SOUND AND VIBRATION PEER REVIEW SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT (SDEIS) Proposed East Link Light Rail Project

PREPARED FOR

CITY OF BELLEVUE
Department of Transportation

PREPARED BY

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1.0 INTRODUCTION

The intent of this peer review is to analyze the new information, new Alternatives and design modifications, related to the noise and vibration aspects of the East Link Light Rail Project, as presented in the Supplemental Draft Environmental Impact Statement (SDEIS). The new information supplements the 2008 Draft Environmental Impact Statement (DEIS) and the 2010 Concept Design Report. Several Alternatives are evaluated in the document. The Alternatives included in this Peer Review include:

- Preferred 112th Avenue SE Modified Alternative (B2M to C11A)
- Preferred 112th Avenue SE Modified Alternative (B2M to C9T)
- Alternative B3-114th Extension Design Option (B3 114th Design Option)
- BNSF Alternative (B7)
- Preferred 108th Avenue NE At Grade Alternative (C11A)
- Preferred 108th Avenue NE Tunnel Alternative (C9T)
- 110th Avenue NE At-Grade Alternative (C9A)
- 114th Avenue NE Elevated Alternative (C14E)

This peer review summarizes Sound Transit's process for the noise and vibration study in a comprehensive report, which includes our evaluation of the following elements:

- Sources of potential noise associated with the project.
- Methodology used in the prediction of project noise.
- Elements included in the predicted project noise levels.
- Potential mitigation proposed.
- Resulting mitigated noise levels for each of the proposed alignments.

2.0 EXECUTIVE SUMMARY

The SDEIS is intended to update data and address new information to refine the study of the Alternates still under consideration. Sound level data associated with the operating trains is now based on the current Sound Transit Light Rail Fleet at Central Link, which is slightly higher than reflected in the 2008 DEIS. New Alternatives and design modifications have resulted from discussions with the City of Bellevue. Areas potentially impacted by the project have expanded slightly due to the new information and the level of impact has increased for some properties. A more refined vibration study has also been undertaken and potential impacts are identified.

Various mitigation approaches are evaluated. Proposed mitigation is intended as a high-level evaluation, until a preferred Alternative is selected. The study concludes that mitigated sound levels will be within Federal Transit Authority (FTA) criteria for No Impact for each Alternative. However, for many upper story units in Multi-family dwellings, if the mitigation selected is sound insulation of these units, the exterior sound levels will remain unmitigated. This would apply only to any outdoor decks or other living areas.

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 sound.
- Sound Levels associated with the current fleet of Link light rail vehicles is 78-79 dBA at 50 feet. The reference level used in the SDEIS study is 79 dBA at 50 feet at 40 mph, which is higher than the level used in the 2008 DEIS.
- Sound Transit is applying the knowledge gained through Central Link issues to the design of East Link. Following are elements of the design:
  - Wheel skirts on all trains.
  - Lowered bell sound pressure levels.
  - Lubricators will be installed on curves where wheel squeal is identified.
  - Track grinding and wheel truing are now capabilities of ST and are included as regular maintenance.
- Sound levels associated with the impact sound of wheels crossing the rail gaps in the crossover switches have been included in the noise model to define impact along the East Link alignments. The crossover locations were not indicated in the 2008 DEIS, but have been identified for each Alternative in the SDEIS. 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 have been included in the noise model to define impact along the East Link alignments. These elements were not included in the 2008 DEIS. Sound Transit has provided the maximum sound levels, L_{max}, associated with the bells. The reported levels of 80 dBA at 50 feet for the train mounted bells are reduced to 72 dBA at 50 feet during the nighttime hours. Nighttime hours are typically considered 10:00 PM to 7:00 AM. The sound level of the bells at gated crossings is listed at 62 dBA at 50 feet. No nighttime reduction is listed for the gated crossings. The sound from the bells is included in the overall, average sound character associated with the Link Light system. A statement is included that measures are evaluated for their effectiveness to mitigate this sound. However, these measures are not identified. An additional statement that noise levels along the various alignments frequently exceed L_{max} 75 dBA, with instances above L_{max} 80 dBA, is intended to establish neighborhood noise levels consistent with that of the bells. While this is an accurate statement based on the dBA value, the character of the sound of the bells differs from that of a passing bus. A bell is designed as a warning device. The tonal, high frequency sound is intended to attract attention. The bell is likely to be more irritating than a sound source with a more broadband characteristic even if the overall sound level is the same because the bells are designed to attract attention.

