# Technical Memorandum

August 24, 2023                                                                 Project# 27003.022

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From:    Katie Popp, Nick Foster, AICP, RSP1, Matt Braughton, RSP1, Pete Jenior, PE, PTOE

CC:      ODOT Technical Advisory Committee

RE:      ODOT Intersection Safety Implementation Plan Update - City of Salem Case Study

## CITY OF SALEM CASE STUDY

The Oregon Intersection Safety Implementation Plan Update is intended to be implementable at the statewide, ODOT Region, and local agency levels. As such, the project team conducted a case study application of the risk factor-based analysis at the local agency level using City of Salem data. The case study demonstrates key considerations that ODOT Regions and local agencies may encounter when implementing the risk factor-based process developed as part of the Plan. The application of this project's methods and these considerations are discussed below.

## Study Network and Available Data

The City's GIS database includes most of the data required to conduct the intersection screening analysis using the risk-based process. Remaining data needs were fulfilled by data available from ODOT. A summary of the data sources for each risk factor is shown in Table 1.

**Table 1. City of Salem Case Study Data Sources**

| Risk Factor | Data Source | Considerations[1] |
|---|---|---|
| Intersection Type | City of Salem (COS_Intersections, COS_SignalizedIntersections, COS_StopSigns) | The COS_Intersections layer did not have traffic control type defined. Therefore, the COS_SignalizedIntersections were used to define signalized intersections and the COS_StopSigns were used to identify stop-controlled intersections. Intersections without a signal nearby or a stop sign were assumed to also be stop signs. |
| Functional Class | City of Salem (COS_FunctionalClass) | Joined functional class for all intersection approaches using a search radius of 50 feet. Maximum functional class was used for the analysis. |
| AADT | ODOT 2021 AADT | Joined AADT for all intersection approaches using a search radius of 50 feet. Maximum AADT was used for the analysis. |
| On a Ramp Terminal | Kittelson – Manual Assignment | Determined manually via reviewing aerial photography (Google Earth). |
| Posted Speed | City of Salem (COS_Centerlines) | Joined posted speed for all intersection approaches using a search radius of 50 feet. Maximum posted speed was used for the analysis. |

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| Risk Factor | Data Source | Considerations[1] |
|---|---|---|
| Left Turn Lane/ Right Turn Lane | City of Salem (COS_TurnLane) | The dataset includes the location of all striped arrows (e.g., some turn lanes have multiple points for each striped arrow). Some intersections without turn lanes may incorrectly be assigned a turn lane because a turn arrow is downstream or upstream of the intersection and within the radius used to assign turn lanes (100 feet). |
| Number of Through Lanes | City of Salem (COS_Centerlines) | Joined number of through lanes for all intersection approaches using a search radius of 25 feet. Maximum number of through lanes was used for the analysis. |
| Presence of a Bike Lane | City of Salem (COS_BikeRoutes) | Joined bicycle data for all intersection approaches using a search radius of 100 feet. Lines for bike routes were not consistent with the centerlines layer. Shared lane markings and Family Friendly Bikeways were included in the search. |
| Presence of a Sidewalk | City of Salem (COS_Sidewalks) | Determined by the presence of a sidewalk within six feet of an intersection. This distance was selected based on reviewing distance of intersection points to the outer edge of intersection where sidewalk lines were located. A distance less than 65' may not capture all intersections with a sidewalk in their vicinity, whereas a distance threshold too large may incorrectly assign presence of a sidewalk to an intersection without one. |
| Equity | City of Salem Equity Data (Census Tract Level) | Tracts that scored 15 points and above are scored the same as the Medium-High and High Equity Disparity levels defined by the ODOT Social Equity Index. |
| Federal Aid Urban Boundaries (FAUB) | Federal Aid Urban Boundaries Data | Not a risk factor but used to clarify intersections as urban or rural. All intersections in Salem's urban growth boundary are classified as Urban. |

[1]Search radius differed depending on the GIS layer that was used to join the data. Layers with larger search radii had linework that was generally farther away from the centerlines layer, which was used to create the intersections.

## Data Screening

The project team screened the COS_Intersections layer and removed the following:

- Intersection nodes that were incorrectly defined as intersections. These incorrect nodes were locations where COS_Centerlines merged, diverged, and crossed at locations other than intersections (e.g., at bridges).
- Intersection nodes with less than three legs (defined by the field WAY_COUNT).

Overall, 3,745 stop controlled intersections and 232 signalized intersections in Salem were analyzed. There are nine intersections at ramp terminals in Salem, all of which are on Interstate 5 (I-5). Therefore, intersections on a ramp terminal were excluded from the analysis due to the limited number of these types of intersections in Salem.

# Comparison to ODOT Network Screening Methodology

## Bicycle Facilities

In the Salem analysis, shared bicycle facilities (i.e., where people biking and people driving share the same space) were included. For Salem, these include Family Friendly Bikeways (FFB) and streets with shared lane markings. These facilities are not included in the ODOT data used to develop the risk factors. However, the project team determined that including these facilities would be appropriate at the local level because they are expected to have higher bicycle traffic than roadways without shared or designated bicycle facilities.

## One-Way Streets

Intersection data available from ODOT did not include directionality (e.g., one- or two-way) data for all intersection traffic control types. Therefore, directionality was not considered in the statewide ODOT network screening. At a local level, it may be more feasible to include directionality as an additional screening factor if an agency is searching for locations for a specific intersection treatment. The City of Salem could include this as an additional screening factor since they have directionality data.

## Data Coverage

The City of Salem GIS database included most of the data items that could be used to conduct the risk factor analysis. Salem's data included public roadways in the city except for most private roads and local streets/alleys in the dense residential areas. The ODOT AADT data covered most arterials and collectors in Salem. Because of this AADT coverage, and Salem having speed limit and number of lanes data, functional classification was not included in the final risk factor score[1].

Some of the minor differences between data coverage include:

- Intersection Data – The City of Salem has intersection, traffic signals, and stop signs datasets. Therefore, all signalized intersections and all stop-controlled intersections on arterials and collectors were included in the Salem analysis.
- Turn Lane Data Format – The City of Salem has turn lanes in a point format at each painted turn lane arrow, whereas ODOT has turn lane data in a linear format representing the length of a turn lane.
- Bicycle Facility Data – The City of Salem bicycle facility data is more detailed than the ODOT network screening data and contains more types (i.e., Family Friendly Bikeways, shared lane markings, cycle tracks, unpaved paths, and shared use paths). As discussed, shared facilities were included in the analysis in addition to separated bicycle facilities such as bike lanes, cycle tracks, and shared use paths.

## Ramp Terminals

The City of Salem only has a few intersections at ramp terminals, so they were excluded from the screening analysis. At the local level, any intersection improvements at ramp terminals would likely be assessed on a case-by-case basis and would necessitate coordination with ODOT.

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[1] As discussed in Technical Memorandum #1, 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.

## Equity Index

The City of Salem case study used Salem's city-specific equity index to identify areas with high equity disparity. The Salem equity index broadly uses the same population demographic factors as the ODOT Social Equity Index (SEI) from the American Community Survey (ACS) data to calculate the equity index[2]. The two indexes differ in the weighting of factors and the subsets of population groups included in the calculation (e.g., Salem's calculation includes a category for persons 65 years or older with a disability, whereas the SEI includes persons aged 20 to 64 to that have a disability). Additionally, the Salem index is at the Census Tract level, whereas the ODOT index evaluates at the Census Block Group level. Additionally, the Salem equity index uses a 25-point scoring system, whereas the ODOT screening uses a different scoring system that assigns equity based on categories like "High Equity Disparity". The project team along with the City of Salem determined that an equity score of 15 or greater would align with "medium-high" or "high" equity disparity defined by the ODOT Social Equity Index.

A comparison of the ODOT equity index versus the City of Salem equity index data coverage is shown in Figure 1. As displayed, census tracts scoring 15 or higher based on the Salem equity index results in lower coverage, which better targets areas of higher equity disparity. However, because Salem uses Census Tracts, the coverage also expands further beyond Block Groups used by ODOT, including some areas outside of the City boundary to the east.

# Risk-Based Analysis Results

Each intersection was scored using the risk factor weights defined in *Technical Memorandum #2: Network Screening*. The rural risk factor weights did not apply to intersections in the City of Salem dataset. The top scoring signalized intersections and stop controlled intersections are provided in Table 2. Intersections scoring in the top 10% of the analysis are displayed in Figure 2. A full list of intersections scoring in the top 10% of the analysis is in Appendix A.

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[2] The Salem Equity Tool (Beta Version) uses 2016-2020 ACS data and ODOT SEI uses 2017-2021 data.

