



**New York State Department of Transportation
Metropolitan Transportation Authority Metro-North Railroad
New York State Thruway Authority**

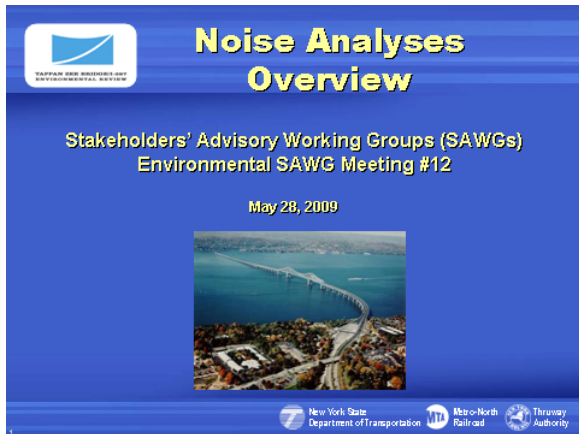
Presentation

***Stakeholders' Advisory Working Groups (SAWGs)
Environmental SAWG Meeting #12***

***Tappan Zee Bridge/I-287 Corridor
Environmental Review***



May 28, 2009



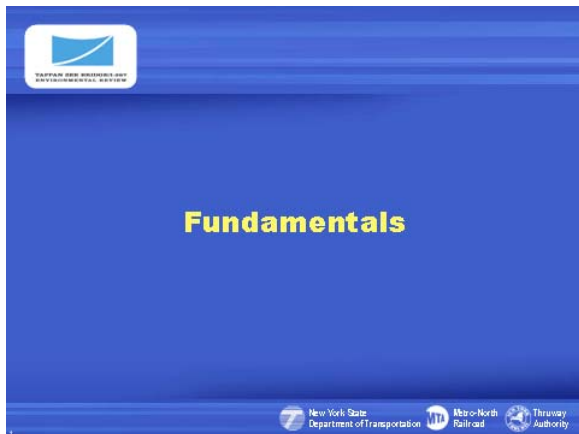
Slide 1

This presentation focuses on methods used to establish existing noise conditions in the project vicinity and methods for developing the impact analysis that will be presented in the EIS.




Slide 2

The topics to be covered include noise fundamentals, impact and abatement criteria, existing noise conditions along the I-287 corridor, impact analysis methodologies for both highway and transit components, construction noise, and abatement measures.






Slide 3

This topic discusses the characteristics of noise, particularly traffic noise, and the perception of noise by the listener.



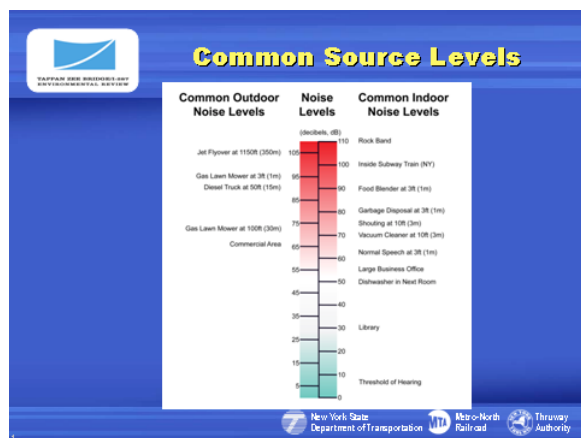
Noise Definition

- Unwanted Sound
- Decibel (dB) – unit of measurement
- dBA – decibel with A-weighting
- Logarithmic relationship
 - 60dB + 60dB = 63dB
 - 80dB + 60dB = 80dB


Slide 4

This slide defines noise, presents units of measurement, frequency weighting (A-weight) that best fits human perception of noise, and mathematical relationship applicable to adding and subtracting noise from different sources.






Slide 5

This chart provides a brief summary of typical exterior and interior noise levels from various common sources. For example, noise from normal speech would generate a sound level of around 63 dB at 3 feet.



Perception of Noise Change

- 3 dB: barely perceptible
- 5 dB: clearly perceptible
- 10 dB: twice or half as loud

Slide 6

This slide summarizes human perception of noise change. A noise change (increase or reduction) of 3 dB is barely perceptible.