- Construction noise was not fully evaluated in the SDEIS. The 2008 DEIS document cites WAC 173-60 regulations for Construction noise. Bellevue City Code[1] also places restrictions on construction noise. These Code limits are acknowledged in the SDEIS. It has been assumed that all construction will occur during the daytime and that a noise variance will be obtained from the City for any nighttime work. A complete noise model should be completed to predict the level of construction noise, once an Alternative is selected.

- Transit vibration and ground-borne noise were studied throughout the alignments. The studies concentrated on noise sensitive facilities such as Meydenbauer Center, various Hotels and the Winter's House. A few areas with operational vibration impact or ground borne noise impact were identified. Mitigation was proposed to eliminate the impact.

- Construction vibration was studied in depth at Winter's House. There will be a lidded retained cut for 170 feet in front of the Winter's House. The construction will come very near to the house's foundation**. Predicted levels of vibration at the Winter's House during the excavation of the trench are at the threshold for damage to a sensitive structure.** Extreme care will be needed when constructing this segment of the alignment. Special measures have been identified to be imposed on the contractor along with monitoring vibration levels during construction. A more refined study will be required if this is the selected Alternative to ensure that the approach to both construction and operations will not put this historic structure at risk.

- Vibration from the operation of the train at Winter's House is below the FTA impact criteria. **Ground borne noise** due to the operation is predicted to be **slightly to significantly above the impact criteria.** Typical mitigation, such as resilient fasteners or ballast mats, are not estimated to eliminate the impact. The study concludes that a floating slab would be required to eliminate the impact. The floating slab is a costly approach to mitigation. Again a more refined study of the operational ground borne noise will be required, if this is the selected Alternative. The potential impact to this facility is significant.

- All track curvature, with the exception of two tight curves at the Downtown locations, exceeds 600-foot radii to minimize the occurrence of wheel squeal. A provision for lubrication is being included in the event that wheel squeal develops. The two Downtown locations will have the lubricators installed. Redesigning the Downtown alignment with a gentler curve would be preferable.

[1] Bellevue City Code 9.18.020C

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, L_{dn}

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, L_{eq}

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.

Maximum Sound Level, L_{max}

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 REGULATORY CRITERIA

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 in this area 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.

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.

5.0 IDENTIFIED IMPACTS

Segment B Alternatives

Table 3-1 and Appendix G Table G-1 report the summary of potential noise and vibration impacts for each of the B Segment Alternatives. All impacts are predicted to be mitigated to within levels acceptable according to the FTA criteria. Several locations in Preferred 112th Avenue SE Modified Alternative (B2M to C11A and B2M to C9T) are noted as potential locations for residential sound insulation packages. While the interior impacts can be mitigated with this approach, any exterior areas such as decks, pools, yard, etc would remain impacted.

The Table shows a range of 20 impacts for traffic related noise for Alternate B3-114th . No traffic impacts are identified.

A significant vibration impact is also noted at Winter's House. Construction vibration is predicted to be right at the threshold for structural damage to the house. An operational impact of ground borne noise is also predicted. A floating slab for the track in front of the Winter's House is proposed.

5.1 Preferred 112th Avenue SE Modified Alternative (B2M to C11A)

The predicted impact for this Alternative is 62 moderate Light Rail impacts, 10 serious Light Rail impacts and 0 Traffic Noise impacts. The project noise levels are predicted to be 52-70 dBA. Four of the severe impacts are due to the location of a crossover. Bell –related noise contributed to impacts as the train sounds a warning bell entering and exiting the South Bellevue Station. There are no at-grade crossings for the B2M Alternate.

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

As the alignment transitions to at-grade after the Winter's House, several impacts are noted along 112th Avenue SE at both single family homes and multi-family homes in the Bellefield Residential Park. Bells contribute to the impact at the SE 8th street crossing due to the train warning bell.

Wheel squeal is not anticipated, as no track radius is less than 600 feet in radius.

Preferred Alternate C11A is closer to receptors and has at-grade crossing to the median.

Sound Walls, sound insulation packages, low noise crossovers and the provision for lubrication at track curvatures are proposed as mitigation. A lidded retained cut, 170 feet in length, is proposed as the trains passes the Winter's House, to mitigate the impact on this Historic structure.

All noise impacts are reported to be mitigated, with the exception of potential exterior noise for those 6 multifamily and 8 single family units, which may receive sound insulation.

