

FINAL



Transportation Safety Technical Report

I-5 Rose Quarter Improvement Project

Oregon Department of Transportation

January 8, 2019



I-5 ROSE QUARTER
IMPROVEMENT PROJECT



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¹ Appendix F 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

Acronyms and Abbreviations

AADT	average annual daily traffic
AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
API	Area of Potential Impact
APM	<i>Analysis Procedures Manual</i>
DMV	Department of Motor Vehicles
EB	eastbound
FHWA	Federal Highway Administration
ft/s ²	feet per second squared
HSIP	Highway Safety Improvement Program
HSM	<i>Highway Safety Manual</i>
I-405	Interstate 405
I-5	Interstate 5
I-84	Interstate 84
ISATe	Enhanced Interchange Safety Analysis Tool
IV	indicator value
mvmt	million vehicle miles travelled
NACTO	National Association of City Transportation Officials
NB	northbound
NEPA	National Environmental Policy Act
ODOT	Oregon Department of Transportation
OHP	Oregon Highway Plan
ORS	Oregon Revised Statute
OTP	Oregon Transportation Plan
PDO	Property Damage Only
RTP	<i>Regional Transportation Plan</i>
SAC	Stakeholder Advisory Committee
SB	southbound
SPIS	Safety Priority Index System
STIP	Statewide Transportation Improvement Program



TMA	Transportation Management Association
TSP	transportation system plan
vpd	vehicles per day
WB	westbound

Executive Summary

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 (the 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.

The purpose of the Project is to improve the safety and operations on I-5 between I-405 and I-84, the Broadway/Weidler interchange, and adjacent surface streets in the vicinity of the Broadway/Weidler interchange. The existing short weaving distances and lack of shoulders for crash/incident recovery in this segment of I-5 are physical factors that may contribute to the high number of crashes and safety problems. In achieving the purpose, the Project also would support improved local connectivity and multimodal access in the vicinity of the Broadway/Weidler interchange.

This report identifies existing and anticipated future transportation safety conditions, including long-term effects of the no action (No-Build) alternative and the long-term, short-term (construction), and cumulative effects of the proposed action (Build) alternative.

Between 2011 and 2015, there were 881 crashes on the highway and ramps in the Project Area of Potential Impact (API). The majority of the crashes were in the southbound (SB) direction, most frequently between 11:00 AM and 6:00 PM. During the study period, there was one fatal crash and eight other crashes resulting in serious injuries on the mainline and ramps combined in the Project Area. The fatal crash involved a pedestrian and occurred on SB I-5 just south of N Russell Street; the pedestrian was illegally in the roadway at 11:00 PM, and alcohol was flagged in the crash report. One of the serious injury crashes involved a pedestrian and occurred on the SB on-ramp from I-405 (SB-R2) and involved careless driving, speeding, and icy road conditions (no further narrative provided in the crash data). The other seven serious injury crashes involved motorized vehicles. The majority of crashes on the highway and ramps were property damage-only, rear-end collision crashes and were typically attributed to following too closely.

In the SB direction, the majority of the Project Area has existing crash rates exceeding the statewide average. In the northbound direction, the sections of I-5 between the I-84 on-ramp and NE Weidler Street off-ramp, and the Broadway on-ramp to the Greeley off-ramp also have crash rates exceeding the statewide average for comparable facilities.

There are top 5 percent and top 10 percent Safety Priority Index System sites located within the following segments of the highway:

- I-5 from approximately I-405 to approximately the N Broadway off-ramp and the N Williams (formerly NE Wheeler Avenue) on-ramp to I-84
- I-5 from just south of the I-84 on-ramp to NE Weidler off-ramp and from approximately the N Broadway on-ramp to approximately I-405

The largest safety benefit of the proposed Project results from upgrading shoulders to full standard on both sides of the highway. Additionally, the Project would substantially reduce emergency braking events, which would reduce the incidence of rapid deceleration that can result in rear-end crashes. It is also estimated that of the crashes that do occur, the severity distribution would be similar to the existing crash severity profile. Upon the year of opening, it is forecast that the Project would reduce crashes; however, changes in traffic patterns or volumes would affect the number of crashes, as the predictions are highly sensitive to traffic volume. It is estimated that the crash rate in the Build scenario would be lower than in the No-Build scenario, providing an overall safety benefit in the corridor.

There were 268 crashes on the local street network study intersections between 2011 and 2015; 18 of these crashes involved cyclists and two involved pedestrians. There were four crashes resulting in serious injuries. One of the serious injury crashes involved a pedestrian and occurred at the intersection of N Vancouver Avenue/N Weidler. The other three serious injury collisions occurred at the intersection of N Larrabee Avenue/N Hancock, one of which involved a cyclist and the other two involved motorists. The highest number of crashes occurred at the intersection of NE Victoria Avenue/NE Broadway. Turning movements were the most common collision type at the Project study intersections. Ranking intersections for crash conditions using the City of Portland method showed the intersection of NE Victoria/NE Broadway as having the greatest potential for safety improvement.

Proposed improvements to the local network include the following:

- Adding highway covers around Broadway/Weidler/Williams and N Vancouver/N Hancock to provide surface space for pedestrians and bicycles as well as additional community space
- Relocating the I-5 SB on-ramp to N Weidler to provide a more direct connection and improve safety and operations
- Modifying N Williams between N Ramsay Way and Weidler to close through-travel for private motor vehicles and revising traffic flow on N Williams between Weidler and Broadway to accommodate a median multi-use path
- Adding a new roadway crossing, including a multi-use path to connect N/NE Hancock to N Dixon
- Adding a new bicycle and pedestrian bridge south of N/NE Weidler (Clackamas bicycle and pedestrian bridge) to provide an alternative bike/pedestrian route away from the Broadway-Weidler interchange

- Additional Americans with Disabilities Act improvements and upgrades to pedestrian and bike facilities on the local road network
- Integrating guidance from the National Association of City Transportation Officials and other best practices for pedestrian and bicycle design into Project development and design

These improvements are expected to increase safety for all road users by providing safer connections for pedestrians and bicyclists, changing the character of the local road system (and therefore the behavior of drivers) by making the area more community-centric, reducing driver speeds, and simplifying ramp configurations.

Qualitative safety analysis rated the local intersections for exposure (i.e., number of people), complexity (i.e., user experience and familiarity with physical characteristics), and severity (i.e., posted speed limits). The Project may decrease the risk of crashes at the following intersections:

- **N Weidler/N Vancouver:** Expected decrease in bicycle crashes due to the proposed Clackamas bicycle and pedestrian bridge decreasing bicycle presence at this intersection (reduced exposure for bicyclists)
- **N Wheeler/N Williams (formerly NE Wheeler)/N Ramsay:** Expected decrease in motorized vehicle crashes due to ramp relocation/removal of fifth leg, which decreases traffic volumes (therefore reducing exposure for motorists) and decreases intersection complexity (improves user experience by making intersection configuration more familiar and easier to navigate)

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.

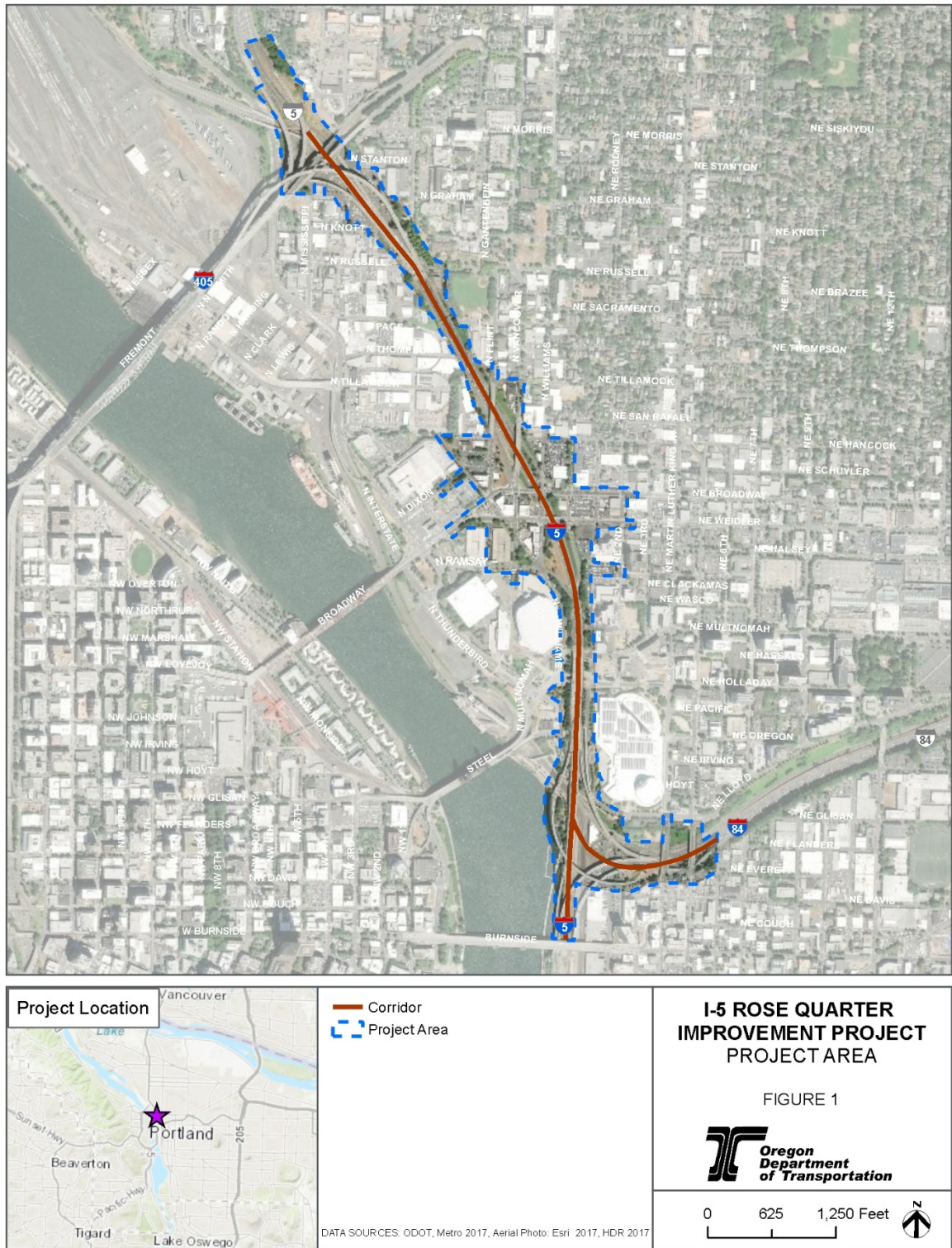
1.3 Project Need

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 crashes²) 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 2017), 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	<ul style="list-style-type: none"> I-84 N Broadway/N Williams Avenue 	<ul style="list-style-type: none"> NE Weidler Street/NE Victoria Avenue I-405 N Greeley Avenue
Southbound	<ul style="list-style-type: none"> N Greeley Avenue I-405 N Wheeler Avenue/N Ramsay Way 	<ul style="list-style-type: none"> 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* (RTP) 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.

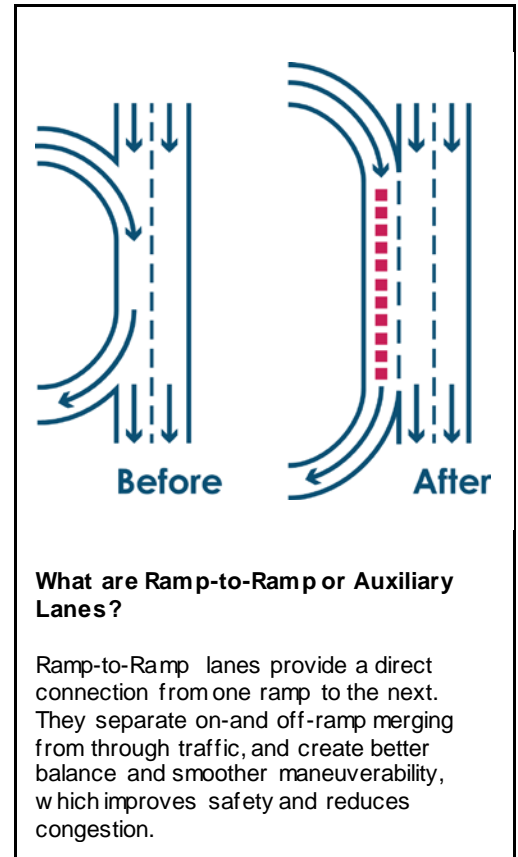
The Build Alternative includes I-5 mainline improvements and multimodal improvements to the surface street network in the vicinity of the Broadway/Weidler interchange. The proposed I-5 mainline improvements include the construction of auxiliary lanes (also referred to as ramp-to-ramp lanes) and full 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).

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

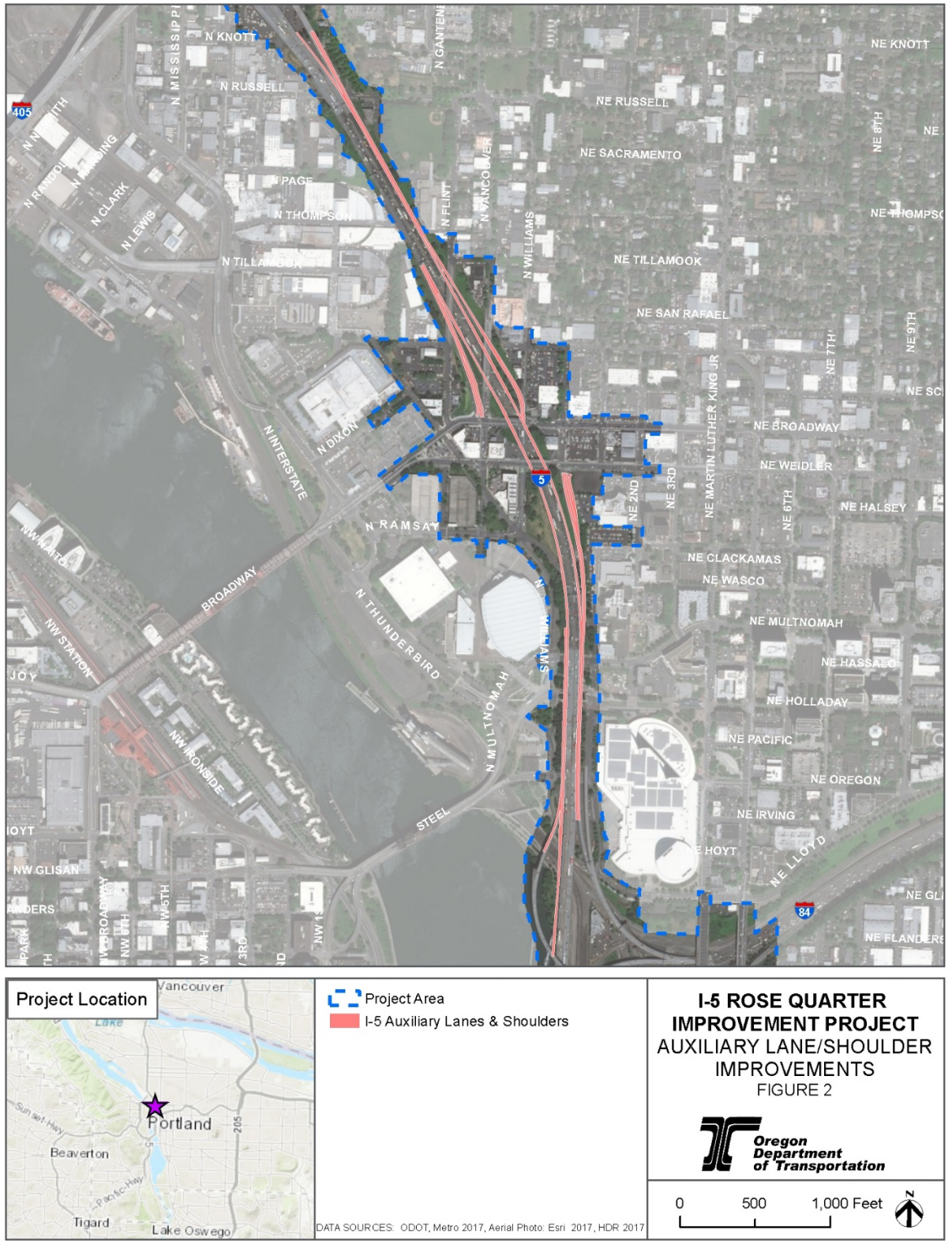


Figure 3. I-5 Auxiliary (Ramp-to-Ramp) Lanes – Existing Conditions and Proposed Improvements

