Noise Technical Analysis

Prepared for:

Washington State Department of Transportation

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FEBRUARY 2018
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<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>dBA</td>
<td>A-weighted decibels</td>
</tr>
<tr>
<td>EIS</td>
<td>Environmental Impact Statement</td>
</tr>
<tr>
<td>EPA</td>
<td>U.S. Environmental Protection Agency</td>
</tr>
<tr>
<td>FHWA</td>
<td>Federal Highway Administration</td>
</tr>
<tr>
<td>FTA</td>
<td>Federal Transit Administration</td>
</tr>
<tr>
<td>GSA Alternative</td>
<td>Grade-Separated Option A Alternative</td>
</tr>
<tr>
<td>Leq</td>
<td>Equivalent Sound Level</td>
</tr>
<tr>
<td>Leq(h)</td>
<td>Hourly equivalent sound level</td>
</tr>
<tr>
<td>Lmax</td>
<td>Maximum noise levels</td>
</tr>
<tr>
<td>Lmin</td>
<td>Minimum noise levels</td>
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<td>NAC</td>
<td>Noise Abatement Criteria</td>
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<tr>
<td>PGSB Alternative</td>
<td>Partial Grade-Separated Option B Alternative</td>
</tr>
<tr>
<td>WAC</td>
<td>Washington Administrative Code</td>
</tr>
<tr>
<td>SR</td>
<td>State Route</td>
</tr>
<tr>
<td>TNM</td>
<td>FHWA Traffic Noise Model</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
<tr>
<td>WSDOT</td>
<td>Washington State Department of Transportation</td>
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1.0 INTRODUCTION

The Industrial Way / Oregon Way Intersection Project is located in the industrial area of Longview, Washington at the intersection of Industrial Way (State Route (SR) 432), Oregon Way, and SR 433. This intersection provides a critical connection of two Highways of Statewide Significance that support significant passenger and freight truck movement. The purpose of the project is to develop an affordable long-term solution that:

- Maintains or improves emergency response
- Improves travel reliability for all vehicles
- Accommodates current and future freight truck and passenger vehicle movement through the intersection and across the region and states.

The purpose of this document is to describe the existing noise conditions, discuss effects and benefits the project would have on those conditions, and recommend mitigation measures to address adverse effects. The information contained in this technical analysis supports the project’s Environmental Impact Statement (EIS).

Methodology for the analysis contained in this document is presented in the Impact Assessment Methodology memorandum included as Attachment A and in Section 3.3.

2.0 DESCRIPTION OF ALTERNATIVES

Three alternatives are being evaluated to address the project’s purpose and need: the No Build Alternative, the Grade-Separated Option A Alternative (GSA Alternative), and the Partial Grade-Separated Option B Alternative (PGSB Alternative). Each alternative is described in Chapter 2 of the project’s EIS.

3.0 AFFECTED ENVIRONMENT

3.1 Regulatory Setting

The National Environmental Policy Act of 1969 provides a regulatory framework that promotes the general welfare and fosters a healthy environment for noise considerations. Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR 772), and the current WSDOT Traffic Noise Policy and Procedures (last updated October 2012) provide the basis for analyzing and abating highway traffic noise impacts in the State of Washington.

The noise regulations govern noise prediction requirements, noise analyses, noise abatement criteria, and requirements for informing local officials. The noise abatement criteria are thresholds used to determine when a noise impact would occur. The noise abatement criteria differ depending on the type of land use under analysis. For example, the noise abatement criteria for residences (67 A-Weighted decibels or dBA) are lower than the noise abatement criteria for commercial areas (72 dBA). Table 1 lists the Federal Highway Administration (FHWA) Noise Abatement Criteria (NAC) used in conjunction with WSDOT’s NAC for this noise analysis.
Table 1. FHWA Noise Abatement Criteria by Land Use

<table>
<thead>
<tr>
<th>Activity Category</th>
<th>L_{eq}(h) at Evaluation Location (dBA)</th>
<th>Description of Activity Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>57 (exterior)</td>
<td>Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.</td>
</tr>
<tr>
<td>B</td>
<td>67 (exterior)</td>
<td>Residential (single and multi-family units)</td>
</tr>
<tr>
<td>C</td>
<td>67 (exterior)</td>
<td>Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings</td>
</tr>
<tr>
<td>D</td>
<td>52 (interior)</td>
<td>Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.</td>
</tr>
<tr>
<td>E</td>
<td>72 (exterior)</td>
<td>Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F. Includes undeveloped land permitted for these activities.</td>
</tr>
<tr>
<td>F</td>
<td>-</td>
<td>Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing</td>
</tr>
<tr>
<td>G</td>
<td>-</td>
<td>Undeveloped lands that are not permitted</td>
</tr>
</tbody>
</table>

Source: USDOT 2010.

Traffic noise impacts occur when predicted L_{eq}(h) noise levels approach or exceed the NAC established by the FHWA, or substantially exceed existing noise levels (USDOT 2010). WSDOT considers a noise impact to occur if predicted L_{eq}(h) noise levels approach within 1 dBA of the NAC. The FHWA NAC specify exterior L_{eq}(h) noise levels for various land activity categories as described in Table 1. WSDOT also considers an increase of 10 dBA or more to be a substantial increase and a traffic noise impact.

Along with the federal noise impact criteria, most cities in Washington, including the City of Longview, rely, at least in part, on the Washington State Noise Control Ordinance (WAC 173-60). The WAC 173-60 establishes residential, commercial, and industrial noise limits, along with construction noise limits. Traffic noise from public roadways is exempt from the WAC 173-60. Project construction would need to adhere to the ordinances applicable in the individual jurisdictions, which are based on the WAC noise control ordinance. Local noise ordinances can include different provisions from the state law.

3.2 Definition of Noise

Noise is unwanted or unpleasant sound. Noise is a subjective term because sound levels are perceived differently by different people. Magnitudes of typical noise levels are presented in Figure 1.
3.2.1 Traffic Noise Sources

Traffic noise is a combination of noises from the engine, exhaust, and tires of vehicles. Defective mufflers, truck compression braking, steep grades, the terrain and vegetation near the roadway, shielding by barriers and buildings, and the distance from the road can also contribute to the traffic noise heard at the roadside. An increase in traffic volumes, vehicle speeds, or the amount of heavy trucks increases traffic noise levels.

3.3 Methodology

The noise study area was determined using CFR 772 requiring identification of all existing land uses, and undeveloped lands permitted for development that may include noise-sensitive land uses (residences, parks, and other land uses described in Table 1). A 500-foot limit from the anticipated project footprint was used as a starting point for noise study boundaries and was confirmed after field reconnaissance and field measurements identified areas that could be impacted by the project (Figure 2).
Figure 2. Study Area for Noise
Ambient noise levels were measured at six locations within the noise study area, shown in Figure 3, to identify major noise sources in the project area and to establish existing peak-hour noise levels. Measurements were conducted on January 6 and 7, 2016 with calibrated sound level monitoring instrumentation which comply with ANSI S1.4 for instrument accuracy. Traffic counts and meteorological conditions were also recorded during field measurements for model validation. All noise measurements were performed during satisfactory weather conditions for performing noise measurements.

Figure 3. Noise Measurement Locations
3.4 Traffic Noise Levels

Land use in the noise study area is a mix of residential, commercial, and light industrial along with small portions of land located within the Port of Longview, property used for logging and paper processing, and an active railroad line. Residences in the area are mostly single and multi-family residences located west of SR 433. The Columbia Trailer Court, which comprises mobile homes, is located along Oregon Way at Alaska Street. The Oregon Way Hotel, located 421 Oregon Way, and Archie Anderson Park, located at 22nd Avenue and Alabama Street, were considered in the noise analysis; however, both properties are located outside the noise study area. Areas of vacant land are located outside the proposed project limits; no building permits for future development of these lands are on file with the City of Longview at this time. The Highlands Trail was recently constructed alongside the Consolidated Diking Improvement District #1’s Ditch No. 3 parallel to Industrial Way (SR 432).

