CLARK COUNTY

# URBAN FREEWAY CORRIDOR OPERATIONS STUDY

SOUTHWEST WASHINGTON
REGIONAL TRANSPORTATION COUNCIL
JUNE 2020

RTC

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DKS

# ACKNOWLEDGMENT


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# EXECUTIVE SUMMARY

The Urban Freeway Corridor Operations (UFCO) Study used a data-driven process to develop lower-cost, positive-benefit improvement opportunities for the four main corridors of the greater Vancouver highway system. The study team developed recommended spot and system strategies from this study that could be pursued for implementation in the near term (10-15 years).

The process included planning-level cost estimates and an analysis of each strategy's benefits to traffic operations and safety. The results are summarized in one-page info sheets within this Plan. With these details, the Southwest Washington Regional Transportation Council (RTC) and its regional partners can pursue various strategies for project development and implementation. Ultimately, the UFCO Study provides decision-makers with an important resource for planning investments that will reduce congestion and crashes and improve travel time reliability. The strategies recommended for this study correlate to the practical solutions approach developed by the Washington State Department of Transportation (WSDOT) and can be used to assist WSDOT in developing near term transportation investments for the region.

## STUDY AREA

The UFCO Plan included a comprehensive review of the four freeway corridors (I-5, I-205, SR 500 and SR 14) serving the greater Vancouver area and correlates congestion and safety concerns with recommended enhancement measures.

The bi-state corridors of I-5 and I-205 continue to see increased demand, particularly southbound during the weekday, morning commute times. Without improvements to the existing system, the congestion has continued to worsen and further degrade traffic conditions on the segments of SR 500 and SR 14 that serve as connections to I-5 and I-205.

## PLAN DEVELOPMENT

The development of the UFCO plan included collecting existing traffic, safety and geometric conditions to serve as a baseline for identifying current and anticipated deficiencies. In addition, the Clark County Origin Destination Study was a critical step to supplement other data sources to better understand travel characteristics in developing potential strategies. It provided important information on ramp to ramp travel patterns, lane by lane speed differences and vehicle route diversion from freeways.

A broad list of strategies was developed through coordination with project partners. Through a screening process that started with over 100 strategies, a multi-agency workshop was used to screen initial strategies at both a spot location and system level into a set of 60 strategies for more detailed evaluation. Post workshop evaluation looked at operations, safety and cost benefits and impacts to develop an overall assessment of each strategy.

Safety is an important component of developing lower-cost congestion management strategies. Congestion often occurs as a result of collisions or other incidents that temporarily reduce a road's capacity and can address through physical changes as well as traffic management and driver awareness strategies.

Through the this process the initial set of strategies were organized into spot and system strategies and refined to a menu of 48 potential strategies that meet the UFCO practical solutions approach to identify lower-cost, positive-benefit opportunities.

These strategies were categorized into four tiers. Tier 1 strategies address existing, near term needs that could move to implementation; Tier 2 strategies have potential for implementation in the near-term; Tier 3 strategies also benefits, but higher costs and could be considered if funding or opportunities emerge; Tier 4 are strategies for future consideration.

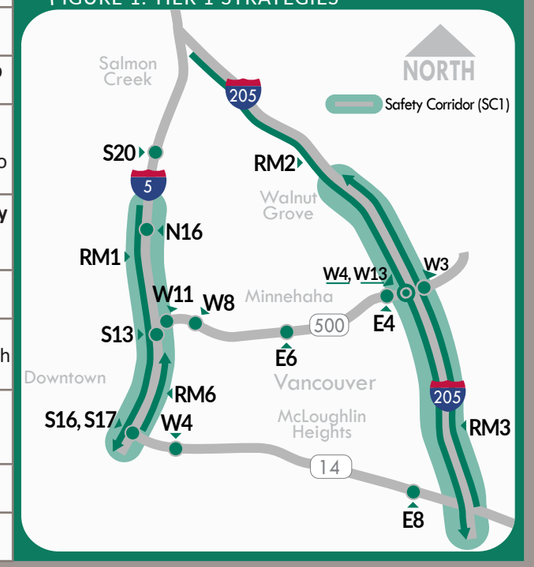
## OUTCOME

The outcome of the UFCO process is a tiered set of recommendations that address one or more of the key safety, congestion, and user experience issues identified within the study area. The Tier 1 strategies are summarized in Table 1 with approximate locations in Figure 1. These strategies provide lower cost improvements to address existing and near-term needs, with positive benefits and agency support to move forward with design refinement, funding and implementation in the near-term. Many of these strategies are currently in agency capital improvement plans. Some are programmed and funded for implementation.

