Appendix A
Meeting Agenda

Billy Bishop Toronto City Airport
Noise Sub Committee Meeting 12

Wednesday January 27th, 2020
7:00 pm to 8:30 pm
Zoom Meeting (Online)

AGENDA

7:00 Agenda Review and Updates

- NMSC Meeting Minutes publication

7:15 Noise Comparison from Pre-COVID and COVID (Michael MacWilliam)

7:30 Permanent Noise Management Terminal update (Michael MacWilliam)

7:40 Ground Noise Study update (Michael David and Colin Novak)

8:10 Discussion of approach to:

- Learning more about DBA versus DBZ and whether Airport Noise Reports can report out using these scales;
- Understanding the noise characteristics of the airport ferry based on the bass rumbling that is produced; and
- Learning about the aircraft noise certification protocols through ICAO.

8:30 Adjourn

Appendix B
Pre and Post COVID Levels 2019 vs. 2020

Pre and Post COVID Levels 2019 vs. 2020

Date: January 27, 2021

Presented By: M. MacWilliam

Location: Zoom Conference

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

Agenda

- 2019 – 3 NMT Locations
- 2020 – 4 NMT Locations
- LDEN Change 2019 vs. 2020
- Individual Month Charts

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

NMT Locations 2020

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

2019

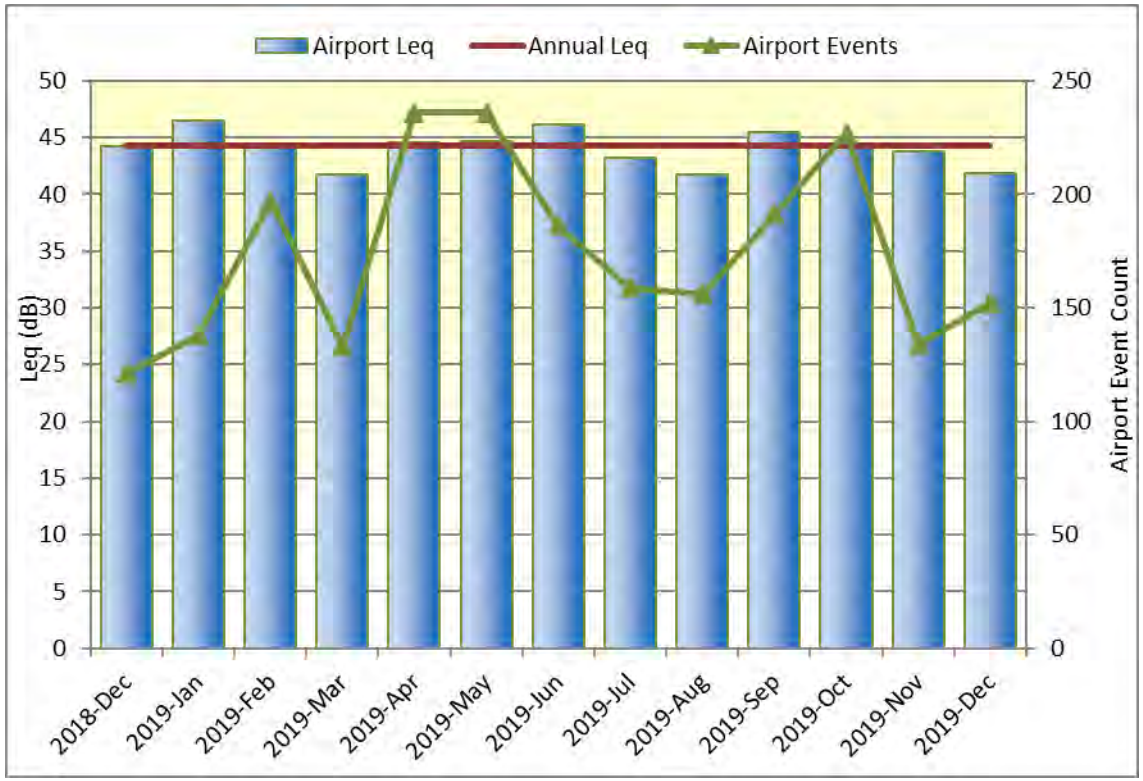
Fire Station

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

2019

Police Station



PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

2019

Terminal Building

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

2020

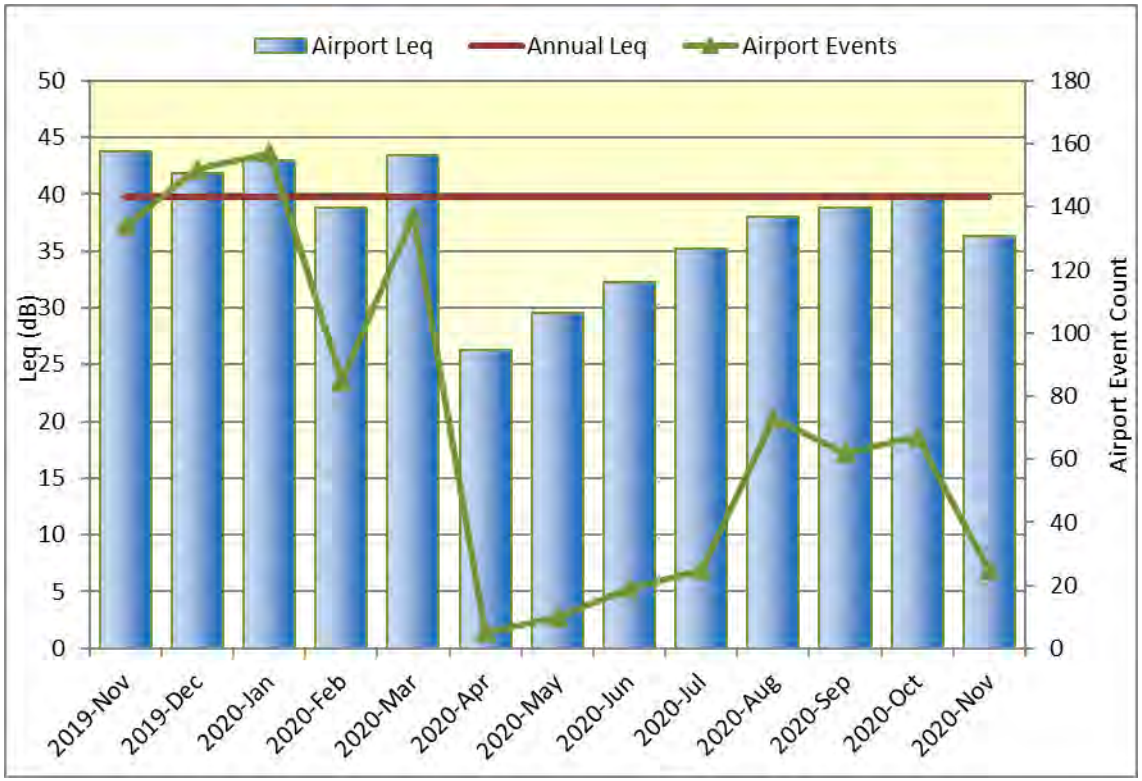
Fire Station

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

2020

Police Station

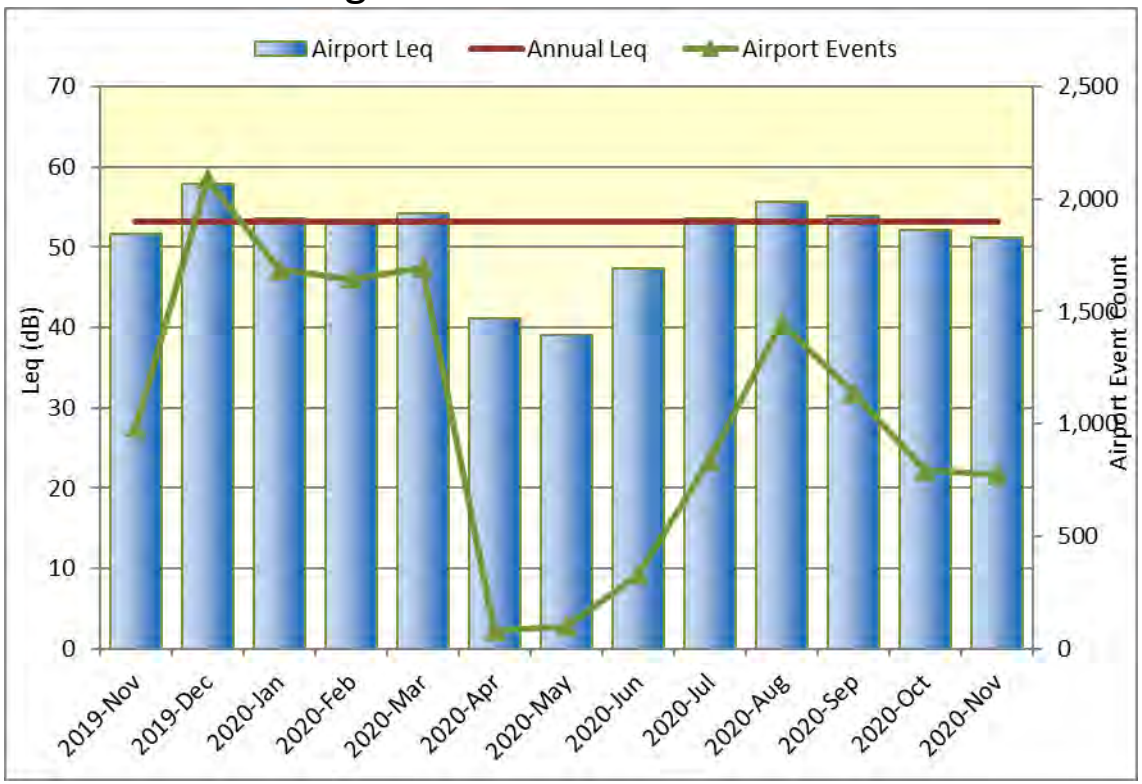


PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

2020

Terminal Building



PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

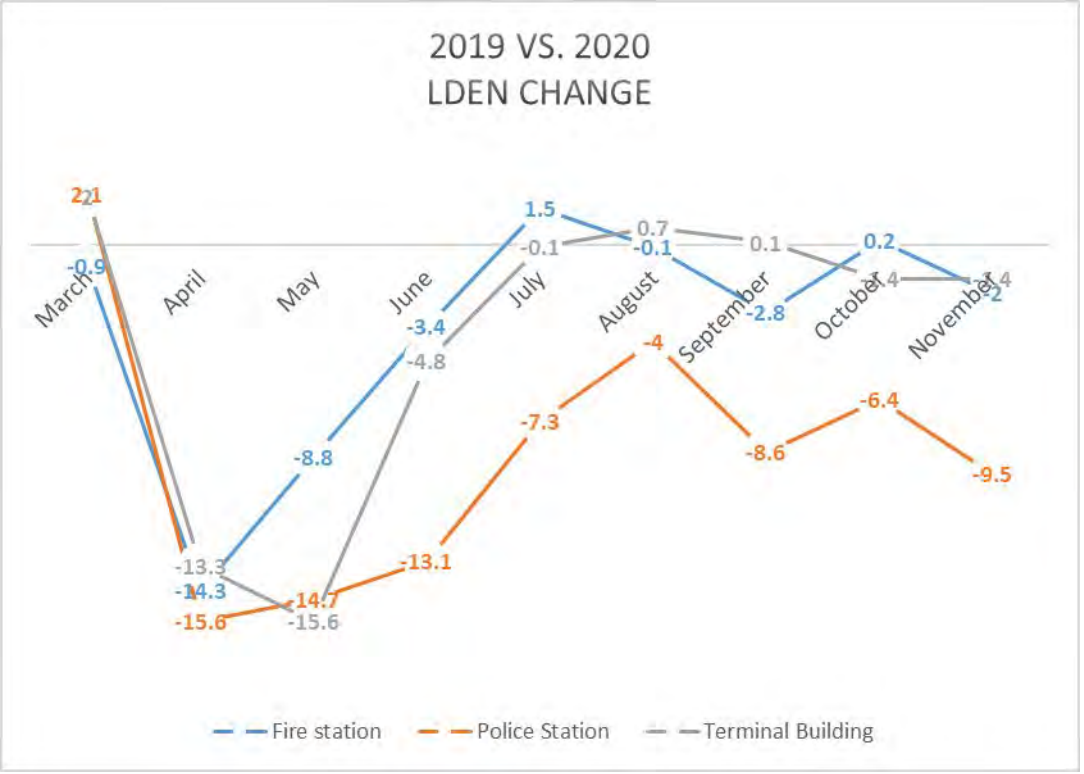
2020

YTZ6 “Kings Landing”

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

LDEN Change



PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

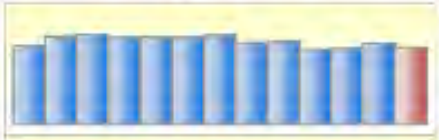
March 2020

daa

Airport Noise Overview - March 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN Mar '20	LDEN Mar '19	Change	Monthly LDEN Trend
3: Fire Station	41.7	42.5	-0.9	
4: Police Station	45.3	43.3	+2.1	
5: Terminal Building	57.8	55.8	+2.0	
6: YTZ6	54.1	0.0	+54.1	
:	0.0	0.0	0.0	