Short-term noise events from passing trains, commercial and light-industrial operations, and traffic on Industrial Way (SR 432), Oregon Way, SR 433, and local side streets all contribute to the noise environment in the study area. Local traffic includes a high percentage of heavy trucks traveling to and from the many commercial and industrial businesses in the area and the connections to other major highway and interstate routes from SR 432 and SR 433.

3.4.1 Existing Traffic Noise

Existing (2015) noise levels were analyzed using a combination of noise measurements and computer assisted modeling. Noise modeling was conducted using the latest version of the FHWA’s Traffic Noise Model (TNM 2.5). Existing modeled worst-hour traffic noise levels for residential areas range from 55 dBA to 65 dBA (Table 2). The modeled noise levels at these residences depend on the proximity of the residence to the existing roadways, primarily Oregon Way. Of the 81 total modeled sites, none currently experience traffic noise levels above the NAC of 66 dBA. Existing traffic noise levels for all modeled sites are shown in Table 2. The location of each modeled receiver is shown in Figure 4.

<table>
<thead>
<tr>
<th>Noise Receptor Number</th>
<th>NAC L_{eq} (dBA)/Land Use Category</th>
<th>Dwelling Units/Residential Equivalent</th>
<th>Existing 2015 (L_{eq}) (dBA)</th>
<th>No Build 2040 (L_{eq}) (dBA)</th>
<th>Build GSA 2040 (L_{eq}) (dBA)</th>
<th>Build PGSB 2040 (L_{eq}) (dBA)</th>
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<td>1*</td>
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<td>66</td>
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<td>6</td>
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<td>Noise Receptor Number</td>
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<td>Dwelling Units/Residential Equivalent</td>
<td>Existing 2015 ($L_{eq}$) (dBA)</td>
<td>No Build 2040 ($L_{eq}$) (dBA)</td>
<td>Build GSA 2040 ($L_{eq}$) (dBA)</td>
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</table>

Notes:
1. Impacts are noted by bold text.
2. See Table 1 for definitions of Activity Categories.
3. Star (*) denotes measurement location used to validation noise model.
4.0 ENVIRONMENTAL CONSEQUENCES

4.1 No Build Alternative

4.1.1 Direct Effects

Future modeled worst-hour traffic noise levels for the residential areas under the No Build Alternative range from 59 dBA to 69 dBA (Table 2). The modeled noise levels at these sites depend on the proximity of the site to the existing roadways, primarily Oregon Way, as shown in Figure 5. Of the 81 total modeled sites, 32 residences and one trail are predicted to experience traffic noise levels above the NAC of 66 dBA with the No Build Alternative in 2040. Roadway traffic noise levels under the No Build Alternative would not result in a large change in noise levels over time due to a steady increase in traffic volumes on the existing roadway network. No Build Alternative traffic noise levels in the year 2040 for all modeled sites are within 4 dBA of existing noise levels and are shown in Table 2.

Table 3 provides a comparison of noise impacts predicted for Existing Conditions (2015) and future (2040) noise impacts for the No Build, GSA, and PGSB Alternatives.

4.1.2 Indirect Effects

Indirect effects for the No Build Alternative would be similar to the indirect effects of both build alternatives, as described later in Sections 4.2.3 and 4.3.3. Data presented in Table 2 reflect modeled noise levels for the No Build Alternative through 2040.
Figure 5. Future No Build Alternative Traffic Noise Levels (2040)

Table 3. Comparison of Noise Impacts under Existing Conditions, the Future No Build Alternative, and the Future Build Alternatives

<table>
<thead>
<tr>
<th>Alternative / Conditions (Year)</th>
<th>Category B Impacts</th>
<th>Category C Impacts</th>
<th>Category E Impacts</th>
<th>Impact Total</th>
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</thead>
<tbody>
<tr>
<td>Existing Conditions (2015)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Build Alternative (2040)</td>
<td>32</td>
<td>Highlands Trail (Residential Equivalent of 9)</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td>GSA Alternative (2040)</td>
<td>20</td>
<td>Highlands Trail (Residential Equivalent of 9)</td>
<td>0</td>
<td>29</td>
</tr>
<tr>
<td>PGSB Alternative (2040)</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

Notes:
1. See Table 1 for definitions of Activity Categories
2. See Table 2 for Residential Equivalent
4.2 Grade-Separated Option A (GSA) Alternative

4.2.1 Effects during Construction

During the construction of the GSA Alternative, areas adjacent to the project would be exposed to construction noise in addition to ongoing traffic-related noise. Impacts during construction would be of short duration and standard specifications for noise control would minimize or eliminate impacts during construction. The GSA Alternative would take approximately two years longer to construct than the PGSB Alternative with longer periods of loud equipment operating near noise sensitive land uses close to the construction area.

4.2.2 Direct Effects

Future modeled worst-hour traffic noise levels for the residential areas near the GSA Alternative range from 59 dBA to 69 dBA (Table 2). The modeled noise levels at these sites depend on the proximity of the site to the existing roadways, primarily Oregon Way. Of the 81 total modeled sites, 20 residences and one trail are predicted to experience traffic noise levels above the NAC of 66 dBA with the GSA Alternative in 2040, as shown in Figure 6. The 20 impacted residences and 1 impacted trail are also above impact criteria under the No Build Alternative. Roadway traffic noise levels under the GSA Alternative would not result in a large change in noise levels over time due to a steady increase in traffic volumes on the existing roadway network. GSA Alternative traffic noise levels in the year 2040 for all modeled sites are within 5 dBA of existing noise levels and are shown in Table 2. No substantial increase in impacts are predicted under 2040 GSA Alternative conditions compared to the No Build Alternative. Although rail traffic is anticipated to increase in the future from other projects (as described under the No Build Alternative in Chapter 2 of the Draft EIS), residents may benefit from the realignment of the Reynolds Lead under the GSA Alternative, which would create a greater separation between this rail line and the neighborhood, thereby reducing railroad noise levels.

4.2.3 Indirect Effects

The noise analysis for this project is based on the transportation demand forecasting model and includes the effects of capacity constraints on the transportation system. By including the vehicles that are not moving efficiently through the transportation system, the indirect effects of increased transportation capacity are included in the analysis. The results of the noise analysis already reflect the potential delayed and distant effects of the Industrial Way/Oregon Way Intersection Project. Data presented in Table 2 reflect modeled noise levels for the GSA Alternative through 2040.
4.3 Partial Grade-Separated Option B (PGSB) Alternative

4.3.1 Effects during Construction

Effects during construction of the PGSB Alternative would be the same as those described for the GSA Alternative in Section 4.2.1, except that the duration of construction for the PGSB Alternative would take approximately two years less to construct than construction of the GSA Alternative. During the construction of the PGSB Alternative, areas adjacent to the project would be exposed to construction noise in addition to traffic-related noise. Impacts during construction would be of short duration and standard specifications for noise control would minimize or eliminate impacts during construction. The PGSB Alternative would take less time to construct than the GSA Alternative with shorter periods of loud equipment operating near noise sensitive land uses close to construction.

4.3.2 Direct Effects

Future modeled worst-hour traffic noise levels for the residential areas near the PGSB Alternative range from 60 dBA to 69 dBA (Table 2). The modeled noise levels at these sites, shown in Figure 7, depend on the proximity of the site to the existing roadways, primarily Oregon Way. Of the 81 total modeled sites, 20 residences are predicted to experience traffic noise levels above the NAC of 66 dBA with the PGSB Alternative in 2040. The 20 impacted residences are also above impact criteria under the No Build Alternative. Roadway traffic noise levels under the PGSB Alternative would not result in a large change in noise levels over time due to a steady increase in traffic volumes on the existing roadway network. PGSB Alternative traffic noise levels in the year 2040 for all modeled sites are within 5 dBA of existing noise levels and are shown in Table 2. No substantial increase in impacts are predicted under 2040 PGSB Alternative conditions compared to the No Build Alternative.
4.3.3 Indirect Effects

Alternative, as described in Section 4.2.3. Data presented in Table 2 reflect modeled noise levels for the PGSB Alternative through 2040.

