Point Defiance Bypass Project

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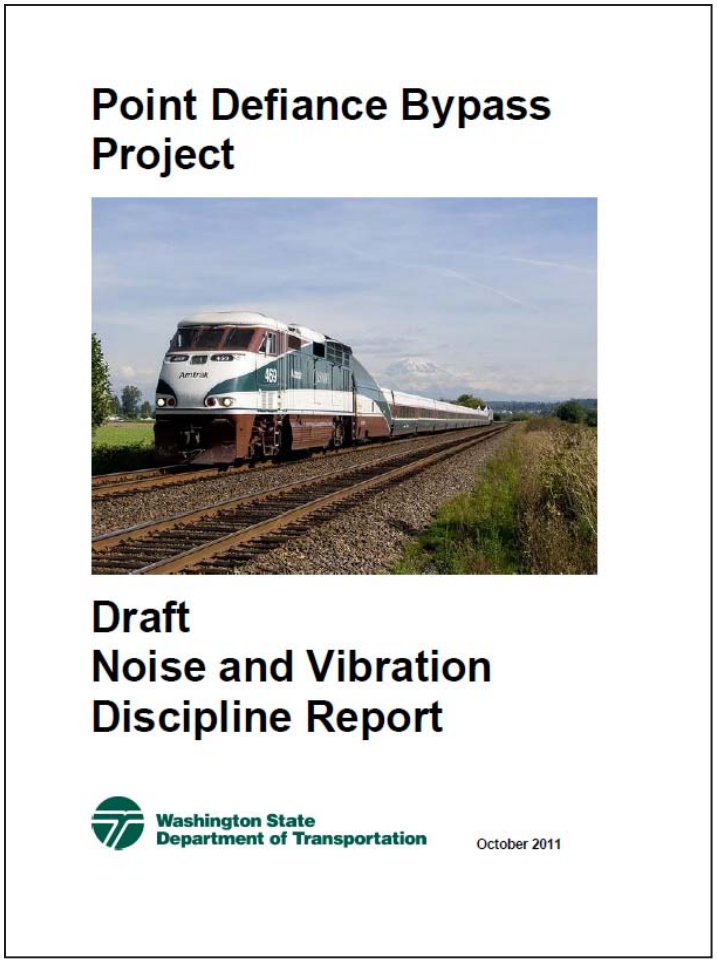
Washington State
Department of Transportation