TABLE 1. TIER 1 STRATEGIES

| CORRIDOR | | DESCRIPTION OF TIER 1 STRATEGIES |
|---|---|---|
| I-5, I-205 | SC1 | **I-5 and I-205** – Create a safety corridor. |
| I-5 | RM1 | **SB: 78th St to SR 14** – Meter entrance ramps. |
| I-5 | RM6 | **NB: SR 14 to Fourth Plain Blvd** – Meter entrance ramps. |
| I-5 | S13 | **SB: Mill Plain Blvd Entrance Ramp** – During ramp meter operation, allow use of the shoulder on the Mill Plain Blvd entrance ramp to I-5 SB. This project is part of the I-5 ATM project by WSDOT. |
| I-5 | S16 | **SB: SR 14/City Center Entrance Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| I-5 | S17 | **SB: SR 14/City Center Entrance Ramp** – Close the ramp to general traffic from City Center to I-5 SB during the morning peak commute hours. Becomes transit only ramp. |
| I-5 | S20 | **SB: 99th St Park and Ride to I-5** – Prioritize transit access to I-5 by providing Transit Priority at the signals. |
| I-5 | N16 | **NB: 78th St Exit Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| I-205 | RM2 | **SB: 134th St to SR 14** – Meter entrance ramps. |
| I-205 | RM3 | **NB: SR 14 to Padden Parkway** – Meter entrance ramps. |
| SR 500 | E4 | **EB: SR 500 at I-205 Interchange** – Install VMS to warn drivers of back up at I-205 merge. |
| SR 500 | E6 | **EB: 54th Ave Entrance Ramp to Andresen Rd Exit Ramp** – Construct an auxiliary lane. |
| SR 500 | W3 | **WB: I-205 NB Exit Ramp** – Construct a barrier on WB SR 500 to prohibit WB SR 500 traffic from exiting to NB I-205. Traffic would still be able to travel from Gher Rd to I-205 NB. |
| SR 500 | W4 | **WB: I-205 Southbound Entrance Ramp to Thurston Way Exit Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| SR 500 | W8 | **WB: I-5 Southbound Exit Ramp** – Install VMS to warn drivers of back up at I-5 merge. |
| SR 500 | W11 | **WB: 39th St at I-5 Northbound Ramp Terminal** – Construct a dedicated right turn lane for vehicles on 39th St turning right onto the I-5 NB entrance ramp. |
| SR 500 | W13 | **WB: I-205 SB Exit Ramp to Vancouver Mall Dr and SR 500 WB Entrance Ramp** – Install static sign to provide advance information about lane assignment. |
| SR 14 | E8 | **EB: I-205 Exit Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| SR 14 | W4 | **WB: I-5 Exit Ramps** – Use ATM to provide advance information about real-time traffic conditions. |

FIGURE 1. TIER 1 STRATEGIES



# OVERVIEW

The Urban Freeway Corridor Operations (UFCO) Study is one part of the Southwest Washington Regional Transportation Council (RTC) and its regional partners' efforts to develop an efficient, balanced, multimodal regional transportation system. The solutions in this plan are aimed at maximizing the return on investment for highway users. Solutions are intended to address specific problems under existing conditions. Solutions envisioned are lower in cost and smaller in scope than traditional highway investments, which allows them to be delivered quicker and with various funding sources.

