# SOUND AND VIBRATION PEER REVIEW
# 2013 STATE ENVIRONMENTAL POLICY ACT ADDENDUM
# to the
# East Link Extension
# Final Environmental Statement (July 2011)


**PREPARED FOR**

**CITY OF BELLEVUE**
**Department of Transportation**

**PREPARED BY**

THE GREENBUSCH GROUP, INC.

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# 1.0 INTRODUCTION

In July of 2011, Sound Transit published the East Link Light Rail Transit Project Final Environmental Impact Statement. The Sound Transit Board selected the project to be built, including a tunnel in downtown Bellevue. The Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA) issued their Record of Decision (ROD) in November of 2011. At this same time, a Memorandum of Understanding (MOU) was executed between the City of Bellevue (City) and Sound Transit. The MOU establishes a framework for Sound Transit and the City to share the cost of a tunnel in downtown Bellevue, beyond the funding designated for the project. The City's funding commitment is $100 million in up-front contributions and $60 million in contingency funding.

The MOU specifies that cost reductions from value engineering, design advancement and scope modifications will count toward the City's contingency. The goal is $60 million in cost reduction. Sound Transit, in collaboration with the City, identified several potential modifications as cost cutting measures. The Options developed were evaluated for preliminary environmental impact in the 2013 State Environmental Policy Act Addendum (Addendum) March 2013. The Options include the following modifications:

### SHIFT BELLEVUE WAY OPTION

- Without HOV
- With HOV

### 112TH ROAD OVER RAIL OPTION

- SE 4th Emergency Access Sub option
- SE 4th Open Sub option
- Rail Under SE 4th Option

### BELLEVUE TRANSIT CENTER STATION OPTIONS

- Optimize Selected Alternative Station Option
- NE 6th Station Option

In February 2013, the City of Bellevue adopted a Land Use Code Amendment ("Light Rail Overlay District") focused on light rail permitting and land use code requirements. One of the requirements of the amendment is a 60 foot separation from the edge of the light rail guideway to an existing residential primary structure. The noise analysis has been updated to reflect this new code requirement.

Impacts were evaluated against FTA criteria for the light rail noise, vibration and ground borne vibration and with FHWA criteria for the traffic noise. The intent of this Peer Review is to analyze the impacts and the mitigation strategies outlined in the Addendum from the following elements:

- noise from the operation of the light rail

- noise from traffic due to the alignment shifts
- vibration
- ground borne noise due to the vibration.

## 2.0 EXECUTIVE SUMMARY

The Addendum is intended to update and address cost saving options which have resulted from discussions with the City of Bellevue. Input data used in the model was provided and reviewed.

The following areas were evaluated as part of this study:

- Methodology used in the predictions appears to be in line with industry standards and best practices for the evaluation of the vibration and airborne transit and traffic sound.

- Sound levels predicted for the residential community due to relocating traffic nearer to the residential properties.
- Sound Levels associated with the operation of the light rail transit. The current fleet of Link light rail vehicles is 78-79 dBA at 50 feet. The reference level used in the Addendum study is $L_{max}$ 79 dBA at 50 feet at 40 mph. Projected noise levels correct for speed, track type and topographical conditions.

- Sound levels associated with the impact sound of wheels crossing the rail gaps in the crossover switches was included in the noise model to define impact along the East Link alignments. Sound Transit provided the maximum sound level, $L_{max}$, associated with a train passing over a standard track crossover, at 90 dBA at 50 feet. Mitigation is proposed with implementation of special track to eliminate impacts.

- Sound levels associated with bells were included in the noise model to define impact along the various alignment options. Sound Transit has provided the maximum sound levels, $L_{max}$, associated with the bells. The reported reference level for the bells is $L_{max}$ 80 dBA at 50 feet for the train mounted bells. This level is reduced to $L_{max}$ 72 dBA at 50 feet during the nighttime hours. Nighttime hours are typically considered 10:00 PM to 7:00 AM. The reference sound level of the wayside pedestrian audible warning device near the gated crossings is 77 dBA at 15 feet. The sound from the bells and warning devices is included in the overall, average sound character associated with the Link Light system. The bells and warning devices are designed with a tonal, high frequency sound intended to attract attention. The bells and warning devices will likely be more noticeable than a sound source with a more broadband characteristic even if the overall sound level is the same because the devices are designed to attract attention.

The bells continue to be averaged in the overall Project $L_{dn}$ levels. The following impacted segments are dominated by the bells and/or warning devices even when they are averaged over 24 hours:

### *Final EIS*

*Surrey Downs Park to the Tunnel portal-*
5 severe impacts located near the Station. Impact due, in part, to bells and warning devices.

### *Addendum*

*SE 4th Emergency Access Suboption-*
10 severe impacts located near the East Main Station due to two at-grade crossings with pedestrian audible warning devices and train mounted bells.

*SE 4th Open Suboption*
2 additional moderate impacts, 2 moderate impacts increase to severe and an additional noise impact at the Bellevue Club Hotel due to the at-grade crossing at SE 4th Street requiring train bells and pedestrian audible warning devices. The impact assumes that the gated crossings will not be equipped with bells but will flash as the gates are dropped.

