Oregon Department of Transportation

OREGON INTERSECTION SAFETY IMPLEMENTATION PLAN UPDATE

September 2023

Photo credit: Kittelson & Associates

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INTRODUCTION

The 2021 Oregon Transportation Safety Action Plan (TSAP)[1] supports our ongoing long-term vision of eliminating fatalities and serious injuries on Oregon roadways by 2035. The TSAP noted that an estimated 36% of all fatal and injury crashes occurred at intersections between 2014-2018 (the most recent data available at that time). As a result, one of the key action items identified by the TSAP is developing this update to the Oregon Intersection Safety Implementation Plan to replace the version completed in 2012.

[1] *Oregon Department of Transportation (ODOT) (2021). Oregon Transportation Safety Action Plan. https://www.oregon.gov/odot/Safety/Documents/2021_Oregon_TSAP.pdf.*

What's New in This Update?

Whereas the previous plan focused on certain countermeasures, this update has developed a data-driven framework for conducting systemic intersection safety analyses that is in line with the Safe System Approach (SSA). The resulting framework can be used by local agencies and ODOT Regions in conjunction with ODOT All Roads Transportation Safety (ARTS) program-approved countermeasures to identify and implement low-cost systemic projects over multiple sites.

This update also includes several example applications, including:

- Applying the screening methodology to:
  - A sample of intersections on the ODOT highway network
  - City of Salem intersections
- Potential intersection countermeasures at 30 ODOT highway intersections.
- Using the screening methodology to identify sites for installing a specific countermeasure at intersections in Salem.

Incorporating the Safe System Approach

This plan incorporates a Safe System Approach (SSA)-based framework. The SSA approaches roadway safety with the notion that a crash resulting in a fatal or serious injury on a roadway is unacceptable. It focuses on human mistakes and vulnerabilities and establishes multiple layers of protection to prevent crashes from occurring and reduce crash severity when they do occur. It encourages proactively designing intersections to reduce crash risk in anticipation of human error. SSA intersection design principles are shown in Figure 1.

While crashes are unavoidable, their severity can be mitigated through appropriate countermeasures focused on these design principles[2]. In accordance with the SSA, **this plan is focused on fatal and suspected serious injury (i.e., Injury A) crashes**. SSA principles inform other aspects of this plan, including screening characteristics selection, network screening, and countermeasure identification and prioritization methods.

[2] *Federal Highway Administration (FHWA) (2021). A Safe System-Based Framework and Analytical Methodology for Assessing Intersections. Tech Brief: A Safe System-Based Framework and Analytical Methodology for Assessing Intersections (dot.gov).*

Figure 1. SSA Principles for Intersection Design

Integration with the ARTS Program

Consistent with the SSA framework, this plan approaches intersection safety through a proactive, data-driven systemic process that identifies intersections with the greatest potential for fatal and serious injury crashes. This approach complements the "Hotspot" approach, which focuses on intersections with the highest historic crash rates (ODOT's Safety Priority Index System (SPIS) is an example of a hot-spot screening approach. **The systemic approach is well-suited for evaluating high-severity, low-frequency crash types, such as severe intersection crashes**.

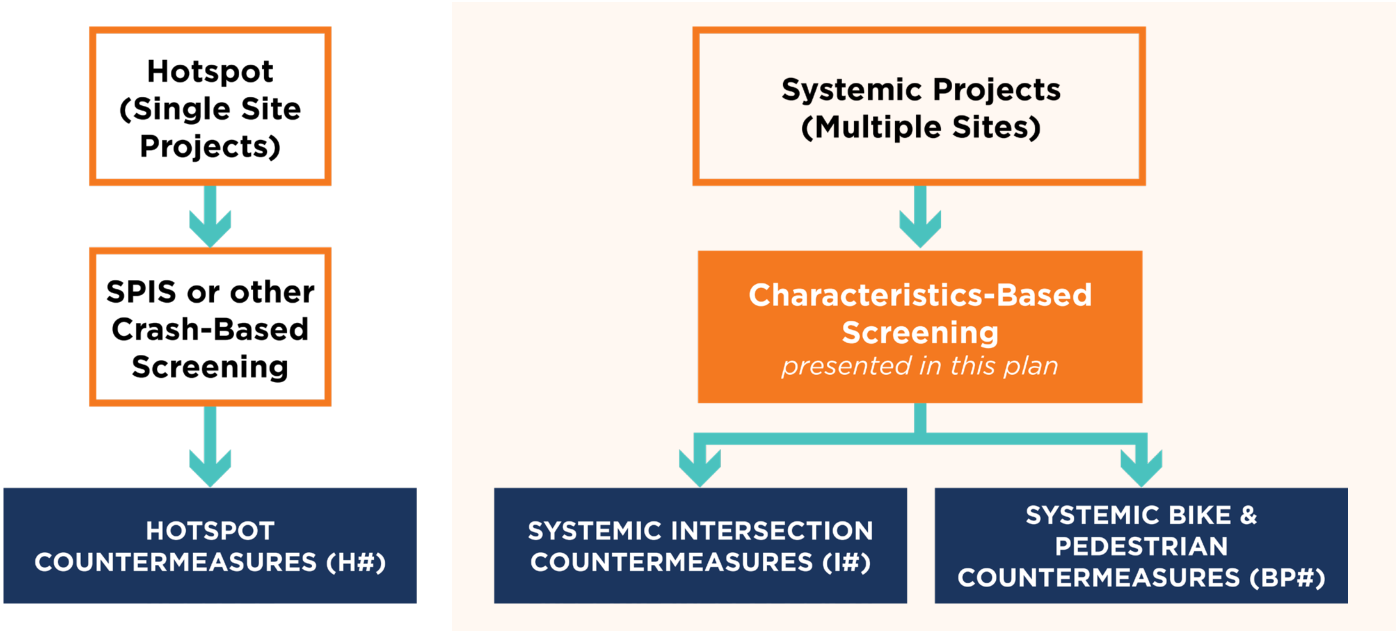
The systemic approach considers that while the location of severe intersection crashes may appear random, ***the underlying contributing factors are predictable.***

