Highway Barrier Reflections Screening Tool

Keith Yoerg
Associate, ATS Consulting

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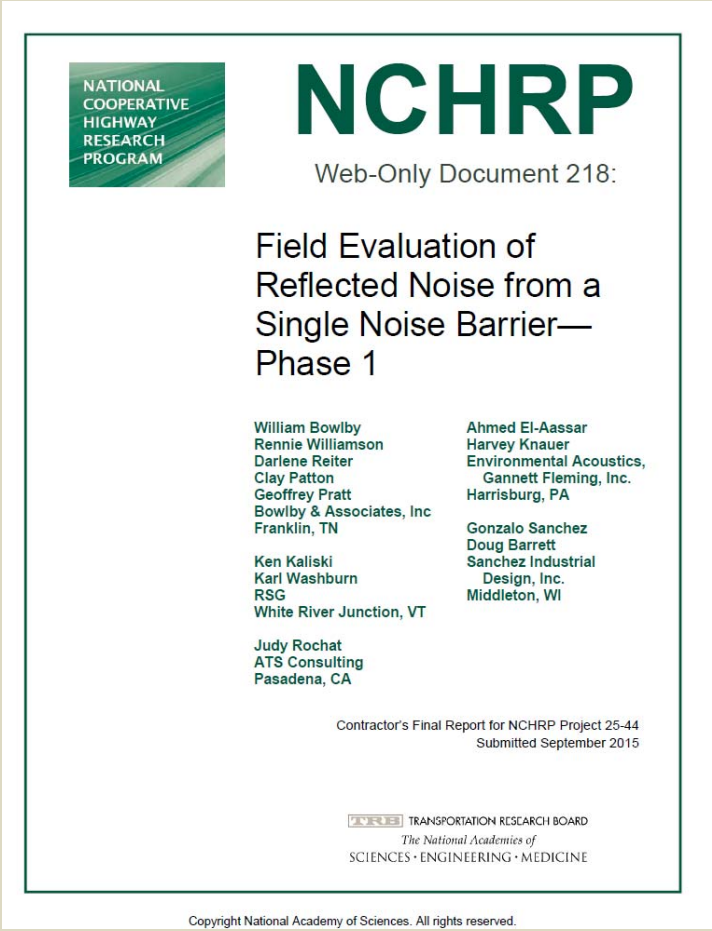
acoustics, transportation + strategy

NCHRP Project No. 25-44

- Two main objectives:
  - Determine spectral noise level characteristics in the presence of a single noise barrier on the opposite side of the road
  - Summarize results to help understand actual and perceived effects of a barrier

- Phase 1: barriers with reflective surfaces
  - Sound levels higher in presence of barrier
  - Frequency-specific differences varied by site
  - Greater effects farther from road and higher above ground



NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP

Web-Only Document 218:

Field Evaluation of Reflected Noise from a Single Noise Barrier—Phase 1

William Bowlby
Rennie Williamson
Darlene Reiter
Clay Patton
Geoffrey Pratt
Bowlby & Associates, Inc
Franklin, TN

Ken Kaliski
Karl Washburn
RSG
White River Junction, VT

Judy Rochat
ATS Consulting
Pasadena, CA

Ahmed El-Aassar
Harvey Knauer
Environmental Acoustics, Gannett Fleming, Inc.
Harrisburg, PA

Gonzalo Sanchez
Doug Barrett
Sanchez Industrial Design, Inc.
Middleton, WI

Contractor's Final Report for NCHRP Project 25-44
Submitted September 2015

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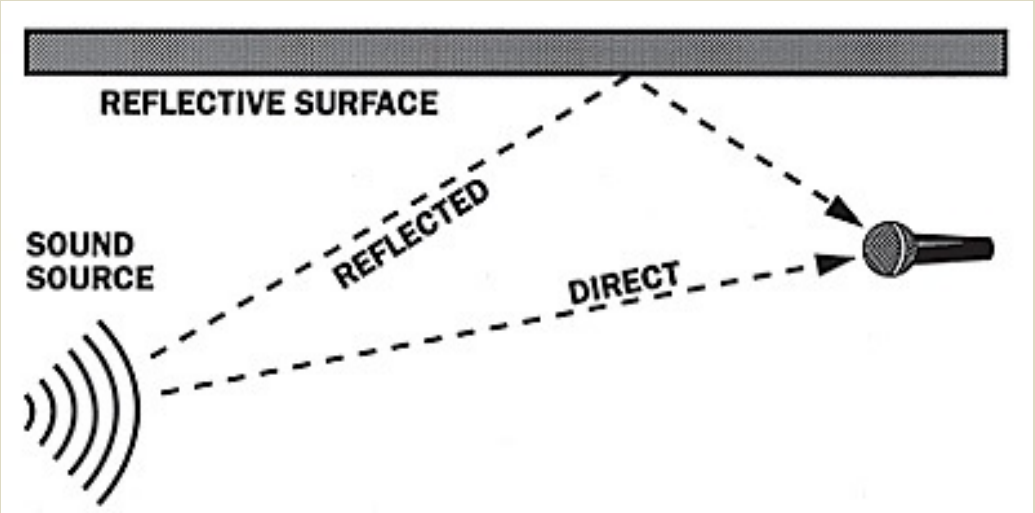
Purpose of Screening Tool