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

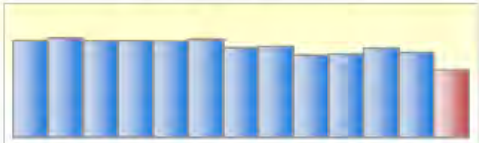
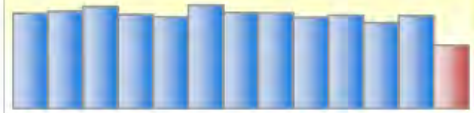
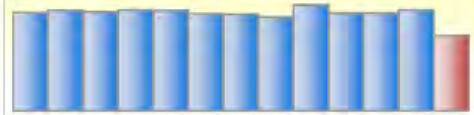
April 2020

daa

Airport Noise Overview - April 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN Apr '20	LDEN Apr '19	Change	Monthly LDEN Trend
3: Fire Station	33.2	47.6	-14.3	
4: Police Station	30.9	46.5	-15.6	
5: Terminal Building	43.0	56.3	-13.3	
6: YTZ6	39.7	0.0	+39.7	

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

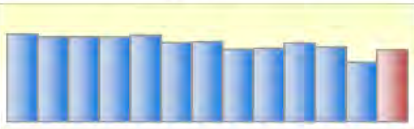
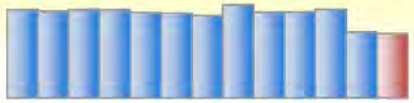
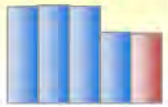
May 2020

daa

Airport Noise Overview - May 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN May '20	LDEN May '19	Change	Monthly LDEN Trend
3: Fire Station	39.9	48.7	-8.8	
4: Police Station	32.8	47.4	-14.7	
5: Terminal Building	42.0	57.6	-15.6	
6: YTZ6	39.0	0.0	+39.0	
:	0.0	0.0	0.0	

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

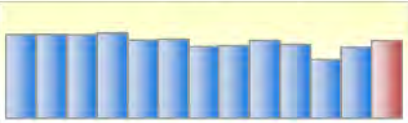
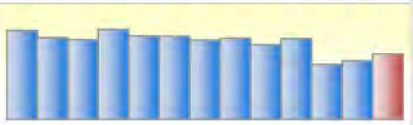
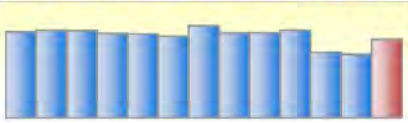
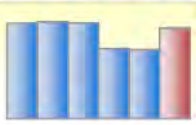
June 2020

daa

Airport Noise Overview - June 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN Jun '20	LDEN Jun '19	Change	Monthly LDEN Trend
3: Fire Station	43.7	47.1	-3.4	
4: Police Station	36.8	49.9	-13.1	
5: Terminal Building	51.7	56.6	-4.8	
6: YTZ6	51.2	0.0	+51.2	
:	0.0	0.0	0.0	

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

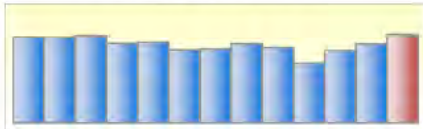
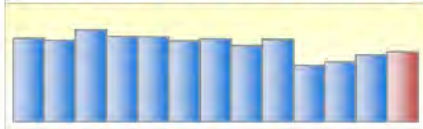
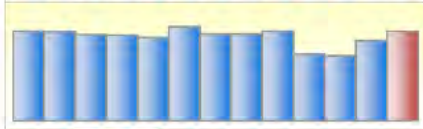
July 2020

daa

Airport Noise Overview - July 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN Jul '20	LDEN Jul '19	Change	Monthly LDEN Trend
3: Fire Station	48.9	47.4	+1.5	
4: Police Station	38.5	45.9	-7.3	
5: Terminal Building	57.7	57.7	-0.1	
6: YTZ6	49.6	0.0	+49.6	
:	0.0	0.0	0.0	

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

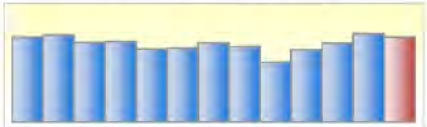
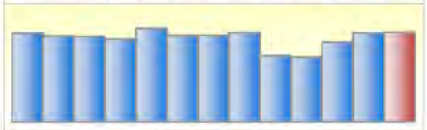
August 2020

daa

Airport Noise Overview - August 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN Aug '20	LDEN Aug '19	Change	Monthly LDEN Trend
3: Fire Station	47.0	47.1	-0.1	
4: Police Station	40.8	44.8	-4.0	
5: Terminal Building	58.1	57.3	+0.7	
6: YTZ6	50.8	0.0	+50.8	
:	0.0	0.0	0.0	

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

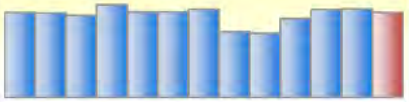
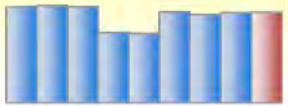
September 2020

daa

Airport Noise Overview - September 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN Sep '20	LDEN Sep '19	Change	Monthly LDEN Trend
3: Fire Station	45.4	48.1	-2.8	
4: Police Station	41.9	50.5	-8.6	
5: Terminal Building	55.7	55.6	+0.1	
6: YTZ6	50.9	0.0	+50.9	
:	0.0	0.0	0.0	

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

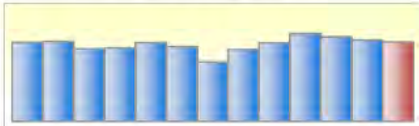
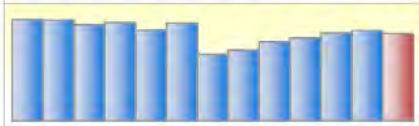
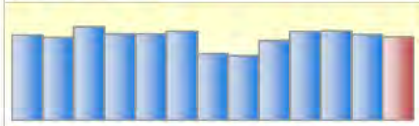
October 2020

daa

Airport Noise Overview - October 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN Oct '20	LDEN Oct '19	Change	Monthly LDEN Trend
3: Fire Station	44.3	44.0	+0.2	
4: Police Station	40.5	46.9	-6.4	
5: Terminal Building	54.0	55.3	-1.4	
6: YTZ6	46.3	0.0	+46.3	
:	0.0	0.0	0.0	

