

Los Angeles Metro Orange Line BRT Noise Emissions Evaluation

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Orange Line Bus Rapid Transit

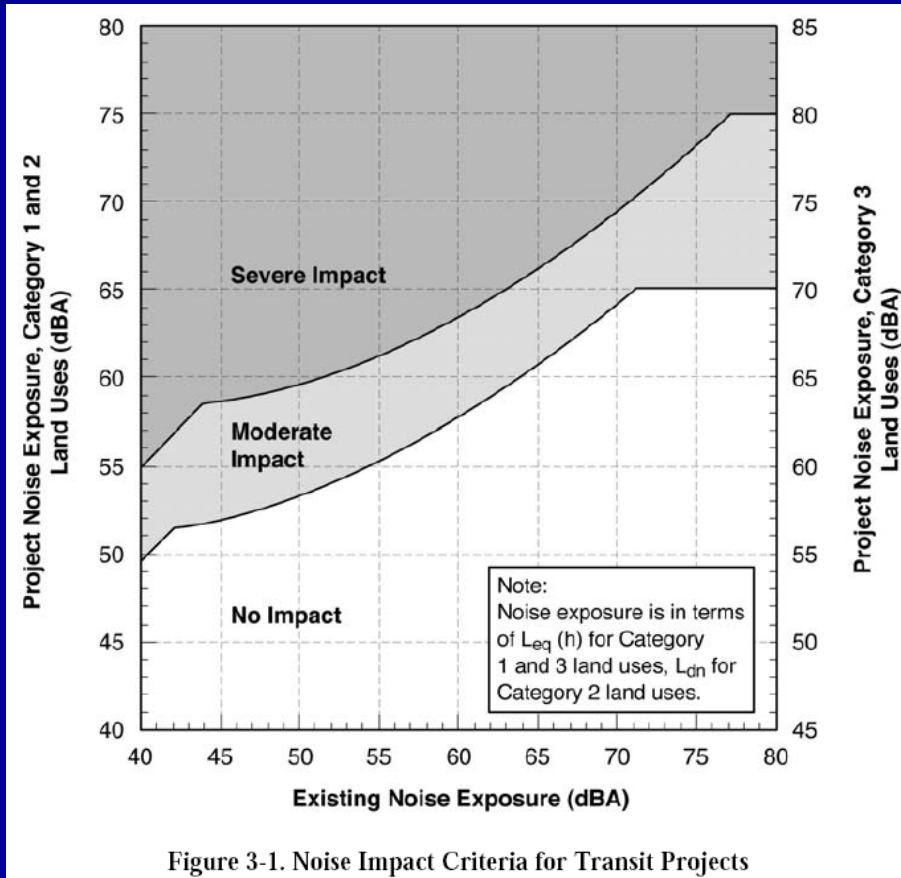
- 14 mile BRT extends from end of Red Line Train (North Hollywood) to the western end of the San Fernando Valley (Warner Center)
- Opened October 31st, 2005



Orangeline Ridership

- Total Calendar Monthly Boarding's
 - May 2008 = 639,563
 - May 2007 = 631,087
 - May 2006 = 579,371

FTA Noise Impact Criteria



Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor $L_{eq}(h)^*$	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq}(h)^*$	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

* L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.

