FINAL

Noise Study Technical Report

I-5 Rose Quarter Improvement Project

Oregon Department of Transportation

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Stamp Page

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Figures[1]

[1] Appendix H includes written descriptions of all figures referenced in this Technical Report. If needed, additional figure interpretation is available from the ODOT Senior Environmental Project Manager at (503) 731-4804.

Appendices

Acronyms and Abbreviations

AASHTO	American Association of State Highway Transportation Officials
API	Area of Potential Impact
CFR	Code of Federal Regulations
dBA	A-weighted decibel
EB	eastbound
FHWA	Federal Highway Administration
I-405	Interstate 405
I-5	Interstate 5
I-84	Interstate 84
L_{eq}	hourly equivalent sound pressure level
mvmt	million vehicle miles travelled
NAC	Noise Abatement Criteria
NAAC	Noise Abatement Approach Criteria
NB	northbound
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
ODOT	Oregon Department of Transportation
R	Receiver
ROW	right of way
SAC	Stakeholder Advisory Committee
SB	southbound
SPIS	Safety Priority Index System
TNM	Traffic Noise Model
WB	westbound

Executive Summary

The Oregon Department of Transportation (ODOT) proposes the Interstate 5 (I-5) Rose Quarter Improvement Project (the Project) to improve the safety and operations on I-5 between Interstate 405 (I-405) and Interstate 84 (I-84), the Broadway/Weidler interchange, and adjacent surface streets in the vicinity of the Broadway/Weidler interchange.

The Project is considered a Type I project because it would include the additions of auxiliary lanes and new ramp construction. As a result, a noise analysis was prepared in conformance with 23 Code of Federal Regulations 772.

Noise levels were modeled for the peak noise impact hour (peak truck hour) for existing conditions (year 2017) and the Build and No-Build Alternatives. The Build and No-Build Alternatives were modeled using traffic data for the year 2045.

The results from the noise analysis show that under existing conditions, noise levels (in A-weighted decibels [dBA]) predicted for the Project Area ranged from 55 to 75 dBA for outdoor use areas and 34 to 49 dBA for interior areas. Seventy-one receivers representing 116 residential receptors, 2 medical facility outdoor use areas, 1 park, and 1 day care outdoor use area are predicted to have existing noise levels that meet or exceed ODOT Noise Abatement Approach Criteria (NAAC). Noise levels in exceedance of the Oregon NAAC under existing conditions are predicted throughout the Area of Potential Impact (API) and occur predominantly east of the I-5 corridor.

Noise level predictions for the No-Build Alternative were between 56 to 75 dBA for outdoor use areas and 34 to 49 dBA for interior areas. Sixty-nine receivers representing 112 residential receptors, 2 medical facility outdoor use areas, 1 park, and 1 day care outdoor use area were predicted to meet or exceed the ODOT NAAC for this alternative.

Noise level predictions for the Build Alternative were between 56 to 76 dBA for outdoor use areas and 36 to 51 dBA for interior areas. Seventy-six receivers representing 117 residential receptors, 66 medical facility indoor use areas, 1 school indoor use area, 2 medical facility outdoor use areas, 1 park, and 1 day care outdoor use area were predicted to meet or exceed the ODOT NAAC for this alternative. Compared to existing conditions, noise levels under the Build Alternative are predicted to decrease by up to 1 dBA or increase by up to 3 dBA. Compared to both existing conditions and the No-Build Alternative, noise levels are predicted to decrease under the Build Alternative near R17 due to the decommissioning of N Flint Avenue proposed in the Build Alternative. Compared to the No-Build Alternative, noise levels under the Build Alternative are predicted to decrease by up to 1 dBA or increase by up to 3 dBA. Per ODOT *Noise Manual* (ODOT 2011), ODOT considers a 10 dBA increase over existing noise levels to be substantial. Increases of 10 dBA were not predicted under the Build Alternative.

Noise mitigation was considered and evaluated for feasibility and reasonableness for properties predicted to meet or exceed the ODOT NAAC or where substantial increase in noise level (more than 10 dBA over existing noise levels) was predicted under the Build Alternative. Seven noise wall alignments were evaluated to mitigate predicted noise impacts within the Noise API. Two noise walls were judged to be acoustically feasible by meeting the design goal of at least a 7 dBA reduction at one receiver, as well as achieving a better than 50% rate of benefits (at least a 5dBA noise reduction) at impacted receivers in the vicinity. In addition, both walls were found to be reasonable based upon the ODOT cost effectiveness requirements and were therefore recommended for further consideration. Further evaluation of feasibility and reasonableness will be made during final design, including a more detailed analysis of constructability, as well as the viewpoints of affected property owners and residents.

The other five walls were not able to achieve the required noise reductions at adjacent properties because of challenges with complex traffic noise sources or because elevation issues precluded the breaking of the line of sight between noise sources and receivers. As a result, these walls were not recommended.

Temporary construction noise for the Project would result from normal construction activities in the construction year for the Project. Noise levels for these activities could range from approximately 70 to 100 dBA at sites 50 feet from the activities.

One of the requirements of the ODOT *Noise Manual* (ODOT 2011) is to supply information to local governments on existing and future noise levels so it can be used in guiding local land use decisions. The City of Portland, Multnomah County, and Metro should consider the information in this report regarding traffic noise levels within the Project Area. These jurisdictions should be consulted again during the final design phase of the Project to address any development that occurs between the date of this report and final design.

1 Introduction

1.1 Project Location

The I-5 Rose Quarter Improvement Project (Project) is located in Portland, Oregon, along the 1.7-mile segment of Interstate 5 (I-5) between Interstate 405 (I-405) to the north (milepost 303.2) and Interstate 84 (I-84) to the south (milepost 301.5). The Project also includes the interchange of I-5 and N Broadway and NE Weidler Street (Broadway/Weidler interchange) and the surrounding transportation network, from approximately N/NE Hancock Street to the north, N Benton Avenue to the west, N/NE Multnomah Street to the south, and NE 2nd Avenue to the east.

Figure 1 illustrates the Project Area in which the proposed improvements are located. The Project Area represents the estimated area within which improvements are proposed, including where permanent modifications to adjacent parcels may occur and where potential temporary impacts from construction activities could result.

1.2 Project Purpose

The purpose of the Project is to improve the safety and operations on I-5 between I-405 and I-84, of the Broadway/Weidler interchange, and on adjacent surface streets in the vicinity of the Broadway/Weidler interchange and to enhance multimodal facilities in the Project Area.

In achieving the purpose, the Project would also support improved local connectivity and multimodal access in the vicinity of the Broadway/Weidler interchange and improve multimodal connections between neighborhoods located east and west of I-5.

1.3 Project Need

The Project would address the following primary needs:

- **I-5 Safety:** I-5 between I-405 and I-84 has the highest crash rate on urban interstates in Oregon. Crash data from 2011 to 2015 indicate that I-5 between I-84 and the merge point from the N Broadway ramp on to I-5 had a crash rate (for all types of crashes[2]) that was approximately 3.5 times higher than the statewide average for comparable urban interstate facilities (ODOT 2015a).

[2] Motor vehicle crashes are reported and classified by whether they involve property damage, injury, or death.

Figure 1. Project Area

- Seventy-five percent of crashes occurred on southbound (SB) I-5, and 79 percent of all the crashes were rear-end collisions. Crashes during this 5-year period included one fatality, which was a pedestrian fatality. A total of seven crashes resulted in serious injury.
- The Safety Priority Index System (SPIS) is the systematic scoring method used by the Oregon Department of Transportation (ODOT) for identifying potential safety problems on state highways based on the frequency, rate, and severity of crashes (ODOT 2015b). The 2015 SPIS shows two SB sites in the top 5 percent and two northbound (NB) sites in the top 10 percent of the SPIS list.
- The 2015 crash rate on the I-5 segment between I-84 and the Broadway ramp on to I-5 is 2.70 crashes per million vehicle miles. The statewide average for comparable urban highway facilities is 0.77 crashes per million vehicle miles travelled (mvmt).
- The existing short weaving distances and lack of shoulders for accident/incident recovery in this segment of I-5 are physical factors that may contribute to the high number of crashes and safety problems.

- **I-5 Operations:** The Project Area is at the crossroads of three regionally significant freight and commuter routes: I-5, I-84, and I-405. As a result, I-5 in the vicinity of the Broadway/Weidler interchange experiences some of the highest traffic volumes in the State of Oregon, carrying approximately 121,400 vehicles each day (ODOT 2017a), and experiences 12 hours of congestion each day (ODOT 2012a). The following factors affect I-5 operations:
  - Close spacing of multiple interchange ramps results in short weaving segments where traffic merging on and off I-5 has limited space to complete movements, thus becoming congested. There are five on-ramps (two NB and three SB) and six off-ramps (three NB and three SB) in this short stretch of highway. Weaving segments on I-5 NB between the I-84 westbound (WB) on-ramp and the NE Weidler off-ramp, and on I-5 SB between the N Wheeler Avenue on-ramp and I-84 eastbound (EB) off-ramp, currently perform at a failing level-of-service during the morning and afternoon peak periods.
  - The high crash rate within the Project Area can periodically contribute to congestion on this segment of the highway. As noted with respect to safety, the absence of shoulders on I-5 contributes to congestion because vehicles involved in crashes cannot get out of the travel lanes.
  - Future (2045) traffic estimates indicate that the I-5 SB section between the N Wheeler on-ramp and EB I-84 off-ramp is projected to have the most critical congestion in the Project Area, with capacity and geometric constraints that result in severe queuing.
- **Broadway/Weidler Interchange Operations:** The complexity and congestion at the I-5 Broadway/Weidler interchange configuration is difficult to navigate for vehicles (including transit vehicles), bicyclists, and pedestrians, which impacts

access to and from I-5 as well as to and from local streets. The high volumes of traffic on I-5 and Broadway/Weidler in this area contribute to congestion and safety issues (for all modes) at the interchange ramps, the Broadway and Weidler overcrossings of I-5, and on local streets in the vicinity of the interchange.

- The Broadway/Weidler couplet provides east-west connectivity for multiple modes throughout the Project Area, including automobiles, freight, people walking and biking, and Portland Streetcar and TriMet buses. The highest volumes of vehicle traffic on the local street network in the Project Area occur on NE Broadway and NE Weidler in the vicinity of I-5. The N Vancouver Avenue/N Williams couplet, which forms a critical north-south link and is a Major City Bikeway within the Project Area with over 5,000 bicycle users during the peak season, crosses Broadway/Weidler in the immediate vicinity of the I-5 interchange.
- The entire length of N/NE Broadway is included in the Portland High Crash Network—streets designated by the City of Portland for the high number of deadly crashes involving pedestrians, bicyclists, and vehicles.[3]
- The SB on-ramp from N Wheeler and SB off-ramp to N Broadway experienced a relatively high number of crashes per mile (50-70 crashes per mile) compared to other ramps in the Project Area during years 2011-2015. Most collisions on these ramps were rear-end collisions.
- Of all I-5 highway segments in the corridor, those that included weaving maneuvers to/from the Broadway/Weidler ramps tend to experience the highest crash rates:
  - SB I-5 between the on-ramp from N Wheeler and the off-ramp to I-84 (SB-S5) has the highest crash rate (15.71 crashes/mvmt).
  - NB I-5 between the I-84 on-ramp and off-ramp to NE Weidler (NB-S5) has the second highest crash rate (5.66 crashes/mvmt).
  - SB I-5 between the on-ramp from I-405 and the off-ramp to NE Broadway (SB-S3) has the third highest crash rate (4.94 crashes/mvmt).

- **Travel Reliability on the Transportation Network:** Travel reliability on the transportation network decreases as congestion increases and safety issues expand. The most unreliable travel times tend to occur at the end of congested areas and on the shoulders of the peak periods. Due to these problems, reliability has decreased on I-5 between I-84 and I-405 for most of the day. Periods of congested conditions on I-5 in the Project Area have grown over time from morning and afternoon peak periods to longer periods throughout the day.

[3] Information on the City of Portland's High Crash Network is available at https://www.portlandoregon.gov/transportation/54892.

1.4 Project Goals and Objectives

In addition to the purpose and need, which focus on the state's transportation system, the Project includes related goals and objectives developed through the joint ODOT and City of Portland N/NE Quadrant and I-5 Broadway/Weidler Interchange Plan process, which included extensive coordination with other public agencies and citizen outreach. The following goals and objectives may be carried forward beyond the National Environmental Policy Act (NEPA) process to help guide final design and construction of the Project:

- Enhance pedestrian and bicycle safety and mobility in the vicinity of the Broadway/Weidler interchange.
- Address congestion and improve safety for all modes on the transportation network connected to the Broadway/Weidler interchange and I-5 crossings.
- Support and integrate the land use and urban design elements of the Adopted N/NE Quadrant Plan (City of Portland et al. 2012) related to I-5 and the Broadway/Weidler interchange, which include the following:
  - Diverse mix of commercial, cultural, entertainment, industrial, recreational, and residential uses, including affordable housing
  - Infrastructure that supports economic development
  - Infrastructure for healthy, safe, and vibrant communities that respects and complements adjacent neighborhoods
  - A multimodal transportation system that addresses present and future needs, both locally and on the highway system
  - An improved local circulation system for safe access for all modes
  - Equitable access to community amenities and economic opportunities
  - Protected and enhanced cultural heritage of the area
  - Improved urban design conditions
- Improve freight reliability.
- Provide multimodal transportation facilities to support planned development in the Rose Quarter, Lower Albina, and Lloyd.
- Improve connectivity across I-5 for all modes.

2 Project Alternatives

This technical report describes the potential effects of no action (No-Build Alternative) and the proposed action (Build Alternative).

2.1 No-Build Alternative

NEPA regulations require an evaluation of the No-Build Alternative to provide a baseline for comparison with the potential impacts of the proposed action. The No-Build Alternative consists of existing conditions and any planned actions with committed funding in the Project Area.