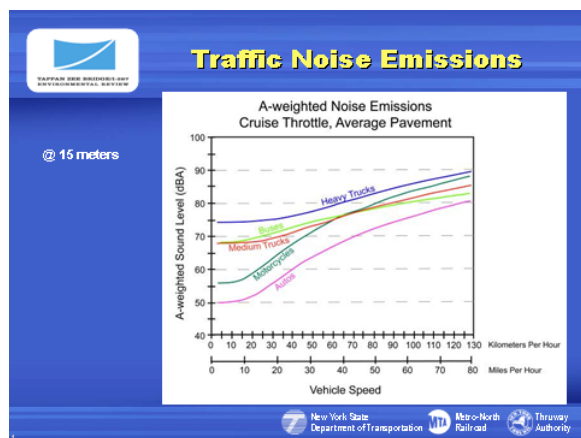
Traffic Noise Characteristics

- Volume
 - 3 dB increase: doubling volume
- Speed
- Mix
 - Heavy truck
 - Medium truck
 - Bus
 - Auto
 - Motorcycle

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 7

The level of highway traffic noise depends on 3 factors or parameters: traffic volume, traffic speed, and vehicle classification.



Slide 8

This chart shows that traffic noise increases when speed increases and heavy trucks generate the most noise as compared to other vehicle classes.

Traffic Noise Attenuation Rule of Thumb

- Distance
 - 3 dBA per doubling distance
 - Additional 1.5 dBA from soft site
- Tree zone
 - 5 dBA to 1st 30-meter deep tree zone
 - Additional 5 dBA to 2nd 30-meter deep tree zone
- Building block
 - 3 dBA from 1st row (40 – 65% block area)
 - 5 dBA from 1st row (65 – 90% block area)
 - 1.5 dBA from each additional row

New York State Department of Transportation Metro-North Railroad Thruway Authority

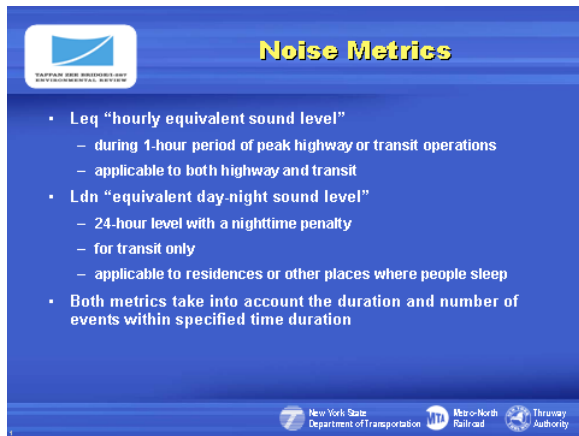
Slide 9

This slide provides a general sense for the level of noise attenuation that occurs when sound propagates from a source to a receptor.



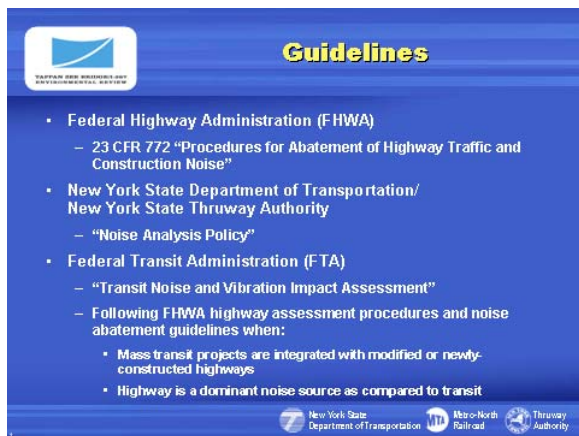
Slide 10

We now discuss noise metrics and impact criteria.




Slide 11

Leq is the standard noise metric used for highway projects. Transit projects use both Leq and Ldn metrics depending on the adjoining land use type.



Slide 12

This slide summarizes regulatory guidelines to be followed for evaluating impacts. Since the project includes an integration of both highway and transit components, FHWA's analysis procedures and abatement guidelines will be used for the majority of study corridor. FTA methods will be used where the transit system diverges from the highway.




Type I Highway Project

- **Type I**
 - New highway
 - Significant changes in horizontal and/or vertical alignment
 - Additional through-traffic lanes
- **TZB project is a Type I project and analysis is mandatory**

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 13

A Type I highway noise project is subject to the most intensive noise analysis requirements. TZB is a Type I project that would involve alignment changes and potentially adding through traffic lanes.



Highway Noise Abatement Criteria (NAC)


Activity Category	Hourly Leq	Description of Activity Category
A	57 (Exterior)	Land for which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Park areas, recreation areas, playgrounds, active sports areas, parks, residences, hotels, motels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	–	Undeveloped land.
E	52 (Interior)	Residences, hotels, motels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: US Department of Transportation, FHWA, 1995.