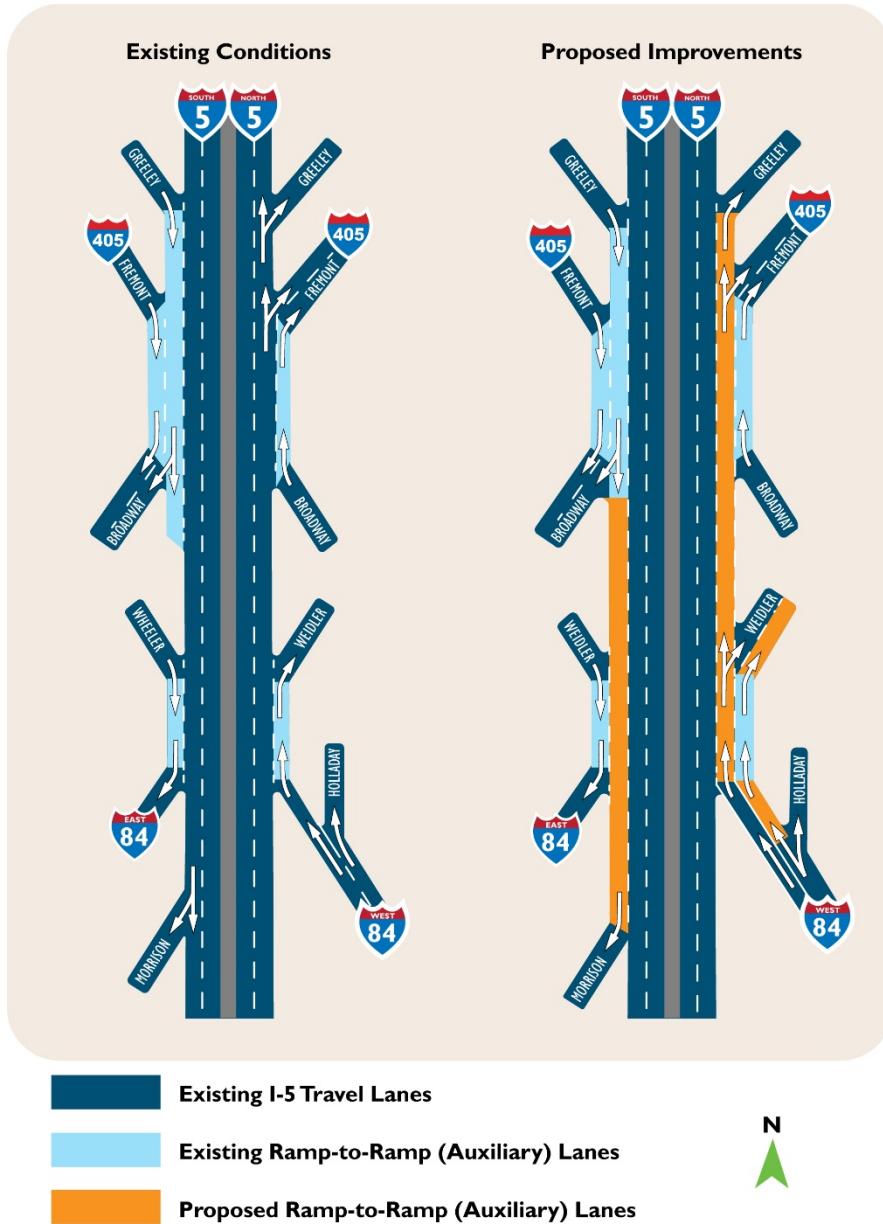
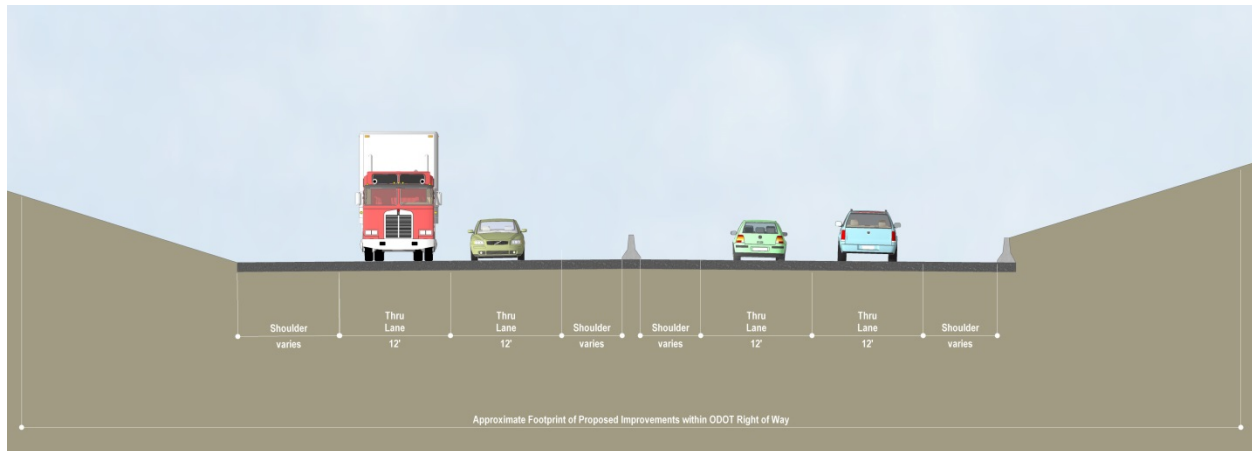
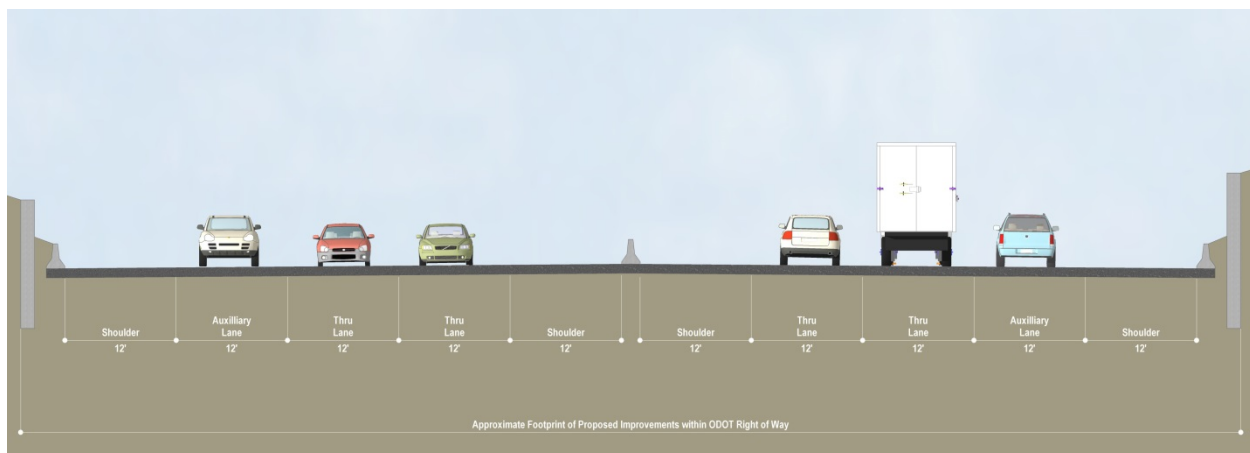


Figure 4. I-5 Cross Section (N/NE Weidler Overcrossing) – Existing Conditions and Proposed Improvements



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.

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



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.

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

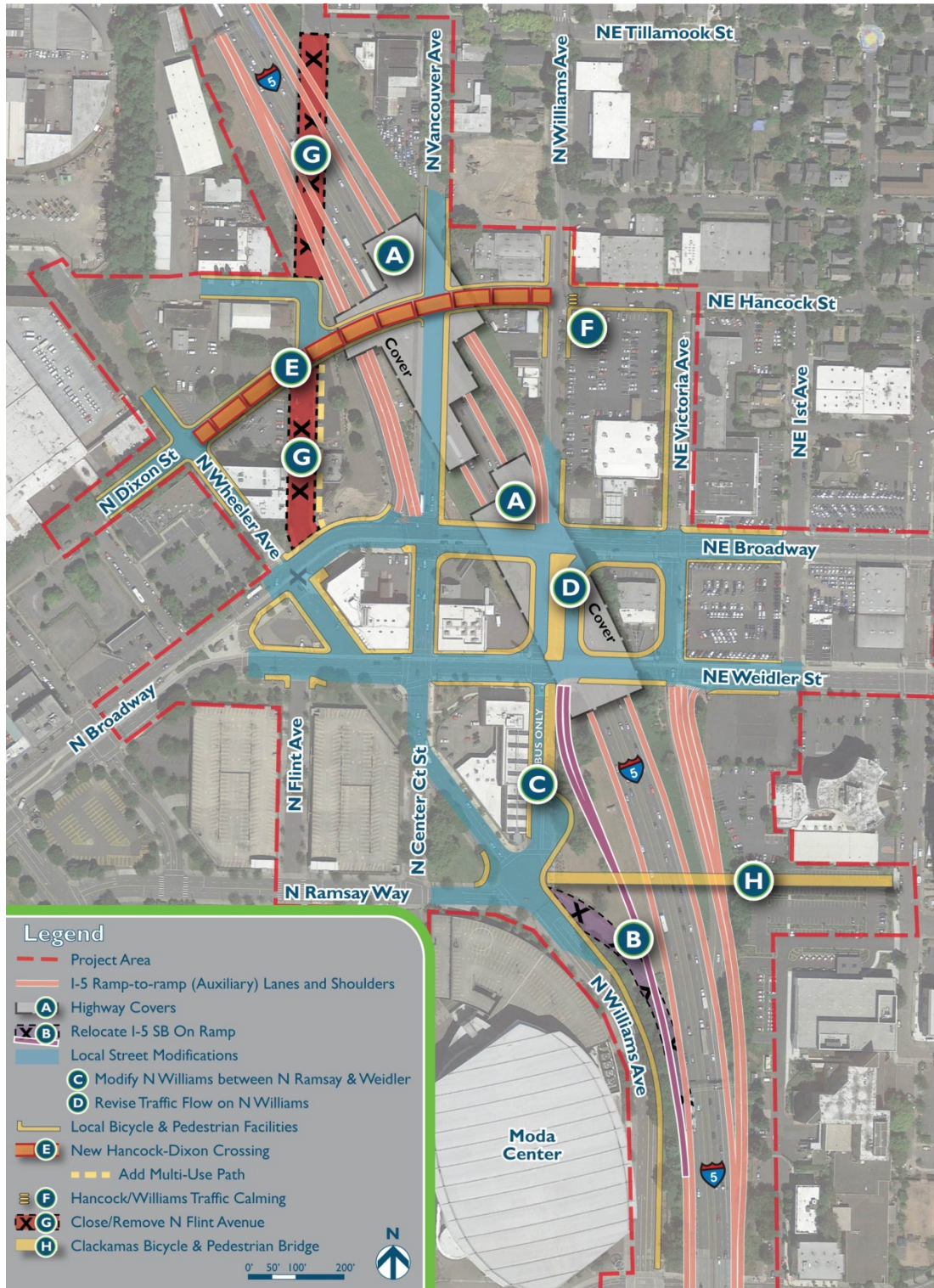


Figure 7. Conceptual Illustration of Proposed N Williams Multi-Use Path and Revised Traffic Flow



The revised NWilliams 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

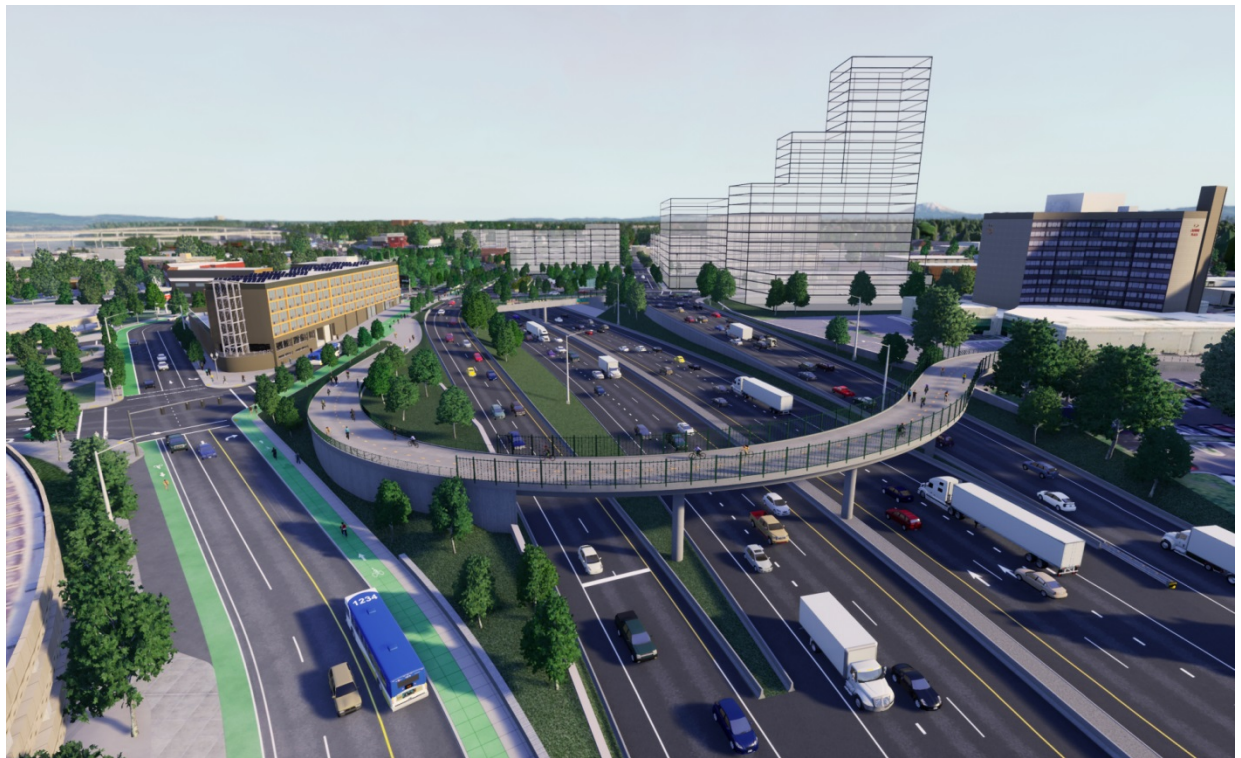
The existing N Flint structure over I-5 would be removed, and N Flint south of N Russell Street would terminate at and connect directly to N Tillamook (see Figure 6, element “G”). The portion of Flint between the existing I-5 overcrossing and Broadway would be closed as a through street for motor vehicles.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

Federal, state, regional, and local plans and policies have been established that guide the development of transportation projects. Some of these plans and policies relate to the design and operation of the Project. The *Land Use Technical Report* (ODOT 2019a) includes detailed descriptions of the most applicable regulatory documents (i.e., Oregon Statewide Planning Program, Transportation Planning Rule, Metro's RTP, and City of Portland Comprehensive Plan). Additional planning and policy documents that are directly related to implementing a transportation project in this location are described below.

3.1 Federal Plans and Policies

3.1.1 ADA Guide

The ADA Guidelines contains scoping and technical requirements for accessibility to buildings and facilities by individuals with disabilities under the ADA of 1990. These scoping and technical requirements are to be applied during the design, construction, and alteration of buildings and facilities to ensure accessibility and usability to individuals with disabilities. The 2010 ADA Standards for Accessible Design, dated September 15, are the most recent guidelines (U.S. Department of Justice 2010).