*Rail Under SE 4th Suboption*

9 severe impacts result from the train bells and pedestrian warning devices 2 at-grade pedestrian crossings at the East Main Station. Sound insulation is proposed for residences near the pedestrian crossing due to the impact from the bells.

*NE 6th Station Option*
3 dBA increase noise levels at Bravern Condominiums due to station bell noise from the at-grade station.

It is our professional opinion that averaging a noise source with a very short duration under predicts the true effect on the nearby residential receivers. While the averaging of the noise levels associated with the bells and warning devices is consistent with FTA methodology, the FTA manual, on which the study is based, states that “Transit vehicles are equipped with horns and bells for use in emergency situations and as a general audible warning to track workers and trespassers within the right-of-way as well as to pedestrians and motor vehicles at highway grade crossings. Horns and bells on the moving transit vehicle, combined with stationary bells at grade crossings can generate noise levels considered to be extremely annoying to nearby residents.” [Note that for this extension, the train does not sound a horn except in the very rare circumstance of an emergency. Sound Transit trains ring a bell at the crossings.

The impacts are identified as a worst case, without additional mitigation. Directional bells, bell shrouds and bells that automatically adjust to the ambient conditions are suggested as alternate mitigation. No specific approach is outlined.

Mitigation identified in the Final EIS is appropriate. The Addendum identifies various additional mitigation approaches. Proposed mitigation is intended as a high-level evaluation for the Addendum, until a preferred Alternative is selected. The study concludes that mitigated sound levels will be within FTA and FHWA criteria for No Impact for each Alternative. For many upper story units in Multi-family dwellings or hotels, the mitigation selected may be sound insulation of these units. This is an effective mitigation to protect interior areas where people sleep. However, the exterior sound levels will remain unmitigated. This would apply only to any outdoor decks or other living areas which are above grade and not shielded by the noise barriers. The Addendum states that, "…if during final design, Sound Transit determines that the relevant noise criterion can be achieved using a different method, or that the noise impact at that location will not occur, even without mitigation, then the mitigation measure might be eliminated or modified, as needed."

The current design has several curves with radii of less than 600 feet. These occur at 112th Ave SE to Main St., Main St. to 110th Ave NE, 110th Ave NE to NE 6th St. Station. The curve at Main to 110th is inside the tunnel, so will likely not be an issue. It is stated that wheel squeal may be noticeable and that they will be fitted with lubricators. It would be preferable, from a noise minimization perspective, to design the alignment to eliminate these tight curves. However, in a conversation with Sound Transit, it was indicated that the lubricators have successfully resolved the wheel squeal issues at the curves and inclined track at Central Link and Tukwila and a level of confidence in the mitigation technique has been established.

Impacts were also evaluated for both vibration and ground borne noise resulting from the vibration. The ground borne noise impacts identified in the FEIS at the Winter's House would be eliminated with the Shift Bellevue Way option. One residual vibration impact is identified at the Coast Bellevue Hotel for the optimized Selected Alternative Station Option.

A high level analysis of construction noise was included in the FEIS.

## 3.0 NOMENCLATURE

*Decibel, dB*
The most common measure of sound level is expressed in decibels. The auditory response to sound is a complex process, which occurs over a wide range of frequencies and intensities. Decibel levels, or "dB", are a form of shorthand that compresses this broad range of intensities into a convenient numerical scale.

The decibel scale is logarithmic, and as such, a doubling or halving of energy causes the sound level to change by 3 dB; it does not double or halve the sound level as might be expected. The minimum sound level variation perceptible to a human observer is generally around 3 dB. A 5-dB change is clearly perceptible, and an 8 to 10 dB change is associated with a perceived doubling or halving of loudness.

*A-weighted Decibel, dBA*
The human ear has a unique response to sound pressure. It is less sensitive to those sounds falling outside the speech frequency range. Sound level meters and monitors

utilize a filtering system to approximate human perception of sound. Measurements made utilizing this filtering system are referred to as "A weighted" and are called "dBA".

*Ambient Sound Level*
A sound pressure level that describes the sound environment at a specified location during a specified time period including contributions from all sound sources, both local and distant, excluding specific sources of interest or under investigation.

*Day-Night Sound Level, Ldn*
$L_{dn}$ is the $L_{eq}$ measured over a 24 hour interval, with sound levels occurring between 10:00 PM and 7:00 AM penalized by 10 dBA to reflect greater potential for disturbance. The nighttime penalty is imposed where sleep interference is a consideration. The $L_{dn}$ has been found to have a close correlation with community response to noise. The $L_{dn}$ is the descriptor upon which FTA bases their impact criteria.

*Equivalent Sound Level, Leq*
$L_{eq}$ is the A-weighted level of a constant sound having the same energy content as the actual time-varying level during a specified interval. The $L_{eq}$ is used to characterize complex, fluctuating sound levels with a single number. Typical intervals for $L_{eq}$ are hourly, daily and annually. Leq is the descriptor on which the FHWA bases a traffic noise impact.

