



# Using OBSI Data to Implement Pavement Effects in the FHWA Traffic Noise Model

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## Outline

- ◆ **Purpose of study**
- ◆ **Highlights of OBSI application in highway noise prediction**
- ◆ **Outcome of initial OBSI application**
- ◆ **Further investigations**

## **Tire/Pavement Noise**

- substantially contributes to highway traffic noise
- studies have shown measureable differences among pavement types

## **NOISE-REDUCING PAVEMENTS**

## **Potential Application**

- noise mitigation or noise impact avoidance
  - U.S. federal policy excludes use (exceptions)

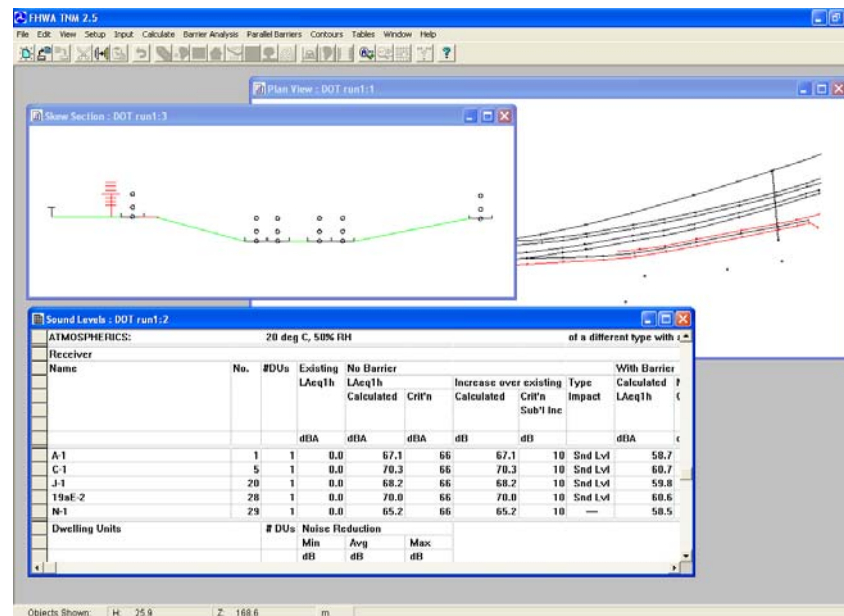
## **Potential Policy Change**

- requires more understanding about pavement reductions and longevity
- requires a change in noise impact predictions

## Including pavement effects in noise predictions

- ◆ FHWA and the Volpe Center currently assessing options for incorporating a broad range of pavement effects in the Federal Highway Administration Traffic Noise Model® (FHWA TNM)

A.k.a, FHWA's TNM Pavement Effects Implementation Study  
(TNM PEI Study)



## Options for implementing pavement effects

$$L_{\text{received}} = L_{\text{source}} + \text{Adjust}_{\text{propagation}}$$

**Adjust predicted sound levels:**  
currently being investigated in FHWA QPPP

- simple implementation
- approximation of effect

**Adjust source levels and sound absorption of pavement:**  
currently being investigated in TNM PEI Study

- more complex implementation
- more accurate way to account for effect

## Adjust source levels and sound absorption of pavement

- ◆ **Two options for FHWA TNM:**
  - 1) **Directly adjust tire/pavement source level and sound absorption of pavement**
  - 2) **Integrate new REMEL data into vehicle noise database for ranges of specific pavement types**
  
- ◆ **Today's focus: Option 1**
  - **Attractive option because ...**
    - Tire/pavement source level data is fairly easy and inexpensive to collect**
    - For some data collection methodologies, a large database for many pavement types already exists**
    - Propagation effects can be properly accounted for**

## Tire/pavement source level adjustment

- ◆ **Focusing on 4 pavement types for proof of concept**
  - open-graded rubberized asphalt (RAC)**
  - dense-graded asphalt (DGAC)**
  - longitudinally tined PCC (LPCC)**
  - transversely tined PCC (TPCC)**
- ◆ **Large database of existing On-Board Sound Intensity (OBSI) data**
- ◆ **OBSI data used in TNM PEI Study from Caltrans, ADOT, and FHWA-ISU studies**
  - **Data captured at 60 mph (500-5000 Hz) provided by Paul Donovan of Illingworth & Rodkin and Rob Rasmussen of The Transtec Group**



## Tire/pavement source level adjustment (continued)

### ◆ Analysis

For each of the 4 generalized pavement types ...