3.1.2 Federal Highway Administration (FHWA) Bicycle and Pedestrian Guides

The purpose of FHWA guidance is to describe federal legislative and policy direction related to safety and accommodation for bicycling and walking. The Intermodal Surface Transportation Efficiency Act of 1991 enacted significant changes to federal transportation policy and programs that expanded consideration of and eligibility for funding bicycle and pedestrian improvements. The Transportation Equity Act for the 21st Century ([TEA-21](#)) in 1998 and the Safe Accountable, Flexible, Efficient Transportation Equity Act: a Legacy for Users ([SAFETEA-LU](#)) in 2005 continued these provisions. The Moving Ahead for Progress in the 21st Century Act ([MAP-21](#)) of 2012 enacted some program and funding changes but continued broad consideration and eligibility for bicycling and walking. Bicycle and pedestrian design standards are included in the American Association of State Highway and Transportation Officials (AASHTO) guidance document *A Policy on Geometric Design of Highways and Streets – 2011* (AASHTO 2011) and in the ODOT 2012 *Highway Design Manual* (ODOT 2012b).

3.2 State Laws, Plans, and Policies

3.2.1 Oregon Transportation Plan

The 2006 Oregon Transportation Plan (OTP) is the state's long-range multimodal transportation plan (ODOT 2007). The OTP is the overarching policy document

among a series of plans that together form the state transportation system plan (TSP). The OTP considers all modes of Oregon's transportation system as a single system and addresses the future needs of Oregon's airports, bicycle and pedestrian facilities, highways and roadways, pipelines, ports and waterway facilities, public transportation, and railroads. It assesses state, regional, and local public and private transportation facilities. The OTP establishes goals, policies, strategies, and initiatives that address the core challenges and opportunities facing Oregon. The OTP provides the framework for prioritizing transportation improvements based on varied future revenue conditions, but it does not identify specific projects for development.

3.2.2 Oregon Highway Plan

The 1999 Oregon Highway Plan (OHP; ODOT 1999) defines policies and investment strategies for Oregon's state highway system for the next 20 years. It further refines the goals and policies of the OTP and is part of Oregon's TSP. The OHP has three main elements (the Vision, the Policy Element, the System Element):

- The Vision presents a vision for the future of the state highway system, describes economic and demographic trends in Oregon and future transportation technologies, summarizes the policy and legal context of the OHP, and contains information on the current highway system.
- The Policy Element contains goals, policies, and actions in five policy areas: system definition, system management, access management, travel alternatives, and environmental and scenic resources.
- The System Element contains an analysis of state highway needs, revenue forecasts, descriptions of investment policies and strategies, an implementation strategy, and performance measures.

3.2.3 ODOT Highway Design Manual

The ODOT 2012 *Highway Design Manual* (ODOT 2012b) provides uniform highway design standards and procedures for ODOT. It is intended to provide guidance for the design of new construction; major reconstruction (4R); resurfacing, restoration, and rehabilitation (3R); or resurfacing (1R) projects. The manual is used for all projects that are located on the state highways and by all ODOT personnel for planning studies and project development. The flexibility contained in the manual supports the use of Practical Design concepts and Context Sensitive Design practices.

The manual conforms to the AASHTO document *A Policy on Geometric Design of Highways and Streets - 2011* (AASHTO 2011). National Highway System or federal-aid projects on roadways that are under the jurisdiction of cities or counties will typically use the AASHTO design standards or ODOT 3R design standards. State and local planners will also use the manual in determining design requirements as they relate to the state highways in TSPs, Corridor Plans, and Refinement Plans.

3.2.4 ODOT Pedestrian and Bicycle Safety Implementation Plan

The ODOT 2014 *Pedestrian and Bicycle Safety Implementation Plan* (ODOT 2014a) provides guidance for implementing Oregon's Transportation Safety Action Plan, which "identifies corridors with the most potential for reducing frequency and severity of pedestrian and bicycle crashes" (ODOT 2014a). The Implementation Plan does not identify specific projects but identifies priority locations and offers countermeasure options. The Implementation Plan:

- "Prioritizes state highway corridors with the highest risk of a pedestrian or bicycle crash;
- Identifies risk factors present on local roadways associated with pedestrian or bicycle crashes;
- Prioritizes state and non-state roadway corridors based on reported pedestrian or bicycle crash frequency and/or severity;
- Identifies a toolbox of countermeasures expected to have the greatest potential to reduce frequency and/or severity of pedestrian or bicycle crashes; and
- Lays the framework for efficient development of corridor projects based on site-specific evaluations by ODOT Regions and local agencies."

3.2.5 Division 51: Access Management Rules

Division 51 establishes procedures, standards, and approval criteria used by ODOT to govern highway approach permitting and access management consistent with Oregon Revised Statutes (ORS), Oregon Administrative Rules, statewide planning goals, acknowledged comprehensive plans, and the OHP. The intent of Division 51 is to provide a highway access management system based on objective standards that balance the economic development objectives of properties abutting state highways with the transportation safety and access management objectives in a manner consistent with local TSPs and the land uses permitted in local comprehensive plan(s) acknowledged under ORS Chapter 197.

3.3 Regional and Local Plans

3.3.1 TriMet Plans

TriMet has adopted service enhancement plans for various portions of the metropolitan area. The North/Central Service Enhancement Plan encompasses the Area of Potential Impact (API) for this Project (TriMet 2016). Service enhancements included in the plan for this area include extended service hours for Line 4 Division/Fessenden and a new bus route connecting the Parkrose/Sumner Transit Center to downtown via NE Prescott Street, NE Alberta Street, and NE Martin Luther King Jr. Boulevard to the Rose Quarter Transit Center and the Steel Bridge.

TriMet is currently considering long-term plans for the Steel Bridge, including consideration of a new transit-only crossing, as well as the long-term layout and

function of the Rose Quarter Transit Center. No final documents or policy decisions have been made regarding these opportunities.

3.3.2 City of Portland Transportation System Plan and Modal Plans

The City of Portland TSP, which is necessary to meet state and regional planning requirements, was updated in 2018 (City of Portland 2018). The TSP is an element of the City's Comprehensive Plan, and it contains several modal plans including bicycle, pedestrian, and freight, as well as neighborhood area plans and street plans. Transportation projects included in the TSP that are in or adjacent to the Project Area include streetcar turnarounds at NE Grand Avenue and NE Weidler and at NE Grand and NE Oregon Street, new traffic signals along NE Grand and NE Martin Luther King Jr. Boulevard, a new bicycle and pedestrian bridge across I-84 in the vicinity of NE 7th, redesign of the Rose Quarter Transit Center, and a multi-use pathway along the east bank of the Willamette River north of the Steel Bridge.

3.3.3 Go Lloyd

Go Lloyd was founded in 1994 as the Lloyd District Transportation Management Association (TMA). TMAs are public/private partnerships formed so that employers, developers, building owners, and government entities can work collectively to establish policies, programs, and services to address local transportation issues and foster economic development. Go Lloyd is managed by a board of directors and works closely with local government agencies, non-profits, and business to promote transportation and economic development improvements for Lloyd.

Go Lloyd tracks transportation activities and plans in the district and prepares an annual report that includes results of the Employee Commute Choice Survey. Survey results are used to report on transportation mode split to the district and help to measure the effectiveness of various programs. Go Lloyd does not adopt specific plans and policies but has worked closely with the City of Portland on the N/NE Quadrant Plan as part of the Central City Plan and Comprehensive Plan updates.

3.4 Other Relevant Guidance

3.4.1 American Association of State Highway and Transportation Officials (AASHTO)

AASHTO is a standards-setting body that publishes specifications, test protocols, and guidelines, which are used in highway design and construction throughout the United States. AASHTO sets transportation standards and policy for the United States but is not an agency of the federal government; rather, it is an organization of the states themselves. Policies of AASHTO are not federal laws or policies, but rather are ways to coordinate state laws, policies, and design standards in the field of transportation. The association represents not only highways but includes air, rail, water, and public transportation.

The voting membership of AASHTO consists of the Department of Transportation of each state in the United States as well as those of Puerto Rico and the District of Columbia. The United States Department of Transportation; some U.S. cities, counties, and toll-road operators; most Canadian provinces; the Hong Kong Highways Department; the Ministry of Public Works and Settlement; and the Nigerian Association of Public Highway and Transportation Officials have non-voting associate memberships.

3.4.2 National Association of City Transportation Officials Urban Street Design Guide

The National Association of City Transportation Officials (NACTO) is an association of 62 American cities and 10 transit agencies. The Urban Street Design Guide provides guidance on the design and operation of urban streets (NACTO 2018). The guide is not prescriptive but provides recommendations and description of best practices for implementing urban streets that function safely for all modes of travel.

4 Methodology and Data Sources

This section presents the methodology used to analyze existing and future safety conditions on I-5 between I-405 and I-84, the Broadway/Weidler interchange, and adjacent surface streets. Potential cumulative impacts were assessed based on the Metro RTP-based regional travel demand model, in which traffic numbers consider identified reasonably foreseeable future actions.

4.1 Project Area and Area of Potential Impact

The API for the transportation safety study generally corresponds to the Project Area, as shown on Figure 1, except along N Broadway, where the API extends west to N Larrabee (see Figure 9).

4.2 Resource Identification and Evaluation

The existing safety analysis presents findings of a comprehensive evaluation of current safety issues throughout the API by defining the extent of the problems and the underlying factors. Future safety conditions on the highway, ramps, and ramp terminal intersections were also estimated using procedures from the ODOT *Analysis Procedures Manual (APM)* (ODOT 2016). On the local streets, future safety conditions were estimated using a qualitative approach developed in collaboration with the City of Portland and ODOT.

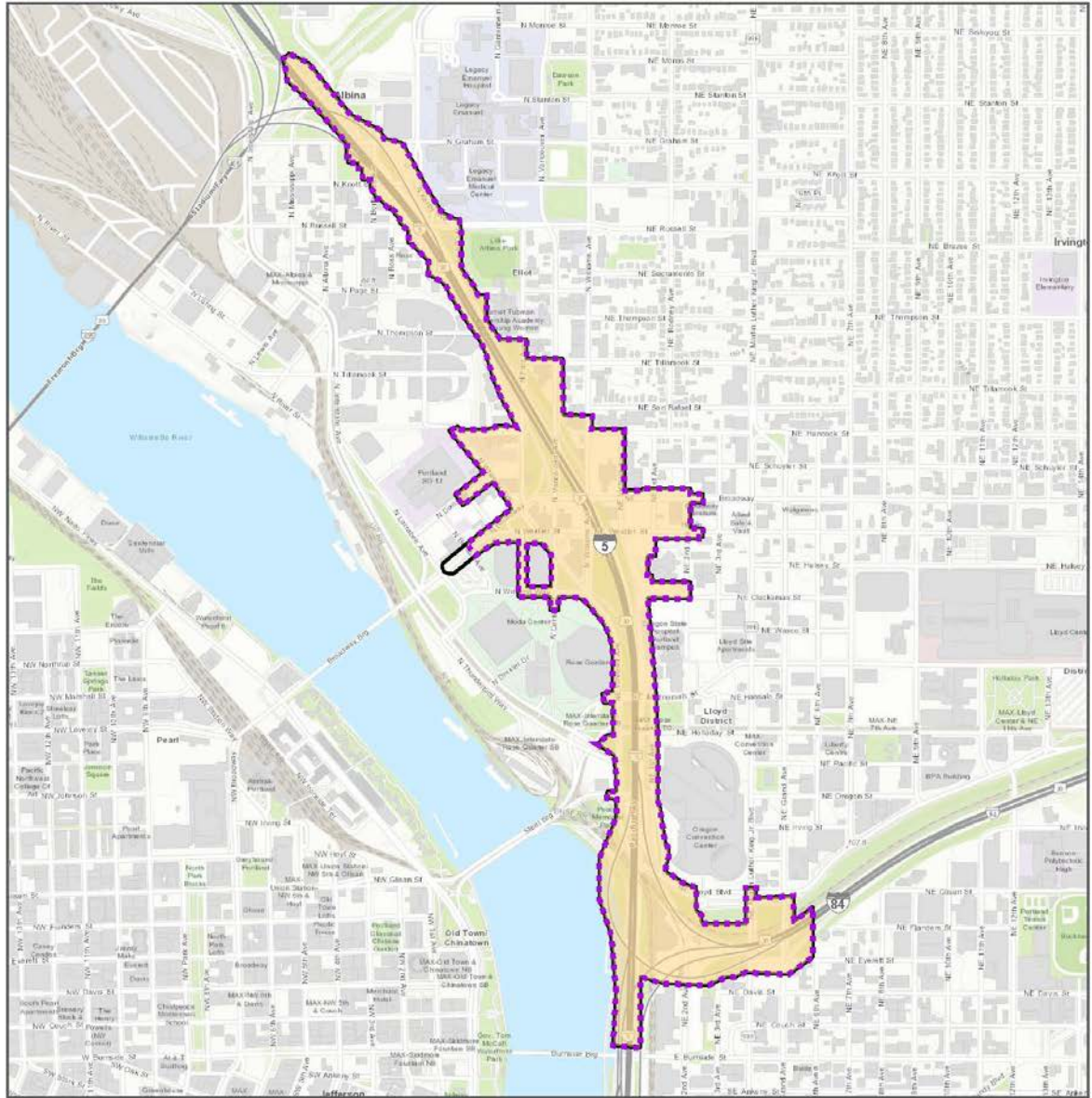
4.3 Assessment of Impacts

4.3.1 Crash Reporting

As specified in ODOT's *Statewide Crash Data System Motor Vehicle Traffic Crash Analysis and Code Manual* (ODOT 2014b), injuries reported from a crash are classified by severity and comprise five major types:

- Fatality crashes are crashes that result in death.
- Injury A crashes are classified as serious or major injuries.
- Injury B crashes are classified as moderate injuries.
- Injury C crashes are classified as minor injuries.
- Property Damage Only (PDO) crashes result in property damage only. There are no injuries associated with the crash.

Figure 9. Transportation Area of Potential Impact



<p>Project Location</p>	<ul style="list-style-type: none"> Area of Potential Impact Boundary for Transportation Project Area <p>DATA SOURCES: Sources: Esri, HERE, DeLorme, Intermop, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapyIndia, © OpenStreetMap contributors, and the GIS User Community</p>	<p>I-5 ROSE QUARTER IMPROVEMENT PROJECT TRANSPORTATION AREA OF POTENTIAL IMPACT</p> <p>NOVEMBER 2017</p> <p>0 750 1,500 Feet</p>
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Crash data in Oregon are obtained from two sources: citizen reports and enforcement. These data are then compiled into a crash database managed by ODOT. Not all crashes are reported, as a number of crashes do not qualify to be reported, and some crashes that qualify still go unreported. The Oregon Department of Motor Vehicles (DMV) provides ODOT with crash data after the DMV collates driver and police reports and records any driver violations or suspensions. Crash data are coded into the crash database, which include all general data regarding the vehicle involved, crash type, location, conditions, errors, etc. All data are validated by data analysts, and errors are corrected before the file is finalized for each completed year of crashes. This database can be retroactively corrected if errors are found after finalization and complete year submission.

Even with the extensive efforts to collect all crash data and to do so accurately, not all crashes are recorded and some may not be accurate. Studies have shown that crashes with greater severity are reported with greater precision than crashes of lower severity. Additionally, crash data may contain only partial information. A report may fail to note that the crash occurred in a school or work zone or that the driver was on a cell phone when the crash occurred. In addition, the location of the crash recorded is often an approximation. As such, the following safety analysis shows trends but not definitive causation of crashes.

The crash analysis for the Project was conducted on 2011-2015 crash data provided by ODOT.

4.3.2 Safety Priority Index System

ODOT develops and maintains the state SPIS for prioritizing safety issues on roadways. The SPIS process ranks roadway segments as a function of crash frequency, crash rate, and crash severity. This system complies with the Federal Highway Safety Improvement Program (HSIP) and has been accepted by the FHWA as fulfilling HSIP requirements.

Based on this system, a segment of roadway on the state highway system is broken down to 0.10-mile sections. This segment becomes a SPIS site if the location has three or more crashes or has one or more fatal crashes within a 3-year period. The system considers three crash indicator values (IVs) to determine the overall SPIS rating of the site, as shown below.