Photo credit: Kittelson & Associates

ODOT ARTS Countermeasure H18/H19: Install Roundabout from Minor Stop Control/Signalized Intersection

ODOT administers its federal (Highway Safety Improvement Program) safety funding through the ARTS program. ARTS is currently divided into Hotspot and Systemic categories, as shown in Figure 2. Hotspot projects typically focus on one site and tend to be higher cost. These projects are prioritized using benefit-cost analysis, so a crash history-based screening method (e.g., SPIS) is the most effective way to identify sites for this funding category. Systemic projects are meant to be lower-cost projects deployed across multiple sites, some with fatal and serious injury crash history and some without. Identifying sites without crash history for including in a systemic project application can be challenging. **The characteristics-based screening method presented in this plan can be used to identify sites, with and without crash history, to include in a systemic project application.** It can also be used to supplement a crash-based screening method to prioritize Hotspot sites.

Figure 2. ARTS Intersection Countermeasure Categories and Most Relevant Screening Methods



Crashes at Oregon Intersections (2015 – 2021)

From 2015 to 2021, the number of intersection crashes has decreased in most years. The number of fatal and suspected serious injury crashes recently peaked in 2021 at 993 compared to 636 to 776 crashes per year in the preceding years. They also represented about 5% of all intersection crashes in 2021, compared to approximately 2.5% to 3.7% in previous years. To achieve ODOT's goal of zero fatal and serious injury crashes by 2035, this plan focuses on fatal and serious injury crashes.