5.0 MEASURES TO AVOID OR MINIMIZE PROJECT EFFECTS

Noise abatement, including noise barrier evaluation, is necessary only where frequent human use occurs and where a lower noise level would provide benefits (FHWA 2010). To be effective, the barrier must block the line-of-sight between the highest point of a noise source and the receptor. It must be long enough to prevent sounds from passing around the ends, have no openings (i.e., side streets), and be dense enough so that noise would not be transmitted through it. Intervening rows of buildings that are not noise sensitive could also be used as barriers (FHWA 1998). Access limitations, location in relation to surrounding roadways, and the low number of noise-sensitive land uses at some impact locations prevent feasible and reasonable noise barrier placement to effectively reduce traffic noise levels predicted for the project as discussed below.

Abatement was considered for this project because traffic noise impacts are predicted at 20 residences and one trail under the GSA Alternative and the same 20 residences under the PGSB Alternative. These 21 total sites where noise levels are predicted to be above the NAC in 2040 are representative of the discrete areas where noise barrier placement was considered. Areas where impacts are predicted were evaluated to determine if a feasible noise barrier could be constructed as described below.

Sections 5.1 and 5.2 provide an overview of the evaluation criteria for noise abatement, and Sections 5.3 through 5.5 present an assessment summary of those noise barriers assessed for this project. Section 5.6 presents mitigation measures that can be used to minimize noise construction and long-term noise impacts.
5.1 Feasibility

Feasibility is a combination of acoustic and engineering considerations. All of the following must occur for abatement (e.g., noise barrier) to be considered feasible.

- Abatement must be physically constructible.
- The majority of first row receivers experiencing noise impacts must obtain a minimum 5 dBA of noise reduction as a result of abatement (insertion loss), assuring that every reasonable effort will be made to assess outdoor use areas as appropriate.

5.2 Reasonableness

For each location where abatement was determined to be feasible, the reasonableness of abatement was assessed. Noise walls, or other types of abatement, would only be constructed by the department if they have been determined to be reasonable by satisfying criteria for cost effectiveness and design goal achievement.

5.2.1 Cost Effectiveness

The cost of noise abatement sufficient to provide at least the minimum feasible noise reductions must be equal to or less than the allowable cost of abatement for each noise wall location analyzed. Based on noise wall costs from 2007-2010, the current average cost for Washington State is $51.61 per square foot ($ft^2$) of wall area. The cost is applied to the allowed wall surface area ($ft^2$) to generate the allowable cost per qualified resident described in Table 4. The allowable cost per receiver, based on build condition traffic noise levels is described in Table 4.

5.2.2 Design Goal Achievement

The minimum feasibility design goal for abatement on all projects is at least 5 dBA of noise reduction for the majority of impacted front row receivers and, for reasonableness, at least 7 dBA of reduction for one or more receivers. Noise walls cannot be recommended if they do not achieve the design goal. In addition to the design goal requirement, WSDOT makes a reasonable effort to get 10 dBA or greater insertion loss (noise reduction) at the first row of receivers for all projects where abatement is recommended.

5.3 Grade-Separated Option A (GSA) Alternative

For the GSA Alternative, three noise barriers were evaluated to determine whether abatement could sufficiently reduce traffic noise levels at the 20 residences and one trail predicted to experience noise levels above the NAC under this alternative. As shown in Figure 8, noise barriers were evaluated along both sides of Oregon Way north of Alabama Street and along Industrial Way in an attempt to reduce noise levels at impact locations. All three noise barriers were evaluated within WSDOT right-of-way near the edge of roadway shoulder.
Table 4. Reasonableness Allowances

<table>
<thead>
<tr>
<th>Design Year Traffic Sound Decibel Level (dBA)</th>
<th>Noise Level Increase as a Result of the Project (dBA)</th>
<th>Allowed Wall Surface Area Per Qualified Residence or Residential Equivalent</th>
<th>Allowed Cost Per Qualified Residence or Residential Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>700 Square Feet</td>
<td>$36,127</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>768 Square Feet</td>
<td>$39,636</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>836 Square Feet</td>
<td>$43,146</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>904 Square Feet</td>
<td>$46,655</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>972 Square Feet</td>
<td>$50,165</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td>10 (substantial, step 1) ³</td>
<td>1,040 Square Feet</td>
<td>$53,674</td>
</tr>
<tr>
<td>72</td>
<td>11 (substantial, step 1)</td>
<td>1,108 Square Feet</td>
<td>$57,184</td>
</tr>
<tr>
<td>73</td>
<td>12 (substantial, step 1)</td>
<td>1,176 Square Feet</td>
<td>$60,693</td>
</tr>
<tr>
<td>74</td>
<td>13 (substantial, step 1)</td>
<td>1,244 Square Feet</td>
<td>$64,203</td>
</tr>
<tr>
<td>75</td>
<td>14 (substantial, step 1)</td>
<td>1,312 Square Feet</td>
<td>$67,712</td>
</tr>
<tr>
<td>76</td>
<td>15 (substantial, step 2)⁴</td>
<td>1,380 Square Feet</td>
<td>$71,222</td>
</tr>
</tbody>
</table>

(1) Current costs based on $51.61 per square foot constructed cost developed in 2011.
(2) If the noise level increases 10 dBA or more as the result of the project (Column B), regardless of Design Year traffic sound level, follow the allowed wall surface and cost for the level of increase in Column C in lieu of the total design year sound decibel level in Column A. For total highway related sound levels at 76 or more dBA or the project results in an increase of 15 or more decibels, continue increasing the allowance at the rate provided in the table unless circumstances determined on a case-by-case basis require an alternative methodology for determining allowance.
(3) Step 1 is when the noise levels are 10 to 14 dBA over Existing condition traffic noise as a result of the transportation project.
(4) Step 2 is when the noise levels are 15 or more dBA over Existing condition traffic noise as a result of the transportation project (or total highway related noise levels are between 76 and 79 decibels). Additional consideration for abatement may be considered under these circumstances.

5.3.1 GSA Noise Barrier 1—Site 3 Trail

GSA Noise Barrier 1 is located to the north of Industrial Way westbound travel lanes along the roadway shoulder as shown on Figure 8. The barrier was evaluated at heights up to 20 feet tall and 1,330 feet long in this location to reduce noise levels at Site 3 Trail. At a minimum feasible barrier height of 16 feet tall and 1,330 feet long, this barrier would reduce traffic noise levels by at least 5 dBA at a majority of first row impacted receiver locations in this area. A minimum reasonable barrier height of 16 feet tall and 1,330 feet long for GSA Noise Barrier 1 would achieve WSDOT’s design goal of at least a 7-dBA noise reduction. At a height of 16 feet and length of 1,330 feet, GSA Noise Barrier 1 would cost approximately $1,098,261. The barrier would benefit seven receiver locations, which represent 22 dwelling units, resulting in a reasonable allowance of $794,794. Due to the allowable cost of barrier being less than the construction cost of the barrier, the noise barrier does not meet the WSDOT reasonableness criteria and is not recommended.
5.3.2 GSA Noise Barrier 2—Site 5

GSA Noise Barrier 2 is located to the west of Oregon Way southbound travel lanes along the roadway shoulder as shown on Figure 8. The barrier was evaluated at heights up to 20 feet tall and 670 feet long in this location to reduce noise levels at Site 5. At a minimum feasible barrier height of 14 feet tall and 670 feet long, this barrier would reduce traffic noise levels by at least 5 dBA at a majority of first row impacted receiver locations in this area. A minimum reasonable barrier height of 14 feet tall and 670 feet long for GSA Noise Barrier 2 would achieve WSDOT’s design goal of at least a 7-dBA noise reduction. At a height of 14 feet and length of 670 feet, GSA Noise Barrier 2 would cost approximately $484,102. Constructing this barrier along Oregon Way would require changes to local utilities and access improvements to sidewalks and alley ways. These additional costs totaled $740,000 and were added to the typical construction costs totaling $1,224,102. The barrier would benefit seven receiver locations, which represent 22 dwelling units, resulting in a reasonable allowance of $831,333. Due to the allowable cost of barrier being less than the construction cost of the barrier and associated improvements, the noise barrier does not meet the WSDOT reasonableness criteria and is not recommended.