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 14

This table summarizes typical land use categories defined by FHWA and the associated Leq level that results in application of noise abatement measures for each land use type.



Traffic Noise Impact Criteria - New York State

- Applicable to a Type I project
- Predicted future noise level approaches, equals, or exceeds the NAC:
 - 66 dBA for Category B land use
 - 71 dBA for Category C land use
- Predicted future noise level substantially exceeds the existing noise level:
 - 6 dBA
- Category B, which includes residences, parks and churches, represents a typical land use type that would be given particular attention in the EIS

New York State Department of Transportation Metro-North Railroad Thruway Authority

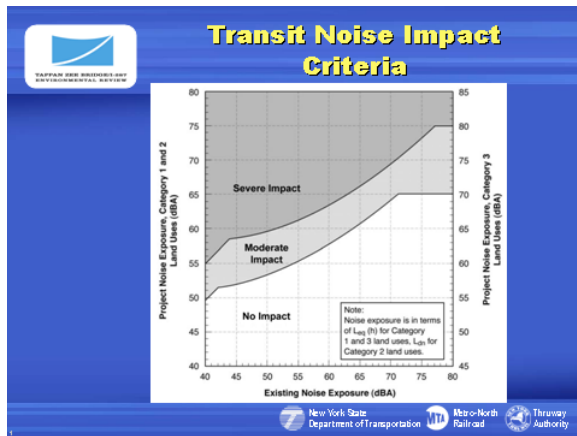
Slide 15

To follow up the FHWA general guidance, NYS DOT has established specific traffic noise impact thresholds based on 1) total future noise levels and 2) incremental noise levels over existing condition. The EIS will particularly focus on the impact on Category B land uses along the corridor.

FTA Noise Metric		
Land Use Category	Noise Metric (dBA)	Description of Activity Category
1	Outdoor $L_{eq}(1)$	Tracts of land where quiet is an essential element in their intended purpose. This category includes tracts of land set aside for serenity and quietude, such as outdoor concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{eq}	Residences and buildings where people normally sleep. This category includes homes, hotels and hospitals where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq}(1)$	Institutional land use with primarily daytime and evening use. This category includes schools, libraries, churches, and active parks where it is important to avoid interference with such activities as speech, meditation, and concentration on reading materials. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category. Places for meditation or study isolated with cemeteries, monuments, museums, certain historical sites, parks, and recreational facilities are also included in this category.
Note: The L_{eq} for the noise at hour of transit-related activity during hours of noise sensitivity. Source: US Department of Transportation, FTA, March 2004.		

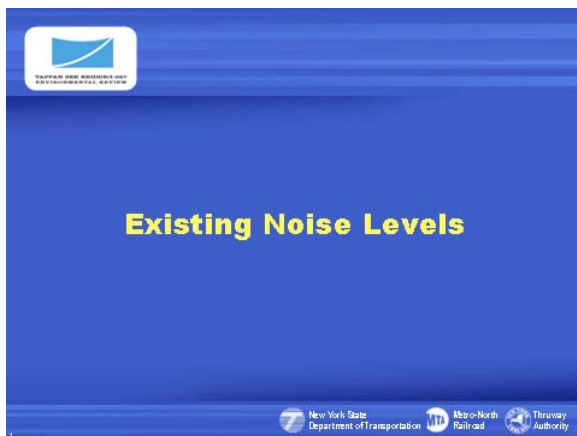
Slide 16

Since transit development could occur along non-highway corridor segments, the FTA noise metrics shown in the slide would be applied along such segments.




Slide 17

FTA transit noise impact criteria shown in the chart are based on a comparison of project noise levels to existing noise levels.






Slide 18

This section of the presentation addresses existing noise levels along the corridor.




Traffic Noise

- 24-hour noise measurement to determine peak traffic noise hours:
 - 8 sites
 - AM peak periods are peak traffic noise periods
- Short-term noise measurement:
 - Purpose: to assist in the development of a traffic noise model
 - Performed during peak traffic noise hours or equivalent periods (derived from 24-hour data)
 - 95 sites




Slide 19

Since noise abatement measures are based on absolute noise levels, it is important to establish the peak hour traffic noise condition. Full day noise measurements taken along the corridor are the basis for selecting a peak noise hour for the analysis. Furthermore, short-term measurements assisted in development of a noise model for the corridor.




