New Hampshire Department of Transportation Statewide Noise Barrier Evaluation

Presented to Transportation Research Board
ADC40 Committee on Transportation-Related Noise and Vibration
Summer Meeting – Minneapolis, MN July 24, 2017

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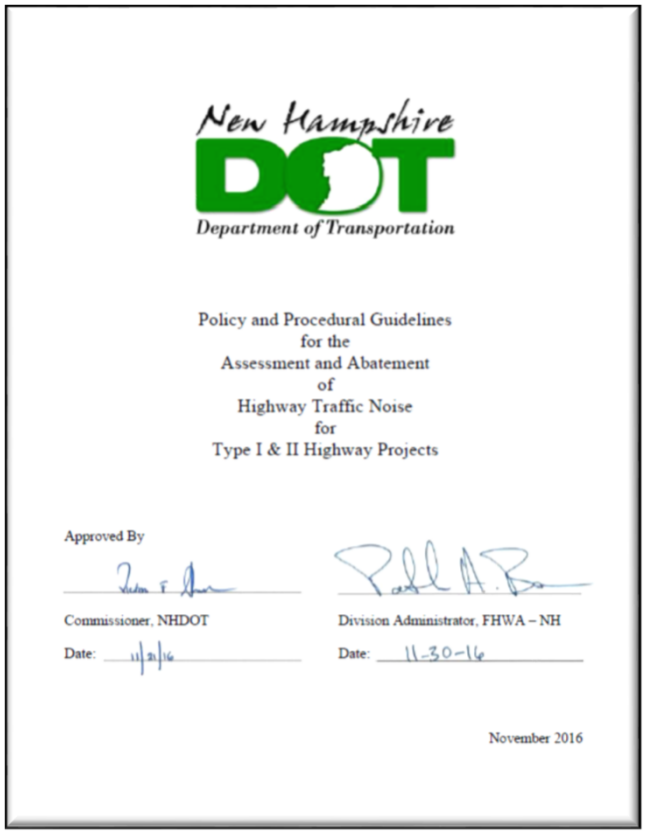
Presentation Overview

- Primary study goal:
  To Identify the locations, height, length and cost of noise barriers which may be feasible and reasonable under the 2016 NHDOT noise policy including a new Type II noise barrier policy
- Developed a screening procedure to estimate highway noise emissions from all Tier 1 highways across the state and evaluated distances to exceeding the Noise Abatement Criteria
- Investigated fundamental noise barrier design principles
  - How far back from a barrier can benefits be found?
  - How does the horizontal shielding angle of a noise barrier affect insertion loss?
  - How does existing terrain affect noise barrier effectiveness?
- Developed an easy method to access study results

Study Purpose

- Inform NHDOT administrators what the potential cost of noise barriers may be across the entire state

- Identify municipalities where noise barriers may be feasible and reasonable to facilitate outreach and coordination with local officials (such as local planning boards) for noise-compatible planning:
  - Type II program requires municipalities to enact planning and development regulations which require avoidance, minimization or mitigation of exterior noise impact for new noise-sensitive developments



New Hampshire DOT
Department of Transportation

Policy and Procedural Guidelines
for the
Assessment and Abatement
of
Highway Traffic Noise
for
Type I & II Highway Projects