- Data averaged on 1/3-octave band basis
- Calculated energy adjustments from reference pavement (currently using DGAC as the reference)

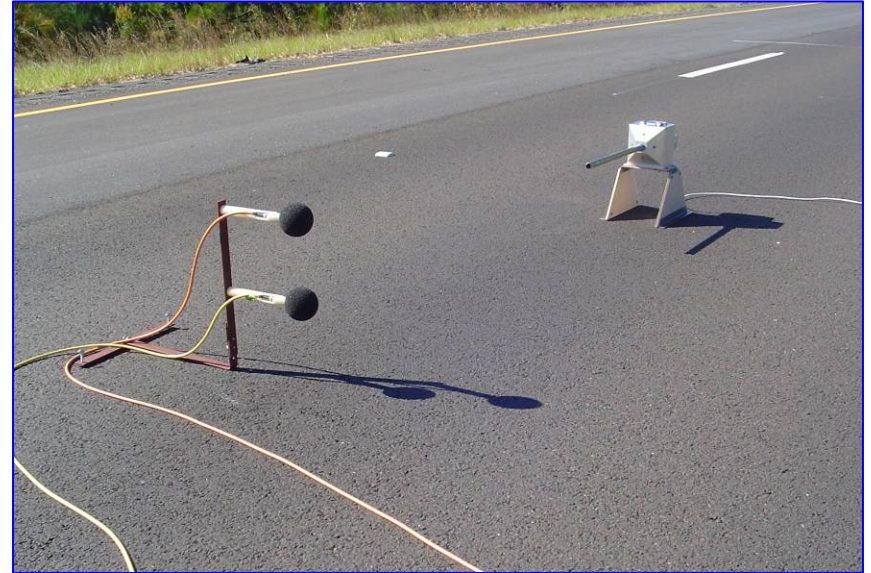
### ◆ Implementation in FHWA TNM

- Lower sub-source is isolated and 1/3-octave band adjustments are applied to DGAC database
- Created research test version of FHWA TNM v2.5



## Pavement sound absorption adjustment

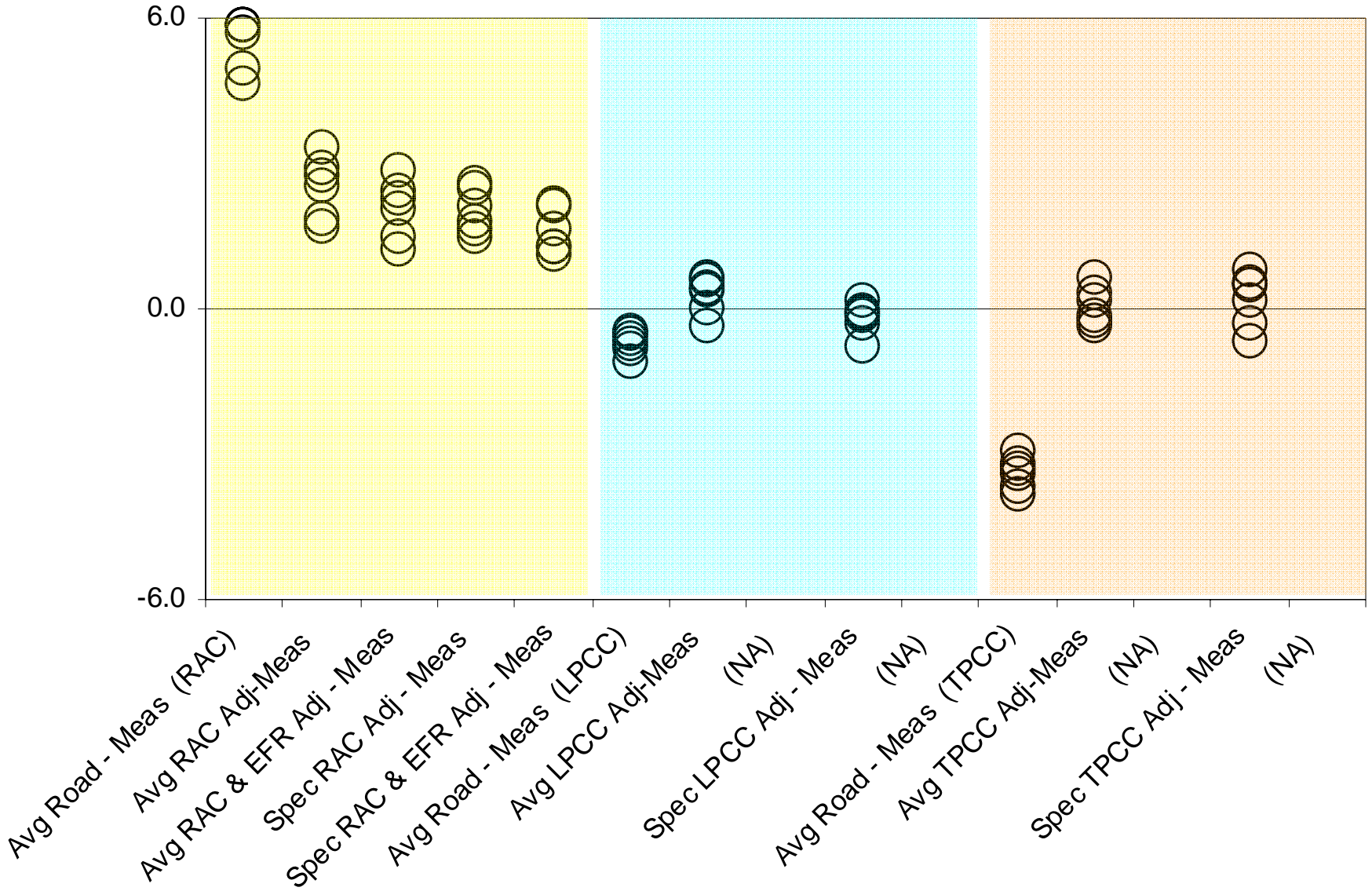
- ◆ FHWA TNM uses effective flow resistivity (EFR) values to represent the ground absorption upon reflection
- ◆ Used EFR data from Caltrans and FHWA studies conducted by Volpe Center
  - ANSI S1.18 augmented and modified to introduce sensitivity to pavements
- ◆ Implementation in FHWA TNM
  - EFR = 6100 cgs rays for RAC
  - EFR = 20000 cgs rays for PCC (TNM default pavement value)