*Maximum Sound Level, Lmax*
$L_{max}$ is the maximum recorded root mean square (rms) A-weighted sound level for a given time interval or event. $L_{max}$ "fast" is defined as a 125-millisecond time-weighted maximum, while $L_{max}$ "slow" corresponds to a 1-second time-weighted maximum. $L_{max}$ "slow" is used in the FTA evaluation.

## 4.0 PROCESS/EVALUATION OVERVIEW

Sound Transit Mitigation Policy[1] directs Sound Transit to comply with applicable Federal/State and/or Local law and relevant guidelines for evaluating noise impacts and determining appropriate mitigation. The FTA guidelines published in the *Transit Noise and Vibration Assessment*[2] is the governing authority by which Sound Transit abides.

FTA does not have a specific noise mitigation policy embodied in a regulation. In conjunction with FHWA, FTA has adopted the general policy of the National Environmental Policy Act (NEPA) for environmental mitigation. This policy includes requirements that "…measures necessary to mitigate adverse impacts are to be incorporated into the projects…" FTA identifies two levels of impact; Moderate and Severe. The requirements for Moderate impacts are less stringent than for Severe impacts. Sound Transit mitigates all Moderate and Severe impacts that are feasible and reasonable. Further, "…such measures are eligible for Federal funding when FTA determines that the proposed mitigation represents a reasonable public expenditure

[1] Sound Transit Board Motion M2004-08, 2004

[2] Transit Noise and Vibration Impact Assessment, Federal Transit Administration, 2006

after considering the impacts of the actions and benefits of the proposed mitigation measures".

In order to meet the test for Federal project funding, FTA must demonstrate the following prior to project approval:

- The project design elements have endeavored to preserve and enhance the environment and interests of the community.
- Mitigation is included, where practical, to address adverse environmental effects as a result of the project.
- Options are analyzed to ensure that no feasible, prudent alternative exists and all reasonable steps have been taken to minimize the effect of the project. "Feasible" is determined objectively by quantitative elements such as engineering considerations, safety, maintenance and achieving a sound reduction of at least 5 dBA. "Reasonable" is more subjective and considers community desires, aesthetics, views, and evaluates whether the overall mitigation outweighs adverse social, economic and environmental effects and cost

In order to evaluate the noise impact of a project and the extent of mitigation, FTA and project planners need to determine:

- Number of affected properties.
- Increase in sound level over ambient conditions.
- Noise sensitivity of the property.
- Effectiveness of the mitigation.
- Neighborhoods already impacted with high noise are eligible for more mitigation so as not to increase the noise above existing high levels.
- Community views (i.e. view obstructed by noise wall).
- Protected Historic sites, Parks, Wildlife refuge.
- Cost per benefited residence.

Mitigation of the sound can occur at the *source* (train or rails) along the *path* between source and receiver (barriers) and at the *receiver* (residence or other noise sensitive property). It is preferable to treat the noise at the source whenever possible to reduce the sound at the point of origin. This is typically accomplished through vehicle specification (ie. Quieter trains) or addressing the wheel/rail interface to reduce the noise. Source mitigation approaches include:

- Quiet train purchase.
- Wheel skirts.
- Rail grinding.
- Wheel truing.

- Lubrication or friction modifiers between rail and wheel on tighter curves.
- Quieter train bells or crossing bells.

These mitigation elements have been incorporated, as standard policy, by Sound Transit, for all Link Light Rail alignments.

As sound travels away from the source, it radiates with spherical spreading. Locating the mitigation further from the source increases the extent of the mitigation. Path mitigation includes:

- Sound walls.
- Earth berms.
- Alignment modifications.
- Buffer zones.

Mitigation at the residential receiver (where required) is typically a sound insulation package, which includes:

- Acoustically rated windows.
- Mechanical ventilation.
- Seals along doors.

A sound insulation package can effectively reduce sound levels at the interior of a residence. However, exterior sound levels on decks and other outdoor living areas will not be affected by the path mitigation and will remain unmitigated. Sound insulation is typically considered as a last option for mitigation and is typically provided for residential properties that are not benefitted by the barriers. This may be due to elevation (either topography or upper story residential units), where there is line-of-sight over the barrier or along view corridors where barriers are not practical.

### *4.1 FTA*

The FTA evaluation considers ambient conditions in setting Noise Impact Criteria for public transit systems. Both existing ambient and the cumulative effect of the predicted project sound are used to determine the criteria for impact. The quieter the ambient condition, the greater exposure above ambient is allowed. Table 1 below outlines the FTA criteria.