PORTS TORONTO

BILLY BISHOP TORONTO CITY AIRPORT

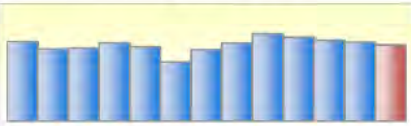
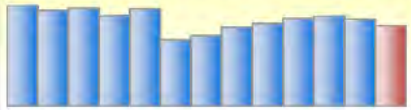
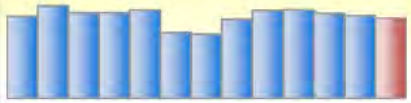
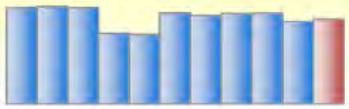
November 2020

daa

Airport Noise Overview - November 2020

Toronto City Airport

LDEN Trend - 2020

Location	LDEN Nov '20	LDEN Nov '19	Change	Monthly LDEN Trend
3: Fire Station	42.6	44.6	-2.0	
4: Police Station	37.3	46.8	-9.5	
5: Terminal Building	52.4	53.8	-1.4	
6: YTZ6	47.5	0.0	+47.5	
:	0.0	0.0	0.0	

PORTS TORONTO

THANK YOU

Appendix C
Akoustik Engineering Presentation

Billy Bishop Toronto City Airport

Noise Management Subcommittee

Dr. Colin Novak P.Eng.

Akoustik Engineering Limited

January 27, 2021

akoustik
engineering limited

Introduction – Colin Novak PhD, PEng

- Senior Partner, Akoustik Engineering Limited
  - Noise and Vibration specialist since 1993
  - Airports, Mining, Automotive, Environmental Assessments, Residential Developments
- Associate Professor, University of Windsor
  - Specialization in Psychoacoustics, Sound Quality, Automotive and Aerospace NVH and Structural Vibrations

akoustik
engineering limited

Introduction – Airport Experience

- Technical noise advisor for the Community Environment and Noise Advisory Committee (*CENAC*) at Toronto's Pearson Airport
- Technical noise advisory services for Winnipeg International Airport
- Third party review of noise reports for Greater Toronto Airports Authority
- Noise measurement and complaint investigation for Greater Toronto Airports Authority
- Provided expert testimony, including for the Canadian House of Commons Standing Committee on Transport, Infrastructure and Communities
- Noise measurement and analysis services for proposed aircraft route trials for NavCanada
- Three-year government grant for research on the development of community noise annoyance metric for aircraft noise
- Provide noise monitor installation and services at Toronto Pearson, Montreal Pierre Elliot Trudeau Airport, Toronto Billy Bishop Airport, Calgary Airport and Westchester Airport
- Completed over 300 environmental noise impact assessments (other)

Billy Bishop Toronto City Airport
Airport Ground Noise Mitigation Study

- Study to characterize the ground source noise emissions from the airport and associated operations and their impact on the community and to make abatement recommendations where necessary.
- The study procedures and guidelines to follow the Ontario MECP noise pollution control document NPC-300.
  - Sources of noise to be measured at the source and spectral sound pressure data to be converted to sound power data.
  - Model cumulative sound impacts at the sensitive receptor locations using Bruel & Kjaer Predictor in compliance ISO 9613 Part 1 and Part 2.
  - Ambient noise levels are to be characterized at the sensitive receptor locations.
- Study will include targeted characterizations that are outside of NPC-300 including factors which contribute to annoyance.

Noise Management Subcommittee Discussion – Noise Reporting

Question

I know some work on noise has been done at Pearson and perhaps they have some algorithms that could be modified to meet our needs. What kinds of algorithms are available already to parse the noise data being gathered, and if there are not any yet, who will produce these and do the data analysis and when will this occur. And how will we provide input to this person?

Answer

Yes, a subcommittee was formed, and much effort was given in 2018 to "design" a noise report which gave specific noise data for the various areas of the GTA. The noise data is taken from the 25 permanent NMT locations.

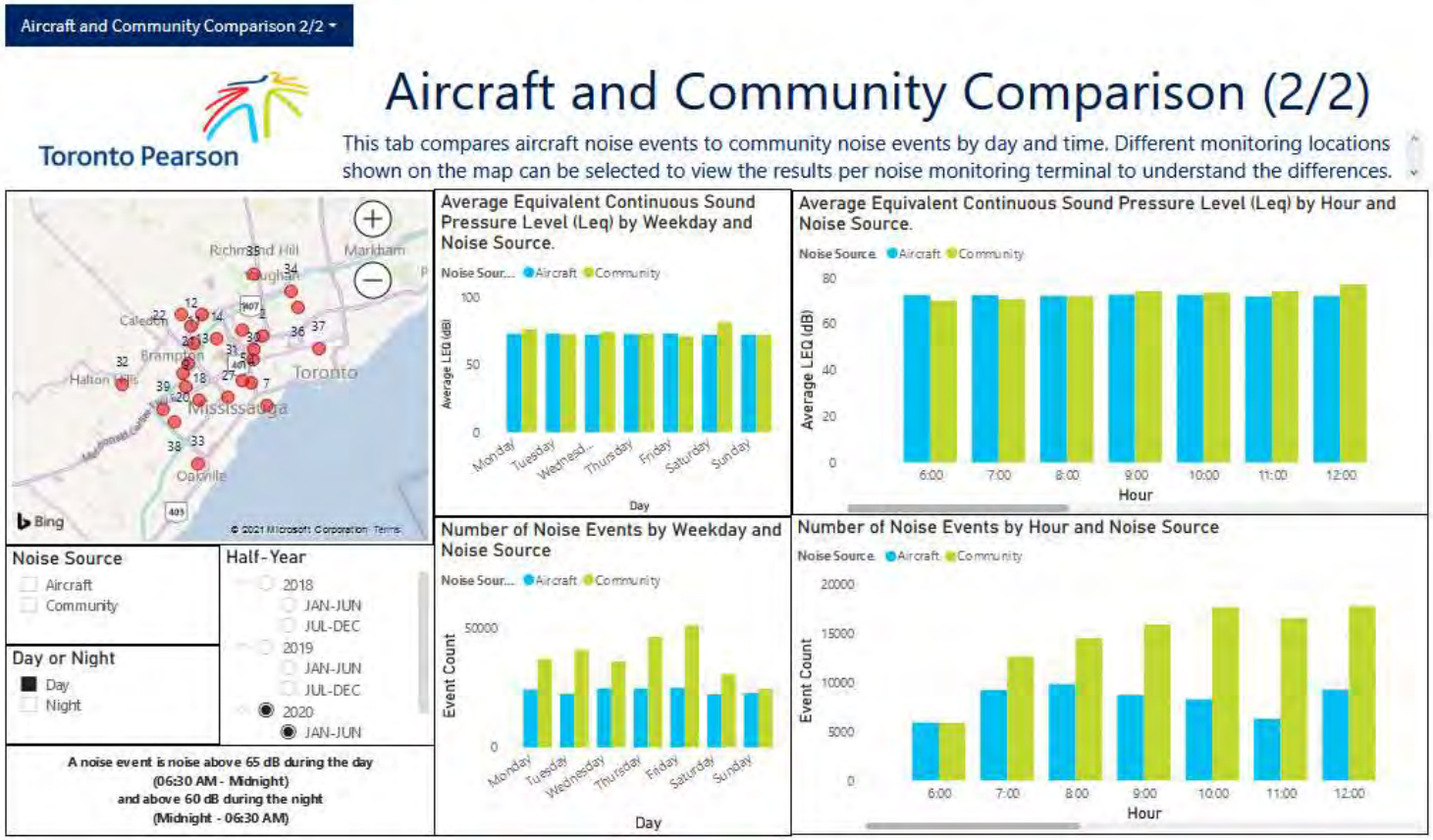
The reports are derived from the NMT's ability to quantify:

1. Noise event confirmed (by radar) to be an associated aircraft operation
2. Noise event confirmed not be an associated aircraft (eg leaf blower)
3. Ambient noise level

Note: a noise event is any sound which exceeds a predefined threshold (eg 65 dBA)

Noise reports can be viewed on the GTAA website through their "insightful" portal

Noise Management Subcommittee Discussion – Example Noise Report



akoustik engineering limited

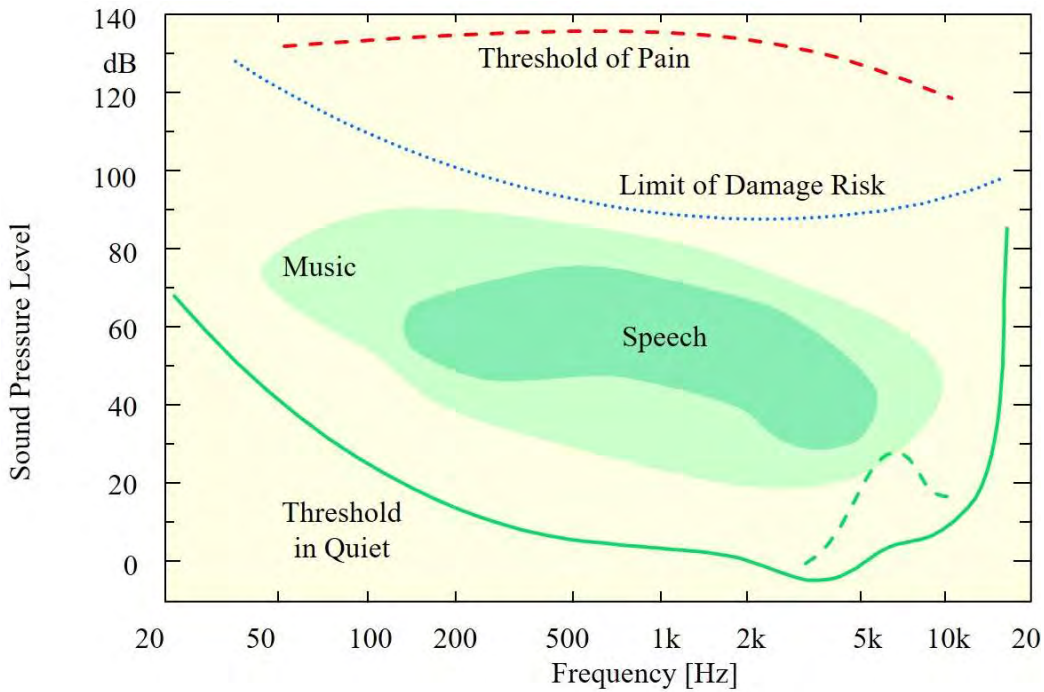
Noise Management Subcommittee Discussion – Frequency Weighting

Question

Want to learn more about dBA versus dBZ and whether Airport Noise Reports can report out using these scales?

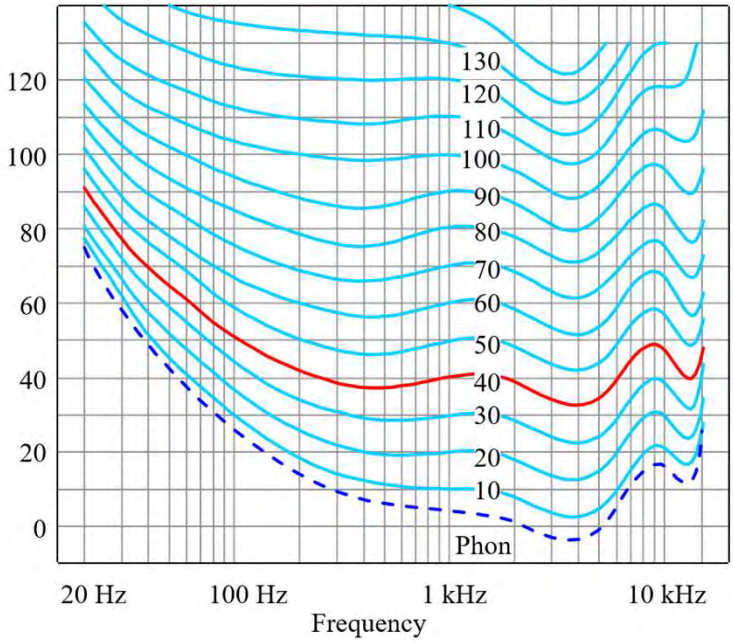
Answer

Yes, the NMTs do measure both A-weighted and unweighted (Z) noise levels. However, unweighted sound levels have no correlation to what we hear.

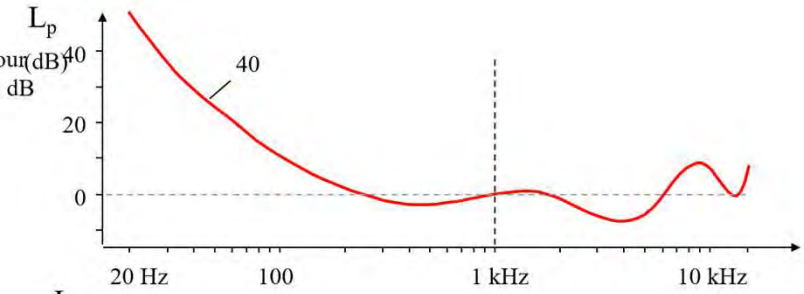


akoustik
engineering limited

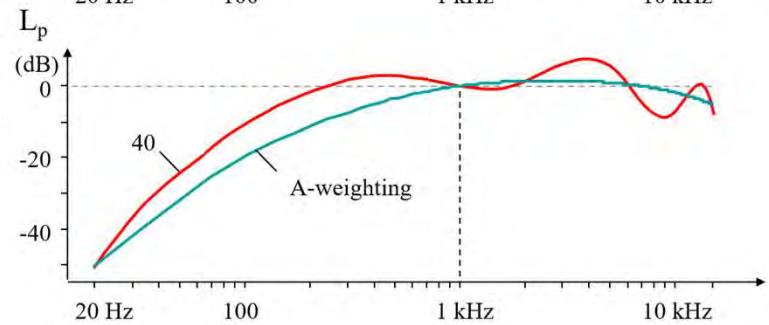
Noise Management Subcommittee Discussion – Frequency Weighting