Figure 3. Oregon Intersection Crashes, 2015 to 2021

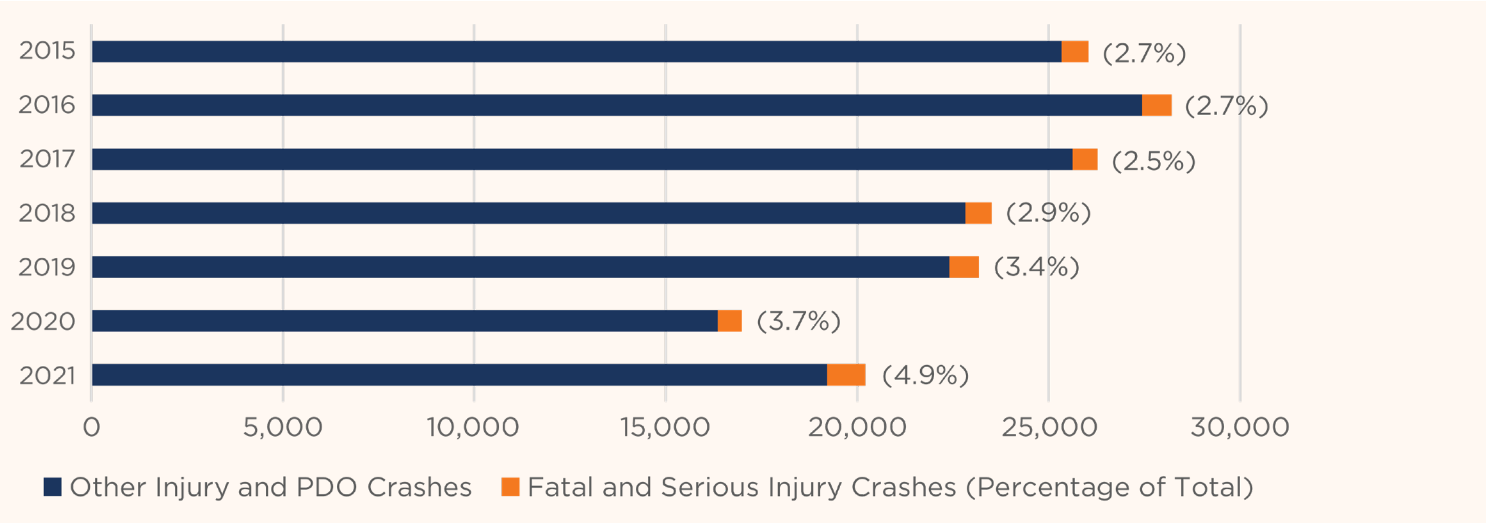
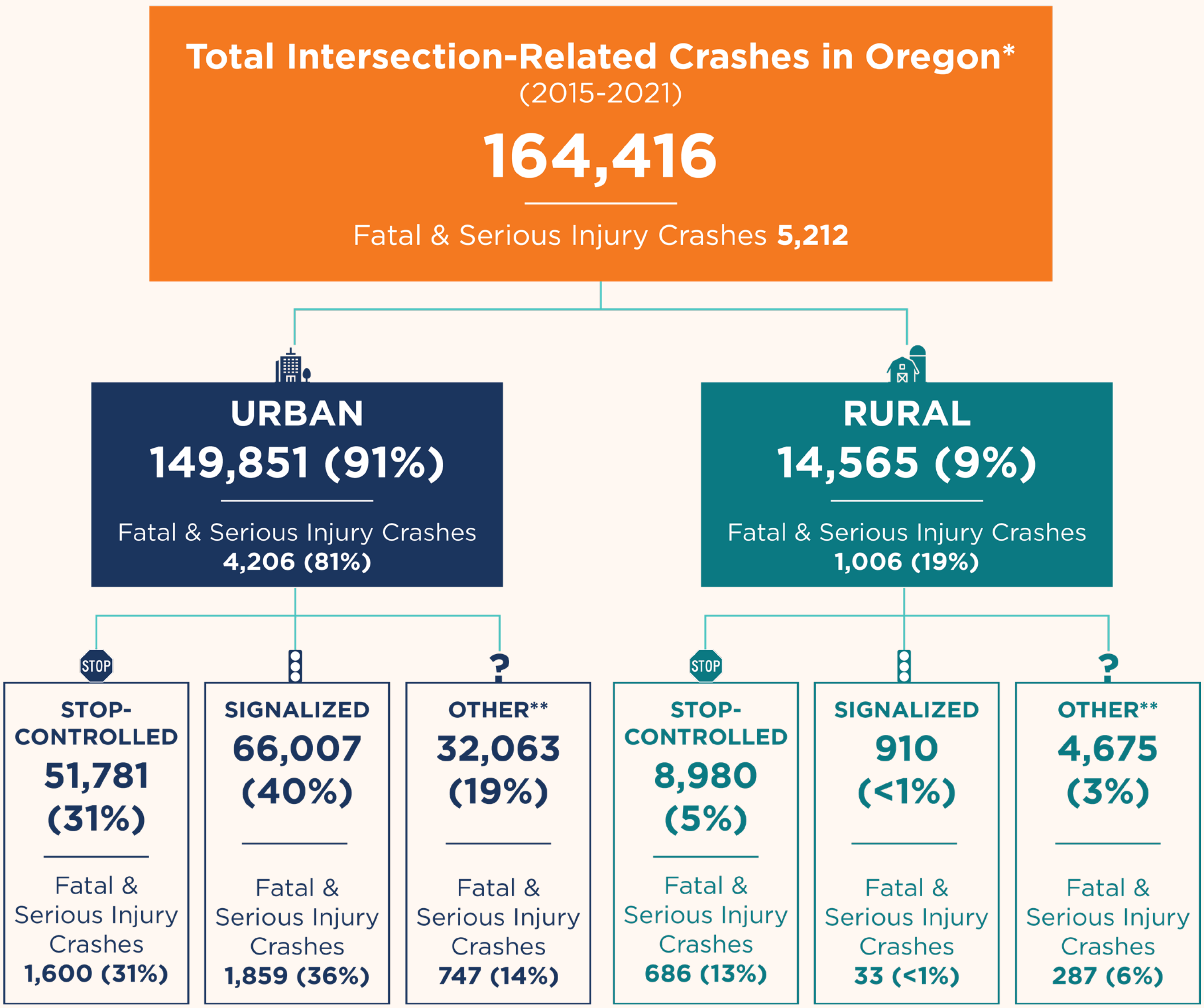


Figure 4 shows a crash tree illustrating the distribution of crashes by area type and traffic control. There were 164,416 intersection-related crashes in Oregon from 2015-2021. Urban intersections accounted for most intersection crashes at 91%, including 81% of all fatal and suspected serious injury crashes. Despite accounting for only 9% of all intersection crashes, rural intersection crashes account for 19% of all fatal and suspected serious injury crashes. This indicates that a fatality or suspected serious injury is more likely at a rural intersection than an urban intersection. A similar pattern occurs with stop-controlled intersections, which account for 36% of all crashes but 44% of all fatal and suspected serious injury crashes.

Figure 4. Crash Tree - Intersection-Related Crashes in Oregon (2015-2021)



**Traffic control is summarized as provided in the crash data and urban/rural designation is based on roadway functional classification indicated in the crash data.*

*** Other crashes are typically when the traffic control is listed as "unknown" in the crash data*

PROJECT APPROACH AND APPLICATION

This plan applied a methodology for identifying and implementing intersection safety projects that aligns with the systemic approach. This methodology frames a process for statewide, regional, and local applications of the Oregon Intersection Safety Implementation Plan Update. The process outlined in this section is a summary of work previously conducted by the project team in four technical memoranda, which are included in the Appendix.

PROJECT PROCESS

The methodology for the Oregon Intersection Safety Implementation Plan Update is outlined in the five steps shown in Figure 5 and described in the following section.

Figure 5. Oregon Intersection Safety Implementation Plan Update Process

Photo credit: Kittelson & Associates

ODOT ARTS Countermeasure BP6: Install Urban Green Bike Lanes at Conflict Points

STEP #1: CONFIRM STUDY NETWORK AND COMPILE AVAILABLE DATA

This step includes identifying the study network, including target crash and/or intersection types (e.g., angle crashes, signalized intersections) and then compiling available data for the analysis. *The completion of this step for this plan is documented in detail in Technical Memorandum #1, provided in Appendix A.*

Confirm Study Network

First, the agency/ODOT Region should determine the overall study network that will be analyzed. This will likely be defined based on the overall goal of the analysis. Study networks may be defined by jurisdictional ownership and/or boundaries (e.g., all intersections within a city, intersections involving county roads only) or specific sub-areas (e.g., a specific District within an ODOT Region). *For this plan, the study network was a sampling of intersections on ODOT highways*.