I-5 is the primary north-south highway serving the West Coast of the United States from Mexico to Canada. At the northern portion of the Project Area, I-5 connects with I-405 and the Fremont Bridge; I-405 provides the downtown highway loop on the western edge of downtown Portland. At the southern end of the Project Area, I-5 connects with the western terminus of I-84, which is the east-west highway for the State of Oregon. Because the Project Area includes the crossroads of three regionally significant freight and commuter routes, the highway interchanges within the Project Area experience some of the highest traffic volumes found in the state (approximately 121,400 average annual daily trips). The existing lane configurations consist primarily of two through lanes (NB and SB), with one auxiliary lane between interchanges. I-5 SB between I-405 and Broadway includes two auxiliary lanes.

I-5 is part of the National Truck Network, which designates highways (including most of the Interstate Highway System) for use by large trucks. In the Portland-Vancouver area, I-5 is the most critical component of this national network because it provides access to the transcontinental rail system, deep-water shipping and barge traffic on the Columbia River, and connections to the ports of Vancouver and Portland, as well as to most of the area's freight consolidation facilities and distribution terminals. Congestion on I-5 throughout the Project Area delays the movement of freight both within the Portland metropolitan area and on the I-5 corridor. I-5 through the Rose Quarter is ranked as one of the 50 worst freight bottlenecks in the United States (ATRI 2017).

Within the approximately 1.5 miles that I-5 runs through the Project Area, I-5 NB connects with five on- and off-ramps, and I-5 SB connects with six on- and off-ramps. Drivers entering and exiting I-5 at these closely spaced intervals, coupled with high traffic volumes, slow traffic and increase the potential for crashes. Table 1 presents the I-5 on- and off-ramps in the Project Area. Table 2 shows distances of the weaving areas between the on- and off-ramps on I-5 in the Project Area. Each of the distances noted for these weave transitions is less than adequate per current highway design standards (ODOT 2012b). In the shortest weave section, only 1,075 feet is available for drivers to merge onto I-5 from NE Broadway NB in the same area where drivers are exiting from I-5 onto I-405 and the Fremont Bridge.

Table 1. I-5 Ramps in the Project Area

I-5 Travel Direction	On-Ramps From	Off-Ramps To
Northbound	• I-84 • N Broadway/N Williams Avenue	• NE Weidler Street/NE Victoria Avenue • I-405 • N Greeley Avenue
Southbound	• N Greeley Avenue • I-405 • N Wheeler Avenue/N Ramsay Way	• N Broadway/N Vancouver Avenue • I-84 • Morrison Bridge/Highway 99E

Notes: I = Interstate

Table 2. Weave Distances within the Project Area

I-5 Travel Direction	Weave Section	Weave Distance
Northbound	I-84 to NE Weidler Street/NE Victoria Avenue	1,360 feet
Northbound	N Broadway/N Williams Avenue to I-405	1,075 feet
Southbound	I-405 to N Broadway	2,060 feet
Southbound	N Wheeler Avenue/N Ramsay Way to I-84	1,300 feet

Notes: I = Interstate

As described in Section 1.3, the high volumes, closely spaced interchanges, and weaving movements result in operational and safety issues, which are compounded by the lack of standard highway shoulders on I-5 throughout much of the Project Area.

Under the No-Build Alternative, I-5 and the Broadway/Weidler interchange and most of the local transportation network in the Project Area would remain in its current configuration, with the exception of those actions included in the Metro 2014 *Regional Transportation Plan* financially constrained project list (Metro 2014).[4] One of these actions includes improvements to the local street network on the Broadway/Weidler corridor within the Project Area. The proposed improvements include changes to N/NE Broadway and N/NE Weidler from the Broadway Bridge to NE 7th Avenue. The current design concept would remove and reallocate one travel lane on both N/NE Broadway and N/NE Weidler to establish protected bike lanes and reduce pedestrian crossing distances. Proposed improvements also include

[4] Metro Regional Transportation Plan ID 11646. Available at: https://www.oregonmetro.gov/sites/default/files/Appendix%201.1%20Final%202014%20RTP%20%20Project%20List%208.5x11%20for%20webpage_1.xls.

changes to turn lanes and transitions to minimize pedestrian exposure and improve safety. The improvements are expected to enhance safety for people walking, bicycling, and driving through the Project Area. Implementation is expected in 2018-2027.

2.2 Build Alternative

The Project alternatives development process was completed during the ODOT and City of Portland 2010-2012 N/NE Quadrant and I-5 Broadway/Weidler Interchange planning process. A series of concept alternatives were considered following the definition of Project purpose and need and consideration of a range of transportation-related problems and issues that the Project is intended to address.

In conjunction with the Stakeholder Advisory Committee (SAC) and the public during this multi-year process, ODOT and the City of Portland studied more than 70 design concepts, including the Build Alternative, via public design workshops and extensive agency and stakeholder input. Existing conditions, issues, opportunities, and constraints were reviewed for the highway and the local transportation network. A total of 19 full SAC meetings and 13 subcommittee meetings were held; each was open to the public and provided opportunity for public comment. Another 10 public events were held, with over 100 attendees at the Project open houses providing input on the design process. Of the 70 design concepts, 13 concepts advanced for further study based on SAC, agency, and public input, with six concepts passing into final consideration.

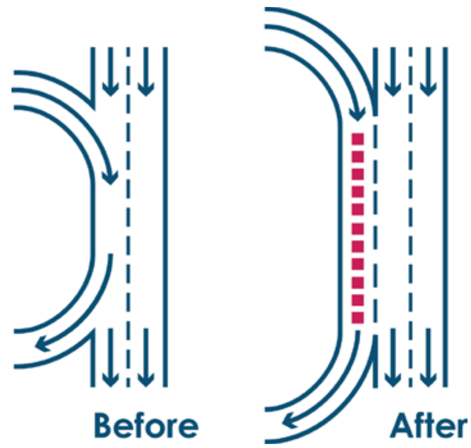
One recommended design concept, the Build Alternative, was selected for development as a result of the final screening and evaluation process. The final I-5 Broadway/Weidler Facility Plan (ODOT 2012a) and recommended design concept, herein referred to as the Build Alternative, were supported by the SAC and unanimously adopted in 2012 by the Oregon Transportation Commission and the Portland City Council.[5] The features of the Build Alternative are described below.

The Build Alternative includes I-5 mainline improvements and multimodal improvements to the surface street network in the vicinity of the Broadway/Weidler interchange. The proposed I-5 mainline improvements include the construction of auxiliary lanes (also referred to as ramp-to-ramp lanes) and full shoulders between I-84 to the south and I-405 to the north, in both the NB and SB directions. See Section 2.2.1 for more detail.

Construction of the I-5 mainline improvements would require the rebuilding of the N/NE Weidler, N/NE Broadway, N Williams, and N Vancouver structures over I-5.

[5] Resolution No. 36972, adopted by City Council October 25, 2012. Available at: https://www.portlandoregon.gov/citycode/article/422365

With the Build Alternative, the existing N/NE Weidler, N/NE Broadway, and N Williams overcrossings would be removed and rebuilt as a single highway cover structure over I-5 (see Section 2.2.2). The existing N Vancouver structure would be removed and rebuilt as a second highway cover, including a new roadway crossing connecting N/NE Hancock and N Dixon Streets. The existing N Flint Avenue structure over I-5 would be removed. The I-5 SB on-ramp at N Wheeler would also be relocated to N/NE Weidler at N Williams, via the new Weidler/Broadway/ Williams highway cover. A new bicycle and pedestrian bridge over I-5 would be constructed at NE Clackamas Street, connecting Lloyd with the Rose Quarter (see Section 2.2.4.3).



What are Ramp-to-Ramp or Auxiliary Lanes?

Ramp-to-Ramp lanes provide a direct connection from one ramp to the next. They separate on-and off-ramp merging from through traffic, and create better balance and smoother maneuverability, which improves safety and reduces congestion.

Surface street improvements are also proposed, including upgrades to existing bicycle and pedestrian facilities and a new center-median bicycle and pedestrian path on N Williams between N/NE Weidler and N/NE Broadway (see Section 2.2.4.4).

2.2.1 I-5 Mainline Improvements

The Build Alternative would modify I-5 between I-84 and I-405 by adding safety and operational improvements. The Build Alternative would extend the existing auxiliary lanes approximately 4,300 feet in both NB and SB directions and add 12-foot shoulders (both inside and outside) in both directions in the areas where the auxiliary lane would be extended. Figure 2 illustrates the location of the proposed auxiliary lanes. Figure 3 illustrates the auxiliary lane configuration, showing the proposed improvements in relation to the existing conditions. Figure 4 provides a cross section comparison of existing and proposed conditions, including the location of through lanes, auxiliary lanes, and highway shoulders.

A new NB auxiliary lane would be added to connect the I-84 WB on-ramp to the N Greeley off-ramp. The existing auxiliary lane on I-5 NB from the I-84 WB on-ramp to the NE Weidler off-ramp and from the N Broadway on-ramp to the I-405 off-ramp would remain.

The new SB auxiliary lane would extend the existing auxiliary lane that enters I-5 SB from the N Greeley on-ramp. The existing SB auxiliary lane currently ends just south of the N Broadway off-ramp, in the vicinity of the Broadway overcrossing structure.

Figure 2. Auxiliary Lane/Shoulder Improvements

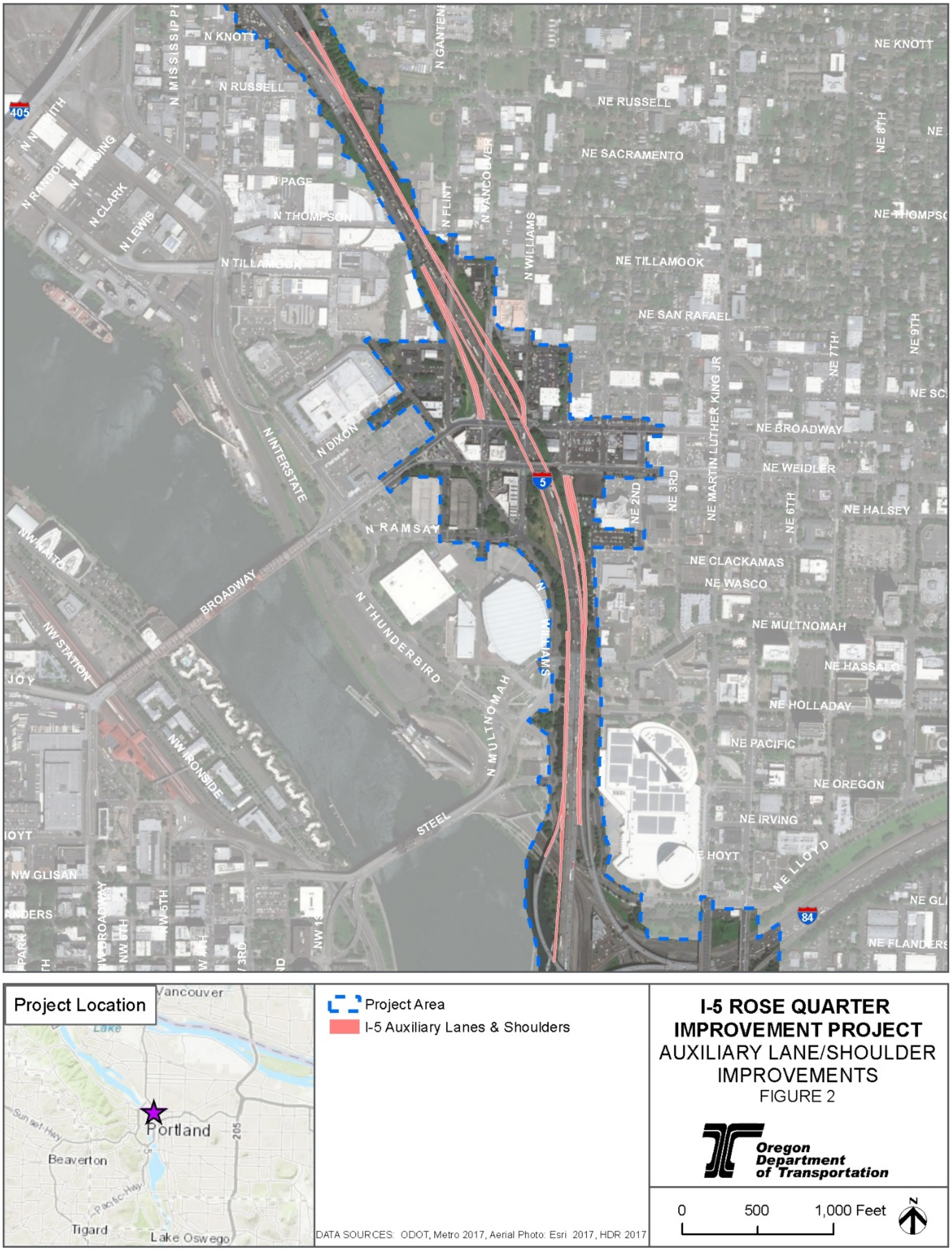


Figure 3. I-5 Auxiliary (Ramp-to-Ramp) Lanes – Existing Conditions and Proposed Improvements