FTA Noise Impact Criteria

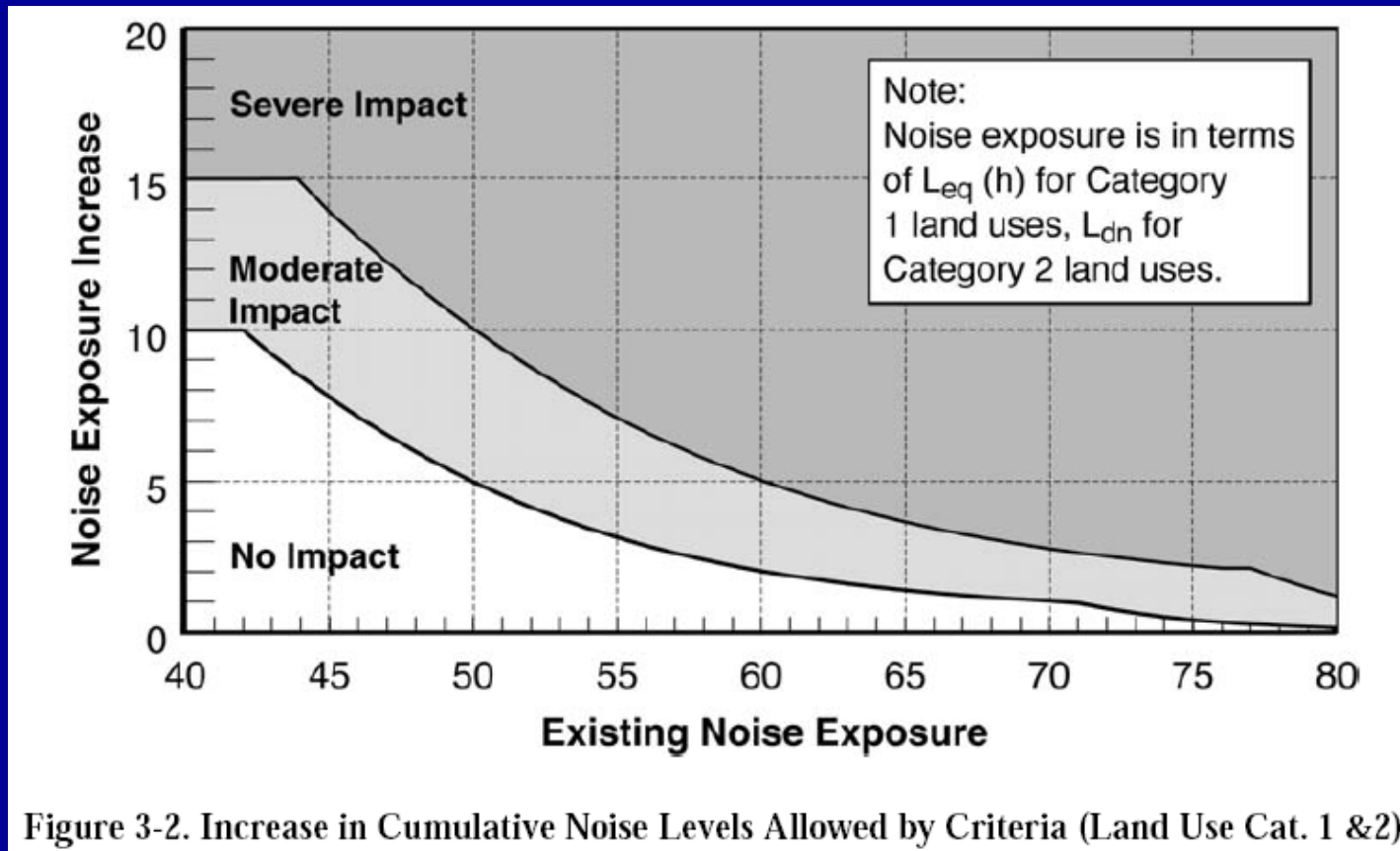


Figure 3-2. Increase in Cumulative Noise Levels Allowed by Criteria (Land Use Cat. 1 &2)

Original EIR / EIS

- Without Mitigation
 - 371 Moderate Impacts
 - 127 Sever Impacts
- Original TNM Modeling
 - TNM national average bus noise emission profiles
 - Buses did NOT stop at all intersections (originally planned that buses would have lights timed specifically to allow them through)

Original EIR / EIS

- Measurements
 - 14 miles of residential, commercial, and open space border the corridor on both sides.
 - 20 measurements were taken, less than 1 measurement per mile.
 - Route divided into 11 areas with a “Generalized Ldn”
 - Each area has multiple arterial cross streets
 - Possible that noise levels mid-block are lower than noise levels near intersections

Original EIR / EIS

- Recommended Noise Mitigation
 - Quieter Vehicles no noisier than “national average bus”
 - 12 foot tall sound barriers
 - Rubberized asphalt
 - Sound Insulation for residences with “residual impacts”

Metro Liner Bus

- North American Bus Industries Model 60-BRT
- 60 foot bus with 320 HP Cummins CNG engine



Acentech's Role

Acentech provided acoustical expertise to Metro during construction and operation.