## PURPOSE AND NEED

Between 2011 and 2016, Clark County's population increased by more than 8% and the Portland/Vancouver region added over 116,000 jobs, an increase of almost 10.5%, during the same time period. This growth is forecast to continue with population growing from 460,000 today to 600,000 in 2040. Past growth and future trends, as well as an improving economy over the last 5 years, are reflected through increasing traffic congestion on Clark County freeways. In addition, WSDOT and the Washington State Legislature have developed policy goals that include developing lower cost practical solutions to address system demands.

This outlook prompted RTC and partner agencies to develop a plan to improve reliability, reduce congestion, improve safety, and foster a higher level of service for residents and visitors. Many parts of the regional transportation system are developed, and surrounding land uses are built out, and further expansion is significantly expensive. To meet regional transportation goals, cost-effective transportation management and operations (TSMO) strategies are needed to maximize the existing transportation system. This is in alignment with the Regional Transportation Plan that envisions "an integrated transportation system that balances modal needs while providing mobility and access to support the region's growing prosperity and protecting the environment." In addition, the Access and Mobility goals of the RTP are to be accomplished through "development of an efficient, balanced, multi-modal regional transportation system."

The intent of the UFCO Study was to meet both these objectives and align with WSDOT's practical solutions approach by developing a strategic investment plan that draws from a toolbox of strategies including active traffic management (ATM), Integrated Corridor Management (ICM), Transportation System Management (TSM), Travel Demand Management (TDM), and low-cost capital investments.

The UFCO Study analyzed near term operational and system management improvements on approximately 35 miles of urban freeways in Clark County that result in a transportation system that operates with improved efficiency and predictably. The strategies include approaches to get the most out of the existing system by using traffic management tools to optimize the flow of traffic and maximize available capacity, as well as low cost capital improvements to improve safety at bottlenecks and merge weave conflict points. These improvements may also supplement future planned capital improvements in the study corridors.

## PLANNING FOR THE FUTURE

The efficient movement of people and goods is at the core of this study. Both spot and system strategies were identified, screened, refined, and evaluated for their return on investment.

The resulting set of UFCO projects and the projects identified in the Vancouver Eastside Highway Operations Study (VEHOPS) will be key resources for RTC, WSDOT, and other stakeholders working jointly to assess the urban freeway corridors in Southwest Washington and develop a strategic implementation and outreach plan.

## RELATED STUDIES AND PLANS

This study builds upon a strong base of regional planning in Southwest Washington, including the Regional Transportation Plan, the I-205 Access and Operations Study, Transportation System Management and Operations Plan, Clark County Origin Destination Study and Vancouver Eastside Highway Operations Study (VEHOPS).

The VEHOPS study completed a practical solutions evolution of southern half of I-205 similar to this UFCO study. Beneficial strategies identified for I-205 in the VEHOPS study are recommended in this study, are noted as part of the implementation plan and introduction to the I-205 corridor. Additional information on the VEHOPS strategies are in the Appendix. The UFCO Study expands on those plans to take a focused look at freeway operations and identify, evaluate, and prioritize transportation system management and low-cost capital investments to improve efficiency, reliability, and safety at congestion points.

# PROCESS

The four freeway corridors (I-5, I-205, SR 500 and SR 14) connect Clark County communities in every direction and provide critical local and regional connections. In recent years, traffic along the freeway system has grown as development has increased and people have moved to the area. In the peak commute hours, heavy local, commuter and regional vehicle traffic is increasing congestion and decreasing safety for users of the transportation system. Motor vehicles and freight share a congested roadway space with limited mobility during peak commute times and these conditions prompted RTC and partner agencies to develop a set of low-cost capital improvements to improve safety and reliability as the Portland-Vancouver region continues to grow.

## STUDY AREA

The study area consists of four freeway corridors located in the greater Vancouver area in Clark County: I-5, I-205, SR 500 and SR 14. The I-5 corridor is bounded on the north by the Battle Ground interchange (SR 502) and on the south by the Interstate Bridge (Columbia River). The I-205 corridor is bounded on the north by I-5 and on the south by the Glenn Jackson Bridge (Columbia River). The SR 500 corridor includes its entire extents, from I-5 to Padden Parkway. The SR 14 corridor extends east from I-5 to the SE 192nd interchange. In addition to the freeway mainline, the UFCO Study also includes freeway-to-freeway connections and exit and entrance ramps. This study does not directly include evaluation of parallel roadway facilities.

