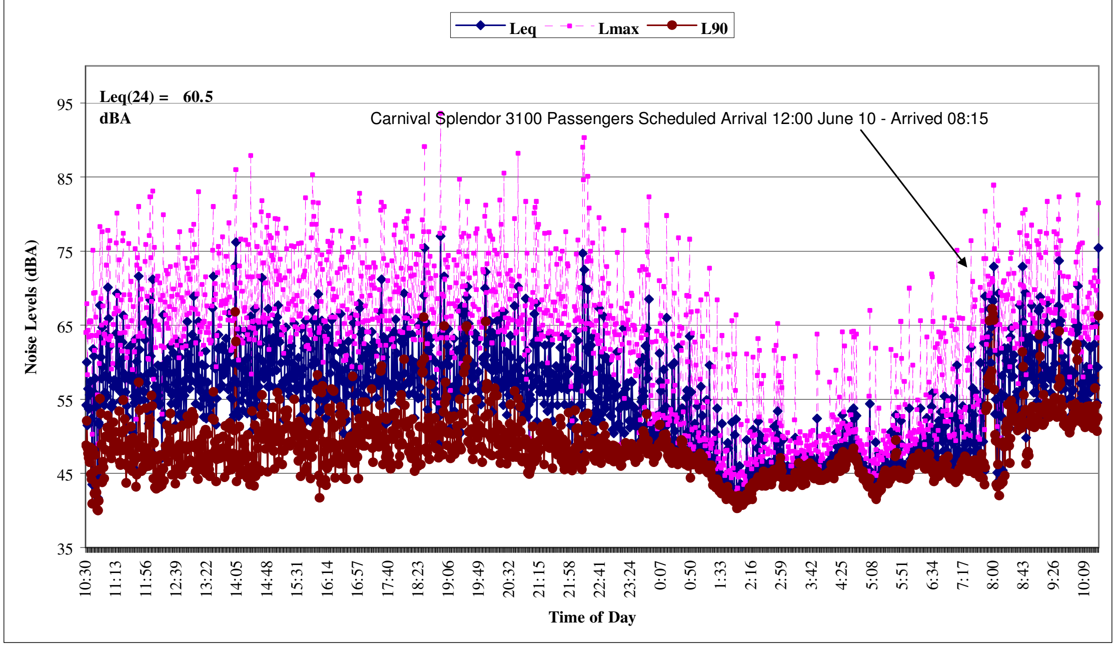


Figure 2:

James Bay Neighborhood Association, Unattended Monitoring
Site 2 - Suite #428 Shoal Point, 21 Dallas Road, June 9 to 10, 2009
(Noise Levels in 1 minute Intervals)