Approved By

Commissioner, NHDOT
Date: 11/30/16

Division Administrator, FHWA – NH
Date: 11-30-16

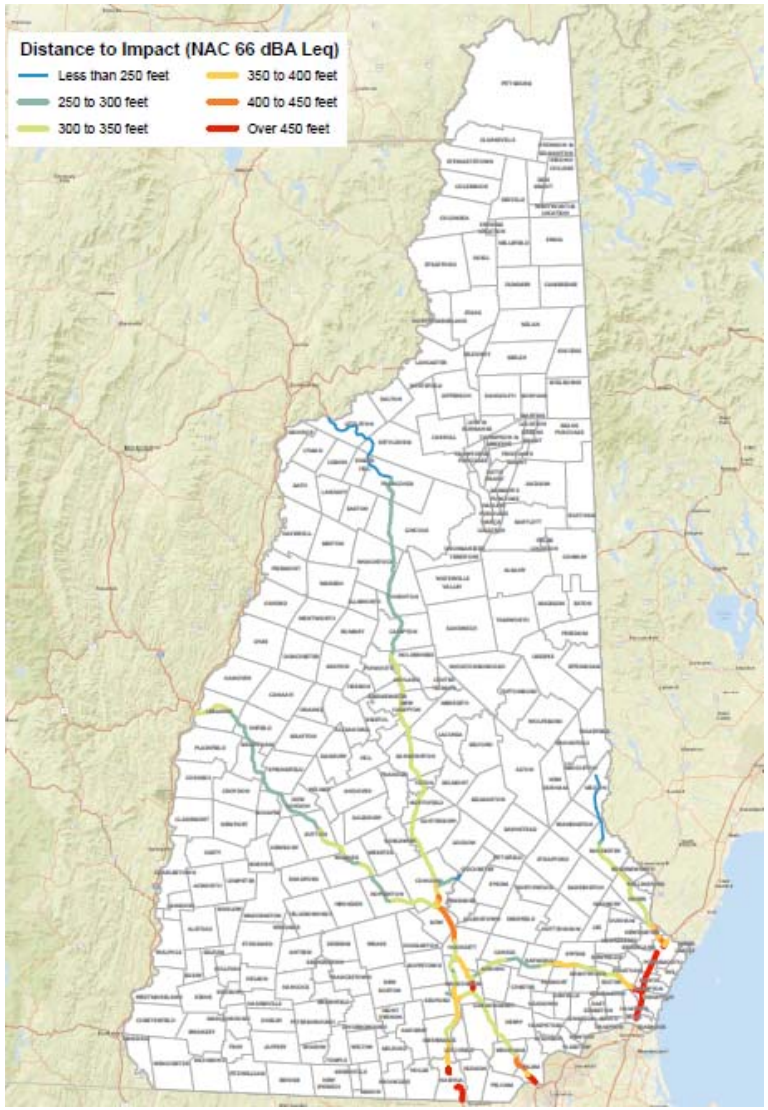
November 2016

Type II Barrier Eligibility Criteria

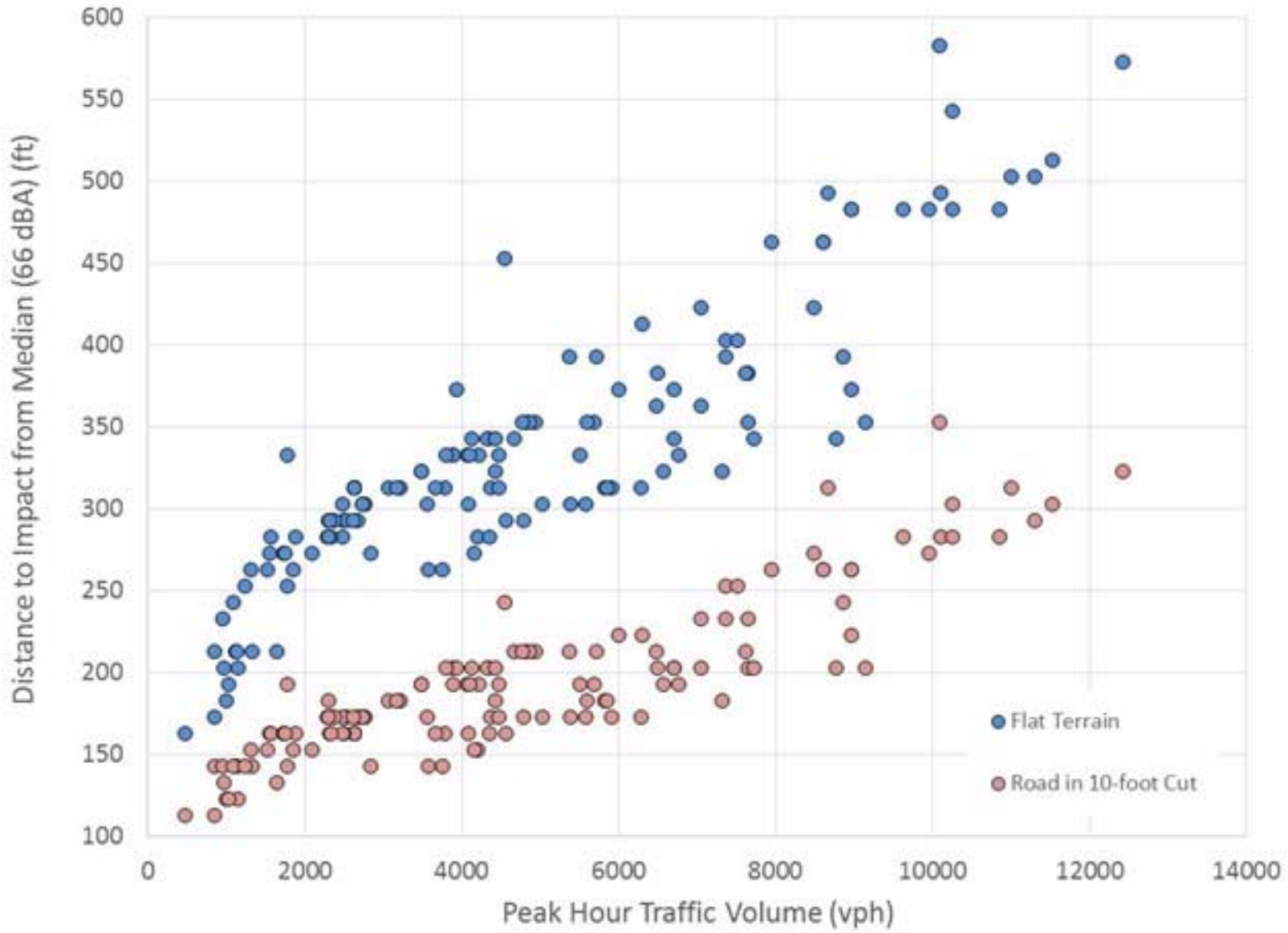
- Must be along existing Tier 1 highway (over 300 miles)
- Not eligible under a Type I project programmed under the 10-year Transportation Improvement Plan
- Not previously determined to not be feasible and reasonable under a previous detailed Type I or II noise study
- At least one benefited receptor must have been permitted prior to original opening year of the highway or November 1995
- The dimensional effectiveness index (square feet of barrier per receptor) must be below criterion that is adjusted negatively based on the percentage of receptors developed after November 1995 and adjusted positively based on the percentage that existed prior to the opening of the highway
- Detailed noise study conducted prior to recommendation

Highway Noise Levels

- Obtained traffic data from automated counters across the state and estimated peak-hour traffic volumes, speeds, vehicle type percentages, and roadway geometry (number of lanes and median width) for 137 exit-to-exit highway segments
- Calculated highway noise levels using TNM 2.5 assuming a semi-infinite straight highway for flat ground and for a 10-foot terrain cut
  - Computed noise levels up to 1,500 feet
  - Computed distance to Activity Category B NAC (66 dBA, Leq)