- Construction noise and vibration monitoring
- Developed noise emissions for new bus
- Modeled to evaluate residual impacts
- Assisted with residential sound insulation
- Evaluated Bus Noise Control Options

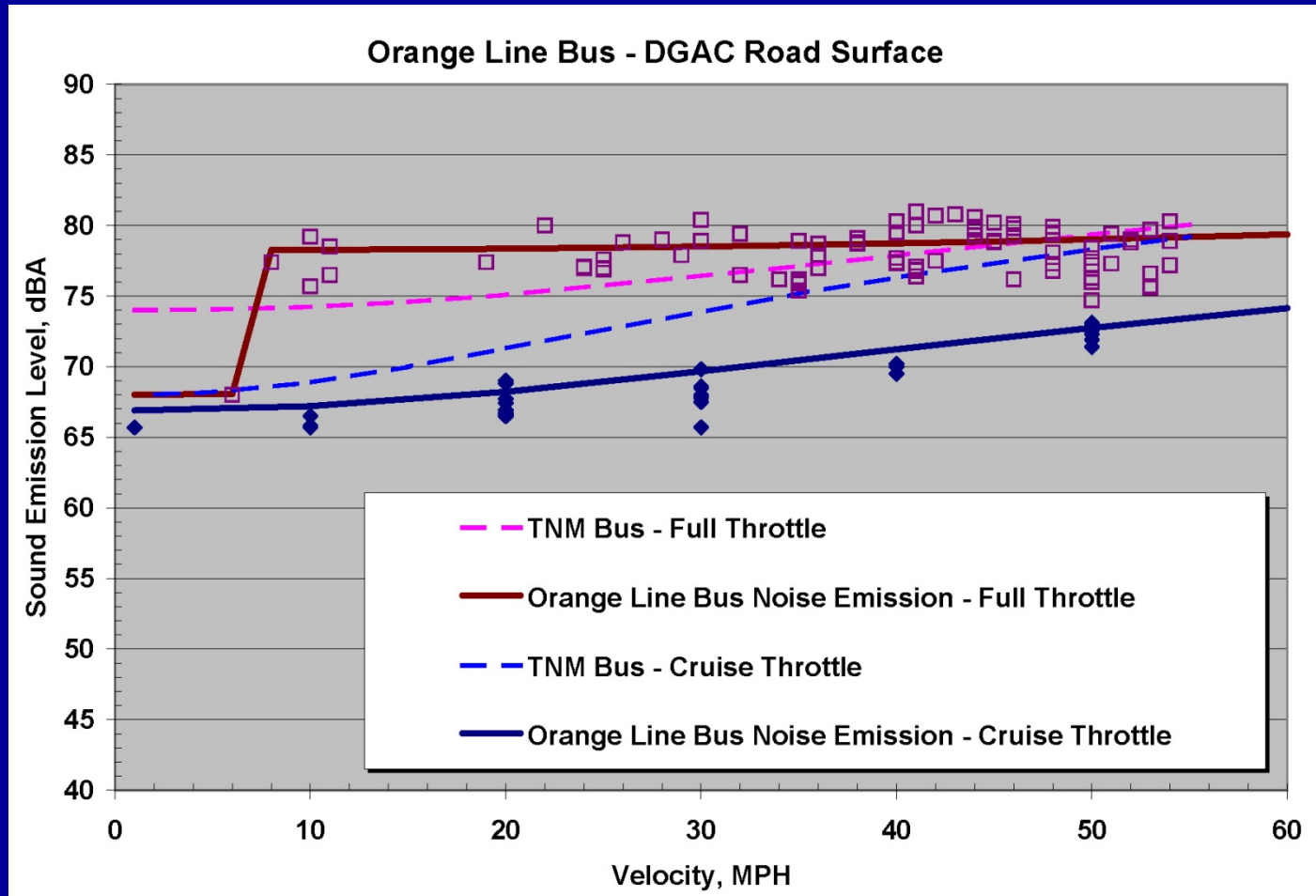
Ambient Noise Measurements

- Performed 57 measurements to verify ambient Ldn.
- EIR “Generalized Ldn” was ± 7 dBA of new measurements
- Large errors occurred due to the broad generalization of neighborhood noise in the EIR/EIS