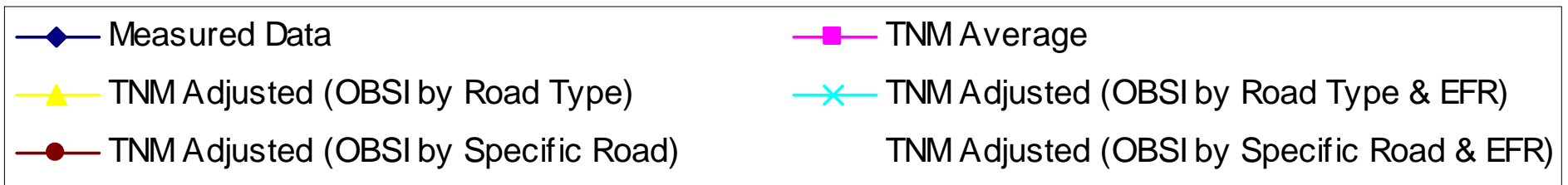
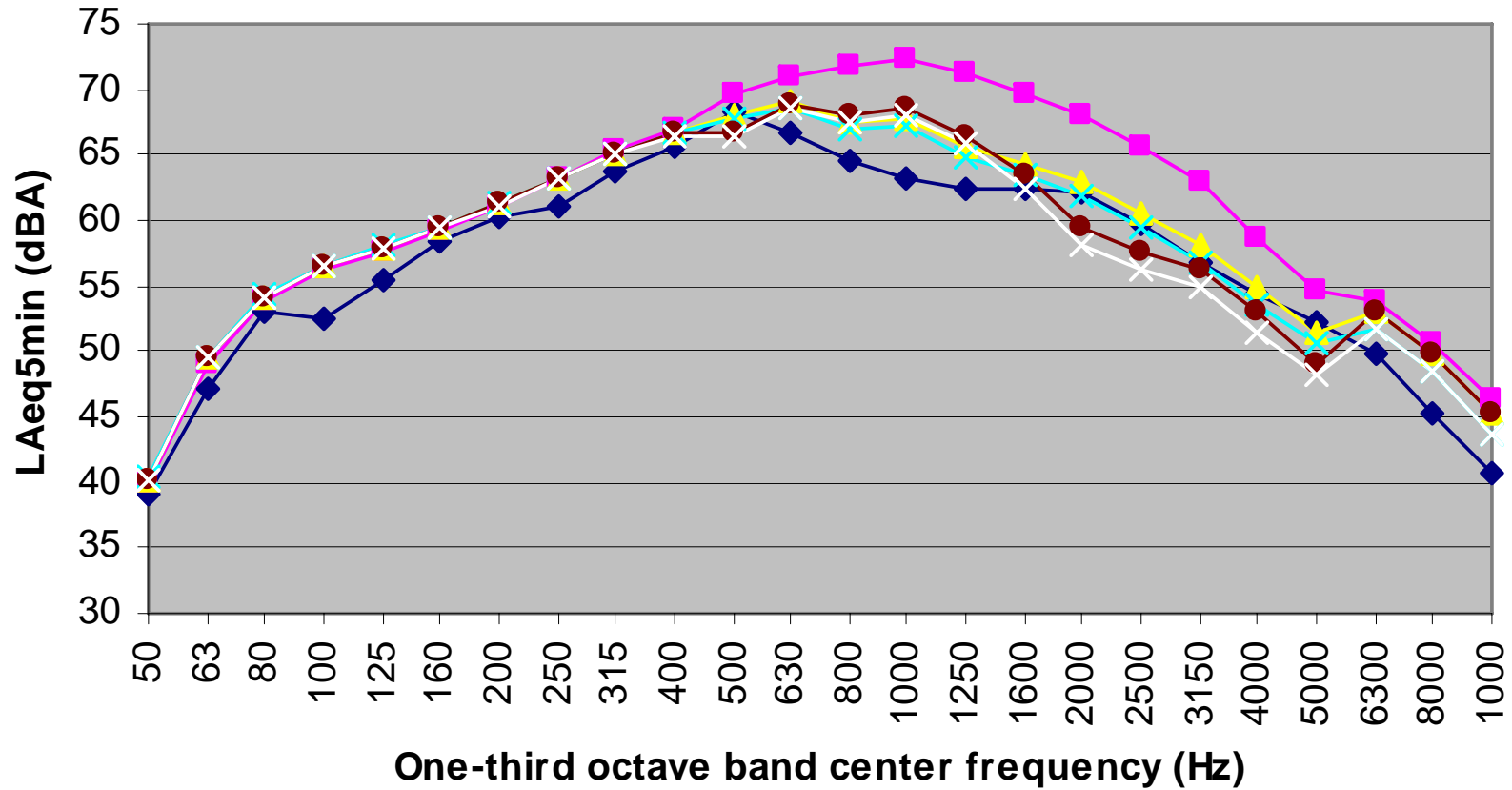
## Evaluating success of OBSI and EFR implementation