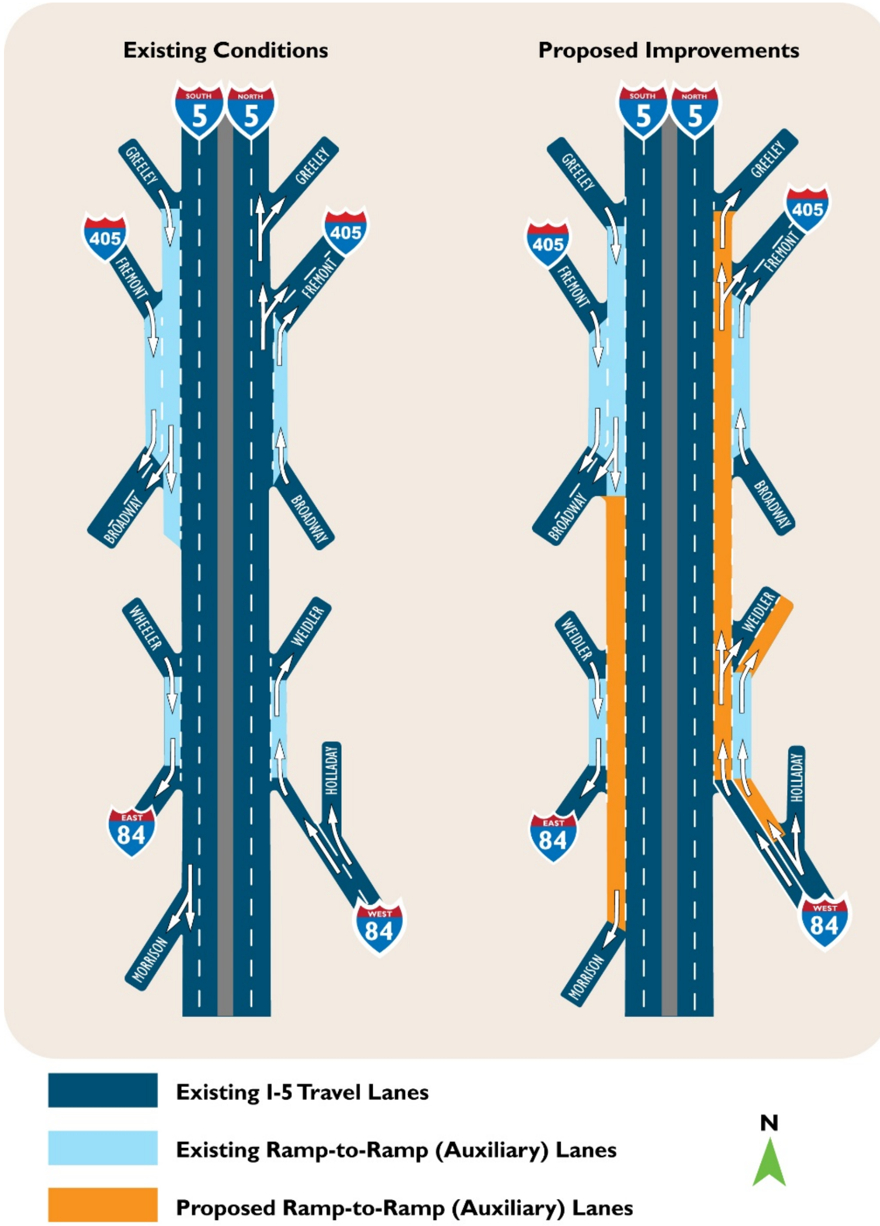
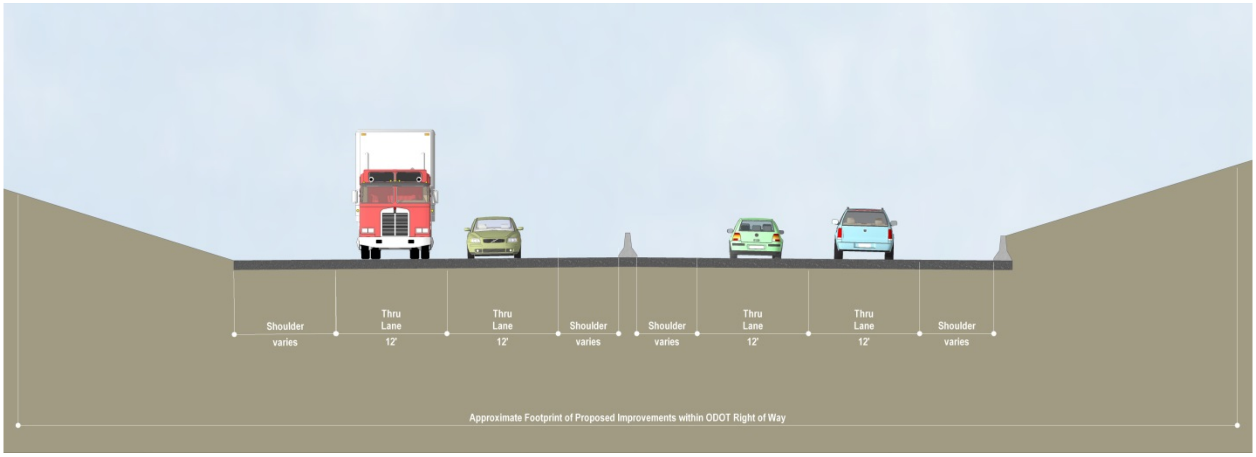
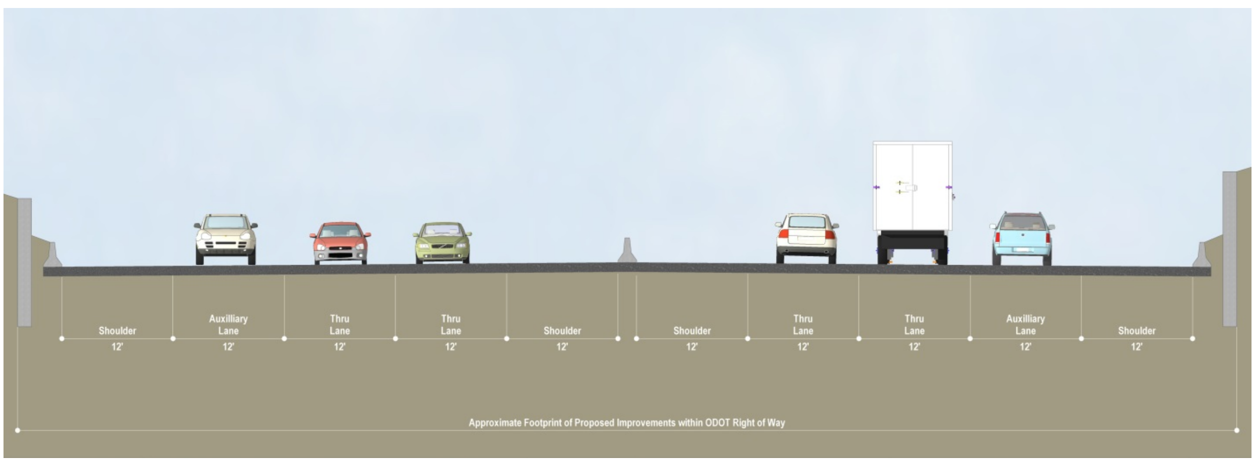


Figure 4. I-5 Cross Section (N/NE Weidler Overcrossing) – Existing Conditions and Proposed Improvements



Existing Lane Configuration



Proposed Lane Configuration

Under the Build Alternative, the SB auxiliary lane would be extended as a continuous auxiliary lane from N Greeley to the Morrison Bridge and the SE Portland/Oregon Museum of Science and Industry off-ramp. Figure 4 presents a representative cross section of I-5 (south of the N/NE Weidler overcrossing within the Broadway/Weidler interchange area), with the proposed auxiliary lanes and shoulder, to provide a comparison with the existing cross section.

The addition of 12-foot shoulders (both inside and outside) in both directions in the areas where the auxiliary lanes would be extended would provide more space to allow vehicles that are stalled or involved in a crash to move out of the travel lanes. New shoulders would also provide space for emergency response vehicles to use to access an incident within or beyond the Project Area.

No new through lanes would be added to I-5 as part of the Build Alternative; I-5 would maintain the existing two through lanes in both the NB and SB directions.

2.2.2 Highway Covers

2.2.2.1 Broadway/Weidler/Williams Highway Cover

To complete the proposed I-5 mainline improvements, the existing structures crossing over I-5 must be removed, including the roads and the columns that support the structures. The Build Alternative would remove the existing N/NE Broadway, N/NE Weidler, and N Williams structures over I-5 to accommodate the auxiliary lane extension and new shoulders described in Section 2.2.1.

The structure replacement would be in the form of the Broadway/Weidler/Williams highway cover (Figure 5). The highway cover would be a wide bridge that spans east-west across I-5, extending from immediately south of N/NE Weidler to immediately north of N/NE Broadway to accommodate passage of the Broadway/Weidler couplet. The highway cover would include design upgrades to make the structure more resilient in the event of an earthquake.

The highway cover would connect both sides of I-5, reducing the physical barrier of I-5 between neighborhoods to the east and west of the highway while providing additional surface area above I-5. The added surface space would provide an opportunity for new and modern bicycle and pedestrian facilities and public spaces when construction is complete, making the area more connected, walkable, and bike friendly.

Figure 5. Broadway/Weidler/Williams and Vancouver/Hancock Highway Covers

2.2.2.2 N Vancouver/N Hancock Highway Cover

The Build Alternative would remove and rebuild the existing N Vancouver structure over I-5 as a highway cover (Figure 5). The Vancouver/Hancock highway cover would be a concrete or steel platform that spans east-west across I-5 and to the north and south of N/NE Hancock. Like the Broadway/Weidler/Williams highway cover, this highway cover would provide additional surface area above I-5. The highway cover would provide an opportunity for public space and a new connection across I-5 for all modes of travel. A new roadway connecting neighborhoods to the east with the Lower Albina area and connecting N/NE Hancock to N Dixon would be added to the Vancouver/Hancock highway cover (see element "A" in Figure 6).

2.2.3 Broadway/Weidler Interchange Improvements

Improvements to the Broadway/Weidler interchange to address connections between I-5, the interchange, and the local street network are described in the following subsections and illustrated in Figure 6.

2.2.3.1 Relocate I-5 Southbound On-Ramp

The I-5 SB on-ramp is currently one block south of N Weidler near where N Wheeler, N Williams, and N Ramsay come together at the north end of the Moda Center. The Build Alternative would remove the N Wheeler on-ramp and relocate the I-5 SB on-ramp north to N Weidler. Figure 6 element "B" illustrates the on-ramp relocation.

2.2.3.2 Modify N Williams between Ramsay and Weidler

The Build Alternative would modify the travel circulation on N Williams between N Ramsay and N Weidler. This one-block segment of N Williams would be closed to through-travel for private motor vehicles and would only be permitted for pedestrians, bicycles, and public transit (buses) (Figures 6 and 7). Private motor vehicle and loading access to the facilities at Madrona Studios would be maintained.

2.2.3.3 Revise Traffic Flow on N Williams between Weidler and Broadway

The Build Alternative would revise the traffic flow on N Williams between N/NE Weidler and N/NE Broadway. For this one-block segment, N Williams would be converted from its current configuration as a two-lane, one-way street in the NB direction with a center NB bike lane to a reverse traffic flow two-way street with a 36-foot-wide median multi-use path for bicycles and pedestrians. These improvements are illustrated in Figures 6 and 7.

Figure 6. Broadway/Weidler Interchange Area Improvements

Figure 7. Conceptual Illustration of Proposed N Williams Multi-Use Path and Revised Traffic Flow

The revised N Williams configuration would be designed as follows:

- Two NB travel lanes along the western side of N Williams to provide access to the I-5 NB on-ramp, through movements NB on N Williams, and left-turn movements onto N Broadway.
- A 36-foot-wide center median with a multi-use path permitted only for bicycles and pedestrians. The median multi-use path would also include landscaping on both the east and west sides of the path.
- Two SB lanes along the eastern side of N Williams to provide access to the I-5 SB on-ramp or left-turn movements onto NE Weidler.

2.2.4 Related Local System Multimodal Improvements

2.2.4.1 New Hancock-Dixon Crossing

A new roadway crossing would be constructed to extend N/NE Hancock west across and over I-5, connecting it to N Dixon (see Figure 6, element "E"). The new crossing would be constructed on the Vancouver/Hancock highway cover and would provide a new east-west crossing over I-5. Traffic calming measures would be incorporated east of the intersection of N/NE Hancock and N Williams to discourage use of NE Hancock by through motor vehicle traffic. Bicycle and pedestrian through travel would be permitted (see Figure 6, element "F").

2.2.4.2 Removal of N Flint South of N Tillamook and Addition of New Multi-Use Path

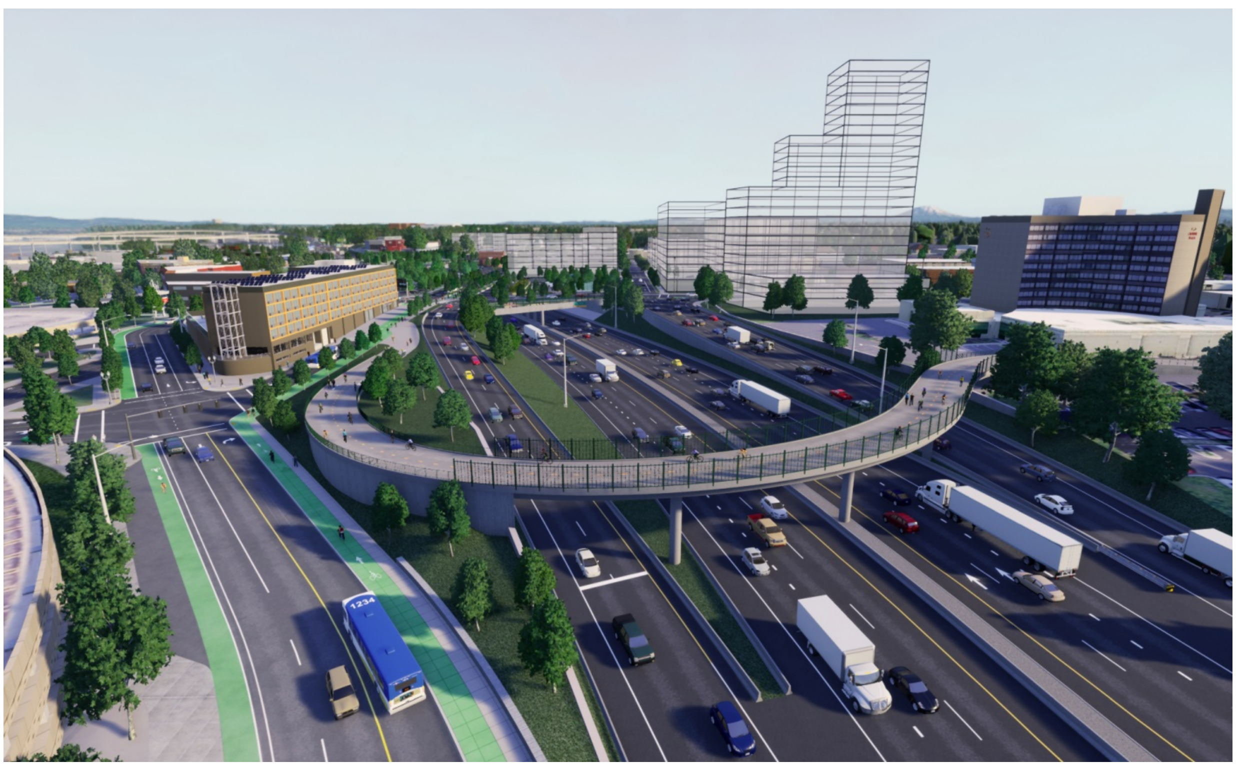
The existing N Flint structure over I-5 would be removed, and N Flint south of N Russell Street would terminate at and connect directly to N Tillamook (see Figure 6, element “G”). The portion of Flint between the existing I-5 overcrossing and Broadway would be closed as a through street for motor vehicles. Driveway access would be maintained on this portion of N Flint to maintain local access.

