OGDEN POINT CRUISE SHIP-RELATED TRAFFIC NOISE STUDY

Prepared For:

Greater Victoria Harbour Authority

Victoria, B.C.

December 1, 2011

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The James Bay waterfront is a busy area attracting tourist and local recreational traffic along Dallas Road and Erie, Kingston and Quebec Streets. Seaplanes regularly arrive and depart from Victoria's Inner Harbour while helicopters come and go from the Ogden Point Helijet Airways terminal. All of these transportation activities expose the residents of the James Bay waterfront to noise. However, noise generated by surface traffic serving the Ogden Point cruise ship terminal, and in particular buses, has been of particular concern to local residents as represented by the James Bay Neighbourhood Association (JBNA). In August 2011, the Greater Victoria Harbour Authority (GVHA) retained Wakefield Acoustics Ltd. (WAL) to carry out a two-phase study of the noise environment in this neighbourhood. Phase 1 was to occur during active cruise ship season and was completed on the Labour Day weekend in September 2011. Phase 2 was to occur after cruise ship season had ended and was conducted in October 2011.

Four noise-monitoring sites were selected with assistance from the JBNA. These were Site 1 (215 Quebec Street), Site 2 (21 Dallas Road - Shoal Point Condos), Sites 3 (104 Dallas Road – The Dolphin) and Site 4 (558 Dallas Road). At each site, 48-hours of continuous, unattended noise monitoring were conducted between September 2 and 4 and again between October 14 and 16, 2011. Several hours of attended noise monitoring were also done at each site to identify specific noise sources and, in particular, tally the numbers of tourism-related bus movements.

Graphical noise level histories were generated which illustrate the effects of cruise ship-related traffic (and any other seasonal tourism related noise) on average community noise exposures and on near-maximum noise levels such as created by bus pass-bys. During late afternoon and evening hours (5:30 to 11:30 PM) while cruise ships were in dock, the 1-hour average noise levels, or L_{eq}(1 hr)'s were increased by as much as 8.8 dBA, and by averages of 4.1 dBA (on September 2 with two cruise ships in port) and 5.4 dBA (on September 3 with 3 cruise ships in port) relative to levels during the same periods on October 14 and 15 after cruise ship season had ended. For reference, such noise level increases of 4.1 to 8.8 dBA correspond to increases in the subjective loudness, or noisiness, of the acoustic environment of roughly 32 to 84%.

Since there is little cruise ship-related activity outside the hours the ships were in port, effects of cruise ship-related traffic on 24-hour average community noise exposures were smaller. Effects on the 24-hour Equivalent Sound Levels, or L_{eq}(24)'s, at the various sites ranged from 0.5 to 3.0 dBA while those on the Day-Night Average Sound Levels, or L_{dn}'s (which includes a 10 dBA penalty for noise at night) were 0.7 to 3.9 dBA. These are minor to moderate noise increases, but they come on top of baseline noise exposures that, at L_{eq}(24) 55 to 61 dBA and L_{dn} 59 to 63 dBA, equal or exceed recognized thresholds for residential neighbourhoods (typically 55 dBA).

Buses are the largest contributors to these noise increases. The average numbers of buses observed at the four sites during the attended noise monitoring sessions (between 5 and 7 PM) decreased from 16.5 per hour on September 2 and 3 to 0 to 2 per hour on October 15 and 16. Measurements at Site 2 (21 Dallas Road) showed that the average bus movement created an L_{max} of 74.3 dBA at this residential façade. Such intermittent noise events are capable of interfering with speech communications outdoors (60 dBA or more) and with sleep and relaxation indoors (WHO sleep disturbance threshold, is L_{max} 45 dBA indoors). That the presence of cruise ships and their associated traffic extends into the late evening clearly aggravates the community noise situation in James Bay.

1.0 INTRODUCTION

1.1 Background

Ogden Point, on the western shore of the James Bay neigbourhood of Victoria, B.C., is home to an active cruise ship terminal as well as a commercial heliport and a Canadian Coast Guard maintenance facility. To the north of these waterfront transportation and service facilities lies Victoria's Inner Harbour, an active water velodrome for commercial seaplane services between Victoria and Vancouver and other locations on the southwest coast of B.C. as well as Seattle. The related seaplane and helicopter movements create fairly intense but short-lived noise events to which those residing along the Dallas Road waterfront or visiting the local waterfront amenities such as the Ogden Point seawall and breakwater, are periodically exposed.

The James Bay waterfront route attracts considerable tourist and local recreational traffic (including many sports cars and motorcycles), particularly in the warmer months. Added to this is the surface traffic associated with the operation of the Ogden Point Cruise Ship terminal, this being primarily taxis and buses of various types and sizes which transport cruise ship passengers from Ogden Point to and from downtown Victoria or other tourist-related destinations nearby. In heading into or out of downtown Victoria, much of this cruise ship-related traffic takes a route involving Dallas Road and Erie, Kingston, Quebec and Belleville Streets. In following this route, in heading east from Ogden Point along Dallas Road and in returning, this traffic passes by the residences (single and multiple family dwelling) which line the, largely inshore, sides of these various streets. The noise generated by the cruise ship-related component of this waterfront traffic, in particular buses, is a concern to local area residents as represented by the James Bay Neighbourhood Association (JBNA). The JBNA has communicated this concern to the City of Victoria and the Greater Victoria Harbour Authority (GVHA) and has encouraged a study to assess the significance of cruise ship traffic-related noise along the Dallas Road waterfront between Erie Street and Douglas Street. Figure 1-1 provides a plan of the study area.

In August 2011, the GVHA retained Wakefield Acoustics Ltd. (WAL) to carry out a two-phase study of the noise environment along the Dallas Road waterfront. The first phase was to be conducted during active cruise ship season and so was completed in first few days of September 2011. The second phase was to take place after cruise ship season had ended for the year and so was conducted in mid-October 2011.

WAL has considerable experiences with the community noise environments around James Bay and Victoria's Inner Harbour, having, in 2009, conducted a more limited study of the Dallas Road noise environment directly for the JBNA. In addition, between 1999 and 2001, WAL conducted a series of extensive noise surveys and analyses for Transport Canada that were focused on the noise created by seaplane and helicopter operations in and around Victoria's Inner and Outer Harbours, including the James Bay waterfront.

This report describes the methodology, conditions and outcomes of the two phases of the noise study with a primary focus on identifying the effects of cruise-ship related surface traffic on overall community noise exposures.

Figure 1-1; Plan of James Bay Study Area showing locations of Noise Monitoring Sites.

1.2 Scope

The scope of these noise studies, largely as outlined in WAL's proposal letter of August 22, 2011, has been as follows:

Phase 1 – During Cruise Ship Season

- Conduct 48-hours of continuous, largely unattended noise monitoring at four locations in James Bay study area,
- Conduct 3 to 4 hours of attended noise monitoring at each monitoring site with a focus on the numbers and types of cruise ship-related traffic noise events.

Phase 2 – After Cruise Ship Season

- Repeat 48-hours of continuous unattended noise monitoring at the same four locations in James Bay,
- Repeat 3 to 4 hours of attended noise monitoring at each monitoring site with a focus on the numbers and types of traffic noise events,
- Analyze the data collected during this noise monitoring and compare to data collected during Phase 1 monitoring.

Phase 3 – Report Preparation

- Prepare an engineering report documenting the methodology and outcomes and comparing the observed community noise levels to relevant guidelines including the City's noise bylaw. This report would also quantify the differences observed between the community noise environments that existed during and after the cruise ship season. The significance of any such changes in the noise environment would be described in terms of their anticipated effects on community residents.

Note that, under the original scope of work as described in WAL's proposal, there were to be two reports prepared; one after each of the two phases of field investigations. However, given the limited period between the two noise monitoring sessions, it was agreed that it would be sufficient to include the noise monitoring data from both phases, together with the associated data analysis and impact assessment, in this single report.

2.0 NOISE MONITORING SCHEDULE AND PROCEDURES

2.1 Noise Monitoring Schedule

Table 2.1 herein provides the locations and times at which noise monitoring, both attended and unattended, was conducted during and after the 2011 cruise ship season, It may be seen that the "During Cruise Ship Season" unattended noise monitoring was conducted over a 48-hour period starting at 11:45 hours on Friday, September 2 and terminating at 11:45 on Sunday, September 4, 2011. The "After Cruise Ship Season" unattended noise monitoring was conducted between 11:45 hours on Friday, October 14 and 11:45 hours on Sunday, October 16, 2011.

Four attended noise monitoring sessions were conducted at each of the four monitoring sites, with the sessions generally lasting between 30 and 60 minutes. Over these periods, the field engineer logged the sources and times of identifiable, largely transportation-related, noise events.

Site No.	Address	Unattended Monitoring		Attended Monitoring	
		Start	Finish	Start	Finish
1	215 Quebec Street	Sept. 2, 11:45	Sept. 3, 11:45	Sept. 2, 19:06	Sept 2, 19:44
		Sept. 3, 11:45	Sept. 4, 11:45	Sept. 3, 16:04	Sept. 3, 16:51
		Oct. 14, 11:45	Oct. 15, 11:45	Oct. 14, 15:50	Oct. 14, 16:27
		Oct. 15, 11:45	Oct. 16, 11:45	Oct. 15, 18:17	Oct. 15, 18:38
2	21 Dallas Road	Sept. 2, 11:45	Sept. 3, 11:45	Sept. 2, 15:55	Sept. 2, 16:55
		Sept. 3, 11:45	Sept. 4, 11:45	Sept. 3, 19:08	Sept. 3, 19:59
		Oct. 14, 11:45	Oct. 15, 11:45	Oct. 14, 16:43	Oct. 14, 17:30
		Oct. 15, 11:45	Oct. 16, 11:45	Oct. 15, 17:30	Oct. 15, 18:04
3	104 Dallas Road	Sept. 2, 11:45	Sept. 3, 11:45	Sept. 2, 18:00	Sept. 2, 18:50
		Sept. 3, 11:45	Sept. 4, 11:45	Sept. 3, 17:04	Sept. 3, 17:55
		Oct. 14, 11:45	Oct. 15, 11:45	Oct. 14, 17:40	Oct. 14, 18:15
		Oct. 15, 11:45	Oct. 16, 11:45	Oct. 15, 15:55	Oct. 15, 16:42
4	558 Dallas Road	Sept. 2, 11:45	Sept. 3, 11:45	Sept 2, 17:00	Sept. 2, 17:38
		Sept. 3, 11:45	Sept. 4, 11:45	Sept. 3, 18:03	Sept. 3, 18:51
		Oct. 14, 11:45	Oct. 15, 11:45	Oct. 14,18:23	Oct. 14, 18:41
		Oct. 15, 11:45	Oct. 16, 11:45	Oct. 15, 16:51	Oct. 15, 17:21

Table 2.1; Schedules of Unattended and Attended Noise Monitoring at the Four Sites.

2.2 Noise Monitoring Equipment and Procedures

Noise monitoring at Sites 1, 3 and 4 was conducted with Larson-Davis Model 820 and 812 Community Noise Analyzers. These instruments are ANSI S1.4 [1983] Type 1 Sound Level Meters which sample the noise environment[1] several times per second and store the noise level information (in A-weighted decibels[2] or dBA) for subsequent downloading and display. These sound level meters provide a variety of noise level descriptors, the primary one being the Equivalent Sound Level[3], or L_{eq}. Also provided are the maximum level, or L_{max}, the median noise level, or L_{50}, and the background noise level, or L_{90}, during selectable time periods (15-minute periods were used in this case). Appendix B herein presents community noise fundamentals.

[1] As is standard practice during community noise monitoring when no very rapid variations in noise level (such as from blasting or impacts) are expected, the LD812/820 sound level meter were set on "Fast" meter response.
[2] To simulate the pitch sensitivity of the human ear, sound level meters contain an "A-weighting" network. The noise levels measured with this network in place are then expressed in A-weighted decibels, or "dBA".
[3] The Equivalent Sound Level, or Leq, 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.