**Table 1.** FTA Noise Impact Criteria and Project Cumulative Noise Levels

| ***Noise Levels Defining Impact for Transit Projects-Residential Sites*** | | | | |
|---|---|---|---|---|
| ***Existing (Ambient) Noise Exposure $L_{dn}$*** | ***Project Noise Impact Exposure $L_{dn}$*** | | | ***Allowable Increase Over Ambient, No Impact*** |
| | ***No Impact*** | ***Moderate Impact*** | ***Severe Impact*** | |
| <43 | <Ambient + 10 | Ambient +10 to 15 | >Ambient +15 | <10 |
| 43 | 51 | 52-58 | 59 | 9 |
| 44 | 51 | 52-58 | 59 | 8 |
| 45 | 51 | 52-58 | 59 | 7 |
| 46 | 52 | 53-59 | 60 | 7 |
| 47 | 52 | 53-59 | 60 | 6 |
| 48 | 52 | 53-59 | 60 | 5 |
| 49 | 53 | 54-59 | 60 | 5 |
| 50 | 53 | 54-59 | 60 | 5 |
| 51 | 53 | 54-60 | 61 | 4 |
| 52 | 54 | 55-60 | 61 | 4 |
| 53 | 54 | 55-60 | 61 | 4 |
| 54 | 54 | 55-61 | 62 | 3 |
| 55 | 55 | 56-61 | 62 | 3 |
| 56 | 55 | 56-62 | 63 | 3 |
| 57 | 56 | 57-62 | 63 | 3 |
| 58 | 56 | 57-62 | 63 | 2 |
| 59 | 57 | 58-63 | 64 | 2 |
| 60 | 57 | 58-63 | 64 | 2 |
| 61 | 58 | 59-64 | 65 | 2 |
| 62 | 58 | 59-64 | 65 | 1 |
| 63 | 59 | 60-65 | 66 | 1 |
| 64 | 60 | 61-65 | 66 | 1 |
| 65 | 60 | 61-66 | 67 | 1 |
| 66 | 61 | 62-67 | 68 | 1 |
| 67 | 62 | 63-67 | 68 | 1 |
| 68 | 62 | 63-68 | 69 | 1 |
| 69 | 63 | 64-69 | 70 | 1 |
| 70 | 64 | 65-69 | 70 | 1 |
| 71 | 65 | 66-70 | 71 | 1 |
| 72 | 65 | 66-71 | 72 | 1 |
| 73 | 65 | 66-71 | 72 | 1 |
| 74 | 65 | 66-72 | 73 | 1 |
| 75 | 65 | 66-73 | 74 | 0 |
| 76 | 65 | 66-74 | 75 | 0 |
| 77 | 65 | 66-74 | 75 | 0 |
| >77 | 65 | 66-75 | 76 | 0 |

*Source: Table 3.1 Noise Impact Criteria: Effect on Cumulative Noise Exposure FTA Transit Noise and Vibration Impact Assessment, May 2006*

Given that the ambient noise levels along the alignment south of Downtown are in the higher range, $L_{dn}$ 59-70, the allowable increase above ambient is only 1-2 dBA. This is usually not a noticeable increase, although the light rail system may be audible even if the overall noise is lower than the FTA $L_{dn}$ criteria due to the different character of the light rail sounds. This is particularly true for the sound of the bells and warning devices due to the tonal quality of the source. The sound is designed to attract attention and

while the overall dBA level may be within the same range as other sources, the acoustical signature is audibly different than other community sources to warn the hearer of an impending danger.

### *4.2 FHWA*

The Federal Highway Administration (FHWA) impact criteria[1] for highway projects are based on a "level not to be exceeded" basis. The threshold for FHWA noise abatement criteria (NAC) for Residential is $L_{eq}$ 66 dBA and 71 dBA for Commercial. However, under WSDOT policy, a traffic noise study is only required if the proposed realignment is expected to increase noise levels by 3 dBA or more, as this is the threshold of discernment for most people. These criteria apply to the alignment shifts where the source is traffic, rather than light rail.

### *4.3 City Of Bellevue*

City of Bellevue Chapter 9.18 Noise Control, BCC 9.18.020C outlines that construction sites are exempt from the Bellevue Noise Code between the hours of 7:00 a.m. and 6:00 p.m. on weekdays, and 9:00 a.m. and 6:00 p.m. on Saturdays.

BCC 9.18.045B addresses Development Restrictions as follows:

A. If the exterior $L_{dn}$ exceeds 65 dBA unless attenuated to:
1. Forty dBA or lower for sleeping areas; and
2. Forty-five dBA or lower for nonsleeping areas.
B. Play area equipment shall not be installed if the exterior $L_{eq}$ (daytime) at the play area site exceeds 55 dBA

## 5.0 IDENTIFIED IMPACTS

### SHIFT BELLEVUE WAY OPTION

This modification brings the light rail to at-grade on the east side of Bellevue Way SE and shifts Bellevue Way SE to the west. The shift west begins at the elevated South Bellevue Station and continues to 112th Avenue SE. This option is evaluated with a potential City project of adding a southbound HOV lane between Bellevue Way SE and 112th Ave SE.

| Area of Change | Moderate Light Rail Impacts (Before/After mitigation) | Severe Light Rail Impacts Before/After mitigation) | Traffic –Related Noise Impacts (Before/After mitigation) |
|---|---|---|---|
| Selected Alternative (Rail trench in front of Winter's House) | 13/0 | 0/0 | 0/0 |
| Shift Bellevue Way | 14/0 | 0/0 | 26/0 |
| Shift Bellevue Way with HOV option | 14/0 | 0/0 | 28/0 |

[1] Transit Noise and Vibration Impact Assessment, Federal Transit Administration, 2006, Table 3-4

| Area of Change | Vibration Impacts (Before/After mitigation) | Ground borne Noise Impacts (Before/After mitigation) |
|---|---|---|
| Selected Alternative (Rail trench in front of Winter's House) | 0/0 | 1/0 |
| Shift Bellevue Way | 0/0 | 0/0 |

## 112TH ROAD OVER RAIL OPTIONS

At SE 15th, the road will be built on a bridge structure with light rail crossing underneath from the east to the west side of 112th Ave SE.