Point Defiance Bypass
Noise & Vibration Report


Point Defiance Bypass Project

Draft
Noise and Vibration Discipline Report

Washington State Department of Transportation

October 2011

Presenter: Patrick Romero

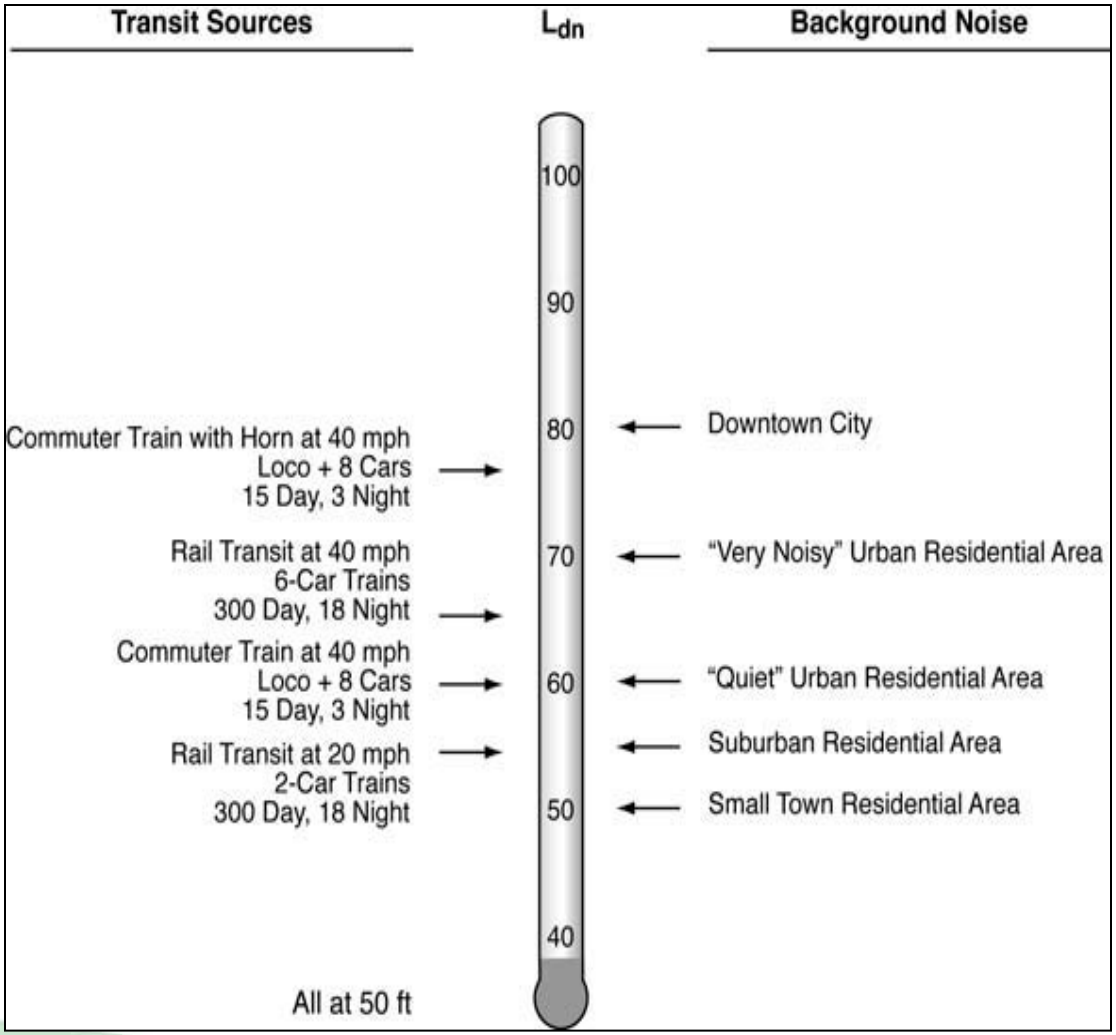
Presentation Outline

1. Noise
   a. Noise Basics and Impact Criteria
   b. Noise Study
   c. Noise Effects, Mitigation, and Design Elements
2. Vibration
   a. Vibration Basics and Impact Criteria
   b. Vibration Study
   c. Vibration Effects, Mitigation, and Design Elements

Understanding Noise

- Decibel (dB) is the basic unit of measurement for noise, a logarithmic measure of sound energy.
- The “A” scale approximates the average human ear’s sensitivity to sounds comprised of many different frequencies (dBA).
- Leq is the equivalent sound level (dBA) that is the energy sum of all the sound that occurs during a measurement period.
- Ldn is the day/night average sound level that adds a 10-dB penalty to nighttime noise from 10 p.m. to 7 a.m. (dBA).