5.3.3 GSA Noise Barrier 3—Site 4

GSA Noise Barrier 3 is located to the east of Oregon Way northbound travel lanes along the roadway shoulder with segment breaks to allow for access to homes located nearby as shown on Figure 8. The barrier was evaluated at heights up to 20 feet tall and 500 feet in total length in this location to reduce noise levels at Site 4. With the breaks required for access to private property in this area, GSA Noise Barrier 3 is not recommended as a barrier in the location would not be feasible to benefit a majority of the first row impacted receiver sites in the area.
5.4 Partial Grade-Separated Option B (PGSB) Alternative

For the PGSB Alternative, two noise barriers were evaluated to determine whether abatement could sufficiently reduce traffic noise levels at the 20 residences predicted to experience noise levels above the NAC under this alternative. As shown in Figure 9, noise barriers were evaluated along both sides of Oregon Way between Alabama Street and Beech Street in an attempt to reduce noise levels at impact locations. All noise barriers were evaluated within WSDOT right-of-way near the edge of roadway shoulder.

Figure 9. PGSB Alternative: Predicted 2040 Traffic Noise Levels and Evaluated Noise Barriers

5.4.1 PGSB Noise Barrier 2—Site 5

PGSB Noise Barrier 2 is located to the west of Oregon Way southbound travel lanes along the roadway shoulder as shown on Figure 9. The barrier was evaluated at heights up to 20 feet tall and 670 feet long in this location to reduce noise levels at Site 5. At a minimum feasible barrier height of 12 feet tall and 670 feet long, this barrier would reduce traffic noise levels by at least 5 dBA at a majority of first row impacted receiver locations in this area. A minimum reasonable barrier height of 12 feet tall and 670 feet long for PGSB Noise Barrier 2 would achieve WSDOT’s design goal of at least a 7-dBA noise reduction. At a height of 12 feet and length of 670 feet, PGSB Noise Barrier 2 would cost approximately $414,944. Constructing this barrier along Oregon Way would require changes to local utilities and access improvements to sidewalks and alley ways. These additional costs totaled $740,000 and were added to the typical construction costs totaling $1,154,944. The barrier would benefit seven receiver locations, which represent 15 dwelling units, resulting in a reasonable allowance of $679,806. Due to the allowable cost of barrier being less than the construction cost of the barrier and associated improvements, the noise barrier does not meet the WSDOT reasonableness criteria and is not recommended.
5.4.2 PGSB Noise Barrier 3—Site 4

PGSB Noise Barrier 3 is located to the east of Oregon Way northbound travel lanes along the roadway shoulder with segment breaks to allow for access to homes located nearby as shown on Figure 9. The barrier was evaluated at heights up to 20 feet tall and 500 feet in total length in this location to reduce noise levels at Site 4. With the breaks in this barrier required for access to private property in this area, PGSB Noise Barrier 3 is not recommended as a barrier in the location would not be feasible to benefit a majority of the first row impacted receiver sites in the area.

5.5 Noise Abatement Summary

Noise abatement was evaluated at three locations for the GSA Alternative and two locations for the PGSB Alternative where traffic noise impacts were predicted, as previously described in Sections 5.3 and 5.4. None of the locations evaluated for barrier placement for either alternative met both WSDOT Criteria for placement of a feasible and reasonable noise barrier. Thus, the impacts shown in Table 5 would result with or without the project in 2040.

Table 5. Noise Abatement Summary by Build Alternative

<table>
<thead>
<tr>
<th>Build Alternative</th>
<th>Impacts Total before Mitigation (Site Numbers)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSA Alternative (2040)</td>
<td>20 Residences and 1 Trail (Sites 3, 4, 5, 4A, 5A, 5B, 5C, 5D)</td>
</tr>
<tr>
<td>PGSB Alternative (2040)</td>
<td>20 Residences (Sites 4, 5, 4A, 5A, 5B, 5C, 5D)</td>
</tr>
</tbody>
</table>

5.6 Mitigation Measures

5.6.1 Mitigation Measures for Construction Noise Impacts

- To the extent feasible, conduct noisier construction activities during daytime hours to reduce noise levels during sensitive nighttime hours.
- Apply additional measures as needed and to the extent feasible to reduce noise levels, including equipping engines with adequate mufflers, turning off equipment during prolonged periods of nonuse, and locating compressors and generators away from residences.

5.6.2 Mitigation Measures for Long-Term Noise Impacts

- During final design of the Preferred Alternative, update the feasible and reasonable analysis for potential noise barriers to reduce predicted traffic noise to residences along the west side of Oregon Way.
6.0 REFERENCES


Attachment A: Noise Impact Assessment Methodology Memorandum
Memorandum

To: Joanna Lowrey, PE, WSDOT Kelso Area Engineer
Claude Sakr, Cowlitz County Project Manager

From: Patrick Romero, WSP

Date: April 1, 2016
Revised August 4, 2017

Subject: Impact Assessment Methodology: Noise

1 Methodology Introduction

This memorandum presents the methodology used to analyze potential effects of the proposed Industrial Way/Oregon Way Intersection Project on noise-sensitive land uses. This analysis is included in Appendix K (Noise Technical Analysis) of the project’s environmental impact statement (EIS).

2 Study Area

The noise study area was determined using CFR 772 requiring identification of all existing land uses and undeveloped lands permitted for development that may include noise-sensitive land uses. A 500-foot limit from project improvements was used as a starting point for noise study boundaries and was confirmed after field reconnaissance and field measurements are completed. The limits of project improvements and the study area for noise are shown in Figure A-1. The noise study area encompasses the area for direct and indirect impacts to noise-sensitive land uses resulting from construction and operation of the project.
Figure A-1. Study Area for Noise
3 Regulations, Standards, or Guidelines

The noise analysis was conducted in compliance with EM Chapter 446 (Noise) and Federal Highway Administration (FHWA) requirements including those specifically described in 23 CFR 772 and Washington State Department of Transportation (WSDOT) 2011 Traffic Noise Policy and Procedures (last updated October 2012). The methodology presented below satisfies FHWA and WSDOT requirements for corresponding project improvements. Documentation of methods, analysis, and results generally follow WSDOT’s Noise Discipline Report checklist and template for technical report development with modifications to match the EIS format.

4 Study Coordination and Analysis

The noise analysis was prepared as an appendix to the EIS and documents land uses in the area, existing noise conditions, analysis methods, noise level descriptors, noise regulations and noise impact criteria, long-term project impacts on noise levels, short-term impacts from construction activities, and abatement measures. The following coordination, data gathering, analysis, and reporting was collected in support of the traffic noise analysis.

4.1 Coordination with Project Team

Coordination occurred with the project team to obtain existing and future project design files and traffic data, and related data on other physical features that may affect noise levels. This coordination includes the use of findings from previous environmental assessments performed in the area when that information was available and deemed relevant to this study.

4.2 Coordination with Local Officials

Coordination occurred with local officials to obtain plans of future development in the study area. This coordination helped determine field measurement and noise modeling locations to assess existing and future land uses.

4.3 Field Review

The study area was reviewed to confirm the noise study area, noise-sensitive land uses, and their distance from project improvements, and field noise measurement locations.

4.4 Noise Measurements

Field noise measurements were conducted to help determine existing daytime and nighttime noise levels. Measured noise levels were also used to validate the FHWA Traffic Noise Model (TNM) during free-flow traffic conditions. Field measurements were conducted at noise sensitive land uses or representative locations with simultaneous traffic counts by vehicle type and speed. Field measurements represent all noise-sensitive land uses, including outdoor areas of frequent human use located at at-grade and above-ground residences, condominiums, hotels and related land uses existing along the study area or permitted by local municipalities.

4.5 Noise Model Validation

The noise model was validated with field measurements and corresponding traffic data. All noise modeled locations represent outdoor areas of frequent human use.
4.6 Noise Modeling

The latest version of TNM (TNM 2.5 is the current version) was used to model existing, and future build and no build traffic noise levels at noise sensitive land uses. Existing peak hour traffic volumes were added to the validated noise model to predict existing noise levels. Future design-year peak-hour traffic volumes were added to the validated noise model with and without project improvements to determine potential noise impacts.