**Legend**
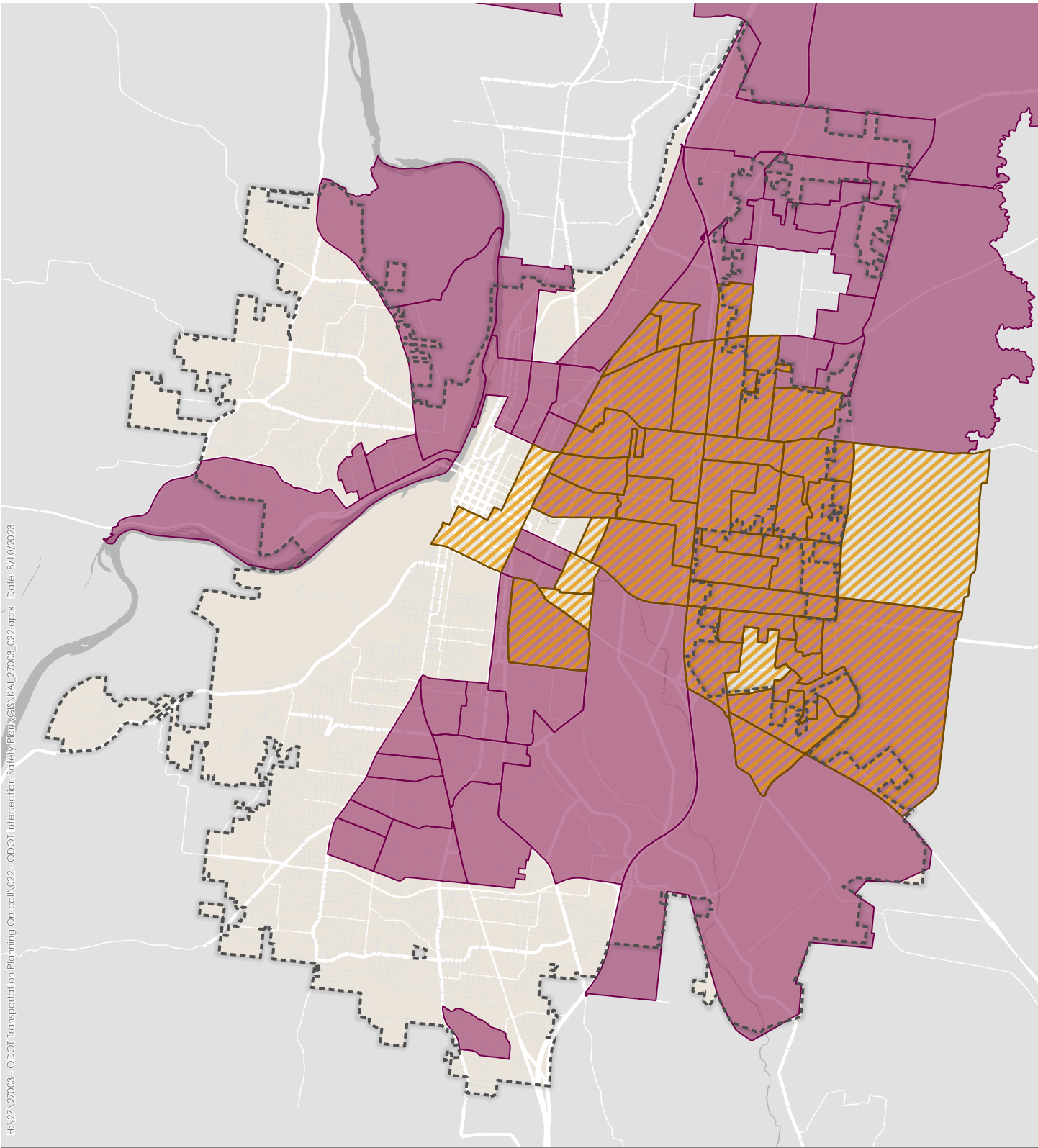
- Salem Equity Index - Score 15 and Above (by Tract)
- ODOT Social Equity Index - High and Medium-High Equity Disparity (by Block Group)
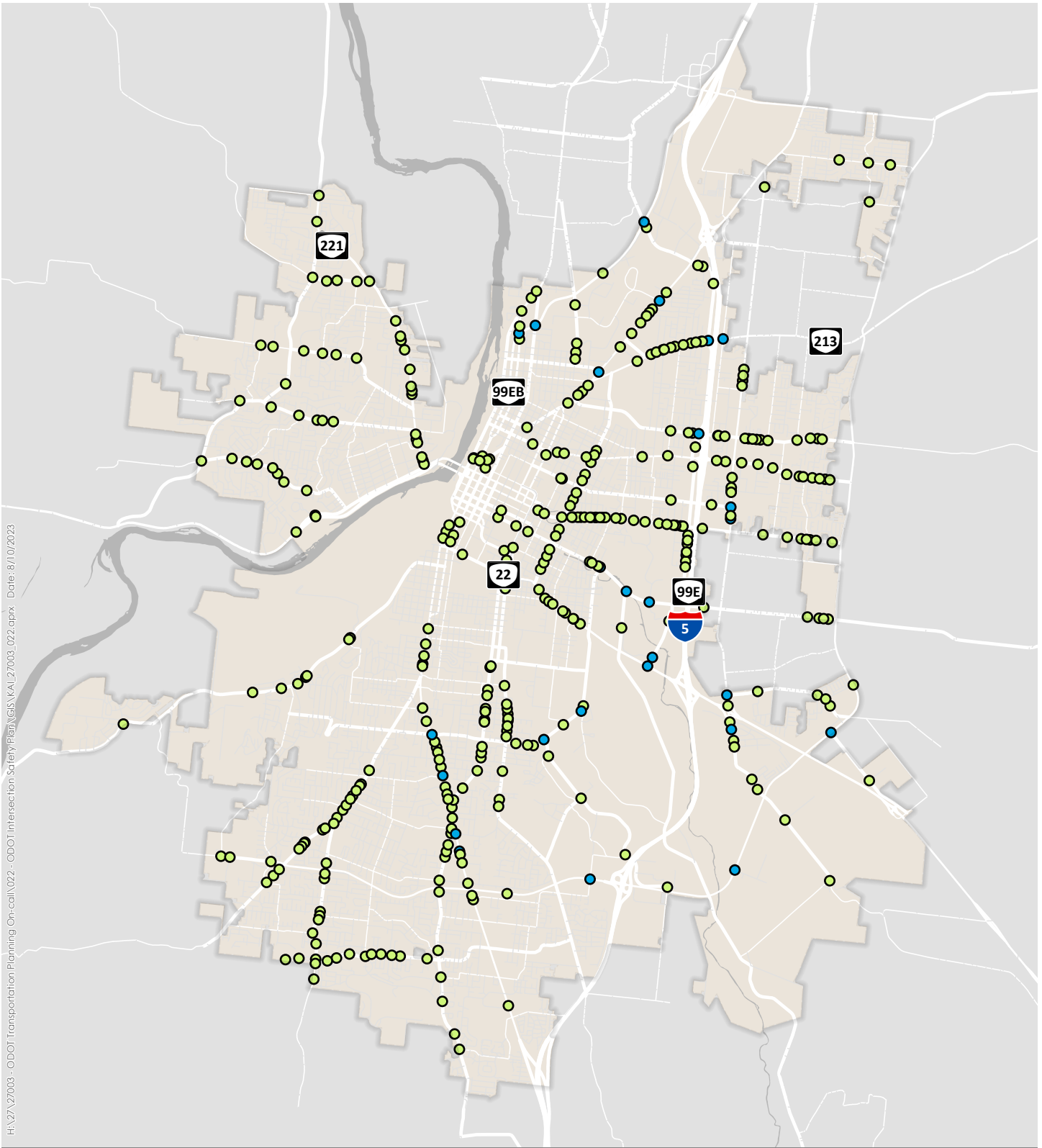- City of Salem

0     2 Miles

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Figure 1

**Equity Index Comparison**

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**Table 2. Top-Scoring Intersections by Traffic Control Using Risk Factor-Based Method**

| Intersection | Risk Factor Score |
|---|---|
| **Signalized** | |
| Hawthorne Ave SE & North Santiam Hwy SE | 8.05 |
| Salem Pkwy NE & Hyacinth St NE | 8.05 |
| Broadway St NE & Salem Pkwy NE | 8.03 |
| Commercial St SE & Keglers Ln SE | 8.03 |
| 27th Ave SE & Kuebler Blvd SE | 8.03 |
| Commercial St SE & Hilfiker Ln SE | 8.03 |
| Browning Ave SE & Commercial St SE | 8.03 |
| D St NE & Lancaster Dr NE | 7.95 |
| Denver Ave NE & Lancaster Dr NE | 7.95 |
| Commercial St SE & Madrona Ave SE | 7.95 |
| Pine St NE & Portland Rd NE | 7.95 |
| **Stop Controlled** | |
| Boone Rd SE & Commercial St SE | 10.38 |
| 12th St Cutoff SE & Oakhill Av SE | 10.38 |
| Hawthorne Ave SE & Kettle Ct SE | 10.38 |
| Doaks Ferry Rd NW & Wallace Rd NW | 10.38 |
| Scotsman Ln NE & Sunnyview Rd NE | 9.89 |
| Commercial St SE & Ratcliff Dr SE | 9.89 |
| Hyacinth St NE & Mainline Dr NE | 9.89 |
| Glendale Ave NE & Lancaster Dr NE | 9.89 |
| Hawthorne Ave NE & Weston Ct NE | 9.89 |
| Portland Rd NE & Rose Garden St NE | 9.89 |

**Traffic Control**

- Traffic Signal
- Stop Control
- City of Salem

0    2 Miles

Figure 2

**Risk-Based Screening Results
Top 10% by Traffic Control (Excluding Ramps)
City of Salem**

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There are several groupings of top 10% intersections along major corridors in Salem, including:

- A concentration of stop-controlled intersections on Silverton Road, Center Street, Sunnyview Road, Liberty Road, Commercial Street, and OR221.
- There is a grouping of top 10% signalized intersections on Commercial Street and State Street.