Then, a target intersection and/or crash type(s) may be identified. This can be accomplished using a crash tree, like the one shown in Figure 4. The crash tree can identify at what type of intersection (e.g., signalized, two-way stop control, ramp terminal) fatal and serious injuries are most prevalent within the study area. It can also be used to identify the crash types (e.g., left-turning, angle, pedestrian) most commonly associated with these crashes. This step may be revisited after a countermeasure is selected in subsequent steps to further narrow down the network. *In the City of Salem example in Appendix B, the study network was further narrowed down to urban signalized intersections with bike lanes after the City selected the countermeasures to install*.

Compile Available Data

Ideally, all data used for the analysis is already in a geographic information system (GIS) or other linear referenced format. If it is not, it may need to be converted to such a format. There are four general data categories to consider when compiling data:

Intersection characteristics (including intersection locations) – functional classification, speed, control type (e.g., signal, two-way stop), number of legs, presence of bicycle or pedestrian infrastructure, turn lanes, and number of lanes can be used in this analysis.

- Intersection location and traffic control are required to complete this analysis.
  - If an agency does not have an intersection file, one can be developed in GIS software using spatial analysis tools to create nodes at roadway network intersections. This process requires quality control checks to remove locations associated with over- or undercrossing locations that may be calculated as an intersection.
  - Intersection control may not be available in many cities. In smaller cities, the lack of traffic control data may be easily overcome by manually assigning signals, which are likely few. For larger cities, the time required to manually assign intersections may impact feasibility of conducting the screening characteristic analysis network screening depending on available resources/staffing. Open-source data sources like OpenStreetMap may be used to assist in identifying signalized intersection locations.
- All other characteristics are useful, but not required, and the agency may omit factors for which it does not have data.

Demographic/equity data – ODOT's Social Equity Index covers the entire state and can be used, or an agency may use its own index.

Crash data – Crash data is required for completing the benefit-cost analysis for ARTS applications or for developing agency-specific factors, if desired. It is not used in the screening process.

Traffic volumes – This analysis uses 24-hour volumes. If an agency does not have its own counts database, ODOT data may provide sufficient coverage, or functional classification can be used as a surrogate measure. *ODOT data is used in the City of Salem example in Appendix B*.

Correlation vs. Causation

The identified characteristics are generally correlated with fatal and suspected serious injury crashes. This does not necessarily mean that the presence of the characteristic is contributing to crashes. This may be particularly true of characteristics that are likely acting as proxies for other features of the intersection (e.g., the presence of a bike lane is likely a surrogate measure for bicyclist exposure as opposed to a feature that creates hazards for intersection users).

Turn lanes are another example where the relationship between the characteristic and crashes is complex. Turn lanes have been shown to reduce certain crash types in specific situations and are included in ODOT's ARTS program's crash reduction factor (CRF) list. Locations with turn lanes may have higher turning volumes or more complex movements. The dataset does not include information about where other countermeasures may exist, such as protected left-turn phasing, prohibiting right-turns-on-red (RTOR), or the specific design of the turn lane (e.g., a right-turn yield control slip lane compared to a more typical right-turn lane with stop or signal control and a tighter radius).

Photo credit: Kittelson & Associates

ODOT ARTS Countermeasures I3: Add 3-inch Yellow Retroreflective Sheeting to Signal Backplates & I8: Replace Doghouse with Flashing Yellow Arrow Signal Heads

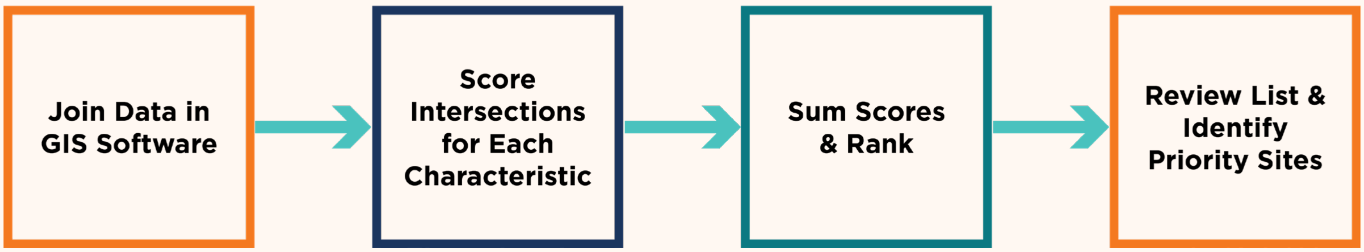
STEP #2: SCREEN NETWORK

The second major step is to screen the network and identify potential sites. Systemic safety analyses can be performed using either a characteristics-based screening method, like the one recommended below, or by using safety performance functions (SPFs). The characteristics-based screening method is recommended for local agencies due to its data flexibility and level of effort to implement.

Characteristics-Based Screening

This approach scores intersections based on the presence of certain characteristics according to the process shown in Figure 6 below:

Figure 6. Characteristics-based Screening Process



Don't Have All the Data?

Network screening can be completed without using all the screening characteristics. Functional classification can be used as a surrogate for volume (AADT), number of lanes, and/or posted speed data if they are not available. Other characteristics can be omitted from the screening process (e.g., if your agency does not have turn lane data, you can still screen without applying that factor).