Noise monitoring at Site 2 (21 Dallas Road) was conducted with a Bruel & Kjaer Type 2250 Portable Analyzer. In addition to providing the various noise metrics described above, the B&K Type 2250 recorded a digital sound file that permits subsequent review (audition) to identify the sources of prominent noise events and determine if they were truly representative of the local noise environment and should be included or excluded from the measurement.

All sound level meters were calibrated before and after each measurement period and checked every 24 hours using a LD CA200 Acoustic Calibrator or a B&K Calibrator Type 4231.

2.3 Noise Monitoring Site Descriptions

The four noise monitoring sites were selected in collaboration with the JBNA. The JBNA is very familiar with the concerns of area residents about noise from cruise-ship and tourist related traffic and with their assistance, four sites were selected along the waterfront route typically followed by tour buses and other tourist –related traffic around the James Bay community. Each of the four noise monitoring sites is described below.

Site 1 – 215 Quebec Street

Noise monitoring Site 1 was located on the balcony of a townhouse at 215 Quebec Street facing northeast towards Quebec Street. Cruise ship and other tourist traffic generally pass this site on their way from downtown Victoria to Ogden Point and the scenic waterfront drive along Dallas Road. Some of this traffic may also pass by Site 1 on its way back downtown. Figure 2.1 shows the Quebec Street townhouse (microphone on rightmost balcony) as seen from the north side of Quebec Street. Figure 2.2 shows the microphone on a tripod with Quebec Street beyond.

Figure 2.1; Noise Monitoring Site 1 – 215 Quebec Street.

Figure 2.2; Noise Monitoring Site 1 – 215 Quebec Street, looking northeast past the microphone from the townhouse balcony towards Quebec Street.

<u>Site 2 – 21 Dallas Road</u>

Noise monitoring Site 2 was located on the balcony of a second floor condominium on the eastern side of the Shoal Point development. This condo overlooks the corner where Erie Street meets Dallas Road. It provides a clear view of traffic heading away from and towards downtown on its way to and from the Dallas Road waterfront and Ogden Point. Figure 2.3 shows the condominium with the microphone located on the leftmost second floor balcony. Figure 2.4 provides the view from the balcony of the corner of Erie Street and Dallas Road.

<u>Site 3 – 104 Dallas Road</u>

Noise monitoring Site 3 was located on a patio directly in front of the condominium building at 104 Dallas Road, known as “The Dolphin”. Figure 2.5 shows the condominium as seen from the west side of Dallas Road while Figure 2.6 shows the view from the patio towards Dallas Road. This site is located just south of the Dallas Road entrance to the Ogden Point cruise ship facility.

<u>Site 4 – 558 Dallas Road</u>

Noise monitoring Site 4 was located in front of a single-family residence at the northeast corner of South Turner Street and Dallas Road. Figure 2.7 shows the view to the northeast towards Site 4 from the west side of Dallas Road. Government Street and Beacon Hill Park are to the right.

Figure 2.3; Noise Monitoring Site 2 on Balcony of Second Floor Condominium at 21 Dallas Road, corner of Erie Street and Dallas Road.

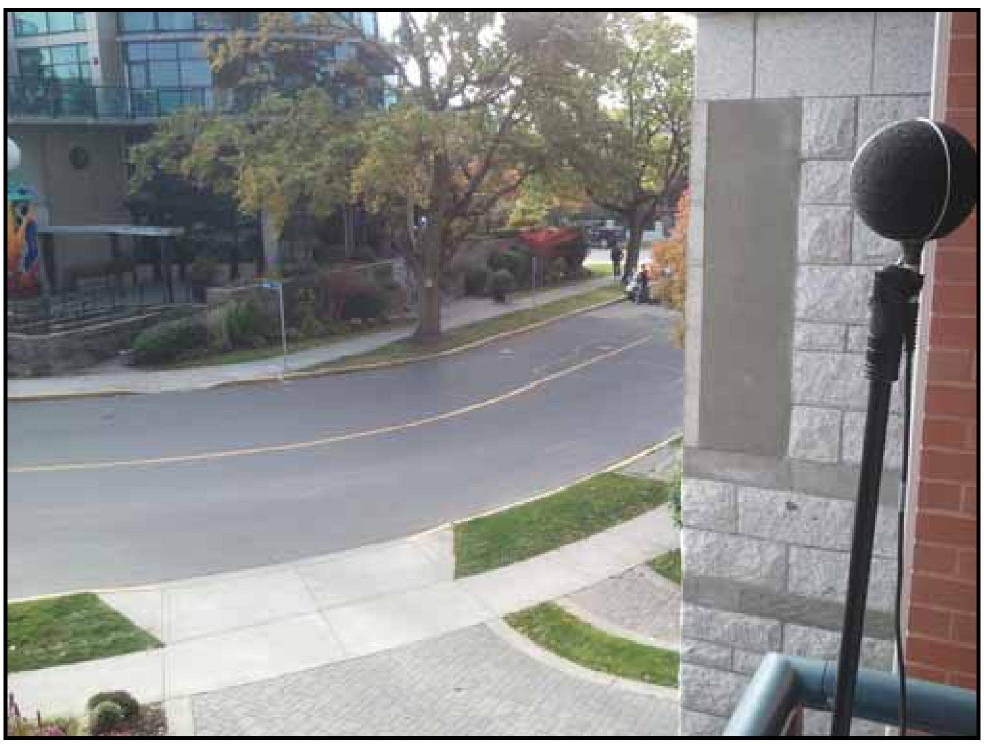


Figure 2.4; View from Monitoring Site 2, (21 Dallas Road) towards corner of Erie Street and Dallas Road

Figure 2.5; Noise Monitoring Site 3, 104 Dallas Road. The microphone was placed on the ground floor patio located directly behind the parked vehicle.

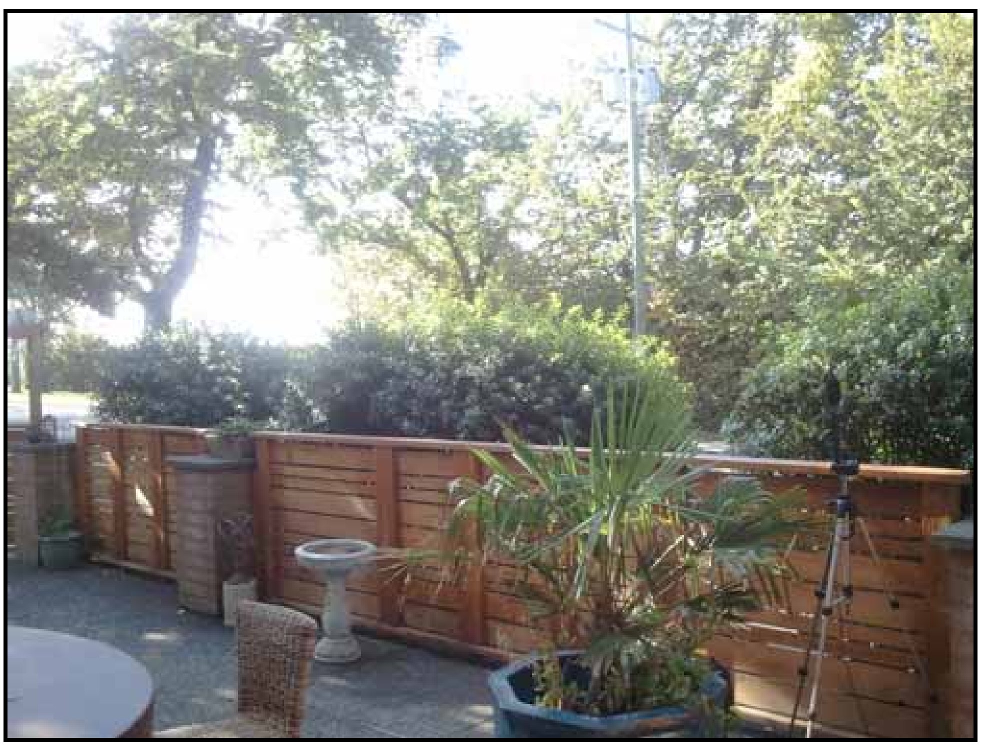


Figure 2.6; View from Noise Monitoring Site 3 westwards towards Dallas Road.

Figure 2.7; Noise Monitoring Site 4 on the Northeast corner of South Turner Street and Dallas Road. Microphone positioned at west façade of house behind the large Evergreen Shrub.

3.0 RESULTS OF UNATTENDED NOISE MONITORING

3.1 24-Hour Noise Level Histories

Each of the four noise monitoring systems produced continuous histories of the variation of community noise levels with time over two consecutive 24-hour periods as were listed in Table 1. These noise level histories are presented as Figures A.1 through A.8 in Appendix A. The time interval employed in these noise levels histories is 15 minutes.

Each of the noise level histories in Appendix A features two types of noise data plotted in 15-minute intervals. The first is the 15-minute Equivalent Sound Level, or L_{eq}(15 min), which is the energy-based, average sound level measured over a given 15-minute interval. The second noise metric presented is the L_1. The L_1 during a given time period is that noise level which was exceeded only 1% of the time, in this case for 9 out of 900 seconds (15 minutes). While not the absolute maximum noise level observed during a given 15-minute period, the L_1 approaches maximum levels and has been found to quite effectively reflect the presence of high noise level events such as bus pass-bys.

Since the primary objective of this study has been to quantify the effects of cruise ship-related transportation activities on community noise exposures, each of Figures A.1 through A.8 compares the noise levels histories obtained during and after cruise ship season. For example, Figure A.1 shows the 24-hour noise level history obtained at Site 1 (215 Quebec Street) between

11:45 hrs, Friday, September 2 and 11:45 hrs, Saturday, September 3, 2011, while cruise ship season was still active. Figure A.1 also contains the noise history obtained over the same period between October 14 and 15, 2011, after cruise ship season had ended. Comparison of these two noise level histories then provides a direct indication of the effects of additional activity (road traffic and otherwise) within the James Bay neighbourhood in early September compared to mid October. To large degree, this additional activity is expected to have been attributable to cruise ship-related traffic, particularly buses, but to some degree may have also been associated with generally higher volumes of other tourist and local traffic around the James Bay waterfront during the early September (Labour Day Weekend) monitoring period.

The following sections describe what each of the comparative noise level histories found in Appendix A reveals about the effects of cruise ship/tourist traffic on community noise exposures.

Site 1 – 215 Quebec Street

Figure A.1 shows the noise level histories obtained at Site 1, 215 Quebec Street, between September 2 and 3 (with cruise ships) and between October 14 and 15 (without cruise-ships). Throughout the afternoon and evening of Friday, September 2, the L_{eq}(15 min)'s at Site 1 were quite consistently between 58 and 61 dBA. However, on Friday October 15, by about 7:45 PM, the L_{eq}(15 min)'s began to decrease from their late-afternoon, early-evening levels of 57 to 60 dBA, falling into the 52 to 56 dBA range between approximately 8:00 and 11:15 PM. During the nighttime hours, there was generally no consistent difference between the Sept 2-3 and October 14-15 L_{eq} results, other than a one hour period between 5:30 and 6:30 AM when the September 3 levels were 3 to 4 dBA higher.

Increased noise levels during the evening when cruise ships were in port is even more evident in the L_1 histories, with the L_1's on Sept. 2 being between 69 and 73 dBA while on Oct. 14 (without cruise ships), they were in the 61 to 67 dBA range. Since the L_1's are measures of the near maximum noise levels observed during each 15-minute interval, they indicate the presence of noisier elements within the local traffic mix, such as buses, during the period between 7 PM and midnight on Sept. 2, 2011. As for the L_{eq}(15 min)'s, during the nighttime and early morning hours, there was no such consistent difference between L_1's with and without cruise ships.