A new multi-use path would be added between the new Hancock-Dixon crossing and Broadway at a grade of 5 percent or less to provide an additional travel route option for people walking and biking. The new multi-use path would follow existing N Flint alignment between N Hancock and N Broadway (see Figure 6, element “G”).

2.2.4.3 Clackamas Bicycle and Pedestrian Bridge

South of N/NE Weidler, a new pedestrian- and bicycle-only bridge over I-5 would be constructed to connect NE Clackamas Street near NE 2nd Avenue to the N Williams/ N Ramsay area (see Figure 6, element “H,” and Figure 8). The Clackamas bicycle and pedestrian bridge would offer a new connection over I-5 and would provide an alternative route for people walking or riding a bike through the Broadway/Weidler interchange.

Figure 8. Clackamas Bicycle and Pedestrian Crossing



2.2.4.4 Other Local Street, Bicycle, and Pedestrian Improvements

The Build Alternative would include new widened and well-lit sidewalks, Americans with Disabilities Act-accessible ramps, high visibility and marked crosswalks, widened and improved bicycle facilities, and stormwater management on the streets connected to the Broadway/Weidler interchange.[6]

A new two-way cycle track would be implemented on N Williams between N/NE Hancock and N/NE Broadway. A two-way cycle track would allow bicycle movement in both directions and would be physically separated from motor vehicle travel lanes and sidewalks. This two-way cycle track would connect to the median multi-use path on N Williams between N/NE Broadway and N/NE Weidler.

The bicycle lane on N Vancouver would also be upgraded between N Hancock and N Broadway, including a new bicycle jug-handle at the N Vancouver and N Broadway intersection to facilitate right-turn movements for bicycles from N Vancouver to N Broadway.

Existing bicycle facilities on N/NE Broadway and N/NE Weidler within the Project Area would also be upgraded, including replacing the existing bike lanes with wider, separated bicycle lanes. New bicycle and pedestrian connections would also be made between the N Flint/N Tillamook intersection and the new Hancock-Dixon connection.

These improvements would be in addition to the new Clackamas bicycle and pedestrian bridge, upgrades to bicycle and pedestrian facilities on the new Broadway/Weidler/Williams and Vancouver/Hancock highway covers, and new median multi-use path on N Williams between N/NE Broadway and N/NE Weidler described above and illustrated in Figure 6.

[6] Additional details on which streets are included are available at http://i5rosequarter.org/local-street-bicycle-and-pedestrian-facilities/

3 Regulatory Framework

3.1 FHWA and ODOT

This technical report has been prepared to meet the requirements of the Federal Highway Administration (FHWA) United States Code of Federal Regulations (CFR), Title 23, Part 772 (23 CFR 772) *Procedures for Abatement of Highway Traffic Noise and Construction Noise* and follows the requirements contained in the ODOT *Noise Manual* (ODOT 2011). All noise levels referred to in this report are stated as hourly equivalent sound pressure levels (L_{eq}) in terms of A-weighted decibels (dBA). The equivalent sound pressure level is defined as the average noise level, on an energy basis, for a stated period of time (hourly). Noise levels stated in terms of dBA approximate the response of the human ear by filtering out some of the noise in the low and high frequency ranges that the ear does not detect well. A-weighting is used in most environmental ordinances and standards.

The ODOT *Noise Manual* (2011) states that noise studies must be prepared for all federal-aid highway construction projects that involve constructing new highways or reconstructing existing highways by significantly changing either the horizontal or vertical alignment or by increasing the number of through travel lanes. Projects that include one or more of these elements are known as Type I projects. The Project is a Type I project because it would include the additions of auxiliary lanes and new ramp construction. All federal-aid highway noise analyses must be prepared in conformance with 23 CFR 772.

The federal noise standard (23 CFR 772) and the ODOT traffic noise policies contained within the ODOT *Noise Manual* (ODOT 2011) require that traffic noise impacts must be identified, and feasible and reasonable mitigation must be considered for traffic noise impacts for Type I projects. Pursuant to 23 CFR 772, noise impacts are considered to occur when traffic noise levels approach or exceed the FHWA noise abatement criteria (NAC) for specific land use types (as shown in Table 3), or when the predicted traffic noise levels substantially exceed the existing noise levels. ODOT is responsible for implementing the FHWA regulations in Oregon and considers a traffic noise impact to occur if predicted noise levels are 2 dBA less than the FHWA criteria. This accounts for the 2 dBA difference between the federal NAC and the state Noise Abatement Approach Criteria (NAAC) shown in Table 3. ODOT considers a 10 dBA increase over existing noise levels to be substantial. The NAAC are applied to the peak noise impact hour.

Table 3. Noise Impact Guidelines by Land Use (L_{eq} – dBA)

Land Use - Primary Activity Category	Activity Category $L_{eq(h)}$[1]		Evaluation Location	Land Use Activity Description[4]
	FHWA Noise Abatement Criteria	ODOT Noise Abatement Approach Criteria[2]		
A	57	55	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where preserving those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	67	65	Exterior	Residential.
C[3]	67	65	Exterior	Active sports 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.
D	52	50	Interior	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.
E[3]	72	70	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A–D or F.
F	-	-	-	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.
G	-	-	-	Undeveloped lands that are not permitted.

Source: ODOT 2011

Notes: dBA =A-weighted decibel; FHWA = Federal Highway Administration; L_{eq} = hourly equivalent sound pressure level; ODOT = Oregon Department of Transportation

[1] The $L_{eq(h)}$ Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.

[2] ODOT noise abatement “approach” criteria (or NAAC)

[3] Includes undeveloped lands permitted for this activity category.

[4] Project Area land uses are discussed in Section 4.5.

3.2 National Environmental Policy Act and 23 CFR 772

NEPA provides a regulatory framework that promotes the general welfare and fosters a healthy environment for noise considerations. FHWA regulation 23 CFR 772 and ODOT's *Noise Manual* (2011) provide the basis for analyzing and abating highway traffic noise impacts in Oregon.

For highway transportation projects with FHWA involvement, the Federal-Aid Highway Act of 1970 and the associated implementing regulations (23 CFR 772) govern the analysis and abatement of traffic noise impacts.

3.3 Oregon Department of Environmental Quality Noise Policy

The Oregon Department of Environmental Quality Chapter 340, Division 35, sets allowable noise levels for individual vehicles and industrial and commercial uses. Maximum allowable noise levels for in-use vehicles in Oregon are determined by vehicle type, operating conditions, and model year.

3.4 Local Noise Policy

The City of Portland has local noise regulations that are set forth in the City of Portland Code, Title 18, Noise Control (City of Portland 1997). The City code would not apply to operational noise from traffic on roadways in the vicinity of the Project but would apply to construction noise during the construction phase of the Project. For any construction work that occurs between 7:00 AM and 6:00 PM, the City of Portland Code section 18.10.060 allows construction noise levels of 85 dBA at 50 feet from the noise source. This standard does not apply to some equipment (trucks, pile drivers, pavement breakers, scrapers, concrete saws and rock drills).

From 6:00 PM to 7:00 AM the following morning, 6:00 PM Saturday to 7:00 AM the following Monday, and on legal holidays, the permissible sound levels of Section 18.10.010 of the City code apply to all construction activities except by variance or for reasons of emergency. The exempted equipment of Section 18.10.060, listed above, is not exempted during these hours. During these restricted periods, noise levels must meet the standards in Section 18.10.010 (Maximum Permissible Sound Levels–Land Use Zones) unless a variance to the standards has been granted. Assuming that roadway construction activities would be considered "industrial" in nature, the allowable noise levels at residential properties would be 60 dBA during nighttime hours (10:00 PM and 7:00 AM). Notwithstanding the sound levels in Section 18.10.010, the City code also states that no person shall cause or permit the operation of an impulsive noise source that has a peak sound pressure level in excess of 100 dB during daytime hours or 80 dB during nighttime hours.

3.5 Project Noise Abatement Requirements

Noise mitigation may be recommended for properties predicted to meet or exceed the ODOT NAAC under the Build Alternative or that are predicted to experience substantial increases in noise levels (more than 10 dBA over existing noise levels). For Type I projects, noise abatement measures must be considered for those developments that existed, or were permitted, prior to the date of public knowledge of the project and that are predicted to experience noise impacts.

FHWA and ODOT state that, at a minimum, noise abatement in the form of a noise barrier shall be considered. The ODOT *Noise Manual* (ODOT 2011) contains criteria for both feasibility and reasonableness to be used in analyzing noise abatement. Feasibility (or constructability) of an abatement measure includes acoustical and engineering factors. For abatement to be feasible, the FHWA requires that noise-impacted receptors achieve at least a 5 dBA reduction in noise levels. For abatement to be feasible, ODOT requires that a simple majority of impacted receptors achieve at least a 5 dBA reduction in noise levels.

ODOT also considers engineering factors such as safety, topography, drainage, utilities, and access issues when determining feasibility. Abatement must be able to be constructed using the American Association of State Highway Transportation Officials (AASHTO) Green Book (AASHTO 2004).

Architectural treatment for noise mitigation may be used for public or nonprofit institutional buildings such as schools, places of worship, libraries, and some commercial activities when a traffic noise impact has been identified. Providing ventilation, storm windows, or air conditioning for residences may be more cost effective than building a noise wall.

In assessing the reasonableness of noise abatement to meet minimum federal requirements, ODOT considers the viewpoints of the residents and property owners that benefit from the proposed abatement, the cost-effectiveness of the abatement measure, and the ODOT noise reduction design goal for abatement of at least one benefited receptor achieving a noise reduction of 7 dBA. All three criteria must be met to satisfy the reasonableness requirement. Assessment of the reasonableness criteria would be performed only after the proposed abatement has been determined feasible.

To determine cost effectiveness for residential areas, all benefited residences are considered in calculating a noise barrier's cost per residence. A benefited residence is any impacted or non-impacted residence that receives a noise reduction of 5 dBA or more. ODOT considers a reasonable cost to be a maximum of $25,000 per benefited residence. This cost is based on $20 per square foot for a post-and-panel sound barrier up to and including 16 feet tall. For wall heights 17 feet to 25 feet tall, the unit cost increases by 25 percent ($25 per square foot) to cover the additional structural considerations. Estimating costs for noise walls higher than 25 feet tall must be done on a case-by-case basis. These costs are based on post-and-panel sound barrier installation and do not include purchase of right of way (ROW), engineering studies, or potential utility moves.

Noise abatement measures for schools, parks, places of worship, and other nonresidential developments would consider the total abatement cost. To assess reasonable cost for nonresidential uses (Categories C, D, and E), ODOT uses a method that considers hours of use of the noise-impacted area relative to peak noise hour traffic, total hours of use per day, and number of persons benefiting from abatement. Appendix F of the ODOT *Noise Manual* details the calculations for assessing cost for Categories C, D, and E land uses in Oregon. This method evaluates the intensity of use of the facility and assigns a value to each user to determine cost reasonableness.

Noise walls are generally unable to achieve effective noise reductions when interrupted by driveways. Walls for single, isolated properties are not usually able to meet the ODOT minimum insertion loss goals while also meeting the cost-effectiveness criteria. In addition, noise mitigation is only provided for areas where frequent human use occurs and where a lowered noise level would be a benefit. Areas where noise mitigation is not normally recommended include areas such as parking lots, storage areas, industrial areas, or areas where people might pass through on a temporary basis but would be unlikely to spend significant amounts of time.

This report analyzes feasible and reasonable abatement for Project traffic noise impacts based on the criteria discussed above.

4 Methodology and Data Sources

4.1 Area of Potential Impact

The Area of Potential Impact (API) used to evaluate traffic noise was developed by applying a 500-foot buffer to the Project Area as defined in Figure 1 (see Appendix A for more detailed figures showing the API). The API captured the full extent of existing traffic behavior and associated noise levels near the proposed construction area during the traffic noise modeling process.

4.2 Resource Identification and Evaluation

Traffic noise receptors were selected based on their land use category, proximity and relative aspect to roadways affected by the Build Alternative, and/or the presence or absence of frequently used exterior areas. For residential properties, exterior areas closest to roadway ROW were used. Interior noise levels for land uses defined by NAC/NAAC Category D were predicted per FHWA's *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA 2011). A receiver can represent more than one land use. Each single land use represented by a receiver is referred to as a receptor.

Existing noise levels (year 2017) were monitored at six locations within the API for the purposes of validating the FHWA Traffic Noise Model (TNM) runs developed to evaluate traffic noise levels for the Project. Noise monitoring locations were selected in coordination with ODOT and are shown with the Existing/No-Build and Build roadway configurations on figures located in Appendix A. Noise monitoring was performed in accordance with the FHWA's *Measurement of Highway-Related Noise* guidance (FHWA 1996). Existing noise levels were measured using a Larson Davis LxT integrating sound level meter (ANSI Type I meter) that was calibrated before and after each monitoring event. At all monitoring sites, the sound level meters were located 15 feet or more from adjacent structures. Concurrent traffic counts were taken during the noise level monitoring. If monitored and modeled results are within 3 dBA, the model is considered to reasonably predict noise levels. The results of the model calibration show that modeled and measured noise levels agree within ±3 dBA. A comparison of the noise levels predicted using the noise model and noise levels measured in the field is shown in Table 4.

A full summary of field monitoring data sheets and site photos taken to document the location of each monitoring location are included in Appendix B. The calibration certificate for the sound level meter is included in Appendix C. Electronic files for the validation runs performed with FHWA's TNM are included in Appendix D.