Table 1 summarizes the screening characteristics and their weighted scores. These scores have been developed based on each characteristic's correlation with crash severity in the statewide dataset used for this plan. These characteristics and their scores can be used by local agencies and ODOT Regions. If desired, a local agency could develop its own scores, though the limited sample size of crash data in small and mid-sized jurisdictions may result in biased results. *More information on how these factors were identified and weighted can be found in Appendices A and C.*

An intersection is given the amount of points shown in Table 1 for each relevant present characteristic (e.g., an urban signalized intersection with a maximum posted speed of 35 miles per hour (MPH), an average annual daily traffic (AADT) volume of 28,000 vehicles per day, a maximum of 5 lanes on one cross-street, and is located in a Medium High Equity Disparity area as noted by ODOT's Social Equity Index would receive a score of 1.01 + 1.00 + 1.04 + 1.16 = 4.21; note that functional classification is not used in this example since speed, volume, and number of lanes is available).

Table 1. Screening Characteristics and Weighted Scores

Characteristic	SIGNALIZED[1] Urban	SIGNALIZED[1] Rural	STOP CONTROLLED[1] Urban	STOP CONTROLLED[1] Rural
Functional Classification[2]				
Arterial (Principal + Minor)	1.03	-	1.25	-
Arterial (Principal)	(1.12)	1.29 (3.59)	(1.24)	1.61 (2.37)
Arterial (Minor)	(1.19)	-	-	-
Other Freeways and Expressways	(1.06)			
Posted Speed				
35 mph	1.01 (1.00)	-	1.00 (1.31)	-
40 – 45 mph	1.09 (1.19)	-	1.49 (2.00)	-
45 – 50 mph	-	1.00	-	1.06 (1.22)
≥ 50 mph	1.11 (1.33)	-	2.04 (1.44)	-
≥ 55 mph	-	1.13	-	2.03 (3.05)
Volume (AADT)				
AADT ≥ 10,000	-	-	1.27 (1.03)	1.80 (2.78)
AADT ≥ 25,000	1.00	1.24 (1.00)	-	-
AADT between 25,000-40,000	(1.00)	-	-	-
AADT ≥ 40,000	(1.18)	-	-	-
Approach Characteristics				
Right Turn Lane Present[3]	(1.05)	-	1.81	2.10
Left Turn Lane Present[3]	1.70 (1.03)	1.10 (2.97)	1.09 (1.34)	1.95 (3.18)
Number of Through Lanes ≥ 3		-	1.33 (1.60)	1.51 (1.00)
Number of Through Lanes ≥ 4	1.04 (1.01)	1.46 (1.02)	-	-
Equity				
Medium High or High Equity Disparity	1.16 (1.03)	1.20 (1.16)	1.05 (1.00)	1.65 (2.16)
Active Transportation				
Bicycle Volumes[4]	1.03 (1.01)	1.27 (3.59)	1.31 (1.36)	1.00 (3.40)
Pedestrian Volumes[5]	1.01 (1.02)	1.44 (3.59)	1.03 (1.01)	1.13

[1] Each cell provides two values, "Value Not on a Ramp | (Value on a Ramp)". Cells with one value only apply to that intersection type.
[2] Functional classification is likely a surrogate for number of lanes, speed, and volume. Therefore, it should only be used when one or more of these datasets are missing.
[3] See discussion in "Correlation vs. Causation"
[4] Bicycle volume data is not available from ODOT at a statewide scale, so the presence of a bicycle lane is used as a proxy to indicate whether an intersection should be prioritized for bicycle related treatments.
[5] Pedestrian volume data is not available from ODOT at a statewide scale so the presence of a sidewalk lane is used as a proxy to indicate whether an intersection should be prioritized for pedestrian related treatments.

SPF-Based Screening

Another approach for conducting systemic safety analysis uses safety performance functions (SPFs) to project long-term crash frequency at intersections of certain types. Projected crashes are calculated based on traffic control, number of legs, and traffic volume. The advantage of using the SPF-based approach is that results can be compared across intersection sub-groups. It can also be used to identify Hotspot projects. However, this approach has a less diverse range of inputs, which results in a heavy focus on higher volume intersections with four legs. Additionally, this approach has more rigid data requirements compared to the screening characteristic-based approach. *Technical Memorandum #2, provided in Appendix C, includes a more detailed comparison and considerations for each screening method.*