Predicted levels of vibration at the Winter's House during the excavation of the trench are at the threshold for damage to a sensitive structure. Extreme care will be needed when constructing this segment of the alignment. Special measures have been identified to be imposed on the contractor, including limits on the construction vibration levels and monitoring vibration levels during construction.

Vibration from the operation of the train is below the FTA impact criteria. Ground borne noise due to the operation is predicted to be slightly to significantly above the impact criteria. Typical mitigation, such as resilient fasteners or ballast mats, are not estimated to eliminate the impact. The study concludes that a floating slab would be required to eliminate the impact and that the cost of such mitigation would be significant.

5.2 Preferred 112th Avenue SE Modified Alternative (B2M to C9T)

The predicted impact for this Alternative is 62 moderate Light Rail impacts, 6 serious Light Rail impacts and 0 Traffic Noise impacts. Predicted project levels are 52-70 dBA. All impacts are reported to be mitigated, with the exception of potential exterior noise for those 6 multifamily and 8 single family units, which may receive sound insulation.

This Alternative differs only slightly from B2M to C11A.

Bells contribute to the overall operational sound at the at-grade crossing at the entrance to the Bellefield Office Park and near SE 15th ST and SE 8th ST. where bells from crossing gates and train warning bells are sounded. Bells are also sounded as the train departs the SE 8th Station.

Mercer Slough Nature Park was evaluated based on existing peak hour Leq. The operational noise from the train is predicted to be 5-18 dBA below the existing ambient. No impact was noted.

Mitigation throughout the alignment consists of special frogs with low noise and vibration at the crossovers. Sound walls and potential residential sound insulation to front line single family homes and the provision for lubrication at any track curves.

Predicted levels of vibration at the Winter's House during the excavation of the trench are at the threshold for damage to a sensitive structure. Extreme care will be needed when constructing this segment of the alignment. Special measures have been identified to be imposed on the contractor along with monitoring vibration levels during construction.

Vibration from the operation of the train is below the FTA impact criteria. Ground borne noise due to the operation is predicted to be slightly to significantly above the impact criteria. Typical mitigation, such as resilient fasteners or ballast mats, are not estimated to eliminate the impact. The study concludes that a floating slab would be required to eliminate the impact and that the cost of such mitigation would be significant.

5.3 Alternative B3-114th Extension Design Option (B3 114th Design Option)

The predicted impact for this Alternative is 80 moderate Light Rail impacts, 1 serious Light Rail impacts and 20 Traffic Noise impacts. Predicted project levels ate 54-68 dBA. All impacts are reported to be mitigated.

The highest noise levels are near the crossover north of I-90 along Bellevue Way. Bells contribute to the operational noise at one at-grade crossing on 112th Avenue SE and two at-grade pedestrian crossings north of SE 15th Street. These three crossings are near one another and the train would also sound a warning bell as it approaches.

Mitigation proposed includes noise reducing trackwork at the crossovers, sound walls and potential sound insulation at upper floor multi-family residences.

The 20 Traffic Noise Impacts are not identified.

5.4 BNSF Alternative (B7)

A sound wall constructed by WSDOT has provided some mitigation for residences along 118th Avenue SE. Receptors to the north and south of the wall remain impacted. The predicted impact for this Alternative is 113 moderate Light Rail impacts, 37 serious Light Rail impacts and 0 Traffic Noise impacts. The number of impacted residents has increased from the 2008 DEIS due to the increased reference sound from the trains and to a more accurate count of units. Project sound is predicted to range between 54 and 74 dBA. All impacts are reported to be mitigated.

The highest sound level is associated with the crossover in the BNSF right-of-way north of I-90. Train bells at the 118th Station are not predicted to create an impact as there are no homes near.

Track curvature from I-90 to the BNSF alignment is greater than 600-foot radius and is not predicted to squeal. This section of track will have provision for lubrication if the need arises.

Other proposed mitigation includes noise reducing trackwork and sound walls.

Segment C Alternatives

Table 3-2 and Appendix G Table G-1 report the noise and vibration impacts for each of the C Segment Alternatives. All impacts are predicted to be mitigated to within levels acceptable according to the FTA criteria. Several locations are noted as potential locations for residential sound insulation packages. Alternative C11A predicts a total of 72 multi-family units with exterior residual impacts. However, it is noted that most of these units have no outdoor use. A residual impact is also predicted due to crossover location at bells at one single family and 61 multifamily units is predicted for 100th NE At-Grade Alternative (C9A)

No traffic impacts are predicted.