## Key Takeaways – City of Salem Intersection Data

The project team reviewed the characteristics of the top 10% intersections in Salem to the characteristics of the top 10% of intersections in the ODOT network screening. Table 3 summarizes this comparison. Exhibits showing these comparisons are provided in Appendix B.

Observations from the comparison to the top 10% of the statewide ODOT network screening include:
- Signalized intersections:
  - There is a higher representation of intersections with AADT between 10,000 and 25,000, likely attributed to the limited number of roadways with greater than 25,000 AADT in the City of Salem.
  - Higher representation of intersections with three legs, a right-turn lane present, bicycle facilities, and sidewalks present.
  - Higher representation of intersections with greater than four lanes; however, the Salem data includes center two way left turn lanes (TWLTL) in this data field, while ODOT does not include the TWLTL in their lane count, so 4-lane highways in ODOT's dataset may sometimes be 5-lane roads.
  - Higher representation of intersections with a 55-mph posted speed or greater.
- Stop controlled intersections:
  - Higher representation of minor arterials, intersections with three legs, and intersections with right-turn lanes.
  - Higher representation of intersections with greater than four lanes. As discussed above, this may be a result of ODOT data not including center turn lanes.
  - Posted speeds are generally lower in the Salem data compared to the ODOT data.

**Table 3. Common Characteristics in Risk-Based Top 10% for the City of Salem**

| Characteristic | Urban Signals | | Urban Stop Controlled | |
|---|---|---|---|---|
| | Salem | ODOT | Salem | ODOT |
| **Highest Functional Classification** | | | | |
| Local | 0% | 0% | 0% | 0% |
| Minor Arterial | 0% | 4.5% | **34%** | 10% |
| Principal Arterial[1] | 92% | 92% | 64% | 88% |
| Other Freeways and Expressways | 4% | 4% | <1% | 1% |
| **AADT** | | | | |
| <1,000 | 0% | 0% | 0% | 0% |
| Between 1,000 and 10,000 | 0% | <1% | **21%** | 12% |
| Between 10,000 and 25,000 | **58%** | 29% | 56% | 74% |
| Between 25,000 and 40,000 | 38% | 65% | **21%** | 13% |
| >40,000 | 4% | 5% | **2%** | <1% |
| **Number of Legs** | | | | |
| 3 Legs | **46%** | 28% | **75%** | 65% |
| 4 Legs | 54% | 66% | 23% | 31% |
| **Number of Lanes** | | | | |
| 1 | 0% | 0% | 0% | 46% |
| 2 | 0% | 0% | 8% | 8% |
| 3 | 0% | 0% | 37% | 36% |
| 4 | 12% | 95% | 1% | 12% |
| 5+ | **88%** | 5% | **53%** | 0% |
| **Turn Lanes** | | | | |
| Left-Turn Lane Present | 100% | 100% | 25% | 65% |
| Right-Turn Lane Present | **59%** | 31% | **67%** | 53% |
| **Max Posted Speed** | | | | |
| 20 mph | 0% | 0% | 0% | 0% |
| 25 mph | 0% | 0% | 0% | <1% |
| 30 mph | 0% | 0% | **7%** | 3% |
| 35 mph | 15% | 29% | **54%** | 31% |
| 40 mph | **42%** | 15% | **18%** | 8% |
| 45 mph | 27% | 45% | 14% | 22% |
| 50 mph | 4% | 5% | <1% | 8% |
| 55+ mph | **12%** | 5% | 0% | 27% |
| **Salem Equity Score ≥ 15** | 100% | 100%[2] | **83%** | 76%[2] |
| **Bike Lane Present** | 100% | 100% | **99%** | 23% |
| **Sidewalk Present** | 100% | 100% | **99%** | 66% |

[1]Roadways classified as "Parkway" in the Salem database were combined with Principal Arterials for comparison purposes.

[2]ODOT Equity Index based on "Medium-High" or "High" Equity disparity.

# Example Application – Intersection Prioritization for Safety Countermeasures

The project team conducted an example application of the risk-based screening to support the City of Salem in identifying high-priority intersections for All Roads Transportation Safety Program (ARTS) applications. The risk-based scores can be used to prioritize intersections with similar characteristics, such as bicycle lane/ right-turn conflicts and lighting within those conflict zones.

The City of Salem identified green paint (ODOT crash reduction factor (CRF) BP6) as a possible systemic intersection safety treatment at signalized intersections with bicycle lanes that cross over right-turn lanes). If there isn't a dedicated right-turn lane, green paint can be applied through the intersection to highlight potential bicycle lane conflicts with right-turning vehicles. Additional lighting at these conflict points (ODOT CRF BP2) will also be considered if there is not existing lighting. To identify potential intersections to prioritize for these treatments, the project team conducted the following steps using GIS software:

1. Identified a sub-group of the study intersection dataset that includes signalized intersections with bike lane and right-turn conflicts by filtering the study intersections dataset with the following characteristics:
    a. Signalized intersection
    b. Bike lanes present on at least one leg
    c. Right turn lane present on at least one leg
2. Sorted the sub-group (190 intersections) by the risk-factor based score.
3. Reviewed the following characteristics for each approach at intersections in the sub-group scoring in the top 50% of the risk factor-based analysis:
    a. Presence of a bike lane and a dedicated right-turn lane conflict point (i.e., the point where right-turn traffic must cross the bike lane to enter the right-turn lane prior to the intersection)
    b. Presence of a bike lane and a through-right turn lane conflict (i.e., the point where a right-turning vehicle turns across the path of people biking in the intersection)
    c. Presence of lighting at each conflict point[3]

The project team reviewed characteristics of the 190 intersections in an Excel spreadsheet that will be provided to the City. The spreadsheet includes lighting and bicycle lane/right-turn conflict information for each approach. For example, the Cordon Road SE/Gaffin Road SE in Salem shown in Figure 3 demonstrates a scenario where green paint could be added to the area where right-turning vehicles cross the bike lane (see the red box) on the northeast leg. The City can also apply green paint through the intersection to highlight the potential conflict between right-turning vehicles and cyclists in the bike lane on Cordon Road.  The intersection may also benefit from additional lighting on the northeast leg to illuminate the conflict point.

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[3] City of Salem provided light pole data.