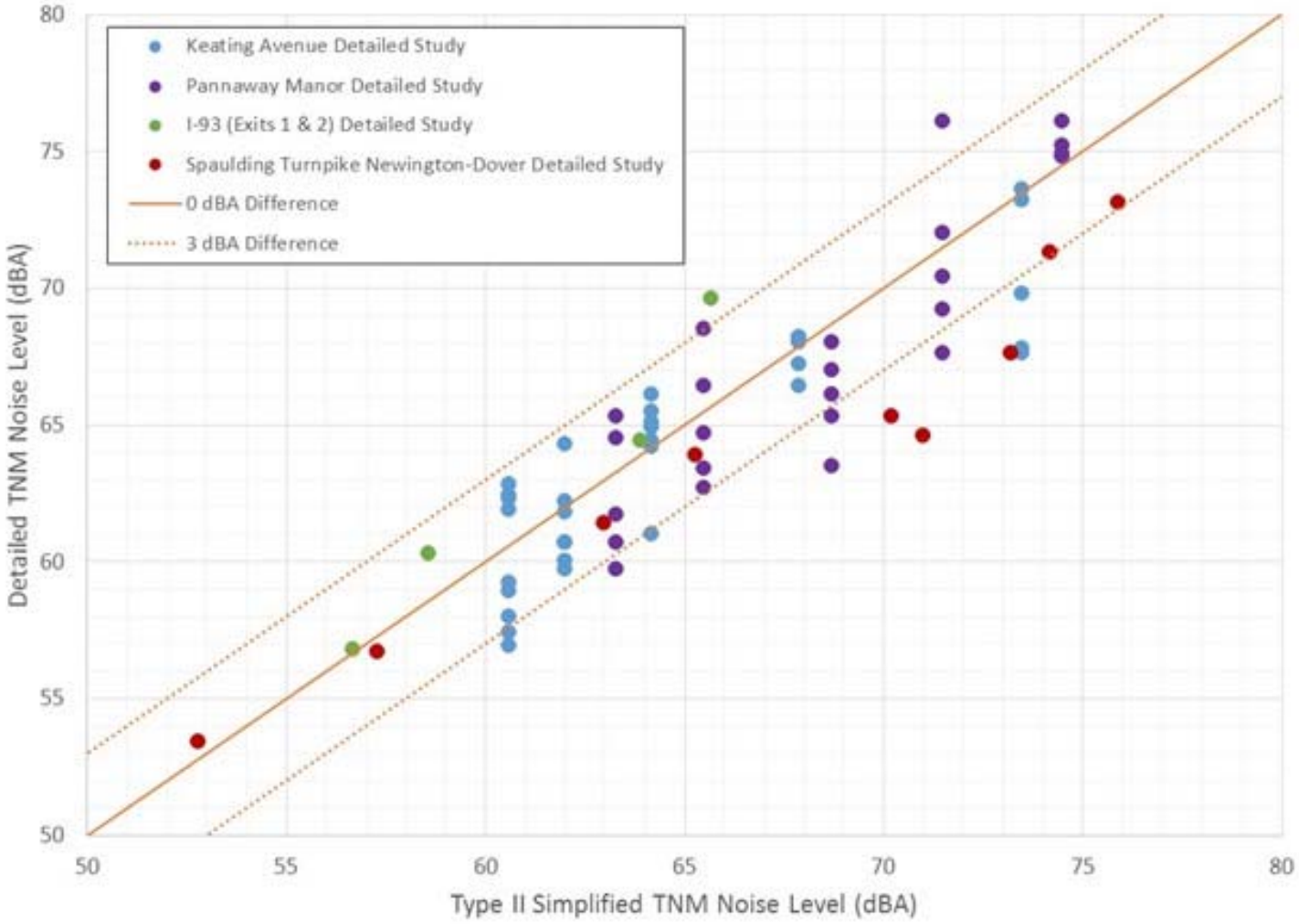


Highway Noise Levels



Highway Noise Levels

- Compare screening procedure results with detailed TNM runs with actual terrain and actual roadway geometry