- Estimates increased traffic noise due to reflections off a barrier on the opposite side of the road
  - Used when only one side of the road has a barrier
- Excel spreadsheet provides a conservative estimate of the increase in noise levels
- If the estimated increase is >=1 dB, a refined analysis using the Traffic Noise Model (TNM) or other modeling tool should be considered
- Results presented today are preliminary – still under NCHRP review

Path Length Difference Calculation

- Calculations are based purely on path lengths
- Direct-path & reflected-path sound waves combine, adding
- Spreadsheet calculates change in direct & reflected sound levels – computes sum



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Assumptions

- Line source & geometrical spreading
- Only highway noise is considered
- Barrier exists at the reflection point
  - Length, height, and continuity of barrier assumed to be in place for a reflection to occur

Input Tabs

- "Based on distances"

direct path length	70
distance from traffic noise source to barrier	100
source offset (distance up (-) or down (+) road)	200
direct path shielding amount (dB)	
barrier reflected path shielding amount (dB)	

Increase in sound due to reflections (dB) 2.1

- "Based on coordinates"

	X	Y	Z	Height
Source	200	0	0	
Receptor	0	-70	0	5
Barrier		100		

direct path shielding (dB)	
barrier reflected path shielding (dB)	

Increase in sound due to reflections (dB) 2.1

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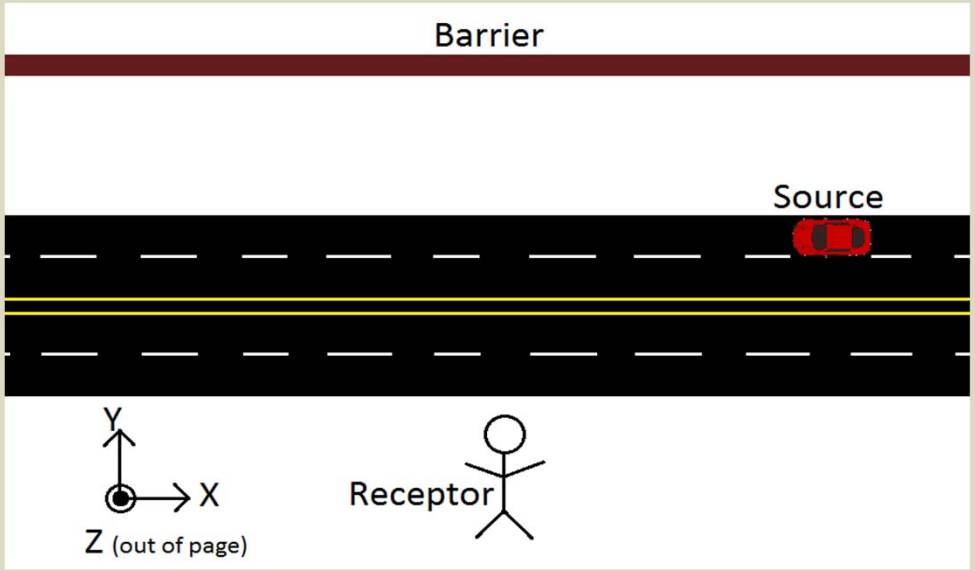
Source location

- Using the centerline of all traffic lanes provides an approximation of barrier reflection contribution from all lanes
  - Can be (but is not always) the center of the median