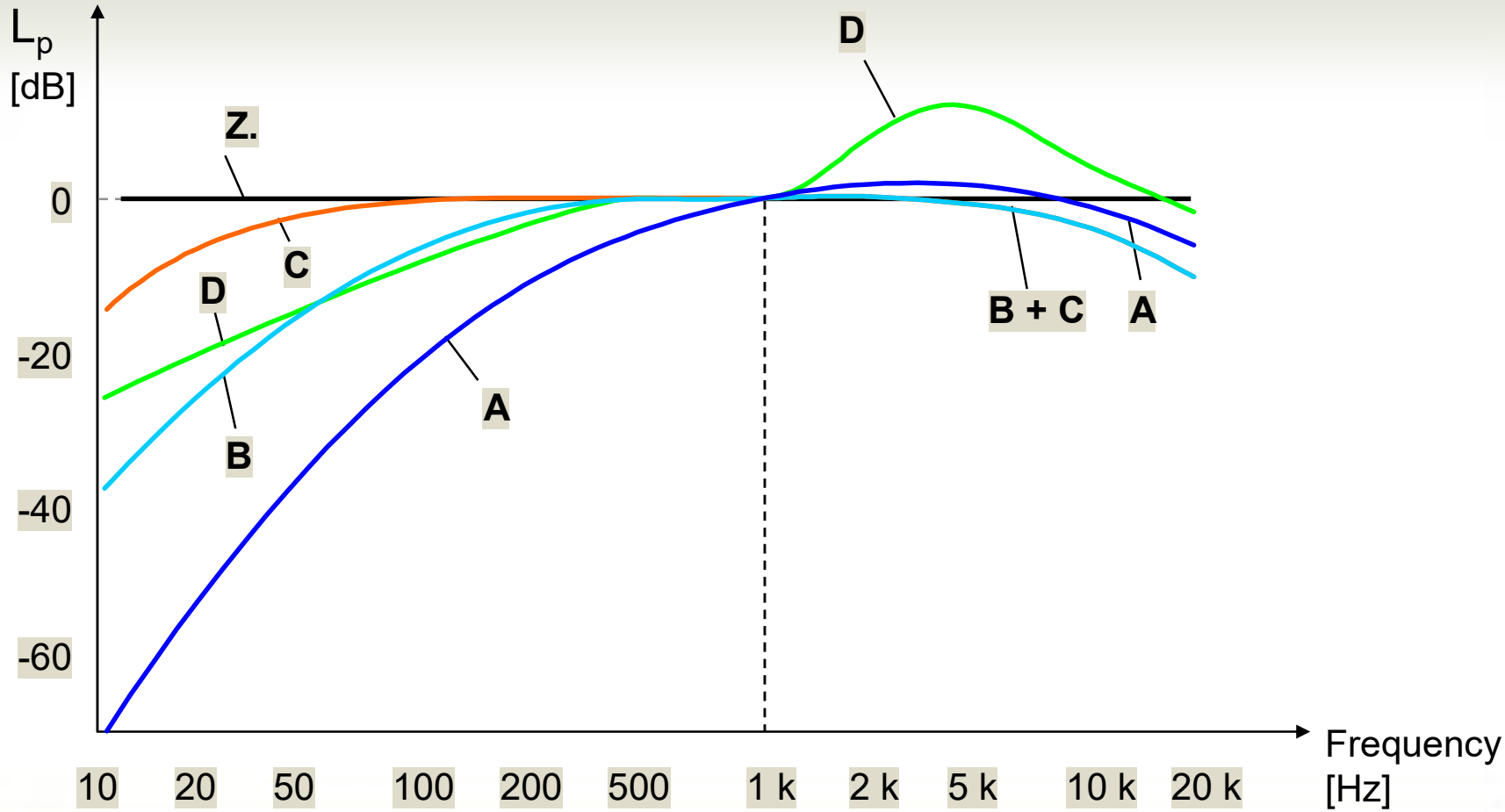
- 40 dB Equal Loudness Contour normalized to 0 dB at 1kHz



40 dB Equal Loudness Contour inverted and compared with A-weighting



Noise Management Subcommittee Discussion – Frequency Weighting



akoustik
engineering limited

Noise Management Subcommittee Discussion – Low Frequency Sound

Question

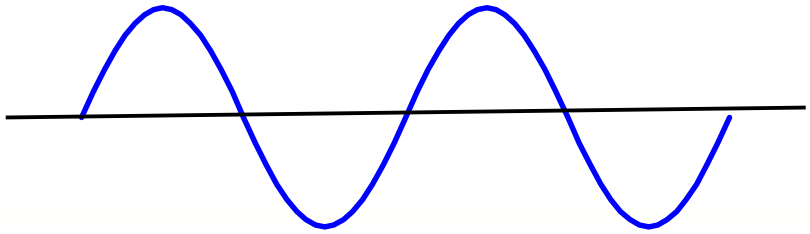
Want to better understand the noise characteristics of the airport ferry based on the bass rumbling that is produced?

Answer

Low frequency noise, such as that produced by the ferry, is generally not as perceptible as mid frequency sounds. However, they are still audible at sufficiently high amplitudes.

The challenge of low frequency sounds is that they can travel long distances and through solid surfaces (ground, building walls and windows etc.) making them more difficult to attenuate.

Narrow band sound, like the ferry, also have the challenge that they can be perceivably more annoying.



Noise Management Subcommittee Discussion

Question

Measuring the average 1-minute peaks do not reflect the impacts felt by people as it is the duration of the peak that is what can be the most disruptive to people when they sleep. As such, can the format of the data and a template be created for how the data would be summarized in the Ground Noise Study report and shared in advance so that the committee can review? For instance, they've noted in the past that in the case of the ferry horn, Leq-1hr does little to measure the annoyance of that singular event

Answer

This is not consistent with the methodology of NPC-300. However, impulsive sounds, and how many occur within a time period are identified and considered (weighted) separately.

Keep in mind that warning devices such as horns (when used appropriately) are exempt for noise limiting guidelines.