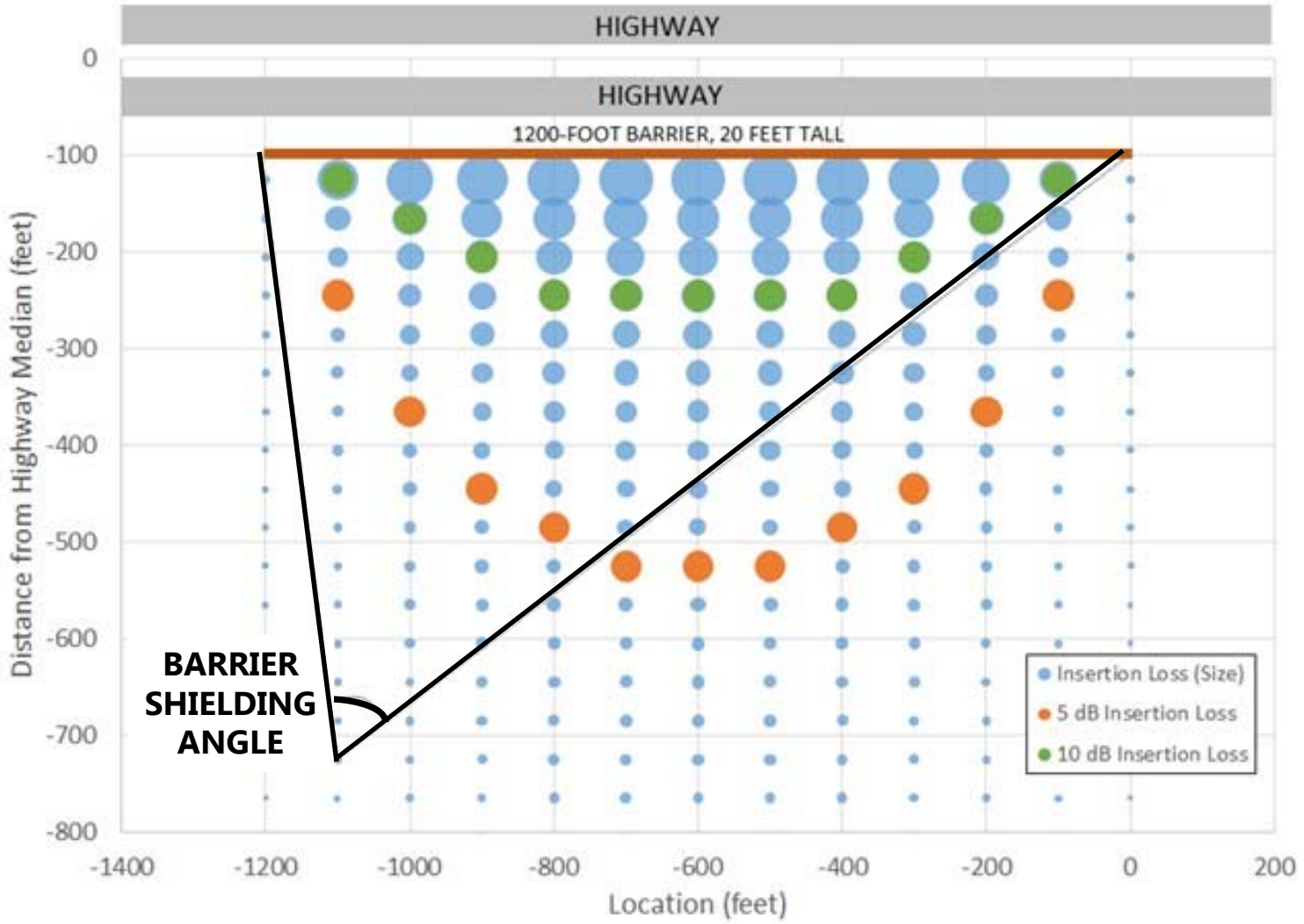
Identify Noise-Sensitive Receptors

- Statewide parcel and zoning data
- Analyzed US census tract data between 1950 and 2015 to estimate percentage of receptors that pre-date highway and were developed after 1995
- Estimated dwelling units at multi-family receptors from parking lots and Google Streetview
- Reviewed aerial photography to find missing receptors

Identified Over 30,0000 Receptor Locations Within 1500'

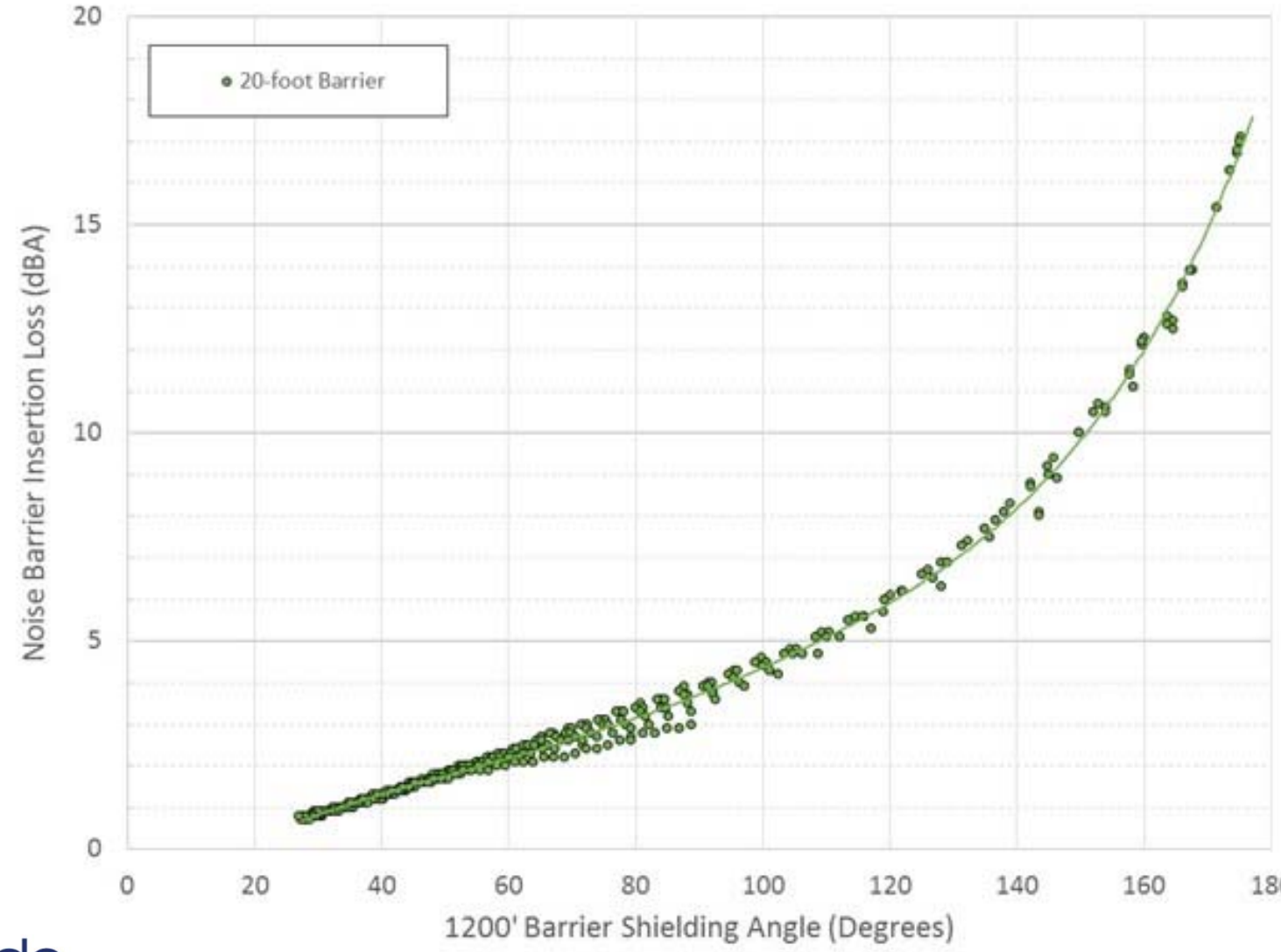
Noise Barrier Insertion Loss

- Computed insertion loss across a grid of receptors for various length and height barriers, terrain features and building rows