Table 4. Noise Levels Monitored in the API (L_{eq} – dBA)

Monitoring Site	Land Use (Activity Category)	Distance to Nearest Major Roadway Centerline (Feet) [Roadway Name]	Monitored Noise Level (dBA)	TNM Predicted Noise Level (dBA)	Difference Between Monitored and TNM Predicted Noise Levels (dBA)
M1 – 1730 N Flint Street (approximately 175 feet north of facility)	Day care facility (C)	65 [I-5 SB off ramp to Broadway WB]	68.8	71.1	2.3
M2 – 2620 N Commercial Avenue	Outdoor use area at temporary housing (C)	265 [I-5 NB ramps to I-405 NB]	68.1	67.5	-0.6
M3 – 2107 N Vancouver Avenue	Single-family residence (B)	260 [Broadway on ramp to NB I-5]	62.9	62.4	-0.5
M4 – N Flint and Russell Avenue	Public park (C)	160 [I-5 NB]	69.2	70.5	1.3
M5 – 1734 NE 1st Avenue	Church (C)	200 [NE Broadway]	55.9	56.3	0.4
M6 – 2723 N Kerby Avenue	Single-family residence (B)	65 [I-5 northbound ramps to NB I-405]	73.1	73.1	0.0

Notes: API = Area of Potential Impact; dBA = A-weighted decibel; I-5 = Interstate 5; L_{eq} = hourly equivalent sound pressure level; NB = northbound; SB = southbound; TNM = Traffic Noise Model; WB = westbound

4.3 Assessment of Impacts

Traffic noise levels for this Project were calculated using FHWA's Traffic Noise Model (TNM® Version 2.5). TNM computes highway traffic noise at nearby receivers and aids in the design of mitigation measures. Inputs to the model include three-dimensional descriptions of road alignments, vehicle volumes in defined vehicle classes, vehicle speeds, traffic control devices, and data on the characteristics and locations of specific ground types, topographical features, and other features likely to influence the propagation of vehicle noise between the roadway and the receiver.

Traffic data inputs to the FHWA TNM used to model traffic noise levels were provided for year 2017 and 2045 by the ODOT Transportation Region 1 Traffic Division (ODOT 2017b) and are included in Appendix E. Traffic noise levels were modeled for the peak volume hour and the peak truck hour to determine the peak noise hour. The results of the analysis showed that the peak truck hour resulted in higher noise levels and so was modeled as the peak noise hour (Appendix E).

Special roadway features were incorporated into the TNM to represent specific elements of the Project that would affect noise transmission between vehicles and adjacent noise sensitive receptors. These features are included below:

- **Roadways on structure –** Roadways that are constructed as overcrossings of I-5 were modeled as aerial structures so that highway noise could pass unrestricted under the structures and prevent underestimation due to shielding of noise contributions at adjacent noise sensitive receptors.
- **Depressed highway sections –** Terrain lines were used to locate the top and bottom of slopes adjacent to sections of I-5 that are constructed below grade so that the effects of topographic shielding are incorporated into the noise predictions.
- **Tunnel effects –** The effects of the proposed Broadway/Weidler/Williams and N Vancouver/NE Hancock highway covers were incorporated into the model using the National Cooperative Highway Research Program (NCHRP) *Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM)* (NCHRP 2014) under the Build Alternative only. The NCHRP guidance provides a methodology for applying precalculated adjustments to the TNM-computed, A-weighted traffic noise levels to account for localized increases in noise levels experienced by receivers adjacent to tunnel openings. The NCHRP guidance indicates that the radiated noise from a tunnel opening is close to negligible at locations behind the tunnel opening or greater than 100 meters from the roadway centerline; therefore, those receivers were omitted from the tunnel effects analysis. According to the guidance, adjustment factors are determined based on the distance of the receiver from the roadway centerline and tunnel opening, the length of the tunnel and number of roadways modeled inside the tunnel (Table 5). The following Project elements were determined based on the proposed Build Alternative design and the NCHRP guidance to determine which receivers met the criteria for application of adjustment factors:
  - A-weighted traffic noise levels were modeled in TNM for receivers adjacent to tunnel opening using the same speeds, traffic volumes, and vehicle classification percentages used for traffic analysis modeling on the roadway inside and outside the tunnel.
  - Three roadways in each direction were modeled inside each tunnel, based on the Build Alternative roadway design files.
  - Highway cover lengths were based on roadway design files as measured between openings and exits. The N Vancouver/NE Hancock cover ranged between 83–128 meters (275–420 feet) in length and the Broadway/ Weidler/Williams cover was 171 meters (560 feet) in length. Tunnels greater than 60 meters are considered "long tunnels." Both the northern and southern tunnels would be considered "long" according to the NCHRP guidance.
  - Distances from the roadway centerline and the tunnel opening to a receiver were evaluated for those receivers adjacent to tunnel openings. Receivers located behind proposed tunnel walls or more than 100 meters from a tunnel opening did not meet the criteria for application of adjustment factors. Receivers R8, R9, R10, R11 and R19a–R19e met the applicable criteria;

therefore, a 1 dB increase in TNM-predicated noise levels for the build condition was applied to these receivers (Table 5).

Table 5. A-weighted Adjustments to add to TNM-calculated Noise Levels

Distance from Roadway Centerline (m)	Distance from Tunnel Opening (m)	Tunnel Effect (dBA) to be Added to TNM-Calculated Noise Levels			
		Single Lane (short tunnel)	Single Lane (long tunnel)	2+ Lanes (short tunnel)	2+ lanes (long tunnel)
10	1	0	1	0	1
	5	1	3	2	5
	10	1	3	2	4
	25	1	1	1	2
	50	0	0	0	1
	100	0	0	0	0
	300	0	0	0	0
25	1	0	0	0	0
	5	0	0	0	1
	10	0	1	1	2
	25	1	1	1	2
	50	0	1	0	1
	100	0	0	0	0
	300	0	0	0	0
50	1	0	0	0	0
	5	0	0	0	0
	10	0	0	0	0
	25	0	1	0	1
	50	0	1	0	1
	100	0	0	0	1
	300	0	0	0	0
100	1	0	0	0	0
	5	0	0	0	0
	10	0	0	0	0
	25	0	0	0	0
	50	0	0	0	1
	100	0	0	0	1
	300	0	0	0	0

Source: NCHRP 2014

Notes: dBA = A-weighted decibel; m = meter; TNM = Traffic Noise Model

Noise levels were modeled for the peak noise impact hour for existing conditions (year 2017) and the No-Build and Build Alternatives. The No-Build and Build Alternatives were modeled using traffic data for year 2045. Receptors evaluated during noise level modeling were selected based upon evidence of frequent human use of exterior areas present on site (i.e., back yards, balconies, break areas, playgrounds, etc.). Indoor use areas were modeled for schools, medical facilities, and medical housing. Most commercial properties within the API do not have outdoor human use areas; therefore, these parcels were not considered during noise impact evaluations. If two or more noise receptors were in close proximity and were expected to experience similar noise levels, one receiver representing multiple receptors was used during modeling.

4.3.1 Indoor Noise Levels

Indoor noise levels were calculated for Activity Category D land uses where those receptors do not have identified outdoor use areas. Within the API, Category D land uses include a school and several medical facilities. Table 6 of the *FHWA Highway Traffic Noise Analysis and Abatement Guidance* (2011) provides several reduction factors for use in estimating interior noise levels. For the Category D structures identified in the API for this Project, a 25 dBA reduction factor for masonry buildings with single-glazed windows was used based upon visual inspection of the buildings in the field.

The reduction factors presented in the FHWA document assume that windows would be closed almost every day of the year. This was assumed for the interior noise levels calculated for the receptors modeled for the following reasons:

- The walls of the Harriet Tubman Middle School that face I-5 have very few windows, and those that are located on the highway side of the building are either elevated (approximately 15 feet above the ground level) and appear to be designed to allow ambient light into the gymnasium or do not appear to be types that can be opened. This is likely due to the proximity to the highway and the ambient noise levels on this side of the building.
- The medical facilities that existing within the API are housed within modern buildings with HVAC systems that allow cooling without the need for opening windows. It is not uncommon for medical facilities to be fitted with fixed windows, and the ambient sound environment of the clinics would not be conducive to cooling using open windows.

A 25 dBA interior noise reduction factor was therefore used for Category D land uses to estimate the contribution of traffic noise inside these facilities. It should be noted, however, that typical noise levels in an office environment would be expected to be higher than predicted for Category D interior uses due to noise sources within the office. Typical professional office environments could be expected to have noise levels between 55 and 65 dBA.

4.4 Cumulative Impacts

The cumulative impacts analysis considered the Project's impacts combined with other past, present, and reasonably foreseeable future actions that would be environmental impacts in the API. A list of reasonably foreseeable future actions was developed through consultation with City and Metro Staff (Appendix F). This list included permitted public and private projects within the API and projects that are in the permit application process. The cumulative impact assessment qualitatively assessed the magnitude of impacts expected from reasonably foreseeable future actions in combination with anticipated Project impacts. This assessment also identified the contribution of the Project to overall cumulative impacts.

4.5 Land Use

Existing land uses in the API include commercial, employment, industrial, residential, and open space. Zoning maps for the API from City of Portland are shown in Appendix A (Figures 9.1 through 9.7).

Land in the northernmost portions of the API and from the I-5/I-405 interchange southward to N Russell is primarily zoned for industrial purposes. The western portion of the API from N Russell to just north of NE Broadway is also used for industrial purposes, while the eastern portion is zoned for industrial, residential, and commercial uses. Lillis Albina City Park, located south of N Russell and west of Flint, is designated open space (Figure 9.2). A relatively small portion of the API near and surrounding the Harriet Tubman Middle School on N Flint is zoned for high-density residential land use. Land use from NE Broadway south to the I-5/I-84 interchange is predominantly zoned for employment and commercial land use. The southernmost portions of the API are designated as commercial, industrial, and open space. No undeveloped land is present within the API. City of Portland overlays within the API include design (d), design scenic (ds), greenway (g), greenway scenic (gs), and scenic resource (s) zones.

ODOT consulted with the FHWA, the City of Portland, and Metro to consider planned and programmed projects within and surrounding the Project Area that would likely be implemented by 2045 (Appendix F). These jurisdictions should be consulted again during the final design phase of the Project to address any development that occurs between the date of this report and final design. Zoning in the Project Area is not expected to change in the foreseeable future. Local planning officials presume development in the area is imminent but consider future expansion unpredictable (City of Portland 2018a, 2018b).

5 Affected Environment

Following validation of the noise model, existing condition (2017) peak noise hour levels were modeled at 100 noise prediction sites (receivers):

- 146 outdoor use areas:
    - 7 single-family residences
    - 132 multifamily residential units
    - 3 outdoor use areas at medical facilities
    - 1 park
    - 1 active sport area
    - 1 church
    - 1 day care use
- 97 indoor use areas:
    - 96 medical facility and/or medical facility residential units
    - 1 school

Sound levels were predicted at 5 feet above ground level. Figures 10.1 through 10.7 located in Appendix A show the locations of the noise prediction sites (receivers) used in the existing and No-Build Alternative noise analysis.

Table 6 shows the predicted noise levels under the existing condition. Noise levels predicted to be in exceedance of the ODOT NAAC are shown in the dark gray shaded cells. The TNM model file for the existing condition is included in electronic format in Appendix D. The traffic data used in the analysis are included in Appendix E.

Existing noise levels (in dBA) predicted for the API ranged from 55 to 75 dBA for outdoor use areas and 34 to 49 dBA for interior areas.

Seventy-one receivers representing 116 residential receptors, 2 medical facility outdoor use areas, 1 park, and 1 day care outdoor use area are predicted to have noise levels that meet or exceed ODOT NAAC under existing conditions. Noise levels in exceedance of the Oregon NAAC under existing conditions are predicted throughout the API and occur predominantly east of the I-5 corridor.

Table 6. Predicted Peak Hour Sound Levels for the Existing Conditions (L_{eq} - dBA)

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2, 3]
R1-M6	B	Single-Family Residence	65	1	73
R2	C	Medical Facility Exterior	65	1	69
R3	C	Medical Facility Exterior	65	1	69
R4-M4	C	Park	65	1	72
R5	D	School Interior	50	1	49
R6	B	Single-Family Residence	65	1	64
R7	B	Single-Family Residence	65	2	61
R8	B	Residential Property	65	1	72
R9	B	Residential Property	65	1	72
R10	B	Residential Property	65	1	72
R11	B	Residential Property	65	1	72
R12	B	Residential Property	65	1	73
R13	B	Residential Property	65	1	74
R14a	B	Residential Property	65	1	69
R14b	B	Residential Property	65	1	72
R14c	B	Residential Property	65	1	72
R14d	B	Residential Property	65	1	72
R14e	B	Residential Property	65	1	72
R15	B	Single-Family Residence	65	3	57
R16-M5	C	Church	65	1	62
R17	C	Daycare	65	1	67
R18a	D	Medical Facility Interior	50	1	34
R18b	D	Medical Facility Interior	50	1	37
R19a	D	Medical Facility Interior	50	1	43
R19b	D	Medical Facility Interior	50	22	47
R19c	D	Medical Facility Interior	50	22	49
R19d	D	Medical Facility Interior	50	22	49
R19e	D	Medical Facility Interior	50	22	49
R20	C	Recreational Area	65	1	61
R21a	B	Residential Property	65	2	64
R21b	B	Residential Property	65	2	65
R21c	B	Residential Property	65	2	65
R21d	B	Residential Property	65	2	65
R21e	B	Residential Property	65	2	66