FIGURE 2. STUDY CORRIDORS

## GOALS

The UFCO Study aims to provide a practical solutions approach to freeway corridor operation improvements:

- Verify congestion location and cause
- Confirm need for congestion relief and/or safety project
- Provide flexibility for use in other potential studies
- Identify lower cost capital, operational and ITS projects with benefits to the corridor at spot locations and at a system level

## PROJECT PARTNERS AND DECISION-MAKING PROCESS

A key component to a successful project is communication and collaboration. The project partners (Figure 3) worked closely with regional partners to develop clear and actionable strategies that meet the study's purpose and need. A Project Management Team (PMT) provided overall project direction and leadership, supported by the Technical Advisory Committee (TAC), as described below.

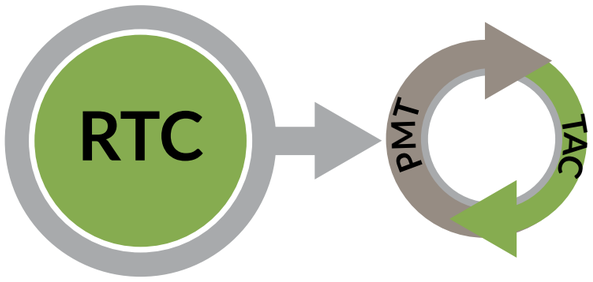
The PMT included decision-makers from RTC and the consultant team. The PMT was the decision-making body for critical elements of the UFCO Study, guiding schedule and dissemination of work products and information.

The TAC provided technical and strategic guidance to the consultant team, while also receiving direction from the PMT. The TAC included representatives from the following organizations:

- WSDOT
- C-Tran
- Clark County
- City of Vancouver
- RTC

Technical processes and outcomes were vetted with the TAC in order to obtain input, communicate the results, and "ground-truth" the analysis at key milestones. The TAC acted as a resource, minimizing the need to collect new data by leveraging the extensive sets of traffic, ITS, transit, and physical characteristics already consolidated by the agencies.

FIGURE 3. WORKFLOW



# STRATEGY DEVELOPMENT

The UFCO Plan identifies potential mitigation measures that improve safety and reliability deficiencies that are a product of congestion bottlenecks on four Southwest Washington freeway corridors (I-5, I-205, SR 500 and SR 14).

The development of strategies consisted of three steps:

**Needs and Issues Identification:**
This step consisted of corridor-level reconnaissance to provide the foundation for specific investigation to identify and validate congestion and causes.

**Analysis and Screening of Potential Projects:**
This step focused primarily on design and operations. Congestion and safety hotspots were analyzed, and potential solutions were developed, evaluated, and screened by an expert multidisciplinary design panel.

**Refinement of Strategies:**
The final step involved an operations and design evaluation of strategies deemed feasible by the screening panel. In most cases, the detailed evaluation and refinement included traffic modeling to assess various performance measures and assessment of feasibility.

It should be noted that traffic volumes on these highways are highest during the commute hours, and because these operational improvements do not add capacity, the benefits achieved will likely be moderate and incremental. As bottlenecks along these corridors often meter traffic flow, reducing the queuing and delay at a specific congestion points may increase system throughput. The proposed projects will improve reliability, particularly on the hours that bookend the peak commute hours and enhance safety by improving the weaves and merges that occur at interchanges.

## NEEDS AND ISSUES IDENTIFICATION

To provide a foundation for the UFCO Study, the project team analyzed existing conditions for each of the four study corridors. The existing conditions review included compiling information on freeway geometry, daily and peak traffic volumes, speed, and collision type, location and severity to verify areas of need. In addition to the quantitative data, the project team gathered institutional knowledge from the TAC to provide context for the data and validate the findings. The inventory and background information within the study area was distilled from this data collection effort and summarized in packets for each corridor. The packets were referenced during the development of potential projects.