Noise Barrier Insertion Loss

- Analyzed insertion loss based on shielding angle …



For a given barrier height and a given terrain condition (such as flat), the insertion loss can be estimated based solely on the shielding angle!

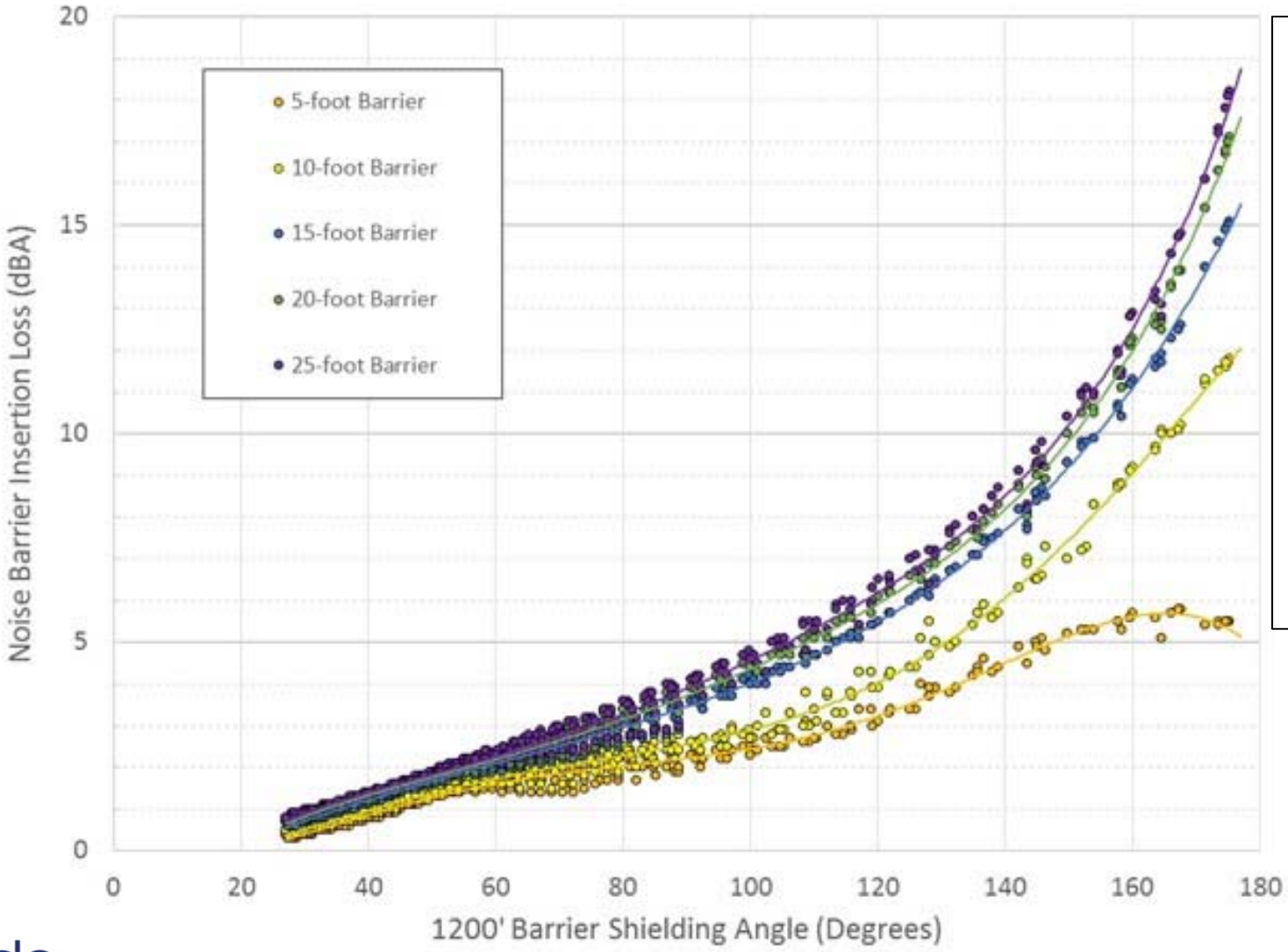
This relationship does not depend on the barrier length (evaluated 600 to 3,600-foot barriers)

Noise benefit can extend up to 1500 feet from long barriers!