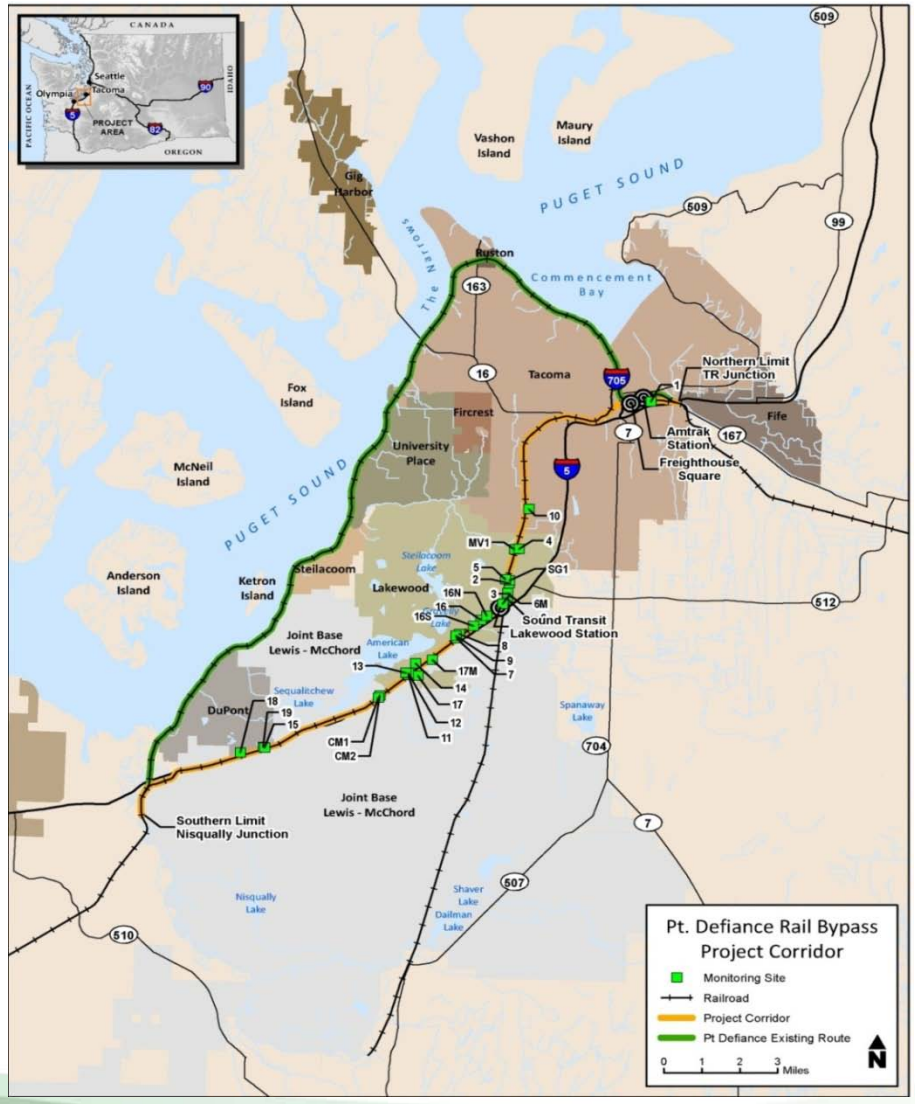
Typical Noise Levels



Source: Transit Noise and Impact Assessment, (FTA 2006)

Noise Study

- Physical and GIS Surveys to locate noise sensitive land uses (residences, parks, schools, etc).
- Baseline Noise Monitoring at 23 sites
- Noise Modeling of **14 daily passenger trains** and all **warning devices** included in the project
- Modeling results validated with train pass-by measurements
- Impact Assessment adds existing noise levels to project noise levels



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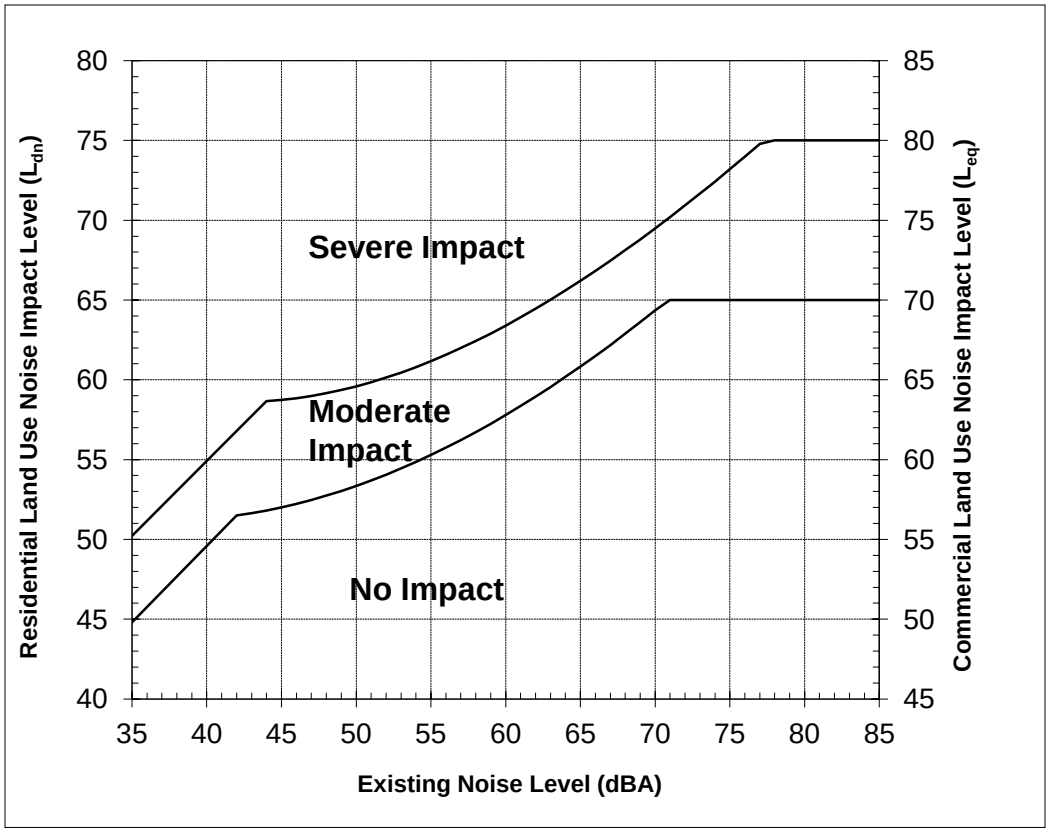
Noise Effect Criteria