**Figure 3. Cordon Road SE & Gaffin Rd SE in Salem, OR**
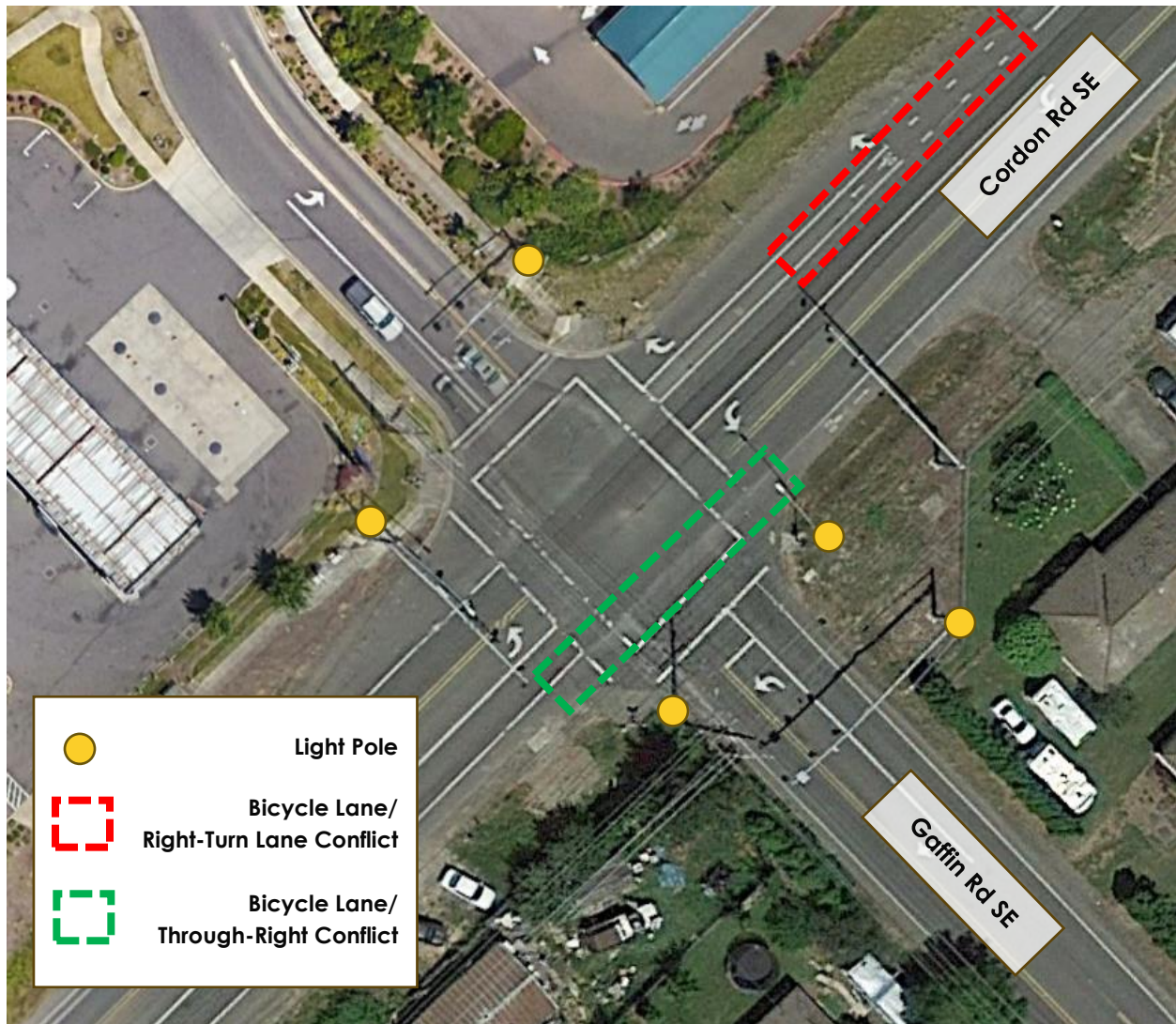


As another example, the Center Street NE/Lancaster Drive NE intersection, shown in Figure 4, has bike lanes on all four approaches. The City can implement green paint (CRF BP6) at the bicycle lane and dedicated right-turn conflict on the west leg. For the remaining legs, the City can apply green paint through the intersection to highlight the potential conflict between right-turning vehicles and people biking. The intersection may benefit from additional lighting (CRF BP2) to illuminate conflicts on the northeast and southeast corners.

**Figure 4. Center Street NE and Lancaster Drive NE in Salem, OR**
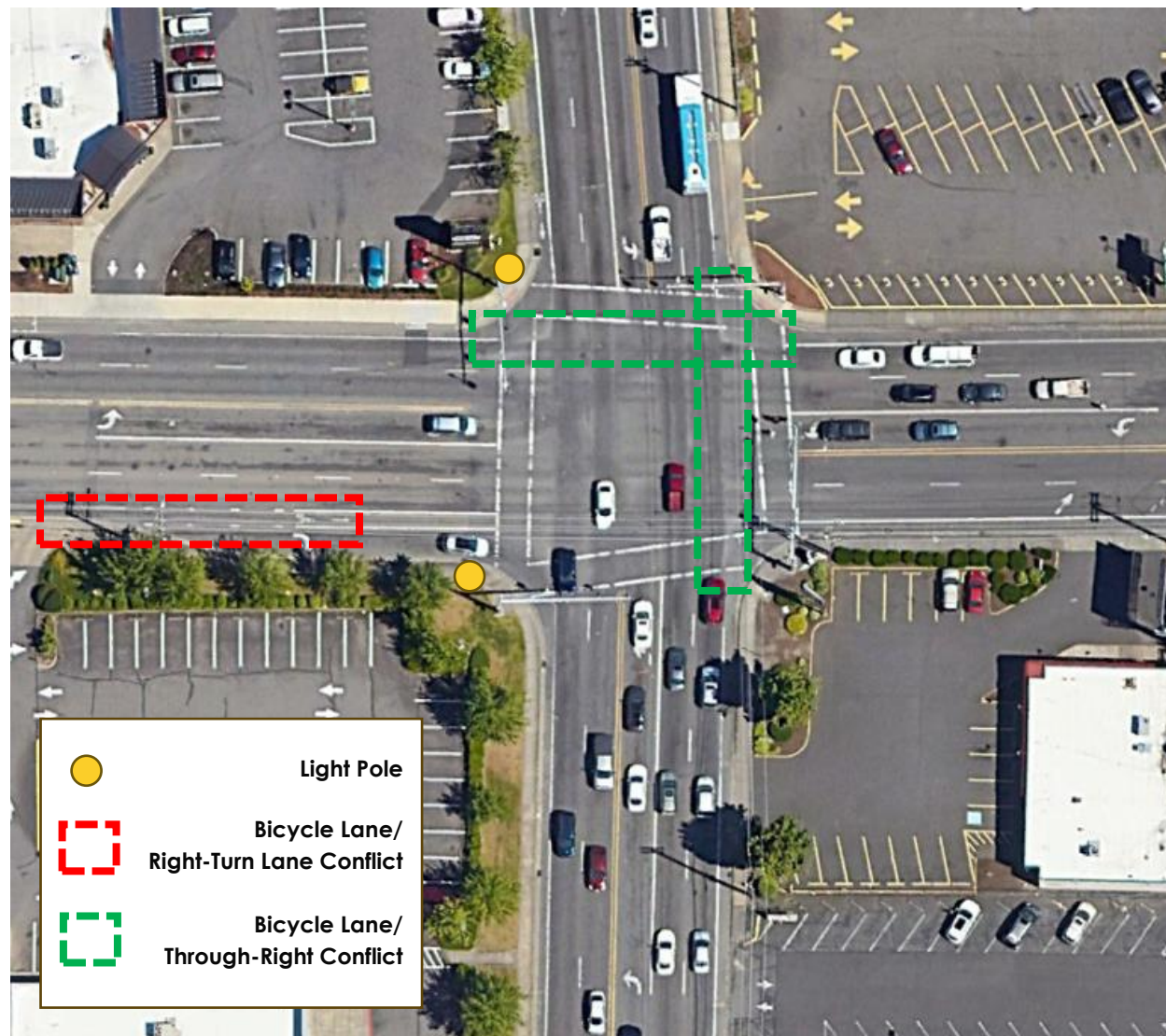


## Salem Next Steps

The project team provided the City with a spreadsheet that includes the 190 intersections in the sub-group with information about lighting and right-turn/bike lane conflict points. The City can use this spreadsheet to support their next ODOT ARTS application. To effectively incorporate this information into the application, the project team recommends the following next steps for the City:

1. Review the project team's findings and confirm the lighting assessment.
2. Develop cost estimates for each site based on the expected level of treatment and number of applicable approaches.
3. Determines which sites to move forward in the grant application based on anticipated budget and the grant funding request.
4. Calculate the cost-effectiveness index (CEI) for the selected sites and adjust the included sites as necessary to develop a competitive application.
5. Complete ARTS application.

# Considerations for Application of the Risk-Based Analysis Approach

## Software and Staffing

- The risk factor-based screening requires knowledge of GIS software to spatially assign data to a single intersection layer.
  - o 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.
  - o The risk factor 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.
  - o 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 risk factor analysis network screening depending on available resources/ staffing. Open-source data sources like OpenStreetMap may be used to assist in identifying signalized intersection locations.
  - o Many cities or counties may not have turn lanes, sidewalks, bicycle lanes, or other roadway characteristic data used in the risk evaluation. The analysis can be completed without this data by omitting these factors from the overall risk factor score.
  - o If ODOT and/or local or regional average annual daily traffic (AADT) volume data is not sufficient, functional class can be used instead as a proxy for relative volume.
  - o 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 risk factor-based analysis scores can provide an initial screening method to identify intersections that may benefit from the treatment.
  - o The project team used this method for the City of Salem case study application.
- Alternatively, a city or county can use the risk-factor based analysis to screen a local jurisdiction network to identify treatments (systemic or hot spot) based on the risk factor-based scoring results.
- Other prioritization criteria (such as community input, crash history, or other community goals) may be integrated with the risk factor scoring to help prioritize locations that would achieve multiple goals within a jurisdiction.