### Common Causes and General Locations of Bottlenecks

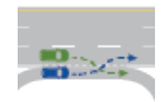
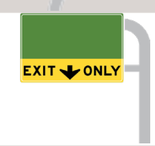
Recurring, localized bottlenecks occur any time the rate of approaching traffic is greater than the rate of departing traffic. The causal effect can usually be attributed to the existence of at least one of two factors:

- **Decision Points**, such as entrance and exit-ramps, merge areas, weave areas, and lane drops; or
- **Physical Constraints**, such as curves, underpasses, narrow structures, or absence of shoulders.

Table 2 provides a summary of common locations for bottlenecks, with a description of their cause. In summary, the major contributing causes are related to decision point characteristics. In addition to locating existing bottlenecks, this list of causes is helpful in anticipating areas that may become a concern with additional traffic volume.

Crash trends such as rear-end or sideswipe collisions on the freeway mainline can also indicate areas of congestion. Bottlenecks may be addressed with various strategies that can be applied at spot locations or at a system level, which in turn improves safety.

TABLE 2. COMMON CAUSES FOR LOCALIZED BOTTLENECKS

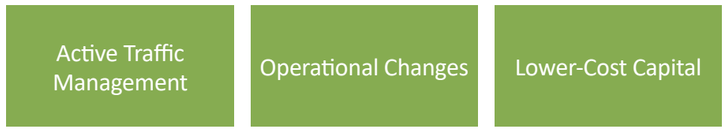
| LOCATION | | DESCRIPTION |
|---|---|---|
| Lane Drops | | Lane drops can create bottlenecks, particularly midsegment where one or more traffic lanes ends or at a low-volume exit ramp. Lane drops might occur at jurisdictional boundaries, just outside the metropolitan area, or at the project limits of the last megaproject. |
| Weaving Areas |  | Weaving areas are locations where traffic must merge across one or more lanes to access entrance or exit ramps, or to enter the freeway mainlines. Bottleneck conditions are exacerbated by complex or insufficient weaving design and distance. |
| Freeway Entrance Ramps | | Entrance ramps are where traffic from local streets or frontage roads merge onto the freeway. Conditions are worsened on entrance ramps without auxiliary lanes or short acceleration ramps, where there are entrance ramps in close proximity, and when peak volumes are high. |
| Freeway Exit Ramps |   | Exit ramps are where traffic leaves the freeway. Bottlenecks are exacerbated on freeway exit ramps with short ramp length, signal deficiencies at the ramp terminal, or insufficient storage length that may cause backups onto the freeway mainline. |
| Freeway-to-Freeway Interchanges | | A freeway-to-freeway interchange is a special case of entrance ramps where flow from one freeway is directed to another. These are typically the most severe form of physical bottlenecks due to the high traffic volumes involved. |
| Changes in Highway Alignment | | Sharp curves and hills cause drivers to slow down either because of safety concerns or because their vehicles cannot maintain speeds on upgrades. Another example of this bottleneck is in work zones where lanes bay be shifted or narrowed during construction. |
| Tunnels/ Underpasses | | Low-clearance structures, such as tunnels and underpasses cause drivers to slow. Even sufficiently tall clearances could cause bottlenecks if an optical illusion causes a structure to appear lower than it really is. |
| Narrow Lanes / Lack of Shoulders | | Narrow lanes and shoulders, and lack of shoulders causes vehicles to slow down, especially in locations with high volumes of oversize vehicles and large trucks. |
| Traffic Control Devices | | Traffic control devices such as traffic signals, freeway ramp meters, and tollbooths can all contribute to disruptions in traffic flow. |

*Source: Federal Highway Administration*

# ANALYSIS AND SCREENING OF POTENTIAL STRATEGIES

## Brainstorm Congestion and Safety Mitigation Strategies

The project team reviewed congestion and safety mitigation tools and their applicability for the study area. The consultant team developed a list of nearly 100 strategies to address areas of concern in the study area. The strategies generally fell into one of three groups and reflect the most appropriate options given the context of the UFCO Study.