Crash frequency indicator value	(IV _{Freq})	25% of SPIS score
Crash rate indicator value	(IV _{Rate})	25% of SPIS score
Crash severity indicator value	(IV _{Severity})	50% of SPIS score
		<hr/>
		Total SPIS score

Each IV is calculated based on the distribution of the total crashes in the 3-year period. Roadway segments are rated and sorted from high to low. Sites with SPIS values in the top 10 percent and top 5 percent statewide are reviewed annually to better evaluate the safety problems that contribute to crashes. The safety analysis for this Project uses SPIS as a basis for evaluating safety in the API. This report references SPIS sites and those that rank in the top 10 percent in Oregon.

4.3.3 Highway Corridor, Segment, and Ramp Crash Analysis Methods

The existing conditions highway analysis was conducted at two levels: an assessment for the entire corridor and a segment-by-segment and ramp assessment within the API. For the purposes of a crash analysis, the highway is segmented from ramp gore point to ramp gore point. The following crash trends are evaluated:

- Total number of crashes
- Crash rate
- Crash severity throughout the API
- SPIS⁷ sites
- Crash distributions by time of day, month, weather, and lighting
- Contributing factors
- Collision type, including pedestrian- and bicycle-involved collisions
- Impairment
- Speeding

Future safety conditions on the highway were estimated by applying elements from the Enhanced Interchange Safety Analysis Tool (ISATe) to estimate the safety benefits associated with the proposed auxiliary lane NB on I-5 between the I-84 on-ramp and the Weidler off-ramp.

Emergency braking events were identified as a surrogate for crashes in the *I-5 Broadway/Weidler Interchange Improvements: Traffic Operations Analysis Summary* (HDR 2015). As in the previous work, an emergency braking event is defined as a vehicle decelerating faster than 14.8 feet per second squared (ft/s²). The document *Policy on Geometric Design of Highways and Streets* (AASHTO 2011) notes that the majority of drivers decelerate at a rate greater than 14.8 ft/s² when confronted with the need to stop for an unexpected object.

To capture each of these braking events within the models, the Project team collected second-by-second data from the VISSIM model for all vehicles on the network during the AM and PM peak periods.⁸ This data captured vehicle characteristics such as location on the highway, speed, deceleration, and various other attributes. Vehicles decelerating faster than 14.8 ft/s² were mapped in GIS to generate a network-wide heat map of the highways, highlighting the most concentrated areas of emergency braking events.

⁷ For more details on SPIS formulation, go to http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/pages/spis.aspx#SPIS_Formulation

⁸ As described in detail in the *Traffic Analysis Technical Report* (ODOT 2019b), traffic operations for intersections and roadways, including the local street network, were modelled using VISSIM 10, a widely used, behavior-based multi-purpose traffic microsimulation program.

4.3.4 Local Street Crash Analysis Methods

The local street safety analysis evaluated existing safety conditions at the following 14 intersections within the API (see Figure 10):

- N Broadway and N Benton
- N Broadway and N Larrabee
- N Vancouver and N Broadway
- N Vancouver and N Weidler
- N Williams and N/NE Broadway
- N Williams and N/NE Weidler
- N/NE Hancock and N Williams
- N Hancock and N Vancouver – (future conditions only)
- N Hancock and N Flint – (existing conditions only)
- NE 2nd Ave and NE Broadway
- NE 2nd Ave and NE Weidler
- NE Victoria and NE Broadway
- NE Victoria and NE Weidler
- NE Wheeler/N Williams (formerly NWheeler) and N Ramsay Way

The analysis focused only on intersections because the API has relatively short blocks.

4.3.4.1 Existing Conditions Analysis

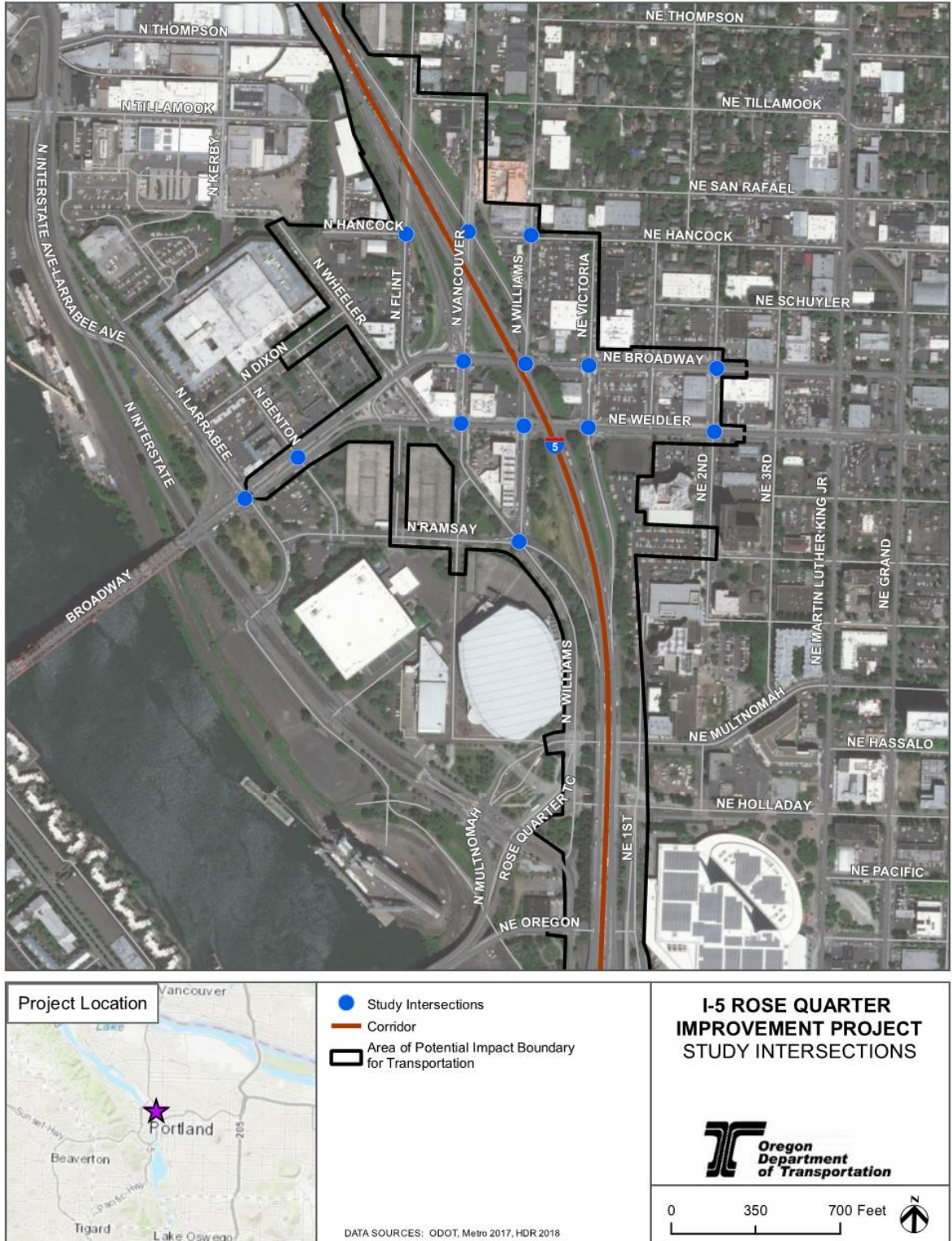
For overall crash trends, the crash frequency, severity, and collision types for all the study intersections combined were considered. Analysis results provide an indication of overall crash trends in the API. The following were evaluated:

- Type
- Severity
- Time of day
- Mode (heavy vehicle, passenger vehicle/light truck, pedestrian, or bicycle)
- Driver age
- Month

The existing conditions individual intersection analysis was conducted using a combination of three performance measures:

- Total number of crashes (all severities, all modes) at each intersection

Figure 10. Local Street Study Intersections



- Total crash rate (all severities, all modes) at each intersection
- Total dollar value of crashes at each intersection (i.e., equivalent PDO). According to the City of Portland, Vision Zero work,⁹ the following dollar value of crashes were applied:
 - Fatal Value = \$1,500,000
 - Injury A Value = \$74,900
 - Injury B Value = \$24,000
 - Injury C Value = \$13,600
 - PDO Value = \$9,300

Each intersection was evaluated according to each performance measure and ranked from highest to lowest. The performance measures are not weighted, and the final ranking is a sum of the rank of each performance measure. A lower score indicates a higher potential for safety improvement under existing conditions.

The City of Portland's list of High Crash Network Intersections¹⁰ was also reviewed to identify if any of the intersections within the API are currently identified as high crash locations by the City.

Qualitative methods were used to compare safety performance for existing versus future (No-Build and Build) conditions. This methodology is further explained in the following section (Section 4.3.4.2).

4.3.4.2 Future Conditions Analysis – Multimodal Risk Analysis

The Project team conducted an existing and future No-Build and Build conditions qualitative risk/safety assessment of the local street Project intersections. The assessment qualitatively rates the risk of collision at each intersection for each transportation mode (motor vehicle, bicycle, pedestrian) as a function of three characteristics:

- **Exposure:** Exposure represents the total volume of pedestrians, bicyclists, and motor vehicles entering an intersection. For each mode, a “high”/“moderate”/“low” rating was assigned to each intersection based on total entering volumes. The rating was given relative to modal volume at other intersections in the API. For each scenario (existing, No-Build, Build) and each mode (motor vehicle, bicycle, pedestrian), high-moderate-low threshold values were based off an even one-third split between the minimum and maximum values.
 - Motor vehicle exposure ratings were based off the following ranges of average annual daily traffic (AADT) (in vehicles per day [vpd]):

⁹ City of Portland High Crash Network Intersections,
<https://www.portlandoregon.gov/transportation/59279#method>

¹⁰ <https://www.portlandoregon.gov/transportation/59279>

- Existing:
 - High: 18,650-26,400 vpd
 - Moderate: 10,900-18,649 vpd
 - Low: 3,150-10,899 vpd
- No-Build:
 - High: 18,983-26,600 vpd
 - Moderate: 11,367-18,982 vpd
 - Low: 3,750-11,366 vpd
- Build:
 - High: 19,350-27,575 vpd
 - Moderate: 11,125-19,349 vpd
 - Low: 2,900-11,124 vpd
- Bicycle exposure ratings were based off the following ranges of PM peak hour (5:00–6:00 PM) bicycle volumes:
 - Existing:
 - High: 472-610
 - Moderate: 225-471
 - Low: 31-224
 - No-Build:
 - High: 441-637
 - Moderate: 245-440
 - Low: 48-244
 - Build:
 - High: 442-659
 - Moderate: 223-441
 - Low: 2-222
- Pedestrian exposure ratings were based off the following ranges of PM peak hour (5:00–6:00 PM) pedestrian volumes:
 - Existing:
 - High: 248-330
 - Moderate: 165-247
 - Low: 81-164
 - No-Build:
 - High: 337-450
 - Moderate: 224-336
 - Low: 110-223

- **Build:**
 - High: 301-440
 - Moderate: 162-300
 - Low: 22-161
- **Complexity:** Complexity generally refers to intersection physical characteristics (e.g., number and type of lanes, alignment, signal phasing, separated/non-separated pedestrian and bicycle facilities). Intersections with conventional layouts (e.g., right angles) or operations (e.g., two-phase signals) and modal separation were deemed less complex. Intersections with less conventional layouts (e.g., skewed crossings, broad turning radii, or slip lanes) or operations (e.g., split-phase signals) and mixed modal operations were deemed more complex. It should be noted that while some less conventional bicycle treatments (e.g., bike boxes and bike signals) exist, these treatments were determined to contribute positively to an intersection’s safety. The Project team also identified some granular features that may add complexity to the pedestrian environment (e.g., diagonal curb ramps, missing detectable warning strips), as these features could substantially impact user comfort and safety, particularly for visually impaired users. A high, moderate, or low rating was assigned to each intersection.
- **Severity:** A severity rating was assigned to each intersection based on posted speed limits for motorized travel through the intersections. Table 3 shows the ratings.

Table 3. Qualitative Severity Rating

Posted Speed Limit Major/ Minor Street	20 MPH	25 MPH	30 or more MPH
20 MPH	Low	Low	Moderate
25 MPH	Low	Moderate	High
30 or more MPH	Moderate	High	High

Notes: MPH = miles per hour

The ratings in each category are assigned on a relative basis within the category and are not a prediction of a crash. They are provided for comparative purposes to assess advantages and disadvantages of the different scenarios. Results of this analysis are provided in Section 6.2.2.3.

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 result in environmental impacts in the Project Area. Because transportation impacts typically occur on a broader, system-wide scale, the Project team considered actions within and immediately beyond the Project Area. The cumulative impact assessment qualitatively assessed the magnitude of impacts associated with projects listed in the financially constrained element of Metro's RTP (Metro 2014) and other shorter-term projects and service improvements identified by the City of Portland and TriMet (summarized in Appendix A), in combination with anticipated Project impacts. This assessment also identified the contribution of the Project to overall cumulative impacts.

5 Affected Environment

This section describes existing transportation safety conditions in the API.

5.1 Highway Crash Analysis

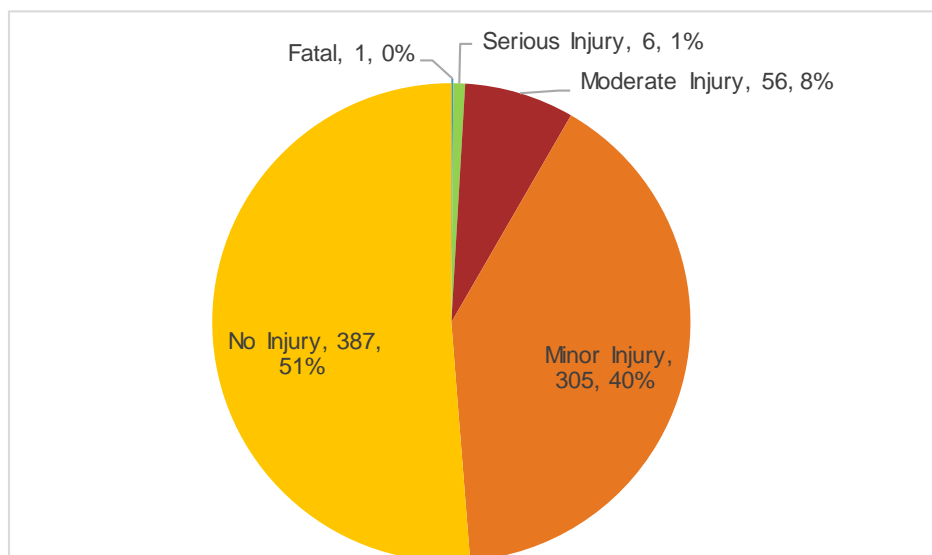
5.1.1 Overall Highway Mainline Crash Analysis

The analysis in this section of the *Transportation Safety Technical Report* focuses on mainline crash data along the I-5 highway corridor within the API. Ramps were analyzed separately and discussed in Section 5.1.3. Crash data were obtained for 5 years (2011 through 2015) for the API, which includes the section of I-5 from I-405 to I-84.

Corridor-wide trends include the following:

- **Total crashes:** There were 755 reported highway mainline segment crashes in the corridor.
- **Top crash sites in frequency and severity:** I-5 NB between I-84 and NE Weidler and between N Broadway and the NB off-ramp to I-405 have been among the state's top 5 percent crash sites for the last three SPIS years (2014-2016). Figure 11 summarizes the severity of crashes through the entire corridor. From 2011 to 2015, seven crashes on the mainline resulted in fatal or serious injury. The clear majority of crashes resulted in no injury or minor injury.