4.7 Impact Assessment

Modeled noise levels for existing year and future year scenarios were evaluated with WSDOT Noise Abatement Criteria (NAC) to determine impact by land use category and impacts resulting from substantial increase in noise levels (10 dBA or more) over existing noise levels. Potential construction impacts were qualitatively discussed.

4.8 Abatement Measures

At a minimum, noise barrier placement was considered at all noise impact locations. Other mitigation measures, including traffic management measures, were evaluated. However, mitigation other than noise barriers is not anticipated for this study.

4.9 Reporting

The documentation for this analysis follows WSDOT 2011 Policy and Procedures guidance for preparing a noise study, including characteristics of sound and noise, FHWA/WSDOT NAC, written details, maps/graphics, and/or tables that describe the project design, traffic data, land use, methodology, measurements existing and future year modeling results, and any operational or construction impacts identified; evaluate mitigation measures if impacts are identified; describe the preliminary location of any feasible and reasonable mitigation measures; and provide anticipated future noise levels to local officials.

4.10 Construction Impacts

Construction activities would have short-term noise impacts on noise sensitive land uses in the immediate vicinity of construction activities. Impacts on adjacent communities would include noise from the operation of construction equipment and noise from construction and delivery vehicles traveling to and from the construction site. The level of impact would depend on the noise characteristics of the equipment, activities involved, the construction schedule, and the distance of equipment from sensitive receptors.

A qualitative discussion of noise levels anticipated during construction will be developed once construction timing and the mix of construction equipment and locations is known.

4.11 Direct Impacts

Predicted noise levels for existing and future build and no build conditions was compared with the WSDOT NAC. All impact locations were described and shown graphically. Abatement measures were evaluated for all impacted noise sensitive land uses.
4.12 Indirect Impacts

This noise analysis is based on the transportation demand forecasting model that generates projected traffic volumes and includes the impacts of unmet demand on the transportation system from future population, housing and land use changes and growth. Therefore, the traffic analysis used to assess the direct noise impacts also takes into account indirect impacts.

5 Summary of Potential Impacts and Mitigation

The following is a brief summary of the types of benefits and adverse impacts that may result from the project. This section also includes mitigation measures that could be considered to reduce or eliminate adverse impacts.

5.1 Potential Benefits

When existing traffic noise levels were found to meet or exceed WSDOT’s NAC for noise impacts in the future, all impact locations were considered for noise abatement. A reduction in traffic noise levels resulting from the project through changes in traffic or roadway design, or potential abatement measures could provide a benefit to noise sensitive land uses located nearest to project improvements and abatement areas.

5.2 Potential Adverse Impacts

Future traffic noise levels could increase at areas closest to project improvements as a result of the project. An increase in noise levels could result in noise impacts at noise sensitive land uses.

5.3 Potential Mitigation

Abatement measures were considered at all future noise impact locations.

6 Limitations and Constraints

Computer modeling of construction noise levels is not included in this assessment.
Attachment B: Supporting Information
Traffic Noise Analysis and Abatement Process

When are noise reports and/or recommendations final?

The noise abatement process from the preparation of a noise wall to the final noise wall design (or decision not to build) can be confusing. The following process attempts to provide some clarification to project teams and outlines a recommended “standard” process, but acknowledges that variations to this process are likely because of the differences between projects.

Environmental Discipline Reports

The noise analyst works with the project team to model project elements affecting noise that include traffic, topography, and the location of noise sensitive receivers. If traffic noise impacts are discovered through modeling, then abatement is evaluated.

Abatement is compared to the feasibility (constructability, effectiveness) and reasonableness (allowable barrier size/cost) for a “standard” project. If abatement is feasible and reasonable, the report recommends the optimal (cost to benefit) noise barrier.

The traffic noise discipline report can be finalized.

Design Phase

Design Phase and Public Involvement steps (below) may be incorporated before report is finalized.

The project office reviews the recommended noise wall height and horizontal alignment to determine if there are any conflicts that were not realized at the time the discipline report was prepared.

If conflicts from utilities, steep slopes, etc. are present, the details and costs of the conflicts are provided to the noise analyst by the project team. The noise analyst will then add any additional (“but for” the noise wall) costs to the reasonableness evaluation.

If noise wall costs including accommodation of conflicts are still less than the allowable costs for the noise wall, the barrier height and/or alignment are re-evaluated and a new barrier will be recommended. If barrier costs plus the new costs exceed the allowable costs, the barrier may not be recommended by the WSDOT Air, Noise, and Energy (ANE) Program.

If a noise wall is recommended, the ANE Program will review and confirm noise wall dimensions throughout the design process.

Public Involvement

If abatement is recommended in the Traffic Noise Discipline Report, public outreach to determine public desires for abatement must occur. The noise wall discussion may be introduced to the public before the Design Phase, but should happen after the noise wall alignment, height, and length (or other abatement description) is established so that people can understand any effects of the noise wall (or other abatement) on their community.

The final determination whether to construct a noise wall or other abatement that is recommend in the traffic noise analysis, cannot be made until public outreach has occurred.
**Final Steps**

Any updates to the Traffic Noise Discipline report to clarify changes that occurred during the Design Phase or from Public Involvement can be made at the project engineering offices discretion. Addendum or supplementary memorandum to clarify changes can also be added to the discipline report or project file.

The noise wall is constructed or a letter from the ANE Program is added to the project file clarifying why a noise wall was not constructed.
Permitted Future Land Use

This section presents the results of a review of available building permits from the City of Longview.

A review of building permits provided on the city's website was performed online in February 2016 and April 2017. The review indicated that no permits have been submitted to develop structures that include residences, commercial uses, or other WSDOT and FHWA noise-regulated land uses NAC B, C, D, or F at properties located within the noise study area.
Traffic Noise Model Validation

FHWA’s Traffic Noise Model (TNM) Version 2.5 (FHWA, 2004) was used for validation and to predict future $L_{eq}(h)$ traffic noise levels. TNM Version 2.5 is the most current version of the noise model. TNM calculates precise estimates of noise levels at discrete points. The model estimates the sound levels from a series of straight-line roadway segments. TNM also considers the effects of existing barriers, topography, vegetation, and atmospheric absorption. Noise from sources other than traffic is not included, so when non-traffic noise is present, such as aircraft noise, TNM will under predict the total noise level. To create the model, design files outlining major roadways, topographical features, and sensitive receptors were imported into the TNM model as background features and the corresponding values were entered manually. Aerial photographs and site visits were used to verify site conditions.

WSDOT provided all base maps and project design maps for use in the noise study. As standard practice, base maps were exported as DXF files and imported into the TNM package. In addition, ArcGIS was used to develop the TNM model. Major roadways, topographical features, and sensitive receptors were digitized into the model. The United States Geological Survey (USGS) 7.5-minute Digital Elevation Model was also used (USGS 2017).

To ensure that the noise model used to predict traffic noise impacts accurately reflects the sound levels in the noise study area, a model is constructed using the same traffic volumes, speed, and vehicle types that were present during the sound level measurements. Modeled values must be within ±2.0 dBA of the measured levels for the model to be validated.

Table B-1 describes the validation locations and the comparison of measured to modeled values. Recorded traffic information during the measurements in subsequent tables in Attachment B. Traffic volumes, vehicle mix, and speed data collected during each validation measurement is included in Attachment B. Each of the six short-term measured sites was found to model within ±2 dBA of the measured levels (Table B-1). Because a 2 to 3-dBA change in noise levels is barely perceptible to the average human ear, an agreement of ±2 dBA is acceptable for noise model validation purposes.

