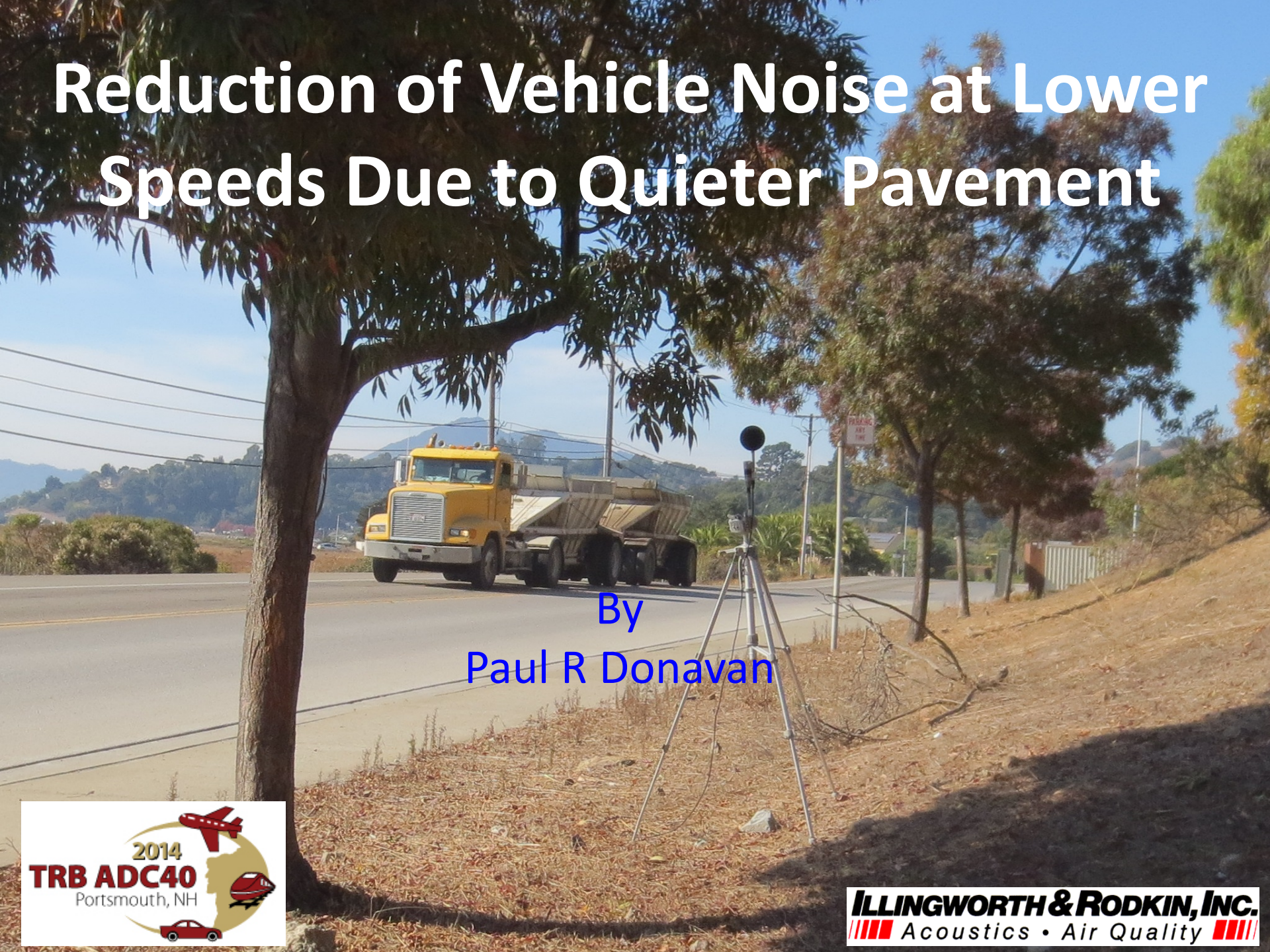
Reduction of Vehicle Noise at Lower Speeds Due to Quieter Pavement



By

Paul R Donavan

2014 TRB ADC40 Portsmouth, NH

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality

Project Description

- Noise complaints along Pt. San Pedro Road in Marin County, CA
- Quarry traffic along 4 mile road to freeway
- Primary issue – heavy duty trucks

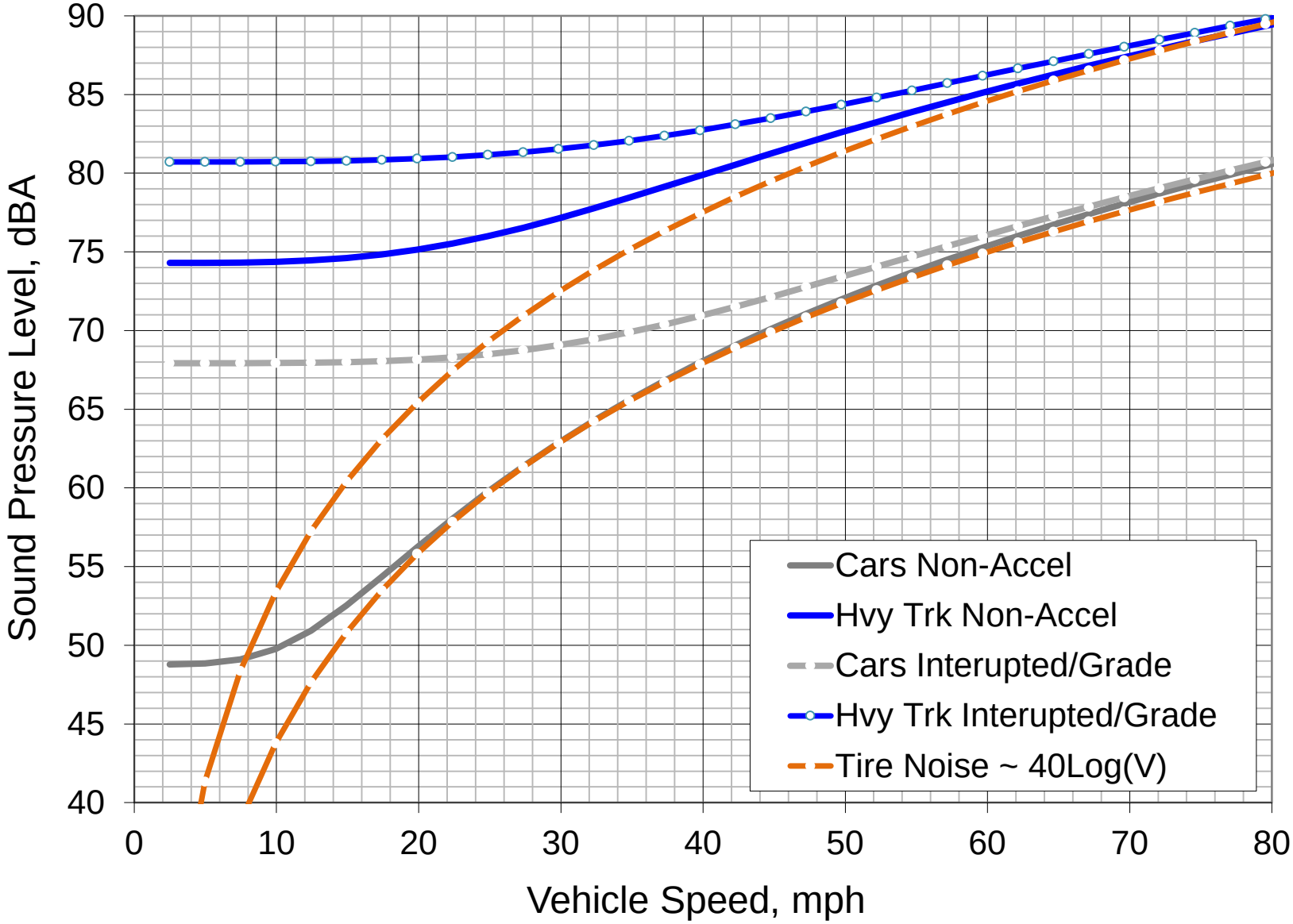
Project Description

- Evaluate quieter pavement on a ½ mile test section prior to repaving 4 miles
- Traffic includes light vehicle, heavy and medium trucks
- Operating conditions near quarry entrance:
  - Cruise
  - Acceleration (away from quarry entrance)
  - Deceleration (approaching quarry entrance)
  - 35 mph posted speed limit