# APPENDIX

**Appendix A:** Risk-Based Analysis - City of Salem Intersections Scoring in the Top 10%

**Appendix B:** Comparison of Salem Top 10% and ODOT Top 10%

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## APPENDIX A: RISK-BASED ANALYSIS - CITY OF SALEM INTERSECTIONS SCORING IN THE TOP 10%

**Table 4. Risk-Based Analysis - City of Salem Intersections Scoring in the Top 10%**

| Intersection | Risk Factor Score |
|---|---|
| **Signalized** | |
| Hawthorne Av SE & North Santiam Hwy SE | 8.05 |
| Salem Pw NE & Hyacinth St NE | 8.05 |
| Broadway St NE & Salem Pw NE | 8.03 |
| Commercial St SE & Keglers Ln SE | 8.03 |
| 27th Av SE & Kuebler Blvd SE | 8.03 |
| Commercial St SE & Hilfiker Ln SE | 8.03 |
| Browning Av SE & Commercial St SE | 8.03 |
| D St NE & Lancaster Dr NE | 7.95 |
| Denver Av NE & Lancaster Dr NE | 7.95 |
| Commercial St SE & Madrona Av SE | 7.95 |
| Pine St NE & Portland Rd NE | 7.95 |
| Cordon Rd SE & Gaffin Rd SE | 7.05 |
| Kuebler Blvd SE & Mill Creek Dr SE | 7.05 |
| Fairview Industrial Dr SE & Madrona Av SE | 7.03 |
| Fisher Rd NE & Silverton Rd NE | 7.03 |
| Bill Frey Dr NE & Portland Rd NE | 7.03 |
| 25th St SE & State St | 7.03 |
| Airport Rd SE & State St | 7.03 |
| Hawthorne Av NE & Silverton Rd NE | 7.03 |
| Hawthorne Av NE & Sunnyview Rd NE | 7.03 |
| Hawthorne Av SE & Ryan Dr SE | 7.03 |
| Geer Dr NE & State St | 7.03 |
| Liberty St NE & Salem Pkwy NE | 7.03 |
| Carson Dr SE & Lancaster Dr SE | 7.03 |
| Lancaster Dr SE & Rickey St SE | 7.03 |
| 25th St SE & Madrona Av SE | 7.03 |
| **Stop Controlled** | |
| Boone Rd SE & Commercial St SE | 10.38 |
| 12th St Cutoff SE & Oakhill Av SE | 10.38 |
| Hawthorne Av SE & Kettle Ct SE | 10.38 |
| Doaks Ferry Rd NW & Wallace Rd NW | 10.38 |
| Scotsman Ln NE & Sunnyview Rd NE | 9.89 |
| Commercial St SE & Ratcliff Dr SE | 9.89 |
| Hyacinth St NE & Mainline Dr NE | 9.89 |
| Glendale Av NE & Lancaster Dr NE | 9.89 |
| Hawthorne Av NE & Weston Ct NE | 9.89 |
| Portland Rd NE & Rose Garden St NE | 9.89 |
| 12th St SE & Vista Av SE | 9.89 |
| Commercial St SE & Waln Dr SE | 9.33 |
| Kuebler Blvd SE & Stroh Ln SE | 9.33 |
| Barnes Av SE & Commercial St SE | 9.33 |
| Commercial St SE & Winding Wy SE | 9.29 |
| Edgewater Cp NW & Wb Edgewater Rp | 9.11 |

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| | |
|---|---:|
| Airport Rd SE & Ryan Dr SE | 9.11 |
| Pringle Rd SE & Strong Rd SE | 9.11 |
| 25th St SE & Aviation Lp SE | 9.07 |
| Michigan City Ln NW & Wallace Rd NW | 9.05 |
| 38th Pl NE & Market St NE | 8.89 |
| Capitol St NE & Myrtle Av NE | 8.89 |
| 12th St SE & Cannon St SE | 8.89 |
| Liberty Rd S & Marietta St SE | 8.84 |
| Front Cp NE & Front St NE | 8.84 |
| Front Cp NE & Front St NE | 8.84 |
| Liberty Rd S & Pembrook St SE | 8.84 |
| Cherry Av NE & Van Ness Av NE | 8.84 |
| 49th Av SE & State St | 8.8 |
| Eb Edgewater Rp & Edgewater Cp NW | 8.63 |
| Idylwood Dr SE & Sunnyside Rd SE | 8.62 |
| Boone Rd SE & Sunnyside Rd SE | 8.62 |
| Aguilas Ct NE & Market St NE | 8.58 |
| Silverton Rd NE & Williams Av NE | 8.58 |
| 22nd St SE & Madrona Av SE | 8.57 |
| 12th St Cutoff  SE & Doris Av SE | 8.57 |
| Lancaster Dr SE & Lancaster North Santiam Rp | 8.57 |
| 37th Av NE & State St | 8.57 |
| Madrona Av SE & Madrona Ct SE | 8.57 |
| Commercial St SE & Promontory Pl SE | 8.57 |
| Portland Rd NE & Wayside Tr NE | 8.57 |
| Portland Rd NE & Stortz Av NE | 8.57 |
| 12th St Cutoff SE & Ibsen St SE | 8.57 |
| Commercial St SE & Lansford Dr SE | 8.57 |
| Commercial St SE & Crowley Av SE | 8.57 |
| Lancaster Dr SE & Saddle Club St SE | 8.57 |
| Brush College Rd NW & Wallace Rd NW | 8.57 |
| Commercial St SE & Royvonne Av SE | 8.57 |
| 2nd St NW & Wallace Rd NW | 8.56 |
| Musgrave Ln NW & Wb Wallace Rd Rp | 8.56 |
| 7th St NW & Wallace Rd NW | 8.56 |
| 12th St SE & Hillendale Dr SE | 8.08 |
| Fairview Av SE & Pringle Rd SE | 8.08 |
| Commercial St SE & Oakhill Av SE | 8.08 |
| 42nd Pl NE & Sunnyview Rd NE | 8.08 |
| Center St NE & Norman Av NE | 8.08 |
| Carolina Av NE & Lancaster Dr NE | 8.08 |
| 12th St SE & Morningside St SE | 8.08 |
| 12th St SE & Harris Av SE | 8.08 |
| Greentree Dr NE & Sunnyview Rd NE | 8.08 |
| Delmar Dr N & River Rd N | 8.08 |
| Brown Rd NE & Sunnyview Rd NE | 8.08 |
| State St & Thoroughbred Pl SE | 8.08 |
| 12th St SE & Shamrock Dr SE | 8.08 |
| Icabod St NE & Sunnyview Rd NE | 8.08 |
| Lancaster Dr NE & Watson Av NE | 8.08 |
| Earle Av NE & Lancaster Dr NE | 8.08 |
| 41st Av NE & Sunnyview Rd NE | 8.08 |

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| | | |
|---|---|---|
| Commercial St SE & Ewald Av SE | | 8.08 |
| Bieber St NE & Center St NE | | 8.08 |
| Center St NE & Oregon Av NE | | 8.08 |
| Lancaster Dr NE & Weathers St NE | | 8.08 |
| Carleton Wy NE & Portland Rd NE | | 8.08 |
| Anita Dr NE & Lancaster Dr NE | | 8.08 |
| Liberty St NE & River Rd N | | 8.08 |
| Donald St NE & Portland Rd NE | | 8.08 |
| 36th Av NE & Center St NE | | 8.08 |
| 12th St SE & Marshall Dr SE | | 8.08 |
| Neota St NE & Swegle Rd NE | | 8.08 |
| Center St NE & Illinois Av NE | | 8.08 |
| Gem Pl NE & Swegle Rd NE | | 8.08 |
| Freeway Ct NE & Hawthorne Av NE | | 8.08 |
| Highway Av NE & Portland Rd NE | | 8.08 |
| Judy Av NE & Lancaster Dr NE | | 8.08 |
| Hollywood Dr NE & Sunnyview Rd NE | | 8.08 |
| Center St NE & Edina Ln NE | | 8.08 |
| River Rd N & Stark St N | | 8.08 |
| Mousebird Av NW & Orchard Heights Rd NW | | 8.06 |
| Skyline Rd S & Skyline Village Lp S | | 8.06 |
| Croisan Scenic Wy S & Kuebler Rd S | | 8.06 |
| Doaks Ferry Rd NW & Glen Creek Rd NW | | 8.06 |
| Holder Ln SE & Liberty Rd S | | 8.06 |
| Davis Rd S & Liberty Rd S | | 8.06 |
| Eola Dr NW & Burley Hill Dr NW | | 8.06 |
| Skyline Rd S & Skyline Village Lp S | | 8.06 |
| Burley Hill Dr NW & Sunwood Dr NW | | 8.06 |
| Eb Edgewater Rp & Wb Edgewater Rp | | 8.03 |
| Church St NE & Hood St NE | | 8.02 |
| Hines St SE & Mission St SE | | 8 |
| 21st St SE & Mission St SE | | 8 |
| 23rd St SE & Mission St SE | | 8 |
| 23rd St SE & Mission St SE | | 8 |
| Lee St SE & Mission St SE | | 7.96 |
| 12th St SE & Cannon St SE | | 7.84 |
| Liberty St NE & Union St NE | | 7.84 |
| Lansing Av NE & Sunnyview Rd NE | | 7.8 |
| Commercial St NE & Front Cp NE | | 7.75 |
| Liberty Rd S & Mize Rd SE | | 7.75 |
| Pringle Rd SE & Tiburon Ct SE | | 7.62 |
| 36th Av SE & Trelstad Av SE | | 7.59 |
| 13th St NE & Center St NE | | 7.58 |
| 12th St SE & Mill St SE | | 7.58 |
| Kimeron St SE & Liberty Rd S | | 7.57 |
| Barnes Av SE & Sunnyside Rd SE | | 7.57 |
| Sunnyside Rd SE & Valleywood Lp SE | | 7.57 |
| Commercial St SE & Welcome Wy SE | | 7.54 |
| Bliler Av NE & Liberty St NE | | 7.53 |
| Barnes Av SE & Commercial St SE | | 7.52 |
| 9th St NW & Wallace Rd NW | | 7.51 |
| Hagers Grove Rd SE & Lancaster Dr SE | | 7.48 |