Figure 11. I-5 Corridor – Crashes Based on Severity (2011–2015)



- **Top 10 Percent 2016 SPIS Sites:** Approximately 37 percent of the Project Area is on the ODOT top 5 or 10 percent SPIS list. SPIS scores are assigned to sites as a function of crash frequency, rate and severity. A higher SPIS score indicates a worse condition from a crash perspective. ODOT ranks all public roads from a high to low SPIS score. Sites within the top 5 or 10 percent on this list indicate a high mix of crash frequency, rate and severity. Figure 12 shows the locations of SPIS sites, SPIS scores, and the rank within ODOT Region 1. The top 10 percent SPIS sites are most concentrated near the south end of the I-5 corridor, between just south of I-405 and just north of I-84.
- **Directionality:** Most of the crashes (74 percent) involved vehicles traveling SB on the corridor.
- **Time of Day:** Most of the crashes (70 percent) occurred during the afternoon from noon to 6:00 PM. Figure 13 shows the total distribution of crashes by time of day over the 5-year study period (2011-2015, all severities).

Figure 12. SPIS Segments in the Project Area

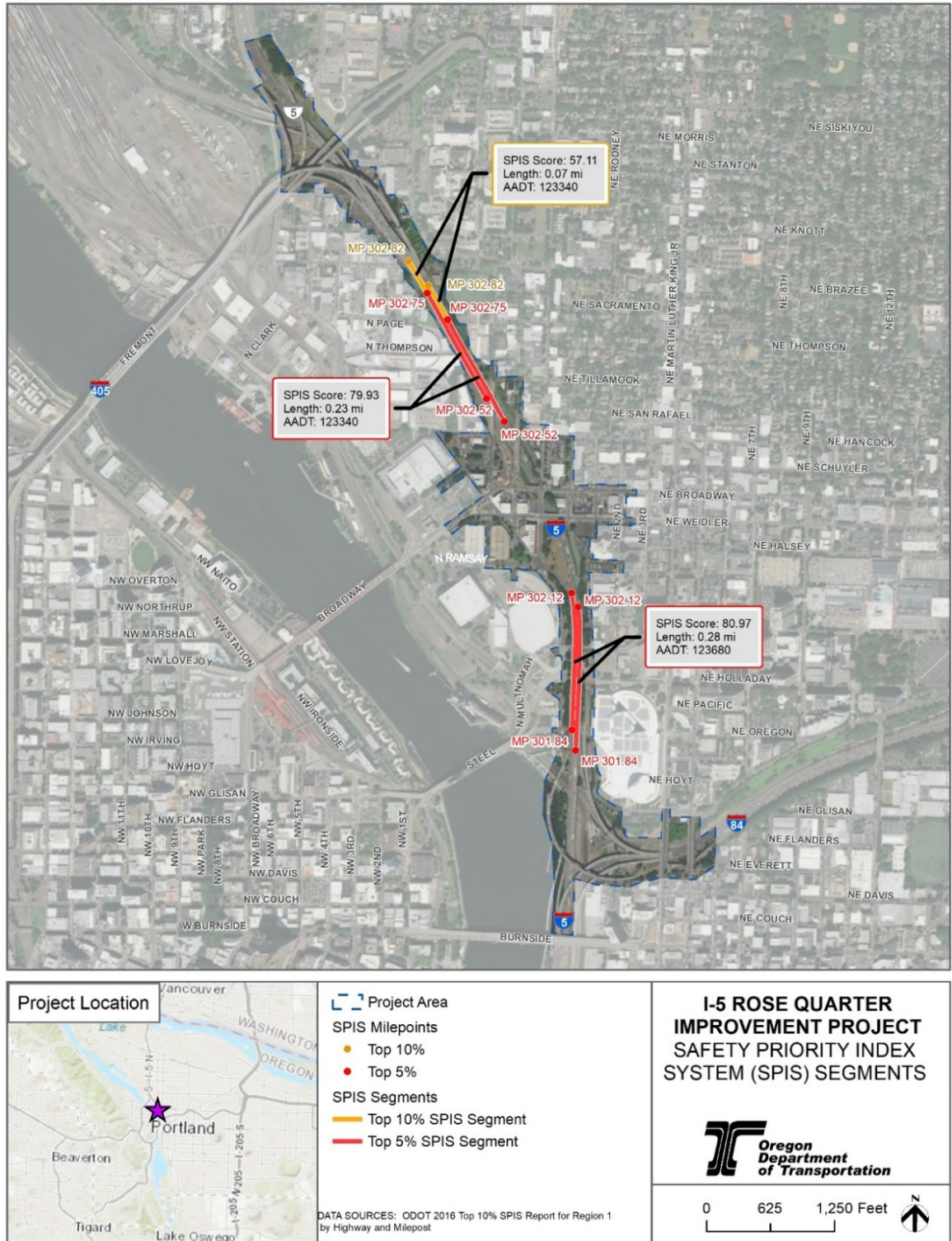
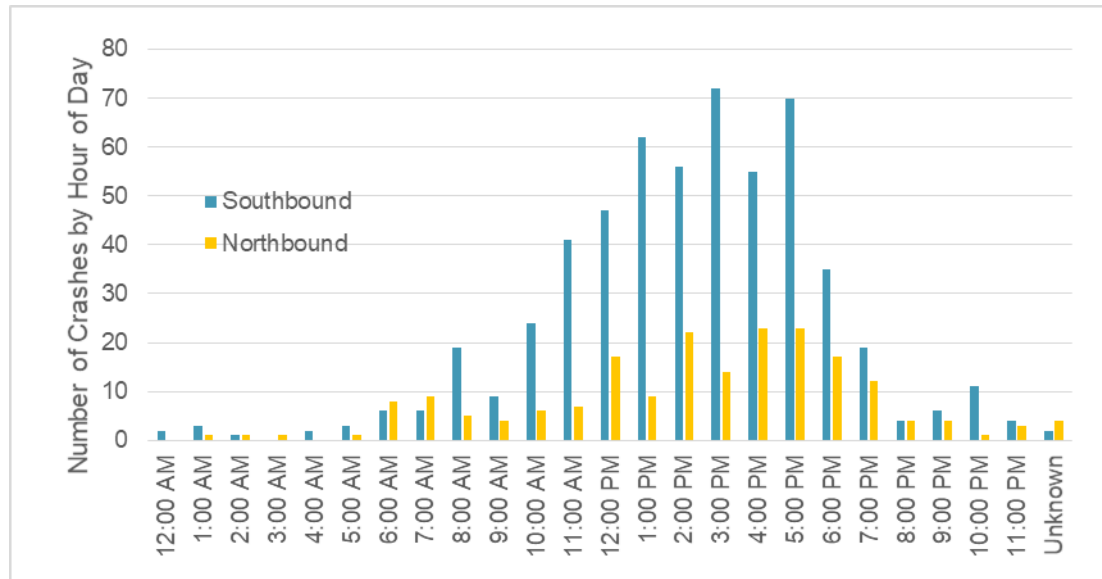


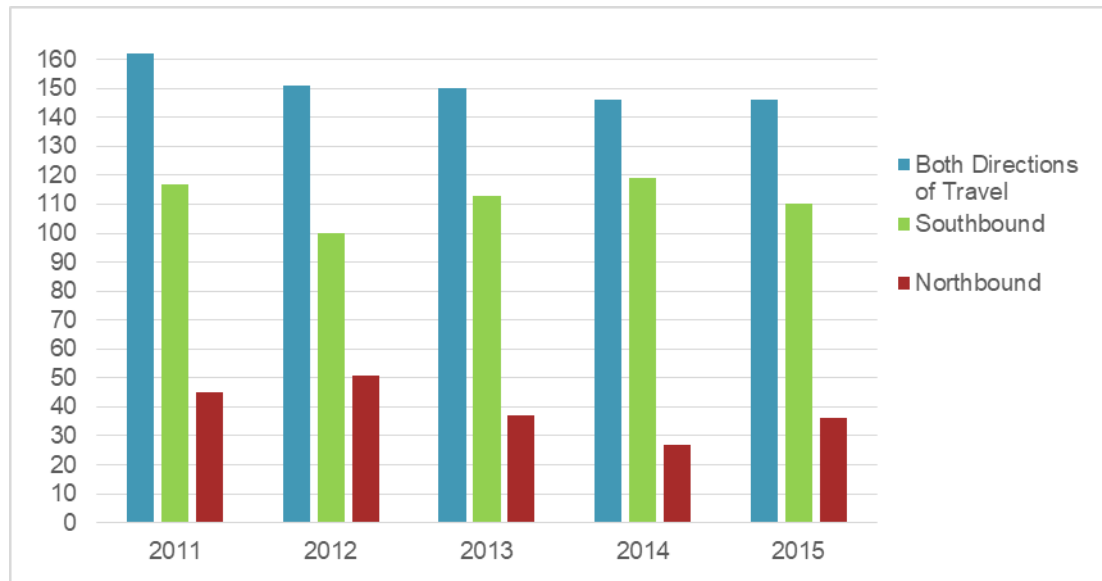
Figure 13. I-5 Corridor – Crashes by Hour of Day (2011-2015)



- Year:** On average, approximately 151 crashes per year (approximately two crashes every 5 days) occurred during the study period. Overall, the total number of annual crashes has decreased over the study period (162 crashes in 2011 and 146 crashes in 2015) (Figure 14). The reduction in crashes generally seems to correlate with historical traffic trends in the Project Area; in general, the AADT on I-5 within the API¹¹ dropped from 2011 to 2012 and remained fairly constant between 2012 and 2015. Using ODOT historical average traffic volume data in the vicinity of the NE Holladay Street overcrossing, the approximate total crash rate on the corridor has also declined since 2011 (2.34 crashes per mvmt in 2011 to 2.18 crashes per mvmt in 2015).

¹¹ AADT Source: <http://www.oregon.gov/ODOT/Data/Pages/Traffic-Counting.aspx>

Figure 14. I-5 Corridor – Crashes by Year (All Severities, 2011-2015)



- **Weather:** Of the 2011–2015 crashes, 73 percent occurred in clear weather, 20 percent occurred in rain, and 3 percent occurred in cloudy conditions.
 - Of the seven crashes that resulted in fatal or serious injury, all of them occurred under either clear or cloudy conditions, almost all with dry surface conditions.
- **Lighting:** Overall, most crashes occurred during daylight, dawn, or dusk. Two percent of crashes occurred in dark (no streetlight) conditions, and 14 percent of crashes happened in dark (with streetlight) conditions.
 - Of the seven crashes that resulted in fatal or serious injury, five occurred during daylight and two occurred during dark but with streetlight conditions.
- **Crash Contributing Factors:** Following too close was the most common (63 percent) crash contributing factor, followed by improper lane changing (16 percent) and failure to avoid (9 percent). Figure 15 shows a summary of crashes classified by primary crash cause. Figure 16 shows a summary of fatal and serious injury crashes classified by primary crash cause. Overall, most (57 percent) fatal and injury crashes were caused by following too close. The other fatal and injury crash causes included pedestrian in roadway, inattention, and reckless driving.

Figure 15. I-5 Corridor – Crash Contributing Factors (2011-2015)

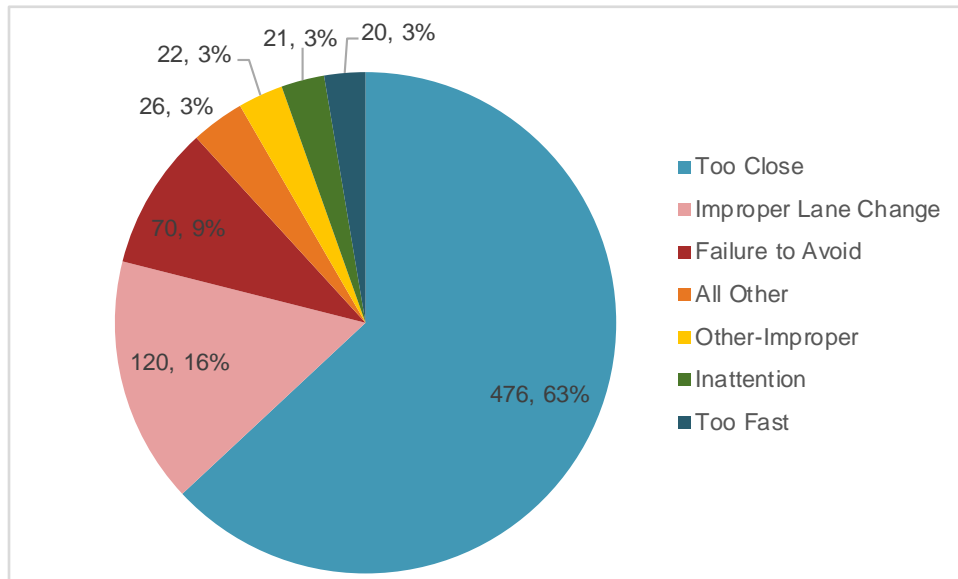
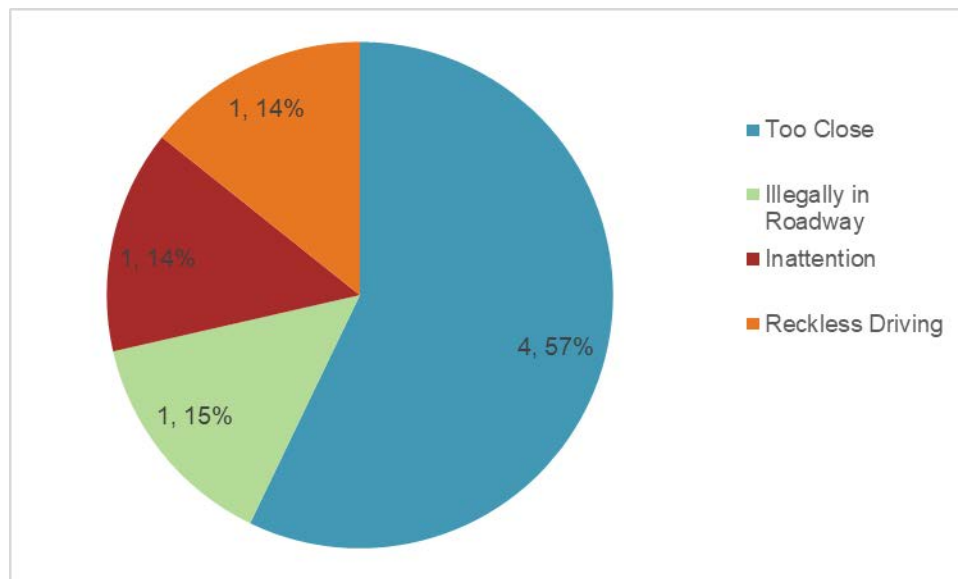
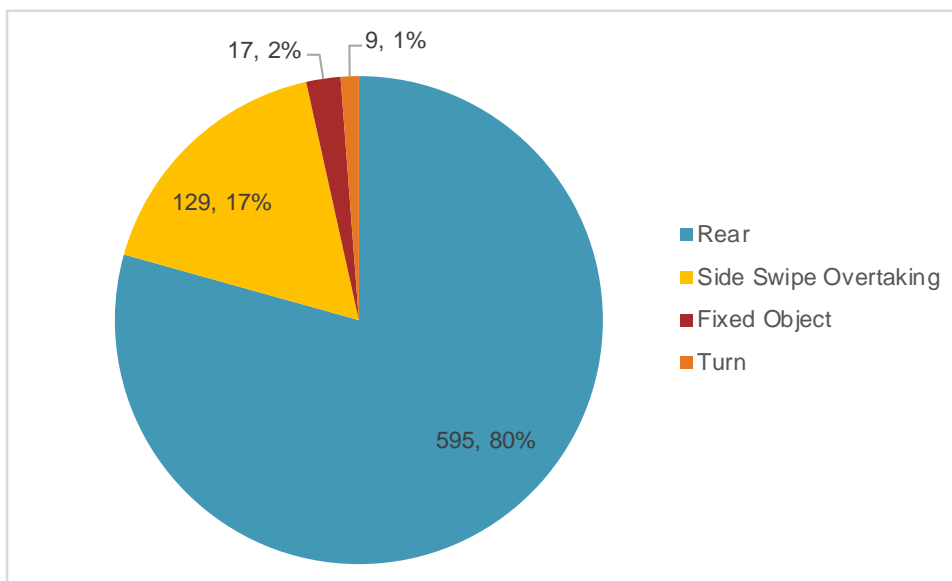


Figure 16. I-5 Corridor – Crash Causes for Fatal and Serious Injury Collisions (2011-2015)



- **Collision Type:** Majority of crashes were rear-end (79 percent), sideswipe-overtaking (17 percent), or collision with fixed object (3 percent).
 - Figure 17 shows a summary of crashes classified by collision type.
 - Most crashes with a primary cause of following too close or failure to avoid resulted in a rear-end collision type.
 - Most crashes with a primary cause of improper lane changing resulted in a side-swipe-overtaking collision type.