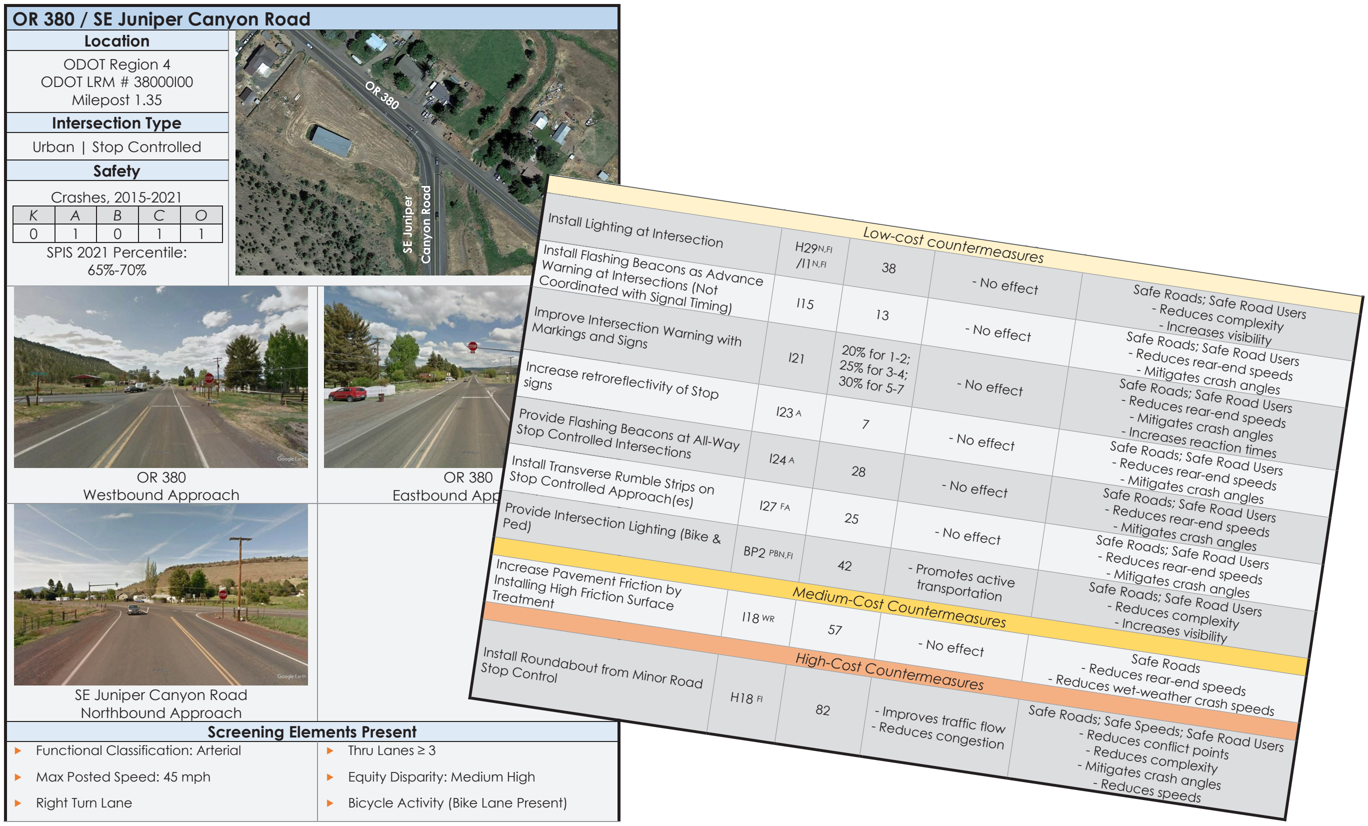
STEP #3: SELECT POTENTIAL COUNTERMEASURES

In this third step, the agency/ODOT Region selects potential countermeasures for the sites identified in Step 2. In certain cases, the countermeasure may be identified before Step 2 is completed based on an identified crash type, which was the case in the City of Salem example in Appendix B. Considerations in selecting a countermeasure(s) include:

- **Effectiveness –** the crash reduction factors (CRFs) in the ARTS list indicate how effective treatments are expected to be at reducing crashes.
- **Crash type addressed –** countermeasures should be reviewed to ensure they are relevant to the crash type being addressed. ODOT's CRF Manual provides more information on the crash type(s) addressed by each countermeasure: https://www.oregon.gov/odot/Engineering/ARTS/CRF-Manual.pdf.
- **Cost –** There may be a fixed budget already identified for the project. If applying for ARTS funding, the ARTS program considers the benefit-cost ratio of Systemic Intersection projects.
- **Feasibility/Suitability –** Each site should be evaluated to determine whether the identified countermeasure(s) is appropriate and feasible for the site. This includes reviewing physical and geometric conditions, traffic data, land-use context, and crash history. Desktop reviews can be used for an initial screening, but field reviews should be conducted prior to finalizing recommendations.

Technical Memorandum #3, provided in Appendix D, documents how this process was completed for this plan. This appendix includes example potential countermeasures at 30 sites around the state. Figure 7 shows an example of potential countermeasures at one site.

Figure 7. Example Potential Countermeasures at One Site in Appendix D



STEP #4: PRIORITIZE AND IMPLEMENT PROJECTS

In Step 4, the plan identified a process for prioritizing and implementing projects based on the results of Steps 1-3. This process includes:

- **Consider additional community priorities and programming needs** - This could include turning movement counts, crash data, speed studies, planning documents, equity concerns, public input, maintenance costs, and/or construction schedules and resources.
- **Perform additional diagnostics** - A field review of potential sites should be completed.
- **Perform economic assessments** - Most intersection projects are assessed using a benefit-cost analysis. Systemic projects can be grouped together to calculate a combined benefit-cost ratio across all sites. Systemic pedestrian and bicycle projects are prioritized using ODOT's cost-effectiveness index methodology.
- **Allocate funding and implement projects** - ODOT allocates funding for systemic intersection safety projects through the ARTS program. Funds are allocated to each ODOT Region based on a five-year fatal and serious injury crash history. The Regions are encouraged to use at least half of the funds on systemic projects. Of their systemic funds, Regions are encouraged to dedicate about 35% to intersection projects.