Metro Liner Noise Emissions

- Measurements conducted in accordance with FHWA-PD-96-046 “measurement of highway related noise”
- Three Metro Liner buses were used
- Measurements performed on the new busway
- REMELS determined at various speeds, in cruise and acceleration modes

Metro Liner REMELS



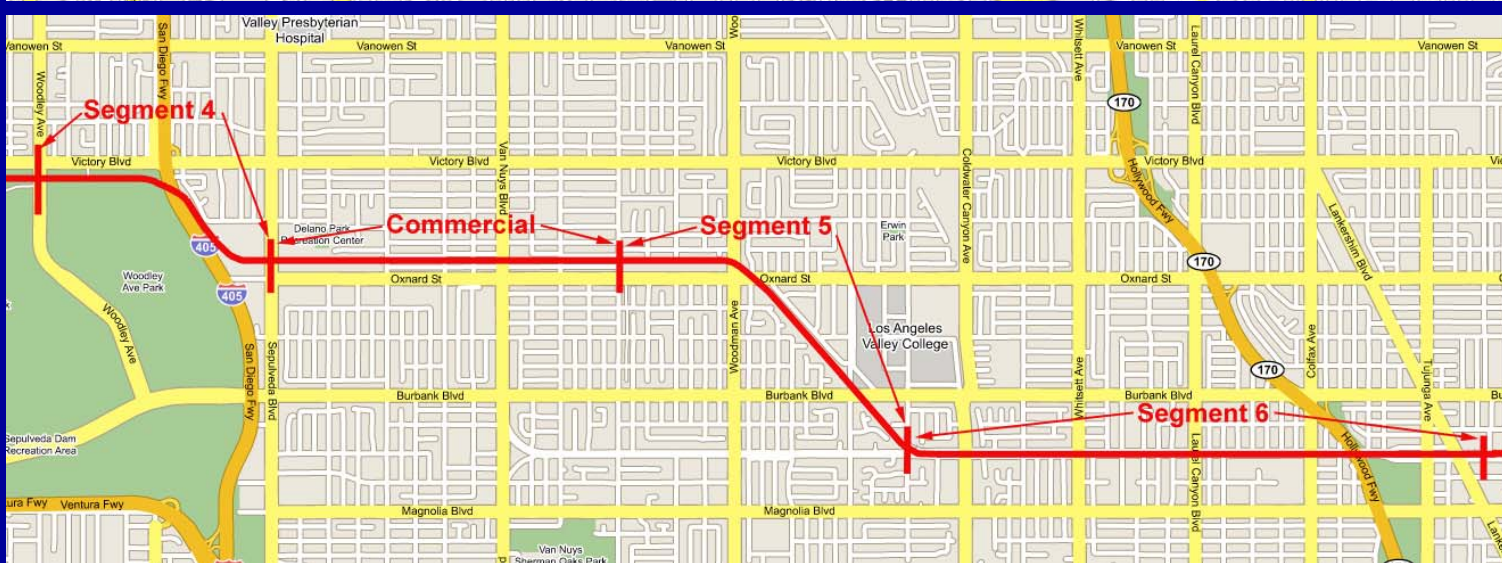
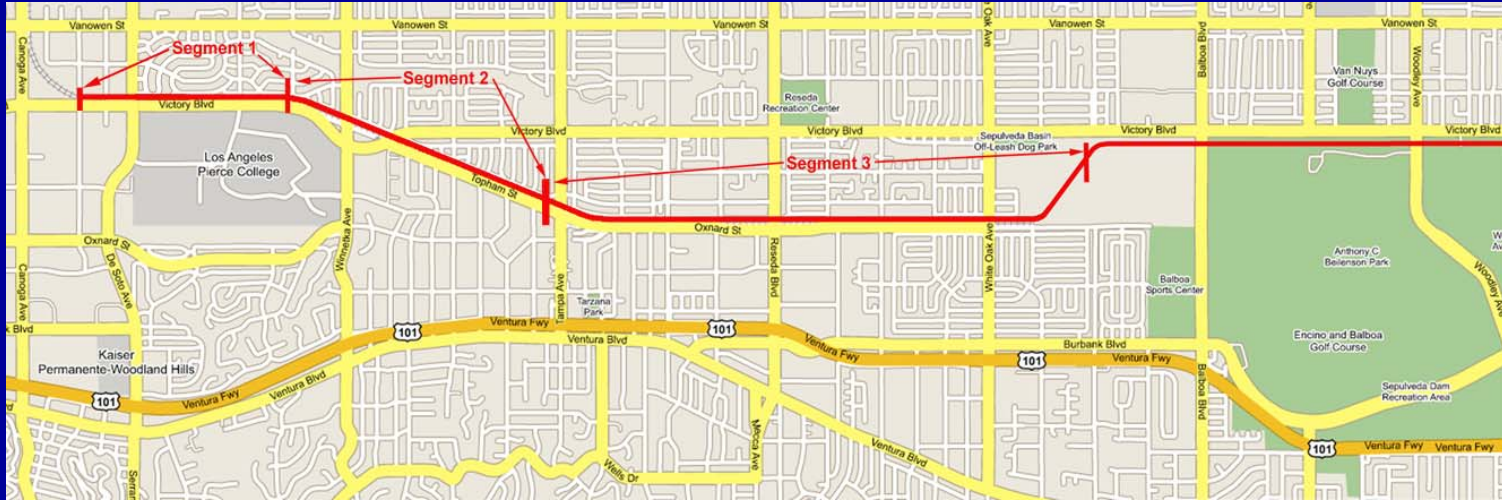
TNM Modeling