Figure 17. I-5 Corridor – Collision Types (2011-2015)



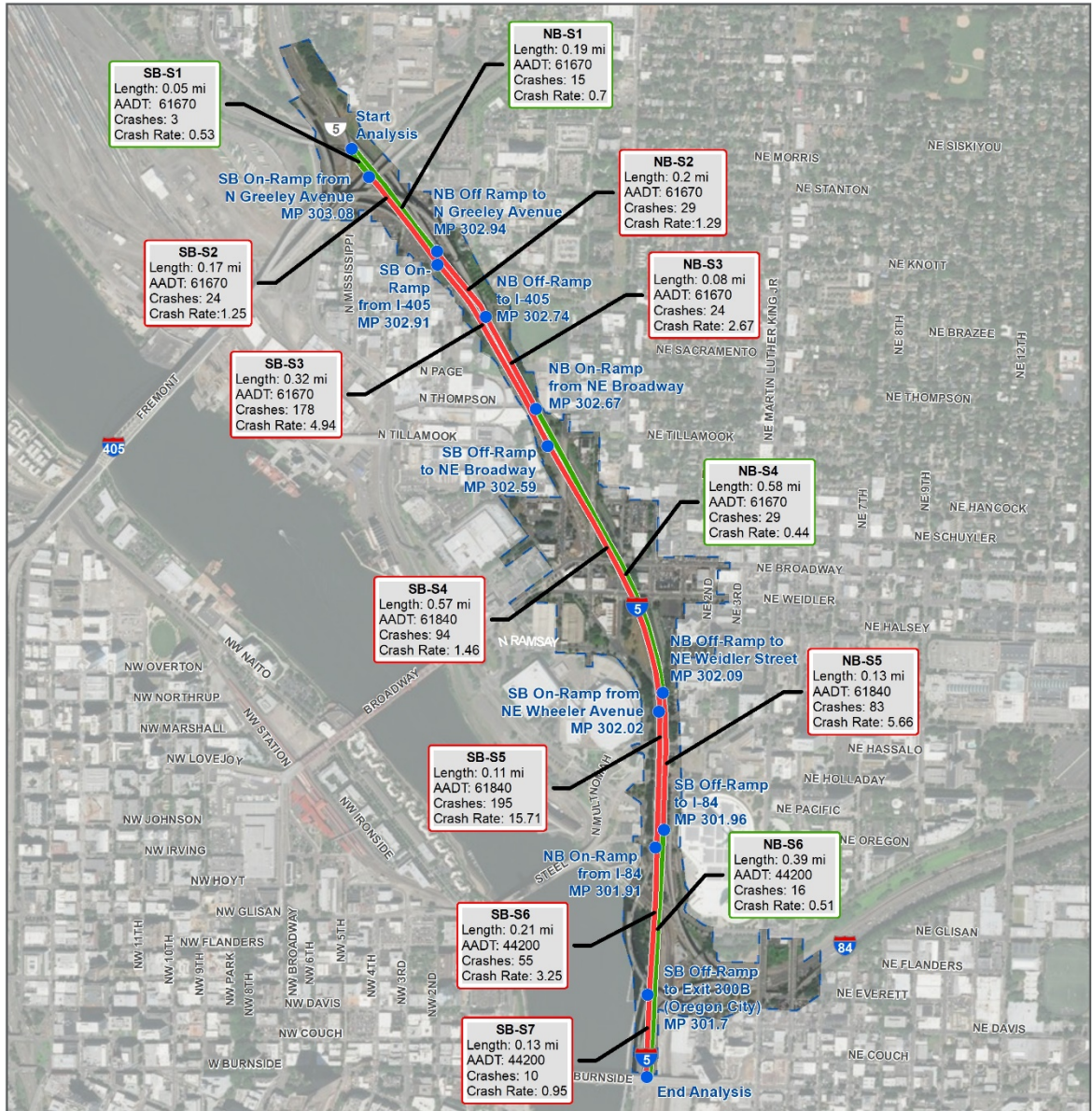
- **Pedestrian/Bike Crashes:** There was one pedestrian crash on the highway that occurred in 2013 around midnight with street lighting present. The collision resulted in a fatal injury. The collision occurred on SB I-5 just south of N Russell.
- **Drug/Alcohol Related-Crashes:** Of the total 755 corridor crashes, seven crashes (just under 1 percent) were reported with a cause related to driving or operating under the influence of alcohol or drugs.
- **Speeding Related-Crashes:** Of the total 755 corridor crashes, 24 crashes (just over 3 percent) were reported with a cause related to driver speeding.
 - Approximately half of fixed object collisions involved speeding.
 - The SB highway segment between the Greeley on-ramp and I-405 off-ramp and NB highway segment between the Greeley and I-405 off-ramps had higher percentages of speeding than in other segments (13 to 17 percent of collisions).

5.1.2 Existing Conditions Highway Segment Crash Analysis

The corridor was also analyzed on a directional segment-by-segment basis (i.e., ramp gore point to ramp gore point). The segments are shown in Figure 18. Figure 18 also summarizes total crashes and total crash rate on each segment and compares these rates to the statewide averages for comparable facilities. As identified in the 2015 State Highway Crash Rate Tables (ODOT 2015a), the average crash rate for comparable facilities is 0.77 crashes per million vehicle miles (crashes/mvmt). Overall, the following trends are observed:

- Six out of seven SB and three out of six NB highway segments have crash rates that exceed the state average for corridors similar to I-5.

Figure 18. Corridor Segmentation and Crash Rates



Project Location

Project Area

- Segment Start/End Point

Corridor Segments:

- Green line: Crash Rate is Below Statewide Average (0.77 crashes/mvmt)
- Red line: Crash Rate Exceeds Statewide Average (0.77 crashes/mvmt)

DATA SOURCES: ODOT Traffic Data (2011-2015 Average); ODOT Crash Data (2011-2015); ODOT 2015 State Highway Crash Rate Tables, Table IV

**I-5 ROSE QUARTER
IMPROVEMENT PROJECT
CORRIDOR SEGMENTATION
AND CRASH RATES**

0 625 1,250 Feet

- SB I-5 between the N Williams (formerly NE Wheeler) on-ramp 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 Street (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 N Broadway (SB-S3) has the third highest crash rate (4.94 crashes/mvmt).

Details of the individual segment crash performance are shown in Appendix B.

5.1.3 Existing Highway Ramp Crash Analysis

Crash data for the on- and off-ramps on I-5 in the Project Area were reviewed for years 2011-2015. Overall, the following trends are observed on the I-5 ramps within the Project Area:

- **Total Crashes:** There were 126 total crashes on the ramps over the study period (2011-2015). The most ramp crashes occurred on NB on-ramp from WB I-84 (NB-R5): 23 crashes
- **Crashes per Mile:** Considering ramp length, the following ramps had the highest number of crashes per mile (highest to lowest):
 - NB on-ramp from I-84 (NB-R5): 77 crashes/mile
 - SB on-ramp from N Williams (formerly NE Wheeler) (SB-R4): 70 crashes/mile
 - SB off-ramp to N Broadway (SB-R3): 50 crashes/mile
- **Crash Severity:** There were no fatal crashes on the ramps. Two ramps had a serious injury crash occur:
 - SB on-ramp from I-405 (SB-R2)
 - Collision with pedestrian in 2013 around 2 PM. There was clear weather and daylight, but the road was icy. The crash was a result of carelessness and speeding was involved. The collision occurred on the ramp just before the gore entering SB I-5.
 - NB on-ramp from I-84 (NB-R5)
 - Rear-end collision in 2011 around 10 PM. There was rainy weather, wet roadway, and it was dark but there was street lighting. The crash was a result of driving too fast.
- **Weather:** Weather does not appear to have played a significant role in crashes on the ramps. General trends seem to match those of highway segments.
- **Lighting:** Approximately 3 percent of ramp crashes occurred in dark conditions without streetlights. Of these 3 percent, they all occurred on different ramps (one crash per ramp maximum). As there were no crash clusters related to lighting, it does not appear that lighting is a significant role in ramp crashes.

- **Crash Contributing Factors:** Following too close was the most common primary crash cause (48 percent), followed by improper lane changing (13 percent), and driving too fast (13 percent).
 - For most ramps, following too close is the most common crash cause.
 - Improper lane changing was a common crash cause in the following ramps:
 - SB off-ramp to Exit 300B (SB-R6): 3 out of 7 crashes (43 percent)
 - NB on-ramp from I-84 (NB-R5): 6 out of 23 crashes (23 percent)
 - SB off-ramp to N Broadway (SB-R3): 2 out of 10 crashes (20 percent)
 - NB off-ramp to I-84 (NB-R6): 5 out of 36 crashes (14 percent)
 - The ramps noted under “Speeding-Related Crashes” trends for ramps were associated with the primary crash cause of driving too fast.
- **Collision Type:** Most ramp crashes were rear-end (64 percent), collision with fixed object (17 percent), or sideswipe-overtaking (16 percent). This trend is similar to trends observed for highway segments.
- **Pedestrian/Bike Crashes:** There was one severe-injury pedestrian crash, which occurred on the SB on-ramp from I-405 (SB-R2). See crash described under “Crash Severity” trends for ramps.
- **Drug/Alcohol Related-Crashes:** Of the total 126 ramp crashes, 5 crashes (just under 4 percent) were reported with a cause related to driving or operating under the influence of alcohol or drugs.
- **Speeding-Related Crashes:** Of the total 126 ramp crashes, 20 crashes (approximately 16 percent) were reported with a cause related to driver speeding.
 - NB ramps generally have more speeding-related crashes than SB ramps.
 - The following ramps had more than one speeding-related crash:
 - NB off-ramp to N Greeley (NB-R1): 6 out of 10 crashes (60 percent)
 - NB off-ramp to I-405 (NB-R2): 4 out of 7 crashes (57 percent)
 - SB on-ramp from I-405 (SB-R2): 2 out of 9 crashes (22 percent)
 - SB off-ramp to I-84 (NB-R6): 4 out of 36 crashes (11 percent)
 - NB on-ramp from I-84 (NB-R5): 2 out of 23 crashes (9 percent)

See Table 4 for descriptions of the ramps and an overview of crash data.

Table 4. Ramps Evaluated for Crash Analysis

Ramp #	Direction	On/Off Ramp	Road to/from	Approximate Length (Miles)	Total Crashes	Crashes Per Mile	Fatal or Severe Injury Crashes
SB-R1	SB	On	N Greeley Avenue	0.4	2	5	0
SB-R2	SB	On	I-405	0.4	9	23	1
SB-R3	SB	Off	N Broadway	0.2	10	50	0
SB-R4	SB	On	N Williams Avenue (formerly NE Wheeler Avenue)	0.1	7	70	0
SB-R5	SB	Off	I-84	0.5	1	2	0
SB-R6	SB	Off	Exit 300 B (Oregon City)	0.3	7	23	0
SB-R7	SB	On	I-84	0.4	2	5	0
NB-R1	NB	Off	N Greeley Avenue	0.5	10	20	0
NB-R2	NB	Off	I-405	0.5	7	14	0
NB-R3	NB	On	N Broadway	0.3	7	23	0
NB-R4	NB	Off	NE Weidler Street	0.2	5	25	0
NB-R5	NB	On	I-84	0.3	23	77	1
NB-R6	NB	Off	I-84	1.0	36	36	0

Notes: I = Interstate; NB = northbound; SB = southbound

Values denoted in red indicate higher values relative to other ramps in the Project Area.

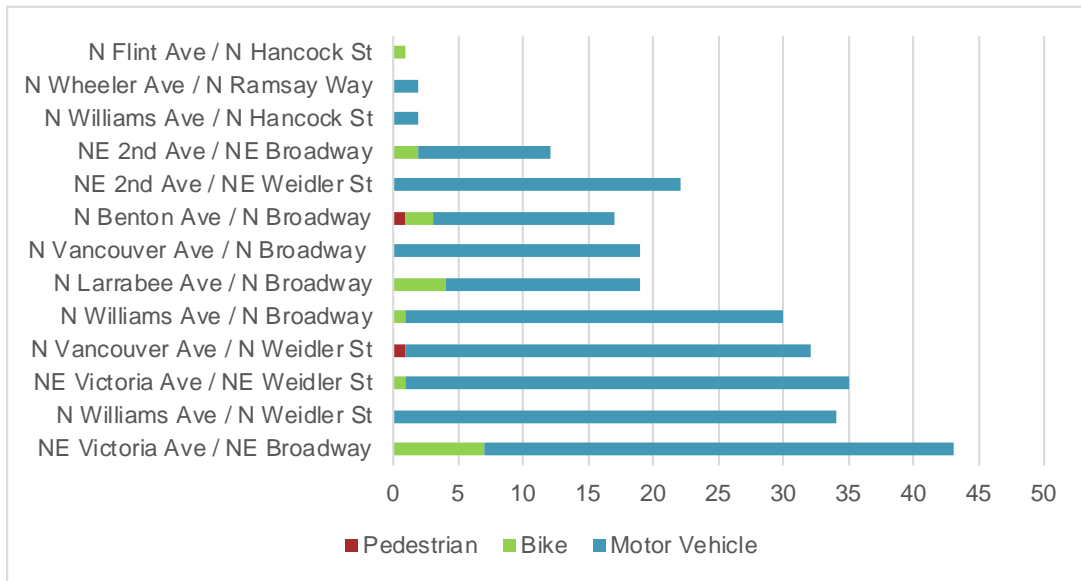
5.2 Local Intersections Crash Analysis

The following sections summarize key findings/results on the local intersections crash analysis. Please refer to Section 4.3.4 for methodology.

5.2.1 Overall Intersection-Related Crash Conditions

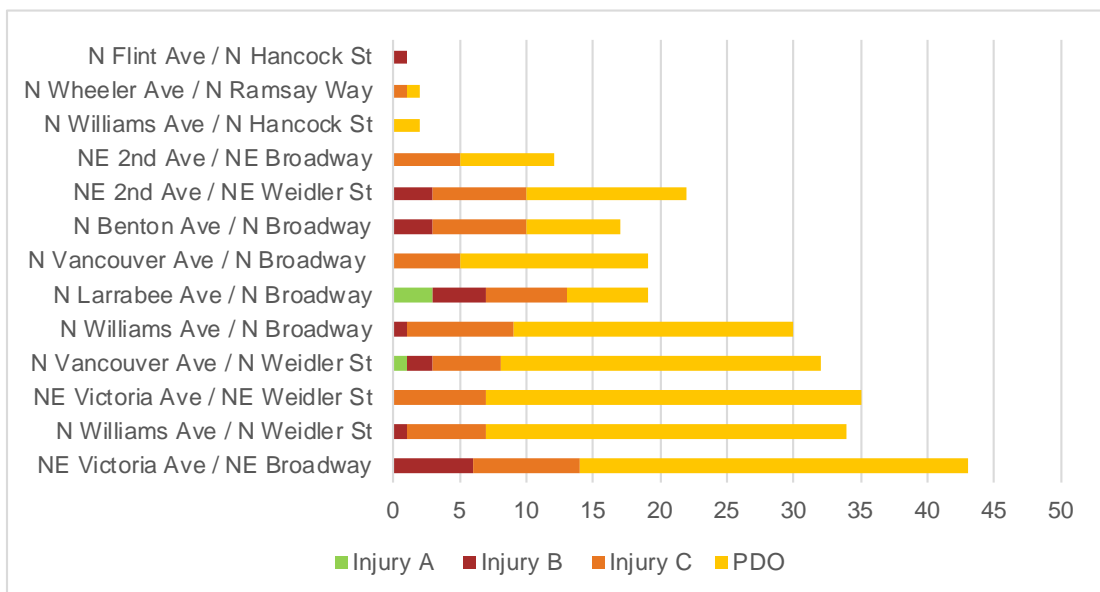
- Total Crashes:** There were a total of 268 crashes (all severities) at the API intersections from 2011-2015. The intersection of NE Victoria/NE Broadway had the highest number of crashes (43). Figure 19 shows the total number of crashes at each intersection within the API by mode.