Insertion loss effects due to side diffraction is not included in the FTA guidance manual barrier calculations

Noise Barrier Insertion Loss

- Analyzed different height barriers

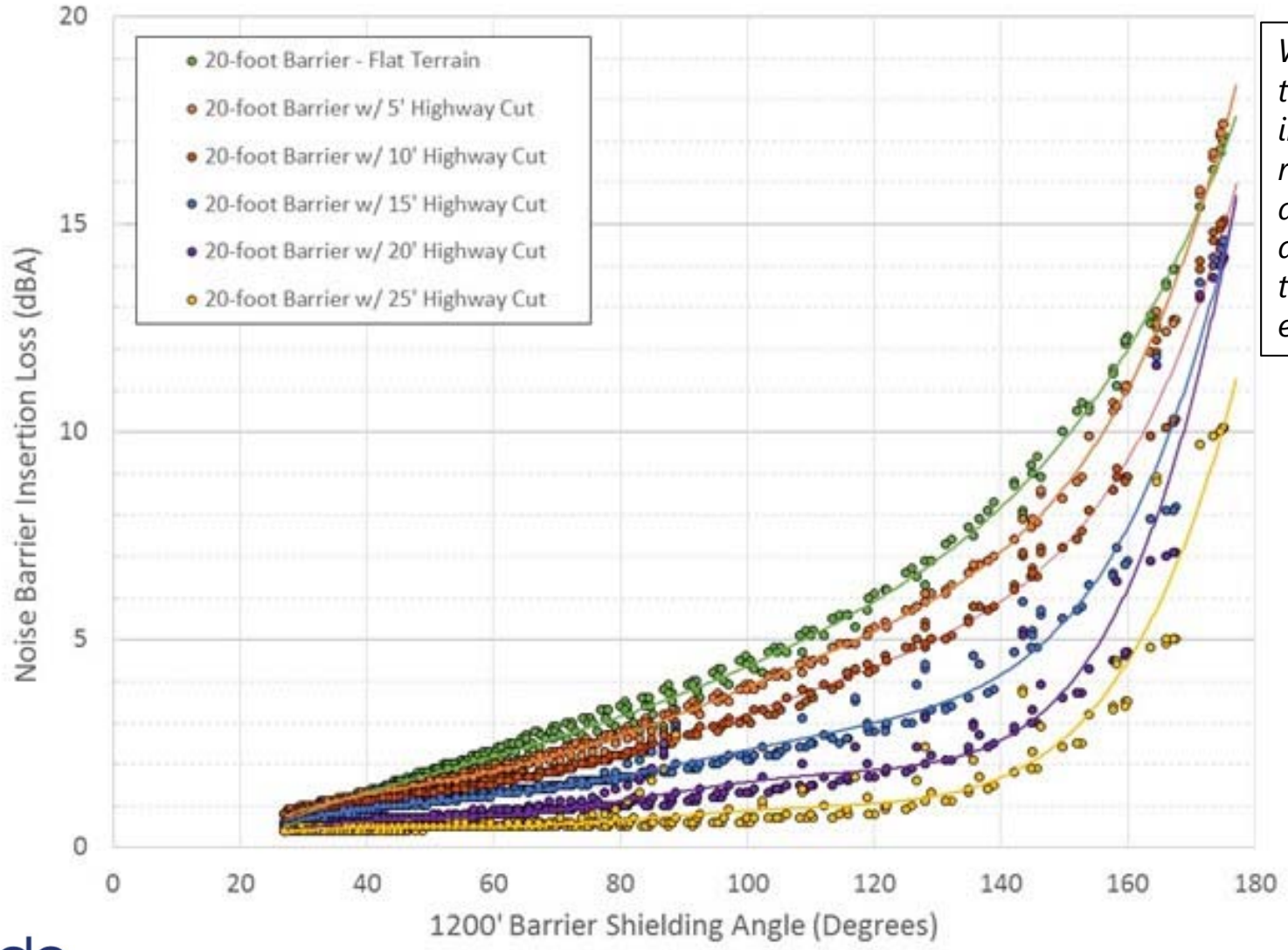


The length of a barrier can be more important than barrier height in TNM!

For example, increasing a barrier height from 15 to 25 feet may only increase IL by 1 dB while extending it for 20 degrees more shielding can increase IL by 2-3 dB

Noise Barrier Insertion Loss

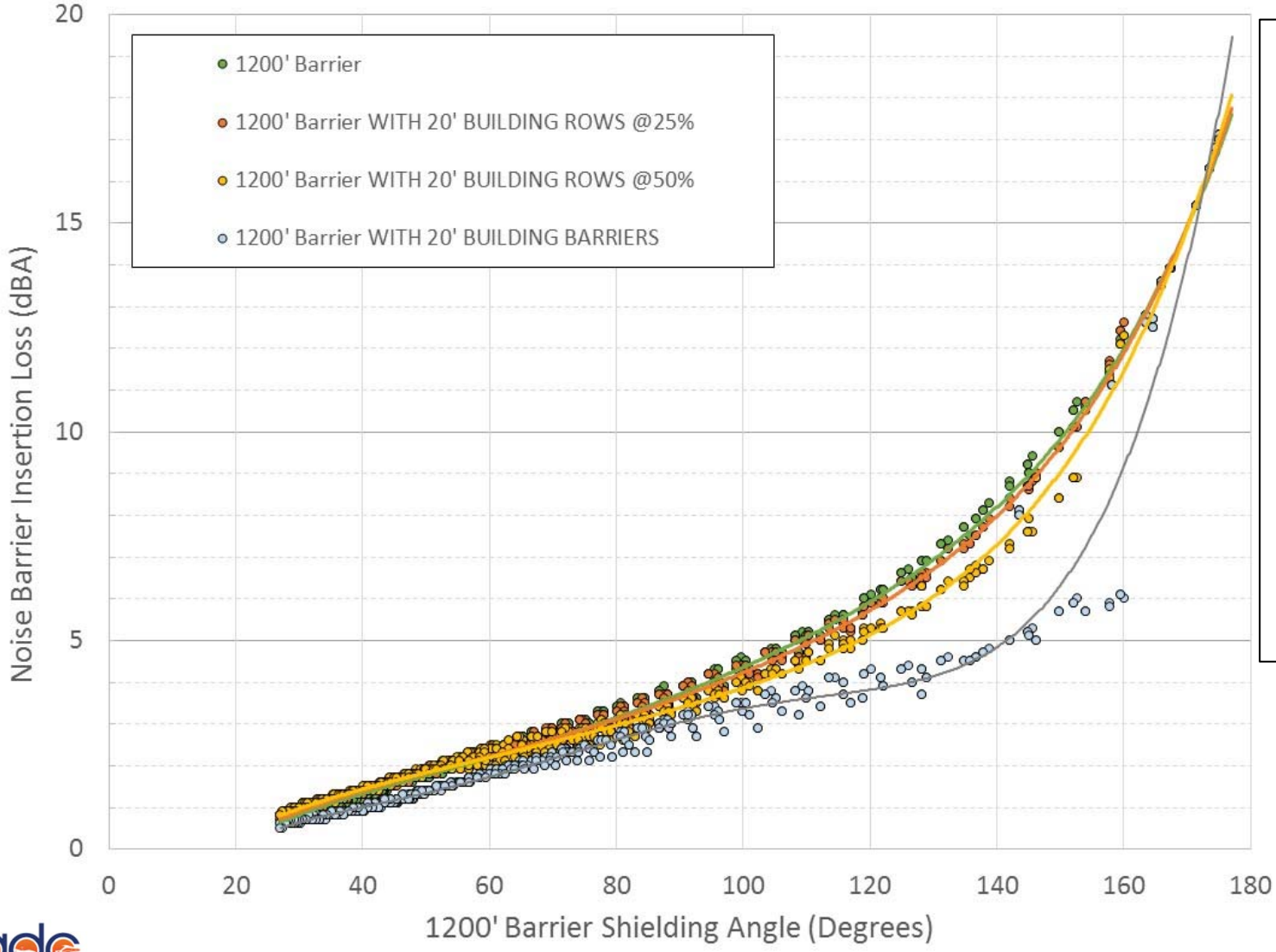
- Evaluated highway cuts / terrain ….