- Modeled 902 Receiver locations
- Modeled existing and future noise levels using the measured REMELS
- Daytime = 15 busses/hr/direction
- Nighttime = 9 busses/hr/direction
- Pavement Types
 - TNM “Average” pavement
 - Rubberized Asphalt – TNM “OGAC”
 - Non Rubberized Asphalt – TNM “DGAC”

TNM Modeling

- Maximum speed 55 MPH, limited by acceleration
- Bus stops at ALL intersections
 - Decelerates to each intersection
 - Accelerates from all stops
- All property walls and sound barriers were modeled
- Split project into 6 segments

Orange Line Segment Map



Analysis

- Refined background noise using TNM model of all major streets with ½ mile
- Modeling results:
 - 38 moderate impacts
 - 4 sever impacts

Field Observations

- Complaints not based upon modeled Ldn
- Low frequency tones were observed
- Intermittent noise
 - Turbo waste gate
 - Station enunciators
 - Bus enunciators

Lessons Learned

- Must consider cross streets in establishing neighborhood noise levels
- One measurement per mile is insufficient
- Rubberize asphalt ineffective noise mitigation for BRTs
- Use vehicle specific REMELS to model
- REMELS does not tell whole story
 - Engine tonal noise
 - woosh-woosh-woosh from turbo waste gate
 - Station and bus enunciator noise
 - Wear and tear noise resulting in squeals & whines

Questions