Transit-Alone Areas

- Additional Ldn noise measurement at 7 sites to determine existing conditions in transit alone areas:
 - 2 in Suffern
 - 3 in Tarrytown
 - 2 in White Plains

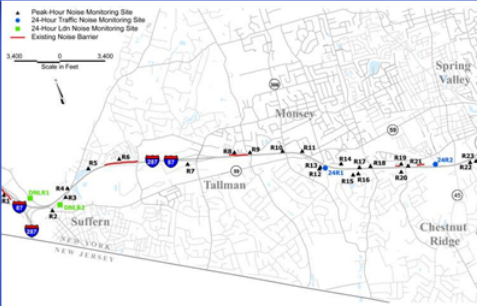







Slide 20

In order to address the case where transit is not along the highway corridor, several sites were also selected for Ldn measurements so that FTA criteria could be applied.



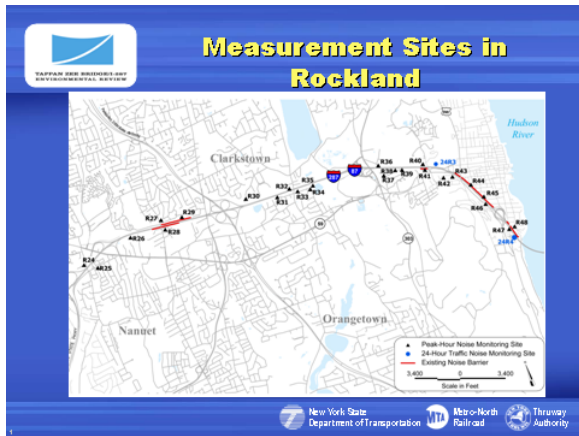
Measurement Sites in Rockland



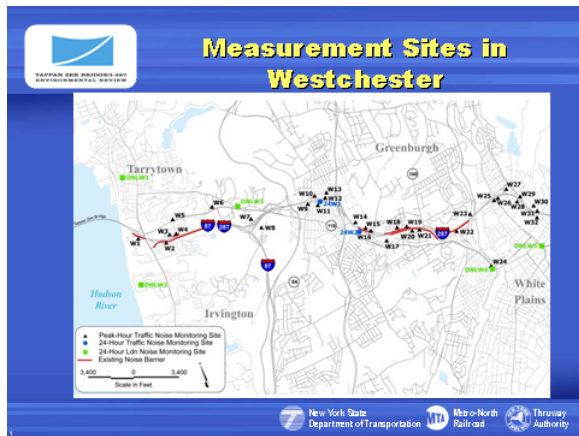
Slide 21

This slide identifies noise measurement sites selected on west side of Rockland.



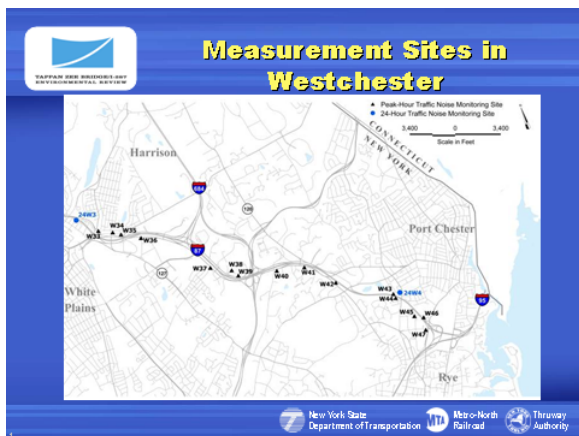
Slide 22

This slide shows noise measurement sites selected on east side of Rockland.



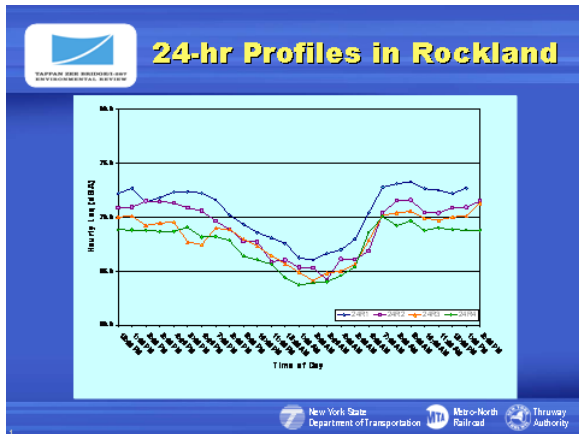
Slide 23

This slide identifies noise measurement sites selected on east side of Westchester.