One of the requirements of the Light Rail Overlay District is a 60 foot separation from the edge of the light rail guideway to an existing residential primary structure. In order to develop a conservative noise analysis, Sound Transit assumed that eight additional residences on 111th Place SE within the 60' separation would be displaced. This would result in impacts to the homes to the west which are currently shielded by the displaced residences. This is reflected in the impacts identified in the Tables below. The mitigation along this alignment modification would include a noise wall.

### *SE 4th Emergency Access Sub option*

With this Suboption, the light rail would cross SE 4th St at-grade so the street would be vacated, except for emergency vehicle access. Left turns from and/or to 112th Ave SE and the Bellefield Residential Park would be allowed at the southern entrance of the Park. A new access to the Surrey Downs Neighborhood may be created at SE 15th St with a new roadway between Bellefield Park Lane and 111th Place SE. This is reflected in the Tables below as the Bellefield Access Variation.

| Area of Change | Moderate Light Rail Impacts (Before/After mitigation) | Severe Light Rail Impacts Before/After mitigation) | Traffic –Related Noise Impacts (Before/After mitigation) |
|---|---|---|---|
| Selected Alternative (Rail at grade 112th Ave) | 42/0 | 2/0 | 0/0 |
| SE 4th Emergency Access Sub option | 17-24/0 | 12-19/0 | 0/0 |
| Bellefield access Variation | 17-24/0 | 11-18/0 | 0/0 |

| Area of Change | Vibration Impacts (Before/After mitigation) | Ground borne Noise Impacts (Before/After mitigation) |
|---|---|---|
| Selected Alternative (Rail at grade 112th Ave) | 3/0 | 0/0 |
| SE 4th Emergency Access Sub option | 10/0 | 0/0 |
| Bellefield access Variation | 9/0 | 0/0 |

### *SE 4th Open Sub option*

This option allows access at the at-grade crossing of SE 4th St. The intersection would include crossing gates and audible pedestrian warning devices. Left turns would not be allowed from SE 4th St. at 112th Ave SE. A U-turn would be provided for entrance into the Surrey Downs neighborhood from the south.

| Area of Change | Moderate Light Rail Impacts (Before/After mitigation) | Severe Light Rail Impacts Before/After mitigation) | Traffic –Related Noise Impacts (Before/After mitigation) |
|---|---|---|---|
| Selected Alternative (Rail at grade 112th Ave) | 42/0 | 2/0 | 0/0 |
| SE 4th Open Sub option | 18-25/0 | 14-21/0 | 0/0 |

| Area of Change | Vibration Impacts (Before/After mitigation) | Ground borne Noise Impacts (Before/After mitigation) |
|---|---|---|
| Selected Alternative (Rail at grade 112th Ave) | 3/0 | 0/0 |
| SE 4th Open Sub option | 10/0 | 0/0 |

### *Rail under SE 4th Sub option*

This option continues the alignment along the west side of 112th Ave SE, lowering the light rail into a retained cut from Surrey Downs Park, crossing under SE 4th St and rising near the East Main Station.

| Area of Change | Moderate Light Rail Impacts (Before/After mitigation) | Severe Light Rail Impacts Before/After mitigation) | Traffic –Related Noise Impacts (Before/After mitigation) |
|---|---|---|---|
| Selected Alternative (Rail at grade 112th Ave) | 42/0 | 2/0 | 0/0 |
| Rail Under SE 4th Sub option | 15-22/0 | 11-18/0 | 0/0 |

| Area of Change | Vibration Impacts (Before/After mitigation) | Ground borne Noise Impacts (Before/After mitigation) |
|---|---|---|
| Selected Alternative (Rail at grade 112th Ave) | 3/0 | 0/0 |
| Rail Under SE 4th Sub option | 10/0 | 0/0 |

## BELLEVUE TRANSIT CENTER STATIONS SUB OPTION

### *Optimized Selected Alternative Station Option*

This option optimizes the Selected Alternative's design below grade. The above grade change shifts the northern entrance from the southwest corner of 110th Ave NE and NE 6th St. to the far west lane of 110th Ave NE.