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2, 3]
R21f	B	Residential Property	65	2	66
R21g	B	Residential Property	65	2	66
R21h	B	Residential Property	65	2	67
R21i	B	Residential Property	65	2	67
R21j	B	Residential Property	65	2	67
R21k	B	Residential Property	65	2	68
R21l	B	Residential Property	65	2	68
R21m	B	Residential Property	65	2	68
R22a	B	Residential Property	65	2	64
R22b	B	Residential Property	65	2	65
R22c	B	Residential Property	65	2	65
R22d	B	Residential Property	65	2	66
R22e	B	Residential Property	65	2	66
R22f	B	Residential Property	65	2	66
R22g	B	Residential Property	65	2	67
R22h	B	Residential Property	65	2	67
R22i	B	Residential Property	65	2	67
R22j	B	Residential Property	65	2	68
R22k	B	Residential Property	65	2	68
R22l	B	Residential Property	65	2	68
R22m	B	Residential Property	65	2	68
R23a	B	Residential Property	65	2	64
R23b	B	Residential Property	65	2	65
R23c	B	Residential Property	65	2	65
R23d	B	Residential Property	65	2	66
R23e	B	Residential Property	65	2	66
R23f	B	Residential Property	65	2	66
R23g	B	Residential Property	65	2	67
R23h	B	Residential Property	65	2	67
R23i	B	Residential Property	65	2	67
R23j	B	Residential Property	65	2	68
R23k	B	Residential Property	65	2	68
R23l	B	Residential Property	65	2	68
R23m	B	Residential Property	65	2	68
R24a	B	Residential Property	65	2	64
R24b	B	Residential Property	65	2	65
R24c	B	Residential Property	65	2	66

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2, 3]
R24d	B	Residential Property	65	2	66
R24e	B	Residential Property	65	2	66
R24f	B	Residential Property	65	2	67
R24g	B	Residential Property	65	2	67
R24h	B	Residential Property	65	2	68
R24i	B	Residential Property	65	2	68
R24j	B	Residential Property	65	2	68
R24k	B	Residential Property	65	2	68
R24l	B	Residential Property	65	2	68
R24m	B	Residential Property	65	2	68
R25a	B	Residential Property	65	2	57
R25b	B	Residential Property	65	2	59
R25c	B	Residential Property	65	2	64
R25d	B	Residential Property	65	2	68
R26a	B	Residential Property	65	1	55
R26b	B	Residential Property	65	1	57
R26c	B	Residential Property	65	1	62
R26d	B	Residential Property	65	1	68
R27	C	Medical Facility Exterior	65	1	63
R28a	B	Residential Property	65	1	73
R28b	B	Residential Property	65	1	75
R28c	B	Residential Property	65	1	75
R28d	B	Residential Property	65	1	75
R28e	B	Residential Property	65	1	75
R29	D	Medical Facility Interior	50	1	47
R30a	D	Medical Facility Interior	50	1	45
R30b	D	Medical Facility Interior	50	1	46
R30c	D	Medical Facility Interior	50	1	46
R30d	D	Medical Facility Interior	50	1	46

Notes: dBA = A-weighted decibel; FHWA = Federal Highway Administration; L_{eq} = hourly equivalent sound pressure level; NAAC = Noise Abatement Approach Criteria; ODOT = Oregon Department of Transportation

[1] Receivers can represent multiple receptors for multiple-story buildings.

[2] Noise levels predicted to be in exceedance of the ODOT NAAC are shown in the dark gray shaded cells.

[3] Interior noise level predictions were calculated using a reduction factor of 25 dB per Table 6 of the *FHWA Highway Traffic Noise Analysis and Abatement Guidance* (FHWA 2011).

6 Environmental Consequences

6.1 No-Build Alternative

As described in Section 2.1, the No-Build Alternative consists of existing conditions and other planned and funded transportation improvement projects that would be completed in and around the Project Area by 2045.

6.1.1 Direct Impacts

Under the No-Build Alternative, the proposed I-5 mainline and Broadway/Weidler interchange area improvements would not be constructed, and the current road system would remain in place. Exceedances of the NAAC for the existing condition and No-Build Alternative are not considered to be "impacts" as defined in the ODOT *Noise Manual* (ODOT 2011).

The results for the No-Build analysis are shown in Table 7. Predicted noise levels that meet or exceed the ODOT NAAC are shown in dark gray shaded cells. Future No-Build noise levels range from 56 to 75 dBA for outdoor use areas and 34 to 49 dBA for interior areas.

Sixty-nine receivers representing 112 residential receivers, 2 medical facility outdoor use areas, 1 park, and 1 day care outdoor use area are predicted to have noise levels that meet or exceed ODOT NAAC under the No-Build Alternative (see Figures 10.1 through 10.7, Appendix A). Noise levels in exceedance of the Oregon NAAC under the No-Build Alternative are predicted throughout the API and occur predominantly east of the I-5 corridor. The No-Build noise levels range from 1 lower to 1 dBA higher than the existing noise levels. Traffic noise reduction for this alternative is attributed to projected changes in traffic distribution across the roadway network and changes in future traffic volumes in the No-Build Alternative.

The TNM model file for the No-Build Alternative is included in electronic format in Appendix D. The traffic data used in the analysis are included in Appendix E.

6.1.2 Indirect Impacts

Impacts identified in this report are direct impacts. The traffic data used in the noise analysis were developed by traffic engineers using assumptions about levels of future development in the region and capture the indirect or secondary effects that may result from the Project.

Table 7. Predicted Peak Hour Sound Levels for the Existing and Future Conditions (L_{eq} - dBA)

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2]	No-Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative (Year 2045) Noise Increase Over Existing Level (dBA)	Build Alternative (Year 2045) Noise Increase Over No-Build Level (dBA)
R1-M6	B	Single-Family Residence	65	1	73	73	73	0	0
R2	C	Medical Facility Exterior	65	1	69	69	70	1	1
R3	C	Medical Facility Exterior	65	1	69	69	69	0	0
R4-M4	C	Park	65	1	72	72	73	1	1
R5	D	School Interior	50	1	49	49	50	1	1
R6-M3	B	Single-family Residence	65	1	64	64	67	3	3
R7	B	Single-Family Residence	65	2	61	62	63	2	1
R8[4]	B	Residential Property	65	1	72	72	73	1	1
R9[4]	B	Residential Property	65	1	72	71	73	1	2
R10[4]	B	Residential Property	65	1	72	72	74	2	2
R11[4]	B	Residential Property	65	1	72	72	74	2	2
R12	B	Residential Property	65	1	73	73	74	1	1
R13	B	Residential Property	65	1	74	73	75	1	2

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2]	No-Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative (Year 2045) Noise Increase Over Existing Level (dBA)	Build Alternative (Year 2045) Noise Increase Over No-Build Level (dBA)
R14a	B	Residential Property	65	1	69	69	70	1	1
R14b	B	Residential Property	65	1	72	71	72	0	1
R14c	B	Residential Property	65	1	72	72	72	0	0
R14d	B	Residential Property	65	1	72	72	72	0	0
R14e	B	Residential Property	65	1	72	72	72	0	0
R15	B	Single-Family Residence	65	3	57	57	57	0	0
R16-M5	C	Church	65	1	62	61	62	0	1
R17	C	Daycare	65	1	67	67	66	-1	-1
R18a	D	Medical Facility Interior[3]	50	1	34	34	36	2	2
R18b	D	Medical Facility Interior[3]	50	1	37	37	38	1	1
R19a[4]	D	Medical Facility Interior[3]	50	1	43	43	46	3	3
R19b[4]	D	Medical Facility Interior[3]	50	22	47	47	49	2	2
R19c[4]	D	Medical Facility Interior[3]	50	22	49	48	50	1	2
R19d[4]	D	Medical Facility Interior[3]	50	22	49	49	50	1	1

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2]	No-Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative (Year 2045) Noise Increase Over Existing Level (dBA)	Build Alternative (Year 2045) Noise Increase Over No-Build Level (dBA)
R19e[4]	D	Medical Facility Interior[3]	50	22	49	49	50	1	1
R20	C	Recreational Area	65	1	61	61	62	1	1
R21a	B	Residential Property	65	2	64	64	64	0	0
R21b	B	Residential Property	65	2	65	65	65	0	0
R21c	B	Residential Property	65	2	65	65	65	0	0
R21d	B	Residential Property	65	2	65	65	66	1	1
R21e	B	Residential Property	65	2	66	66	66	0	0
R21f	B	Residential Property	65	2	66	66	66	0	0
R21g	B	Residential Property	65	2	66	66	67	1	1
R21h	B	Residential Property	65	2	67	67	67	0	0
R21i	B	Residential Property	65	2	67	67	67	0	0
R21j	B	Residential Property	65	2	67	67	67	0	0
R21k	B	Residential Property	65	2	68	68	68	0	0
R21l	B	Residential Property	65	2	68	68	68	0	0

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2]	No-Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative (Year 2045) Noise Increase Over Existing Level (dBA)	Build Alternative (Year 2045) Noise Increase Over No-Build Level (dBA)
R21m	B	Residential Property	65	2	68	68	68	0	0
R22a	B	Residential Property	65	2	64	64	64	0	0
R22b	B	Residential Property	65	2	65	65	65	0	0
R22c	B	Residential Property	65	2	65	65	66	1	1
R22d	B	Residential Property	65	2	66	65	66	0	0
R22e	B	Residential Property	65	2	66	66	66	0	0
R22f	B	Residential Property	65	2	66	66	67	1	1
R22g	B	Residential Property	65	2	67	67	67	0	0
R22h	B	Residential Property	65	2	67	67	67	0	0
R22i	B	Residential Property	65	2	67	67	67	0	0
R22j	B	Residential Property	65	2	68	67	68	0	1
R22k	B	Residential Property	65	2	68	68	68	0	0
R22l	B	Residential Property	65	2	68	68	68	0	0

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2]	No-Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative (Year 2045) Noise Increase Over Existing Level (dBA)	Build Alternative (Year 2045) Noise Increase Over No-Build Level (dBA)
R22m	B	Residential Property	65	2	68	68	68	0	0
R23a	B	Residential Property	65	2	64	64	64	0	0
R23b	B	Residential Property	65	2	65	64	65	0	1
R23c	B	Residential Property	65	2	65	65	66	1	1
R23d	B	Residential Property	65	2	66	66	66	0	0
R23e	B	Residential Property	65	2	66	66	66	0	0
R23f	B	Residential Property	65	2	66	66	67	1	1
R23g	B	Residential Property	65	2	67	67	67	0	0
R23h	B	Residential Property	65	2	67	67	67	0	0
R23i	B	Residential Property	65	2	67	67	68	1	1
R23j	B	Residential Property	65	2	68	67	68	0	1
R23k	B	Residential Property	65	2	68	68	68	0	0
R23l	B	Residential Property	65	2	68	68	68	0	0

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2]	No-Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative (Year 2045) Noise Increase Over Existing Level (dBA)	Build Alternative (Year 2045) Noise Increase Over No-Build Level (dBA)
R23m	B	Residential Property	65	2	68	68	68	0	0
R24a	B	Residential Property	65	2	64	63	64	0	0
R24b	B	Residential Property	65	2	65	64	65	0	1
R24c	B	Residential Property	65	2	66	65	66	0	1
R24d	B	Residential Property	65	2	66	66	66	0	0
R24e	B	Residential Property	65	2	66	66	66	0	0
R24f	B	Residential Property	65	2	67	67	67	0	0
R24g	B	Residential Property	65	2	67	67	68	1	1
R24h	B	Residential Property	65	2	68	67	68	0	1
R24i	B	Residential Property	65	2	68	68	68	0	0
R24j	B	Residential Property	65	2	68	68	68	0	0
R24k	B	Residential Property	65	2	68	68	68	0	0
R24l	B	Residential Property	65	2	68	68	68	0	0

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2]	No-Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative (Year 2045) Noise Increase Over Existing Level (dBA)	Build Alternative (Year 2045) Noise Increase Over No-Build Level (dBA)
R24m	B	Residential Property	65	2	68	68	68	0	0
R25a	B	Residential Property	65	2	57	55	58	1	1
R25b	B	Residential Property	65	2	59	59	60	1	1
R25c	B	Residential Property	65	2	64	64	64	0	0
R25d	B	Residential Property	65	2	68	68	68	0	0
R26a	B	Residential Property	65	1	55	56	55	0	-1
R26b	B	Residential Property	65	1	57	58	58	1	0
R26c	B	Residential Property	65	1	62	62	62	0	0
R26d	B	Residential Property	65	1	68	67	68	0	1
R27	C	Medical Facility	65	1	63	64	64	1	0
R28a	B	Residential Property	65	1	73	74	75	2	1
R28b	B	Residential Property	65	1	75	75	76	1	1
R28c	B	Residential Property	65	1	75	75	76	1	1
R28d	B	Residential Property	65	1	75	75	75	0	0

Receiver (R)[1] - Monitoring Location	Activity Category	Current Land Use Designations	NAAC (dBA)	Number of Receptors	Existing Noise Levels: Year 2017 (dBA)[2]	No-Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative Noise Levels: Year 2045 (dBA)[2]	Build Alternative (Year 2045) Noise Increase Over Existing Level (dBA)	Build Alternative (Year 2045) Noise Increase Over No-Build Level (dBA)
R28e	B	Residential Property	65	1	75	75	75	0	0
R29	D	Medical Facility Interior	50	1	47	47	48	1	1
R30a	D	Medical Facility Interior	50	1	45	46	46	1	0
R30b	D	Medical Facility Interior	50	1	46	46	46	0	0
R30c	D	Medical Facility Interior	50	1	46	46	46	0	0
R30d	D	Medical Facility Interior	50	1	46	46	47	1	1

Notes: dBA = A-weighted decibel; FHWA = Federal Highway Administration; L_{eq} = hourly equivalent sound pressure level; NAAC = Noise Abatement Approach Criteria; NCHRP = National Cooperative Highway Research Program; ODOT = Oregon Department of Transportation; TNM = Traffic Noise Model

[1] Receivers can represent multiple receptors for multiple story buildings.

[2] Noise levels predicted to be in exceedance of the ODOT NAAC are shown in the dark gray shaded cells.

[3] Interior noise level predictions were calculated using a reduction factor of 25dB per Table 6 of the *FHWA Highway Traffic Noise Analysis and Abatement Guidance* (FHWA 2011).

[4] Precalculated adjustments were applied to the TNM-computed noise prediction to account for tunnel effects per the NCHRP *Supplemental Guidance of the Application of FHWA's Traffic Noise Model* (NCHRP 2014); see Table 5.

