INTERSTATE 95 EXPRESS LANES
FUNDAMENTALS OF TRAFFIC NOISE

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PRESENTATION SUMMARY

• What is noise?
• The Decibel
• Noise Model
• Mitigation
• Criteria
• Results
WHAT IS NOISE?

• Noise is unwanted sound.
• It is perceived differently by every person.
• Can be irritating to one person may be tolerant to another.
• Sound is transmitted by pressure variations in the air from its source.
• Most sound sources are characterized as a point or lines sources.
POINT vs. LINE SOURCE

• A point source occurs when a sound source is stationary (e.g. a horn).
• Sound radiates equally in all directions.
• Noise levels for a point source decreases by 6 decibels per doubling of distance.
POINT vs. LINE SOURCE

• A line source occurs when many source are moving in a line (e.g. traffic noise).

• Noise levels for a line source decreases by 3 decibels per doubling of distance.
  
  – Example: If you experience 60 decibels at 50 feet then you would experience 57 decibels at 100 feet.
THE DECIBEL

- Noise is measured in decibels on a logarithmic scale. This scale does not work the same way as most other familiar scales.

<table>
<thead>
<tr>
<th>When two decibel Values differ by:</th>
<th>Add the following amount to the higher value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 or 1 dB</td>
<td>3 dB</td>
</tr>
<tr>
<td>2 or 3 dB</td>
<td>2 dB</td>
</tr>
<tr>
<td>4 to 9 dB</td>
<td>1 dB</td>
</tr>
<tr>
<td>Greater than or equal to 10 dB</td>
<td>0 dB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Decibel</th>
<th>SPL</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
THE DECIBEL

45dB
52dB
58dB
59dB
65dB

53dB
58dB
59dB

59dB
62dB
67dB

≠ 279 dB
The Decibel

- An increase in 10 decibels is considered as twice as loud to the average listener.

<table>
<thead>
<tr>
<th>Actual Sound Level Change</th>
<th>Perceived Sound Level Change</th>
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<tbody>
<tr>
<td>+20 dBA</td>
<td>Four times as loud</td>
</tr>
<tr>
<td>+10 dBA</td>
<td>Twice as loud</td>
</tr>
<tr>
<td>+5 dBA</td>
<td>Readily perceptible</td>
</tr>
<tr>
<td>+3 dBA</td>
<td>Barely perceptible</td>
</tr>
<tr>
<td>0 dBA</td>
<td>Reference level</td>
</tr>
<tr>
<td>-3 dBA</td>
<td>Barely perceptible</td>
</tr>
<tr>
<td>-5 dBA</td>
<td>Readily perceptible</td>
</tr>
<tr>
<td>-10 dBA</td>
<td>Half as loud</td>
</tr>
<tr>
<td>-20 dBA</td>
<td>One quarter as loud</td>
</tr>
</tbody>
</table>
Doubling of the sound source causes noise levels to increase by 3 decibels.
THE DECIBEL

2000 vehicles per hour sound twice as loud as...

200 vehicles per hour
THE DECIBEL

One truck at 55 miles per hour (mph) sounds as loud as...

28 cars at 55 mph
### THE DECIBEL

<table>
<thead>
<tr>
<th>Traffic at 65 mph sounds twice as loud as...</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Traffic at 30 mph</th>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

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12
THE DECIBEL

- Diesel Truck at 50 feet (88 dBA)
- Quiet Urban Nighttime (40 dBA)
- Normal Speech at 3 feet (66 dBA)
- Vacuum Cleaner at 10 feet (71 dBA)
- Rock Band (110 dBA)
THE NOISE MODEL

• Traffic Noise Model 2.5 (TNM)
• TNM used to predict and assess noise levels in future (design) year.
• TNM went through an extensive validation effort to ensure its accuracy.
• April 14, 2004 FHWA mandated the use of TNM.
THE NOISE MODEL

• Noise Model Inputs
  – Noise Sensitive Receptors
  – Proposed design alternative
  – Traffic (volume, speed, composition)
  – Propagation Features (Cut/Fill Lines, Building Rows, Ground Zones, etc.)
  – Existing or Proposed Barriers
THE NOISE MODEL

- Noise Model Results
  - Noise levels (existing, design year, mitigated)
  - Barrier design information

![Noise Model Results Table](image)

![Noise Model Diagram](image)
MITIGATION

- Where do we place the sound wall?
  - Between the source and the receiver.

Each additional 2 feet height = approximately 1 dBA additional noise reduction.

Line of Site blockage 5 dBA Noise Reduction.
MITIGATION

• Is there an optimal location?
  – Yes but it depends on the terrain, existing utilities, and structures (bridges, signs and culverts) which is balanced among these variables.
MITIGATION

• How high should we design the wall?
  – That depends on where noise impacts occur.
  – Was the line of sight broken?

Sound walls will not totally eliminate traffic noise.
CRITERION

• Warranted
  - Predicted highway traffic noise levels (for the design year) approach or exceed the highway traffic noise abatement criteria in Table 1. “Approach” has been defined by VDOT as 1 dB(A) below the noise abatement criteria.
  - A substantial noise increase has been defined by VDOT as a 10 dB(A) increase above existing noise levels for all noise-sensitive exterior activity categories. A 10 dB(A) increase in noise reflects the generally accepted range of a perceived doubling of the loudness.
• Feasible
  o (1) at least a 5 dB(A) highway traffic noise reduction at impacted receptors. Per 23 CFR 772 FHWA requires the highway agency to determine the number of impacted receptors required to achieve at least 5 dB(A) of reduction. VDOT requires that fifty percent (50%) or more of the impacted receptors experience 5 dB(A) or more of insertion loss to be feasible; and;
  o (2) the determination that it is possible to design and construct the noise abatement measure. The factors related to the design and construction include: safety, barrier height, topography, drainage, utilities, and maintenance of the abatement measure, maintenance access to adjacent properties, and general access to adjacent properties (i.e. arterial widening projects).
CRITERION

• Reasonable
  - Viewpoints of the benefited receptors: Fifty percent (50%) or more of the respondents shall be required to favor the noise abatement measure in determining reasonableness.
  - Cost-effectiveness: VDOT’s noise barrier cost effectiveness value is based upon a Maximum Square Footage of Abatement per Benefited Receptor (MaxSF/BR) value of 1,600.
  - Noise Reduction Design Goals: VDOT’s design goal is 7 dB(A) of insertion loss for at least one impacted receptor.
RESULTS

- Highway traffic noise analyses will be performed for developed lands as well as undeveloped lands if they are considered “permitted.” Undeveloped lands are deemed to be permitted when there is a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of at least one building permit.

- VDOT will consider noise abatement only for noise-impacted development for which a building permit was issued prior to the Date of Public Knowledge.