The package of strategies is not intended to be considered as the only solutions, but are most applicable to the intended outcome of the UFCO Study.

## Workshop

The expert panel of transportation planning and traffic engineering staff from the partner agencies attended a workshop to screen a list of nearly 100 lower cost capital, operational and ITS projects/strategies to address congestion on each of the four corridors in the project area. Projects were organized into three categories to identify additional analysis and evaluation needed to finalize project/strategy evaluation post workshop.

The panel was be briefed on each project, the associated bottleneck(s), and traffic issues the project was developed to address. They were also be briefed on corridor design context and potential solutions that have been explored to date. From this starting point, the panel worked to refine and screen potential solutions as well as categorize the projects into categories.

**Categories**

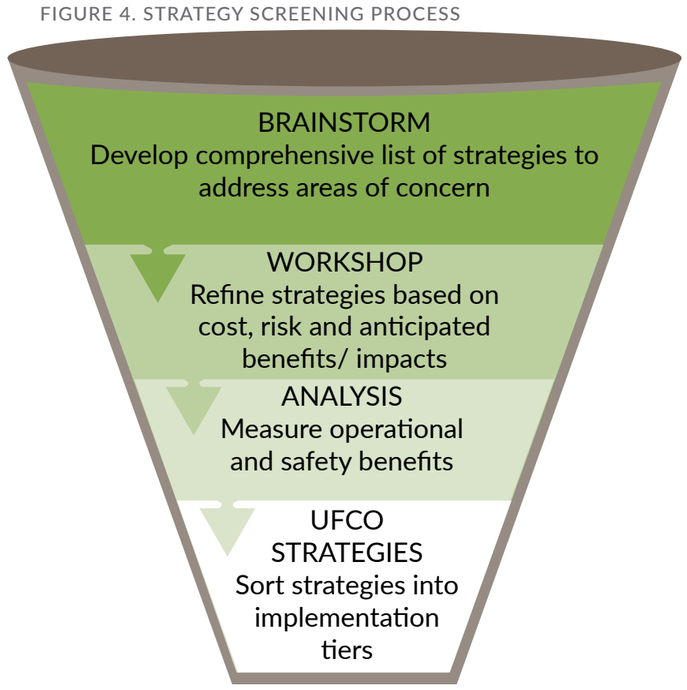
The three project categories from the workshop were:

- Category 1 – Lower Cost, Lower Impact, and Lower Risk projects that will be evaluated as part of the UFCO and could be implemented in a five to ten-year time frame.
- Category 2 – Lower/Moderate Cost, Impact and Risk projects that will haves some evaluation as part of UFCO to may be implemented in a five to ten-year time frame.
- Category 3 – Moderate/High Cost, Impact and/or Risk projects that may take more than five to ten years to implement and may take further study beyond the scope of UFCO.

At the end of the workshop, the following outcomes were achieved:

- Agreement on projects that should move forward for evaluation (Category 1 and Category 2)
- Identification of next steps for project refinement and evaluation
- Sufficient conceptual design to support modeling, costing, and benefit cost estimating

FIGURE 4. STRATEGY SCREENING PROCESS




# REFINEMENT OF STRATEGIES

## Analysis Methodology

Once the initial project was refined through the workshop screening, a comprehensive project list was developed that summarized potential projects by corridor. The consultant team evaluated the benefits and impacts of each project using qualitative and quantitative methods as appropriate. The evaluation included traffic operations, safety, costs, and constructability, allowing further refinement of the strategy list.

The traffic analysis relied on a variety of data sources and analysis tools. The analysis was completed for a future year to compare traffic conditions with and without the proposed project in place.

**Analysis Software**

A variety of programs consistent with the Highway Capacity Manual (HCM) were used to measure the traffic operations of proposed projects.

**Professional Judgement**

Traffic analysis software can be a helpful tool to evaluate how strategies address transportation needs. However, each tool is designed to perform different traffic analysis functions, and there is no one analytical tool that can do everything or solve every problem. When the results of the traffic analysis do not align with measured results, professional judgement can supplement the analysis.