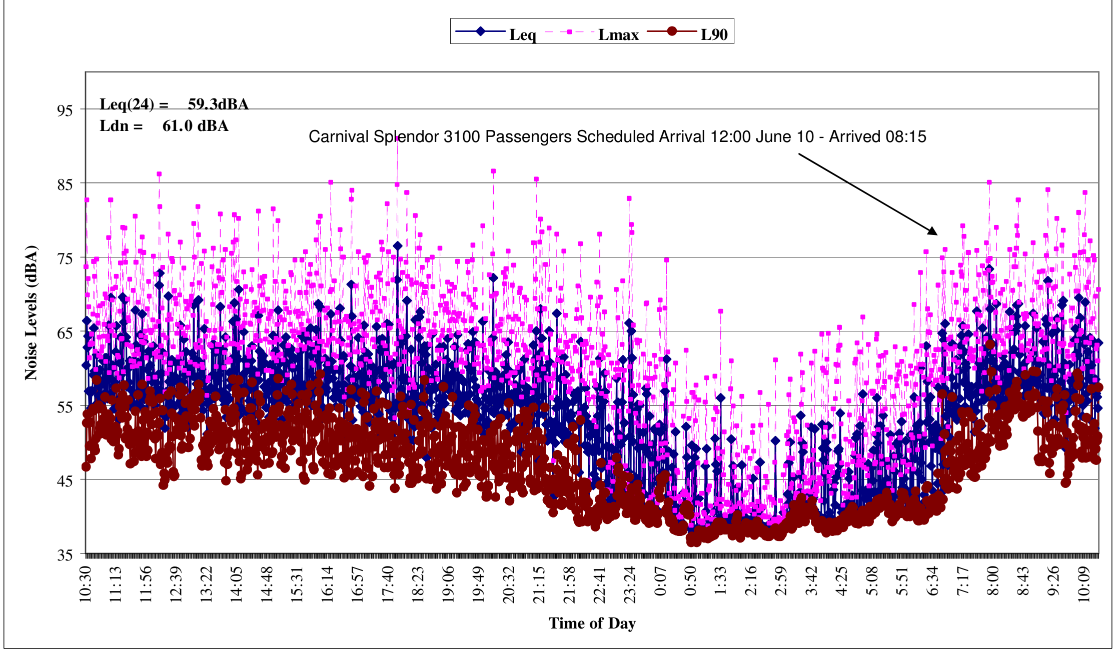


Figure 3:

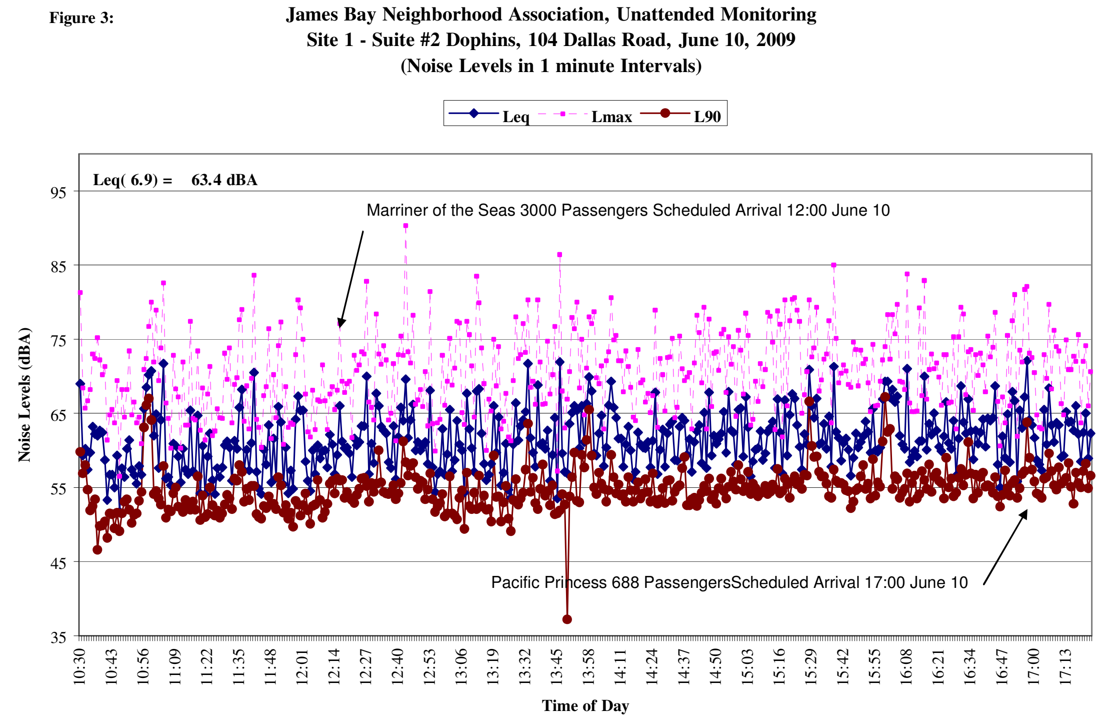


Figure 4:

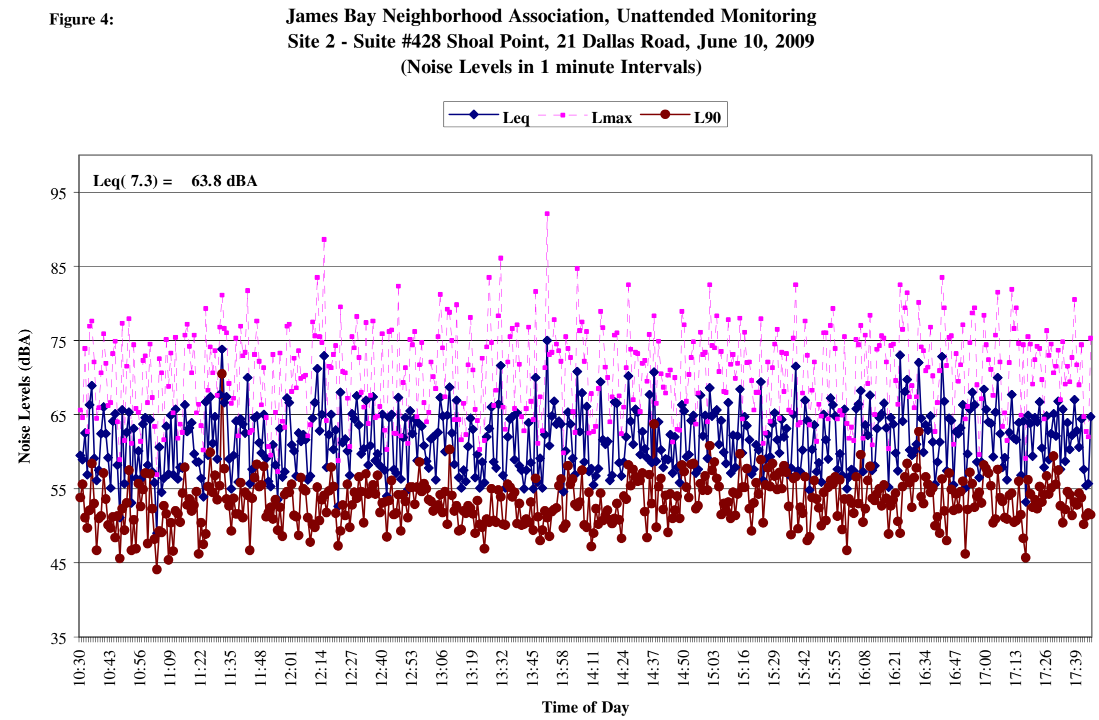


Figure 5: **James Bay Neighborhood Association, Unattended Monitoring**
Site 1 - Suite #2 Dophins, 104 Dallas Road, June 10 to 11, 2009
(Noise Levels in 1 minute Intervals)