When terrain breaks the line-of-sight, insertion loss is reduced substantially and it is more difficult for barriers to be acoustically effective

Noise Barrier Insertion Loss

- Evaluated intervening building rows and barriers…

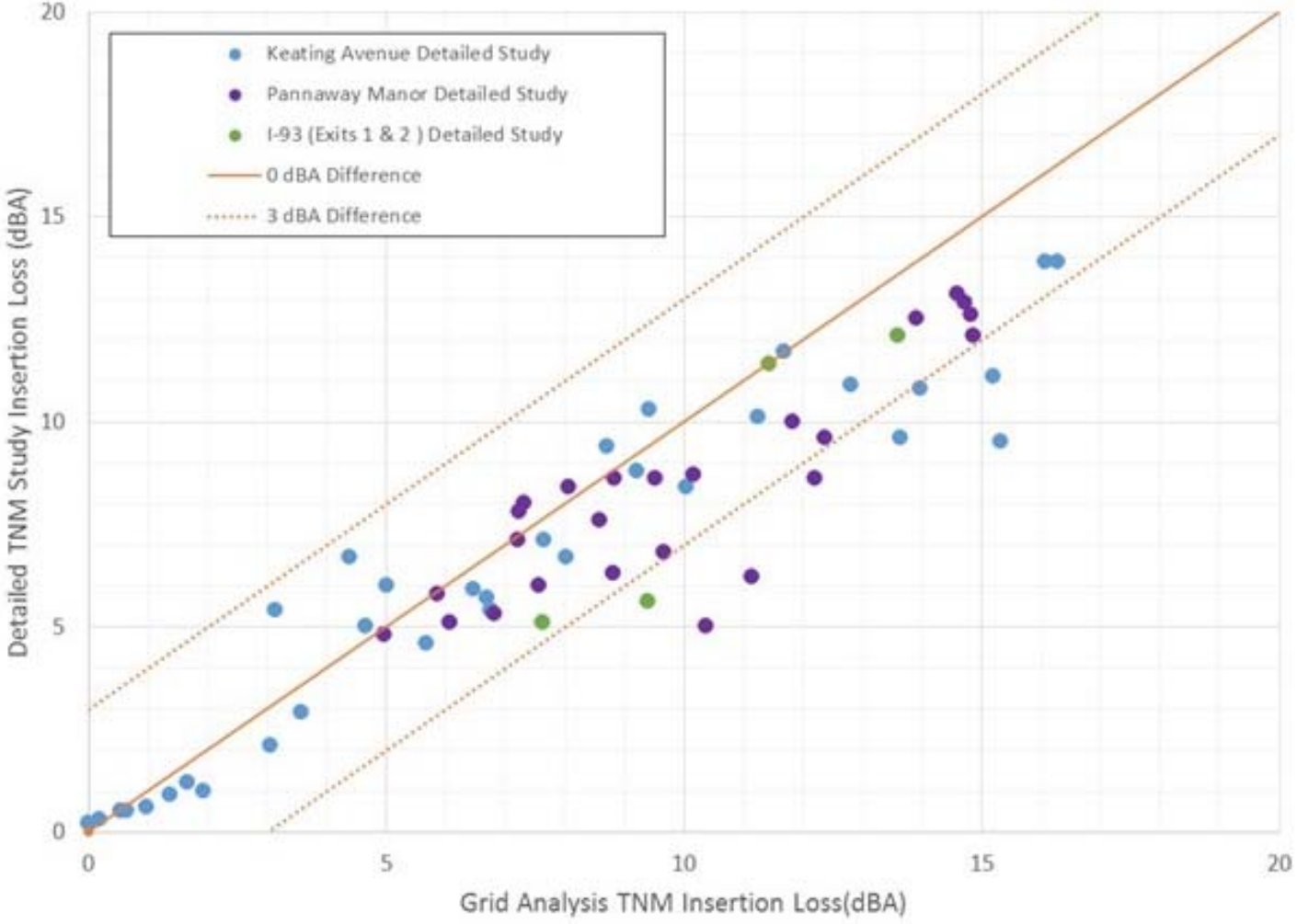


Building rows do not affect insertion loss substantially because they reduce noise levels similarly with and without a barrier