- ◆ **How well can roadside predictions match measured sound levels for the test pavements?**
  
- ◆ **Compare predicted and measured sound levels**
  - **5-minute equivalent sound levels (LAeq5min) for sites with RAC, LPCC, or TPCC and free-flowing mixed traffic**
  - **5 prediction scenarios**
    - 1) **Using TNM Average pavement**
  
    - 2) **Using DGAC with average OBSI adjustment**
  
    - 3) **Using DGAC with average OBSI adjustment and EFR adjustment**
  
    - 4) **Using DGAC with specific OBSI adjustment**
  
    - 5) **Using DGAC with specific OBSI adjustment and EFR adjustment**

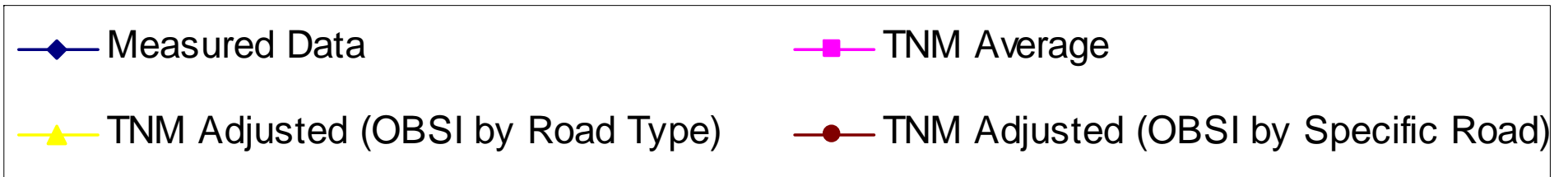
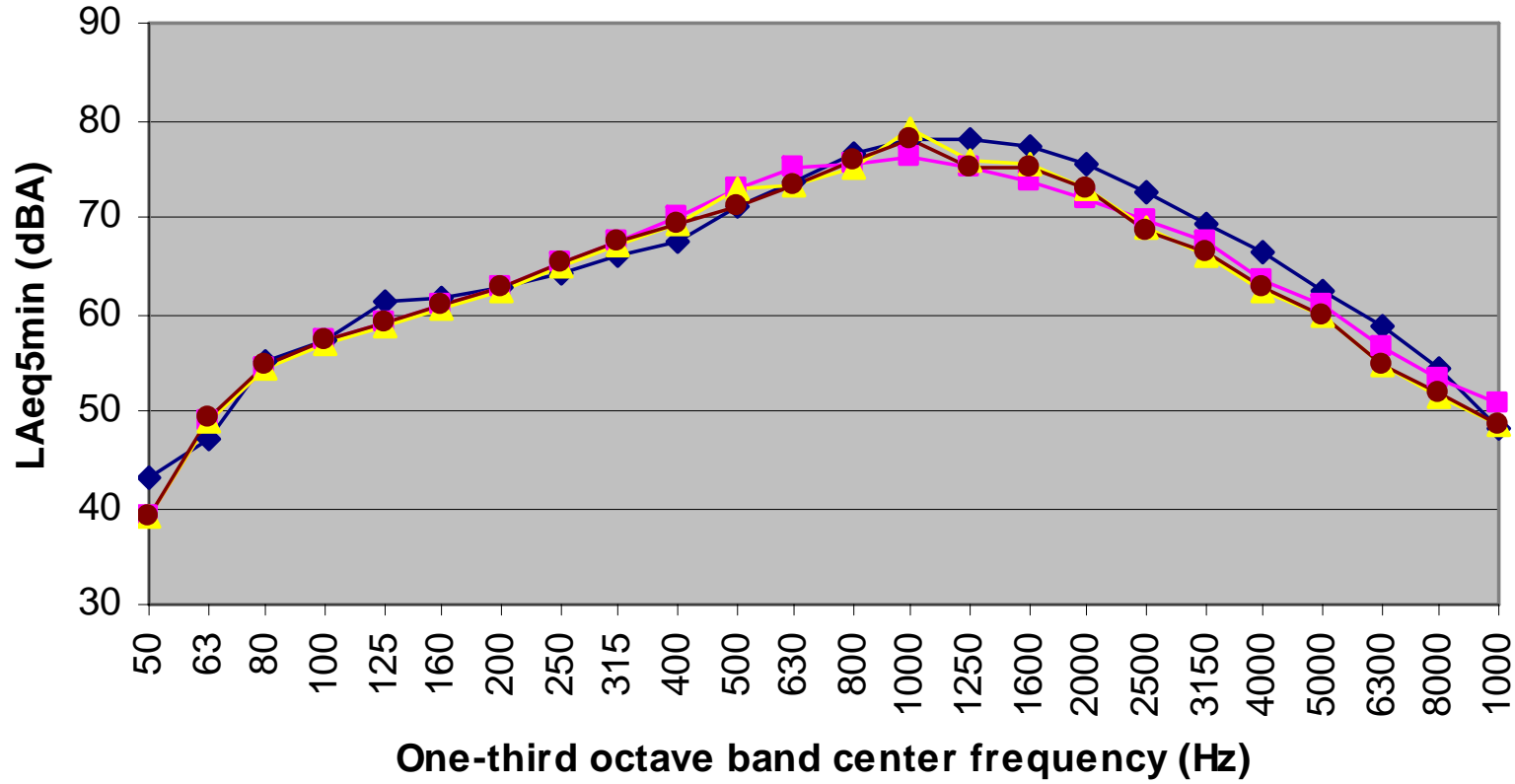
TNM - Measured (LAeq5min, dBA)