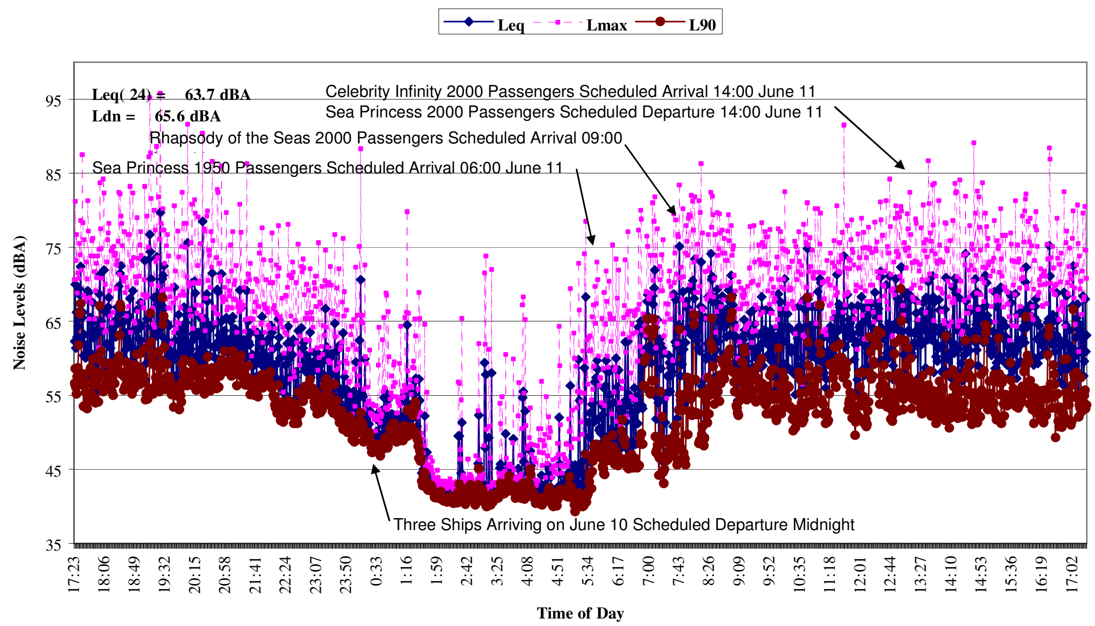
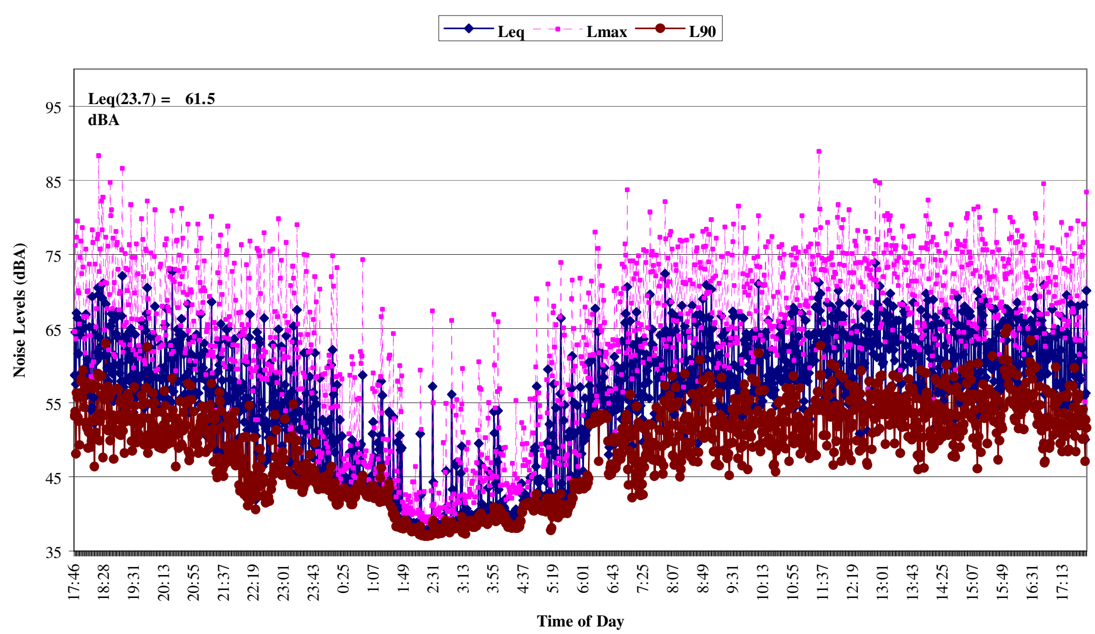


Figure 6: **James Bay Neighborhood Association, Unattended Monitoring**
Site 2 - Suite #428 Shoal Point, 21 Dallas Road, June 10 to 11, 2009
(Noise Levels in 1 minute Intervals)



Average Noise Level by Vehicle Category

Average maximum noise levels of major noise events are provided in Tables 3 and 4.

Table 4: Transportation Noise Event Levels for Site 1

Transportation Noise Source	Event L_{max}(dBA)	Average L_{max}(dBA)	Comment
Helijet Start	70.8, 70.1	70.5	-
Helijet Engine Run-up	75.5, 75.0	75.3	-
Helijet Departure	76.5, 88.4, 77.7	80.9	-
Seaplane Departure	72.9, 69.7, 66.7, 62.8, 76.2, 72.8, 82.4, 77.2	72.6	Turbo Otter, Twin Otter, Beaver
Tour bus Passby along Dallas Road	72.0, 81.2, 76.7, 77.2, 75.6, 73.4, 73.8, 79.6	76.2	-
Tour bus turn into Ogden Point	69.4, 72.7, 70.4, 72.0, 72.1, 68.8, 75.7, 73.7	71.9	Regular and Double Decker