<table>
<thead>
<tr>
<th>Site #/Location</th>
<th>Date</th>
<th>Start Time</th>
<th>Measured $L_{eq}$ (dBA)</th>
<th>Modeled $L_{eq}$ (dBA)</th>
<th>Difference (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1– Residence at 103 Oregon Way</td>
<td>1/6/16</td>
<td>1:05</td>
<td>63.9</td>
<td>62.0</td>
<td>-1.9</td>
</tr>
<tr>
<td>M2– Residence at 114 16th Avenue</td>
<td>1/6/16</td>
<td>1:35</td>
<td>56.4</td>
<td>55.0</td>
<td>-1.4</td>
</tr>
<tr>
<td>M3– Highlands Trail</td>
<td>1/6/16</td>
<td>2:05</td>
<td>63.7</td>
<td>61.7</td>
<td>-2.0</td>
</tr>
<tr>
<td>M4– 326 Oregon Way (Columbia Trailer Court)</td>
<td>1/6/16</td>
<td>3:00</td>
<td>67.6</td>
<td>66.8</td>
<td>-0.8</td>
</tr>
<tr>
<td>M5– Residence at 357 Oregon Way</td>
<td>1/6/16</td>
<td>3:40</td>
<td>68.5</td>
<td>67.8</td>
<td>-0.7</td>
</tr>
<tr>
<td>M6– Residence at 302 15th Avenue</td>
<td>1/6/16</td>
<td>4:15</td>
<td>60.9</td>
<td>58.9</td>
<td>-2.0</td>
</tr>
</tbody>
</table>

Notes: Short term measured noise levels were used for model validation near existing roadways.
Traffic Data

The following tables, Tables B-2 through B-5, provide traffic data collected during field measurements on January 6 and 7, 2016. The data includes traffic volumes, speeds, and vehicle mix by roadway for each noise measurement location. Worst-Hour Existing 2015, 2040 No Build, and 2040 Build (GSA and PGSB) traffic data developed by WSP USA for WSDOT.

Table B-2: Existing 2015 Traffic Volumes

<table>
<thead>
<tr>
<th>Industrial Way/Oregon Way Intersection Project</th>
<th>Existing 2015 Volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industrial Way/Oregon Way</strong></td>
<td></td>
</tr>
<tr>
<td>Approach</td>
<td>AM</td>
</tr>
<tr>
<td>Eastbound</td>
<td>530</td>
</tr>
<tr>
<td>Westbound</td>
<td>550</td>
</tr>
<tr>
<td>Northbound</td>
<td>620</td>
</tr>
<tr>
<td>Southbound</td>
<td>330</td>
</tr>
<tr>
<td><strong>Industrial Way/Columbia Blvd</strong></td>
<td></td>
</tr>
<tr>
<td>Approach</td>
<td>AM</td>
</tr>
<tr>
<td>Eastbound</td>
<td>625</td>
</tr>
<tr>
<td>Westbound</td>
<td>545</td>
</tr>
<tr>
<td>Northbound</td>
<td>60</td>
</tr>
</tbody>
</table>

Table B-3: Modeled Posted Speeds

<table>
<thead>
<tr>
<th>Location</th>
<th>Posted Speed Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR 432 (Industrial Way) East of Weyerhaueser</td>
<td>35 mph</td>
</tr>
<tr>
<td>SR 432 (Industrial Way) West of Weyerhaueser</td>
<td>50 mph</td>
</tr>
<tr>
<td>Oregon Way &amp; SR 433</td>
<td>35 mph</td>
</tr>
<tr>
<td>Columbia Blvd South of Industrial Way</td>
<td>25 mph</td>
</tr>
</tbody>
</table>
### Table B-4: Existing Year Heavy Vehicle Percentages

<table>
<thead>
<tr>
<th>Industrial Way and Oregon Way</th>
<th>EBL</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>WBR</th>
<th>NBL</th>
<th>NBT</th>
<th>NBR</th>
<th>SBL</th>
<th>SBT</th>
<th>SBR</th>
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</thead>
<tbody>
<tr>
<td>AM Peak Heavy Vehicle %</td>
<td>3%</td>
<td>24%</td>
<td>28%</td>
<td>36%</td>
<td>27%</td>
<td>6%</td>
<td>13%</td>
<td>1%</td>
<td>17%</td>
<td>19%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Midday Peak Heavy Vehicle %</td>
<td>4%</td>
<td>38%</td>
<td>24%</td>
<td>28%</td>
<td>30%</td>
<td>3%</td>
<td>9%</td>
<td>1%</td>
<td>25%</td>
<td>3%</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>PM Peak Heavy Vehicle %</td>
<td>3%</td>
<td>24%</td>
<td>8%</td>
<td>12%</td>
<td>11%</td>
<td>2%</td>
<td>1%</td>
<td>2%</td>
<td>9%</td>
<td>5%</td>
<td>1%</td>
<td>4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Industrial Way and Columbia Blvd</th>
<th>EBT</th>
<th>EBR</th>
<th>WBL</th>
<th>WBT</th>
<th>NBL</th>
<th>NBR</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Peak Heavy Vehicle %</td>
<td>19%</td>
<td>26%</td>
<td>20%</td>
<td>26%</td>
<td>38%</td>
<td>50%</td>
</tr>
<tr>
<td>Midday Peak Heavy Vehicle %</td>
<td>25%</td>
<td>29%</td>
<td>22%</td>
<td>24%</td>
<td>14%</td>
<td>33%</td>
</tr>
<tr>
<td>PM Peak Heavy Vehicle %</td>
<td>13%</td>
<td>38%</td>
<td>27%</td>
<td>9%</td>
<td>8%</td>
<td>16%</td>
</tr>
</tbody>
</table>

Note: Existing year HV % is used for future design year (2040) to estimate HV volumes
### Table B-5: Modeled Hourly Traffic Volumes for 2040 No Build and Build (GSA & PGSB)

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>NO BUILD 2040</th>
<th>GSA 2040</th>
<th>PGSB 2040</th>
<th>Round-About/Frontage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Lanes</td>
<td>1 Lane</td>
<td>2 Lanes</td>
<td>1 Lane</td>
</tr>
<tr>
<td></td>
<td>Oregon Way SB</td>
<td>Oregon Way SB</td>
<td>Oregon Way SB</td>
<td>Oregon Way SB</td>
</tr>
<tr>
<td>A</td>
<td>836</td>
<td>418</td>
<td>836</td>
<td>418</td>
</tr>
<tr>
<td>MT</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>HT</td>
<td>94</td>
<td>47</td>
<td>94</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Oregon Way SB</td>
<td>Oregon Way SB</td>
<td>Oregon Way SB</td>
<td>Oregon Way SB</td>
</tr>
<tr>
<td>A</td>
<td>734</td>
<td>367</td>
<td>733.2</td>
<td>366.6</td>
</tr>
<tr>
<td>MT</td>
<td>10</td>
<td>5</td>
<td>9.4</td>
<td>4.7</td>
</tr>
<tr>
<td>HT</td>
<td>196</td>
<td>98</td>
<td>197.4</td>
<td>98.7</td>
</tr>
<tr>
<td></td>
<td>SR 433 NB</td>
<td>SR 433 NB</td>
<td>SR 433 NB</td>
<td>SR 433 NB</td>
</tr>
<tr>
<td>A</td>
<td>1386</td>
<td>693</td>
<td>1401</td>
<td>700.48</td>
</tr>
<tr>
<td>MT</td>
<td>16</td>
<td>8</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>HT</td>
<td>173</td>
<td>86.5</td>
<td>173</td>
<td>86.5</td>
</tr>
<tr>
<td></td>
<td>SR 433 NB</td>
<td>SR 433 NB</td>
<td>SR 433 NB</td>
<td>SR 433 NB</td>
</tr>
<tr>
<td>A</td>
<td>1480</td>
<td>740</td>
<td>1496</td>
<td>748</td>
</tr>
<tr>
<td>MT</td>
<td>16</td>
<td>8</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>HT</td>
<td>78</td>
<td>39</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Industrial Way EB</td>
<td>Industrial Way EB</td>
<td>Industrial Way EB</td>
<td>Industrial Way EB</td>
</tr>
<tr>
<td>A</td>
<td>448</td>
<td>224</td>
<td>371.2</td>
<td>185.6</td>
</tr>
<tr>
<td>MT</td>
<td>16</td>
<td>8</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>HT</td>
<td>173</td>
<td>86.5</td>
<td>203</td>
<td>101.5</td>
</tr>
<tr>
<td></td>
<td>Industrial Way EB</td>
<td>Industrial Way EB</td>
<td>Industrial Way EB</td>
<td>Industrial Way EB</td>
</tr>
<tr>
<td>A</td>
<td>434</td>
<td>217</td>
<td>179.8</td>
<td>180</td>
</tr>
<tr>
<td>MT</td>
<td>7</td>
<td>3.5</td>
<td>2.9</td>
<td>3</td>
</tr>
<tr>
<td>HT</td>
<td>259</td>
<td>129.5</td>
<td>107.3</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>SR 432 WB</td>
<td>SR 432 WB</td>
<td>SR 432 WB</td>
<td>SR 432 WB</td>
</tr>
<tr>
<td>A</td>
<td>969.4</td>
<td>484</td>
<td>990</td>
<td>495</td>
</tr>
<tr>
<td>MT</td>
<td>13.1</td>
<td>7</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>HT</td>
<td>327.5</td>
<td>164</td>
<td>335</td>
<td>167.5</td>
</tr>
<tr>
<td></td>
<td>SR 432 WB</td>
<td>SR 432 WB</td>
<td>SR 432 WB</td>
<td>SR 432 WB</td>
</tr>
<tr>
<td>A</td>
<td>1100</td>
<td>550</td>
<td>1125</td>
<td>562.5</td>
</tr>
<tr>
<td>MT</td>
<td>13</td>
<td>7</td>
<td>13</td>
<td>6.5</td>
</tr>
<tr>
<td>HT</td>
<td>197</td>
<td>98</td>
<td>201</td>
<td>100.5</td>
</tr>
</tbody>
</table>
Modeling Site Descriptions