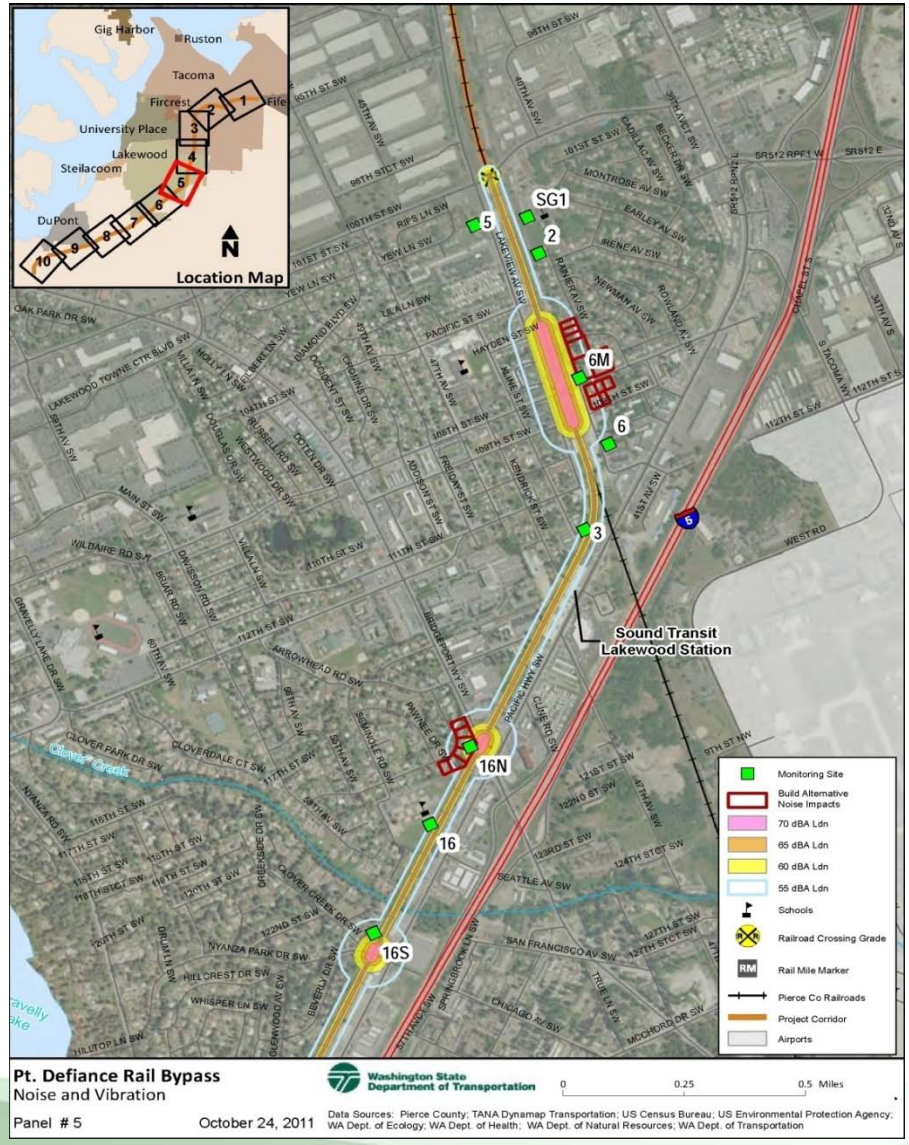
- Existing baseline noise levels are used to predict future noise effects



Source: Transit Noise and Impact Assessment, (FTA 2006)

Noise Effects

- Moderate noise effects predicted at two sites:
  - Site 6M represents 8 residences at 119th St SW and Tomahawk Rd SW.
  - Site 16N represents 6 residences at Rainier Ave SW, 108th St SW and 109th St SW.