Figure 19. Total Number of Crashes (By Mode)



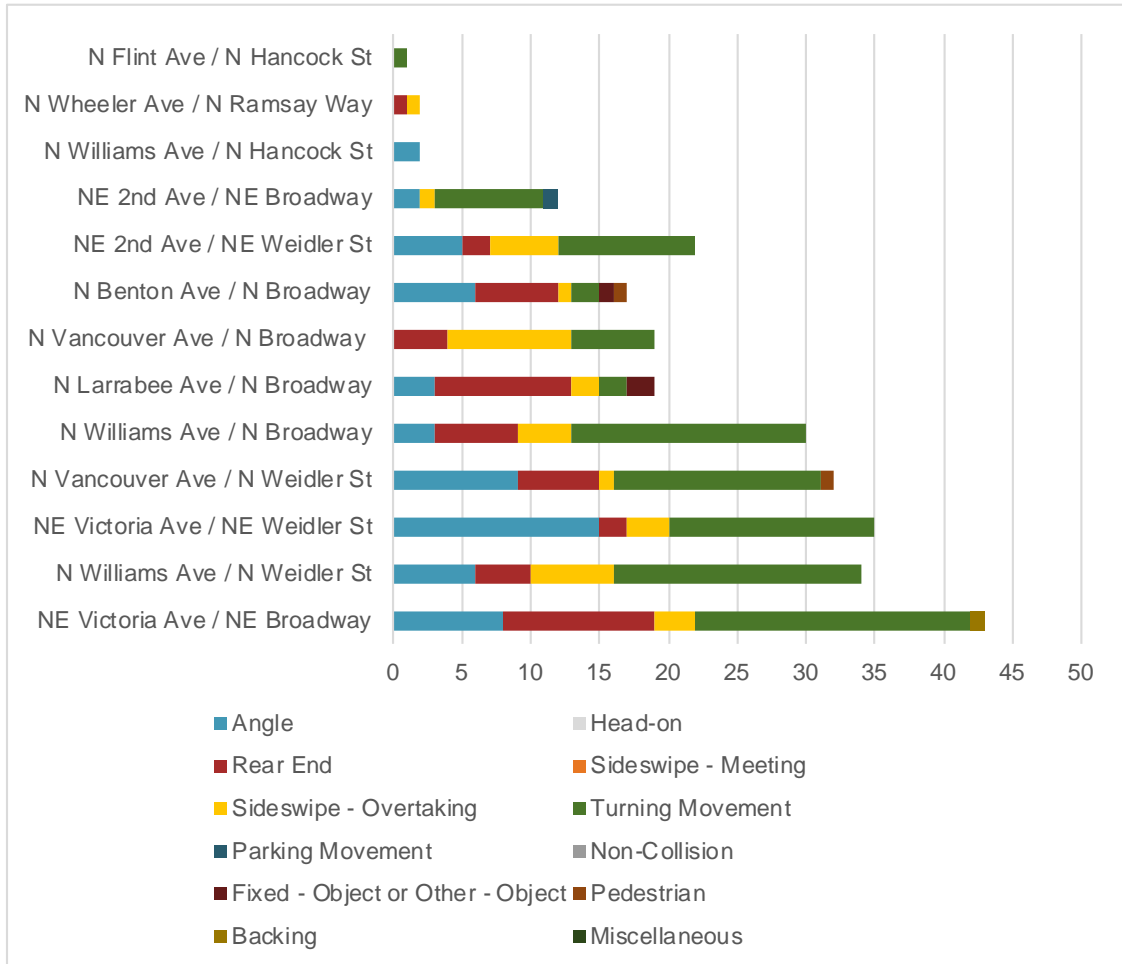
- Crash Severity:** There were no fatal crashes at the API intersections from 2011-2015. Most of the crashes (178 out of 268) crashes were PDO. There were 65 Possible Injury crashes (Injury Type C), 21 Non-Incapacitating but Evident Injury crashes (Injury Type B) crashes, and 4 Incapacitating Injury crashes (Injury Type A). The severity crash distribution for each intersection is shown on Figure 20. As a percentage, the N Larrabee/N Broadway intersection had the highest percentage of crashes with severity greater than PDO. Of the four Injury Type A crashes, three occurred at N Larrabee/N Broadway (one involved a bike and the other two were motorized vehicle) and one occurred at N Vancouver/N Weidler and involved a pedestrian.

Figure 20. Crash Severity Distribution



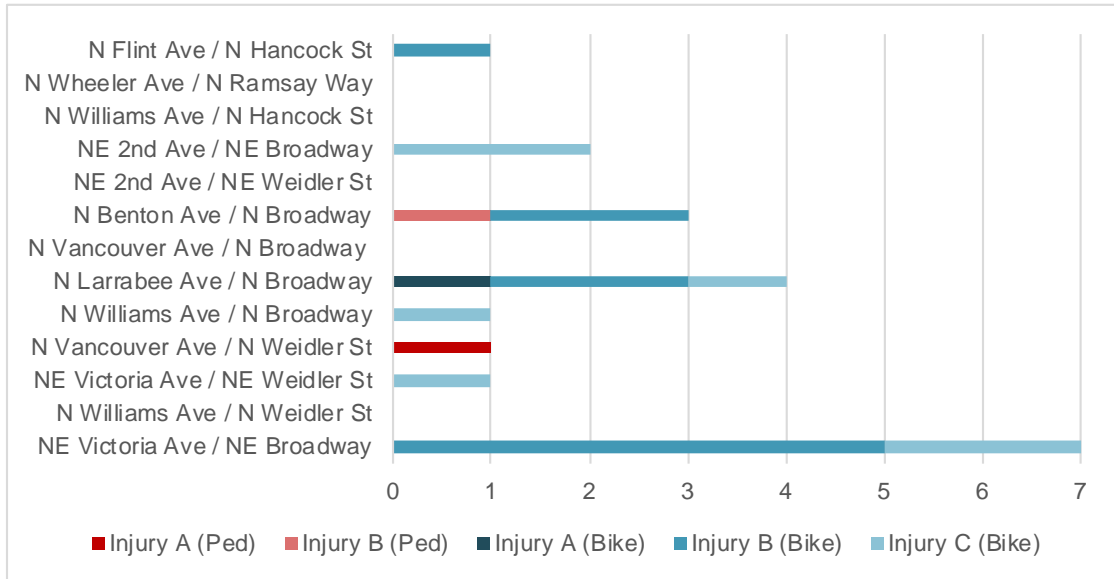
- Crash Type:** Turning movement crashes were the most common collision type. Of the 268 crashes in the study period, 114 were turning movement related crashes. Right-angle and rear-end collisions are the next common collision type. There were 59 right-angle crashes and 52 rear-end crashes. Figure 21 shows the crash distribution by the collision type at each intersection.

Figure 21. Collision Type Crash Distribution



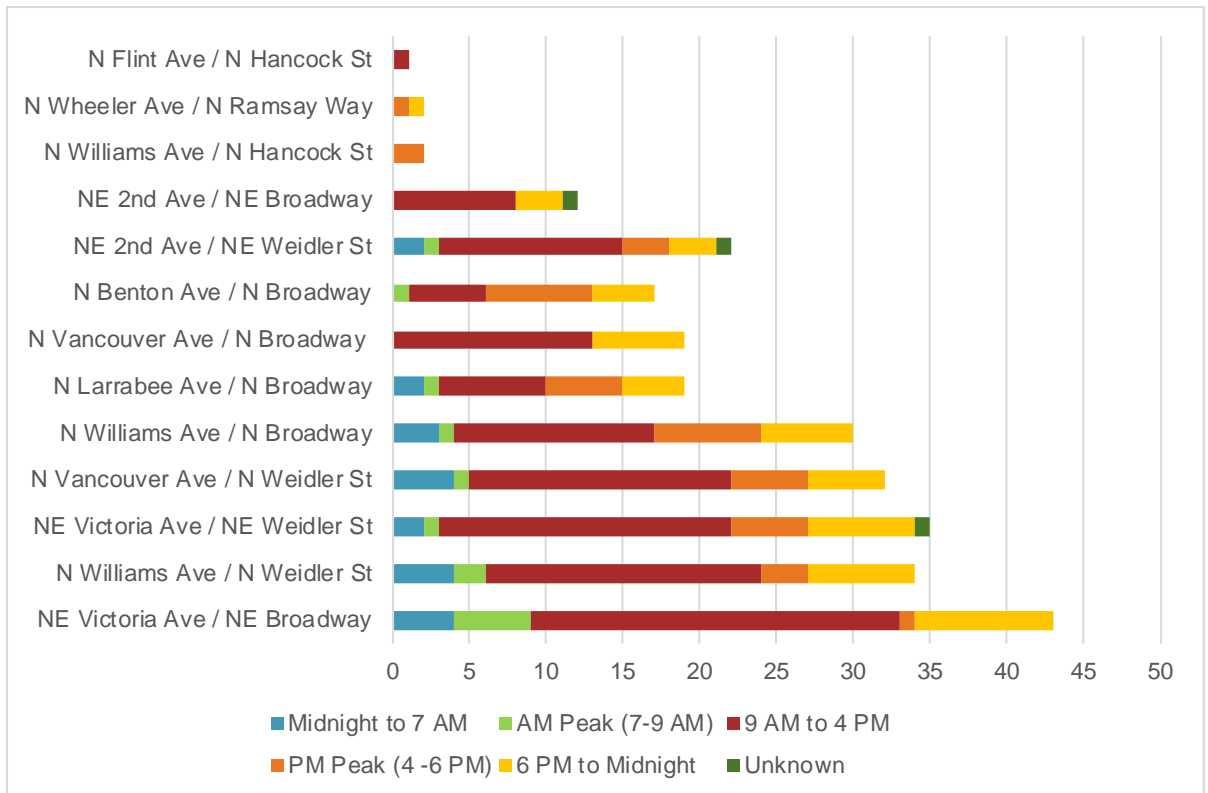
- Pedestrians and Bicyclists:** Eighteen of the 268 crashes in the API involved bicyclists, and two of the 268 crashes involved pedestrians. One of the pedestrian crashes was Injury Type A (at N Vancouver/N Weidler) and the other was Injury Type B (at N Benton/N Broadway). Of the 18 bike crashes, one was Injury Type A (at N Larrabee/N Broadway), ten were Injury Type B, and seven were Injury Type C. Figure 22 shows the intersection pedestrian and bicycle crashes by severity in the API.

Figure 22. Pedestrian/Bike Crashes (By Severity)



- Time of Crash:** Crashes occurred most frequently (144 of 268) during the midday off-peak period (9 AM to 4 PM). Figure 23 shows the total distribution of crashes by time of day at each intersection.

Figure 23. Crash Distribution by the Time of Day



- Distribution of Crashes by Month:** On average, there were four crashes per month during the 5-year study period. Over the 5-year period, July had the most per month (six crashes), and April the fewest crashes per month (two crashes).

5.2.2 Intersection Crash Ranking

Consistent with City of Portland methods, the API intersections were also ranked using a combination of three performance measures, as detailed in Section 4.3.4.1. The crash rates were calculated with the computed Average Daily Traffic data, using the turning movement count data provided by ODOT.

Each intersection was evaluated according to each performance measure and ranked from highest to lowest. There is no weighting of the individual performance measures. The final score is the sum of the rank of each performance measure. A lower score indicates a higher potential for safety improvement. Table 5 provides a summary of this ranking. As shown, the intersection of NE Victoria/NE Broadway has the greatest potential for safety improvement in the API.

Table 5. Intersection Crash Analysis Ranking (2011-2015)

Intersection Name	Dollar Value (\$)	Rank	Number of Crashes	Rank	Total Crash Rate	Rank	Total Score	Final Ranking
NE Victoria Ave / NE Broadway	\$ 522,500	1	43	1	2.2	2	4	1
N Williams Ave / N Weidler St	\$ 356,700	4	34	3	2.6	1	8	2
NE Victoria Ave / NE Weidler St	\$ 355,600	5	35	2	1.7	3	10	3
N Vancouver Ave / N Weidler St	\$ 414,100	3	32	4	1.4	5	12	4
N Williams Ave / N Broadway	\$ 328,100	6	30	5	1.4	5	16	5
N Larrabee Ave / N Broadway	\$ 458,100	2	19	7	0.8	9	18	6
N Vancouver Ave / N Broadway	\$ 198,200	9	19	7	1.4	5	21	7
N Benton Ave / N Broadway	\$ 232,300	8	17	9	1.5	4	21	7
NE 2nd Ave / NE Weidler St	\$ 278,800	7	22	6	1.3	8	21	7
NE 2nd Ave / NE Broadway	\$ 133,100	10	12	10	0.8	9	29	10
N Williams Ave / N Hancock St	\$ 18,600	13	2	11	0.4	11	35	11
N Wheeler Ave / N Ramsay Way	\$ 22,900	12	2	11	0.2	13	36	12
N Flint Ave / N Hancock St	\$ 24,000	11	1	13	0.3	12	36	12

The City of Portland’s list of High Crash Network Intersections was also reviewed to identify if any of the intersections within the API are currently identified as high crash locations.¹² Consistent with the findings in this analysis, the intersection of NE Victoria/NE Broadway was listed as one of the top bike crash locations. The intersection is ranked 6th of the 16 intersections on the city’s list. Of the 43 crashes in the study period, 7 were bicycle related. There were no fatal or serious injury crashes; however, 14 crashes led to injuries. Appendix C provides the detailed crash investigation for all study intersections in the API.

¹² Information on the City of Portland’s High Crash Network can be found here: <https://www.portlandoregon.gov/transportation/54892>.

5.2.3 Existing Local Street Multimodal Risk/Safety Assessment

As described in Section 4.3.4.2, a qualitative risk/safety assessment was conducted for the existing local street intersections. Locations with two of three criteria rated as moderate or higher (including two of three modes in the exposure category) were flagged for consideration.

The qualitative rating analysis showed the following trends under existing conditions:

- Intersections with both moderate and higher motorist, pedestrian, and bicycle exposure and risk ratings are generally concentrated along N/NE Broadway and N/NE Weidler. This higher risk generally correlates with the degree of activity in these corridors.
- Existing complex intersection features with higher bicycle/pedestrian risk potential include slip lanes and double turn lanes. While these risk factors have been addressed through signal timing at several intersections (e.g., bicycle signal at N Broadway and Williams), these conditions create uncomfortable conflict points for non-motorized users. Example intersections include NE Weidler at Victoria and N Broadway and Vancouver.
- Diagonal curb ramps and/or ramps missing detectable warning strips represent the most common intersection complexity for pedestrians. While these conditions may present few challenges for able-bodied people, pedestrians with disabilities (particularly the visually impaired) face challenging crossing conditions, especially at high-volume intersections.
- Prohibited crossing movements present an additional complexity, particularly for pedestrians, as users may be forced to follow circuitous routing to navigate through an intersection. This could result in risky behavior (e.g., non-compliance with prohibited crossings) if pedestrians are unwilling to divert to marked crosswalks. These conditions exist at N/NE Broadway at N Williams and N Wheeler/N Williams (formerly NE Wheeler) at N Ramsay.

The results of this assessment are further summarized in Appendix D. See Section 6.2.2.3 for discussion of the future No-Build and Build local street multimodal risk/safety assessments.

6 Environmental Consequences

This section discusses the anticipated beneficial and adverse impacts of the Project with regards to transportation safety for the No-Build and Build Alternatives.

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. Some improvements, such as curb ramp updates and the addition of protected bike lanes, would be made, however, as part of the Broadway multimodal improvements project. The following subsections describe the anticipated effects to highway and local street safety under the No-Build Alternative.

6.1.1.1 Highway Crash Analysis

Under the No-Build scenario, it is estimated that the highway would experience approximately 10 percent more crashes as compared to existing conditions. The majority of these additional crashes would be PDO.