6.2 Build Alternative

Under the Build Alternative, the Project's proposed roadway, bicycle, and pedestrian improvements would be constructed, as described in Section 2.2.

6.2.1 Short-Term (Construction) Impacts

Construction noise for the Project would result from normal construction activities under the Build Alternative. Noise levels for these activities can be expected to range from approximately 70 to 100 dBA. These noise levels, although temporary in nature, can be disturbing, and ODOT specifications would be followed to help minimize high noise levels during construction.

Construction equipment noise levels are usually measured at 50 feet from the source, and some typical levels are listed in Table 8. Construction equipment noise levels decrease 6 dBA per doubling of distance because of geometric divergence alone, provided there is a clear line of sight to the equipment. For example, a bulldozer creating 80 dBA of noise at 50 feet would have an observed value of 74 dBA at 100 feet and 68 dBA at 200 feet.

Table 8. Typical Construction Equipment Noise (dBA)

Types of Activities	Types of Equipment	Range of Noise Levels at 50 Feet
Materials Handling	Concrete mixers	75-87
	Concrete pumps	81-83
	Cranes (movable)	76-87
	Cranes (derrick)	86-88
Stationary Equipment	Pumps	69-71
	Generators	71-82
	Compressors	74-87
Impact Equipment	Pneumatic wrenches	83-88
	Rock drills	81-98
Land Clearing	Bulldozer	77-96
	Dump truck	82-94
Grading	Scraper	80-93
	Bulldozer	77-96
Paving	Paver	86-88
	Dump truck	82-94

Source: U.S. Environmental Protection Agency 1971
Notes: dBA = A-weighted decibel

Using ODOT standard specifications and best management practices for control of noise sources during construction can minimize construction impacts. The noise control specifications are described in Section 7.1.

6.2.2 Long-Term and Operational Direct Impacts

The results of the TNM analysis presented in this technical report are direct impacts for the Build Alternative.

The results for the Build Alternative analysis are shown in Table 7. Predicted noise levels that meet or exceed the ODOT NAAC are shown in dark gray shaded cells. Under the Build Alternative, noise levels range from 56 to 76 dBA for outdoor use areas and 36 to 51 dBA for interior areas.

Seventy-six receivers representing 117 residential receptors, 66 indoor receptors at medical facilities, 1 school indoor receptor, 2 medical facility outdoor use areas, 1 park, and 1 day care outdoor use area are predicted to meet or exceed ODOT NAAC for this alternative (Appendix A, Figures 11.1 through 11.7). Noise levels in exceedance of the Oregon NAAC under the Build Alternative are predicted throughout the API and occur predominantly east of the I-5 corridor.

Build Alternative noise levels are predicted to change when compared to existing noise levels by between a reduction of 1 dBA to an increase of 3 dBA. No substantial increases of 10 dBA or more are predicted.

Build Alternative noise levels are predicted to change when compared to No-Build Alternative noise levels by between a reduction of 1 dBA to an increase of 3 dBA. Noise reductions predicted near R17 are due to the decommissioning of N Flint proposed in the Build Alternative.

The TNM model file for the Build Alternative is included in electronic format in Appendix D. The traffic data used in the analysis are included in Appendix E.

6.2.3 Long-Term and Operational Indirect Impacts

Impacts identified in this report are direct impacts. The traffic data used in the noise analysis were developed by traffic engineers using assumptions about levels of future development in the region and capture the indirect or secondary effects that may result from the Project.

6.3 Cumulative Impacts

Cumulative impacts are those environmental effects that result from the incremental effect of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes those other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

The analysis of cumulative impacts involves a series of steps conducted in the following order:

- Identify the resource topics that could potentially experience direct or indirect impacts from construction and operation of the proposed project.
- Define the geographic area (spatial boundary) within which cumulative impacts will be assessed, as well as the timeframe (temporal boundary) over which other past, present, and reasonably foreseeable future actions will be considered.
- Describe the current status or condition of the resource being analyzed, as well as its historical condition (prior to any notable change) and indicate whether the status or condition of the resource is improving, stable, or in decline.
- Identify other actions or projects that are reasonably likely to occur within the area of potential impact during the established timeframe and assess whether they could positively or negatively affect the resource being analyzed.
- Describe the combined effect on the resource being analyzed when the direct and indirect impacts of the project are combined with the impacts of other actions or projects assumed to occur within the same geographic area during the established time frame.

6.3.1 Spatial and Temporal Boundaries

The geographic area used for the cumulative impact analysis is the same as the API described in Section 4.1 and shown on the figures in Appendix A. The time frame for the cumulative impact analysis extends from the beginning of large-scale urban development in and around the Project Area to 2045, the horizon year for the analysis of transportation system changes.

6.3.2 Past, Present, and Reasonably Foreseeable Future Actions

The past, present, and reasonably foreseeable future actions that were considered in assessing cumulative effects are described in the following subsections.

6.3.2.1 Past Actions

Past actions include the following:

- Neighborhood and community development
    - Historical development of Portland area and accompanying changes in land use
    - Development of local transportation system (including roads, bicycle and pedestrian facilities, and bus transit)
    - Utilities (water, sewer, electric, and telecommunications)
    - Parks, trails, bikeways
- Commercial and residential development in and around the Project Area
    - Veterans Memorial Coliseum (1960)
    - Lloyd Center (1960)

    - Legacy Emanuel Medical Center (1970)
    - Oregon Convention Center (1990)
    - Rose Garden (1995)
- Regional transportation system development
    - Marine terminal facilities on the Willamette River
        - Port of Portland (1892)
        - Commission of Public Docks (1910)
        - Port of Portland (1970; consolidation of Port of Portland and Commission of Public Docks)
    - Freight rail lines (late 1800s and early 1900s)
    - Highways
        - I-84 (1963)
        - I-5 (1966)
        - I-405 (1973)
    - Rail transit system
        - MAX light rail (1986)
        - Portland Streetcar (2001)

6.3.2.2 Present Actions

Present actions include the ongoing operation and maintenance of existing infrastructure and land uses, including the following:

- Ongoing safety improvements for bicycles and pedestrians
- Local and regional transportation system maintenance
- Utility maintenance

6.3.2.3 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions were identified collaboratively with the City of Portland and consist of redevelopment of existing urban areas in the Project Area and vicinity, and ongoing maintenance and development of existing urban infrastructure in the Project Area and vicinity.

These actions include private redevelopment, public development, and infrastructure projects, as well as combined public/private redevelopments. Specific projects and the plans identifying them are described in detail in the memorandum presented in Appendix F. Given the highly developed nature of the Project Area and vicinity, the reasonably foreseeable future actions are not expected to substantially change the types or intensities of existing land uses.

6.3.3 Results of Cumulative Impacts Analysis

Changes in the distribution of vehicle trips in the API would occur in conjunction with incremental annual traffic volume growth over time that would occur regardless of the Project. Changes in localized vehicle noise would occur in the context of the broader noise environment and would be cumulative relative to other changes that may occur. The general noise environment in the API includes noise sources such as the interstate and local roadways in the area, light industrial and commercial activities in the area, as well as residential development that has occurred.

6.4 Conclusion

Noise level predictions for the Build Alternative were between 56 to 76 dBA for outdoor use areas and 36 to 51 dBA for interior areas. Seventy-six receivers were predicted to meet or exceed the ODOT NAAC for this alternative, compared to sixty-nine receivers under the No-Build Alternative. These seventy-six receivers represent 117 residential receptors, 66 medical facility indoor use areas, 1 school indoor use area, 2 medical facility outdoor use areas, 1 park, and 1 day care outdoor use area.

Compared to existing conditions, noise levels under the Build Alternative are predicted to decrease by up to 1 dBA or increase by up to 3 dBA. Compared to both existing conditions and the No-Build Alternative, noise levels are predicted to decrease under the Build Alternative near R17 due to the decommissioning of N Flint Avenue proposed in the Build Alternative. Compared to the No-Build Alternative, noise levels under the Build Alternative are predicted to decrease by up to 1 dBA or increase by up to 3 dBA. Per ODOT *Noise Manual* (ODOT 2011), ODOT considers a 10 dBA increase over existing noise levels to be substantial. Increases of 10 dBA were not predicted under the Build Alternative.

Noise mitigation was considered and evaluated for feasibility and reasonableness for properties predicted to meet or exceed the ODOT NAAC or where substantial increase in noise level (more than 10 dBA over existing noise levels) was predicted under the Build Alternative. Seven noise wall alignments were evaluated to mitigate predicted noise impacts within the Noise API.

Two of the seven noise walls were judged to be acoustically feasible by meeting the design goal of at least a 7 dBA reduction at one receiver, as well as achieving a better than 50% rate of benefits (at least a 5dBA noise reduction) at impacted receivers in the vicinity. In addition, both walls were found to be reasonable based upon the ODOT cost effectiveness requirements. These two walls were therefore recommended for further consideration. Further evaluation of feasibility and reasonableness will be made during final design, including a more detailed analysis of constructability, as well as the viewpoints of affected property owners and residents.

The other five walls were not able to achieve the required noise reductions at adjacent properties because of challenges with complex traffic noise sources or because elevation issues precluded the breaking of the line of sight between noise sources and receivers. As a result, these five walls were not recommended.

Temporary construction noise for the Project would result from normal construction activities. Noise levels for these activities could range from approximately 70 to 100 dBA at sites 50 feet from the activities.

7 Avoidance, Minimization, and Mitigation Measures

7.1 Construction Noise Mitigation

The following construction noise abatement measures, if applicable, may be included in the Project specifications:

- No construction would be performed within 1,000 feet of an occupied dwelling unit on Sundays, legal holidays, or between the hours of 10 PM and 6 AM on other days without the approval of the ODOT Construction Project Manager.
- All equipment used would have sound-control devices no less effective than those provided on the original equipment. No equipment would have unmuffled exhaust.
- All equipment would comply with pertinent equipment noise standards of the U.S. Environmental Protection Agency.

If a specific noise impact complaint were to occur during the construction of the Project, one or more of the following noise mitigation measures could be required at the Contractor's expense as directed by the ODOT Construction Project Manager:

- Locate stationary construction equipment as far from nearby noise-sensitive properties as feasible.
- Shut off idling equipment.
- Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
- Notify nearby residents whenever extremely noisy work will be occurring.
- Install temporary or portable acoustic barriers around stationary construction noise sources.
- Operate electric-powered equipment using line voltage power or solar power.

7.2 Operational Noise Mitigation

Noise mitigation must be considered and evaluated for feasibility and reasonableness for properties predicted to meet or exceed the ODOT NAAC or that are predicted to experience substantial increases in noise levels for the Build Alternative.

The following subsections describe the mitigation that was considered to reduce noise levels at impacted receivers under the Build Alternative. Initial recommendations on noise mitigation are provided but should be considered preliminary and non-binding. More detailed analysis of noise barrier placement and design would be needed prior to final design and construction to ensure that reasonable and feasible noise mitigation can be safely and effectively constructed.

Full details of the mitigation analysis, including figures depicting the locations of proposed mitigation features, are presented in Appendix G.

7.2.1 Wall 1: Receivers 1 through 3

Receivers 1 through 3 represent one single-family residence and two medical facility outdoor use areas located east of I-5 adjacent to N Kerby.

An 825-foot-long noise barrier located on the I-5 to I-405 ramp structure was evaluated to shield these receivers from highway noise. Appendix G provides a figure (Figure 12.1) showing the barrier location, and Table G1a provides detailed information related to predicted wall performance (i.e., noise reductions due to the barrier [feasibility] and cost-effectiveness calculations based on the number of receptors benefited [reasonableness]). Table G1a also presents feasibility and reasonableness data for several different wall heights between 10 and 16 feet that were evaluated as part of the mitigation analysis.

The results of the mitigation analysis show that Wall 1 was able to achieve the minimum noise reduction goals, including one property with a design goal noise reduction of more than 7 dBA (in this case 12 dBA at R1) plus one additional benefited property. However, the calculated cost of the mitigation ($90,750 per benefited receptor) exceeded the allowable $25,000 per benefited property.

The benefited medical facility outdoor area (R2; Activity Category C) was also evaluated using the methodology in Appendix F of the ODOT *Noise Manual* (ODOT 2011). This assessment methodology is used is used to determine if the cost of a barrier wall is reasonable for a noise-impacted special use area. In this case, the outdoor lawn area is fairly small, but it was conservatively assumed that up to 25 people could spend up to 2 hours a day in this area. The calculated cost (in $/person-hour/square feet) was calculated to be $1,250,000, which exceeds the allowable abatement cost factor of $518,758/ person-hour/square feet (see Table G1b in Appendix G). Therefore, a barrier in this location would not be considered reasonable and is not recommended.

Note that because of the limited number of noise sensitive receptors in this area, analyzing barrier heights greater than 16 feet would not increase the number of properties that would benefit from the noise barrier, thus reducing the cost per benefited property. Therefore, analyses for barriers greater than 16 feet in height were not performed at this location.

7.2.2 Wall 2: Receivers 4 through 6

Receivers 4 through 6 represent one park, one school (modeled as an internal noise receiver), and a single-family residence located east of I-5 adjacent to N Flint. Note that Wall 2 is located adjacent to Wall 3; both walls were modeled together in the mitigation analysis because noise reductions associated with one wall may be detectable at receptors shielded by another. Two walls were evaluated instead of one longer wall due to constructability issues related to constructing walls underneath existing overpasses adjacent to the NB I-5 shoulder. The breakpoint between Wall 2 and Wall 3 was modeled under the N Flint overpass over I-5.

Further, two different alignments for Wall 2 were evaluated (Wall 2a and Wall 2b). Wall 2a is a 1,150-foot-long noise barrier located immediately east of the edge of I-5 between N Russell and N Flint. Appendix G provides a figure (Figure 12.2) showing the barrier location, and Table G2a provides detailed information related to predicted wall performance (i.e., noise reductions due to the barrier [feasibility] and cost-effectiveness calculations based on the number of receptors benefited [reasonableness]). Table G2a also presents feasibility and reasonableness data for several different wall heights between 10 and 16 feet that were evaluated as part of the mitigation analysis.