| Area of Change | Moderate Light Rail Impacts (Before/After mitigation) | Severe Light Rail Impacts Before/After mitigation) | Traffic –Related Noise Impacts (Before/After mitigation) |
|---|---|---|---|
| Selected Alternative (110th downtown tunnel) | 48/0 | 36/0 | 0/0 |
| Optimized Selected Alternative Alternate | 48/0 | 36/0 | 0/0 |

| Area of Change | Vibration Impacts (Before/After mitigation) | Ground borne Noise Impacts (Before/After mitigation) |
|---|---|---|
| Selected Alternative (110th downtown tunnel) | 1/1* | 1/0 |
| Optimized Selected Alternative Alternate | 2/1* | 3/0 |

- The residual impact occurs at the Coast Bellevue Hotel

### *NE 6th Station Option*

This option moves the Bellevue Transit Center Station from with the tunnel under 110th Ave NE to an at-grade location on the south side of NE 6th St. between 110th Ave NE and 112th Ave NE. There is a single entrance on the east side of 110th Ave NE. There is a potential for a second entrance on the west side of 112th Ave NE. This alignment crosses I-405 on the south side of 6th St NE and connects with the Selected Alternative at the Hospital Station.

Two methods are evaluated for the tunneling into downtown for this sub option; cut and cover and "sequential excavation method" (SEM). SEM would excavate the tunnel primarily from the portal south of Main St, avoiding most of the disruption of the surface.

| Area of Change | Moderate Light Rail Impacts (Before/After mitigation) | Severe Light Rail Impacts Before/After mitigation) | Traffic –Related Noise Impacts (Before/After mitigation) |
|---|---|---|---|
| Selected Alternative (110th downtown tunnel) | 48/0 | 36/0 | 0/0 |
| NE 6th Station | 84/0 | 0/0 | 0/0 |

| Area of Change | Vibration Impacts (Before/After mitigation) | Ground borne Noise Impacts (Before/After mitigation) |
|---|---|---|
| Selected Alternative (110th downtown tunnel) | 1/1 | 1/0 |
| NE 6th Station | 0/0 | 2/0 |

## 6.0 PEER REVIEW

### GENERAL

The bells continue to be averaged in the overall Project $L_{dn}$ levels. For residences near gated crossings or near stations, the impact is identified as being dominated by the bells and audible pedestrian warning devices. Averaging a noise source with a very short

duration under predicts the true effect on the nearby residential receivers. The FTA manual, on which the study is based, states that "Transit vehicles are equipped with horns and bells for use in emergency situations and as a general audible warning to track workers and trespassers within the right-of-way as well as to pedestrians and motor vehicles at highway grade crossings. Horns and bells on the moving transit vehicle, combined with stationary bells at grade crossings can generate noise levels considered to be extremely annoying to nearby residents." However, the FTA standard methodology includes averaging the bells with the other sources.

Directional bells, bell shrouds and bells that automatically adjust to the ambient conditions are suggested as mitigation. This type of approach could be effective to provide mitigation, although no specific approach is outlined. Calculations of the sound levels associated with discreet bell events for the SE 4th Open Sub Option, indicate a train horn at the nearest residential structures could be as high as 75 dBA $L_{max}$, unmitigated. The pedestrian warning devices could be around 61 dBA $L_{max}$ at the nearest residence. The existing ambient condition is $L_{dn}$ 64 dBA and the unmitigated project level is $L_{dn}$ 66 dBA, with bells and warning devices identified as the dominant source. This is not to indicate that there is a direct comparison between an $L_{max}$ event and a 24 hour average of noise levels in an environment adjusted for nighttime hours. However, it does demonstrate that the effect of the bells is not adequately portrayed by averaging the levels over 24 hours. Without mitigation, it is likely that the train bells and possibly the pedestrian warning devices for near residents will be audible inside the homes. Sound Transit has identified directional bells, shrouds and/or bells that automatically adjust to the background noise as potential mitigation. The bells typically associated with gated crossings have not been included in the analysis as the approach of using non-audible warning devices (flashing lights and gates) is being investigated to reduce the noise levels in the community. With mitigation, it is likely that the bells and audible warning devices will not be audible inside the nearest residences during active periods, where activity inside the home includes watching TV, dishwasher running, children playing, etc. When the background levels quiet in the home, it may be possible to hear the bells on the trains.

The study was conducted in compliance with the FTA guidelines. The parks and outdoor uses of Bellevue Club (pool, tennis courts) did not meet FTA criteria as noise sensitive uses. The FTA manual states, "Parks are a special case. Whether a park is noise-sensitive depends on how it is used. Most parks used primarily for active recreation would not be considered noise-sensitive. However, some parks---even some in dense urban areas-–are used for passive recreation like reading, conversation, meditation, etc. These places are valued as havens from the noise and rapid pace of everyday city life and they should be treated as noise-sensitive. The noise sensitivity of parks should be determined on a case-by-case basis after carefully considering how each facility is used. The state or local agency with jurisdiction over the park should be consulted on questions about how the park is used and how much use it gets."