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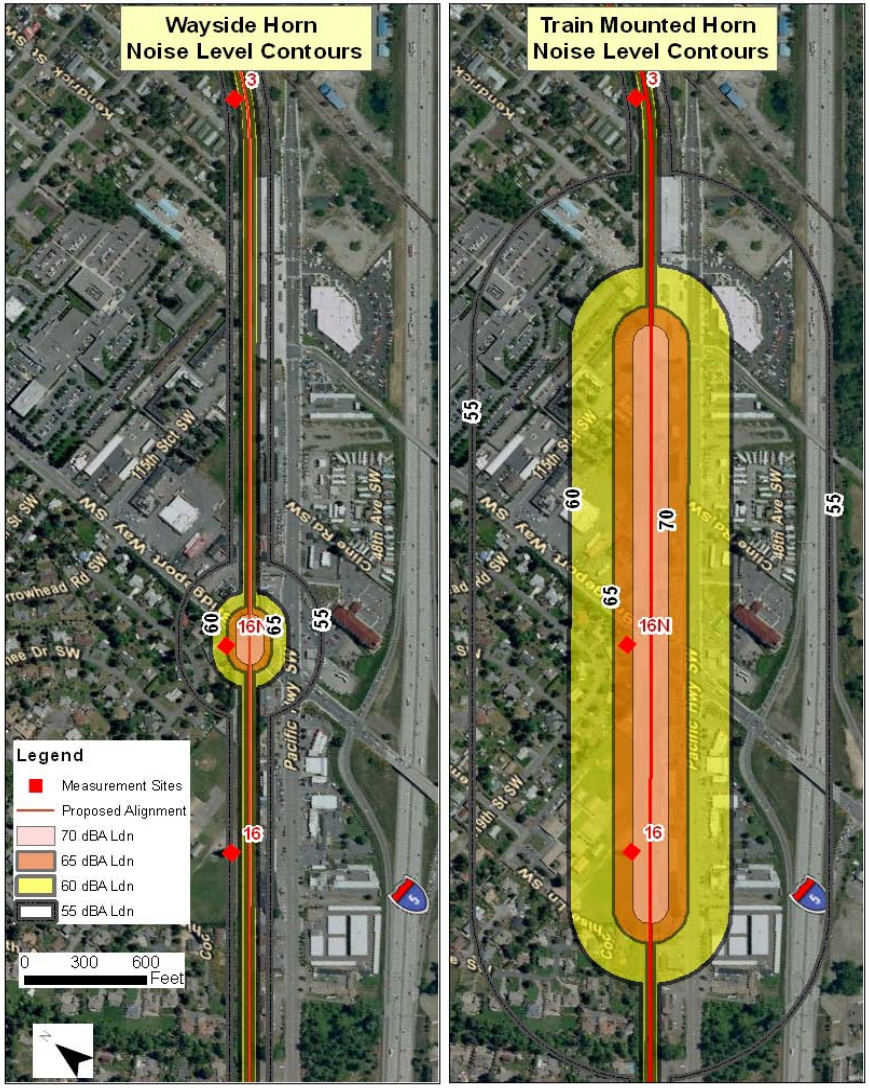
Noise Effects

- The noise levels at these sites would be caused by at-grade crossing warning devices located near the receivers.
- Elements to reduce potential noise levels along the project:

  1. Wayside Horns instead of train horns
  2. Continuous Welded Rail
  3. Spring Frogs

- Sound walls would not reduce the noise levels because of the gap needed for the crossing.
- Since noise is from safety devices and results in moderate effects, no additional mitigation is recommended.

Wayside Horns vs. Train Horns


Wayside Horn
Noise Level Contours
Train Mounted Horn
Noise Level Contours
Legend
Measurement Sites
Proposed Alignment
70 dBA Ldn
65 dBA Ldn
60 dBA Ldn
55 dBA Ldn
0 300 600
Feet
3
16N
16
55
60
65
70
Pacific Hwy SW
Pacific Way SW
Kendrick St SW
115th Sct SW
Clover Park Way SW
Clover Park Hwy SW
Clover Park Ave SW
Clover Park Ave SW
Clover Park Ave

Continuous Welded Rail vs. Jointed Track

Spring Frog Switch

Understanding Vibration

- Vibration is expressed in units of decibels relative to one micro-inch per second, and the abbreviation VdB.

- Train vibration is characterized in terms of the root-mean-square (RMS).

- To evaluate human response to vibration, RMS represents the average energy over a one-second interval.