Figure A.2 shows the corresponding noise level histories obtained over 24-hour periods between Saturdays and Sundays, September 3 to 4 and October 15 to 16. The same pattern of increased noise levels during the late afternoon and evening hours of the day (September 3) when cruise ships were in port is evident here as was seen in the Friday to Saturday data shown in Figure A.1.

Site 2 – 21 Dallas Road

Figures A.3 and A.4 show the 24-hour noise level histories obtained at Site 2 (21 Dallas Road - Shoal Point Condo) between September 2 and 4, and between October 14 and 15. As at Site 1, patterns of increased noise levels were seen at Site 2 during the late afternoons and evenings on those days when cruise ships were in port.

Site 3 – 104 Dallas Road

Figure A.5 shows the 24-hour noise level histories measured at Site 3 (104 Dallas Road) between September 2 and 3 and between October 14 and 15. Patterns of higher noise exposures during the late afternoon and evening on the September 2 when cruise ships were in port are again

evident. These differences are primarily evident in the L_{eq}(15 min)'s, but to a lesser degree than at Sites 1 and 2. However, these effects are largely absent in the L_1,'s histories. Such noise exposures difference effects (where average levels, as indicated by the L_{eq}'s, have increased, but the L_1's, or near maximum levels, have not) would indicate that overall traffic volumes may have been higher during those hours on September 2, but individual vehicles with higher than normal noise emissions (such as buses) were less evident.

Figure A.6 shows the 24-hour noise level histories measured at Site 3 between September 3 and 4 and between October 15 and 16. Patterns of higher noise exposures during the late afternoon and evening on the September 3 when cruise ships were in port are again evident, on this occasion, in both the L_{eq}(15 min)'s and the L_1's.

Site 4 - 558 Dallas Road

Figures A.7 and A.8 show the noise histories obtained at Site 4 (558 Dallas Road) between September 2 and 4 and between October 14 and 15. Again, patterns of increased noise levels are seen during the late afternoons and evenings on days when cruise ships were in port.

3.2 Effects of Cruise Ship-Related Activity Noise During Evening Hours

Figures A.1 through A.8 have revealed that the most significant effects of cruise-ship related activities (and likely other tourism–related traffic) on community noise levels at the four noise monitoring sites occurred during the evening hours, between approximately 5:30 and 11:30 PM. Table 3.1 summarizes the effects of these activities on the hourly equivalent sound levels, or L_{eq}(1 hr)'s, that occurred during those periods. It is seen that the cruise ship/tourism activity-related differences in L_{eq}(1 hr)'s during the evening ranged as little as 0.7 dBA in one specific evening hour at Site 4 to as high as 8.8 dBA during one specific evening hour at Site 3. Taken over the four monitoring sites, the average effect of this activity on L_{eq}(1 hr)'s during the Friday evenings was 4.1 dBA, while during the Saturday evenings, it was 5.4 dBA..

3.3 Effects of Cruise Ship-Related Activities on Daily Average Noise Exposures

Figures A.1 through A.8 have presented the noise levels histories at each monitoring site in 15-minute intervals. While useful in revealing patterns of variation in short-term average noise levels over the 24-hour day, these histories do not lend themselves to the convenient discussion of noise impacts nor comparison to local, national or international community noise guidelines. To facilitate such comparisons, Table 3.2 presents longer-term average noise exposures measured at the four monitoring sites. These are the Daytime Equivalent Sound Level, or L_d, the Nighttime Equivalent Sound Level, or L_n, the 24-hour Equivalent Sound Level, or L_{eq}(24), and the Day-Night Average Sound Level (DNL), or L_{dn}. Daytime extends from 07:00 AM to 10:00 PM, while nighttime extends from 10:00 PM to 07:00 AM. Finally, to reflect the greater

Site No.	**Difference in 1-Hour Leq's During Evening Hours With and Without Cruise Ships (dBA)**					
	Friday Evenings			**Saturday Evenings**		
	Minimum	**Maximum**	**Average**	**Minimum**	**Maximum**	**Average**
1	1.6	6.5	**4.8**	2.9	8.2	**5.8**
2	2.5	6.9	**5.5**	5.0	8.7	**6.5**
3	0.9	6.5	**3.1**	2.8	8.8	**5.0**
4	0.7	6.0	**3.0**	3.4	5.3	**4.3**
Average	**1.4**	**6.5**	**4.1**	**3.5**	**7.8**	**5.4**

Table 3.1; Differences in 1-Hour Equivalent Sound Levels obtained during the evenings of Friday and Saturday September 2 and 3, 2011 (with cruise ships) and Friday and Saturday, October 14 and 15, 2011 (without cruise ships).

potential for disturbance associated with noise occurring at night, in calculating the L_{dn}, a 10 dBA penalty is applied to all noise levels measured between 10:00 PM and 07:00 AM. The L_{dn} is therefore always numerically higher than the corresponding $L_{eq}(24)$, and the more nighttime noise, the greater this difference. The following sections discuss the effects of cruise ship/tourism-related activities on the various daily-average noise exposures at each site.

Site 1 – 215 Quebec Street

Table 3.2 shows that the greatest effects of cruise ship-related activities[4] on noise exposures at Site 1 occurred during the nighttime when with-cruise ship L_n's exceeded without-cruise ship L_n's by approximately 4.5 dBA. This is largely due to increased noise levels between 10 and 11:30 PM. During the 15 daytime hours, the effect of cruise ship-related activities was about 2 dBA. Effects on the $L_{eq}(24)$'s and L_{dn}'s at Site 1 were between those on the L_d's and L_n's.

Site 2 – 21 Dallas Road

At Site 2 the greatest effects of cruise ship-related activities on noise exposures also occurred during the nighttime (between 10 and 11:30 PM). On the Friday-Saturday and Saturday-Sunday monitoring sessions, with-cruise ship L_n's exceeded without-cruise ship L_n's by 3.8 and 4.8 dBA respectively. During daytime hours, the effects of cruise ship-related activities were about 2.7 dBA on both days. Effects on $L_{eq}(24)$'s and L_{dn}'s were again between those on the L_d's and L_n's.

[4] It should be noted that the observed increases in noise exposures between cruise ship and non-cruise ship periods, may not be entirely due to cruise-ship related activities, as tourism-related activities levels in general would be expected to have decreases somewhat between the early September and mid-October monitoring periods.

Site 3 – 104 Dallas Road

At Site 3, the greatest effects of cruise ship-related activities on noise exposures were again during the nighttime. However, at 2.8 and 3.7 dBA, the effects on L_n's were numerically smaller than at Sites 1 and 2. During daytime hours, the effect of cruise ship-related activities on the L_d was only 0.2 dBA between Friday and Saturday but was 2.2 dBA between Saturday and Sunday. The effects of these activities on the $L_{eq}(24)$'s and L_{dn}'s were again between those on the L_d's and L_n's.

Site 4 - 558 Dallas Road

At Site 4, the greatest effects of cruise ship-related activities on noise exposures were again during the nighttime. However, at 1.6 and 2.8 dBA, the effects on L_n's were smaller than at Sites 1, 2 and 3. During daytime hours, the effect of cruise ship-related activities on the L_d was 1.2 dBA between Friday and Saturday but only 0.3 dBA between Saturday and Sunday. The effects of these activities on the $L_{eq}(24)$ and L_{dn} for the Friday to Saturday period were again between those on the L_d's and L_n's. However, during the Saturday to Sunday period, the effect on the $L_{eq}(24)$ was only 0.7 dBA while that on the L_{dn} was 1.7 dBA.

Site No./ Address	Condition	Ld (dBA)		Ln (dBA)		Leq(24) (dBA)		Ldn (dBA)	
		Fri – Sat	Sat - Sun	Fri - Sat	Sat – Sun	Fri - Sat	Sat – Sun	Fri – Sat	Sat - Sun
1 215 Quebec Street	With Cruise Ships	59.1	59.6	54.8	55.2	57.9	58.4	62.1	62.6
	Without Cruise Ships	56.9	57.7	50.4	50.7	55.0	56.1	59.9	59.1
	Difference	**2.2**	**1.9**	**4.4**	**4.5**	**2.9**	**2.3**	**2.2**	**3.5**
2 21 Dallas Road	With Cruise Ships	60.9	60.7	54.3	55.3	59.4	59.4	62.5	63.0
	Without Cruise Ships	58.3	58.0	50.5	50.5	56.6	56.4	59.3	59.1
	Difference	**2.7**	**2.7**	**3.8**	**4.8**	**2.8**	**3.0**	**3.2**	**3.9**
3 104 Dallas Road	With Cruise Ships	63.0	63.9	57.1	58.3	61.6	62.6	65.0	66.1
	Without Cruise Ships	62.8	61.7	54.3	54.6	61.1	60.0	63.4	63.0
	Difference	**0.2**	**2.2**	**2.8**	**3.7**	**0.5**	**2.5**	**1.6**	**3.1**
4 558 Dallas Road	With Cruise Ships	61.7	61.3	54.8	55.4	60.2	59.9	63.1	63.4
	Without Cruise Ships	60.5	61.0	53.2	52.6	58.9	59.2	61.7	61.7
	Difference	**1.2**	**0.3**	**1.6**	**2.8**	**1.3**	**0.7**	**1.4**	**1.7**

Table 3.2; Summary of Daytime and Nighttime Equivalent Sound Levels, 24-Hour Equivalent Sounds Levels and Day-Night Average Noise Levels Measured at the Four Noise Monitoring Sites.

4.0 RESULTS OF ATTENDED NOISE MONITORING

4.1 Attended Noise Monitoring Schedule

The schedule of attended noise monitoring sessions was provided in Table 2.1. It is seen that four attended monitoring sessions of between 30 and 60 minutes duration were conducted at each of the four monitoring sites, with one session being completed on each of September 2 and 3, and October 14 and 15, 2011. All attended monitoring session commenced between 16:00 and 19:00 hours (4 and 7 PM). The intent in selecting these start times was to include a period well before the scheduled cruise ship arrival and another two hours after the arrival. At the time of the September 2011 monitoring it was understood that the anticipated arrival time of the first cruise ship each evening was 6 PM. In fact, on the evening of September 2 cruise ships docked at Ogden Point at 6:11 and 6:34 PM, while on September 3, cruise ships docked at 5:32, 6:37 and 6:52 PM.

During these attended monitoring sessions, the field engineer logged all significant noise events and noted the source of each event. The most frequently observed categories of noise sources included buses, trucks, shuttle buses (Airporters), motorcycles, seaplanes, helicopters, sports cars, boom cars, scooters and ship horns. The surface vehicle movements most directly related to the cruise ship industry are those of tour (highway) buses, shuttle buses and taxis. Taxis, while more numerous, individually contribute much less noise than buses, so that the focus here will be on the numbers of buses observed during the attended noise monitoring.

4.2 Numbers and Types of Buses Observed During Attended Noise Monitoring

Tables 4.1 through 4.4 show the types and numbers of bus movements observed during each attended monitoring session at each of the four sites. Comparing the data from these four tables it is seen that, even on the evenings of Sept. 2 and 3, when two and three cruise ships respectively were docked at Ogden point, there was substantial variation in the numbers of buses observed at the four monitoring sites. The bottom rows of these tables show the rates of bus movements at each site, expressed in movements/hour. During cruise ship season, this rate varied from a low of 2.4 per hour at Site 4 between 5:00 and 5:50 PM on September 2 (before the first cruise arrived), to a high of 42 per hour at Site 4 between 6:04 and 6:51 PM on September 3. The average rate of bus movements over the four monitoring sites and the two days in September was 16.5 per hour. By comparison, in October, after the cruise ship season and the tourist season generally, had ended, bus movement rates had been reduced to between 0 and 2 movements per hour at all four sites.