5.5 Preferred 108th Avenue NE At Grade Alternative (C11A)

The predicted impact for this Alternative is 131 moderate Light Rail impacts and 56 serious Light Rail impacts for the connection to B2M and 89 moderate Light Rail impacts and 80 serious Light Rail impacts for the connection to B3, B3 114th Design Option, or B7. No Traffic Noise impacts are noted. Predicted project levels are 54-74 dBA. All impacts are reported to be mitigated, with some residual exterior sound for the units receiving sound insulation.

Noise impacts are concentrated along the trackway and near crossovers on 112th Avenue SE, just south of SE 6th Street. This includes several rooms in the Bellevue Club Hotel. Additional impacts in the area near SE 6th Street result from the trains, train bells, crossing gates and crossovers. Noise impacts are reduced with the connection to B3 or B7. Noise impacts are also identified near the 108th Station and at it traverses the at-grade crossing at Main Street to 108th Avenue SE. The downtown area also has several noise impacts at multifamily residences along 108th Ave NE and NE 6th Street.

Noise impacts also occur at the Lake Bellevue Village Condominiums due to train proximity and at the Coast Bellevue Hotel due to proximity to the crossover and the train itself. The Coast Bellevue Hotel was also identified as one location with an operational vibration impact. Mitigation efforts would eliminate the impact. No ground borne noise was identified.

Extremely tight radius curves along 108th at Main and NE 6th Street. Lubrication is suggested as the mitigation. Designing a gentler curve would be preferred, if at all possible.

No Impacts were identified at Surrey Downs Park. The cited reasoning was "that under FTA criteria, active recreational areas or playfields are not considered noise sensitive." FTA guidelines actually state that:

"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."[1]

Additional review of Surrey Downs Park is recommended.

The crossovers and bells are the dominant sources triggering many of the impacts. This alignment could require the removal of several residences along the west side of 112th Avenue SE. The impact to the second row of homes could seem greater as they are currently somewhat shielded from the noise from 112th Avenue by the existing houses. Proposed mitigation includes quiet crossovers, sound walls at grade or trackside on elevated tracks, and sound insulation packages. Exterior impacts will remain in some locations.

Construction noise is anticipated to be primarily during daytime hours. If nighttime construction is desired, a noise variance would need to be obtained by the City of Bellevue.

5.6 Preferred 108th Avenue NE Tunnel Alternative (C9T)

The predicted impact for this Alternative is 19 moderate Light Rail impacts and 50 serious Light Rail impacts for the connection to B2M and 8 moderate Light Rail impacts and 76 serious Light Rail impacts for the connection to B3 or B7. No Traffic Noise impacts are noted. Predicted project levels are 59-74 dBA for the connection to B2M and 52-74 dBA for the connection to B3 or B7. All impacts are reported to be mitigated.

The alignment includes a section of tunnel along 110th.

Bellevue Club Hotel is impacted with train noise, bells at the intersection of 112th Ave SE and SE 6th Street. Severe impacts are predicted for the Coast Bellevue Hotel as a result of a crossover and the guideway's close proximity. Severe impacts were also predicted for 8 units at Lake Bellevue Village Condominiums. Mitigation including noise reducing crossovers, sound walls and potential sound insulation are identified.

[1] *Transit Noise and Vibration Impact Assessment, Federal Transit Administration, 2006, Chapter 3, page 3-8*

No impacts were identified at Surrey Downs Park. Additional review of Surrey Downs Park is recommended.

Operational vibration impact is predicted for Coast Bellevue Hotel and ground borne noise is predicted at one mixed-use facility on 110th Avenue NE and NE 4th Street. Meydenbauer is also predicted to have a potential ground borne noise impact. All impacts are eliminated with mitigation.

The construction method identified for the tunnel section is cut and cover. Construction noise is anticipated to be primarily during daytime hours. If nighttime construction is desired, a noise variance would need to be obtained by the City of Bellevue.

5.7 110th Avenue NE At-Grade Alternative (C9A)

The predicted impact for this Alternative is 99 moderate Light Rail impacts and 96 serious Light Rail impacts for the connection to B2M and 68 moderate Light Rail impacts and 78 serious Light Rail impacts for the connection to B3 or B7. No Traffic Noise impacts are noted. Predicted project levels are 56-76 dBA for the connection to B2M and 56-73 dBA for the connection to B3 or B7. All impacts are reported to be mitigated.