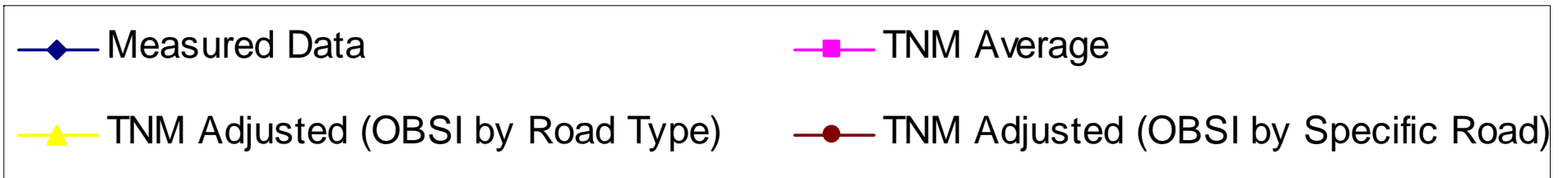
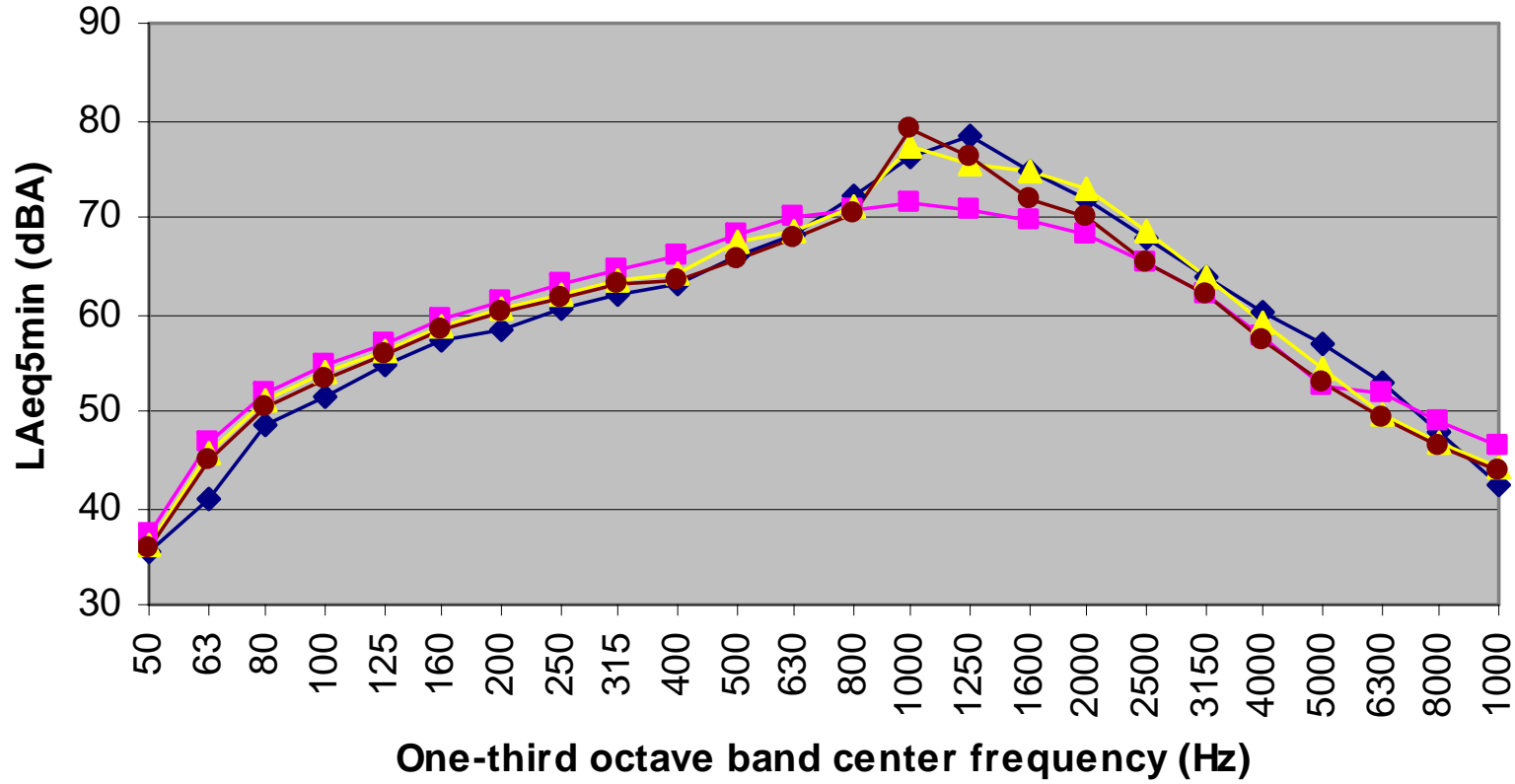
### RAC, Site 3C, 11:15



### LPCC, Site 12CA, 10:25



# TPCC, Site 3B, 8:25



## Conclusions of Initial Study

- ◆ **OBSI adjustment is a valid way to account for pavement effects in FHWA TNM**
- ◆ **OBSI adjustment will be investigated further in preparation for future changes in FHWA noise policy**
- ◆ **Currently examining ...**
  - **Adequacy of frequency range for adjustments (investigating lower speed OBSI data for lower frequency adjustments)**
  - **Separate adjustments according to vehicle type**
  - **Number of OBSI samples needed to adequately represent a specific or more general pavement type**