Bus Type	September 2 (7:06 to 7:58 PM)	September 3 (4:04 to 4:51 PM)	October 14 (3:50 – 4:27 PM)	October 15 (6:10 – 6:37 PM)
Cruise Victoria	6	0	0	0
Pacific Coach	2	1	0	0
Greyhound	1	0	0	0
Victoria Sightseeing	0	5	0	0
VTC	0	2	0	0
Horizon	0	1	0	0
Double-Decker	0	1	0	0
Unmarked/Other	5	3	1	0
Total	**14**	**13**	**1**	**0**
Movements/Hr.	**16.2**	**16.6**	**1.3**	**0**

Table 4.1; Tour Bus Movements Observed during Attended Monitoring at Site 1, 215 Quebec Street. (Note; Cruise ships arrived at 6:11 and 6:34 PM on Sept. 2 and at 5:32, 6:37 and 6:52 PM on Sept. 3, 2011)

Bus Type	September 2 (4:00 to 4:50 PM)	September 3 (7:08 to 7:59 PM)	October 14 (4:43 – 5:29 PM)	October 15 (5:31 – 6:03 PM)
Cruise Victoria	0	11	1	0
Pacific Coach	0	2	0	1
Greyhound	1	1	0	0
Victoria Sightseeing	3	0	0	0
VTC	1	0	0	0
Horizon	1	0	0	0
Grayline	1	0		
West Coast Sightseeing	1	0	0	0
Wilson (school)	0	3	0	0
Unmarked/Other	1	2	0	0
Total	**9**	**19**	**1**	**1**
Movements/Hr.	**11.5**	**22.4**	**1.3**	**1.9**

Table 4.2; Tour Bus Movements Observed during Attended Monitoring at Site 2, 21 Dallas Road. (Note; Cruise ships arrived at 6:11 and 6:34 PM on Sept. 2 and at 5:32, 6:37 and 6:52 PM on Sept. 3, 2011)

Bus Type	September 2 (6:00 to 6:50 PM)	September 3 (5:05 to 5:55 PM)	October 14 (5:40 – 6:14 PM)	October 15 (3:55 – 4:41 PM)
Pacific Coach	2	1	1	0
Victoria Sightseeing	1	0	0	0
Universal Coach	1	0	0	0
Charter Tours	0	0	0	1
Horizon	0	1	0	0
Stage Tours	0	1	0	0
Wilson (school)	0	3	0	0
Unmarked/Other	1	6	0	0
Total	**5**	**12**	**1**	**1**
Movements/Hr.	**6.0**	**14.4**	**1.8**	**1.3**

Table 4.3; Tour Bus Movements Observed during Attended Monitoring at Site 3, 104 Dallas Road. (Note; Cruise ships arrived at 6:11 and 6:34 PM on Sept. 2 and at 5:32, 6:37 and 6:52 PM on Sept. 3, 2011)

Bus Type	September 2 (5:00 to 5:50 PM)	September 3 (6:04 to 6:51 PM)	October 14 (6:23 – 6:41 PM)	October 15 (4:51 – 5:20 PM)
Trafalgar	1	0	0	0
Cruise Victoria	0	8	0	0
Horizon	0	2	0	0
Wilson	0	16	0	0
Wilson (school)	0	4	0	0
Unmarked/Other	1	3	0	0
Total	**2**	**33**	**0**	**1**
Movements/Hr.	**2.4**	**42.1**	**0**	**1.3**

Table 4.4; Tour Bus Movements Observed during Attended Monitoring at Site 4, 558 Dallas Road. (Note; Cruise ships arrived at 6:11 and 6:34 PM on Sept. 2 and at 5:32, 6:37 and 6:52 PM on Sept. 3, 2011)

5.0 RELEVANT COMMUNITY NOISE GUIDELINES

5.1 Introduction

To assess the significance of the observed effects of cruise ship-related surface traffic on the community noise environment around the western perimeter of James Bay, it is useful to compare these effects with relevant community noise guidelines and regulations. These guidelines and regulations exist at local (municipal), federal and international levels. The following sections introduce what are felt to be three relevant sources of such guidance, the first being the City of Victoria's Noise Bylaw No. 03-12, the second being Health Canada's "National Guidelines for Environmental Noise Control", and the third being the World Health Organization's (WHO) "Guidelines for Community Noise".

5.2 City of Victoria Noise Bylaw No. 03012

In 2004, the City of Victoria introduced a quantitative noise bylaw to set limits for noise created within one property and received at an adjacent property. Under this bylaw, the city is divided into four Noise Districts that reflect the general sensitivity of the occupants of these districts to intrusive noise. The four districts are Quiet, Intermediate, Harbour Intermediate and Activity. Quiet Districts are primarily single family residential neighbourhoods such as Rockland, Fairfield, Fernwood and the central and eastern portions of James Bay. Intermediate Districts include the downtown commercial core, much of Vic West, and the portions of James Bay adjacent to the Inner Harbour and the Ogden Point Waterfront. Harbour Intermediate District is limited to the redeveloping lands along the western shore of the Upper Harbour (principally the Railyards and Dockside Green developments) while the Activity District includes the Rock Bay light Industrial area, the Point Hope Shipyards and the Ogden Point Waterfront. Three of the four monitoring sites in this study (Sites 1, 2 and 3) are located within an Intermediate District, while Site 4 is located within a Quiet District.

The noise limits contained in Bylaw 03-12 apply principally to fixed sources of noise such as industrial processes, heating and ventilating equipment, hot tubs etc., and specifically do not apply to noise generated by marine, air or surface traffic. However, it is useful in gaining perspective, to compare these limits with the noise levels to which James Bay residents currently are exposed due largely to these various transportation noise sources. The relevant noise limits for noise generated in an Activity District such as Ogden Point and received in an Intermediate District such as James Bay west, are L_{eq} 65 dBA in the daytime and L_{eq} 60 dBA at night. For Site 4 located in a Quiet District, the limits for noise generated within an Activity District are 60 dBA daytime and 55 dBA nighttime, while for noise generated within a Quiet District, they are 55 dBA daytime and 45 dBA nighttime.

5.3 Health Canada Guidelines

In 1989, the Federal-Provincial Advisory Committee on Environmental and Occupational Health within Health and Welfare Canada, drafted national Guidelines for Environmental noise Control. These guidelines were intended to assist lower levels of government in drafting environmental noise regulations and bylaws. While somewhat dated, this document still provides the only national guidance available in Canada which addresses community noise from all sources. It sets thresholds for generally acceptable levels of noise as received in various outdoor and indoor locations and provides a scale for use in describing the seriousness of community noise impact situations. This guidance focuses on the noise environments in suburban residential neighbourhoods and does not account for any effects that the generally elevated noise exposures found in more urban residential neighbourhoods may have on the inherent intrusiveness of noise from the particular source of interest. The relevant noise thresholds from the Health Canada document are for suburban outdoor areas and are L_{eq} 55 dBA between 7:00 AM and 11:00 PM (daytime and evening) and L_{eq} 50 dBA between 11:00 PM and 07:00 AM (nighttime).

Where these HC noise thresholds are exceeded by up to 5 dBA, a “slight noise problem” is considered to exist, by 6 to 10 dBA, a “definite noise problem”, by 11 to 15 dBA a “serious noise problem” and by 16 dBA or more, a “very serious noise problem” exists. Mitigation is recommended progressively more emphatically for the “definite”, “serious” and “very serious” categories.

5.4 World Health Organization

In 1999, the World Health Organization (WHO) issued Guidelines for Community Noise in which it identified threshold levels for the avoidance of negative health effects due to noise in the community. Note that these “protective” thresholds, at least for residents with sensitivities to noise within the normal range. In regards to general community noise exposure, the WHO suggests outdoor noise thresholds of L_{eq} 55 dBA to avoid serious annoyance and L_{eq} 50 dBA to avoid moderate annoyance. The WHO guidelines also include thresholds for the avoidance of sleep disturbance in bedrooms of L_{eq} 30 dBA for steady noise and of L_{max} 45 dBA for intermittent noises. The latter limit is particularly relevant when considering the impacts of the noise from heavy truck or bus pass-bys upon residents living adjacent to arterial roadways.

6.0 IMPACTS OF CRUISE SHIP-RELATED TRAFFIC NOISE

6.1 Impacts of Cruise Ship-Related Traffic on Average Noise Exposures

Effects on Daytime Noise Exposures, L_d’s

Table 3.1 has shown that, between October 14 and 16, when there was no cruise ship activity, equivalent sound levels in the daytime, i.e., the L_d’s, at the four monitoring sites ranged from 56.9 to 62.8 dBA with an average value of 59.6 dBA. These levels then exceed the protective threshold for daytime noise exposures in suburban residential areas of 55 dBA as identified by Health Canada and the WHO, but are below the Victoria noise bylaw’s daytime limit of 65 dBA for noise originating in an Activity District and received in an Intermediate District (i.e., Sites 1,2 and 3). At 60.5 and 61.0 dBA, the L_d’s at Site 4 (in a Quiet District) without cruise ships just exceeded the daytime bylaw limit of 60 dBA for noise originating in an Activity District.

With the introduction of cruise-ship activity between September 2 and 4, the range of L_d’s was shifted upwards to 59.1 to 63.9 dBA with an average value of 61.3 dBA. The apparent effect of cruise ship-related activities was then to increase daytime average noise exposures at the four sites by an average of 1.7 dBA. The “apparent” qualifier is applied because it is expected that some portion of this additional daytime noise was created by tourist activities not associated with the cruise-ship industry.

An average noise level increase of 1.7 dBA corresponds roughly to a 13% increase in the perceived loudness or noisiness of the acoustic environment. While not a dramatic change in noise nor a readily apparent one if occurring from one day to the next, it does raise daytime noise exposures at all sites somewhat further above the Health Canada/WHO threshold of 55 dBA.

Effects on Nighttime Noise Exposures, L_n's

Table 3.1 shows that between October 14 and 16, when there was no cruise ship activity, equivalent sound levels during the nighttime, i.e., the L_n's, ranged from 50.4 to 54.6 dBA with an average value of 52.1 dBA. These levels then exceed the threshold for nighttime noise exposures in residential areas of 50 dBA as identified by Health Canada, but are well below the Victoria noise bylaw's nighttime limit of 60 dBA for noise originating in an Activity District and received in an Intermediate District (i.e., Sites 1, 2 and 3). At 53.2 and 52.6 dBA, the L_n's at Site 4 (in a Quiet District) without cruise ships are just below the nighttime bylaw limit of 55 dBA for noise originating in an Activity District.

With the introduction of cruise-ship activity between September 2 and 4, the range of L_n's was shifted upwards to 54.3 to 58.3 dBA with an average value of 55.7 dBA. The apparent effect of cruise ship-related activities was then to increase nighttime average noise exposures at the four sites by an average of 3.6 dBA. The "apparent" qualifier is applied because the possibility cannot totally be excluded that some of the additional nighttime noise between September 2 and 4 was due to tourist activities not related to cruise ships. However, if we examine the noise levels histories presented in Figures A.1 to A.8, it is seen that, during the afternoons, prior to the arrival of cruise ships at generally between 6 and 7 PM, there was little consistent difference between noise levels on with and without-cruise ship days. This suggests that cruise ship-related ground transportation activities were the predominant cause of increased noise exposures during the evening and early nighttime hours of September 2 and 3.

An increase in average nighttime noise levels of 3.6 dBA corresponds to roughly a 28% increase in the perceived loudness or noisiness of the acoustic environment. While representing a low-to-moderate change in noise environment when averaged over the nine nighttime hours, this 3.6 dBA effect raises nighttime noise exposures further above the Health Canada nighttime threshold level of 50 dBA.