Understanding Vibration

- Ground-borne vibration from any type of train operation rarely causes building damage
- Principal concern is annoyance to building occupants and sensitive equipment
- FRA/FTA reference levels used to estimate ground vibration distances from the rail line

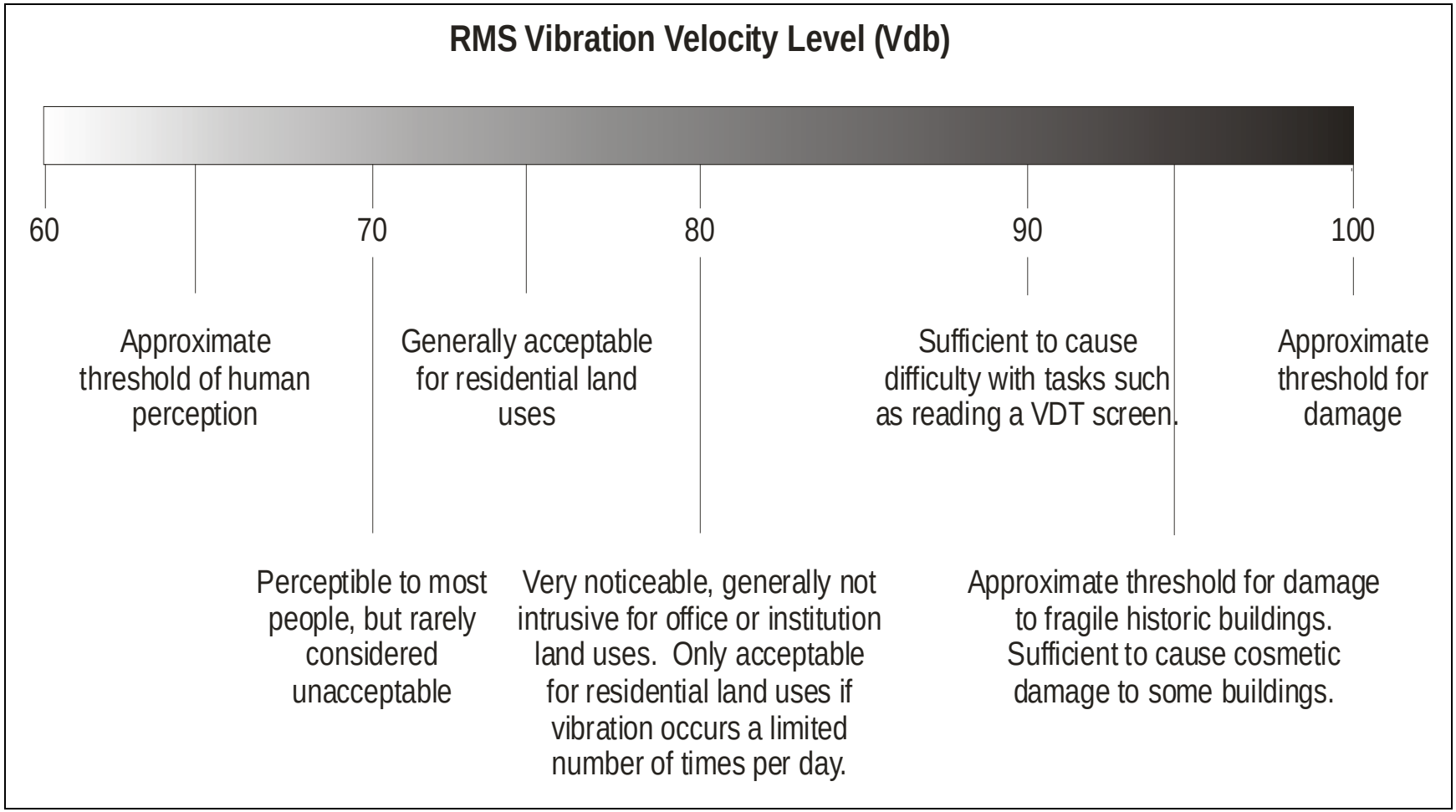
Vibration Impact Criteria

- The threshold of vibration perception for people is around 65 to70 VdB.

- Vibration levels greater than 80 VdB are considered unacceptable.

- For rail systems with fewer than 30 trains per day, the limit for an acceptable level of residential ground-borne vibration is 80 VdB.