The existing ambient noise levels at the parks, Winter's House, Blueberry Farm and Bellevue Club are already high due to the existing traffic, ranging from $L_{dn}$ 69 at Blueberry Farm, $L_{dn}$ 67 at Winter's House and $L_{dn}$ 68 at Bellevue Club. The overall sound levels associated with the East Link project are significantly below the existing ambient at Winter's House and Bellevue Club. The project $L_{dn}$ is predicted to be 2 dBA above ambient at Blueberry Farm. This is typically not a noticeable increase on an overall level. However, a moderate impact is identified at one interior location in the Bellevue Club Hotel for the SE 4th Open Suboption due to the train bells and pedestrian warning devices at the gated crossing. An insulation package is the proposed mitigation.

The light rail noises heard along the Mercer Slough frontage and Surrey Downs will likely be from the train bells and pedestrian bells. Directional bells, bell shrouds and ambient sensing bells would be appropriate mitigation to minimize the noises heard at these Parks.

From SE 4th to Main Street topography rises along the west side of 112th Avenue SE. A right-of-way between the Project structures and the residential property lines will be developed into a 30' landscaped setback, per the recently adopted Light Rail Overlay District. Sound walls should be evaluated along the light rail structures and at the property lines. The added elevation of the sound wall may benefit upper story receivers.

Transit vibration and ground-borne noise were studied throughout the alignments. The studies concentrated on noise sensitive facilities. A few areas with operational vibration impact or ground borne noise impact were identified. Mitigation was proposed to eliminate the vibration impact for all but one location at the Coast Bellevue Hotel. The vibration levels significantly exceed the FTA criterion for the Optimized Selected Alternative Station Option, even with special trackwork. No further mitigation is proposed. All groundborne noise is mitigated.

Construction noise and vibration was evaluated in the FEIS. The high level analysis in the FEIS can be applied to the Addendum. Bellevue City Code[1] places restrictions on construction noise. It is assumed that all construction will occur during the daytime and that a noise variance will be obtained from the City for any nighttime work.

## SHIFT BELLEVUE WAY OPTION

The Winter's House was not considered a noise sensitive receiver in the FEIS. The updated analysis acknowledges the property as a Category 3 institutional use and it is included in the Addendum evaluation for impact.

The shift of the traffic lanes of Bellevue Way results in a large retaining wall on the west side of Bellevue Way and several traffic noise impacts. The proposed mitigation is a noise wall along the top of the retaining wall. The proposed noise wall is up to 18 feet

[1] Bellevue City Code 9.18.020C

above the retaining wall in some locations. This creates a very large (41 feet at the highest point), reflective surface. A quick model of a worst case section of the alignment was created to review the contribution of the reflected sound on the Winters House. The results of the model indicated that the reflected sound has a minimal effect east of the alignment. While the wall is visually imposing, the acoustical effect will not create an impact.

No vibration impacts are predicted, including none at the Winter's House.

## 112TH ROAD OVER RAIL OPTION

The proposed roadway modifications result in only 1 dBA change so no further study of traffic noise was conducted. In order for a full study to be required, a 3 dBA increase needs to be established. For a 3 dBA change to occur, the roadway would need to move ½ the distance closer to the residences, which it did not. This result is reasonable.

In some cases traffic noise levels are predicted to decrease due to the shielding of some residences on 112th by the roadway.

Vibration impacts were identified at single family homes and the King County Courthouse on the west side of 112th Ave SE.

The Light Rail Overlay District 60' separation requirement may result in up to eight additional residences on 111th Place SE being displaced. This results in impacts to homes to the west which are currently shielded by the displaced residences. Mitigation in the form of a 6 foot wall near the tracks or and 8 to 10 foot wall either at grade or on a retaining wall, results in project sound levels significantly below existing ambient conditions.

For the ***SE 4th Emergency Access Sub option***, there are several severe impacts near the East Main Station due to the pedestrian warning devices, the train bells at grade crossings. The highest impacts are eliminated with the displacement of homes on 111th Place south of Surrey Downs Park in compliance with the City's Light Rail Overlay All noise impacts are mitigated.

For the ***Bellefield Access Variation*** one additional home on 111th Pl would be displaced. The remaining impacts are similar to the previous condition. One parcel would be acquired for the access road. The potential vibration impacts included seven residences on 111th Pl SE, one residence on 110th, and the King County Courthouse in the Final EIS. The impacts were not recalculated with the 60 foot separation per the Light Rail Overlay District requirements

***SE 4th Open Sub option*** requires at-grade crossing train bells and pedestrian warning devices. It is our understanding that the gated crossings will not be equipped with bells but will flash as the gates are dropped. Even with reduced warning devices, bells

dominate the impact for this option. Vibration impacts include 8 residences on 111th Pl SE, and one residence on 110th Pl SE, and the King County Courthouse.

The ***Rail Under SE 4th Option*** effectively reduces noise at residences near SE 4th St. due to the light rail being in a trench at this point. The highest noise levels and resulting impacts are due to train bells and the pedestrian crossings warning devices at the East Main Station. Vibration impacts are the same as the SE 4th Open Sub option.