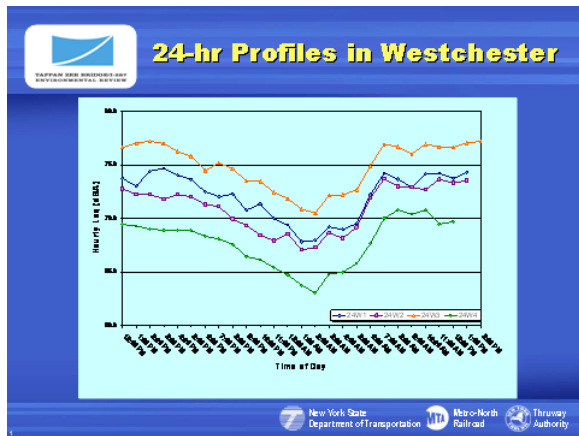
Slide 24

This slide shows noise measurement sites selected on west side of Westchester.



Slide 25

This chart shows the 24-hour noise profiles in Rockland at 4 sites. AM peak hours have the highest noise levels.



Slide 26


This chart shows the 24-hour noise profiles in Westchester at 4 sites. AM and mid-day peak hours are the worst and have comparable noise levels.

Noise Modeling




- Required for a Type I project
- Noise modeling:
 - Development of an accurate noise model allows:
 - Prediction of existing noise levels at more receptors
 - Prediction of future noise levels
 - Model can also be used to develop abatement alternatives if required
- Traffic noise model
 - FHWA Traffic Noise Model (TNM)
 - A state-of-the-art analytical computer program used for predicting noise impacts in the vicinity of highways

Slide 27

This slide discusses the purpose for modeling noise levels and identifies the model to be applied to estimating project impacts.


 **Model Inputs**

- Vehicle type, volume, and speed
- 3-D roadway configuration
- 3-D receiver configuration
- Building rows
- Dense vegetation
- Natural and/or constructed barriers




 New York State Department of Transportation  Metro-North Railroad  Thruway Authority

Slide 28

This slide summarizes the input parameters considered in the noise model.

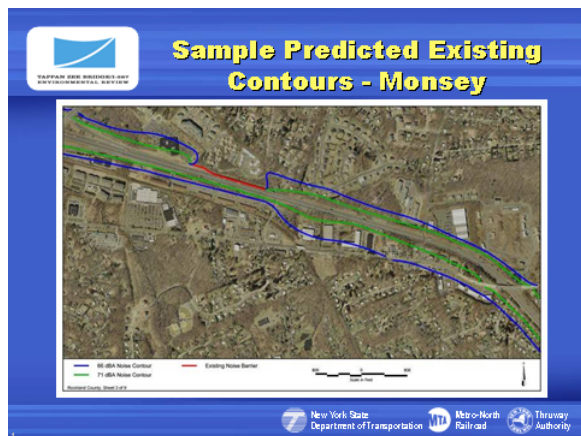
 **Validating the Model**

- Goal is 3 dBA or less between model predicted levels and measurement levels
- Greater than 3 dBA, further checking of dominant existing noise sources other than traffic or re-measuring at those sites affected

 New York State Department of Transportation  Metro-North Railroad  Thruway Authority

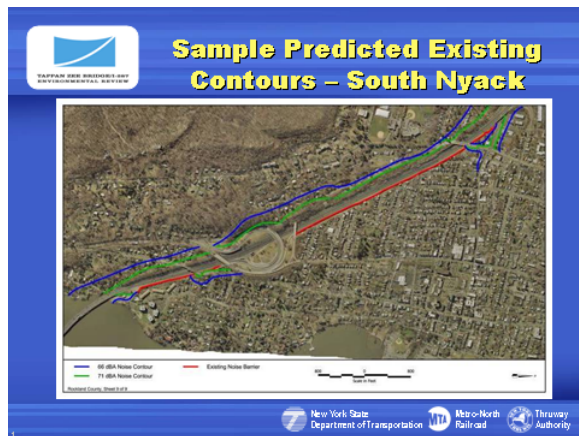
Slide 29

A barely perceptible noise change, i.e. 3 dBA, provides the model validation threshold.