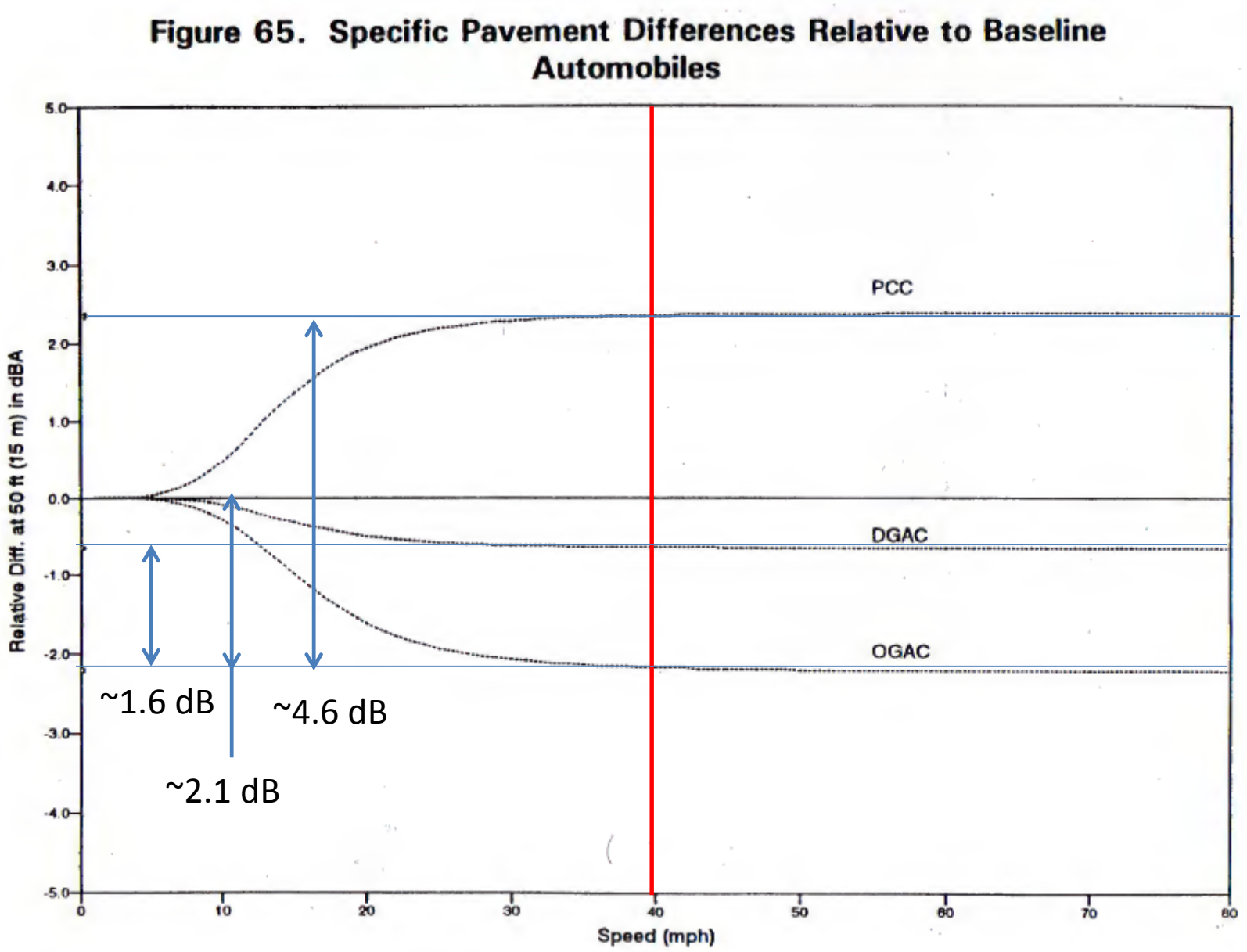
Noise Abatement Issues

- At lower speeds, vehicle noise has lower contribution of tire noise
- Under acceleration, even lower contribution of tire noise
- Danish experience with thin porous layers at lower speed:
  - 2.9 dB reduction for light vehicles (37 mph)
  - 1.2 dB reduction for heavy trucks (35 mph)

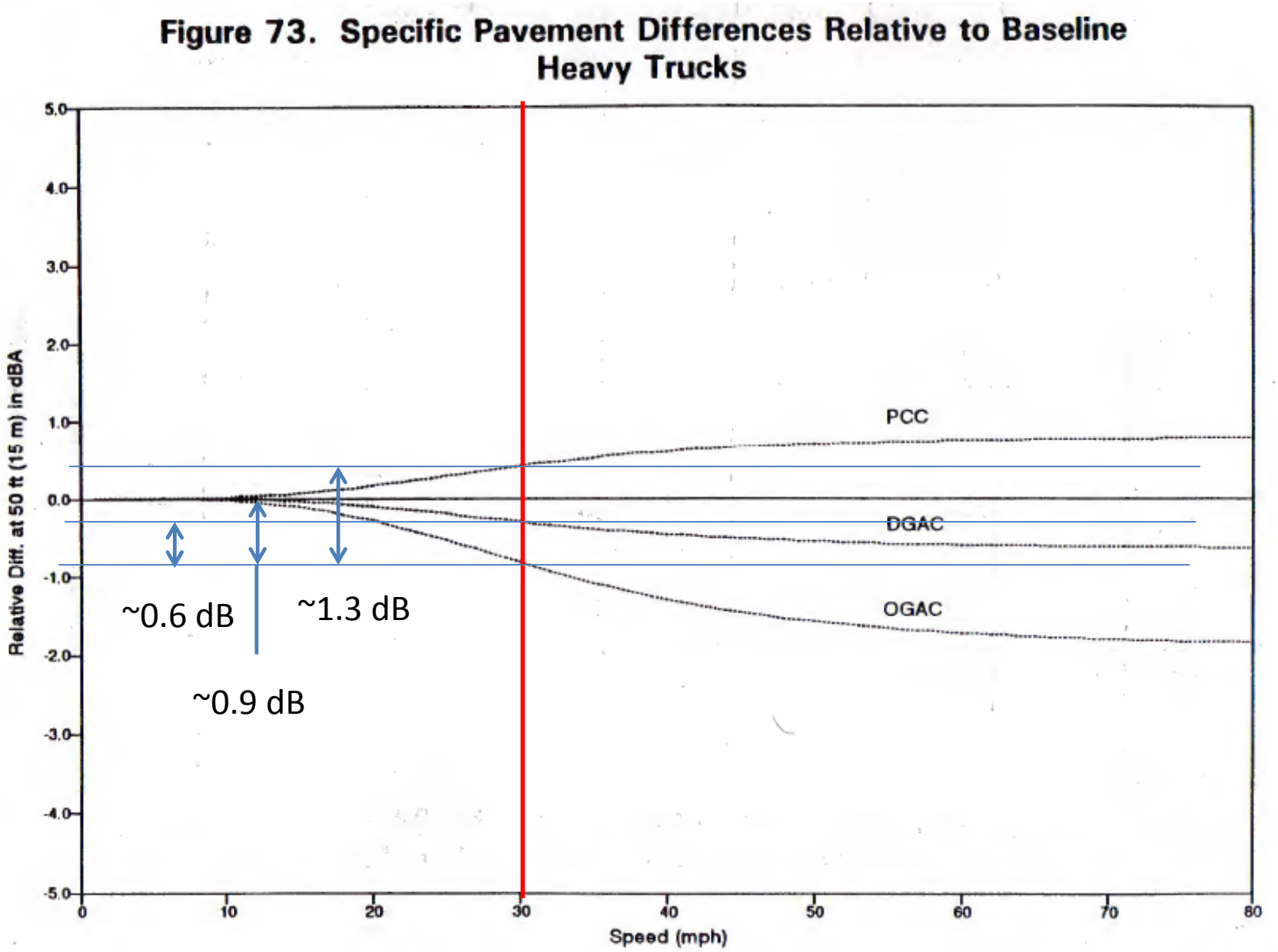
REMELS Database – Average Pavement



REMELS Database



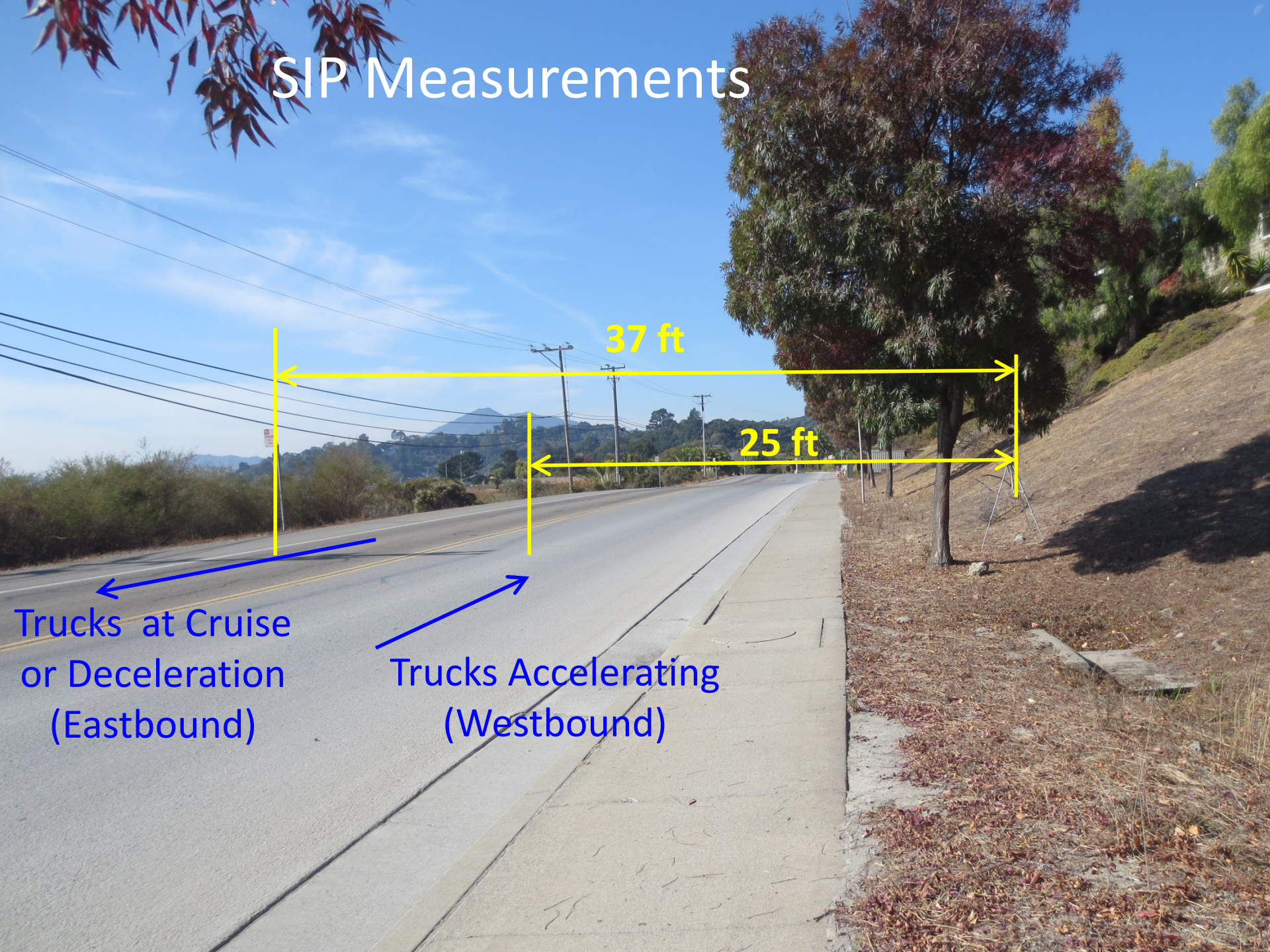
REMELS Database



Measurements

- Statistical Isolated Pass-by
- 10 minute Leq & traffic counts
- On-Board Sound Intensity at 35 mph