Noise Management Subcommittee Discussion

Question

Given that it is currently very quiet near the airport compared to normal, is this a good opportunity to calibrate the ground noise model? For instance, an ongoing concern was identified about the use of a ground-based model in a marine environment discussing how the ground may absorb 10 dB whereas the water may only absorb 1dB. As such, has there been any thought to test at different frequencies of how noise travels?

Answer

The noise propagation model uses internationally standardized absorption coefficients to recognize how different ground conditions will impact the propagation of the sound.

Further, it does this at a one, or one third octave frequency intervals.

Noise Management Subcommittee Discussion

Question

Given that it is currently very quiet near the airport compared to normal, is this a good opportunity to calibrate the ground noise model? For instance, an ongoing concern was identified about the use of a ground-based model in a marine environment discussing how the ground may absorb 10 dB whereas the water may only absorb 1dB. As such, has there been any thought to test at different frequencies of how noise travels?

Answer

The noise propagation model uses internationally standardized absorption coefficient to recognize how different ground conditions will impact the propagation of the sound.

Further, it does this at a one, or one third octave frequency intervals.

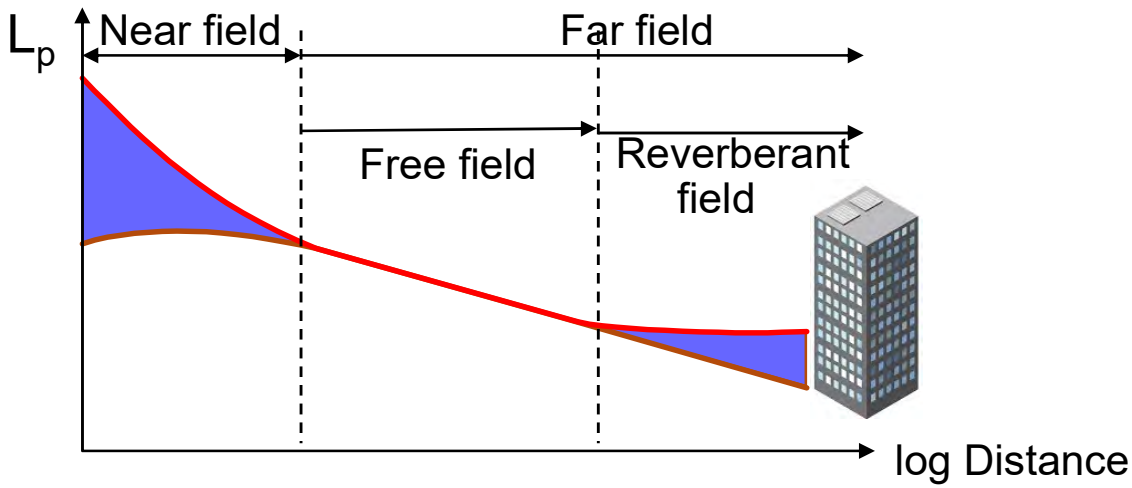
Noise Management Subcommittee Discussion

Question

Is there any thought to consider the effect of noise bouncing off concrete buildings along the waterfront?

Answer

The existence of buildings and other relevant structures can be included in the propagation model so as to include the impact of reflections, refraction and barrier effects. The model will not include minute architectural details of the structures



Noise Management Subcommittee Discussion

Question

Can the model measure noise at different frequencies based off noise emitted from different runway offsets and heights, if you were on a boat in the lake and if you were in the community walking or at home on your condo balcony?

Answer

The model input information is frequency based sound power levels. In the calculation of the receptor sound levels the model will adjust for the various mechanisms for sound absorption, attenuation, or in some cases, increases in level. These adjustments are performed at the frequency level before the overall noise level is given.

Noise Management Subcommittee Discussion

Question

Restate the two components to the Ground Noise Study – the source noise observations (measured at the source of various noise emitters from the airport while on the ground) which feeds into the noise model, and the background noise which measures the background noise at various points around the airport. For the ambient noise measurement, this requires the installation of a temporary noise monitor for at least 1 week to measure the hum. A member of the committee, expressed frustration that there are no monitors on tall buildings to understand the noise profiles of aircrafts as they fly by.

Answer

The study is for the ground based noise. In flight aircraft noise is exempt and their impacts are removed from the ambient noise data.

Any More Questions??

Appendix D
Follow-Up Questions and Comments

On January 28, Max Moore who was unable to attend the meeting provided comments by email as follow:

> If I may comment on the Akoustik Engineering Report, it's a lot of valuable information, and the plan looks great, but I would question the comment about the negligible value of measuring noise with both DBA-DBZ.
>
> In my view, the value of measuring noise with DBZ is not about whether people can hear bass noise (although I do believe we can hear low noise subconsciously). The problem for us is that DBA Decibels do not report well.
>
> Reporting with DBA Decibels and LEQ-averaging under-reports the numbers, by about 15 decibels, making 80 decibels sound like 65 decibels. When city hall staff read the noise reports, they think 65 decibels is nothing, there's almost no noise... when in truth, people on Queens Quay are jumping out of their seats, when the noise peaks at 80 and 90 DBZ. So reporting with DBA and LEQ averaging is nothing more than a scientific way of lying with statistics. Reporting noise in DBA is like trying to buy an American-priced product with Canadian dollars. It's simply under-reporting and misleading. If we report the noise in DBZ Decibels, we report the full noise measurement, and not a discounted number.
>
> Using DBA as a discounted noise measurement creates an even bigger problem when the DBA numbers are compared to city noise standards. Using DBA and LEQ noise averaging makes it look like airplanes make only 60-65 decibels of noise. It's just not true. All we're asking for, as a community, is truth in noise reporting.

<u>Response from Dr. Novak:</u>

> Acoustic reports are generally reviewed by professionals that not only understand the difference between an A-weighted sound level and an unweighted sound level. It is the globally accepted standard that environmental noise, product noise and other noise that is perceivable or impacted on human hearing be reported in A-weighted levels; unless for very specific documented reasons in a standard an alternative is specified. To do otherwise can be misleading and lead to confusion.
>
> There are reasons to measure and/or report unweighted sounds levels which are generally to use for the calculation of abatement, or sound control, or for use as a base data set to apply A or other weightings (eg. B, C, G etc.)

Building on Max’s points, Lesley Monette provided additional comments that were received on February 2, 2021 and are included as follows:

After rethinking our meeting and viewing Max's feedback, I want to echo what Max is saying. If some of the issues with noise is the low tone vibrations felt in your body as well as vibrations of window glass, then not including DBZ does not address these noise impact issues that are actually being felt by people. And the sudden high pitched loud noises from take-off which can startle, or consistent levels of this noise impair being able to hear on balconies and outside (we do have many people even closer in the Music Garden for concerts, and leisure time) we again are missing the boat in understanding the impacts on humans of these noises. So I think we really do need to have DBZ as well as DBA to address the actual impact on humans.