This process is applicable to ODOT Regions and local agencies. *Appendix D contains more information on this step.*

Photo credit: Kittelson & Associates

ODOT ARTS Countermeasures I21: Improve Intersection Warning (Larger Signs) and I25: Provide Flashing Beacons at Minor Road Stop Controlled Intersections

STEP #5: EVALUATE PROGRAM AND PROJECT IMPACTS

In Step 5, documented in further detail in Appendix D, the plan recommends methods for completing before-and-after project evaluations, as well as assessing an overall program. The evaluation and monitoring activities focus on two categories:

Program Implementation – This entails evaluating progress made in implementing the program and could include monitoring and evaluating the following:

- Whether the process is being carried out (i.e., is the process being implemented as intended?).
- The level of funding being allocated to systemic intersection safety projects.
- The number of systemic intersection safety projects implemented.
- The time between when funding is allocated and when projects are implemented.
- Identifying implementation barriers and lessons learned (e.g., additional data needs, policy/funding challenges, training needs, additional coordination needed).
- The percentage of locations in the Top 10% for characteristics-based scores (or another category) that have been treated.
- Number of ARTS applications submitted for systemic intersection projects.

Program Outcomes – This includes evaluating the success of the program in achieving its goals (e.g., reducing intersection-related fatalities and injuries). Performance measures ODOT may consider using for this purpose include:

- Number of intersection crash-related fatalities and serious injuries, including breakouts by:
  - Crash type
  - Intersection control type
  - Social Equity Index category
  - Roadway ownership (i.e., State vs. non-State), including breakouts by urban and rural context.
  - Vulnerable users
- Number of fatal and serious injury intersection crashes, including breakouts by the same categories as those described for the number of fatalities and injuries.

The results of these activities can be used to track progress and continue to improve processes to achieve ODOT's goal of achieving zero fatalities or serious injuries on ODOT roadways by 2035.

Photo credit: Kittelson & Associates

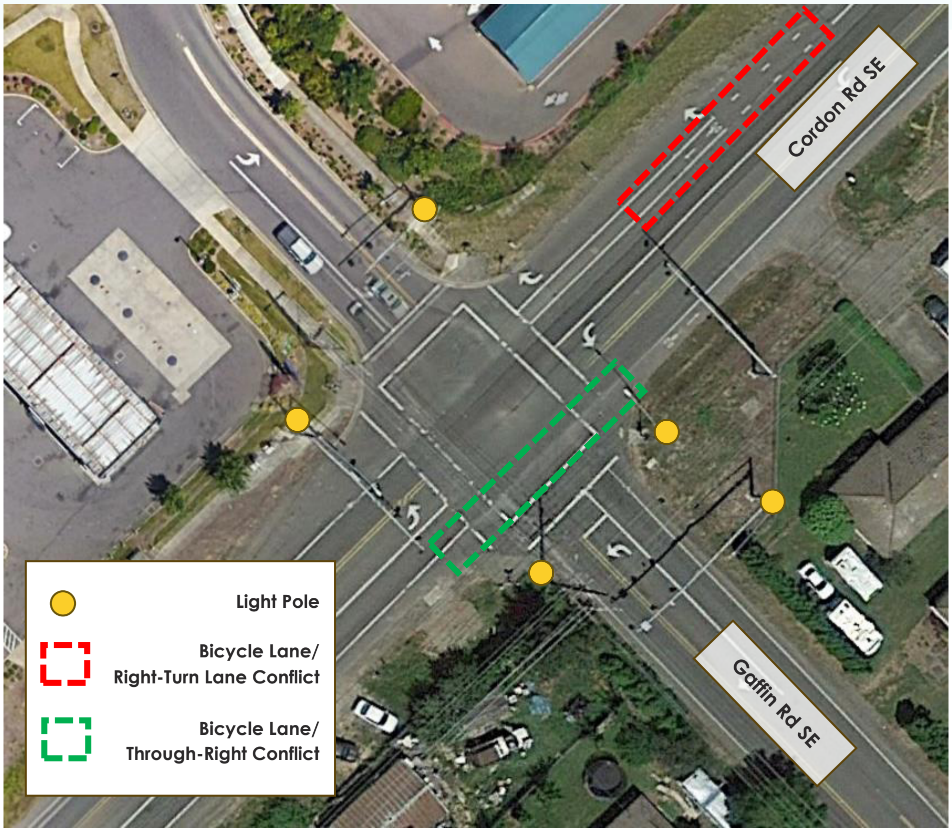
ODOT ARTS Countermeasure I25: Provide Flashing Beacons at Minor Road Stop Controlled Intersections

CASE STUDY APPLICATION
CITY OF SALEM

If a city, county, or region has identified a potential systemic intersection treatment, the characteristic-based analysis scores can provide an initial screening method to identify intersections that may benefit from the treatment. To demonstrate an application at the local level, the plan conducted a case study of the characteristic-based screening process applied in Steps 1-5 to support the City of Salem in identifying high-priority intersections for an ARTS application. The case study demonstrates an example application and key considerations that cities or counties may encounter when implementing the characteristic-based process developed as part of the Plan. This application is documented in detail in a technical memorandum provided in Appendix B.

The City identified two intersection countermeasures that they would like to implement systemically: green pavement markings at bicycle and right-turn conflicts (ODOT Crash Reduction Factor (CRF) BP6) and lighting at bicycle conflict points (ODOT CRF BP2). Using the characteristic-based network screening results, the plan prioritized locations that have potential bicycle and right-turn conflicts. These results can be used by Salem to inform the prioritization process for an ARTS application.