Effects on Evening Noise Exposures

The noise levels histories presented in Figures A.1 to A.8 have shown that the most significant increases in community noise exposures on days when cruise ships arrived at Ogden Point occurred between about 5:30 and 11:30 PM, that is largely during evening hours[5]. Some community noise metrics[6] apply a penalty to noise occurring during evening hours in recognition that residents are more likely to be at home during the evening and will generally be trying to relax, converse, read or listen to music, radio or television. Therefore, while intrusive noise

[5] Note that cruise-ship related traffic activity may begin about one hour before ship arrivals.

[6] addition to the 10 dBA penalty applied to nighttime noise levels in computing L_{dn}, some community noise metrics, like the Community Noise Equivalent Level (CNEL), or L_{den}, apply a 5 dBA penalty to noise occurring during evening hours (7 to 10 PM).

during the evening may not interfere directly with sleep for most residents, it will interfere with the quiet enjoyment of their homes. Increased noise during the late evening and early nighttime hours (10:00 PM to midnight) can also disrupt sleep and delay/prevent people from falling asleep.

Table 3.1 has shown that during the evenings, cruise ship-related activities increased L_{eq} (1 hr)'s at the four monitoring sites by an average of 4.1 dBA on Friday, September 2 and 5.4 dBA on Saturday September 4. During the busiest periods, cruise ship-related activities increased the Leq (1-hr)'s at the various sites by as much as 6.0 to 8.8 dBA, compared to the same time periods during the October 14 and 15 monitoring. Such maximal noise level increases correspond to subjective loudness or noisiness increases of between 50 to 85%.

6.2 Impacts of Individual Bus Noise Events

The discussions in Section 6.1 above dealt with the effects of cruise ship-related activities on average community noise exposures, either hourly or daily. It is also informative to look at the effects of individual noise events, in particular those associated with cruise ship-related bus traffic. Table 4.2 itemized the 28 bus movements observed during the attended noise monitoring conducted at Site 2 on September 2 and 3, 2011. The digital sound files created during these periods by the B&K 2250 sound analyzer were reviewed and the maximum noise level, or L_{max}, created during each bus movement was extracted from the associated sound level histories. This process revealed that bus-generated L_{max}'s at Site 2 ranged from 69.5 to 79.3 dBA with an average value of 74.3 dBA.

Typical bus pass-bys then created maximum levels of 74.3 dBA at the facade of the Shoal Point Condo (21 Dallas Road). Tightly closed double-glazed windows typically reduce traffic noise levels by 25 to 30 dBA so that the average bus pass-by noise levels inside a bedroom overlooking the street will then be in the 45 to 50 dBA range with windows closed. The noise reduction provided by windows left open slightly for ventilation is typically 10 to 15 dBA, so that maximum bus pass-bys noise levels indoors would tend to be in the 60 to 65 dBA range. Since, as introduced in Section 5.4, the WHO identified the protective threshold for sleep disturbance by intermittent noise events as L_{max} 45 dBA indoors, these bus pass-by noise events are all potentially sleep disrupting if windows are not tightly closed, and many events may be sleep disrupting even with windows tightly closed.

The relationship between sleep disturbance and the numbers of individual noise events experienced is complex since some habituation can occur with increasing numbers of events. However, for the numbers of events involved here, it is reasonable to assume that the overall potential for sleep disturbance, and for other forms of noise impact (e.g., speech interference, annoyance), will increase directly with the number of bus pass-bys occurring during the evening.

7.0 CONCLUSIONS

This noise study has found that the effect of cruise ship-related traffic on daily average noise exposures over two consecutive days at four residential monitoring locations along the James Bay waterfront has been to increase L_{eq}(24)'s by from 0.5 to 3.0 dBA and L_{dn}'s by from 0.7 to 3.9 dBA. These are minor to moderate noise increases, however, they come on top of daily average, without-cruise ship noise exposures that, at L_{eq}(24) 55 to 61 dBA and L_{dn} 59 to 63 dBA, already equal or exceed recognized noise thresholds for residential neighbourhoods.

Review of the cruise ship schedule for 2009 has revealed that, typically, 2 or 3 cruise ships arrive at Ogden Point each day. Occasionally four ships will dock during a single day but only three ships can be accommodated simulatneously. The noise generation effects of the additional traffic associated with a fourth ship would be incremental, corresponding to roughly a 1.2 dBA increase in average community noise levels during the period when the ships were in dock, compared to a 3 cruise ship day. The numbers of cruise-ship generated taxis and buses, and their associated individual noise events would, of course increase by about 33%.

During the specific periods that cruise ships are in dock at Ogden Point and their passengers are transported to and from Ogden Point in taxis and small and large buses, there are more significant increases in the noise exposures experienced by residents living along the routes used by these transportation services. During the 48-hour period from September 2 to 4, 2011 that continuous noise monitoring was conducted at four residential locations, a total of five cruise ships docked at Ogden Point. All cruise ships arrived between 5 and 7 PM and all appeared to have departed by midnight. During the intervening late afternoon and evening hours, the 1-hour average noise levels, or L_{eq}(1 hr)'s were increased by as much as 8.8 dBA, and by averages of 4.1 dBA (on Friday, September 2) and 5.4 dBA (on Saturday, September 3), when compared to the same periods on October 14 and 15 after cruise ship season had ended. These increases in hourly average noise levels of 4.1 to 8.8 dBA correspond to increases in the subjective loudness, or noisiness, of the acoustic environment of between 32% and 84%.

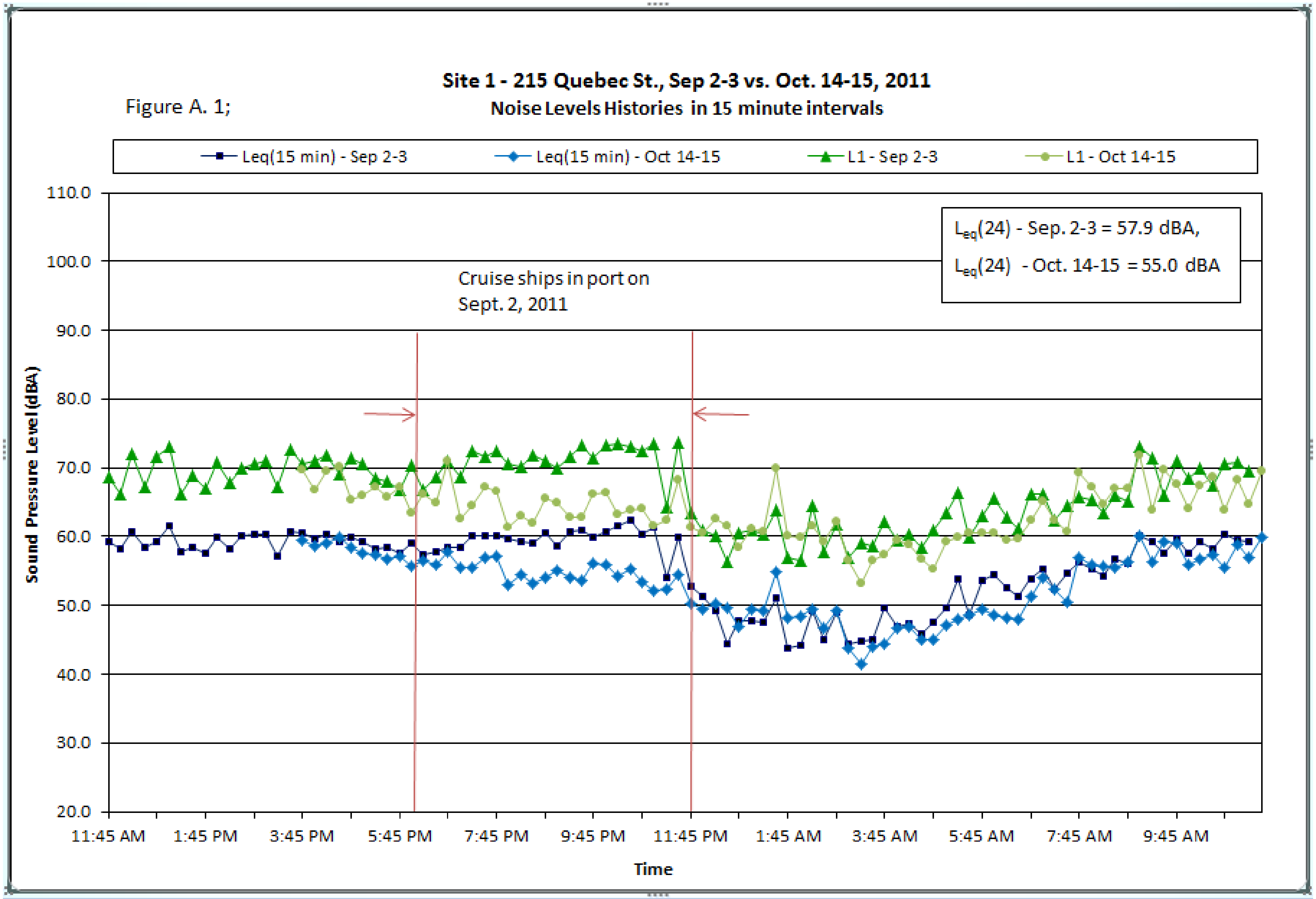
More specifically, community noise impacts associated with the Ogden Point cruise ship facility arise primarily from the passage of buses. The average numbers of buses observed travelling along Quebec Street, Erie Street and Dallas Road during the late afternoon and early evening attended noise monitoring sessions decreased from 16.5 per hour on September 2 and 3 to 0 to 2 per hour on October 15 and 16. Based on measurements made at Site 2 (21 Dallas Road), the average bus movement creates L_{max} 74.3 dBA at this residential façade. Such intermittent noise events are capable of interfering with speech communications outdoors (60 dBA or more) and with sleep and relaxation indoors (WHO sleep disturbance threshold, L_{max} 45 dBA).

The degree of impact which cruise ship-related traffic noise has on the James Bay community depends not only on the number of cruise ships that dock at Ogden Point each day and their associated traffic volumes, but also on their arrival and departure times. Community noise impacts could be moderated if: 1, cruise ship arrivals were scheduled so that peak noise generation hours did not extend into the late evening, and/or 2, technological or other approaches were used to reduce residential exposures to cruise ship passenger transport vehicle noise.