Noise impacts are identified at several single family, multi family and hotel rooms along 112th Avenue SE near the crossovers and at-grade crossings. Impacts are also identified along the transition to Main Street. Bells are sounded for the at-grade crossings at SE 6th Street and Main Street and for crossings along 110th Avenue NE at NE 2nd, 4th and 6th Streets.

Severe impacts are predicted for the Coast Bellevue Hotel and both severe and moderate impacts at the Bellevue Lake Village Condominiums.

Extremely tight radius curves along 110th at Main and NE 6th. Lubrication is suggested as the mitigation. Designing a gentler curve would be preferred, if at all possible.

Vibration impacts have also been identified at the Coast Bellevue Hotel, mixed use building on NE 4th Street and 110th Avenue NE and an apartment building on Main. Mitigation is predicted to eliminate the impacts. No vibration impacts are predicted for the Meydenbauer Center.

Mitigation identified for the remainder of the operational noise includes noise reducing crossovers, sound walls and sound insulation for multifamily units along 110th NE.

Modifications to the alignment of 112th Avenue SE move the northbound traffic to the East, away from the Surrey Downs residential area. The re-alignment moves the roadway approximately 30 feet closer to the Bellevue Club. The distance from Bellevue Club to 112th Avenue SE is currently 150 feet. This results in less than 1 dBA increase in noise levels. WSDOT does not require a noise study for any increases less than 3 dBA.

Construction noise is anticipated to be primarily during daytime hours. If nighttime construction is desired, a noise variance would need to be obtained by the City of Bellevue.

5.8 114th Avenue NE Elevated Alternative (C14E)

The predicted impact for this Alternative is 48 moderate Light Rail impacts, 40 serious Light Rail impacts. Predicted project levels are 60-71 dBA for the connection to B3 or B7. All impacts are reported to be mitigated.

Moderate noise impacts are identified at several rooms at the Bellevue Hilton Hotel and the Sheraton Bellevue Hotel along 114th Ave NE. Moderate and severe impacts are listed at the Lake Bellevue Village Condominiums due to the proximity to the alignment. The highest noise levels are at the Bellevue Hilton Hotel rooms that currently overlook I-405.

There are two crossovers in connection with Alternate B3; one located east of the Bellevue Club and the other is north of the Coast Hotel adjacent to I-405.

No wheel squeal is predicted. The curvature of the track is fairly gentle in this alignment.

No vibration impacts are noted.

Lake Bellevue Condominiums and Coast Bellevue Hotel were identified with impacts. Mitigation included noise reducing crossovers, rail lubrication, sound walls and sound insulation for the Coast Bellevue Hotel.

Construction noise is anticipated to be primarily during daytime hours. If nighttime construction is desired, a noise variance would need to be obtained by the City of Bellevue.

6.0 PEER REVIEW

6.1 Study Methodology

This supplemental evaluation predicted noise levels, proposed mitigation and re-evaluated noise levels with the mitigation in place. The study incorporated a higher reference sound level for the trains. This was done to be consistent with actual noise levels from the current Sound Transit light rail fleet. The study also adjusted for construction modifications to I-405 and a noise wall erected as part of that project. New Alternatives and design modifications have also resulted from discussions with the City of Bellevue. The raw data for the model was not included. However, the study appears to be in line with industry standards and best practices for the evaluation of the airborne transit sound and ground-borne noise and vibration.

Noise monitoring sites selected to establish ambient conditions are appropriate. Recent data collected were in good agreement with data collected in 2007. Therefore re-use of data collection point MC-6 (2007) for M-1 is appropriate.

Surrey Downs Park was listed as a non-sensitive "recreational" use and therefore was not studied for impact. FTA considers Parks a special case. 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. Additional consideration should be given to the noise sensitivity of Surrey Downs Park.

Sounds associated with crossing bells and train bells have been included in the study. However, the sound levels associated with these short-term sources are averaged over a 24-hour period, similar to the train events. While this is in keeping with FTA methodology, it does not fully reveal the noise level the community experiences. Given that the bells are shorter in duration, averaging the sound over an extended period tends to bury the "impact" of each event. The warning devices are also more intrusive due to their very nature of being designed to attract attention. Sound Transit has supplied the L_{max} values used in the model. The reported levels of 80 dBA at 50 feet for the train mounted bells are reduced to 72 dBA at 50 feet during the nighttime hours. Nighttime hours are typically considered 10:00 PM to 7:00 AM. The sound level of the bells at gated crossings is listed at 62 dBA at 50 feet. No nighttime reduction is listed for the gated crossings.