SIP Measurements



Pavement

- New OGAC design same as porous pavement used on US 101 (Reported July 2013)
- Smaller maximum aggregate size
  - ⅜” on Pt San Pedro Road
  - ½” on US 101
- 1” thick overlay

Measurement Details

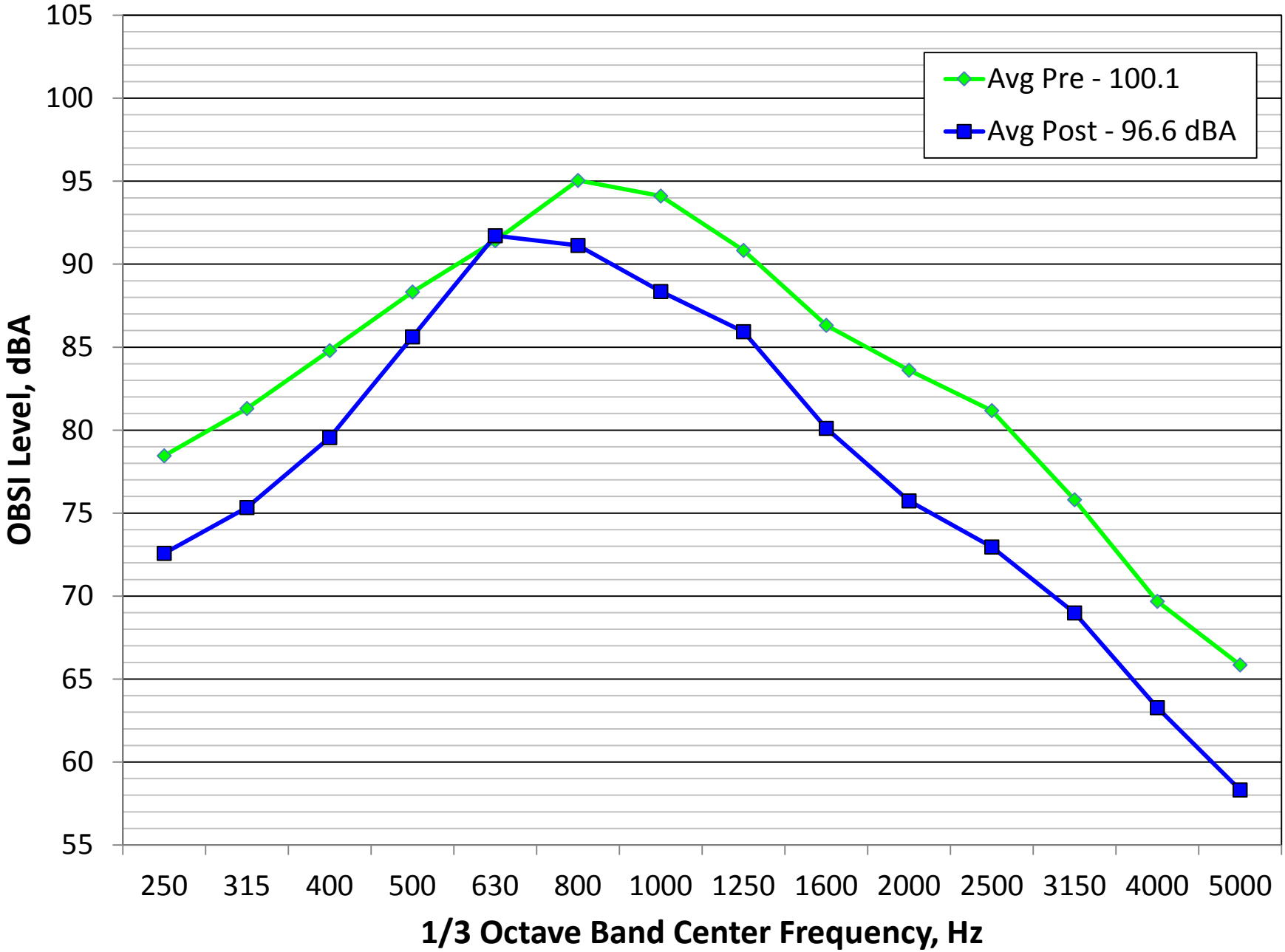
Pre-Overlay

- October 24 & 25, 2013, 8 to 11 am both days
- Mid/upper 50's°F, calm wind
- OBSI on the 24th – sampled on 6 segments

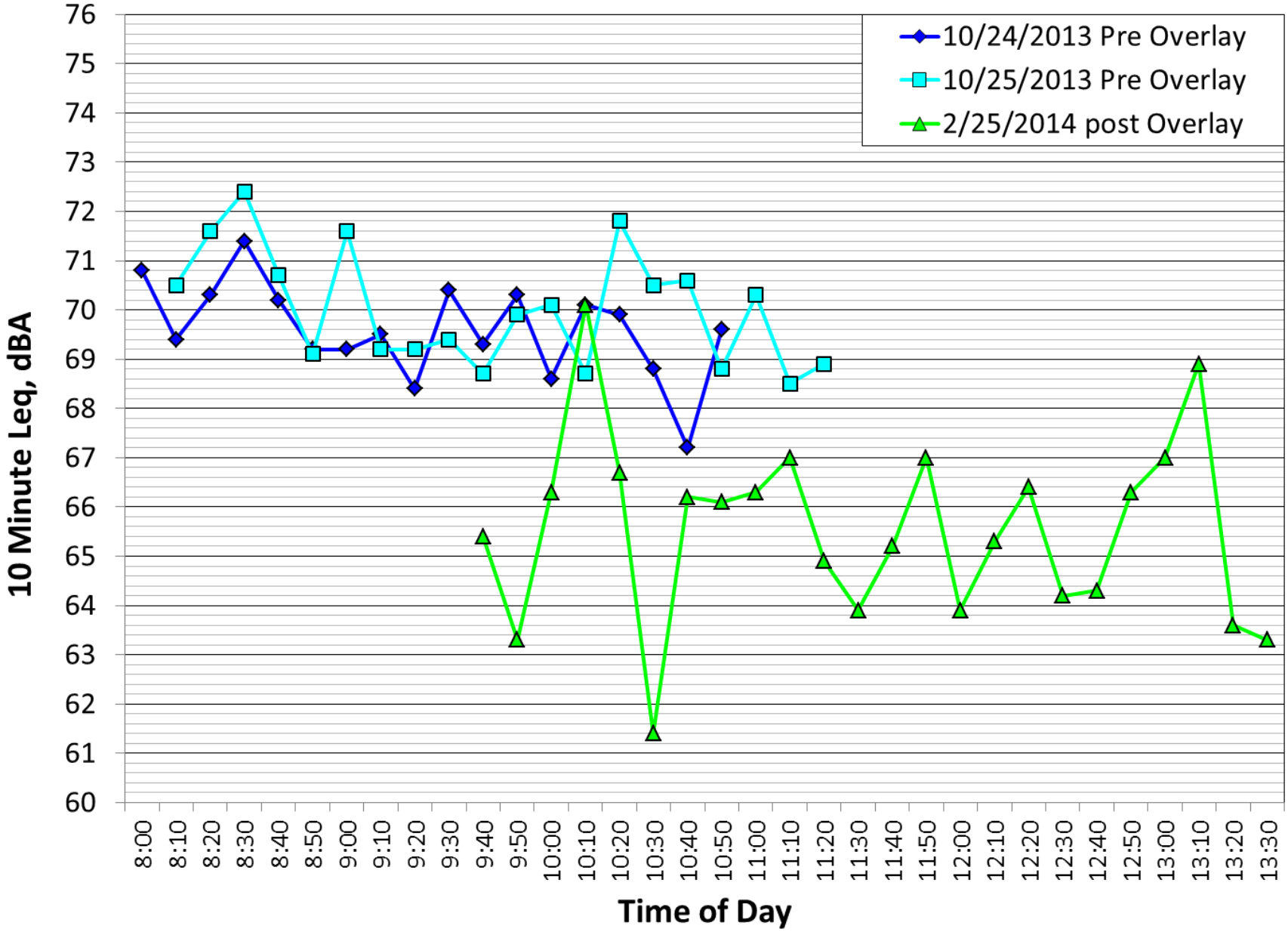
Post-Overlay

- February 25, 2014, 9 am to 2 pm
- Mid/upper 50's°F, occasional wind 6 to max of 8 mph parallel to roadway
- OBSI on January 31, 2014 at 58°F