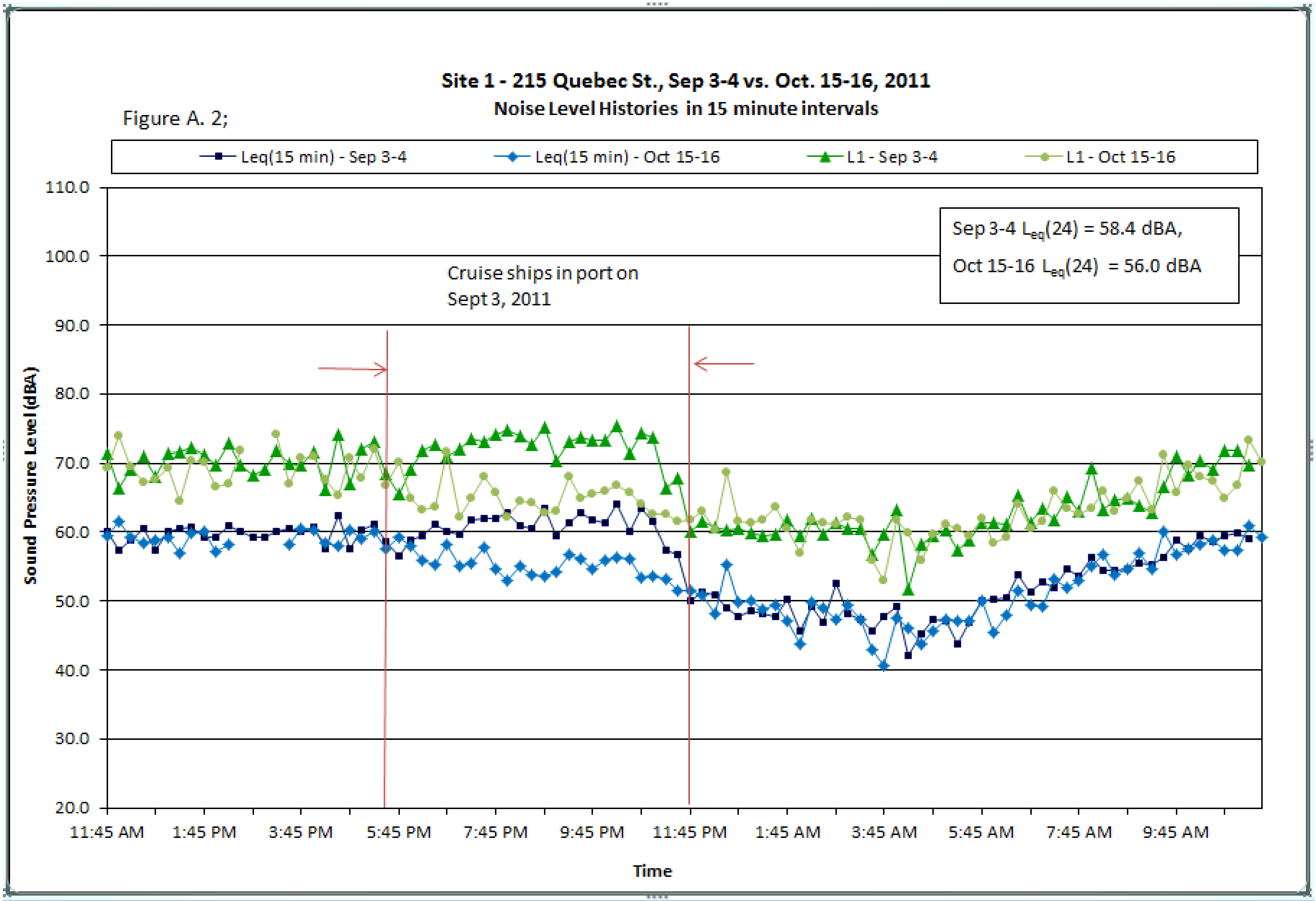
APPENDIX A

24-Hour Noise Level Histories

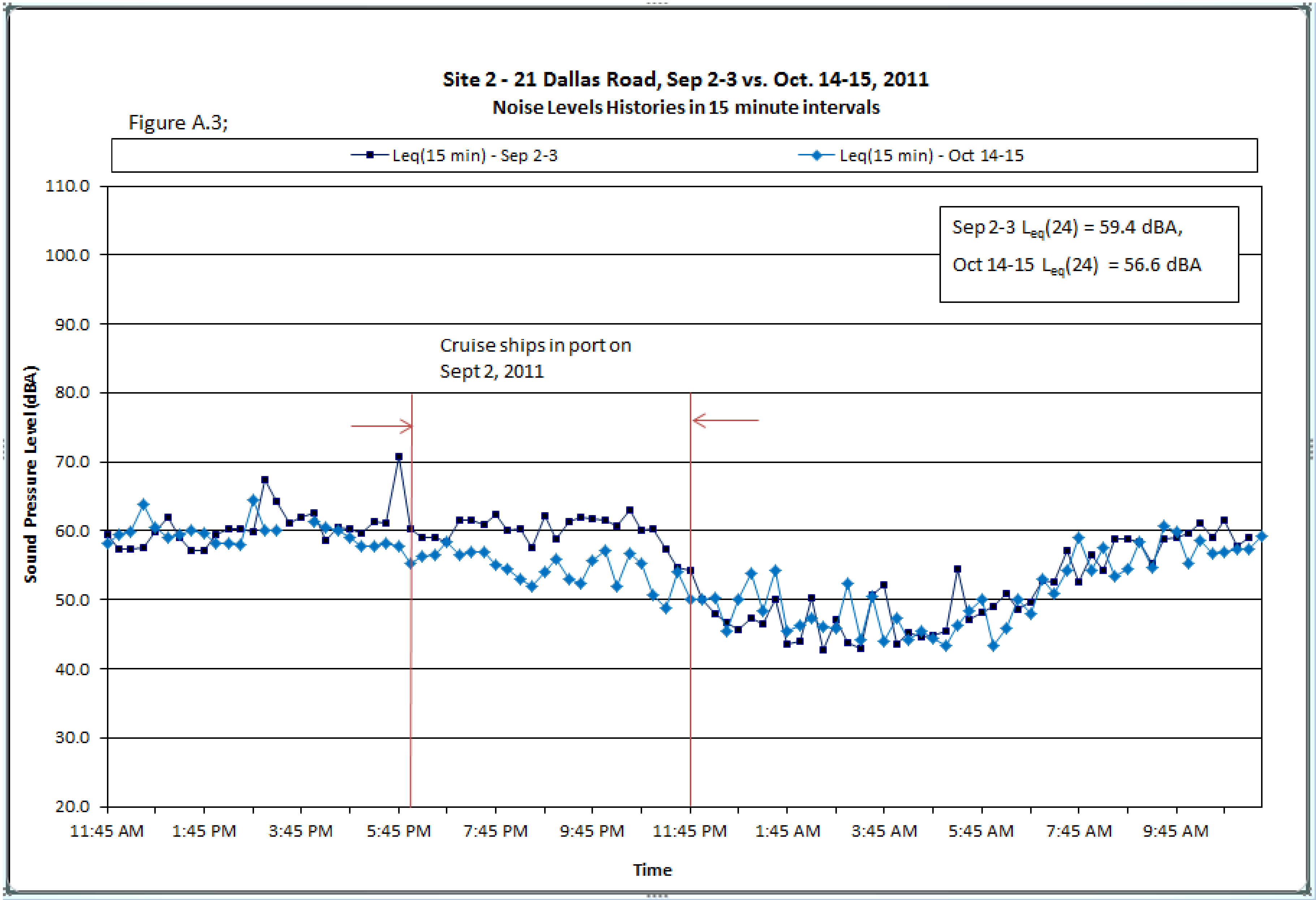
(Figures A.1 through A.8)

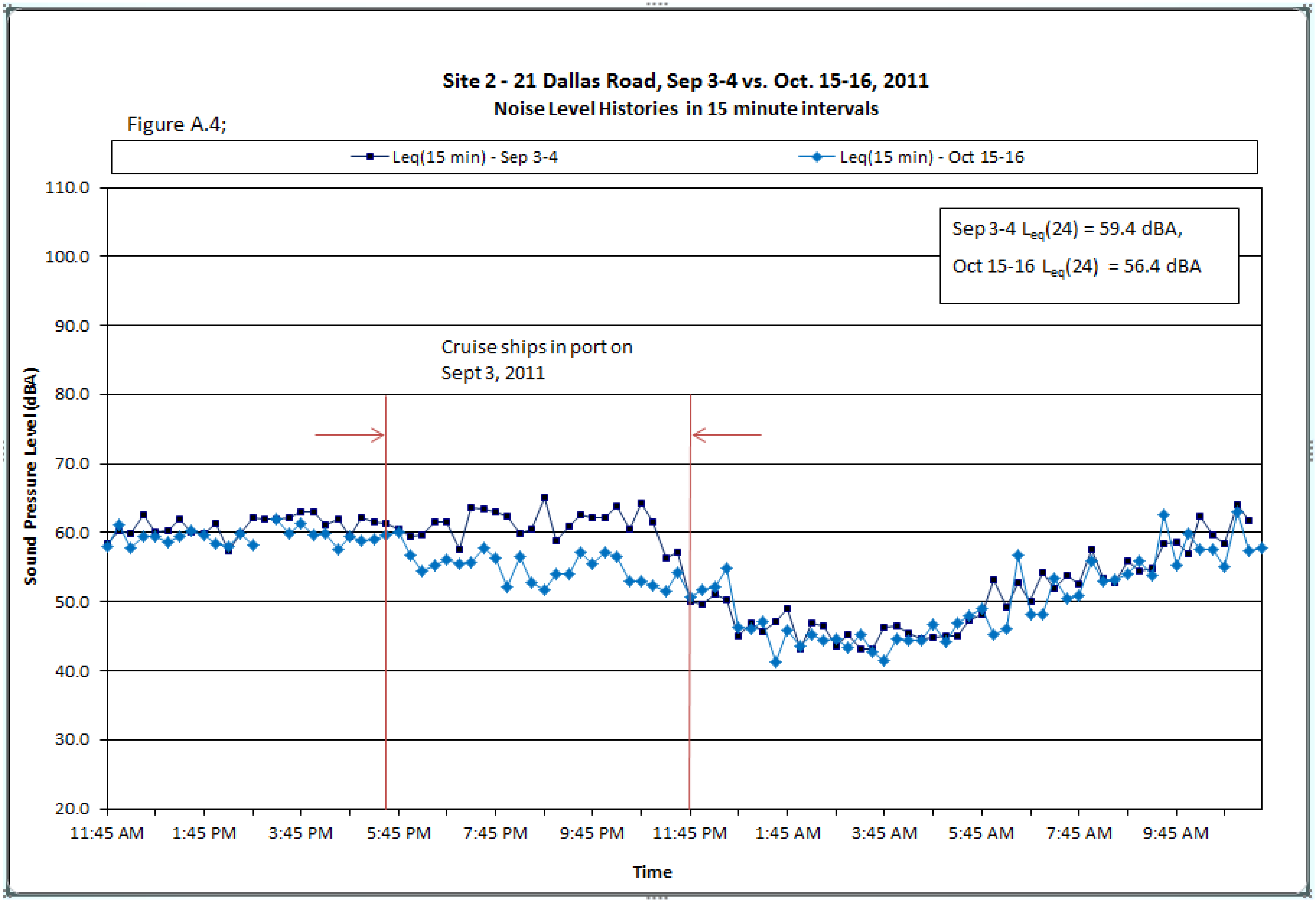


Site 1 - 215 Quebec St., Sep 2-3 vs. Oct. 14-15, 2011
Figure A. 1;
Noise Levels Histories in 15 minute intervals
Leq(15 min) - Sep 2-3
Leq(15 min) - Oct 14-15
L1 - Sep 2-3
L1 - Oct 14-15
L_{eq}(24) - Sep. 2-3 = 57.9 dBA,
L_{eq}(24) - Oct. 14-15 = 55.0 dBA
Cruise ships in port on
Sept. 2, 2011
Sound Pressure Level (dBA)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
11:45 AM
1:45 PM
3:45 PM
5:45 PM
7:45 PM
9:45 PM
11:45 PM
1:45 AM
3:45 AM
5:45 AM
7:45 AM
9:45 AM
Time