Example of Salem Intersection Review Results



CONSIDERATIONS FOR APPLICATION OF THE CHARACTERISTICS-BASED ANALYSIS APPROACH

Software and Staffing

- The characteristic-based screening requires knowledge of GIS software to spatially assign data to a single intersection layer.
  - GIS capabilities may also include the ability to create and perform quality control on an intersection layer if the agency does not already have one.
  - The characteristic-based score calculations can be completed within GIS software, or the results can be exported to a spreadsheet and calculated in spreadsheet software (e.g., Microsoft Excel).

Data Availability

- Some data management and preparation may be required to assign roadway characteristics to intersections.
  - Intersection traffic control may not be available in many cities. In smaller cities, the lack of traffic control data may be easily overcome by manually assigning signals, which are likely few. For larger cities, the time required to manually assign intersections may impact feasibility of conducting the screening characteristic analysis network screening depending on available resources/staffing. Open-source data sources like OpenStreetMap may be used to assist in identifying signalized intersection locations.
  - Many cities or counties may not have turn lanes, sidewalks, bicycle lanes, or other roadway characteristic data. The analysis can be completed without this data by omitting these factors from the overall characteristic-based score.
  - If ODOT and/or local or regional AADT volume data is not sufficient, functional class can be used as a proxy for relative volume.
  - Ramp terminal information would be important for regional analysis or larger metropolitan areas (e.g., Portland).
- An intersection dataset can be developed in GIS using spatial analysis tools to create nodes at roadway network intersections. This process requires quality control checks to remove locations associated with over- or undercrossing locations that may be calculated as an intersection.
- If a local agency does not have sufficient data to conduct the analysis, they should reach out to ODOT for technical assistance in assessing their data and steps necessary to obtain the needed data.
- If a local agency has its own equity index, additional considerations to translate a local equity index to comparative ranges from the ODOT Social Equity Index (medium-high and high) is necessary.

Prioritization of Sites

- If a city or county has identified a potential systemic treatment, the characteristic-based analysis scores can provide an initial screening method to identify intersections that may benefit from the treatment.
  - The project team used this method for the City of Salem case study application.
- Alternatively, a city or county can use the characteristics-based analysis to screen a local jurisdiction network to identify treatments (systemic or hot spot) based on the characteristic-based scoring results.
- Other prioritization criteria (such as community input, crash history, or other community goals) may be integrated with the characteristic scoring to help prioritize locations that would achieve multiple goals within a jurisdiction.

CONCLUSION

The overall process described in this plan can be used for identifying and prioritizing Hotspot or Systemic projects focused on reducing fatal and suspected serious injury crashes. The characteristics-based screening approach developed in this plan is best used for identifying and prioritizing locations for Systemic Intersection treatments. It can be used to:

1. Prioritize locations after a certain treatment has been identified to address a known crash trend, similar to what is done in the City of Salem example.
2. Score all intersections in a network, or subgroup of a network, and identify a treatment(s) based on the characteristics of the intersections that score the highest.

The characteristics-based screening approach is flexible to the data ODOT or a local agency has available. However, it does require an intersections database that contains traffic control information. If an agency does not have such a database, they will need to create one. Creating such a database requires modest GIS software capabilities.

ODOT's ARTS list presents a range of systemic countermeasures focused on intersections, bicycle, and pedestrian crashes. This list is regularly updated and should be consulted each time an agency is developing a project. In addition to reviewing this list, ODOT and local agency staff should consider how Safe System Approach principles for all users can be applied in the design or improvement of an intersection.

Photo credit: Kittelson & Associates

ODOT ARTS Countermeasure I23: Increase Retroreflectivity of Stop Signs

FUTURE CONSIDERATIONS

This section identifies future considerations for ODOT as it moves forward to implement and maintain this plan.

LOCAL AGENCY IMPLEMENTATION

Feedback from ODOT and local agency staff obtained through the project's Technical Advisory Committee (TAC) and Local Agency Advisory Committee (LAAC) indicate that the characteristics-based screening method developed for this plan would be useful for identifying and prioritizing systemic intersections projects. Feedback from the LAAC identified the following obstacles to implementing it at the local agency level:

- Staff time or skillsets
- Understanding how the process can be used within the context of ARTS and other grant funding programs
- Data availability

Given these findings, some ways in which ODOT could support local agencies in applying the results of this plan could include:

- Providing training on how this approach can be used in ARTS applications and on how to conduct the analysis
- Providing technical support in completing analyses, either through ODOT or consultant staff
- Providing technical support in answering questions from local agency staff

DATA

Data-related recommendations include:

- ODOT should continue to maintain its intersection dataset and expand it to include all intersections on the State highway system
- Periodically update screening characteristics weights with new crash data, additional intersection data, or updated roadway characteristic data
- Incorporate additional screening characteristics if new data becomes available, such as
    - Lighting
    - Left-turn signal phasing
    - All-way stop control vs. two-way stop control identification
    - Bicycle and pedestrian intersection treatments (e.g., crossing treatments, bike boxes)
    - Intersection skew angle

TREATMENTS

ODOT should continue to research potential countermeasures to reduce fatal and suspected serious injury intersection crashes and their effectiveness and update the ARTS list as necessary.

Photo credit: Kittelson & Associates

ODOT ARTS Countermeasure I33: Curb Extensions