OBSI Results



10 Minute L_{eq} Levels

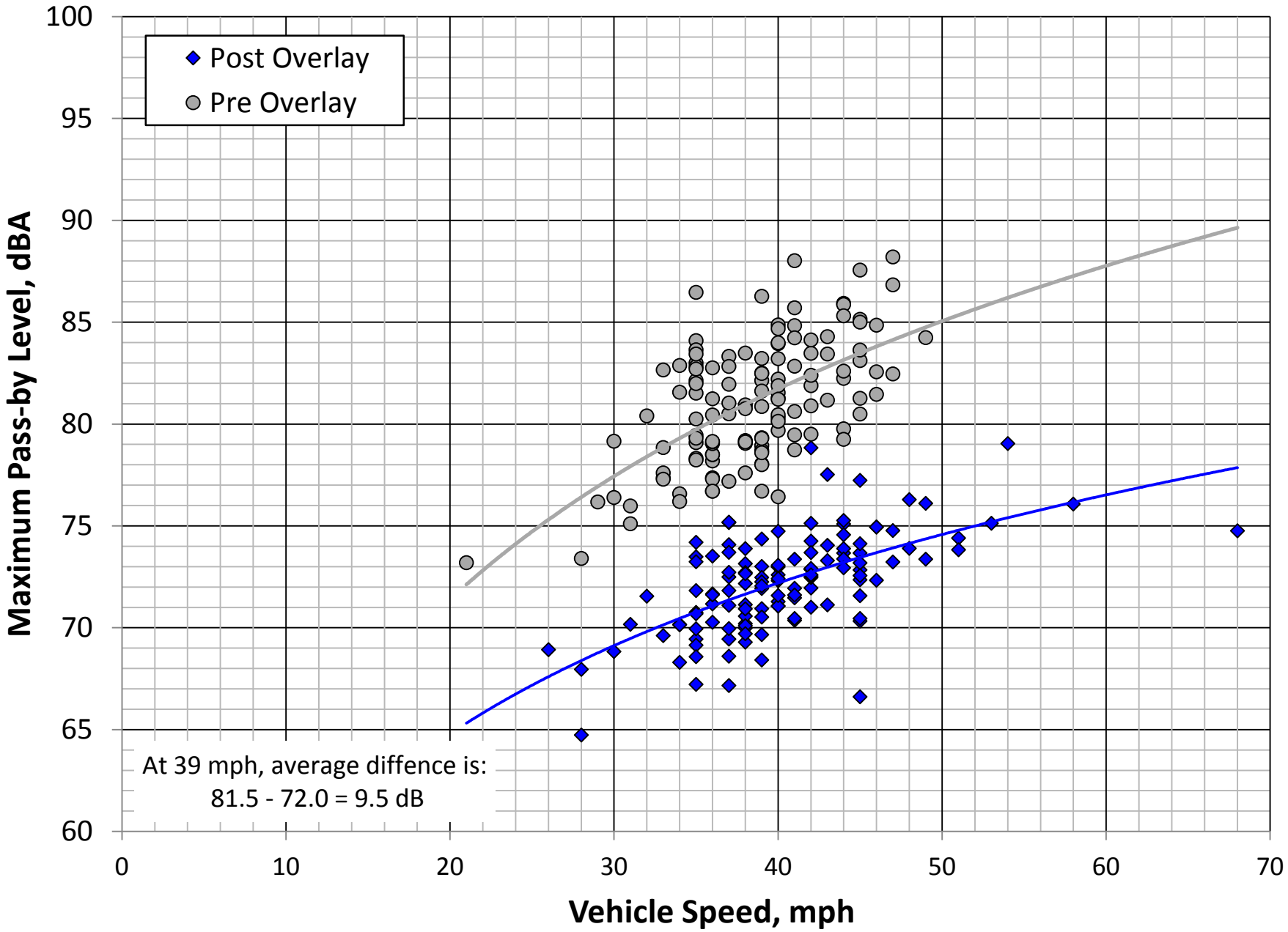


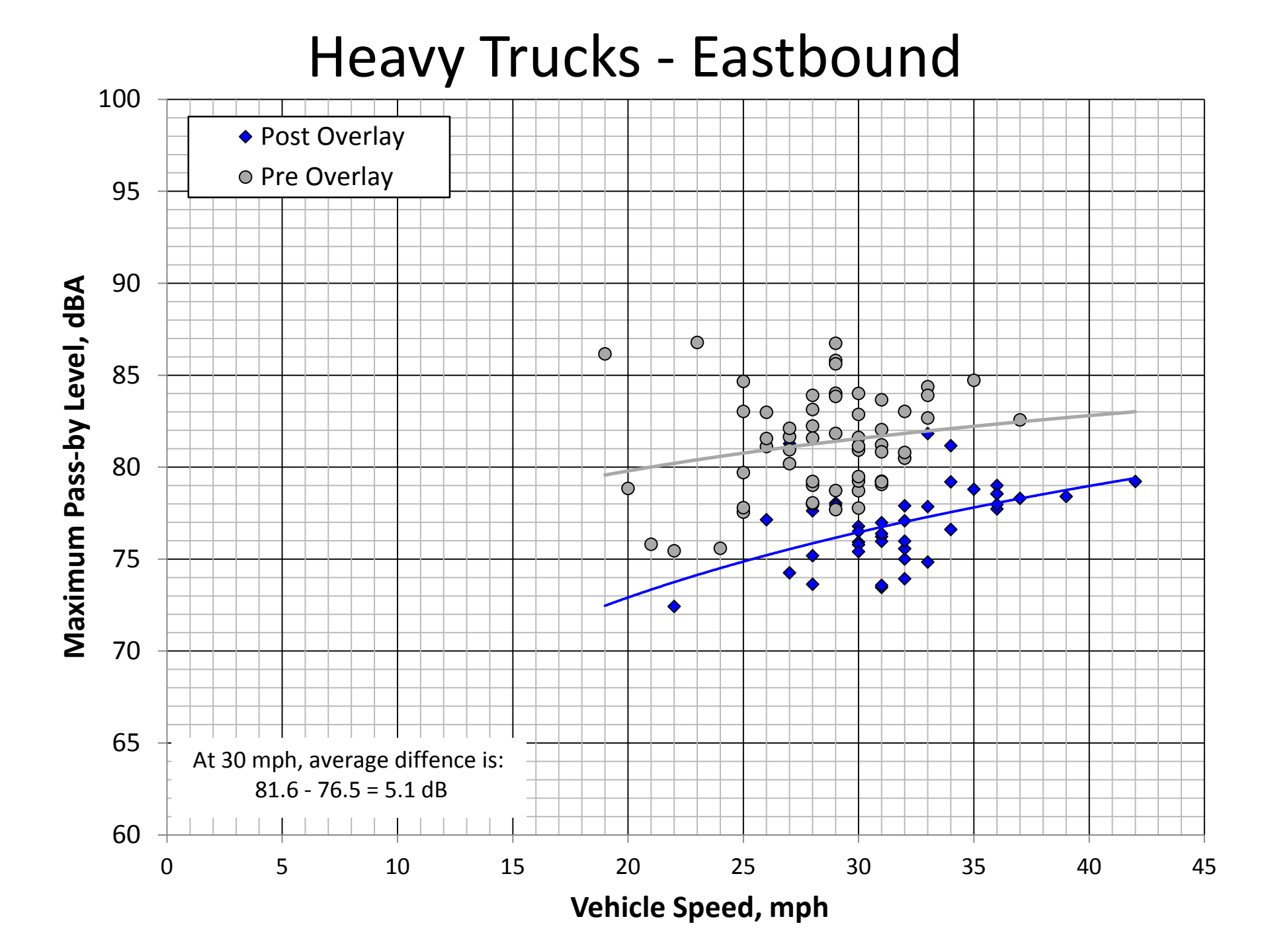
Comparison of L_{eq} Results

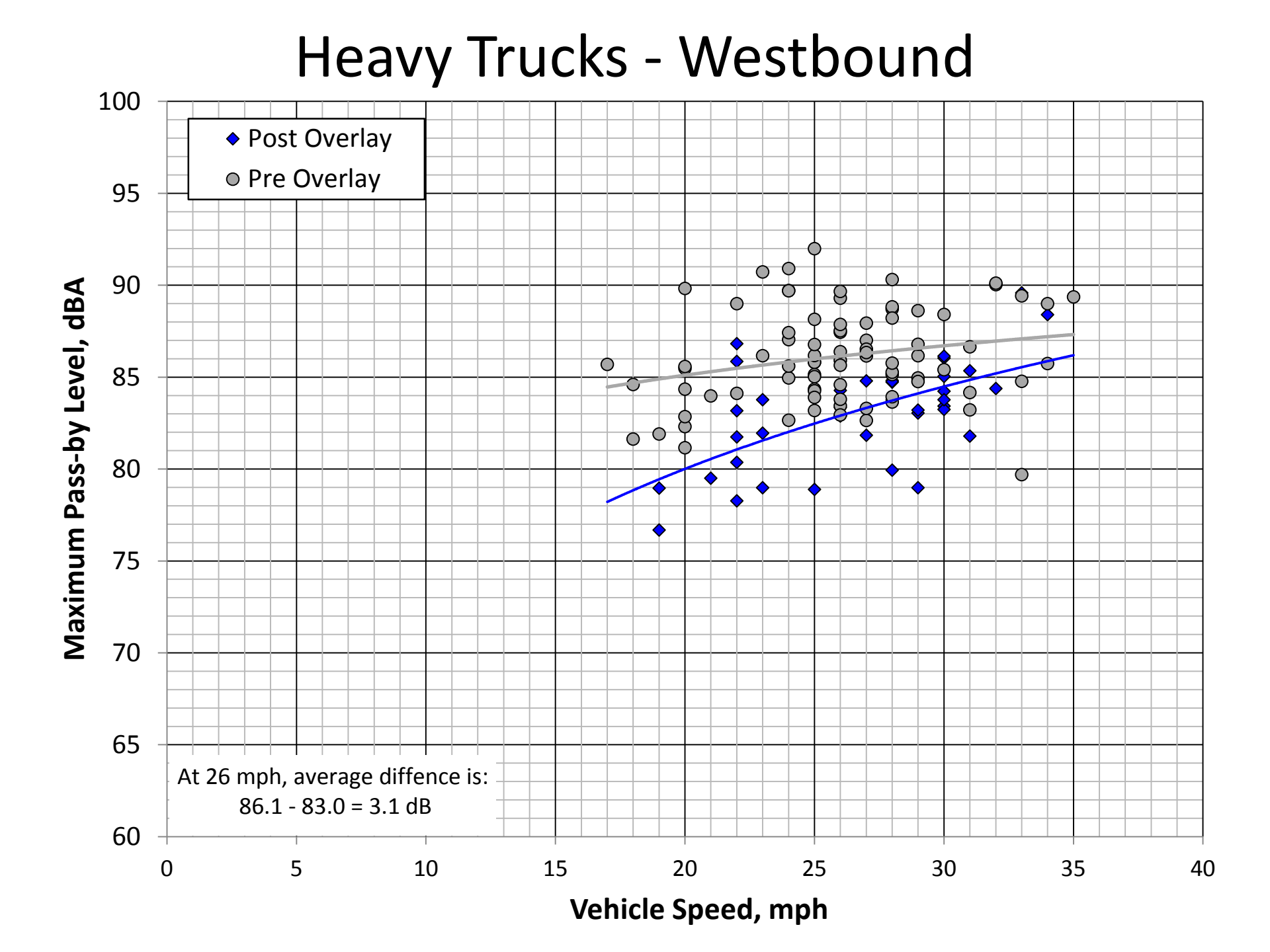
- Somewhat lower truck volumes for post-overlay measurements
- Comparison constructed from 10 minute intervals with the same truck count
- Light vehicle counts were the same for pre- & post-overlay measurements
- Average difference:

5.0 dB

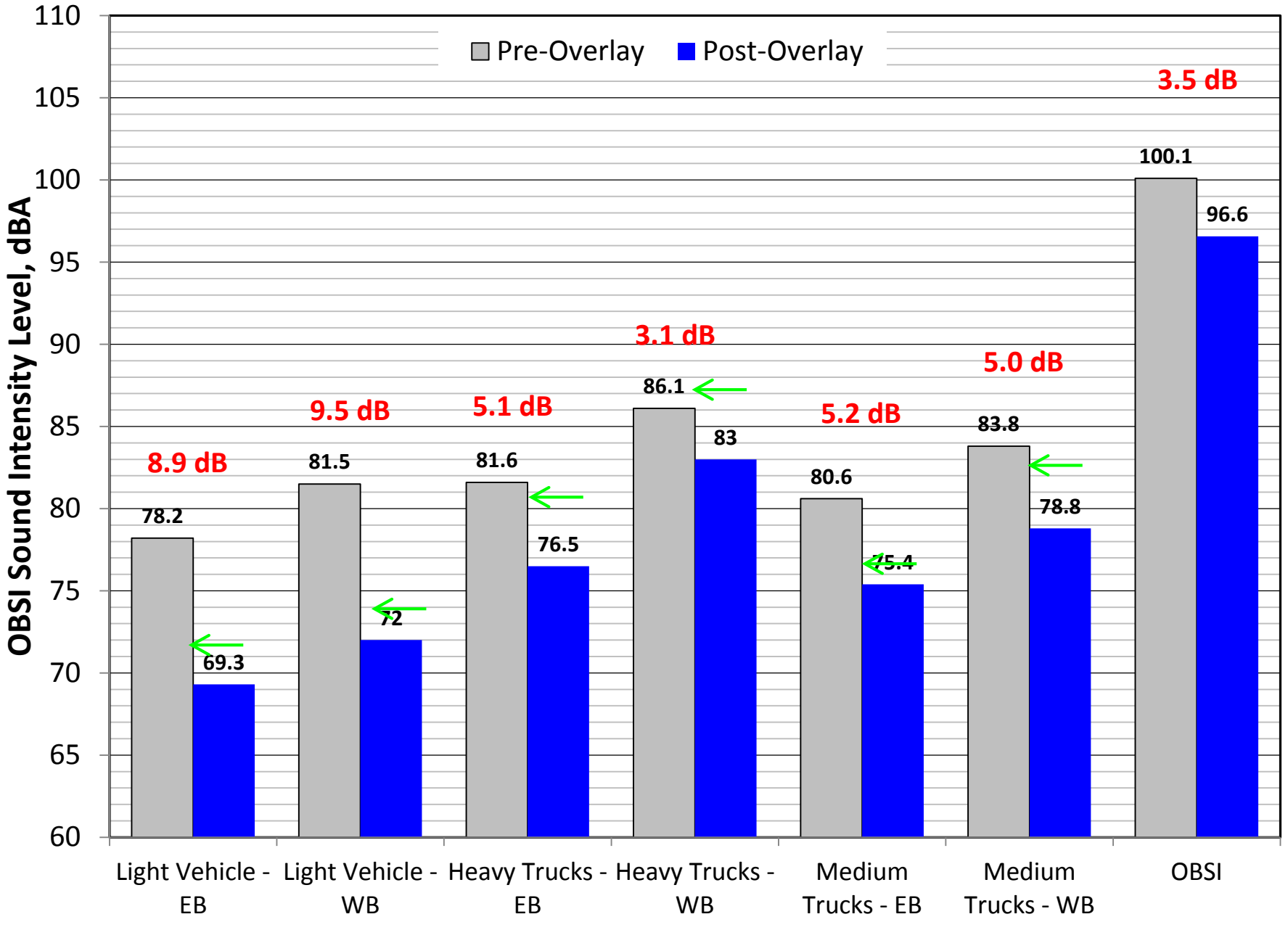
Light Vehicles - Westbound



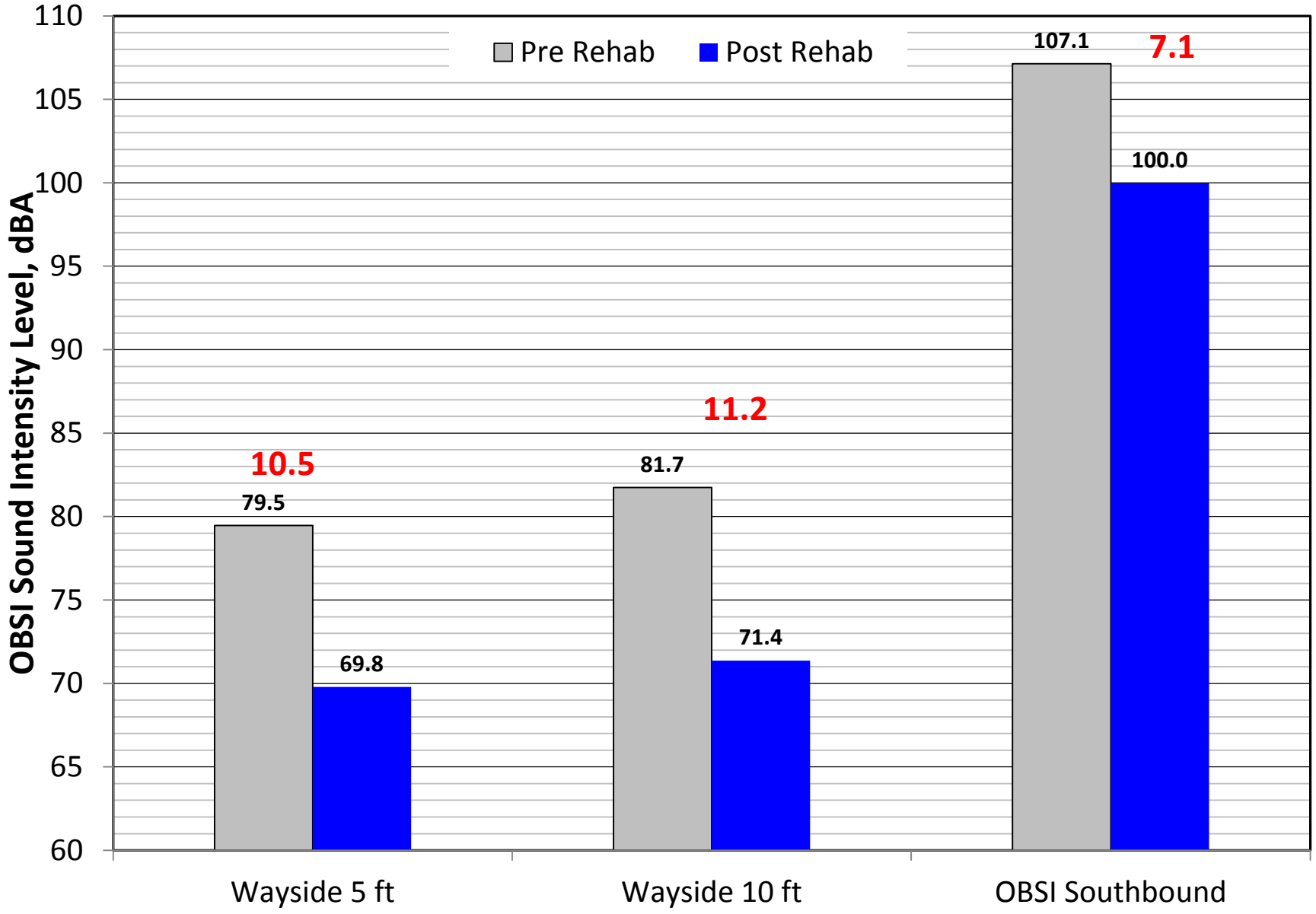

Heavy Trucks - Eastbound
Post Overlay
Pre Overlay
Maximum Pass-by Level, dBA
100
95
90
85
80
75
70
65
60
0
5
10
15
20
25
30
35
40
45
Vehicle Speed, mph
At 30 mph, average diffence is:
81.6 - 76.5 = 5.1 dB


Heavy Trucks - Westbound
Post Overlay
Pre Overlay
Maximum Pass-by Level, dBA
Vehicle Speed, mph
100
95
90
85
80
75
70
65
60
0
5
10
15
20
25
30
35
40
At 26 mph, average diffence is:
86.1 - 83.0 = 3.1 dB