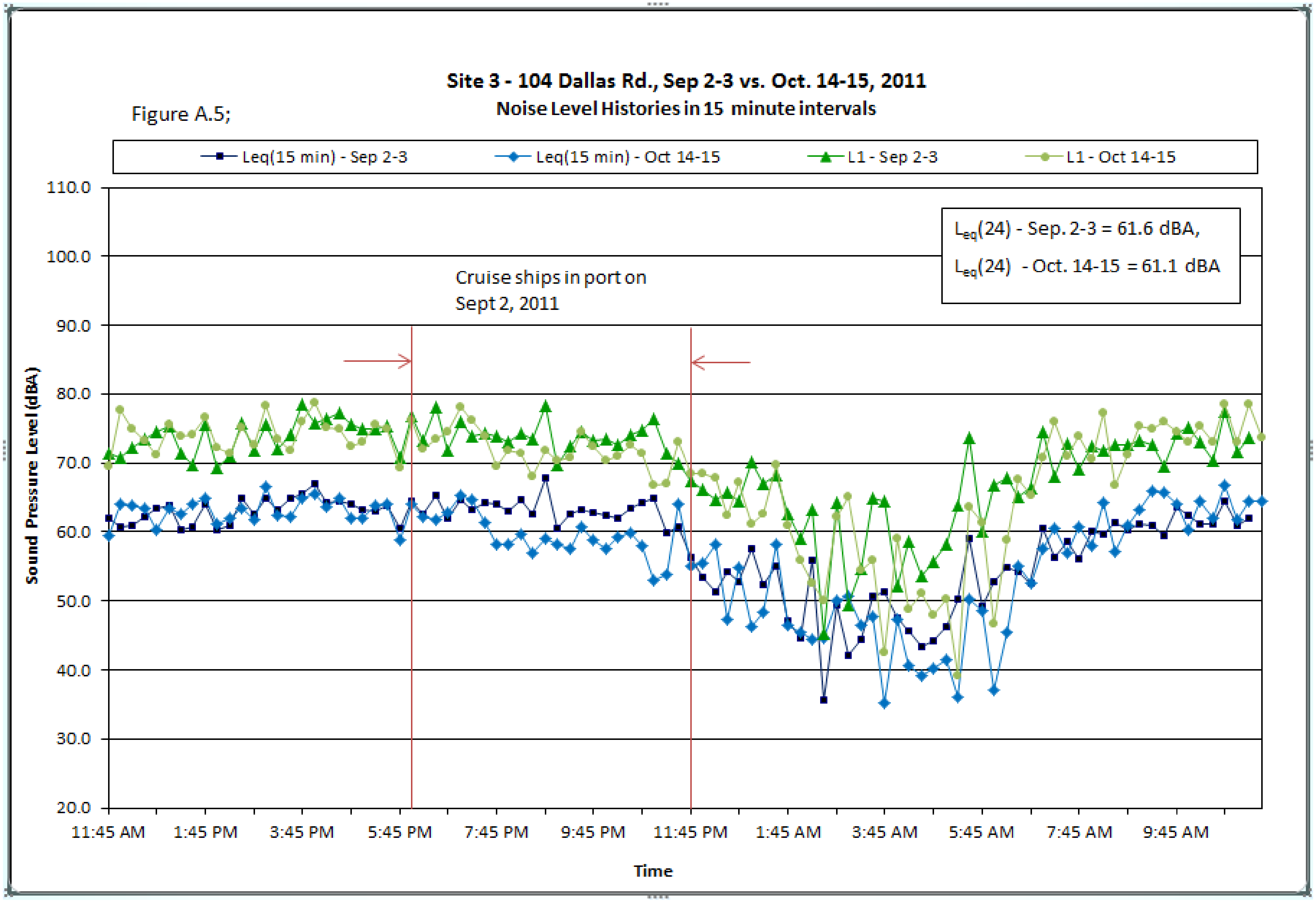


Site 1 - 215 Quebec St., Sep 3-4 vs. Oct. 15-16, 2011
Noise Level Histories in 15 minute intervals
Figure A. 2;
Leq(15 min) - Sep 3-4
Leq(15 min) - Oct 15-16
L1 - Sep 3-4
L1 - Oct 15-16
Sep 3-4 $L_{eq}(24)$ = 58.4 dBA,
Oct 15-16 $L_{eq}(24)$ = 56.0 dBA
Cruise ships in port on
Sept 3, 2011
Sound Pressure Level (dBA)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
11:45 AM
1:45 PM
3:45 PM
5:45 PM
7:45 PM
9:45 PM
11:45 PM
1:45 AM
3:45 AM
5:45 AM
7:45 AM
9:45 AM
Time


Site 2 - 21 Dallas Road, Sep 2-3 vs. Oct. 14-15, 2011
Noise Levels Histories in 15 minute intervals
Figure A.3;
Leq(15 min) - Sep 2-3
Leq(15 min) - Oct 14-15
Sep 2-3 $L_{eq}(24)$ = 59.4 dBA,
Oct 14-15 $L_{eq}(24)$ = 56.6 dBA
Cruise ships in port on
Sept 2, 2011
Sound Pressure Level (dBA)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
11:45 AM
1:45 PM
3:45 PM
5:45 PM
7:45 PM
9:45 PM
11:45 PM
1:45 AM
3:45 AM
5:45 AM
7:45 AM
9:45 AM
Time

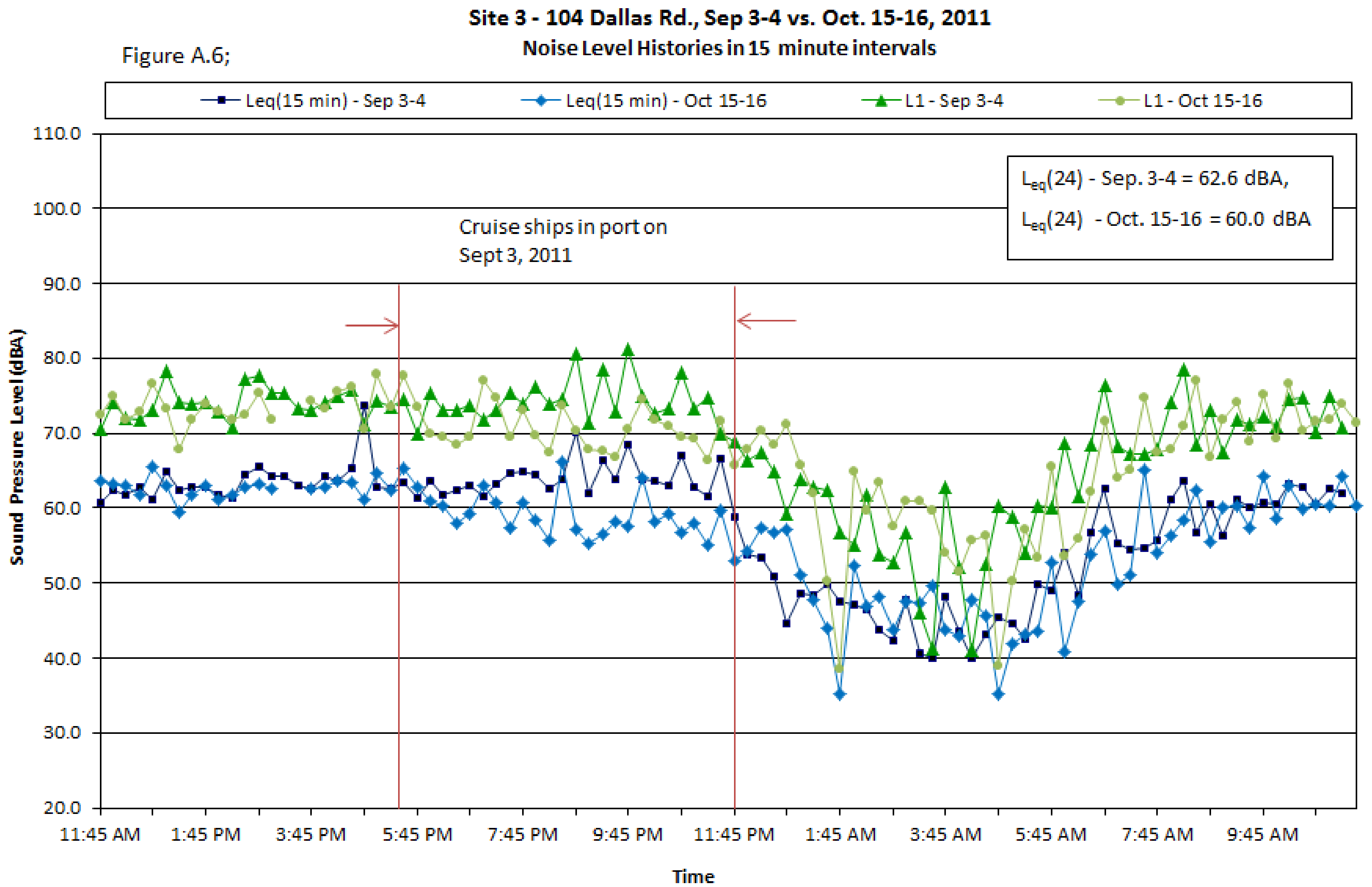


Site 2 - 21 Dallas Road, Sep 3-4 vs. Oct. 15-16, 2011
Noise Level Histories in 15 minute intervals
Figure A.4;
Leq(15 min) - Sep 3-4
Leq(15 min) - Oct 15-16
Sep 3-4 $L_{eq}(24)$ = 59.4 dBA,
Oct 15-16 $L_{eq}(24)$ = 56.4 dBA
Cruise ships in port on
Sept 3, 2011
Sound Pressure Level (dBA)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
11:45 AM
1:45 PM
3:45 PM
5:45 PM
7:45 PM
9:45 PM
11:45 PM
1:45 AM
3:45 AM
5:45 AM
7:45 AM
9:45 AM
Time

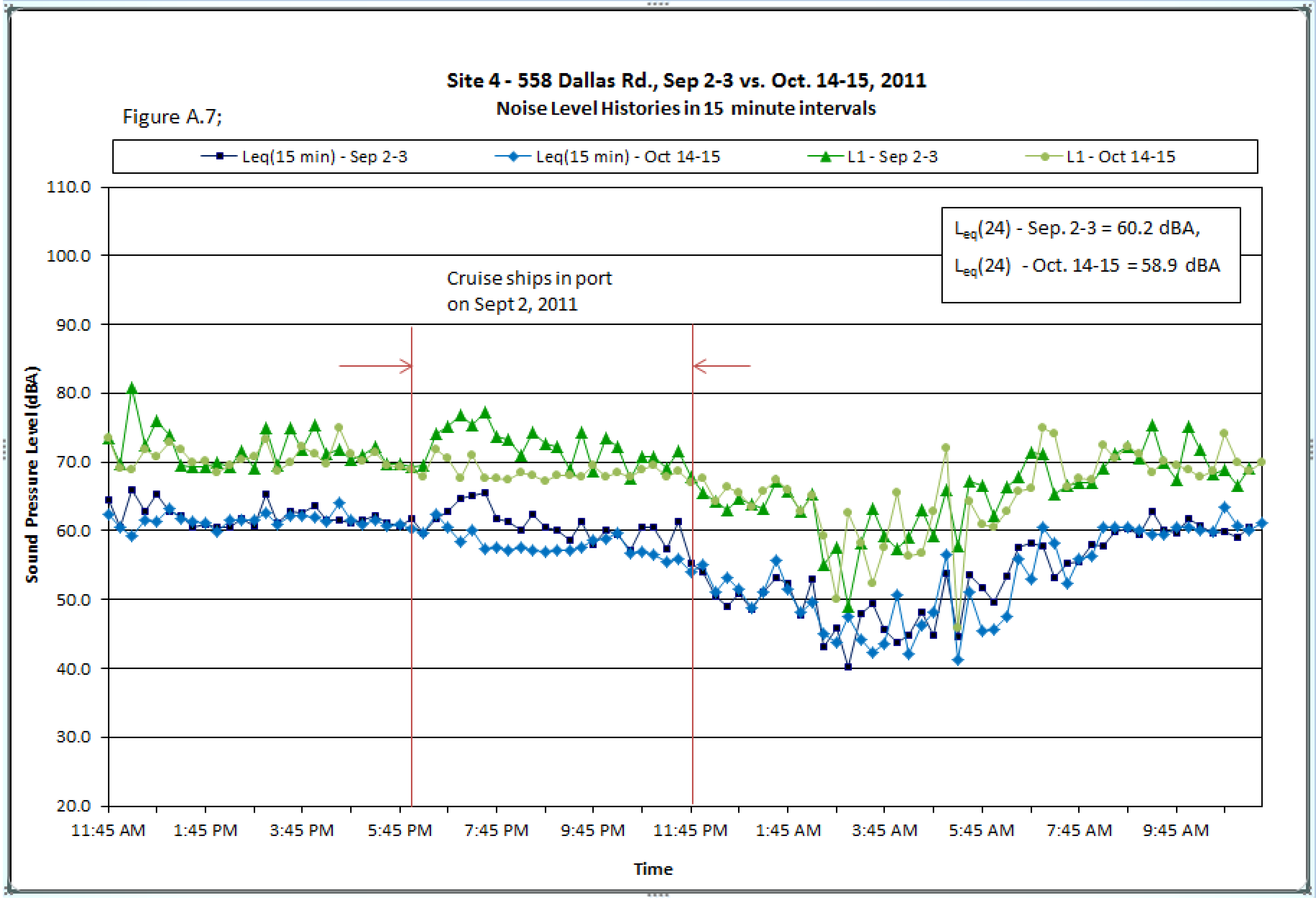


Site 3 - 104 Dallas Rd., Sep 2-3 vs. Oct. 14-15, 2011
Noise Level Histories in 15 minute intervals
Figure A.5;
Leq(15 min) - Sep 2-3
Leq(15 min) - Oct 14-15
L1 - Sep 2-3
L1 - Oct 14-15
Leq(24) - Sep. 2-3 = 61.6 dBA,
Leq(24) - Oct. 14-15 = 61.1 dBA
Cruise ships in port on
Sept 2, 2011
Sound Pressure Level (dBA)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
11:45 AM
1:45 PM
3:45 PM
5:45 PM
7:45 PM
9:45 PM
11:45 PM
1:45 AM
3:45 AM
5:45 AM
7:45 AM
9:45 AM
Time