## Further Investigations

- ◆ **Collected OBSI data on other pavements to help answer questions**
  - **Acquired OBSI system**
  - **Gathered data at National Center for Asphalt Technology (NCAT)**

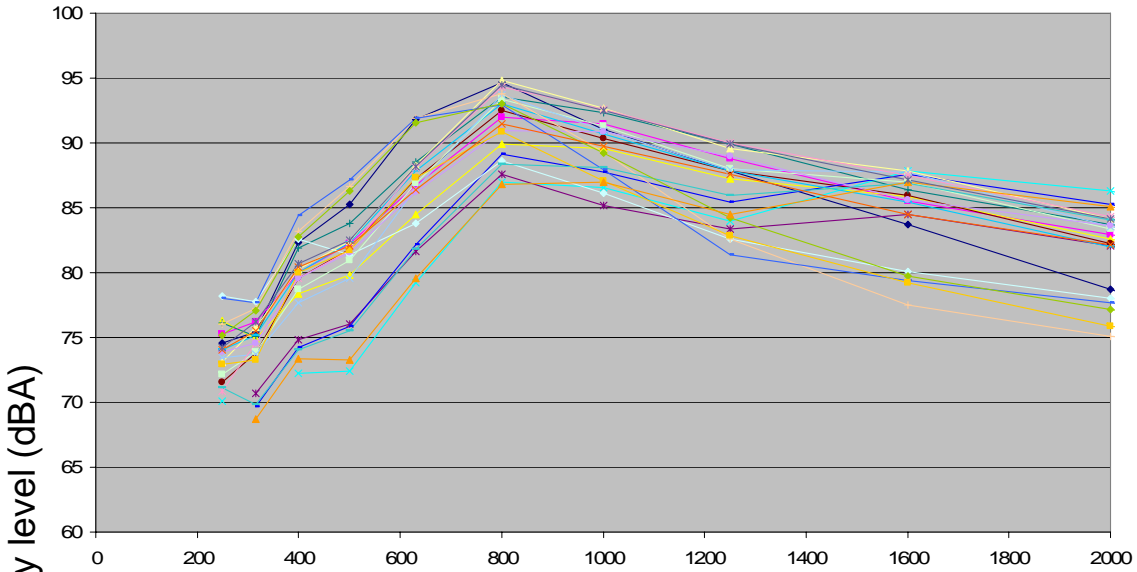