Table 5: Transportation Noise Event Levels for Site 2

Transportation Noise Source	Event L_{max}(dBA)	Average Noise Level (dBA)	Comment
Seaplane Departure	69.5, 72.1, 82.5, 74.0, 73.3, 72.0, 72.1, 77.9	74.2	-
Seaplane Arrival	68.8	68.8	-
Tour bus Passby	78.3, 74.9, 78.9, 73.8, 74.8, 73.4, 74.4, 74.3	75.4	-
BC Transit Passby	73.4, 66.8 Hybrid, 71.9, 72.1, 72.3	71.3	Regular and Hybrid Buses

In addition, the following information is available on request:

- Complete event log for attended monitoring June 10 and June 11, 2009 at the two locations
- Electronic noise files listing noise metric histories L_{eq}, L_{max} and others in 1 minute and 5 second resolution

Conclusions:

Transportation noise was consistent during the two separate one-hour attended noise monitoring sessions on June 10 and 11. Approximately the same number of major noise events (due to seaplanes, tour buses, transit buses, etc.) was counted during each session.

The L_{eq}(24) at Site 1, the Dolphins location, was 3.2 dBA higher for the second 24-hour monitoring session day when numerous cruise ships were berthed at Ogden Point. Since the scheduled seaplane and Helijet arrival and departure noise would be roughly the same for the two adjacent 24-hour periods and transit bus noise would be expected to be same over this period, the increase in noise levels is considered to be largely due to increased tour bus activities associated with the cruise ships. The substantial 3.2

dBA increase in noise levels over 24-hours corresponds, that is, would be equivalent in effect to, roughly a doubling of all transportation noise sources over the day.

The increase in $L_{eq}(24)$ at Site 2, the Shoal Point location, of 2.2 dBA observed during the second 24-hour period while numerous cruise ships were docked was somewhat less pronounced but can still be equated to roughly a 50 to 60% increase in all forms of transportation traffic noise.

Wakefield Acoustics Ltd. does not take responsibility for analysis and/or presentation of unprocessed field data that may be made available to the client.

Please call me at 370-9302 if you have any questions.

Duane Marriner, P.Eng.

Appendix A

COMMUNITY NOISE FUNDAMENTALS AND DESCRIPTORS

Noise Fundamentals

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.