As part of the UFCO Study, the project team reviewed the software output and compared it against real-world knowledge and data. Professional judgement was used in conjunction with aggregate data to refine results for the info sheets to address discrepancies between measured quantities and calculated HCS results.

**Cost Estimates**

The cost estimates developed for the project sheets allow for evaluation of the proposed projects without in depth engineering. They are not considered a substitute for the detailed engineering analysis that would be determined during refined level of design but provide order of magnitude estimates and are a useful tool in providing relative cost comparisons between strategies.

# SPOT AND SYSTEM STRATEGIES

The project team advanced tools and strategies that addressed key issues, were consistent with project goals and aligned with stakeholder and community preferences into implementation strategies and actions. The strategies and actions went through multiple rounds of review with the project partners for inclusion in this Plan.

The potential project solutions in UFCO focus on relieving recurring congestion chokepoints (as opposed to nonrecurring congestion causes) by addressing the operational influences that cause the chokepoints and lead to related safety issues. Widening, lengthening or restriping problem areas can often be done with a lower cost, less intensive "footprint." Such safety and operational improvements are not intended to provide long-term congestion relief, but they will improve safety immediately following construction and, over time, the bottleneck location will continue to operate more safely and efficiently.

UFCO improvements are expected to reduce crash frequency. This is considered a key element of any proposed concept where existing merging or weaving distances are short and crash rates are high, and freeway collisions create significant costs in terms of safety, delay, and reliability.

The type of improvements that were developed for the UFCO Study fall into two major categories: Spot Improvements and System Improvements. These solution types and examples of possible strategies are summarized below.

## PRACTICAL SOLUTIONS

UFCO strategies provide the region tools needed to make noticeable and quantifiable improvements to the operation of the transportation network on a day-to-day basis. The strategies are meant to prolong the health and function of the existing system without large capital improvements. These benefits include:

- Improving network safety (reducing the number and severity of collisions),
- Efficient use of resources,
- Improved reliability of the network, reducing the necessity of travelers to plan extra time to guarantee arriving at their destination on time.
- Providing tools to improve management of incidents and work zones, providing a safer environment for travelers and workers alike.

UFCO improvements are expected to reduce crash frequency, which is a key element of any proposed concept, and freeway collisions create significant costs in terms of safety, delay, and reliability. Using the strategy toolkit shown in Table 3, strategies were applied at spot locations or as a system strategy for a corridor, as summarized below.

### Spot Strategies

Spot strategy improvements are lower cost, high-benefit projects that improve traffic flow and provide bottleneck relief at spot locations. We can get more out of existing infrastructure by eliminating specific bottlenecks that cause recurring problems, making travel movements smoother and more efficient. Spot strategies can alleviate highway congestion without having to add new lanes.

### System Strategies

System strategies focus on maintaining the performance of the existing transportation system without adding capacity through addressing congestion and safety from a systems perspective, looking more at traffic system management and driver behavior strategies on a corridor. System strategies provide independent corridor benefits and can enhance the benefits of spot strategies or in some case reduce the need for a spot strategy.

The system strategies presented in this document include some that have been recently introduced to the Southwest Washington (region ramp metering). WSDOT recently developed its first full ATM system plan for Southwest Washington, consisting of ramp metering, queue warning, advisory speeds and travel information, to improve safety and reliability on I-5 southbound. In addition, the region has implemented several other TSMO applications on selected freeways to address specific congestion and safety issues.