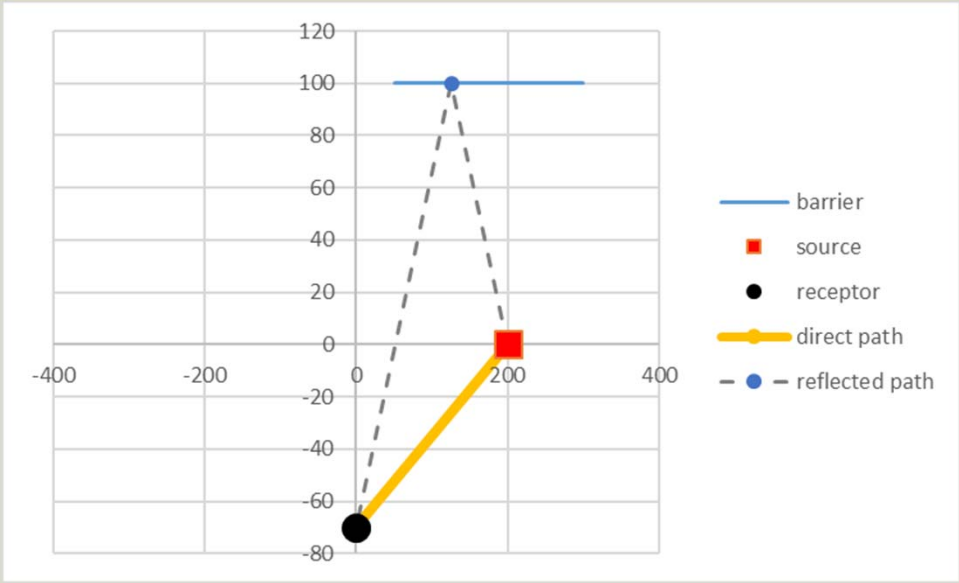
- "Direct Path Length" is the minimum, perpendicular distance between the centerline and the receptor



Source Offset

- Tool allows for calculations where the source is up- or down-stream of the receptor
  - Useful if barrier is not directly across the highway from the receptor

- An offset source will produce a larger noise increase due to the larger path difference
  - However, the direct path will not be as loud as for the zero offset location



Shielding

- Existing shielding can be added for direct- or reflected-path

- Locations with median barriers taller than the standard 32-inch safety barrier can be modeled with reflected shielding of 2 dB
  - Estimates for shielding from *anything* that blocks the line-of-site can be included

Standard Barrier (I-90)

Tall Barrier (Briley Parkway)

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Output

- Results are presented in terms of decibel increase in highway sound due to reflections

- The tool ***does not*** predict actual noise levels
  - Sound engineering judgement should be used when interpreting results

  - Background noise may render barrier-reflected noise increases as negligible, especially if the noise is 10 dB above traffic noise

Other considerations

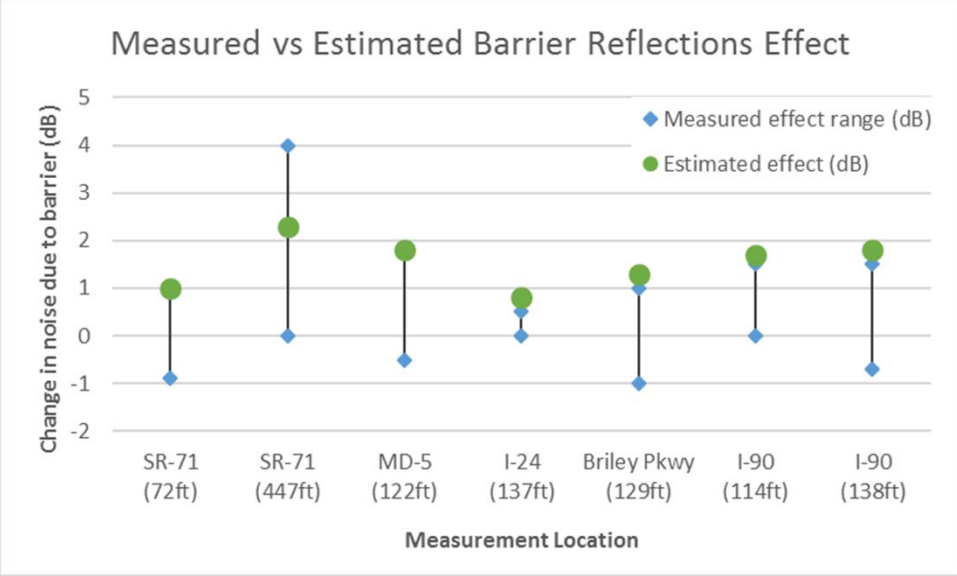
- Important factors that are not included in tool analysis:
  - Existing noise from other sources
  - Ground effects
  - Meteorological effects
  - Frequency-dependent propagation & comb filtering

- Results from tool most closely match unweighted decibel levels
  - This is also slightly more conservative than A-weighted results

Validation

- Estimates from screening tool were compared to unweighted effects measured during Phase 1

- SR-71 has a large range for measured values at 447 ft
  - Large distance allows for greater impact from meteorological conditions



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Conclusions

- Tool is preliminary – still under review by NCHRP
- Screening tool provides a conservative estimate of the increase in noise levels due to barrier reflections
  - Identifies areas where detailed analysis is not necessary
- Sound engineering judgement should be used when considering both the setup and results

Questions?