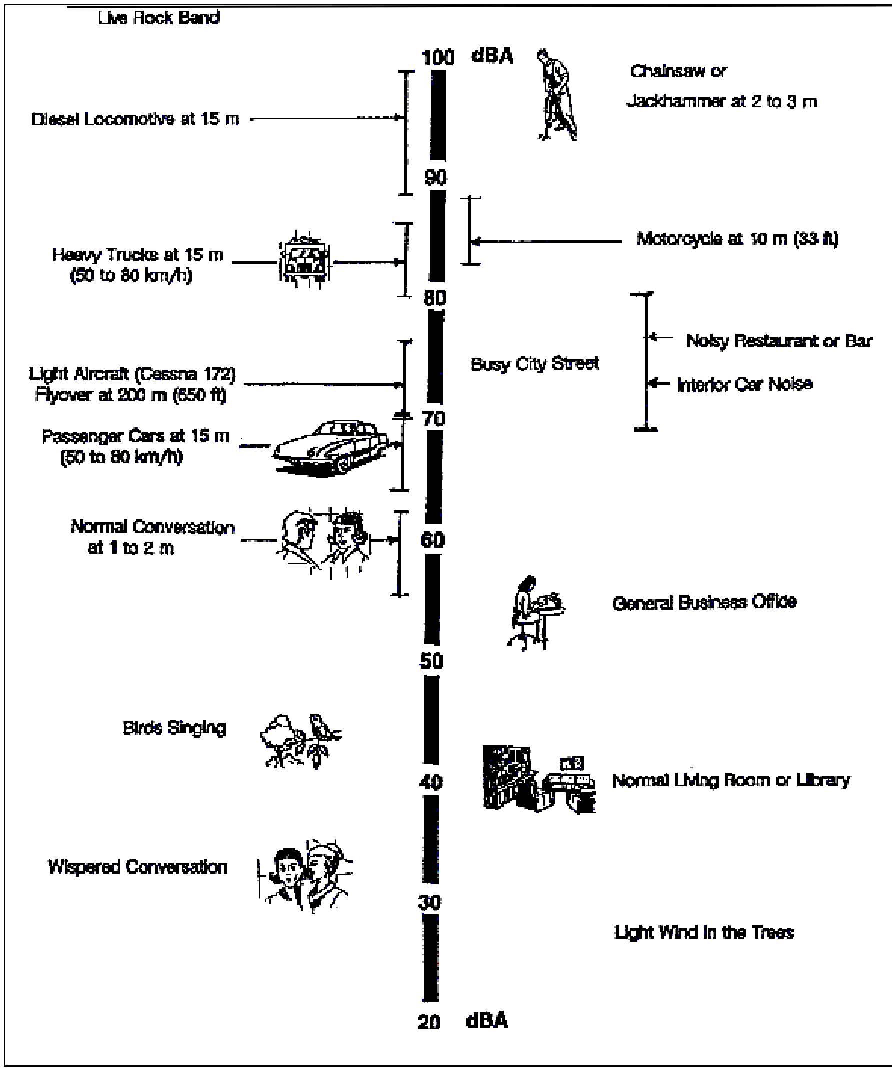


Figure A.1: Levels of Common Noises in the Community (dBA)

How is Sound Energy Lost?

Geometric spreading is the reduction in the intensity of sound waves as they move away from the source due to the spreading of their energy over progressively larger and larger areas.

Atmospheric absorption is the extraction of energy from sound waves as they pass through the atmosphere due to a variety of phenomena.

Ground effect attenuation is the reduction in sound intensity at a distance from the source caused by destructive interference between direct and ground-reflected sound waves and occurs where sound waves travel close to acoustically soft ground.

Principal Community Noise Level Descriptors

The principal descriptor of the baseline community noise environment provided by the monitoring is the Equivalent 24-hour Sound Level, or $L_{eq}(24)$. This is a widely-utilized, single-number descriptor of the average sound energy exposure over a 24-hour day and is employed in the B.C. Ministry of Transportation's noise impact mitigation policy as well as other community noise guidelines. The L_{eq} is that steady sound level which, over a given time period, would result in the same overall sound energy exposure as would the actual time-varying community noise level.

A variant of the $L_{eq}(24)$ is the Day-Night Average Noise Level, or L_{dn}. Like the $L_{eq}(24)$, the L_{dn} is an energy-averaged descriptor of daily noise exposure and is expressed in dBA. However, in computing L_{dn}, all noise levels occurring between 22:00 and 07:00 hours are increased by 10 dBA to reflect the greater sensitivity of residential communities to noise at night. Where noise environments are dominated by highway/road traffic noise (which tends to be substantially lower at night than during the day), these two daily-average noise descriptors yield fairly similar results. However, should industry, railway operations or other noisy activities be prominent and continue during the nighttime, the L_{dn} tends to be significantly higher than the $L_{eq}(24)$. For this reason, L_{dn} is an appropriate noise descriptor where significant nighttime noise is expected and is used in other guidelines.

Other noise descriptors or quantifiers include the maximum sound level, or L_{max}, and exceedance levels, or L_n's. The L_{max} is the highest sound pressure level measured over a defined time interval. The exceedance levels are those noise levels that were exceeded for a given percentage "n" of the monitoring time. For example, the L_{50} is that noise level exceeded 50% of the time, i.e. the median level, while the L_{90} is that noise level exceeded 90% of the time and hence may be considered the background noise level. In all cases, these noise levels are expressed in units of A-weighted decibels, or dBA. The "A-weighting" refers to the electronic weighting network built into most sound measuring devices (sound level meters) which simulate the frequency (or pitch) sensitivity of the human ear. Noise levels measured with this network in place are then expressed in A-weighted decibels, or "dBA".

In addition the L_{Unpk} or un-weighted peak level measured in dB was is widely used for assessing the potential of blast noise to "annoy". The L_{Unpk} is similar to the L_{peak} or A-weighted peak level measured in dBA except it is measured with the A-weighting network deactivated. As such the L_{Unpk} may be significantly higher than the L_{peak} due to the low frequency content of a blast. While the low frequency content may be practically inaudible it has the potential to annoy by causing windows to vibrate or picture frames to rattle on the wall.