Table B-6 provides additional information on modeling site locations and residential equivalency calculations.

Table B-6: Modeled Site Descriptions and Residential Equivalency Calculations

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Land Use / Site Description</th>
<th>Usage Factor Calculation (Hours/Day, Days/Week, Months/Year)(^1)</th>
<th>Average Users at Site</th>
<th>Average Number of People Per Household(^2)</th>
<th>Dwelling Units Residential Equivalency(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 3</td>
<td>Highlands Trail Trail</td>
<td>((16/24) \times (7/7) \times (12/12) = 0.67(^4))</td>
<td>34</td>
<td>2.53</td>
<td>9</td>
</tr>
</tbody>
</table>

\(1\) Calculated using WSDOT’s Residential Equivalency Calculations, unless noted

\(2\) Average number of people per household in Washington State 2.53 (WSDOT, 2012)

\(3\) Dwelling Units Residential Equivalency = Usage Factor x Average Users at site ÷ Average Number of People per Household

\(4\) Assumes use during 8 months of year
TNM Barrier Graphics

The following TNM noise barrier graphics were evaluated for two locations with the GSA Alternative and one location with the PGSB Alternative evaluated for noise barrier placement that met WSDOT criteria for a feasible noise barrier.
TNM Noise Barrier Graphic—GSA Noise Barrier 1
TNM Noise Barrier Graphic—GSA Noise Barrier 2
TNM Noise Barrier Graphic—PGSB Noise Barrier 2
TNM Data

TNM v2.5 files of all noise modeling files are provided electronically with this noise study. Modeling files developed for this noise study are as follows:

- Existing_2015
- Existing_2040_NoBuild
- GSA_Build_Alt
- PGSB_Build_Alt
- Val1
- Val2
- Val3
- Val4
- Val5
- Val6
Field Data Sheets

The following section contains data sheets from the field that describe the noise levels recorded, conditions during measurements, and locations where noise measurements were taken on January 6 and 7, 2016.
### 15-Minute Validation Measurement M1—Residence at 103 Oregon Way—Field Data Sheet

**Project Name:** JWow

**Job #** B0576AA

**Site Identification:** M1

**Start Date & Time:** 1/6/16 1:05 PM

**End Date & Time:** 1/6/16 1:20 PM

**Address:** 103 Oregon Way

**Temp:** 41 °F

**Humidity:** 70% R.H.

**Wind:** CALM MODERATE VARIABLE

**Wind Speed:** 0-3 MPH

**Dir:** N NE

**Sky:** CLEAR SUNNY DRY

**Other:**

**Instrument:** LD 820

**Type:** 02

**Serial #:** 1194

**Calibrator:** LD CAL 1508

**Serial #:** 2399

**Calibration Check:** Pre-Test 114.0 dBA SPL Post-Test 114.0 dBA SPL

**Windscreen:** Yes

**Settings:**

<table>
<thead>
<tr>
<th>Weighting</th>
<th>Slow</th>
<th>Fast</th>
<th>Frontal</th>
<th>Random</th>
<th>ANSI</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rec #</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Start Time/End Time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L 1 (55)</td>
<td>L 2</td>
<td>L 3</td>
<td>L 4</td>
<td>L 5</td>
<td>L 6</td>
<td>L 7</td>
</tr>
<tr>
<td>63.9</td>
<td>65.1</td>
<td>65.1</td>
<td>66.8</td>
<td>66.8</td>
<td>66.8</td>
<td>66.8</td>
</tr>
</tbody>
</table>

**Comments:** No veh. noises.

### Primary Noise Sources

- **Traffic:** 0/0
- **Aircraft:** 0/0
- **Rail:** 0/0
- **Industrial:** 0/0
- **Ambient Other:** 0/0
- **Autos:** 0/0
- **Meds. Trucks:** 0/0
- **Hvy Trucks:** 0/0
- **Buses:** 0/0
- **Motorcycles:** 0/0

**Speed Estimated By:** Radar/Driving

**Other Noise Sources:**
- Distances:
  - Aircraft overhead
  - Rustling leaves
  - Distant barking dogs
  - Birds
  - Children playing
  - Animal traffic
  - Distant landscaping
  - Distant trains
  - Other

**Terrain:** Hard Soft Mix

**Flat Other:**

**Physical Setting:**

**Site Sketch & Photograph:**

![Site Sketch & Photograph](image-url)
15-Minute Validation Measurement M2—Residence at 114 16th Avenue—Field Data Sheet

Project Name: JNWW

Job # 80576AA

SITE IDENTIFICATION:
START DATE & TIME: 1/6/16 1:35AM  
END DATE & TIME: 1/6/16 1:50AM

ADDRESS: 114 16th Ave.

TEMP: 41 °F  HUMIDITY: 30 % R.H.  WIND: CALM   MODERATE VARIABLE
WINDSPEED: 0-2 MPH  DIR: N NE  O S W W NW STEADY GUSTY MPH
SKY: CLEAR SUNNY DARK   PARTLY CLOUDY  OVRST FOG DRIZZLE RAIN Other:

INSTRUMENT: LD 820  TYPE: 0  SERIAL #: 1194
CALIBRATOR: LD CAL 150B  SERIAL #: 2399
CALIBRATION CHECK: PRE-TEST 114.0 dBA SPL POST-TEST 114.0 dBA SPL WINDSCREEN Yes

SETTING: A-WEIGHTED LOW FAST FRONTAL RANDOM ANSI OTHER:

Rec # Start Time / End Time
M2 150B 1:50: 56.4 58.1 49.3 51.9 50.6 50.4

COMMENTS: Variable speeds due to intersection

PRIMARY NOISE(S) TRAFFIC (Roadway Type: SW) AIRCRAFT RAIL INDUSTRIAL AMBIENT OTHER:

COUNT #1 DURATION: 15-MINUTE  SPEED (mph)  COUNT #2: -MINUTE  SPEED (mph)
AUTOs: 96 60 0 0 20 25 45 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
MED. TRUCKS: 18 12 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
HVY TRUCKS: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
BUSES: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
MOTORCYCLES: 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

SPEED ESTIMATED BY: RADAR / DRIVING / OBSERVER

OTHER NOISE SOURCES: distant AIRCRAFT overhead / RUSTLING LEAVES / distant BARKING DOGS / BIRDS
distant CHILDREN PLAYING
distant TRAINS / distant LANDSCAPING

TERRAIN: HARD SOFT MIXED FLAT OTHER:

PHYSICAL SETTING: Residential Back Yard Near Ind. Way

SITE SKETCH / PHOTOGRAPHS:

Digital Photos

900 Third Avenue, Suite 3200, Seattle, WA 98104, 206-782-5200

000 Third Avenue, Suite 2200, Seattle, WA 98104, 206-782-5200

NEXT PAGE
### 15-Minute Validation Measurement M3—Highlands Trail—Field Data Sheet