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ODOT Intersection Safety Implementation Plan Update - City of Salem Case Study   Appendix A: Risk-Based Analysis - City of Salem Intersections Scoring in the Top 10%

| | |
|---|---|
| Caplinger Rd SE & Cordon Rd SE | 7.48 |
| Cranston St SE & Lancaster Dr SE | 7.48 |
| 12th St Cutoff  SE & Albert Dr SE | 7.48 |
| Eden St SE & Lancaster Dr SE | 7.48 |
| Liberty St NE & Taylor St NE | 7.47 |
| Fairview Industrial Dr SE & Marietta St SE | 7.3 |
| Aumsville Hwy SE & Depot Ct SE | 7.3 |
| Aumsville Hwy SE & Joseph St SE | 7.3 |
| Center St NE & Hoffman Rd NE | 7.3 |
| Bayne St NE & Kale St NE | 7.3 |
| 49th Av NE & Kale St NE | 7.3 |
| Eagle View Dr NW & Eola Dr NW | 7.3 |
| Eola Dr NW & Mule Deer St NW | 7.3 |
| Fairview Industrial Dr SE & Lindburg Rd SE | 7.3 |
| Cascadia Industrial St SE & Reed Rd SE | 7.3 |
| Pringle Rd SE & Suntree Dr SE | 7.3 |
| 49th Av NE & Hayesville Dr NE | 7.29 |
| Orchardview Av NW & Wallace Rd NW | 7.24 |
| Hope Av NW & Wallace Rd NW | 7.24 |
| Lynda Ln NW & Wallace Rd NW | 7.24 |
| Harritt Dr NW & Wallace Rd NW | 7.24 |
| Deering Dr NW & Wallace Rd NW | 7.24 |
| 23rd St NE & Recovery Dr NE | 7.08 |
| Fairgrounds Rd NE & Woodrow St NE | 7.08 |
| 17th St SE & Bellevue St SE | 7.08 |
| Felina Av NE & Hawthorne Av NE | 7.08 |
| 17th St SE & Mill St SE | 7.08 |
| 17th St SE & Trade St SE | 7.08 |
| Columbia St NE & Fairgrounds Rd NE | 7.08 |
| Market St NE & Tierra Dr NE | 7.08 |
| 17th St SE & Ferry St SE | 7.08 |
| Clay St NE & Market St NE | 7.08 |
| 17th St NE & Nebraska Av NE | 7.08 |
| Donna Av NE & Fairgrounds Rd NE | 7.08 |
| 17th St NE & Kansas Av NE | 7.08 |
| 17th St NE & Kay St NE | 7.08 |
| 17th St NE & B St NE | 7.08 |
| 17th St NE & A St NE | 7.08 |
| Fairgrounds Rd NE & Smith St NE | 7.08 |
| 17th St NE & C St NE | 7.08 |
| 25th St NE & Center St NE | 7.08 |
| Hrubetz Rd SE & Liberty Rd S | 7.03 |
| Burley Hill Dr NW & Satara Ct NW | 7.03 |
| Idylwood Dr SE & Liberty Rd S | 7.03 |
| Commercial St SE & Duplex Dr SE | 6.99 |
| Heather Ln SE & Pringle Rd SE | 6.99 |
| Cypress St NE & Lancaster Dr NE | 6.99 |
| Pringle Rd SE & Woodacre Dr SE | 6.99 |
| 12th St SE & Peace St SE | 6.99 |
| Hillendale Dr SE & Pringle Rd SE | 6.99 |
| 32nd Pl NE & Hyacinth St NE | 6.99 |
| Cougar Ct SE & State St | 6.99 |

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ODOT Intersection Safety Implementation Plan Update - City of Salem Case Study   Appendix A: Risk-Based Analysis - City of Salem Intersections Scoring in the Top 10%

| | |
|---|---|
| Cherry Av NE & Locust St NE | 6.99 |
| Cherry Av NE & Johnson St NE | 6.99 |
| 12th St SE & Melody Ln SE | 6.99 |
| Commercial St SE & Harris Av SE | 6.99 |
| Pippin St NE & Sunnyview Rd NE | 6.99 |
| Hawthorne Av NE & Monroe Av NE | 6.99 |
| Lawrence St SE & Madrona Av SE | 6.99 |
| Edward Dr SE & Madrona Av SE | 6.99 |
| Liberty Rd S & Lockwood Ln S | 6.99 |
| Plateau St NE & Swegle Rd NE | 6.99 |
| Commercial St SE & Triangle Dr SE | 6.99 |
| Douglas Av SE & Pringle Rd SE | 6.99 |
| Marilyn St SE & Pringle Rd SE | 6.99 |
| 13th Mission Rp SE & Waller St SE | 6.99 |
| Georgia Av SE & Pringle Rd SE | 6.99 |
| Beach Av NE & Portland Rd NE | 6.99 |
| Commercial St SE & Mary Av SE | 6.99 |
| Cherry Av NE & Hickory St NE | 6.99 |
| El Rancho Av NE & Sunnyview Rd NE | 6.99 |
| Center St NE & Vinyard Av NE | 6.99 |
| Future Dr NE & Sunnyview Rd NE | 6.99 |
| 12th St SE & Ridgewood Ln SE | 6.99 |
| 13th St SE & Lee St SE | 6.99 |
| Pringle Rd SE & Salishan St SE | 6.99 |
| Royalty Dr NE & Swegle Rd NE | 6.99 |
| Morningside Ct SE & Pringle Rd SE | 6.99 |
| Lancaster Dr NE & Manor Dr NE | 6.99 |
| Fir Rest Wy NE & Hyacinth St NE | 6.99 |
| Crossler Meadow Lp S & Liberty Rd S | 6.97 |
| Crossler Meadow Lp S & Liberty Rd S | 6.97 |
| Countryside Dr NE & Kale St NE | 6.81 |
| Hilfiker Ln SE & Sunnyside Rd SE | 6.81 |
| Eola Dr NW & Kaley Av NW | 6.81 |
| Boxwood Ln SE & Sunnyside Rd SE | 6.81 |
| Keglers Ln SE & Sunnyside Rd SE | 6.81 |
| Lancaster Dr NE & Milton St NE | 6.81 |
| 49th Av SE & Macleay Rd SE | 6.81 |
| Eola Dr NW & Turnage St NW | 6.81 |
| Sunnyside Rd SE & Woodmansee St SE | 6.81 |

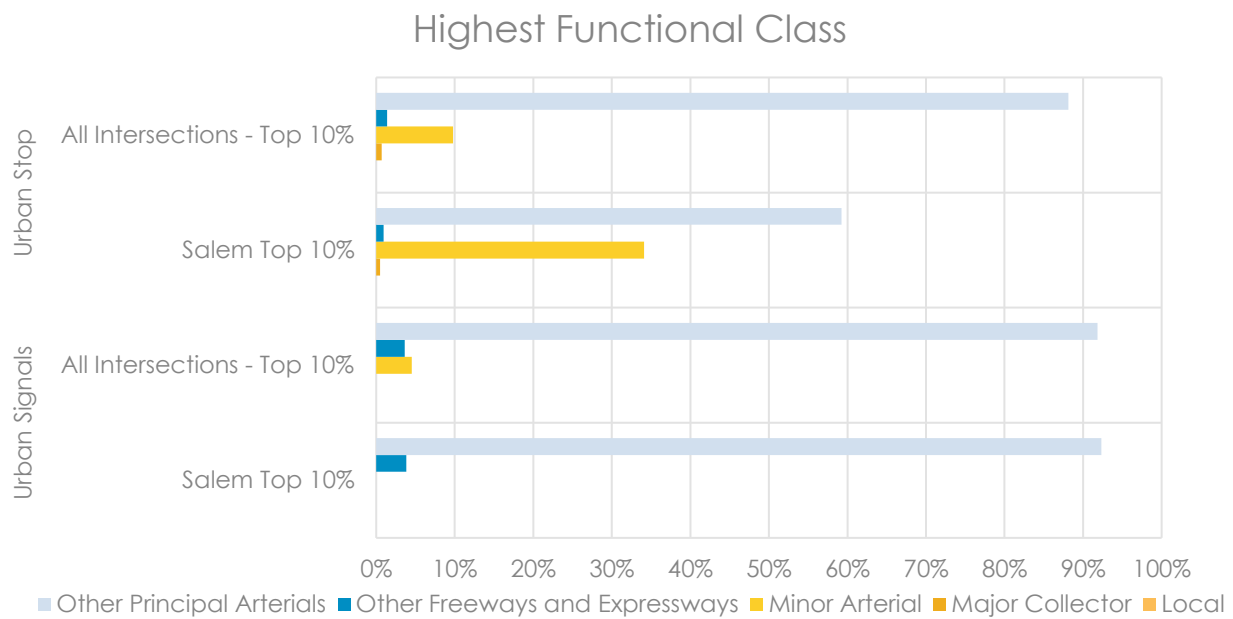# APPENDIX B – COMPARISON OF SALEM TOP 10% AND ODOT TOP 10%