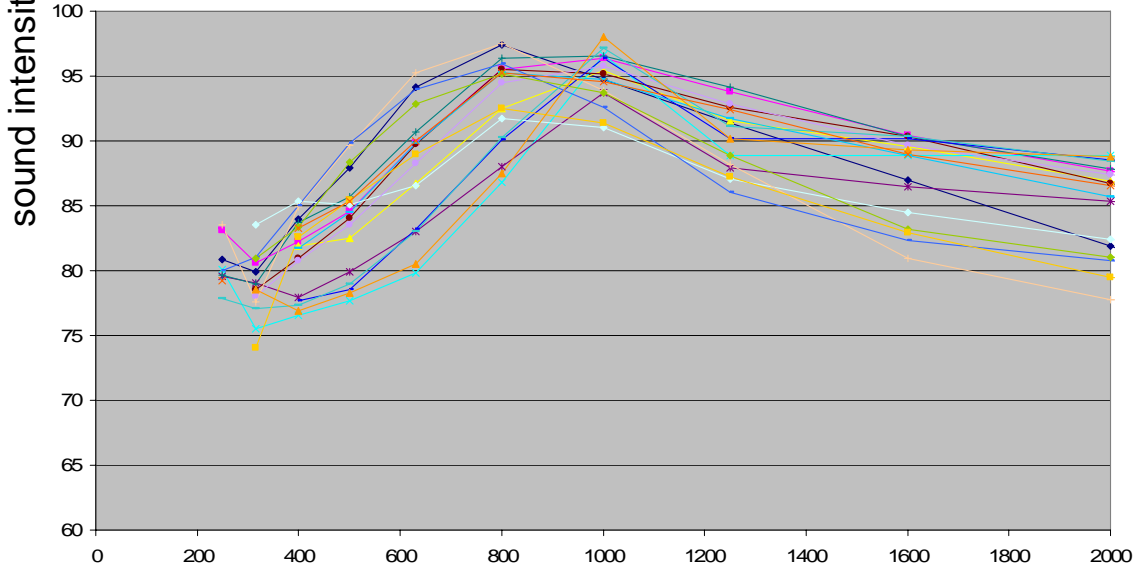
# NCAT Data

◆ In the process of analyzing data

45 mph

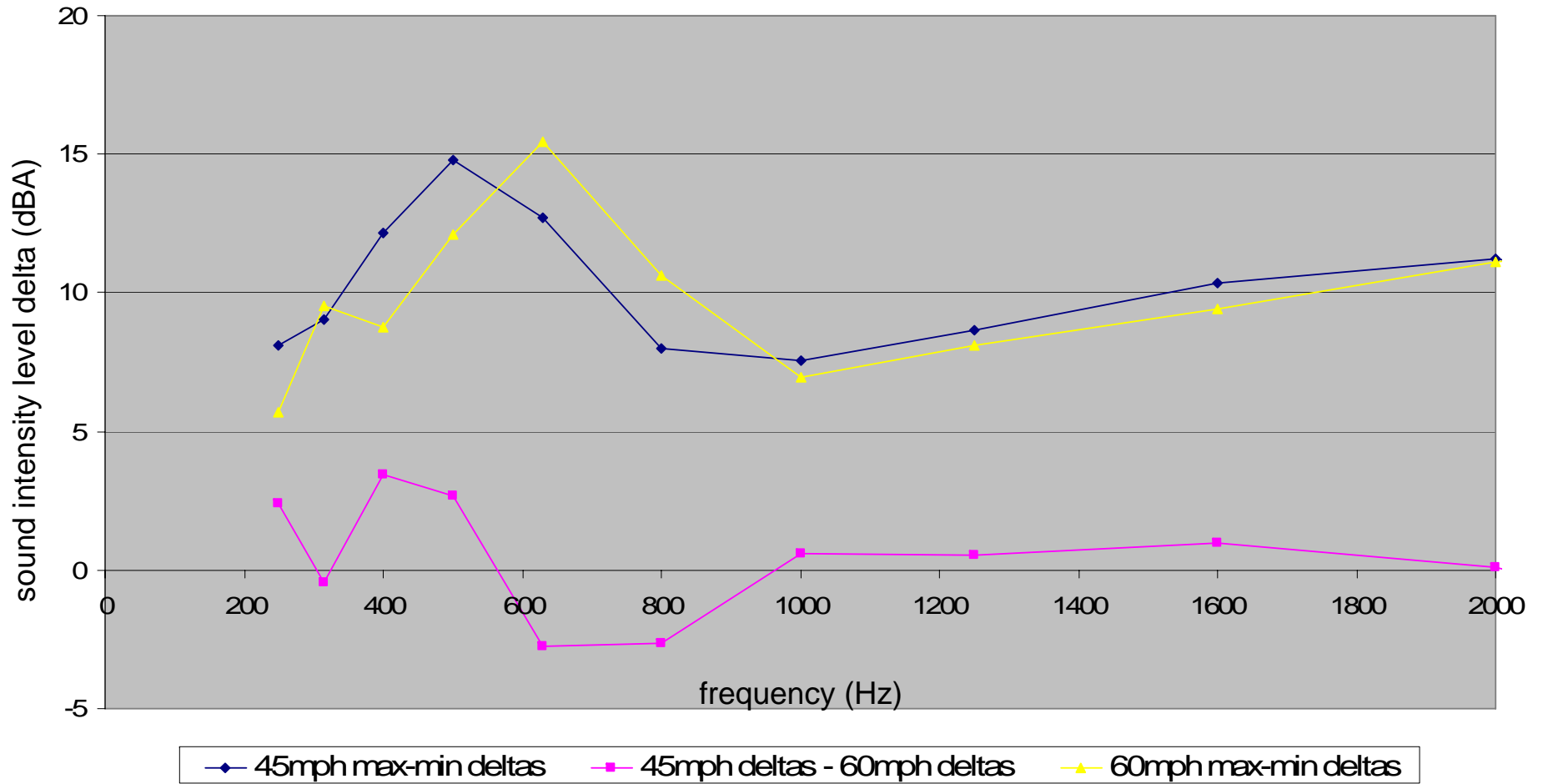


60 mph



frequency (Hz)

# NCAT Data



◆ Stay tuned for updates to TNM PEI Study



**Questions?**