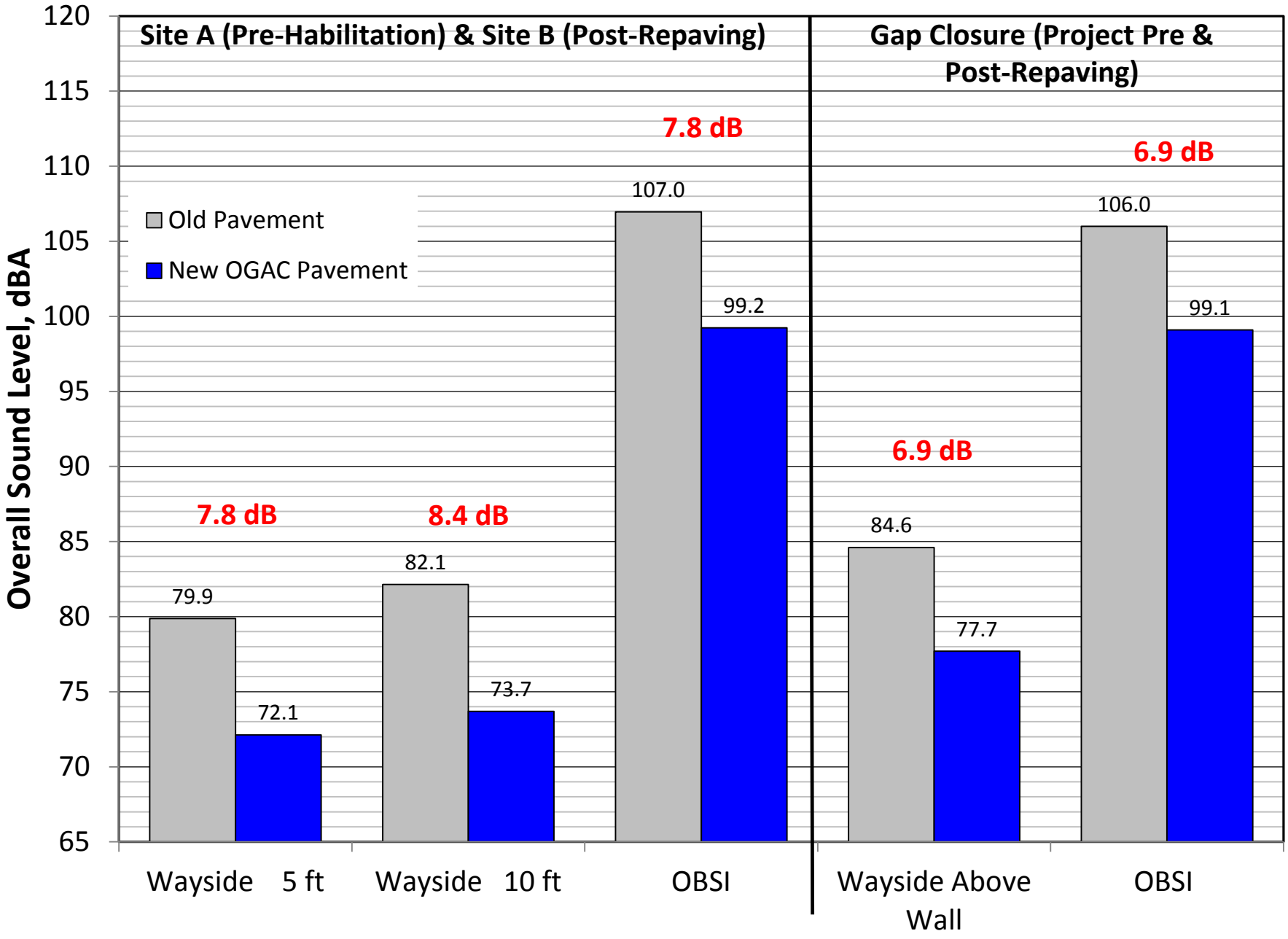
Pre- & Post-Overlay



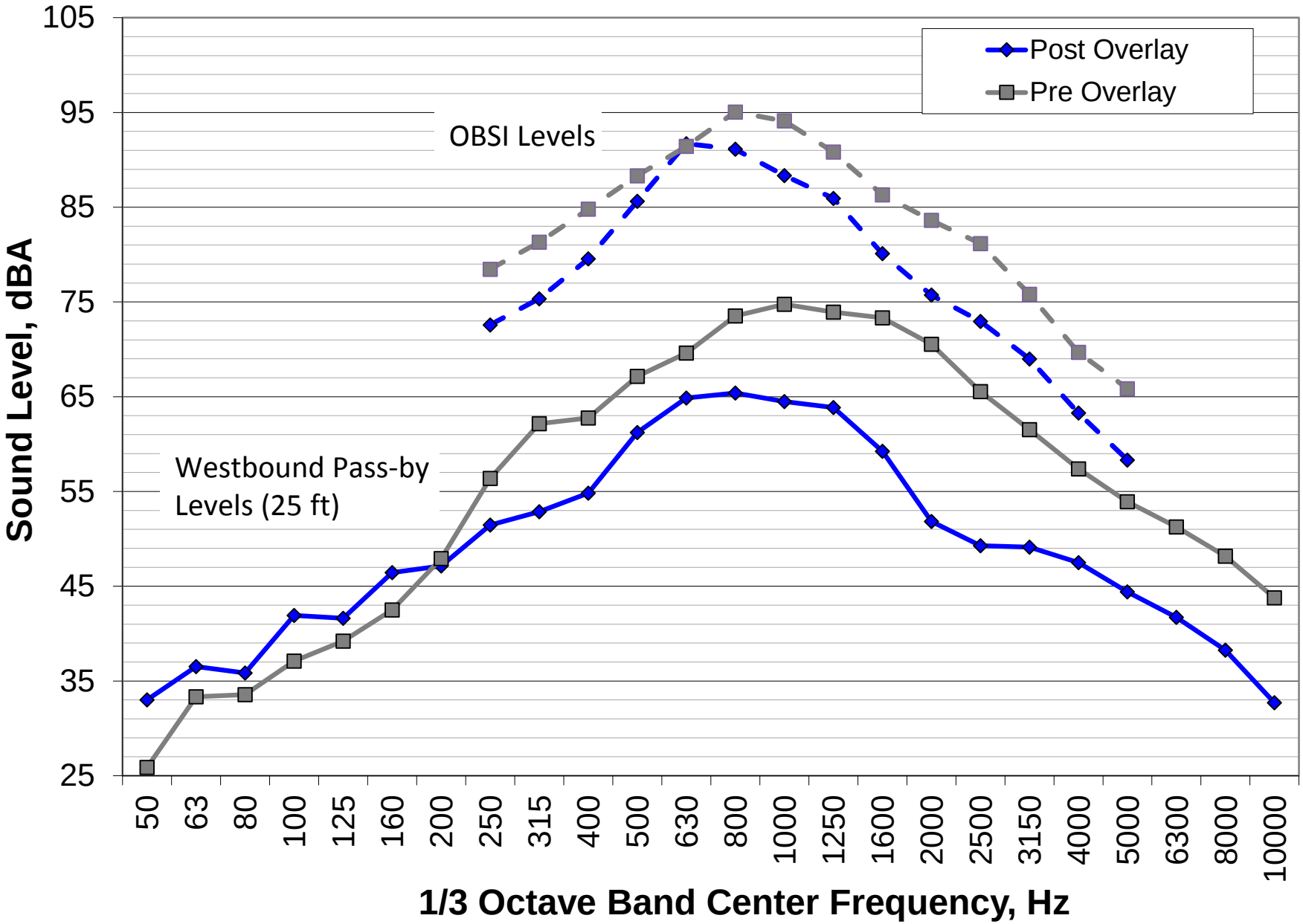
US 101 Noise Reductions - Porous



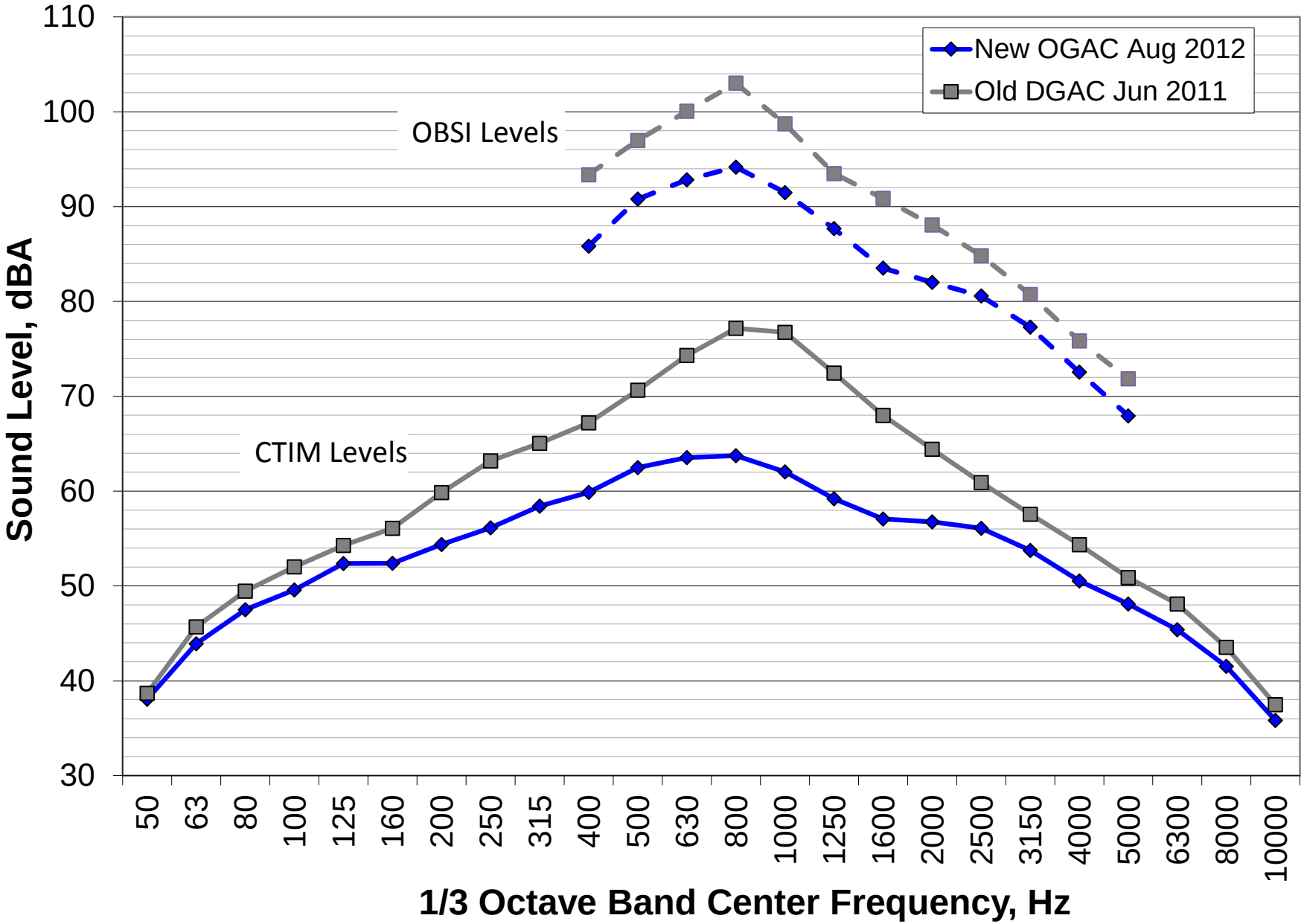
US 101 Noise Reductions – Non Porous



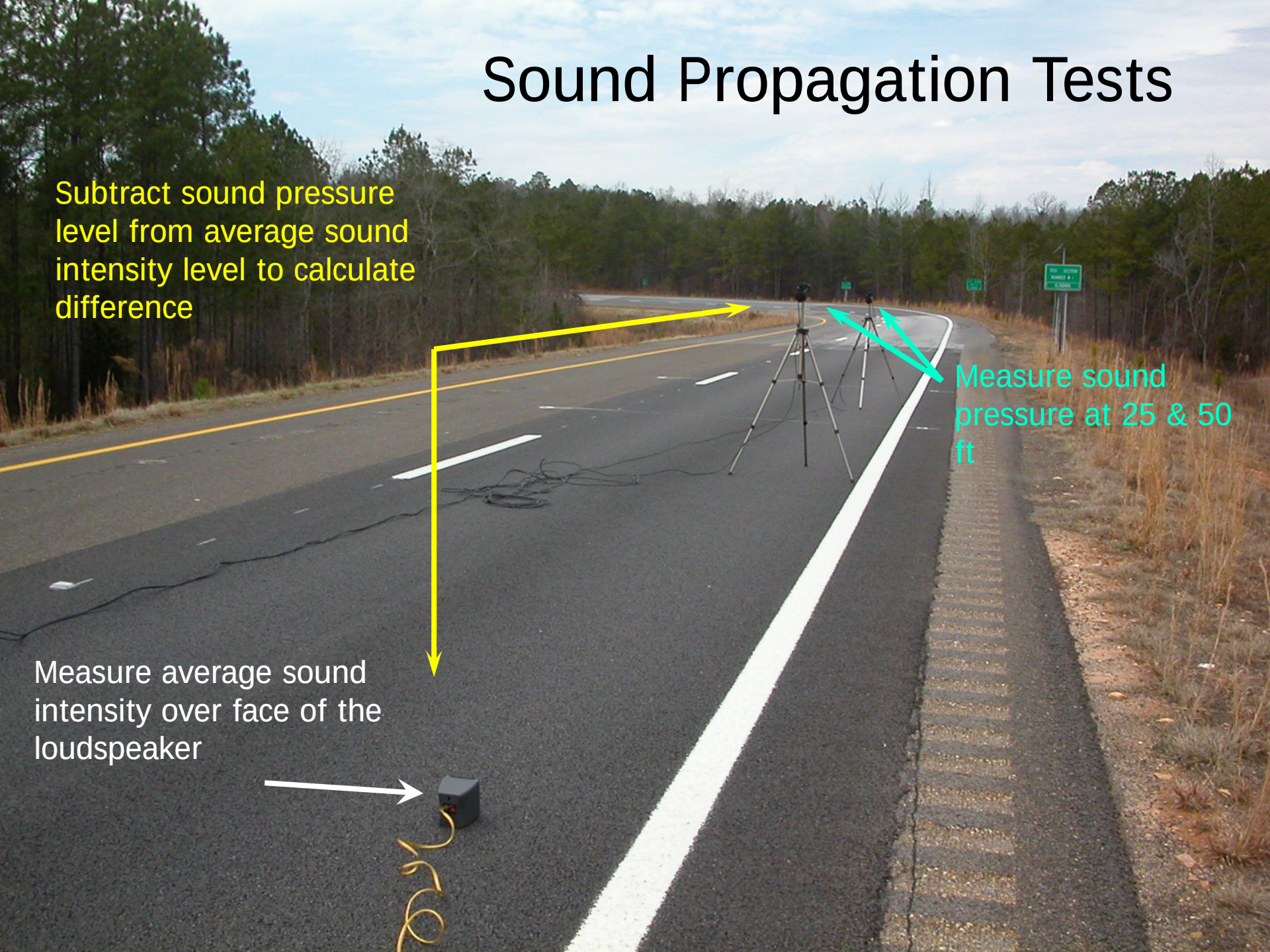
SIP & OBSI Comparison – Light Vehicles WB