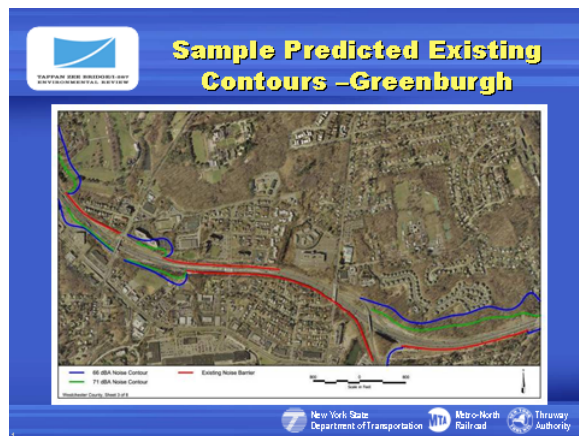
Slide 30

These are model predicted 66 dBA and 71 dBA contours along the corridor near Monsey based on 2005 collected traffic data.



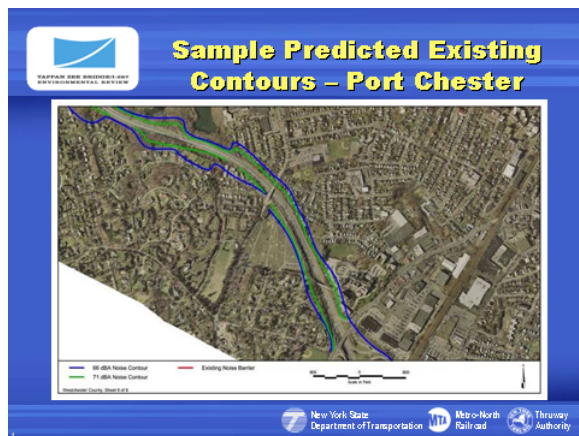
Slide 31

The figure shows 66 dBA and 71 dBA contours along the corridor in South Nyack.




Slide 32

The figure shows 66 dBA and 71 dBA contours along the corridor in Greenburgh.



Slide 33

The figure shows 66 dBA and 71 dBA contours along the corridor in Port Chester.




Predicting Future Noise Levels

- TNM Inputs
 - Peak hour vehicle type, volume, and speed predicted from Paramics model
 - 3-D roadway configuration
- No Build Condition
 - Traffic data projected 30 years in future without the project
- Build Condition
 - Traffic data projected 30 years in future with the project
 - Highway component
 - BRT transit component
 - Geometric alterations of 3-D roadway configuration

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 34

Traffic noise model inputs to be considered under the future no build and build conditions.




FHWA/NYS DOT Abatement Measures

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 35

Now the presentation will address highway traffic noise abatement measures.



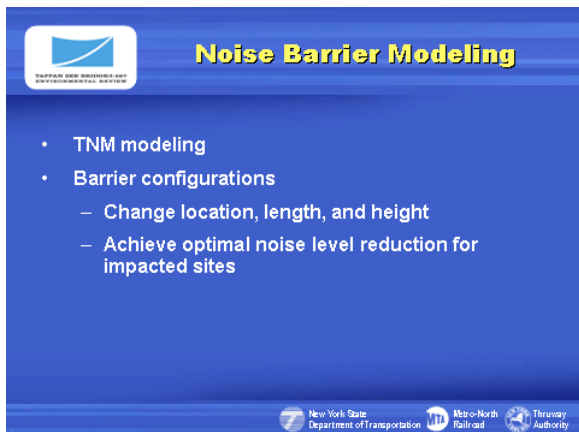
Measures

- Traffic management
- Alter horizontal or vertical alignment
- Construct noise barriers
- Noise insulation of public owned school buildings

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 36

There are four abatement measures that are typically considered for a highway improvement project.



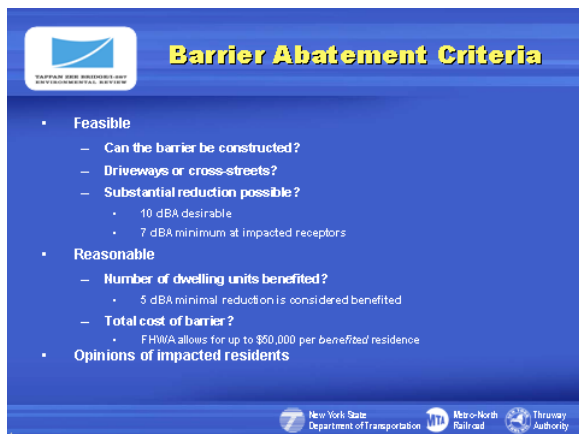
Noise Barrier Modeling

- TNM modeling
- Barrier configurations
 - Change location, length, and height
 - Achieve optimal noise level reduction for impacted sites

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 37

The option of constructing a noise barrier to abate traffic noise is the most common measure. Barrier configurations will be built into the future noise model to determine the optimal length and height to effectively abate noise.