6.1.1.2 Local Street Multimodal Risk/Safety Assessment

Results of the qualitative risk/safety assessment for local street intersections for the No-Build Alternative scenario indicate that the following impacts are anticipated in the future without the Project:

- Moderate and higher exposure ratings for all modes would continue to concentrate along N/NE Broadway and N/NE Weidler.
- The Broadway multimodal improvements project, a reasonably foreseeable future action extending from the Broadway Bridge to the Hollywood District, is anticipated to address a number of curb ramp deficiencies along the Broadway/Weidler corridor. This would reduce the level of pedestrian crossing complexity on these two major streets, particularly for people with disabilities.
- While the Broadway multimodal improvements project would address current pedestrian deficiencies, addition of a protected bike lane could introduce right-hook collision potential for bicyclists at locations where bicycle lanes currently do not exist. It is assumed that the City of Portland would devote particular attention to these conflict points in the Project's design phase.
- Outside of the Broadway/Weidler couplet, intersection complexity would be similar to existing conditions. Depending on location, features contributing to

increased complexity would generally include slip lanes, double turn lanes, broad turning radii, and deficient curb ramps.

6.1.2 Indirect Impacts

While it was not quantitatively evaluated, the No-Build Alternative could result in an increase in the frequency of low severity crashes on the highway within and outside the API due to high vehicle volumes, continued short distances for weaving and merging movements between the on- and off-ramps on I-5 between I-84 and I-405, and lack of shoulders for crash/incident recovery.

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. To increase safety for all road users, the Build Alternative proposes that safer connections would be provided for pedestrians and bicyclists, the character of the local road system would be changed by making the area more community-centric, and ramp configurations would be simplified to improve user experience. Pedestrian and bicycle facility improvements would be consistent with best practices and NACTO guidance. These improvements are summarized in Figures 6, 7, and 8 and are further described in the surrounding text (see Section 2.2).

6.2.1 Short-Term Construction Impacts

Construction of the Project would have short-term impacts to highway traffic, local street motor vehicle traffic, bicyclists, pedestrians, transit, and event access. A detailed transportation management plan would be prepared prior to construction that would describe the construction sequence and strategies for maintaining through travel and local access for all modes of transportation. Overall Project construction and transportation disruption could occur in phases for up to 4 years.

Highway lane closures are likely on I-5 during removal and construction of the overcrossing structures, including potential closure of all directional lanes. Lane closures would be concentrated during late nights and weekends.

All transportation modes (pedestrian, bicycle, motor vehicle, streetcar, and bus) would experience disruption during construction and would require a sequence of temporary accommodations. TriMet has indicated that they may consider temporarily rerouting affected bus lines in the area for the duration of construction to avoid a series of temporary route changes that would be confusing for riders. Future discussions and negotiations would determine specific details regarding accommodations needed to maintain streetcar service and comparable transit connections during construction.

Temporary structures would likely be constructed to accommodate motor vehicles, bicycles, and pedestrians on N/NE Broadway and N/NE Weidler during construction. The temporary structure(s) could be designed with temporary streetcar tracks as

well. Temporary local street closures or turn restrictions would be implemented as necessary to limit traffic diversion onto local streets. Street closures would be limited to 1-week periods and would be managed through extensive outreach and traffic management strategies. Temporary pedestrian accommodations would be ADA-compliant.

Event access would be maintained during construction and may require an increased level of active traffic management before and after events. The Project would coordinate closely with the Moda Center, City of Portland, and Oregon Convention Center in an effort to coordinate major traffic disruptions to avoid major events as much as possible.

6.2.2 Long-Term and Operational Direct Impacts

6.2.2.1 Future Conditions Highway Crash Analysis

The AASHTO *Highway Safety Manual* (HSM) (AASHTO 2010) predictive method for highways and interchanges using the software ISATe was applied to estimate the relative safety performance of the proposed Project. The method was applied without calibration factors, so the results are presented as relative differences rather than absolute predictions. The models are applied on a segment-by-segment basis, and segments are defined to have consistent geometric characteristics. In addition to geometric features, predicted crash frequency is highly sensitive to traffic volume on the roadway segment.

The models show upgrading shoulders to full standard on both sides of the highway in both directions provides the greatest safety benefit of the modifications proposed on I-5 in the API. As the predictions are sensitive to traffic volume, the forecast number of crashes per year would change as traffic volume increases. Upon the year of opening, it is forecast there would be fewer crashes than existing conditions. The decrease in crash frequency associated with the proposed improvements means that despite the growth in traffic, the forecast crash rate in the Build year would be lower than the No-Build scenario. In addition, it is estimated that of the crashes that do occur, the crash severity distribution would be similar to existing conditions.

6.2.2.2 Future Conditions Emergency Braking Assessment

VISSIM model results for future No-Build and Build conditions show the following findings related to emergency braking events:

- **NB:** Compared to the No-Build Alternative, the emergency braking event frequency on I-5 NB from SE Morrison Street to N Going Street is expected to drop by 51 percent and 25 percent for the Build AM and PM analysis period, respectively. Adding an auxiliary lane from I-84 to the Greeley off-ramp reduces weaving disturbances between mainline and entrance/exit traffic, especially at the key weaving segments between I-84 on-ramp and N/NE Weidler and between N/NE Broadway to I-405. The modification improves I-5 NB traffic flow, promoting upstream operation between Morrison and I-84, which decreases emergency braking events and improves safety conditions.

- SB:** The No-Build Alternative SB existing lane drop south of the N/NE Broadway off-ramp, coupled with heavy weaving volumes between I-405 and N/NE Broadway, causes slow speeds and substantial weaving conflicts as far north as the Greeley on-ramp. With the Build Alternative, the continuation of an auxiliary lane substantially minimizes weaving maneuvers. Emergency braking frequency on I-5 SB from Going to Morrison is expected to reduce by 33 percent and 74 percent for AM and PM peak periods, respectively. With the Build Alternative, SB traffic entering the network would travel faster due to downstream improvements related to the continuation of the auxiliary lane. The portion of braking events resulting from downstream congestion would correspondingly decrease in the Build Alternative.

Table 6 summarizes emergency braking event counts for the future No-Build and Build Alternatives. The graphics summarizing these results are included in Appendix E.

Table 6. Number of Emergency Braking Event Counts

Alternatives	I-5 Southbound Going St to Morrison St		I-5 Northbound Morrison St to Going St	
	AM Period	PM Period	AM Period	PM Period
Future No-Build	460,200	323,682	39,869	27,014
Future Build	308,921	83,179	19,413	20,383
Percent Change from No-Build to Build	33% Decrease	74% Decrease	51% Decrease	25% Decrease

Notes: I-5 = Interstate 5; St = Street

6.2.2.3 Local Street Multimodal Risk/Safety Assessment

Elements of the Build Alternative that would impact the local street system are described in Section 2.2. The qualitative risk/safety assessment conducted for local street intersections for the Build Alternative scenario resulted in the following observations:

- Similar to the No-Build Alternative, the NE Broadway multimodal improvements project is anticipated to address most, if not all, curb ramp deficiencies along the Broadway/Weidler couplet. At the same time, addition of protected bike lanes could introduce right-hook collision potential for bicyclists absent sufficient sight distance, intersection geometry, and operations.
- Additional intersection complexities unique to the Build Alternative would include the following:
 - Prohibited pedestrian crossings on some intersection legs (e.g., N Weidler at N Williams)
 - Left-side bike lanes transitioning to right-side bike lanes (e.g., N Vancouver at N Broadway)

- Major bicycle movements requiring two-stage crossings of a single intersection (e.g., N Williams at NE Hancock Street, Vancouver at N/NE Hancock).

Note that the proposed design would accommodate a WB-67 (e.g., truck with a wheelbase of 67 feet) turning movement in the API.

Table 7 shows the qualitative ratings (i.e., low, moderate, and high) for the existing, No-Build, and Build conditions at those study intersections where 1) two of three criteria were rated as moderate or higher (including two of three modes in the exposure category), and 2) there is a possible change from the future No-Build to future Build condition. An improvement is highlighted in green and possible decline is shown in red. Appendix E provides the rating for all study intersections. Again, exposure in this analysis refers to number of people, cars, or bicycles. In this analysis, exposure is a measure of volume, not risk.

Table 7. Summary of Sites with Changes in Qualitative Severity Rating from Future No-Build to Build Condition

Study Intersection	Scenario	Exposure (Motorist, Bicycle, Pedestrian)	Complexity	Risk	Impact of Proposed Project
N Weidler/N Vancouver	Existing	H, M, M	H	H	Potential Improvement
	No-Build	H, M, M	H	H	
	Build	H, L , M	H	H	
N Vancouver/N/NE Hancock (Build Only)	Existing	-	-	-	-
	No-Build	-	-	-	
	Build	M, L, M	M	M	
NE Broadway/NE 2nd	Existing	M, L, L	L	M	Pedestrian volumes increase due to access to Clackamas Bridge
	No-Build	M, L, L	L	M	
	Build	M, L, M	L	M	
N Wheeler/N Williams (formerly NE Wheeler/N Ramsay)	Existing	M, M, M	H	L	Traffic volumes decrease due to ramp relocation; pedestrian volumes increase due to access to Clackamas Bridge
	No-Build	M, M, M	H	L	
	Build	L , M, H	M	L	

Notes: H = high; L = low; M = moderate

Exposure is the number of people traveling through the site, complexity reflects the user experience and familiarity with physical characteristics of the site, and severity is mix of posted speed limits on cross streets. See Section 4.3 for details.

A green letter indicates an improvement from the previous scenario; a red letter indicates a worsening of conditions from the previous scenario.

In summary:

- At the intersection of NWeidler/N Vancouver, there is an expected decrease in bicycle crashes due to the proposed Clackamas bicycle and pedestrian bridge decreasing bicycle presence at this intersection (reduced exposure for bicyclists).
- The N Vancouver/NNE Hancock intersection would be a new intersection in the Build Alternative and is expected to have moderate motorist and pedestrian exposure and low bicycle exposure based on volumes. The intersection is anticipated to have moderate complexity based on the proposed intersection geometry and moderate risk based on speed limit.
- Exposure for pedestrians at the intersection of NE Broadway/NE 2nd is expected to increase because of increased pedestrian volumes due to pedestrians accessing the Clackamas bicycle and pedestrian bridge.
- At the intersection of NWheeler/NWilliams (formerly NE Wheeler)/NRamsay, there is an expected decrease in motorized vehicle crashes due to ramp relocation/removal of fifth leg, which decreases traffic volumes (therefore reducing exposure for motorists) and decreases intersection complexity (improves user experience by making intersection configuration more familiar and easier to navigate).

6.2.3 Long-Term and Operational Indirect Impacts

No indirect safety impacts are anticipated under the Build Alternative.

6.3 Cumulative Effects

Cumulative impacts are the 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 the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (Title 40 Code of Federal Regulations 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 Figure 9. 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 summarized in the following subsections.

6.3.2.1 Past Actions

Past actions include the following:

- Neighborhood and community development
 - Historical development of the Portland area and accompanying changes in land use
 - Development of the 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 included projects listed in the financially constrained element of Metro's RTP (Metro 2014) and other shorter-term projects and service improvements identified by the City of Portland and TriMet (Appendix A). These projects were assumed to be in place under the No-Build Alternative. It was also assumed that these projects would be designed according to applicable agency standards.

6.3.3 Results of Cumulative Impact Analysis

The evaluation of the transportation impacts of the Project is largely cumulative in nature. The forecast of the performance and operation of the transportation system is based on Metro's regional travel demand model and on analysis tools that rely on the regional model data. The travel demand model is built on population and employment growth forecasts adopted by the Metro Council and the financially constrained project list included in the RTP (Metro 2014). These growth forecasts and planned transportation projects incorporate the reasonably foreseeable future growth and major actions that would potentially impact transportation operations in the API.

6.4 Conclusions

Overall, the Project shows a reduced crash rate on I-5 in the API. The AASHTO HSM (AASHTO 2010) predictive method for highways and interchanges using the software ISATe was applied to estimate the relative safety performance of the proposed Project. The method was applied without calibration factors, so the results are presented as relative differences rather than absolute predictions. The models are applied on a segment-by-segment basis, and segments are defined to have consistent geometric characteristics.

The largest safety benefit results from upgrading shoulders to full standard on both sides of the highway. Additionally, the Project would substantially reduce emergency braking events, which would reduce the incidence of rapid deceleration that can result in rear-end crashes. Upon the year of opening, it is forecast there would be fewer crashes than existing conditions. The decrease in crash frequency associated with the proposed improvements means that despite the growth in traffic, the forecast crash rate in the Build year would be lower than the No-Build scenario. In addition, it is estimated that of the crashes that do occur, the crash severity distribution would be similar to existing conditions. Finally, alleviating congestion on the highway would benefit crash frequency on the local system by having less traffic diversion onto the local system.

The qualitative safety analysis rated the local intersections for exposure (i.e., number of people), complexity (i.e., user experience and familiarity with physical characteristics, modal separation) and severity (i.e., posted speed limits). The Project may decrease the risk of crashes at N Weidler/N Vancouver (due to decreased exposure for bicyclists) and N Wheeler/N Williams (formerly NE Wheeler)/N Ramsay Way (due to decreased exposure for motorists and decreased complexity). Pedestrian volumes would increase at NE Broadway/NE 2nd due to pedestrians accessing the Clackamas bicycle and pedestrian bridge. The bridge would allow pedestrians to bypass at least two intersections, reducing overall pedestrian exposure within the API (in relation to the two aforementioned intersections).

Additionally, all the intersection designs in the Build Alternative should consider the following options to reduce risk, where applicable:

- Verify signal timing provides sufficient crossing time.
- Address potential bicycle/motor vehicle conflicts through proactive signing, striping, and signal phasing.
- Review, and adjust if necessary, adjacent on-street parking to improve stopping and intersection sight distance.
- Verify intersection turning radii are consistent with desired interactions between motorists, pedestrians, and bicyclists.



In addition, NACTO guidance and other best practices for pedestrian and bicycle design would be integrated into Project development and design. Further, on-street parking would be reviewed and adjusted as needed to achieve stopping and intersection sight distance for all modes.

7 Avoidance, Minimization, and Mitigation Measures

Safety must be a consideration both during construction and for the long-term operation of the Project. Best practices that can maximize both short-term and long-term safety are discussed below:

- Apply best practice design treatments on the local road system to integrate transit vehicles, separated bicycle lanes, pedestrians, and motorists, specifically as this relates to the potential risks associated with right turn movements or other potential conflict points between modes.
- The Oregon Bicycle and Pedestrian Plan and the City of Portland's Portland Bicycle Plan for 2030 provide example best practices for transportation facility design that should be considered for this Project.
 - Oregon Bicycle and Pedestrian Plan:
https://www.oregon.gov/ODOT/Planning/Pages/Plans.aspx#accordion-collapse-ctl00_ctl00_ctl22_g_85545598_99ee_4a1b_acd0_f0bee524051a_ctl03
 - Portland Bicycle Plan for 2030
<https://www.portlandoregon.gov/transportation/article/289122>
- Construction and traffic management plans should consider best practices and opportunities to reduce risk to construction workers and the traveling public. In Oregon between 2011 and 2015, there were an average of 488 work zone related crashes per year. The distribution of crash severity in work zones vs. non-work-zones is very similar; however, there are slightly more fatal crashes in a work zone.
- ODOT provides a variety of resources that describe best practices for work zone safety, including the following:
 - Traffic Control Plan Design Manual
 - Oregon Temporary Traffic Control Handbook
 - Work Zone Traffic Analysis Handbook
 - Transportation Management Plan Guidance Manual

These ODOT work zone safety documents are available at:

<https://www.oregon.gov/ODOT/Engineering/pages/index.aspx>

8 Contacts and Coordination

To complete this report, the preparers coordinated with the City of Portland and Metro to obtain traffic volume assignments and bicycle trip assignments from the regional travel demand model; TriMet to obtain route- and stop-level transit ridership data and policies and plans for future improvements; and Portland Streetcar Inc. to obtain policies and plans for future improvements. Other contacts included various ODOT staff and other members of the consultant team.

9 Preparers

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