# Preview of
## Validation of FHWA's Traffic Noise Model® (TNM): Phase 1 (TNM v2.5 Addendum)

The Volpe Center Acoustics Facility (Volpe) in support of the Federal Highway Administration (FHWA) is conducting a multiple-phase study to assess the accuracy and make recommendations on the use of FHWA's Traffic Noise Model® (TNM). The TNM Validation Study involves highway noise data collection and TNM modeling for the purpose of data comparison. For modeling in TNM, the input objects were taken directly from the site survey map and maps drawn during site scoping and measurements; these include all roadways, receivers, noise barriers, terrain lines, and ground zones. Traffic data collected during measurements were incorporated into the TNM runs.

In 2002, Volpe completed Phase 1 of the study. For this phase, over 100 hours of traffic noise data were collected at seventeen highway sites around the country. The seventeen sites included: open areas next to the highway with acoustically soft ground (e.g., lawn); open areas with acoustically hard ground (e.g., pavement or water); and areas next to the highway with an open area behind a single noise barrier. Microphones were placed at distances ranging from ~50-1300 ft (~15-400 m) from the road, with reference microphones being placed either at ~50 ft (~15 m) from the road or ~5 ft (~1.5 m) above the barrier. Results indicated that TNM Version 2.0 (TNM v2.0) was, on average, over-predicting when site bias was not accounted for (when accounted for, TNM v2.0 performed well). This issue of over-prediction initiated the development of TNM Version 2.5 (TNM v2.5), which addresses the over-prediction and also has other acoustical improvements.

An addendum to the Phase 1 report [Rochat, Judith L. and Gregg G. Fleming, *Validation of FHWA's Traffic Noise Model® (TNM): Phase 1*, FHWA-EP-02-031, August 2002] is currently being finalized. The addendum includes results generated with TNM v2.5, where the results show TNM's improved performance. A preview of the addendum is presented here.

**Table 1. TNM Validation Phase 1 Results Updated for TNM v2.5; Data Measured during Wind Conditions ≤ 11 mph (5 m/s).**

| Investigation | | | Average difference between TNM-predicted and measured data (TNM-measured) | |
|---|---|---|---|---|
| | | | TNM v2.0 (v2.1) Results | **TNM v2.5 Results** |
| Direct comparison of TNM-predicted and measured sound levels | uncalibrated | all distances from road | +2.6 dB | **+0.5 dB** |
| | | reference mic location* | +3.6 dB | **+1.1 dB** |
| | calibrated to reference mic | all distances from road (except reference location) | –0.4 dB | **+0.2 dB** |

Note: Positive values indicate over-prediction; negative values indicate under-prediction.
* Calculated differently than for all distances – see text in following paragraph.

The TNM-predicted and measured sound levels are analyzed and presented in 15-minute data blocks. A direct comparison is made between the two data sets, plotting measured sound levels versus TNM-predicted sound levels. A linear fit through the data is computed, then the average difference between the linear fit and perfect agreement is calculated. Table 1 shows the average overall difference for uncalibrated TNM predictions and calibrated TNM predictions (data are calibrated to the reference microphone measurements – the difference between TNM-predicted data and measured data is calculated for just the reference microphone location, then the difference is applied to all other receiver positions; this is done to minimize site bias). In addition to the uncalibrated overall difference, the average difference for each reference microphone location was calculated for each measurement site, and the average of all sites is presented in Table 1. Results are presented for both TNM v2.0 (same as results for TNM v2.1) and TNM v2.5. It can be seen that TNM v2.5 is performing very well: overall, both the uncalibrated and calibrated average differences are within 0.5 dB of perfect agreement; for the reference locations, TNM-predictions are within ~1 dB. The results show a substantial improvement from TNM v2.0 (v2.1).

Figure 1 shows the plot of all the uncalibrated data. Each 15-minute data block (15-min $L_{eq}$) is represented as an orange X. A dashed blue line represents the linear fit and solid green lines show the 95 percent confidence band. A solid black diagonal line symbolizes perfect agreement between TNM-predicted data and measured data. Data points that fall above (to the left of) this line indicate over-prediction and points that fall below (to the right of) this line indicate under-prediction.

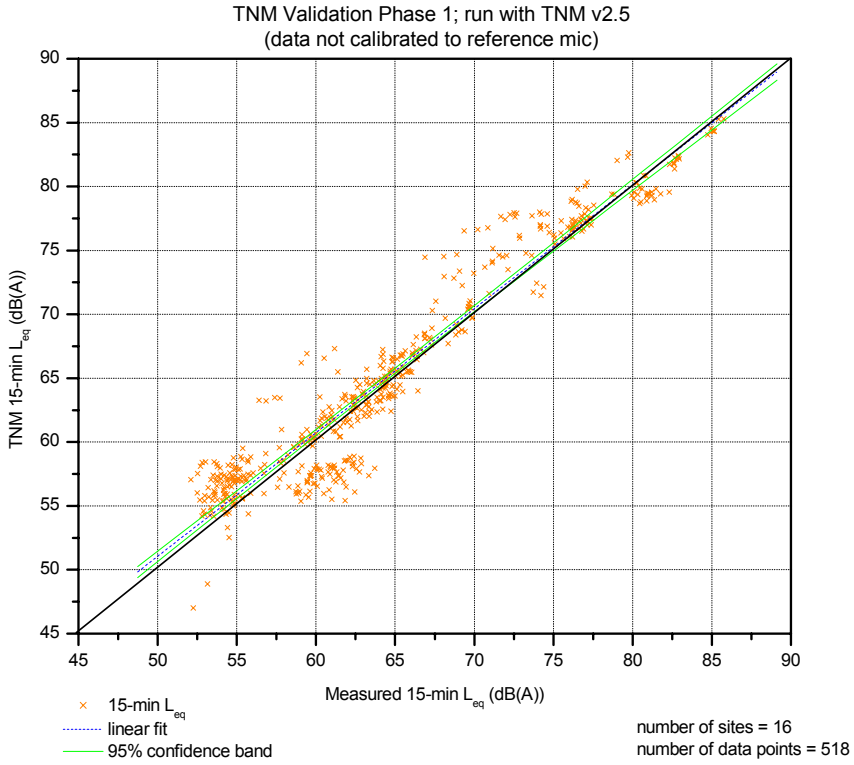


**Figure 1. Direct Comparison of TNM-Predicted (uncalibrated – data not adjusted for site bias) and Measured Data; Data Measured during Wind Conditions ≤ 11 mph (5 m/s).** (Note: Data for 16 of the 17 measurement sites are shown in this plot; for one of the sites (04CT), no data points remained after eliminating the strong wind data.)