**Exhibit 1. Functional Class**



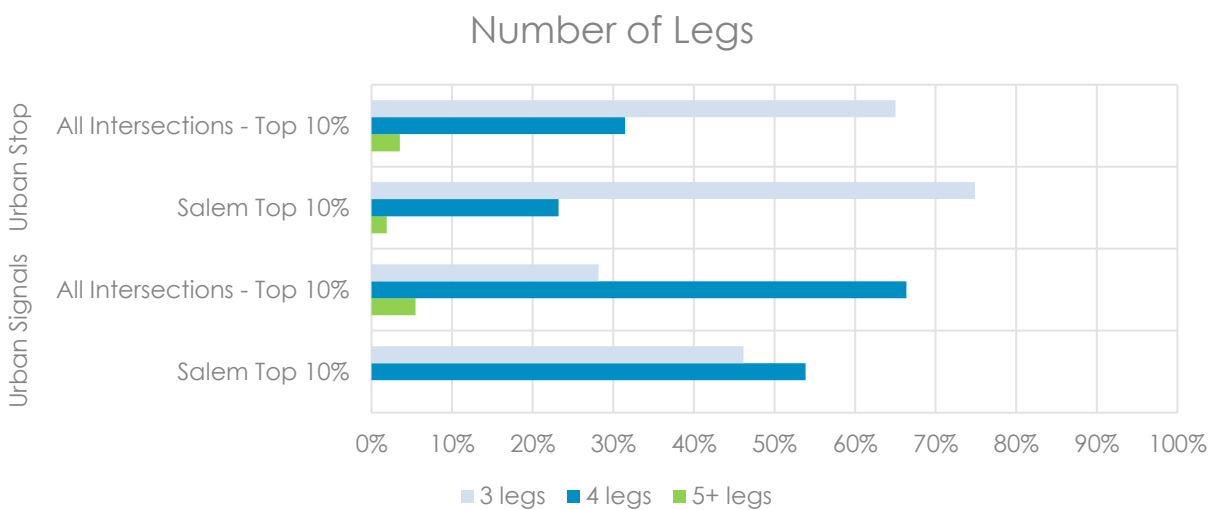Highest Functional Class

**Exhibit 2. Number of Legs**



Number of Legs

**Exhibit 3. Number of Lanes**



Number of Lanes
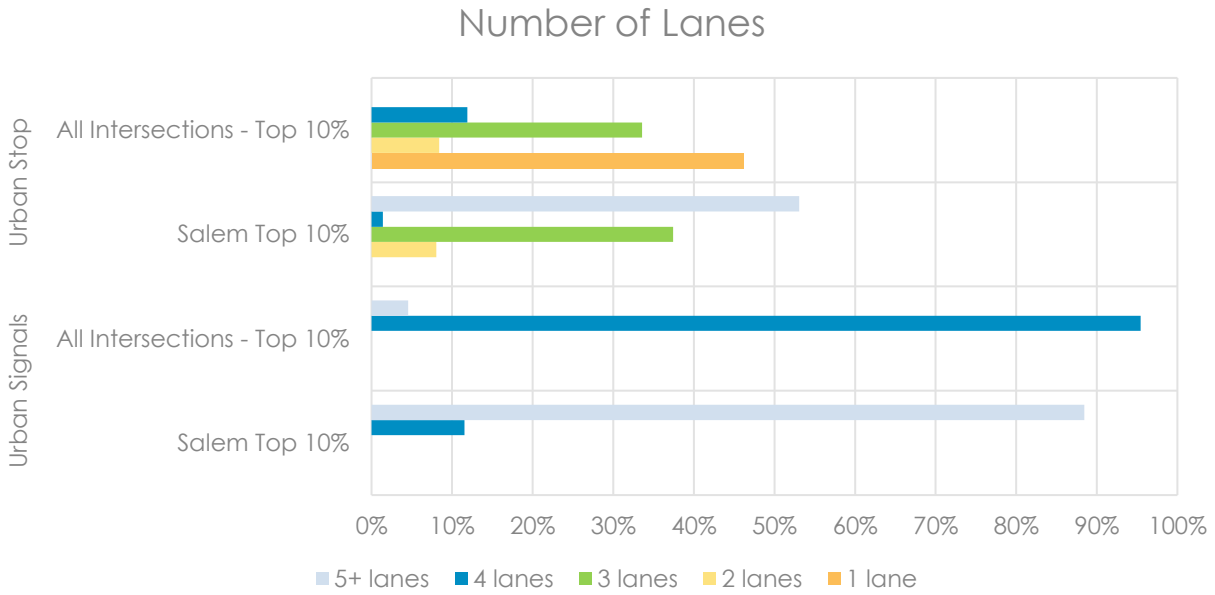
**Exhibit 4. Right Turn Lane Presence**



Presence of a Right Turn Lane
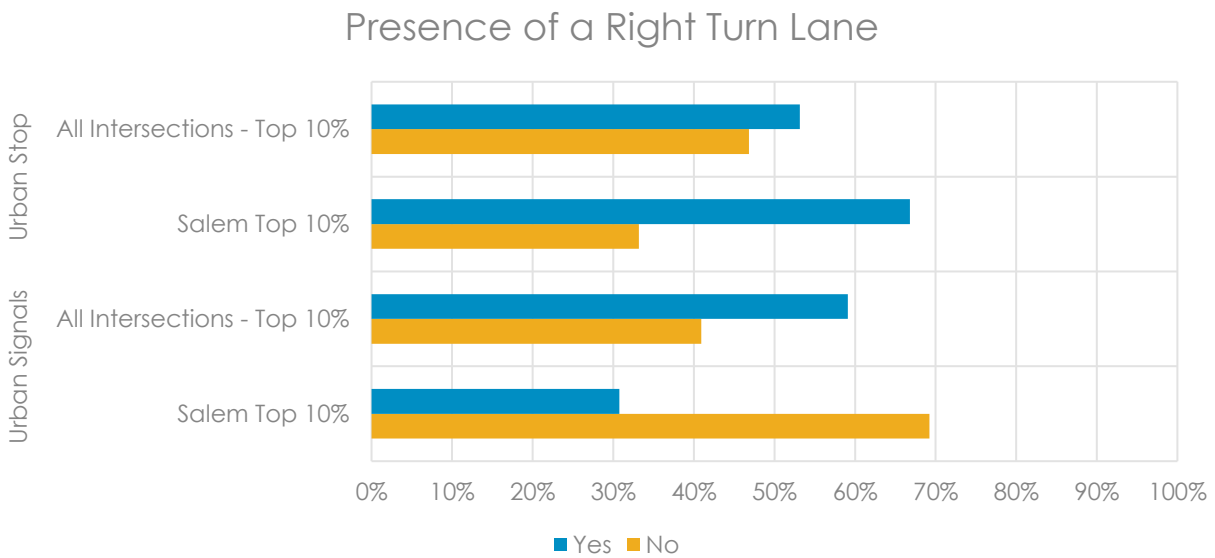
**Exhibit 5. Left Turn Lane Presence**

