Environmental Traffic Noise

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Topics for Discussion

- Decibel Scale
- City of Edmonton Criteria
- Noise and Vibration Measurements & Monitoring
- Noise Barriers (How do they work?)
• Noise is measured using a Decibel (dB) scale

• The dB Scale is a base-10 logarithm scale (similar to the Richter Scale)
  • A reduction of 1 – 2 dB = Threshold for subjective change
  • A reduction of 3 dB = Barely perceptible subjective change
  • A reduction of 5 dB = Strongly perceptible subjective change
  • A reduction of 10 dB = Approximately ½ as loud
Capital Line SLRT Extension

Traffic (20,000 vehicles/day) at 100 m away = 55 dB

x2 Traffic (40,000 vehicles/day) at 100 m away = 58 dB

x4 Traffic (80,000 vehicles/day) at 100 m away = 61 dB
Assessment Criteria
City of Edmonton
“The City of Edmonton will seek to achieve a projected attenuated noise level below 65 dBA Leq24 or as low as technically, administratively, and economically practicable, where any urban transportation facility (arterial roadways, light rail transit) is proposed to be built or upgraded through or adjacent to a developed residential area where private back yards will abut the transportation facility. Funding for noise attenuation, where appropriate, and subject to availability, is considered in the cost of the project.”

“The City of Edmonton will seek to minimize the impact of operational noise associated with the Light Rail Transit (LRT) system on adjacent noise-sensitive land uses while balancing the need for safety and security of road users and patrons at stations, including pedestrians at intersecting roadways.
UTNP (C506A)

- $L_{eq24} = 24$ Hours
- $L_{eq\text{ Day}} = 07:00 - 22:00$
- $L_{eq\text{ Night}} = 22:00 - 07:00$

$Leq24 = 48.9\,\text{dBA}, \; L_{eq\text{ Day}} = 50.7\,\text{dBA}, \; L_{eq\text{ Night}} = 41.3\,\text{dBA}$
What is Sound?

City of Edmonton Criteria 65 dBA

Threshold of Pain
747 on Takeoff
Jackhammer
Medium Truck
Normal Conversation
Quiet Living Room
Whisper
Threshold of Hearing

Rock Band
Heavy Truck
Passenger Car
Quiet Rural Setting
Vibration

- Human Perceptibility: U.S. Department of Transportation = 0.14 mm/s RMS
- Structures: Studies conducted by ACI and the City of Edmonton = 10 mm/s
Capital Line SLRT Extension

Review and Discussion of Previous Studies

CLSE Public Meeting, September, 2018
Two Major Components of noise & vibration impact assessments (NIA & VIA, respectively) include:

1. Monitoring & Measurements
2. Modeling (NIA) & Calculations (VIA)
Monitoring
(Noise and Vibration)

• ACI uses very specialized noise and vibration monitors to perform measurements from 24 - 48 hours.
• Noise: SLM & Omni-directional microphone
• Vibration: Tri-axial accelerometer
• Conditions for Monitoring:
  - Wind speeds are below 15 km/hr,
  - Monitor is downwind or crosswind from source,
  - No precipitation
  - Only performed from Monday to Friday.
  - Performed from April to October (no snow)
In 2009

- ACI conducted 8 Noise Monitorings:
  - 1 on public land,
  - 7 in residential backyards.
- ACI conducted 3 Vibration Monitorings:
  - All 3 were on public land.
Monitoring
(Vibration Monitoring)

24-Hour PPV

24-Hour 1/3 Octave Maximum Vibration Levels

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Monitoring
(Noise Results)

24-Hour Broadband A-Weighted $L_{eq}$ Sound Levels

$Leq24 = 52.9$ dBA

24-Hour 1/3 Octave Band $L_{eq}$ Sound Levels

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Measurements (May 2018)

- Noise and Vibration measurements conducted in May 2018
Vibration (Conclusions)

• Projected vibration levels from vehicle traffic and SLRT Extension Trains will also be under the 0.1 mm/s RMS criteria.

• PPV values are well below the 10 mm/s criteria for structural integrity.
Modeling
(Noise)

• CadnaA Noise Modeling Software

• ISO 9613-2 1996 – Acoustics – Attenuation of sound during propagation outdoors

• Ability to add:
  1. Topographical features such as:
     • Elevation Contours, Vegetation, etc.
  2. Meteorological Conditions such as:
     • Temperature, Relative Humidity, Wind-Speed and Wind-Direction

• Noise Sources
  - Traffic = RLS – 90 German Standard (vehicles/hr, % heavy, speed limit).
  - LRT = Empirical measurements (Completed in May 2018)
Modeling
(Current)
Modeling
(Future + LRT)
Noise Mitigation Options
Noise Barriers
(General)

Reflected Sound

Source

Propagated Sound

Diffracted Sound

Barrier

Shadow Zone

Transmitted Sound (Direct Path)

Receiver

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Noise Barriers
(General)

• Sound transmitted through barrier must be at least 10 dBA less than sound diffracted over barrier

• Mass, Mass, MASS

• At least 20 kg/m² (minimum double board fence)

• No gaps in between or at bottom

• Double Boarded Wood or Masonry materials are preferred

• Need to consider maintenance, longevity, visual appeal

• There is such a thing as “overkill”
Noise Barriers
(Path Length Difference)

PLD = (B + C) – A ≥ 0
Noise Barriers
(Trees)

Myth: “Let’s just put in some trees to block the noise.”

Reality: Trees/bushes are a very ineffective means of noise mitigation.

Trees act as an acoustical placebo: ‘out of sight – out of mind’

≈3 dBA @ 200 ft!
Field Work for 2018

- Noise and Vibration measurements were conducted on existing Capital Line trains in May 2018.

- The results of these measurements will be incorporated into the updated noise model and in the vibration calculations.