The results of the mitigation analysis show that Wall 2a was not able to achieve the minimum noise reduction goals. This is primarily due to 1) elevation differences between the highway and the receivers in this area (which are up to 30 feet higher than the roadway) that preclude breaking the line of sight between the highway and the receivers, and 2) the distance of the receptors from the roadway in some cases (R6), which reduces the effective insertion loss of the wall. Therefore, a barrier in this location would not be considered feasible and is not recommended.

Wall 2b was modeled on the ODOT ROW line to take advantage of potentially higher base-of-wall elevations up the slope between the highway and the receptors. Moving the wall upslope, where possible, improves the chances of breaking the line of sight between the highway and the receivers, thereby improving wall performance. The ROW line in this area moves up and down the slope following the property lines; therefore, a taller wall was evaluated to assess what would be required to break the line of sight. Note that geotechnical information related to the slope is not currently available and may preclude the safe construction of a noise wall in this location. More detailed analysis of noise barrier placement and design would be needed prior to final design and construction to evaluate whether reasonable and feasible noise mitigation can be safely and effectively constructed.

Appendix G provides a figure (Figure 12.2) showing the Wall 2b location, and Table G2b provides detailed information related to predicted wall performance. Table G2b also presents feasibility and reasonableness data for several different wall heights between 17 and 23 feet that were evaluated as part of the mitigation analysis to break the line of sight between the highway and the receivers. The analysis showed that a 22-foot wall on the ROW line would provide the minimum noise reduction goal of at least 7 dBA at one benefited receptor and a 5 dBA benefit to a second receptor.

In order to assess reasonableness for a 22-foot wall in this location, a more detailed assessment of allowable costs was performed using the methodology in Appendix F of the ODOT *Noise Manual*. The methodology provides a quantitative approach for calculating reasonable costs for non-residential use areas. In this case, the analysis was performed using population and use data for the Harriet Tubman Middle School (R5) to assess reasonableness.

The analysis in Table G2c shows that on a per receiver basis, the wall meets the allowable reasonableness criteria. Therefore, a barrier in this location would be considered reasonable and is recommended.

7.2.3 Wall 3: Receivers 7 through 14e

Receivers 7 through 14e represent 2 single-family residences and 11 balconies at residential units in multi-family buildings located east of I-5 adjacent to N Vancouver. These properties are also located just to the northeast of the N Vancouver/NE Hancock highway cover, which is the northerly highway cover of the two proposed as part of the Project. Note that Wall 3 is located adjacent to Wall 2; both walls were modeled together in the mitigation analysis because noise reductions associated with one wall may be detectable at receptors shielded by another. Two walls were evaluated instead of one longer wall due to constructability issues related to constructing walls underneath existing overpasses adjacent to the NB I-5 shoulder. The breakpoint between Wall 2 and Wall 3 was modeled under the N Flint overpass over I-5.

A 975-foot-long noise barrier located immediately east of the edge of I-5 between N Flint and the northern edge of the highway cover was evaluated to shield these receivers from highway noise. Appendix G provides a figure (Figure 12.3) showing the barrier location, and Table G3 provides detailed information related to predicted wall performance. Table G3 also presents feasibility and reasonableness data for several different wall heights between 10 and 16 feet that were evaluated as part of the mitigation analysis.

The results of the mitigation analysis show that Wall 3 was not able to achieve the minimum noise reduction goals. This is primarily due to elevation differences between the highway and the receivers in this area that preclude breaking the line of sight between the highway and the receivers, combined with the distance from the roadway of the receptors in some cases (R7), which reduces the effective insertion loss of the wall. Receiver heights in this area range from 35 to 49 feet above the highway elevation; therefore, an analysis of barrier heights greater than 16 feet was not undertaken because walls would need to reach impractical heights before they were able to break the line of sight and provide meaningful noise reductions approaching those required in the ODOT *Noise Manual*.

A barrier in this location would not be considered feasible and is not recommended.

7.2.4 Wall 4: Receivers 20 through 30d

Receivers 20 through 30d represent 1 recreational area (a basketball court at the Crown Plaza hotel), 1 outdoor use area at a medical facility, 5 indoor uses, 104 balconies at residential units at the Calaroga Terrace building on the northeast corner of the intersection of NE Clackamas and NE 2nd, 12 balconies at residential units at a new mixed-use building constructed on the northeast corner of the intersection of NE Wasco Street and NE 2nd, and 5 balconies at residential units at the Milano Apartment Building located on the northeast corner of the intersection of NE Multnomah and NE 1st.

A 1,715-foot-long noise barrier located immediately east of the edge of I-5 between NE Weidler and a point approximately 265 feet south of NE Holladay was evaluated to shield receivers in this area. Appendix G provides a figure (Figures 12.4 and 12.5) showing the barrier location, and Table G4 provides detailed information related to predicted wall performance. Table G4 also presents feasibility and reasonableness data for several different wall heights between 10 and 23 feet that were evaluated as part of the mitigation analysis. Note that in Appendix G, Wall 4 iterations between 10 and 16 feet are described as Wall 4a, and Wall 4 iterations between 17 and 23 feet are described as Wall 4b because the range of wall heights evaluated required two separate runs in TNM.

The results of the mitigation analysis show that at a height of 23 feet, Wall 4 was able to achieve the minimum noise reduction goals outlined in the ODOT *Noise Manual*. The wall was also able to meet the reasonableness criteria for cost per benefited residence but failed to provide a benefit to the majority of impacted receivers due to the fact that many of the receivers modeled are apartments in high-rise buildings that cannot be shielded from highway noise because the wall is not tall enough to break the line of sight (see Tables G4a and G4b in Appendix G).

The ODOT *Noise Manual* discusses the evaluation of mitigation in such cases where impacts to upper floors cannot be mitigated due to limitations in wall height. ODOT states that

> On occasion, a building with more than one floor may be so located and the topography is such that mitigating traffic noise levels to an upper floor is possible by constructing a noise barrier of reasonable height. Mitigation **should not be excluded** [emphasis added] for ground-floor impacts merely because mitigation cannot be provided for upper-floor impact.

Therefore, a secondary analysis of impacts and benefits was undertaken to evaluate the performance of Wall 4 at lower elevations where there was a potential to provide traffic noise reductions.

An analysis of the data showed that a 23-foot wall generally provided benefits at impacted receivers up to the 6th floor of impacted buildings, although not all receivers up to the 6th floor level received the full 5 dBA required to be considered benefited in the reasonableness analysis. However, due to the elevation, no benefits were predicted at or above the 7th floor at any of the modeled receivers. The receivers included in the analysis at the 6th floor or below were Receivers 20, 21a-d, 22a-d, 23a-d, 24a-d, 25a-d, 26a-d, 27, 28a-e, 29, and 30a-d. When these lower floor receivers were considered as a discrete subset, Wall 4 was able to meet the feasibility and reasonableness criteria. Table G4c in Appendix G shows the modified analysis considering lower level receivers for mitigation.

Therefore, based on the analysis focused on providing noise mitigation to lower level receivers, a barrier in this location would be considered feasible and reasonable, and is recommended.

7.2.5 Wall 5: Receiver 17, Receiver 18a, and Receiver 18b

Receiver 17 represents the outdoor playground area of the day care facility located west of I-5 adjacent to N Flint. Receivers 18a and 18b represent indoor noise levels on the ground and first floor of the Compass Oncology medical facility on the northeast corner of N Dixon and N Wheeler.

A 475-foot-long noise barrier located immediately west of the edge of the SB I-5 off-ramp to NE Broadway that wraps around to the west at the top of the ramp just north of N Broadway was evaluated to shield these receivers from highway noise. Appendix G provides a figure (Figure 12.3) showing the barrier location, and Table G5 provides detailed information related to predicted wall performance. Table G5 also presents feasibility and reasonableness data for several different wall heights between 10 and 16 feet that were evaluated as part of the mitigation analysis.

The results of the mitigation analysis show that Wall 5 was not able to achieve the minimum noise reduction goals primarily due to the complex pattern of traffic noise sources and the effects of the noise emanating from the entry/exit opening of covered sections of highway adjacent to the property. In addition, Receivers 18a and 18b receive no benefit from the proposed wall due to a combination of their distance from the highway (approximately 500 feet) and the fact that they are third-row receivers already shielded by a four-story apartment building (the Paramount Apartments) directly adjacent to Receivers 18a and 18b, between these receivers and the highway. Therefore, because of the limited number of noise sensitive receptors in this area, analyzing barrier heights greater than 16 feet would not likely increase the number of properties that would benefit from the noise barrier, thus reducing the cost per benefited property. Therefore, analyses for barriers greater than 16 feet in height were not performed at this location.

A barrier in this location would not be considered feasible and is not recommended.

7.2.6 Wall 6: Receivers 19a through 19e

Receiver 19 represents 89 indoor medical receptors located on the ground through fourth floors of the Hooper Detox Stabilization Center on the southwest corner of N Weidler and N Williams.

A 655-foot-long noise barrier located immediately west of the edge of the SB I-5 on-ramp from N Weidler was evaluated to shield these receivers from highway noise. Appendix G provides a figure (Figure 12.4) showing the barrier location, and Table G6 provides detailed information related to predicted wall performance. Table G6 also presents feasibility and reasonableness data for several different wall heights between 10 and 16 feet that were evaluated as part of the mitigation analysis.

The results of the mitigation analysis show that Wall 6 was not able to achieve the minimum noise reduction goals primarily due to the complex pattern of traffic noise sources and the elevated position of the receivers compared to I-5 which is lower than the ground elevation at the facility. Walls in excess of 16 feet were not analyzed, as the results of the 16-foot wall analysis showed that no impacted receptors were benefited, and impacted receptors were still 2-4 dBA below the insertion loss required to be considered benefited.

Therefore, a barrier in this location would not be considered feasible and is not recommended.

7.2.7 Unavoidable Impacts Summary

Complex noise environment, topography, and the existence of many receivers above the ground floor make effective noise mitigation challenging within the API. Results of the noise barrier analyses summarized above indicate that the evaluated noise barriers do not meet ODOT's criteria for feasibility and/or reasonableness. As a result, exceedances of the ODOT NAAC at receivers representing 100 residential receptors, 69 indoor receptors at medical facilities, 2 medical facility outdoor use areas, and 1 day care outdoor use area are predicted to be unavoidable impacts under the Build Alternative.

7.2.8 Statement of Likelihood

Based on the noise technical report for this project, ODOT intends to install highway traffic noise abatement measures in the form of barriers immediately east of the edge of I-5 between N Russell and N Flint (Wall 2b) and immediately east of the edge of I-5 between NE Weidler and a point approximately 265 feet south of NE Holladay (Wall 4).

These two noise walls were judged to be acoustically feasible by meeting the design goal of at least a 7 dBA reduction at one receiver, as well as achieving a better than 50 percent rate of benefits (at least a 5 dBA noise reduction) at impacted receivers in the vicinity. In addition, both walls were found to be reasonable based upon the ODOT cost effectiveness requirements and were therefore recommended for further consideration. Further evaluation of feasibility and reasonableness will be made during final design, including a more detailed analysis of constructability and consideration of the viewpoints of affected property owners and residents.

The possibility of likely abatement measures is based upon preliminary design work for barriers costing approximately $484,440 (Wall 2b) and $788,900 (Wall 4). Wall 2b is predicted to reduce the noise level by up to 8 dBA at receivers associated with the park and school. Wall 4 is predicted to reduce the noise level by up to 10 dBA at 39 residences. If during ODOT's final design process these conditions have substantially changed, the abatement measures might not be provided. A final decision of the installation of the abatement measure(s) will be made upon completion of the Project's final design, a cost estimating process, constructability review, and the public involvement process.

8 Information for Local Officials

One ODOT *Noise Manual* (ODOT 2011) requirement is to supply information to local governments on existing and future noise levels so that the information can be used in guiding local land use decisions. The City of Portland and Metro should consider the information in this report regarding traffic noise levels within the Project Area. These jurisdictions should be consulted again during the final design phase of the Project to address any development that occurs between the date of this report and final design.

Table 9 provides information about noise levels that can be used to determine future land use suitability should redevelopment of existing land uses occur. Some land uses may not be compatible with the projected noise environment in the API unless noise is considered in the plans and designs for development of the properties. The FHWA and ODOT are not responsible for providing highway traffic noise abatement for development permitted after the Project has been approved by the FHWA.

8.1 Noise Contours for Activity Category G Land Uses

Some parcels within the Project Area are currently undeveloped (Activity Category G). To provide information to local officials on the suitability of these parcels for different types of future land uses under the 2045 Build Alternative, the distance from the centerline of major Project Area roadways to the impact threshold for Activity Category B, C and E land uses (as defined in Table 3) were predicted using a simplified two-dimensional TNM model run. The simplified TNM runs conservatively assume the roadway is a straight line and that there are no topographical effects to traffic noise propagation. Table 9 presents the distances to the NAAC thresholds.

It should be noted that the distances of noise impact contours for different land uses are guidelines only. More detailed noise analysis should be performed for specific future proposed developments.

Table 9: Predicted Distances to Activity Category B, C and E Noise Impact Thresholds

Roadway	Distance to Residential and Public Use (Activity Category B and C) NAAC Threshold (feet)	Distance to Commercial (Activity Category E) NAAC Threshold (feet)
Interstate 5	330	175

Source: HDR Engineering, Inc., July 2018

Notes: dBA = A-weighted decibel; NAAC = Noise Abatement Approach Criteria

Activity Category B and C NAAC is 65 dBA, and Activity Category E NAAC is 70 dBA.

The distances to the land use Category B and C NAAC contours were calculated at 330 feet from the centerline of I-5 through the Project Area. The distances to the Land Use Category E NAAC contours from the centerline of I-5 were calculated at 175 feet. This means that new residential or public use developments located within these distances would be traffic-noise impacted.

9 Contacts and Coordination

Coordination on noise analysis methodology and noise monitoring sites was conducted between the preparers and ODOT during the noise analysis preparation.

Coordination with individual landowners was also conducted prior to noise monitoring to obtain permission to measure noise on private property.

10 Preparers

Name	Discipline	Education	Years of Experience
Craig Milliken, HDR	Noise	B.A., Geography; M.S., Environmental Sciences	17
Jennifer Maze, HDR	Noise	B.S., Environmental Sciences	7

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