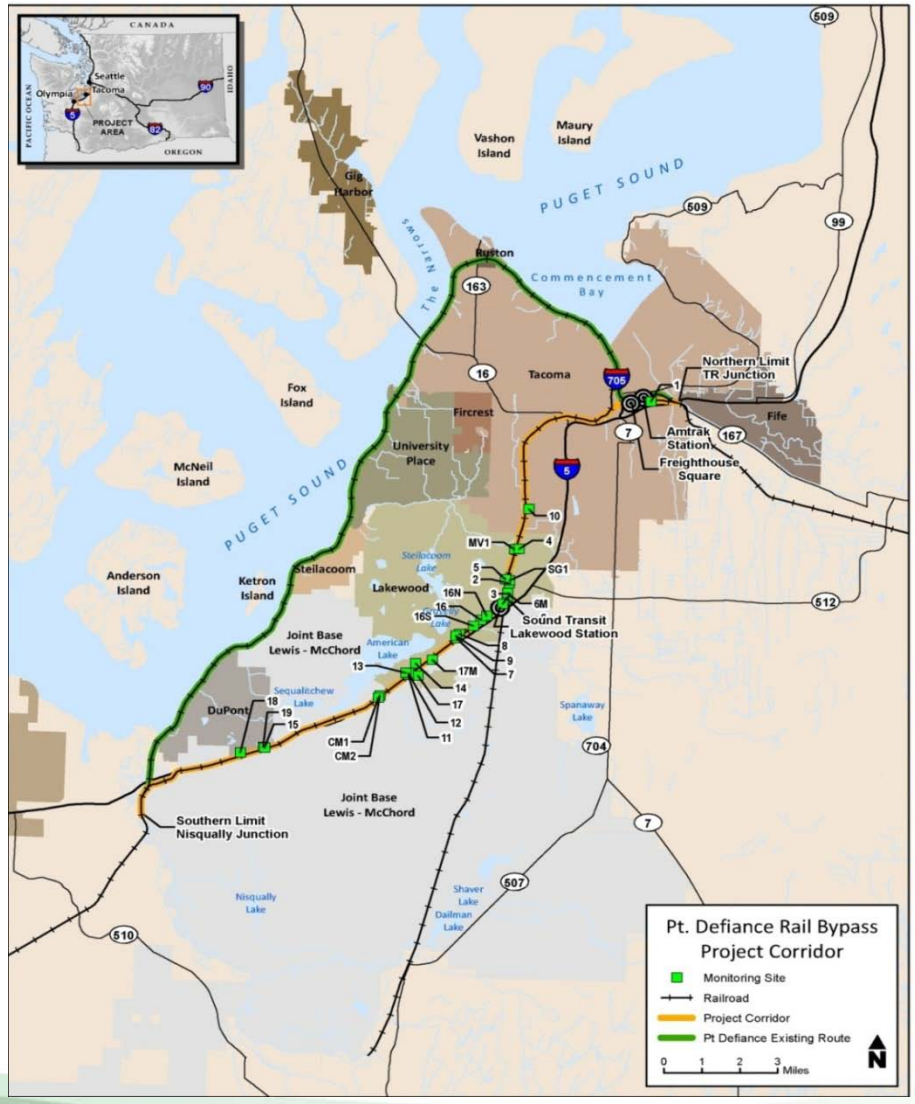
Vibration Velocity Levels



Source: Transit Noise and Impact Assessment, (FTA 2006)

Vibration Study

- Physical and GIS Surveys to locate vibration sensitive structures and land uses (residences, precision equipment).
- Baseline Vibration Monitoring at 2 sites similar to the project alignment.
- FTA Vibration Reference Levels were used to assess potential vibration impacts from the additional **14 trains** included in the project.
- FTA Vibration Levels provide reference data for:
  1. The train's force density
  2. Transfer mobility functions