Response from Dr. Novak:

The shaking of windows is generally a structurborne excitation which is best measured using vibration measurements. There is not a direct correlation between a measured unweighted sound level and the excitation of a window.

The, “the sudden high pitched loud noises from take-off which can startle, or consistent levels of this noise impair being able to hear on balconies and outside” can be somewhat correlated to overall A-weighted sounds levels. They can not be correlated to overall unweighted sound levels, thus further exemplifying the purpose and use of A-weighted sound levels.

Additionally, comments from Hal Beck were received following Lesley’s comments and are included as follows:

In a past meeting, the noise study report contents were discussed with respect to presentation of data collection and findings. Perhaps, draft examples of these populated with some illustrative data could be discussed at next meeting? This may also address some of the thoughts below.

Discussing the reporting alternatives will also bring into sharper focus the purpose of the noise monitoring in the study. Background noise monitoring and documentation is an immediate focus. Then documentation of total noise actually received (which will include the background frequencies) will also be required in order to calibrate and validate any modelling work.

One aspect which may not have been hammered home during the meeting is the measuring and documentation of low frequencies which are outside the range of hearing but are believed or understood to be affecting residents surrounding the airport. In conjunction with the above topic at future meeting, perhaps Colin may have an informative article or two to share on: (a) the physical impact of such super low frequencies versus (b) any special noise management considerations such as propagation, monitoring and documentation, and mitigation.

Response from Dr. Novak:

Specific weightings exist for the reporting of “super low”, or infrasonic sounds; this is the G-weighting adjustment. Specifically, it is intended to

determine annoyance due to infrasound, or sound within the frequency range of 1 Hz to 20 Hz. It is for example used to report sound levels produced by large wind turbines. However, it has little meaning for sounds within the audible frequency range above 20 Hz, this is where the A-weighting curve is used.

I suggest the group play the YouTube videos given in the links below. It demonstrates the audibility of sound played at the frequencies from 20 Hz to 20 000 Hz. In the video, the sounds at all the frequencies are played at the same (dB) level. However, the listener will observe that the low and high frequencies are much quieter, if even audible. The essentially demonstrates why the A-weight adjustment is used; that is why sounds at the lowest and highest frequencies are adjusted when used to report what the human ear experiences.

20Hz to 20kHz (Human Audio Spectrum)

How Old Are Your Ears (Hearing Test)

On February 2, 2021 Hal Beck provided the following list of questions. Responses are provided courtesy of Michael MacWilliam, unless otherwise indicated.

ICAO

Question 1: Why does ICAO exist?
The International Civil Aviation Organization (ICAO) is a specialized agency of the United Nations. It changes the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth Its headquarters is located in the Quartier International of Montreal, Quebec, Canada. A brief presentation on the ICAO general level can be provided at a future Noise Management Subcommittee meeting.

Question 2: What range of documents does it produce? Can Table of Contents be provided of each document containing info relevant to noise?
The ICAO produces various documents, a list of which can be provided at a future date.

Question 3: What are the numbered Annex's?
Please review
https://www.icao.int/safety/airnavigation/nationalitymarks/annexes_booklet_en.pdf

Question 4: A press release in Sept 1, 2020 noted that Dash 8-400 was "recertified to meet latest noise emission standards set by ICAO Chapter 14". From which document is Chapter 14 extracted? Can the full Chapter 14 be distributed and the specific passages applicable to noise certification of Q400 be highlighted?
Please review
https://www.icao.int/environmental-protection/pages/reduction-of-noise-at-source.aspx

Re: Annex 16

Question 5: Incomplete extracts of 'Annex 16 -Environmental Protection' have been floating around for years. Can the full version be distributed, or at least all sections applicable to noise?
Mr. MacWilliam will secure a copy for the subcommittee's use.

Question 6: Some chapter excerpts discuss the reference noise measuring points ie. lateral, flyover, approach. Can the locations of these points for Q400 be explained along with a map of Toronto waterfront showing the specific locations of these points on the map both east and west of Island Airport? Can the methodology using them to approve aircraft at airport sites be discussed using Q400 data?
Response from Dr. Novak: It should be understood that the measurement points are chosen control points are should not be correlated to locations at an airport. The reason for the measurements is to collect data such that a sound power emission (A-weighted by the way) can be determined under controlled conditions to be used in noise prediction models. The NEF contour is an example, among others, of these prediction models.

Question 7: Incomplete excerpts from Annex 16 Appendix 2 have been floating around for years. Can the full version be distributed, or at least all sections applicable to noise?
Mr. MacWilliam will secure a copy for the subcommittee's use.

Question 8: Can a high level technical overview of the contents of Appendix 2 be provided, including an overview of: noise measurement of aircraft and subsequent calculation of EPNL data from measured data. (A little understanding of what goes into the EPNL calcs will assist a future meeting on the NEF formula and its mapping and use.)
Response from Dr. Novak: The Effective perceived noise level (EPNL) is the noise input used for the calculation of the NEF contours. Because it includes additional factors of noise annoyance, it is used instead of the sound level. The following is an extract from a MASc thesis for one of my graduate students. It was part of a research study that I did on the NEF methodology.

The effective perceived noise level is the perceived noise level (PNL) of a single event adjusted for the effect of annoyance due to the event duration and for the presence of discrete frequencies (tones). In the calculation, tone corrections are added first, converting the PNL into the tone corrected perceived noise level (PNLT). The calculation of tone-corrected Perceived Noise Level is detailed in the Federal Aviation Regulations, Part 36, Appendix A2 to Part 36-Section A36.4 [16]. It is generally obtained by adding a correction factor C which is added when

the Perceived Noise Level has discrete frequency components (FAA 2002). The formula for PNLT, having the units TPNdB, is given as:

$$\mathrm{PNLT(k)} = \mathrm{PNL(k)} + C_{max}$$

A correction factor "D" to account for the aircraft flyover duration is calculated using the following equation:

$$\mathrm{D} = 10\log_{10}\left[\sum_{k=0}^{2d}\left(10^{\frac{PNLT(k)}{10}}\right)\right] - PNLTM - 13$$

where d is the time interval during which the level is 10 TPNdB down from PNLTM which is the maximum PNLT during the time interval and K is the index of the time step.

The effective perceived noise level (EPNL), having units of EPNdB, is calculated by adding the duration correction factor "D" as follows:

$$\mathrm{EPNL} = \mathrm{PNLTM} + \mathrm{D}$$

Re: Airplane Testing Facilities (This may be covered under one of the above points.)

Question 9: Where are the testing facilities?
No response available at this time.

Question 10: What happens there?
No response available at this time.