Barrier Abatement Criteria

- Feasible
 - Can the barrier be constructed?
 - Driveways or cross-streets?
 - Substantial reduction possible?
 - 10 dBA desirable
 - 7 dBA minimum at impacted receptors
- Reasonable
 - Number of dwelling units benefited?
 - 5 dBA minimal reduction is considered benefited
 - Total cost of barrier?
 - FHWA allows for up to \$50,000 per benefited residence
- Opinions of impacted residents

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 38

A barrier is effective when it is feasible and its cost is reasonable to achieve the abatement goals for impacted and benefited residences. Opinions from impacted residents are also important for making a final decision on constructing a noise barrier.



Sample Noise Barrier Installation

A photograph showing a large, dark, rectangular noise barrier panel being lifted by a crane at a construction site. The panel is suspended in the air, and several vertical support posts are visible in the background. The scene is set outdoors with trees and a clear sky.

New York State Department of Transportation Metro-North Railroad Thruway Authority

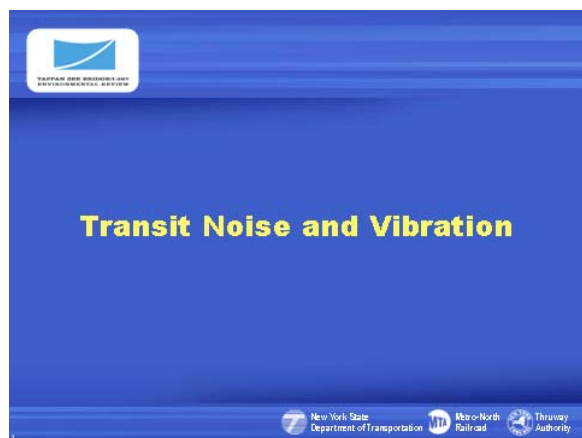
Slide 39

A view of barrier installation site.



Slide 40

A view of a sample barrier type.




Slide 41

The presentation topic now moves to transit noise and vibration where transit is not in the highway corridor.



Slide 42

This is the analysis guideline book from FTA.




Airborne Noise

- BRT
 - To be included in highway TNM model
- CRT
 - FTA assessment method to predict noise
- Combined noise logarithmically in future 30 years
 - TNM highway (including BRT) + CRT

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 43

This slide summarizes the methodologies to be used to predict airborne noise from various transit components.




Noise Mitigation Consideration

- With highway: FHWA abatement method
- Transit alone:
 - Source: stringent vehicle & equipment specs, undercar absorption, rail lubrication, engine compartment treatment, etc.
 - Path: sound barrier, alteration of 3-D alignment, etc.
 - Receiver: barrier construction or building noise insulation if barrier option is not feasible.

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 44

Transit noise mitigation measures are shown in this slide.




Ground-borne Noise and Vibration

- Produced when vibrations of floor, ceiling and walls of a building act like a loudspeaker and radiate noise
- Ground-borne noise is only a concern if trains are in a tunnel (no airborne paths)

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 45

Transit vehicles also generate ground-borne vibration and noise.




Fundamental - Vibration

- Vibration is rapid fluctuation of building surfaces or rattling of windows
- Measured in decibels, but not the same decibel as noise
- Measured in terms of the velocity of moving surfaces and are labeled VdB
 - 65 VdB – limit for human to feel
 - 100 VdB – potential physical damage
 - Event occurrence based

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 46

This slide discusses vibration and its measuring metric.



FTA Impact Threshold

Land Use Category	Vibration Impact Levels (VdB re 1 micro inch/sec)			Ground-Borne Noise Impact Levels		
	Frequent Events ¹	Occasional Events ²	Infrequent Events ³	Frequent Events ¹	Occasional Events ²	Infrequent Events ³
Category 1: Building where vibration would interfere with interior operations	65 VdB ⁴	65 VdB ⁴	65 VdB ⁴	—	—	—
Category 2: Residence and building where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	82 VdB	40 dBA	43 dBA	48 dBA

Notes:
¹ "Frequent Events" is defined as more than 10 vibration events per day. Most rapid transit projects fall into this category.
² "Occasional Events" is defined as less than 10 and 15 vibration events per day. Most commuter rail projects fall into this category.
³ "Infrequent Events" is defined as less than 10 vibration events per day. This category includes most commuter rail projects.
⁴ These values are based on the fact that the acceptable level of vibration is determined by the type of equipment used. The values are based on the fact that the acceptable level of vibration is determined by the type of equipment used. The values are based on the fact that the acceptable level of vibration is determined by the type of equipment used.