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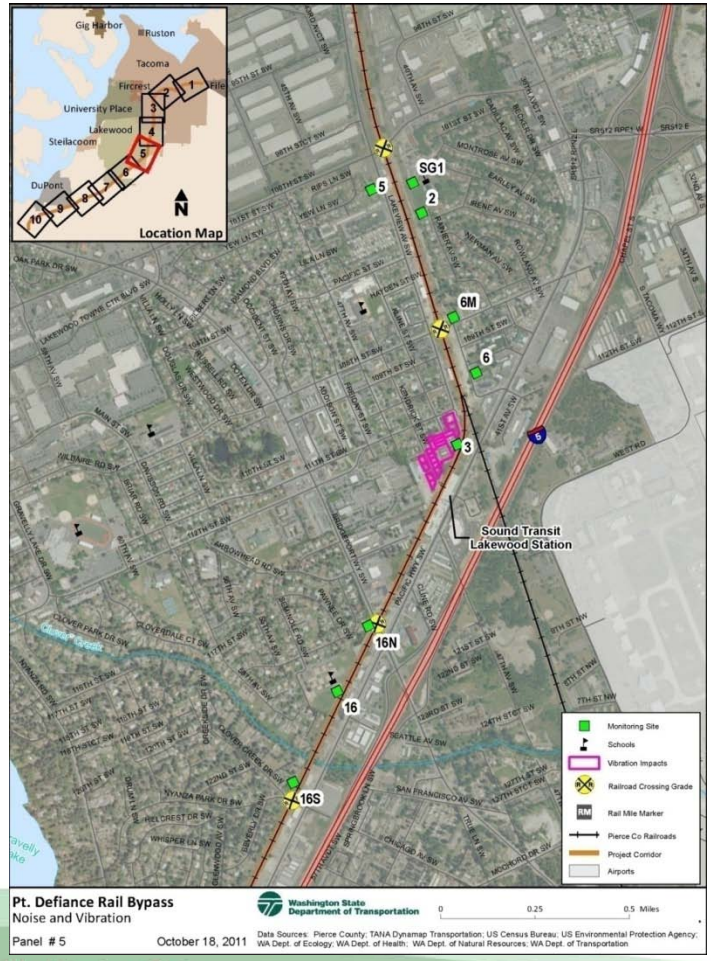
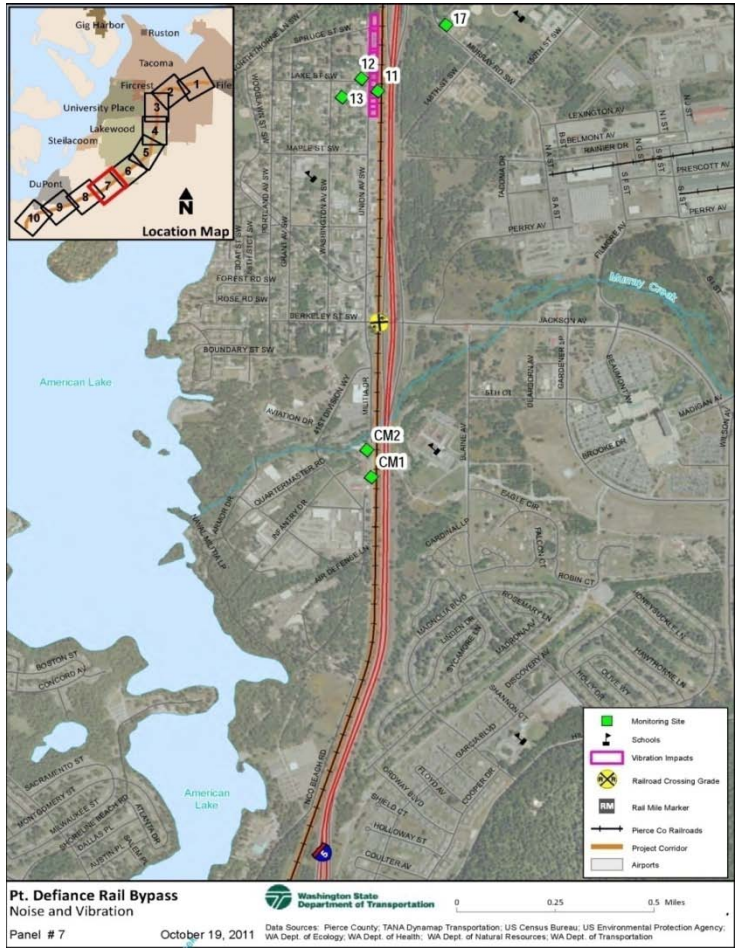
Vibration Effects

- Vibration effects predicted at two sites near the tracks:

Site 3 represents 30 residences at Kline St SW and Kendrick St SW

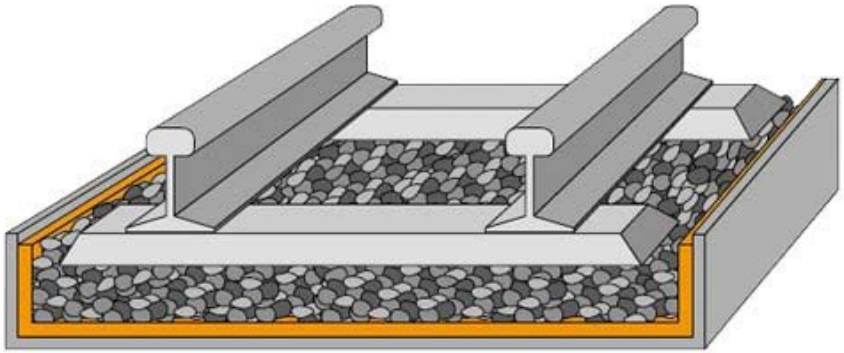


Site 11 represents 22 residences along Union Ave SW



Potential Vibration Mitigation

- Eliminate vibration effects by using track treatments such as:
  - Resiliently Supported Ties
  - Ballast Mats

- Recommend a detailed vibration analysis of the two areas with predicted vibration effects during final design to determine the feasibility of track treatments.

Resiliently Supported Ties and Ballast Mats