Wheel impact was considered at crossover switches and other discontinuous sections of track. Correction factors of +5 dBA were implemented in the evaluation, which is consistent with the FTA manual. Again, this source of sound was averaged over 24 hours. This type of impact noise is more irritating on an event level, rather than a project average. However, mitigation in the form of special trackwork is proposed for crossovers causing impacts.

Sound reflected off of barriers (noise walls), retained cut retaining walls, bridges for access, etc. has not been included in the evaluation. We recommend that the SDEIS be expanded to include the effect of the reflected sound in the community.

Traffic impacts (FHWA) are identified for Alternate B3 only. Although no further mention is included. The relocation of the alignment nearer to Bellevue Club in Alternate C9A is determined to be less than a 3-dBA increase. WSDOT policy is not to require further study if the increase is less that 3 dBA.

Construction noise (FTA) was not fully evaluated in the SDEIS. The 2008 DEIS document cites WAC 173-60 regulations for Construction noise. Bellevue City Code[1] also places restrictions on construction noise. It has been assumed that all construction will occur during the daytime and that a noise variance will be obtained from the City for any nighttime work. A complete noise model should be completed to predict the level of construction noise, once an Alternative is selected.

[1] Bellevue City Code 9.18.020C

Transit vibration and ground-borne noise (FTA) were studied throughout the alignments. The studies concentrated on noise sensitive facilities such as Meydenbauer Center, various Hotels and the Winter's House. A few areas with operational vibration impact of ground borne noise impact were identified. Mitigation was proposed to eliminate the impact.

Construction vibration was studied in depth at Winter's House. There will be a lidded retained cut for 170 feet in front of the Winter's House. The construction will come very close to the house's foundation. **Predicted levels of vibration at the Winter's House during the excavation of the trench are at the threshold for damage to a sensitive structure.** Extreme care will be needed when constructing this segment of the alignment. Special measures have been identified to be imposed on the contractor along with monitoring vibration levels during construction.

Vibration from the operation of the train is below the FTA impact criteria. Ground borne noise due to the operation is predicted to be slightly to significantly above the impact criteria. Typical mitigation, such as resilient fasteners or ballast mats, are not estimated to eliminate the impact. The study concludes that a floating slab would be required to eliminate the impact and that the cost of such mitigation would be significant.

All track curvature, with the exception of two tight curves at the Downtown locations, exceed 600 foot radii. A provision for lubrication will be included in the event that wheel squeal develops. The two Downtown locations will have the lubricators installed. Redesigning the alignment with a gentler curve would be preferable.

6.2 Light Rail Noise Mitigation

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] are 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 for "…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. ST mitigates all Moderate impacts. Further, "…such measures are eligible for Federal funding when FTA determines that the proposed mitigation represents a reasonable public expenditure after considering the impacts of the actions and benefits of the proposed mitigation measures".

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

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

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 above existing high levels.
- Community views (i.e. view obstructed by noise wall).
- Protected Historic sites, Parks, Wildlife refuge.
- Cost per benefited residence.

Sound can be treated with mitigation 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.

Source mitigation approaches include:

- Quiet train purchase.
- Wheel skirts.
- Rail grinding.
- Wheel truing.
- Lubrication or friction modifiers between rail and wheel.
- Quieter train bells or crossing bells.

Many of these elements have been incorporated, as policy, by Sound Transit.

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.

Sound insulation package will effectively reduce sound levels at the interior of a residence. However, exterior sound levels on decks and other outdoor living areas will remain intrusive. Sound insulation is typically considered as a last option for mitigation.

6.3 Potential Additional Mitigation

Crossovers

Potential for noise impact increases at crossovers. Special track work is the listed approach to mitigation. Consideration should be given to strategically locating the crossovers away from residential areas, where possible.

Bells

Bells at crossing and Stations also increase the potential for noise impact. Even with the bell volume turned down at night, the tonal quality of the bell is designed to attract attention. FTA acknowledges that bells are often a noise issue with the community. *"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.[1]"*

Consider ways to localize the bell sound to areas in need of the warning, such as:

- Consider the feasibility of creating a small repositionable barrier on the train at the bell speakers to reflect the sound into the waiting areas and shield it from the neighbors. Reposition with direction of the train.