Buildings modeled as barriers have a more significant effect on insertion loss and are more likely for barriers to not be acoustically effective

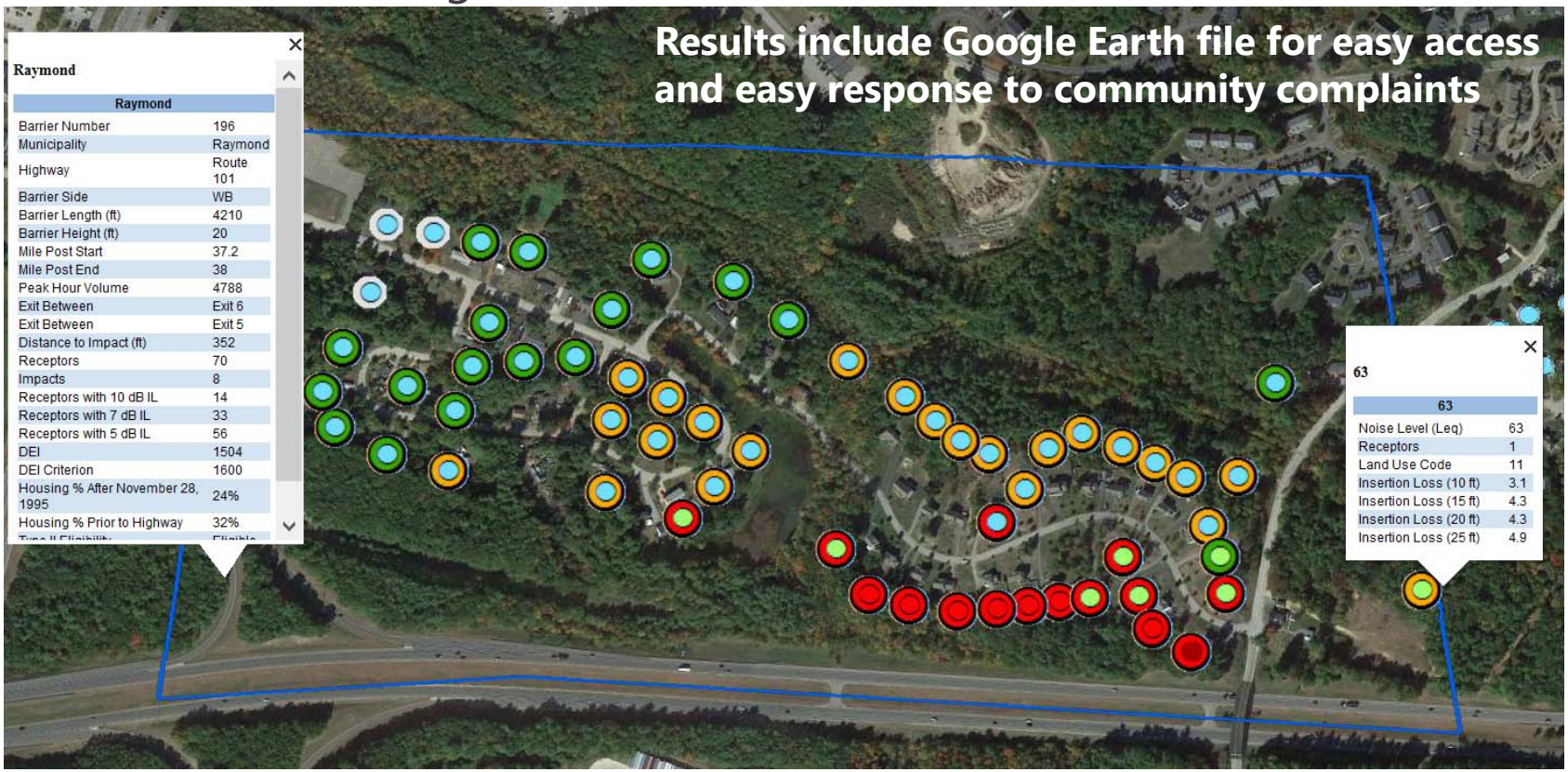
Noise Barrier Insertion Loss

- Compare results from grid analysis to detailed TNM runs



Acoustical and Cost Effectiveness

- Identified 300 noise barrier study areas where receptor clusters exceed the NAC and computed acoustical and cost effectiveness for every receptor based on distance to highway, shielding angle and barrier height



Summary of Results

Type II Noise Barrier Results:

- 50 Type II Noise Barriers for a total length of 37 miles and a cost of $124 million (at $30/SF) may be eligible (feasible and reasonable)
  - Municipalities with potentially eligible Type II barriers narrowed to 20 to aid public outreach and noise-compatible planning efforts

Highway Noise Level and Noise Barrier Design Principle Findings:

- Distance to NAC typically 250 to 500 feet for 2,000 to 10,000 vehicles per hour for flat ground without intervening features
- For a given barrier height and a given terrain condition, insertion loss can be determined based solely on the shielding angle for screening
- Extending barrier length may be more effective than increasing height
- When terrain already breaks line-of-sight, insertion loss is substantially lower
- Building rows have a relatively low effect on insertion loss
- Noise barrier benefit can extend up to 1500 feet for long barriers

Photo: Ken Gallagher

Questions?

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