**FIELD MEASUREMENT DATA SHEET**

<table>
<thead>
<tr>
<th>Project Name:</th>
<th>Znow</th>
<th>Job #:</th>
<th>80516AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITE IDENTIFICATION:</td>
<td>M3</td>
<td>OBSERVER(s):</td>
<td>Romno</td>
</tr>
<tr>
<td>ADDRESS:</td>
<td>Highlands Trail</td>
<td>END DATE &amp; TIME:</td>
<td>1/6/16</td>
</tr>
<tr>
<td>TEMP:</td>
<td>43 °F</td>
<td>HUMIDITY:</td>
<td>30 % R.H.</td>
</tr>
<tr>
<td>WIND:</td>
<td>CALM</td>
<td>MODERATE</td>
<td>VARIABLE</td>
</tr>
<tr>
<td>WINDSPEED:</td>
<td>0-3 MPH</td>
<td>DIR:</td>
<td>N NE E SE S SW W NW</td>
</tr>
<tr>
<td>SKY:</td>
<td>CLEAR</td>
<td>SUNNY</td>
<td>PARTLY CLOUDY</td>
</tr>
<tr>
<td>INSTRUMENT:</td>
<td>LD 820</td>
<td>TYPE:</td>
<td>0</td>
</tr>
<tr>
<td>CALIBRATOR:</td>
<td>LD CAL 150B</td>
<td>SERIAL #:</td>
<td>1299</td>
</tr>
<tr>
<td>CALIBRATION CHECK:</td>
<td>114.0 dBA SPL</td>
<td>POST-TEST:</td>
<td>114.0 dBA SPL</td>
</tr>
<tr>
<td>Windscreen:</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SETTING:</td>
<td>OVERCST</td>
<td>FOG</td>
<td>DRIZZLE</td>
</tr>
<tr>
<td>Wind:</td>
<td>SLOW</td>
<td>FAST</td>
<td>FRONTAL</td>
</tr>
<tr>
<td>Rec #:</td>
<td>Start Time / End Time</td>
<td>A3</td>
<td>2:05 / 2:20</td>
</tr>
<tr>
<td>COMMENTS:</td>
<td>Pain in distance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### PRIMARY NOISE(S): (TRAFFIC (Roadway Type), Aircraft, Rail, Industrial, Ambient, Other)

- Traffic: (Roadway Type)
- Aircraft: (Landing, Takeoff, Overhead, Directly Overhead)
- Rail: (Track Type, Direction, Position)
- Industrial: (Type, Location, Distance)
- Ambient: (Type, Origin, Intensity)
- Other: (Type, Source, Characteristics)

- Autos: (Number, Duration, Speed, Count)
- Med. Trucks: (Number, Duration, Speed, Count)
- Hyv Trucks: (Number, Duration, Speed, Count)
- Buses: (Number, Duration, Speed, Count)
- Motorcycles: (Number, Duration, Speed, Count)

#### TERRAIN: HARD SOFT MIXED FLAT OTHER

- Physical Setting: Trail, Swimming Pool, Industrial Way, Digital Photo

- Site Sketch / Photographs: At north edge of Highlands Trail between 18th & 19th Aves.
15-Minute Validation Measurement M4—Residence at 326 Oregon Way—Field Data Sheet

**FIELD MEASUREMENT DATA SHEET**

**Project Name:** Inow  
**Job #:** 80516AA

**SITE IDENTIFICATION:** M4  
**START DATE & TIME:** 1/6/16 3:00PM  
**ADDRESS:** 326 OR Way (Columbia Tower Cont.)

**TEMP:** 41°F  
**HUMIDITY:** 30% R.H.  
**WIND:** CALM  
**SKY:** CLEAR

**INSTRUMENT:** LD BZo  
**TYPE:** 02  
**SERIAL #:** 1194

**CALIBRATOR:** LD CAL 15DB  
**SERIAL #:** 2399

**CALIBRATION CHECK:** PRE-TEST 140 dBA SPL  
**POST-TEST:** 114 dBA SPL  
**WINDSCREEN:** YES

**SETTINGS:**  
**WEIGHT:** SLOW  
**FREQUENCY:** RANDOM  
**ANIS:** OTHER

**COMMENTS:**

**PRIMARY NOISE(S):** CRAFTY  
**ROADWAY TYPE:** OTHER  
**RAIL:** AIRCRAFT  
**INDUSTRIAL:** AMBIENT  
**OTHER:**

**COUNT #1 DURATION:** 15 MINUTE  
**SPEED (mph):**

<table>
<thead>
<tr>
<th>SERIES</th>
<th>AUTO</th>
<th>MED. TRUCKS</th>
<th>HVY TRUCKS</th>
<th>BUSES</th>
<th>MOTORCYCLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB/EB</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>EB/SW</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SW/EB</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SW/SW</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- **SPEED ESTIMATED BY:** RADAR  
- **DRIVING SITES:**

**OTHER NOISE SOURCES:**  
- **DISTANT AIRCRAFT:** overhead  
- **RUSTLING LEAVES:**  
- **DISTANT BARKING DOGS:**  
- **BIRDS:**
- **DISTANT CHILDREN PLAYING:**  
- **DISTANT TRAFFIC:**  
- **DISTANT LANDSCAPING:**  
- **DISTANT TRAINS:**

**TERRAIN:** HARD  
**SOFT:** MIXED  
**FLAT:** OTHER

**PHYSICAL SETTING:**

**SITE SKETCH:**

- **LOCATION:**
  - Front Yard of Timber Park X Way OR Way
  - Columbia Finken Court
  - Mobile Home Park

**DIAGRAM:**

- **SITE POINTS, DISTANCE:**
  - 092 3rd Avenue, Suite 3200, Seattle, WA 98104, 206-382-4200
# 15-Minute Validation Measurement M6—Residence at 302 15th Avenue—Field Data Sheet

## Field Measurement Data Sheet

- **Project Name:** Jnww
- **Job #:** B0516AA
- **SITE IDENTIFICATION:** M6
- **START DATE & TIME:** 1/16/16 4:15
- **END DATE & TIME:** 1/16/16 4:30
- **ADDRESS:** 302 15th Ave.
- **TEMP:** 43°F
- **HUMIDITY:** 30% R.H.
- **WIND:** CALM EIGHT LIGHT MODERATE VARIABLE
- **WINDSPEED:** 0.2 MPH
- **DIR:** N NE ESE S SW W NW STEADY GUSTY
- **SKY:** CLEAR SUNNY DARK HAZY CLOUDY OVERCAST FOG DRY RAIN

### Instrument
- **Type:** LD B20
- **Serial #:** 194
- **Calibrator:** LD CAL 150 B
- **Serial #:** 2339

### Calibration Check
- **Pre-Test:** 94.9 dBA SPL
- **Post-Test:** 94.9 dBA SPL

### Setting
- **Weighted:** LOW
- **Frontal:** RANDOM
- **Ansi:** OTHER

### Source Info and Traffic Counts

<table>
<thead>
<tr>
<th>Count #1 Duration</th>
<th>Speed (mph)</th>
<th>Count #2 Duration</th>
<th>Speed (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autos</td>
<td>260 / 360</td>
<td>280 / 360</td>
<td>280 / 360</td>
</tr>
<tr>
<td>Med. Trucks</td>
<td>290 / 360</td>
<td>290 / 360</td>
<td>290 / 360</td>
</tr>
<tr>
<td>Hyv. Trucks</td>
<td>2 / 10</td>
<td>2 / 10</td>
<td>2 / 10</td>
</tr>
<tr>
<td>Buses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorcycles</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Other Noise Sources
- Class: AIRCRAFT
- Notes: 1200' NW of EOP of DR-WAY

### Terrain
- **Hard Soft:** HARD
- **Flat Other:** FLAT

### Physical Setting
- **Resident Back yard facing OR-WAY in distance:**

### Site Sketch

![Site Sketch Diagram]

---

**WSP Parsons Brinckerhoff**

**Noise Technical Analysis**

**FEBRUARY 2018** Page B-21