- An awning type of structure could possibly be erected above the bells at crossings to direct the bell sound back into the desired "warning zone", the area in front of the crossing.

Barrier Surface Finishes

Barriers are often used as a mitigation tool to interrupt the path sound is travelling. A noise barrier blocks direct line-of-sight between a sound source and a receiving property. Sound energy diffracts (bends) over the top of the barrier to reach the receiver. This process of diffraction reduces the sound levels received.

[1] Transit Noise and Vibration Impact Assessment, Federal Transit Administration, 2006, Chapter 2, page 2-7

Sound barriers are constructed from solid materials. While barriers can effectively reduce the sound transferred to the receiving properties being screened, in some cases, the reflected sound can generate additional noise for a receiving property on the source side of the barrier.

- Consider adding an absorptive surface to the source side of the barriers.
- Consider absorption inside lidded retained cut at Winter's to minimize sound at ends of lidded area.

7.0 RESPONSE TO CITY OF BELLEVUE QUESTIONS

7.1 Is the taking or condemnation of homes with exterior noise impacts included in industry practices or FTA mitigation methods?

It is assumed that the intent of this question relates to residual exterior noise impacts for residences that receive sound insulation packages. Generally, our experience has been that for residences where sound insulation packages reduce the interior noise levels to within acceptable levels, the impact is considered mitigated. It is not standard practice to take or condemn homes with residual exterior noise impacts. Language from the FTA Guideline states:

"The following statutes and implementing regulations concerning environmental protection guide the Federal Transit Administration's decisions on the need for noise mitigation. While the environmental impact statement requirement in the National Environmental Policy Act (NEPA) is widely known, the statute also establishes a broad mandate for Federal agencies to incorporate environmental protection and enhancement measures into the programs and projects they help finance.(1) In conjunction with FHWA, FTA has issued a regulation implementing NEPA which sets out the agencies' general policy on environmental mitigation. It states that measures necessary to mitigate adverse impacts are to be incorporated into the project and, further, that such measures are eligible for Federal funding when FTA determines that ". . . the proposed mitigation represents a reasonable public expenditure after considering the impacts of the action and the benefits of the proposed mitigation measures.[1, 2]*"*

While NEPA establishes broad policy, a more explicit statutory mandate for mitigating adverse noise impacts is set forth in the Federal Transit Laws.(3) Before approving a construction grant, FTA must make a finding that ". . . (ii) the preservation and enhancement of the environment, and the interest of the community in which a project is located, were considered; and (iii) no adverse environmental effect is likely to result from the project, or no feasible and prudent alternative to the effect exists and all reasonable steps have been taken to minimize the effect." (49 U.S.C. 5324(b)(3)(A))."[2]

1. U.S. Department of Transportation, Federal Transit Administration and Federal Highway Administration, "Environmental Impact and Related Procedures." Final Rule, 52 Federal Register 32646-32669; August 28, 1987 (23 Code of Federal Regulations 771.105(d)).

2. Transit Noise and Vibration Impact Assessment, Federal Transit Administration, 2006, Chapter 3, page 3-10

7.2 Does FTA methodology have guidance for projecting noise impacts for future residential development? The concern is that the residential development that will occur in the Bel-Red area in the future would meet the thresholds for impact but not have the mitigation.

It is not typical to consider undeveloped land.

7.3 Concern was expressed about the different levels of noise impact in the evening when existing ambient noise levels are lower. How is this captured in the analysis? Is there FTA methodology or guidance for doing a stand alone night time noise analysis?

The analysis is based on an L_{dn} (Day-Night Level) descriptor. The L_{dn} represents a 24 hour average with the hours between 10:00 PM and 7:00 AM penalized by 10 dBA to account for the increased sensitivity of residents during the nighttime hours. For example, the sound level of the train-mounted bells is 80 dBA at 50 feet during daytime hours. If that level remained constant during the operational hours, then the evaluation for impact would consider the level at 90 dBA at 50 feet during the nighttime hours to reflect the greater degree of receiver sensitivity. In Sound Transit's case, the level of the train bells is reduced to 72 dBA during the nighttime hours so the overall evaluation of bells assumes 80 dBA during daytime hours and 82 dBA during nighttime hours.

FTA does not suggest methodology or guidance on a stand alone nighttime noise analysis as they have determined that the added sensitivity for nighttime noise is addressed within the L_{dn} descriptor.