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 47

The table presents FTA the impact threshold to measure ground-borne vibration and noise.



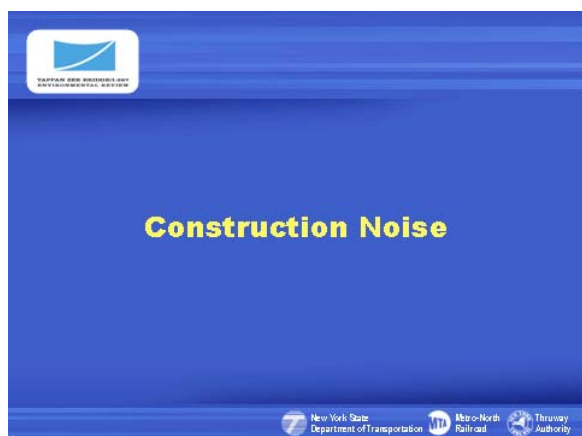
Vibration Mitigation Consideration

- Track maintenance
- Vehicle specifications
- Special track supporting system:
 - Floating slabs, resiliently supported ties, high-resilience fasteners, etc.
- Building modification
- Trenches

New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 48

A summary of various vibration mitigation measures is shown in this slide.



Slide 49

The last topic discussed this evening is construction noise. Construction noise in the project vicinity will be quantified and the applicable abatement measures will be discussed in the EIS.



Slide 50

A typical construction site.



Slide 51

A sample bridge associated construction site.

Construction Noise Impact Threshold

Land Use	L _{eq} (1) in dBA	
	Daytime	Nighttime
Residential	90	80
Commercial	100	100
Industrial	100	100


New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 52

FTA-established construction noise impact thresholds will be used to determine construction noise significance.

Construction Noise Prediction

- FHWA Roadway Construction Noise Model



New York State Department of Transportation Metro-North Railroad Thruway Authority

Slide 53

Construction noise levels will be predicted using FHWA model.

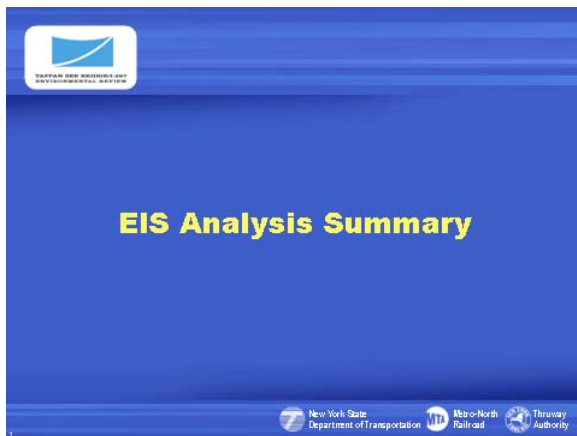
Construction Noise Abatement Consideration

- Public notice
- Noise complaint hotline
- Select less impact detour traffic route
- Engine equipped with a properly maintained muffler
- New construction equipment
- Temporary noise wall
- Minimizing impact pile driving
- Limiting nighttime hour activities

New York State Department of Transportation Metro-North Railroad Thruway Authority

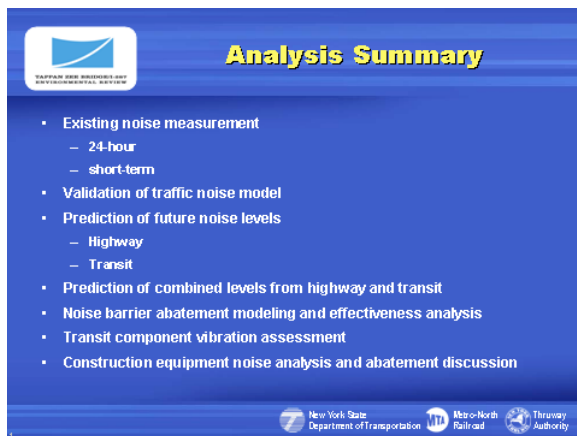
Slide 54

A list of construction noise abatement measures that will be discussed in the EIS.



Slide 55

A summary slide follows.



Slide 56

This slide provides a summary of the analyses to be carried through the EIS.



Slide 57