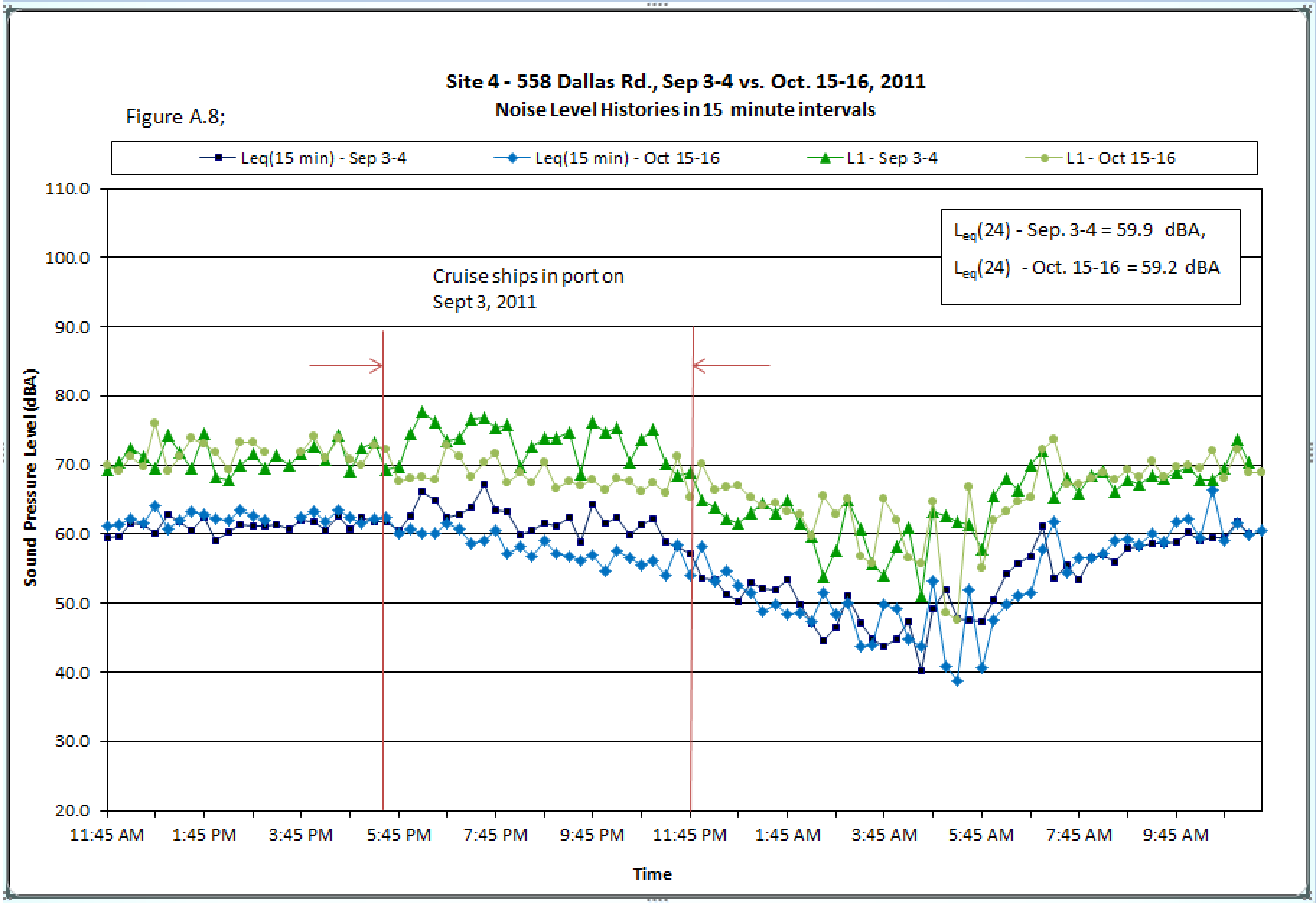
Figure A.6;



Site 3 - 104 Dallas Rd., Sep 3-4 vs. Oct. 15-16, 2011
Noise Level Histories in 15 minute intervals
Leq(15 min) - Sep 3-4
Leq(15 min) - Oct 15-16
L1 - Sep 3-4
L1 - Oct 15-16
Leq(24) - Sep. 3-4 = 62.6 dBA,
Leq(24) - Oct. 15-16 = 60.0 dBA
Cruise ships in port on
Sept 3, 2011
Sound Pressure Level (dBA)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
11:45 AM
1:45 PM
3:45 PM
5:45 PM
7:45 PM
9:45 PM
11:45 PM
1:45 AM
3:45 AM
5:45 AM
7:45 AM
9:45 AM
Time



Site 4 - 558 Dallas Rd., Sep 2-3 vs. Oct. 14-15, 2011
Noise Level Histories in 15 minute intervals
Figure A.7;
Leq(15 min) - Sep 2-3
Leq(15 min) - Oct 14-15
L1 - Sep 2-3
L1 - Oct 14-15
L_{eq}(24) - Sep. 2-3 = 60.2 dBA,
L_{eq}(24) - Oct. 14-15 = 58.9 dBA
Cruise ships in port
on Sept 2, 2011
Sound Pressure Level (dBA)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
11:45 AM
1:45 PM
3:45 PM
5:45 PM
7:45 PM
9:45 PM
11:45 PM
1:45 AM
3:45 AM
5:45 AM
7:45 AM
9:45 AM
Time



Site 4 - 558 Dallas Rd., Sep 3-4 vs. Oct. 15-16, 2011
Noise Level Histories in 15 minute intervals
Figure A.8;
Leq(15 min) - Sep 3-4
Leq(15 min) - Oct 15-16
L1 - Sep 3-4
L1 - Oct 15-16
Leq(24) - Sep. 3-4 = 59.9 dBA,
Leq(24) - Oct. 15-16 = 59.2 dBA
Cruise ships in port on
Sept 3, 2011
Sound Pressure Level (dBA)
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
11:45 AM
1:45 PM
3:45 PM
5:45 PM
7:45 PM
9:45 PM
11:45 PM
1:45 AM
3:45 AM
5:45 AM
7:45 AM
9:45 AM
Time

APPENDIX B

SOUND AND NOISE IN THE COMMUNITY - "THE 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 often referred to as "***unwanted sound".*** It is unwanted because it interferes with human activities and/or creates annoyance. The perception of sound as "noise" is then largely a personal or subjective matter depending on the situation, the activities engaged in and individual attitudes and sensitivity.

Principal Community Noise Level Descriptors

The principal descriptor of the baseline community noise environment provided by the monitoring is the ***24-hour Equivalent 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. This, and most other community noise descriptors are expressed in units of A-weighted decibels, or dBA.

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. 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.

Sound Levels Created by Common Noise Sources in the Home and Community

See the graphic (Figue 1) on the next page.

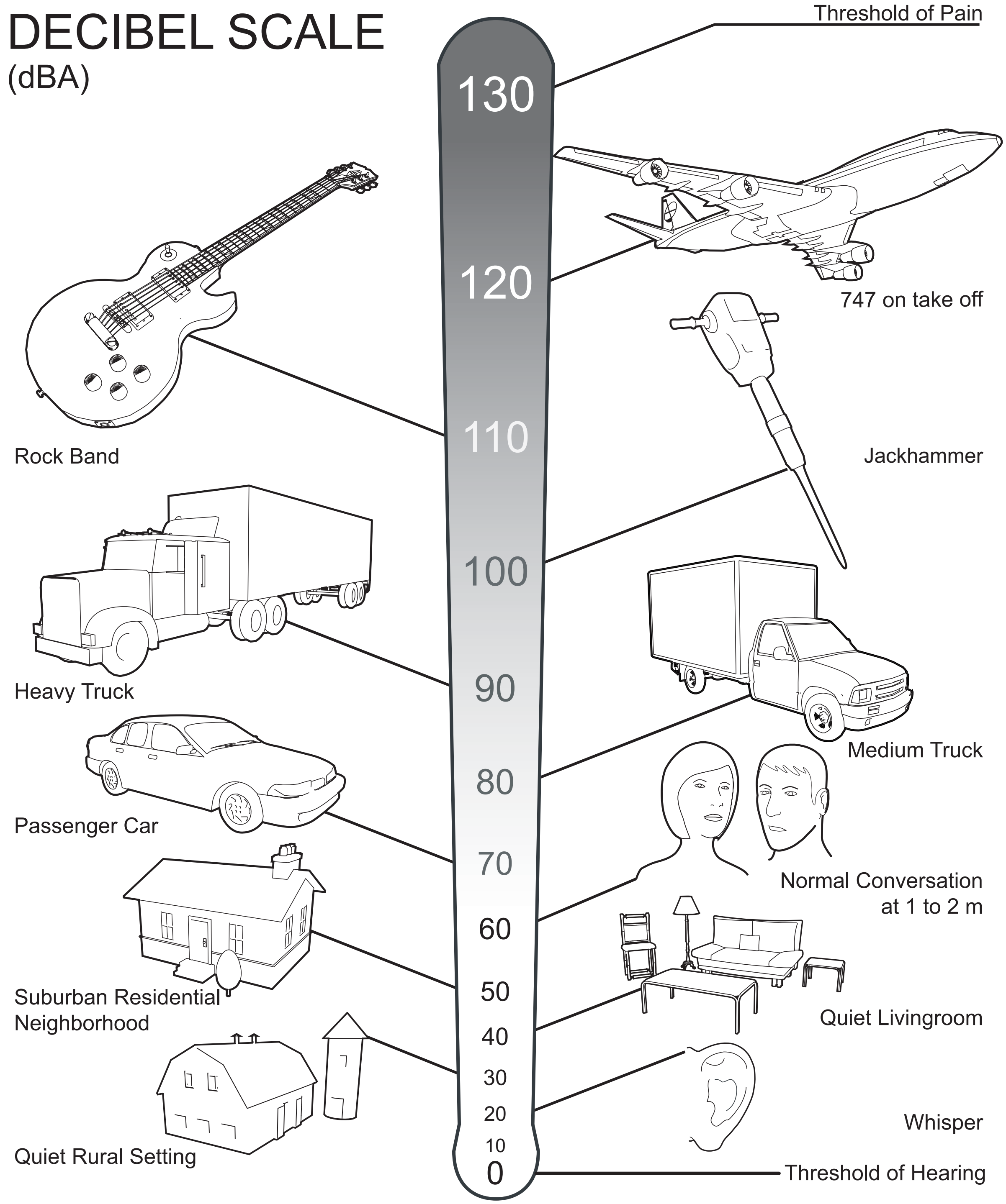


Figure 1: Decibel Scale- Showing sound levels typically created by familiar sources of noise in the home and community