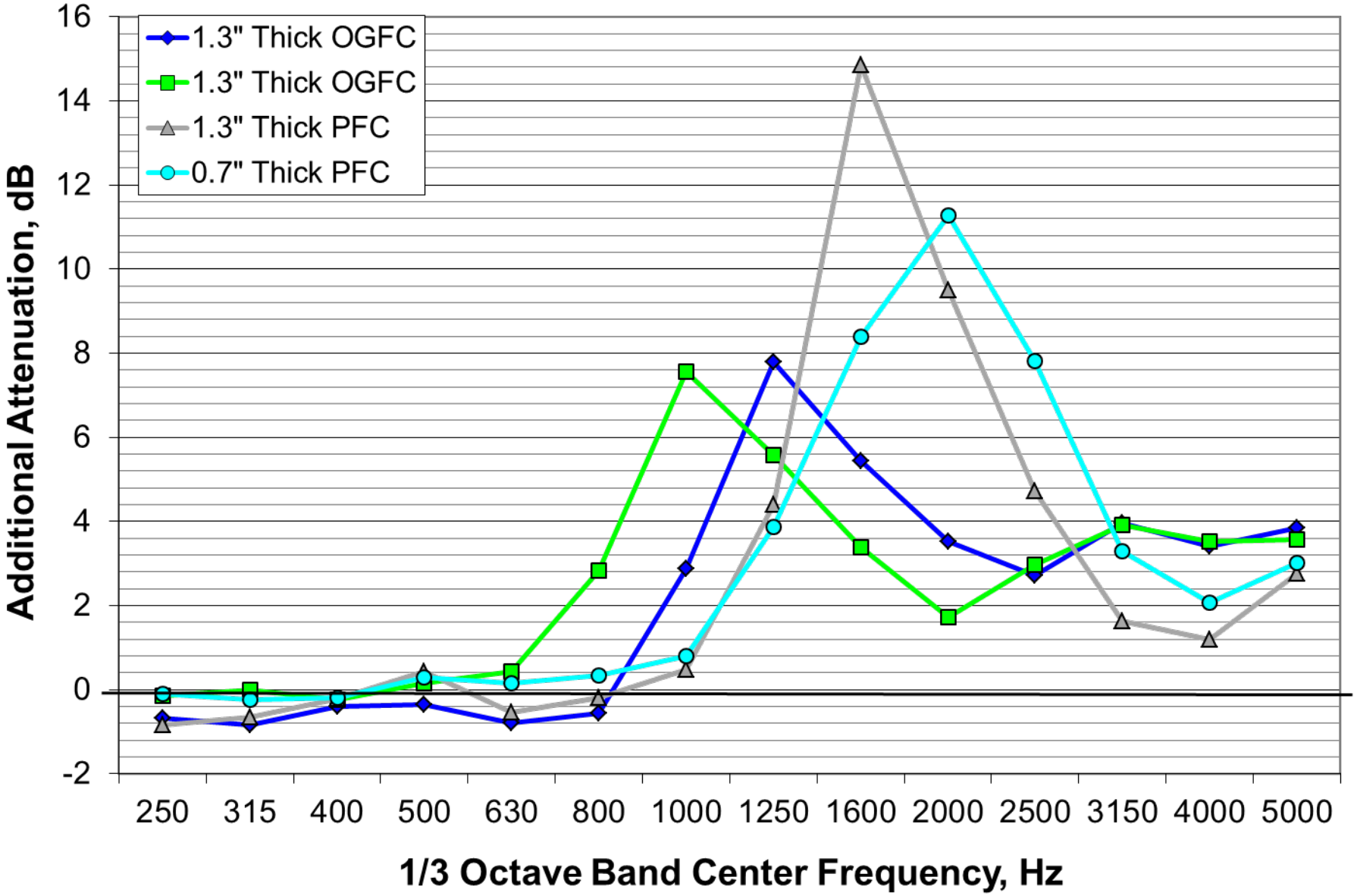
CTIM & OBSI Comparison – US 101 Traffic



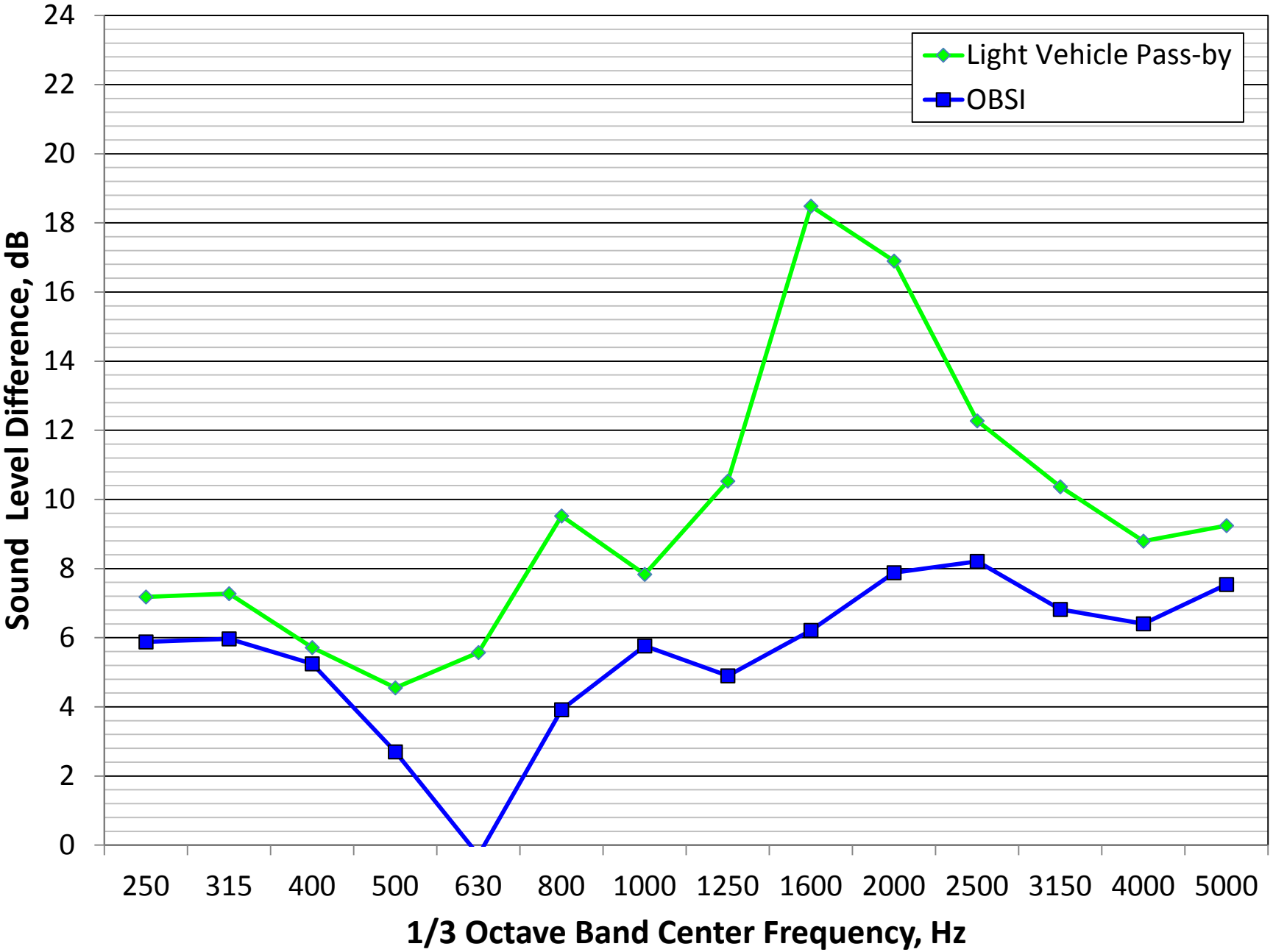
Sound Propagation Tests



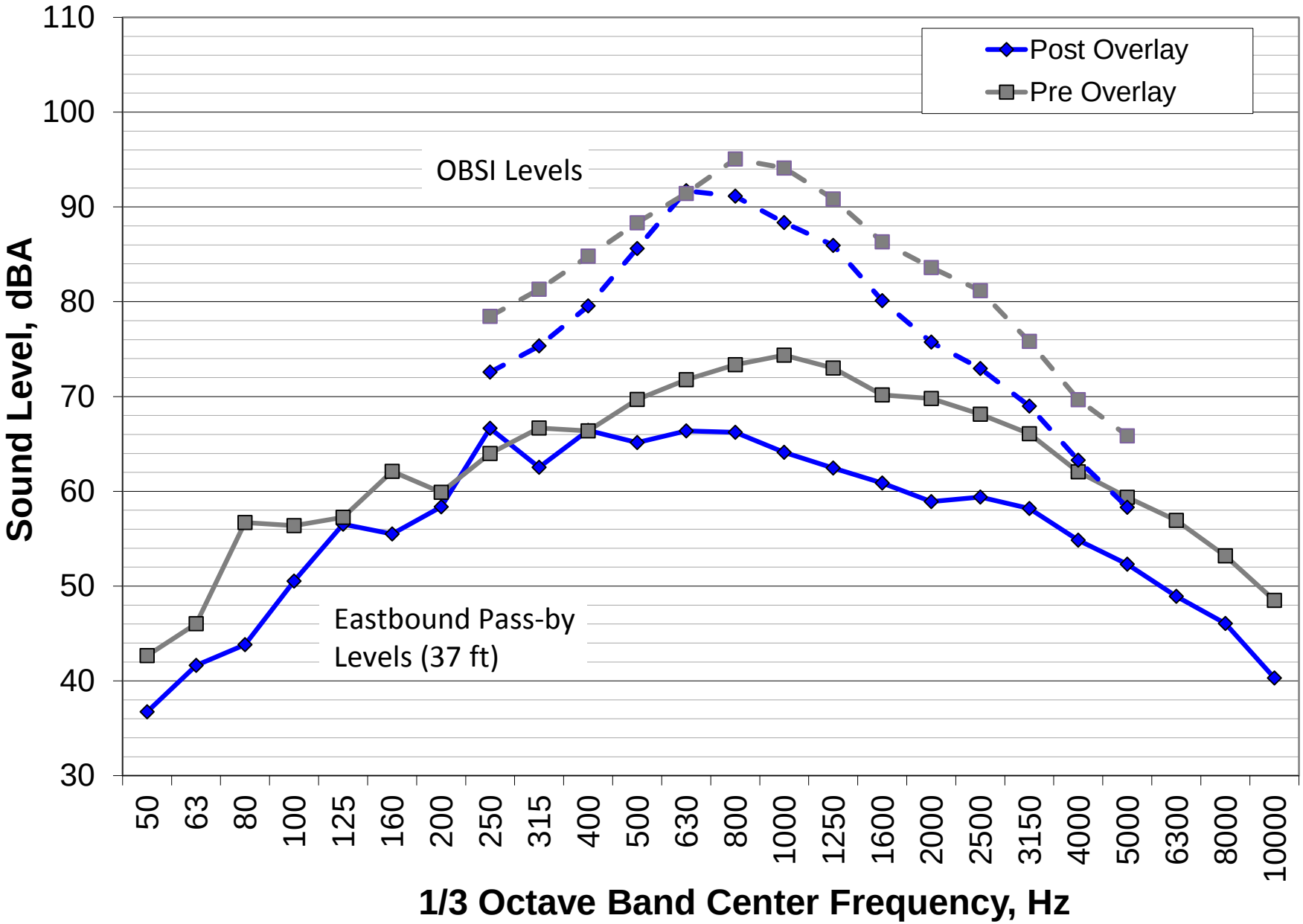
Added Attenuation for Propagation over Porous Pavement Relative to Non-Porous



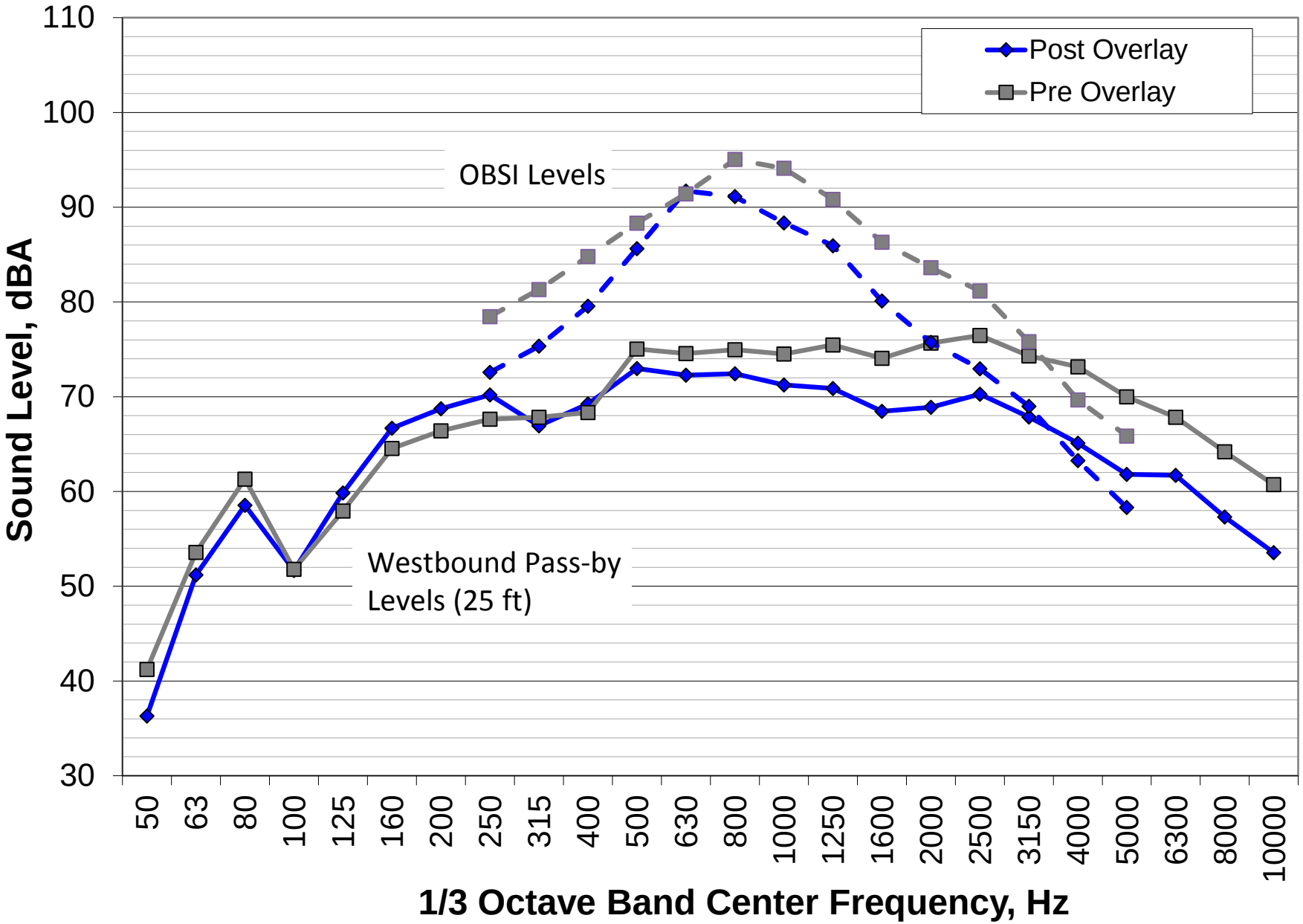
Noise Reduction for SIP & OBSI



SIP & OBSI Comparison – Heavy Trucks Cruise



SIP & OBSI Comparison – Heavy Trucks Accel



Conclusions

- Significant noise reductions with new OGAC:
  - 9.2 dB light vehicle at 40 mph cruise (vs. 4.6 dB)
  - 5.1 dB heavy trucks at 30 mph cruise & decelerating (vs. 1.4 dB)
  - 3.1 dB heavy trucks at 26 mph accelerating (vs. <<1 dB)
- Larger reduction than expected due to:
  - Tire noise source level reduction
  - Added sound propagation attenuation due to porosity
- Overlay applied to remaining 3½ miles


Thank You