### Presence of a Left Turn Lane
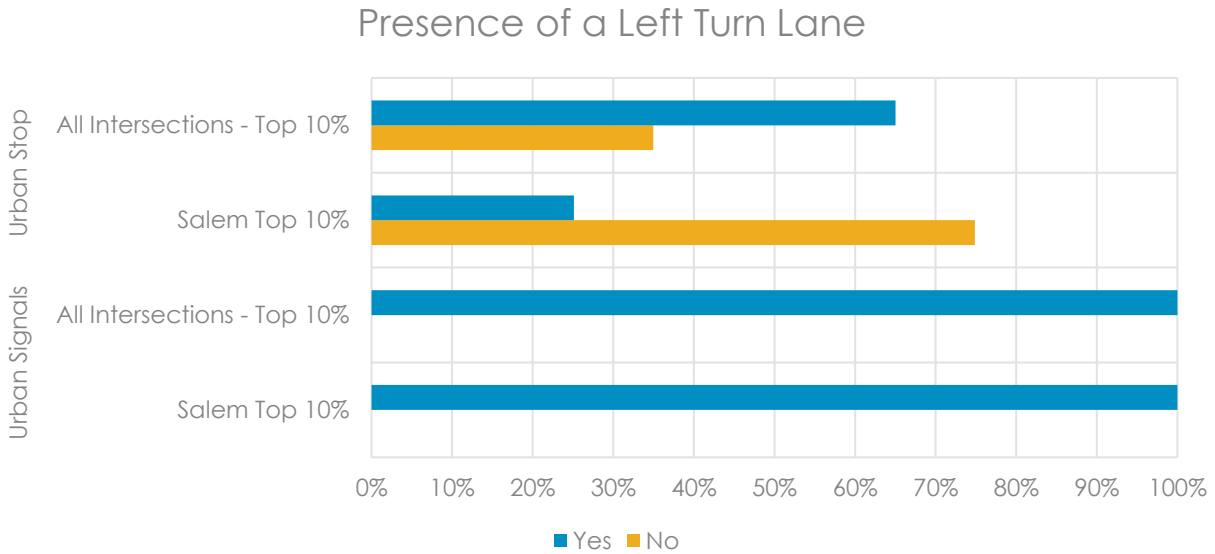


**Exhibit 6. Maximum Posted Speed**

### Maximum Posted Speed
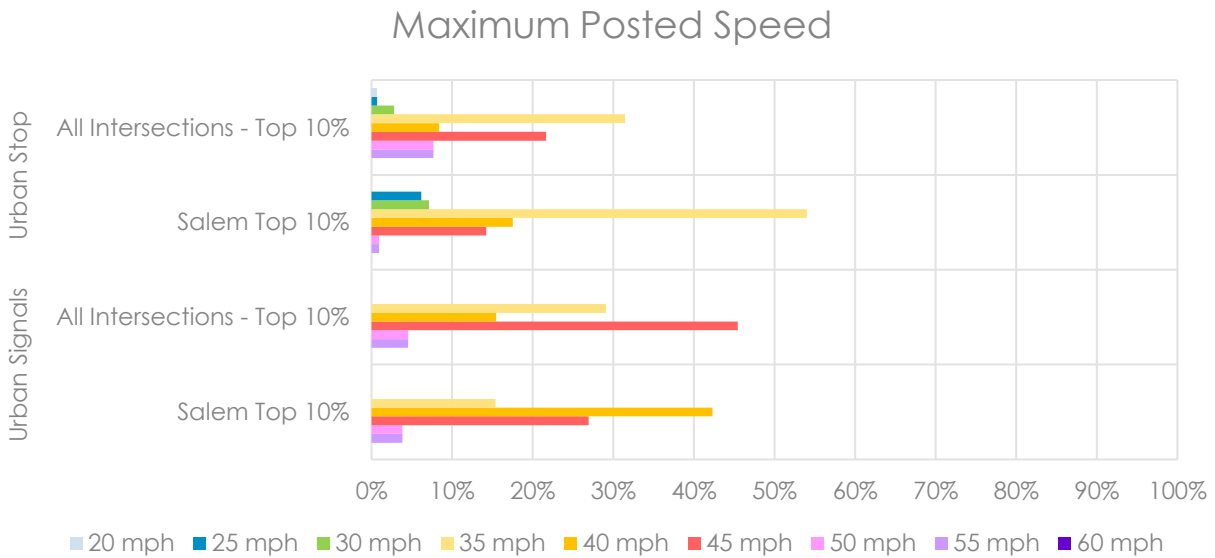
**Exhibit 7. Equity Disparity**

## Equity Disparity
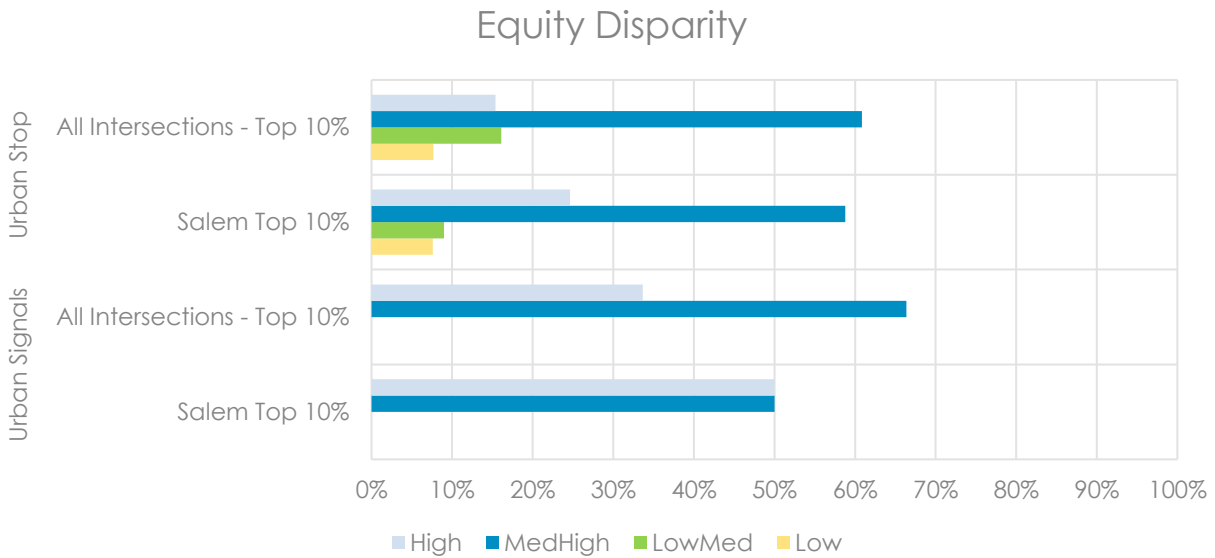


**Exhibit 8. Bike Lane Presence**

## Bike Lane Presence

**Exhibit 9. Sidewalk Presence**
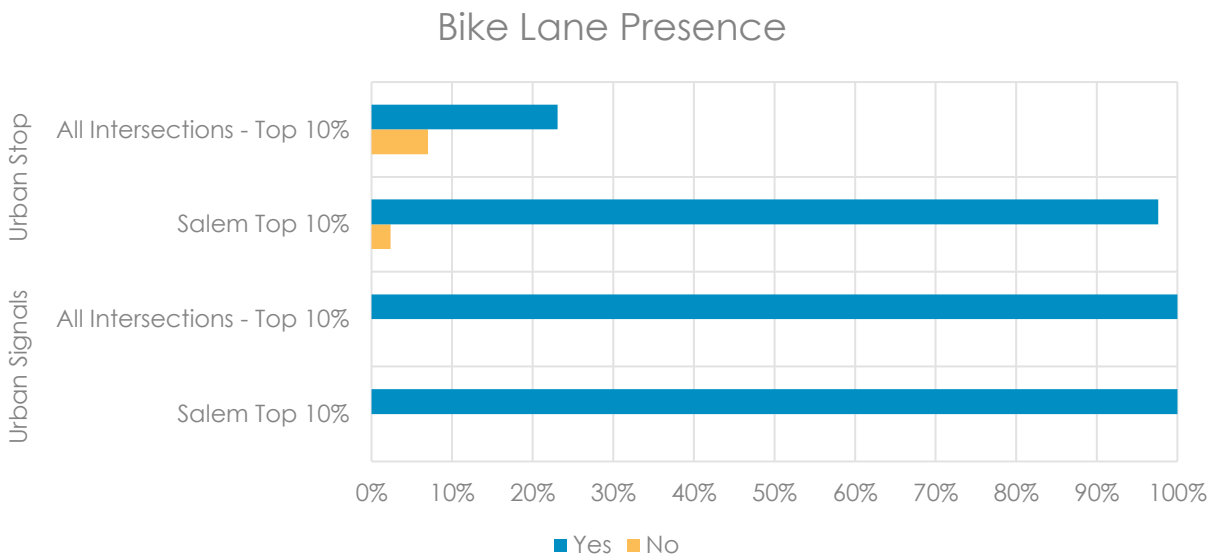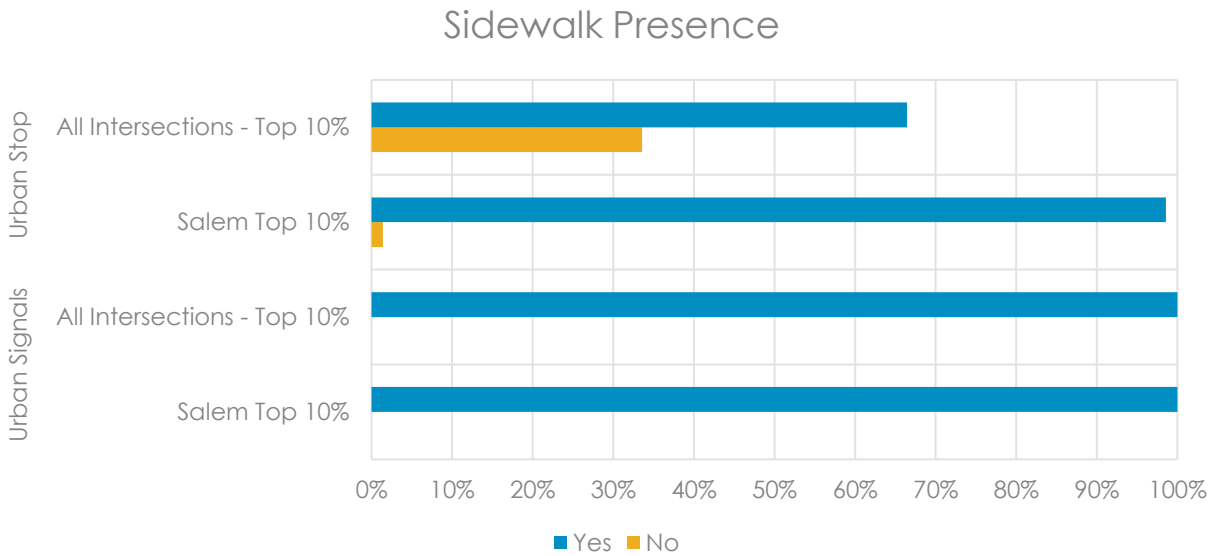


Sidewalk Presence

**Exhibit 10. Average Annual Daily Traffic (AADT)**



Highest Average Annual Daily Traffic (AADT)