## BELLEVUE TRANSIT CENTER STATION OPTIONS

The noise impacts ***Optimize Selected Alternative Station Option*** have not changed from the Selected Alternative, 48 noise impacts at the Bravern Condominium on NE 6th St. There is a potential unmitigated vibration impact at the Coast Bellevue Hotel due to the proximity and speed of the trains. Ground borne noise is also predicted at one multi-family residence; a mixed use building and the Meydenbauer Center are predicted.

The ***NE 6th Station Option*** the train bells at the at-grade station increase the noise levels at Bravern for the initial 48 impacted units by 3 dBA. Directional bells or ambient sensing bells could reduce this impact. Designing the Station to provide additional shielding for the Bravern may be an option. Consider including absorption in the station lid to further reduce the propagation of the bell sound. The Selected alternative crosses I-405 along the north side of NE 6th St near the Coast Bellevue Hotel. This option moves the alignment to the south side of NE 6th St. and the crossover moves to the west of I-405. The result is to reduce the 36 impacts at the Hotel from severe to moderate reducing noise levels from 82 dBA to 65 dBA Ldn. Ground borne noise is also predicted at one multi-family residence and one mixed-use building.

## MITIGATION

The mitigation measures identified may change during final design. Sound Transit has committed to providing mitigation consistent with Sound Transit Environmental Policy (2004). The following mitigation is currently proposed.

Mitigation developed along the 112th Road Over Rail alignment, assumes that the associated audible pedestrian warning devices and train bells are averaged into the predicted 24 hour project $L_{dn}$. It is our opinion that averaging the sound over an extended period tends to bury the “impact” of each event. Additional mitigation options are identified for the bells and warning devices. It is our professional opinion that these additional mitigation approaches for the audible warning devices and bells are necessary to minimize the effect of the project on the identified residences

## SHIFT BELLEVUE WAY OPTION

With or without HOV, the proposed mitigation is a noise wall on top of the retaining wall. Sound insulation packages are suggested if the wall becomes too tall. All impacts can be mitigated.

## 112TH ROAD OVER RAIL OPTION

The basic approaches to mitigation are sound walls, special track work and possibly sound insulation packages if the walls become too tall. The SE 4th Open Sub option identifies 4 residences and 1 hotel that will require sound insulation. For the Rail under SE 4th Option, a portion of sound wall could be eliminated south of SE 4th St.

Bells and pedestrian warning devices dominate the noise levels at East Main Station and 4th for Open Suboption. Reducing sound levels from the train bells and the wayside pedestrian crossing warning devices could mitigate some of the impacts.

Wheel squeal was identified as a potential but was not included in the noise model because Sound Transit has committed to lubricating all curves in noise sensitive areas with a radius less than 600 ft. Given the success Sound Transit has had with the lubricators, this is reasonable.

Table 3 in the D3 Memorandum outlines the potential vibration impacts for 112th Road Over Rail Options. Ten impacts, before mitigation, are identified, all of which are considered mitigated with ballast mats or resilient fasteners. The King County Courthouse is currently planned for relocation which would remove the impact. Two of these properties, single family residences B5000 and B5006, are identified as impacted prior to mitigation, with no impact after mitigation. However, achieving the required mitigation of 15 VdB and 11 VdB, respectively, with ballast mats and/or resilient fasteners seems ambitious. The Addendum identifies these residences as potentially displaced due to the Light Rail Overlay, which will eliminate the impact.

## BELLEVUE TRANSIT CENTER STATION OPTIONS

For the Optimized Selected Alternative, typical vibration mitigation, such as ballast mats, resilient fasteners and engineered special track work may not reduce the vibration levels at Coast Bellevue Hotel below the FTA impact threshold. No additional mitigation is proposed. Additional ground borne noise impacts at a multi-family residence, a mixed-use building and the Meydenbauer Center could be mitigated with ballast mats or resilient rail fasteners. Vibration impacts at the Coast Bellevue Hotel would need further analysis during final design.

Section 4.1 in the Addendum identifies 2 vibration impacts that will not be fully mitigated. However, this is not in agreement with Attachment D3, the Vibration Technical Memorandum. The only residual vibration impact identified in D3 is at the Coast Bellevue Hotel for the Optimized Selected Alternative Station Option. The impact is due to the proximity and speed of the trains and the presence of a crossover. Typical mitigation approaches such as ballast mats or resilient fasteners or engineered special track work were determined to have the potential to not be effective. Table 4 in D3 lists the impact as residual.

Mitigation for the NE 6th Option would include building sound insulation for the impacted Bravern units, because of the height of the building. This facility is new and should have been designed in compliance with BCC 9.18.045B, which requires developers to design multifamily dwellings located in high noise areas, to achieve an interior $L_{dn}$ 40 in bedrooms and $L_{dn}$ 45 in other living areas. The insulation may not be necessary if the properties were constructed in compliance with this Code.

Noise mitigation proposed for the Coast Bellevue Hotel is a sound wall along the elevated structure. Wheel squeal was also identified as a potential impact because of the curve in this area. Lubrication was the proposed mitigation.

The predicted ground borne impacts at a multi-family residence and a mixed use building can be mitigated with ballast mats or resilient rail fasteners.