TABLE 3. STRATEGY TOOLKIT

| TYPE OF STRATEGY | SPOT | SYSTEM |
|---|---|---|
| **Ramp Closure**<br>Ramp closures remove an access point to the freeway and can be implemented permanently or on an as-needed basis. Ramp closures can reduce friction on the mainline by removing an access point to the freeway. | X | |
| **Auxiliary Lane**<br>An additional lane space for travel between entrance and exit ramps. Allows traffic to adjust their speed before making a maneuver to enter or exit the freeway. These improvements help to reduce friction at merge and diverge locations on the freeway and decrease the possibility for conflicts that contribute to freeway congestion. | X | |
| **Acceleration/Deceleration Lanes**<br>Encourage smooth increases in traffic flow by allowing traffic to adjust to the proper speed before merging into or out of mainline traffic. Extending these lanes separates slower traffic from the mainline and improves safety. | X | |
| **Restriping**<br>Utilizes the existing pavement and reconfigures existing striping to accommodate changes in traffic distribution that may have occurred since the freeway was originally designed. | X | |
| **Static Signs**<br>Providing advance or increasing visibility of existing signs can improve driver awareness and provide ample time for a driver to make a decision. | X | X |
| **Temporary Shoulder Use**<br>Involves utilizing the roadway shoulder (inside or outside) as a travel lane during congested periods to alleviate recurrent (bottleneck) congestion for all or a subset of users, such as transit buses. Temporary shoulder use can also be used to manage traffic and congestion immediately after an incident. | X | X |
| **Variable Speed**<br>Utilizing regularly spaced, over-lane speed and lane control signs to dynamically and automatically reduce speed limits in areas of congestion, construction work zones, accidents, or special events in order to maintain traffic flow and reduce the risk of collisions due to speed differentials at the end of the queue and throughout the congested area. | X | X |
| **Queue Warning**<br>Utilizing either side-mount or over-lane signs to warn motorists of downstream queues, thus effectively utilizing available roadway capacity and reducing the likelihood of collisions related to queuing. | X | |
| **Traveler Information**<br>Providing estimated travel time information and other roadway and system conditions reports in order to allow travelers to make better pre-trip and in-route decisions. | X | X |
| **Ramp Metering**<br>Ramp metering manages the amount of traffic entering the freeway. | X | X |
| **Managed Lane**<br>Managed lane involves dynamically indicating the proper use of individual traffic lanes as warranted. Managed lanes can provide advance warning of closures in order to give drivers time to safely merge into adjoining lanes. | X | X |
| **Incident Management**<br>Identifying incidents more quickly, improving response times, and managing incident scenes more effectively. | X | X |

# IMPLEMENTATION

The Implementation Plan includes a road map for realizing the strategies as they best fit within the context of the UFCO Study. The tiered recommendations address one or more of the key safety, congestion, and user experience issues identified in the study area. This tiered approach, provides flexibility to agency to select beneficial strategies from the tiers that align with system needs, funding sources, and existing and future priorities.

## OPPORTUNITY TIERS

To support further design, funding and implementation, the strategies that have been organized into four tiers based on their benefits, costs and alignment with the lower-cost practical solutions approach of the UFCO Study. The four tiers are:

### *Tier 1: Move to Implementation*

These strategies provide lower cost improvements to address existing and near term needs, with positive benefits and agency support to move forward with design refinement, funding and implementation in near-term. Many of these strategies are currently in agency capital improvement plans. Some are programmed and funded for implementation.

### *Tier 2: Potential for Implementation in the Near-Term*

These strategies provide positive benefits and address freeway needs similar to Tier 1, indicating their readiness to move forward with design refinement, funding and implementation. The needs addressed by the strategy are in alignment with UFCO lower-cost practical solutions goals but may be closer to a 10 to 15 horizon or partner agency support is varied based on existing needs.

### *Tier 3: Look for Implementation Opportunities*

These strategies provide positive benefits and reasonable alignment with UFCO practical solutions goals but may be higher in cost or address freeway needs that are just starting to emerge and will have more benefit 10 plus year from now, relative to Tier 1 and Tier 2 strategies. Tier 3 strategies show benefits and agencies are encouraged to look for opportunities to fund design refinement and programming of these strategies to be ready to implement at the appropriate time.

### *Tier 4: Future Consideration*

These strategies provide mixed benefits and some alignment with UFCO practical solutions goals but are higher in cost or longer-term in there freeway need compared to other tiers. Tier 4 strategies may have future potential but are strategies for future consideration

### *VEHOPS*

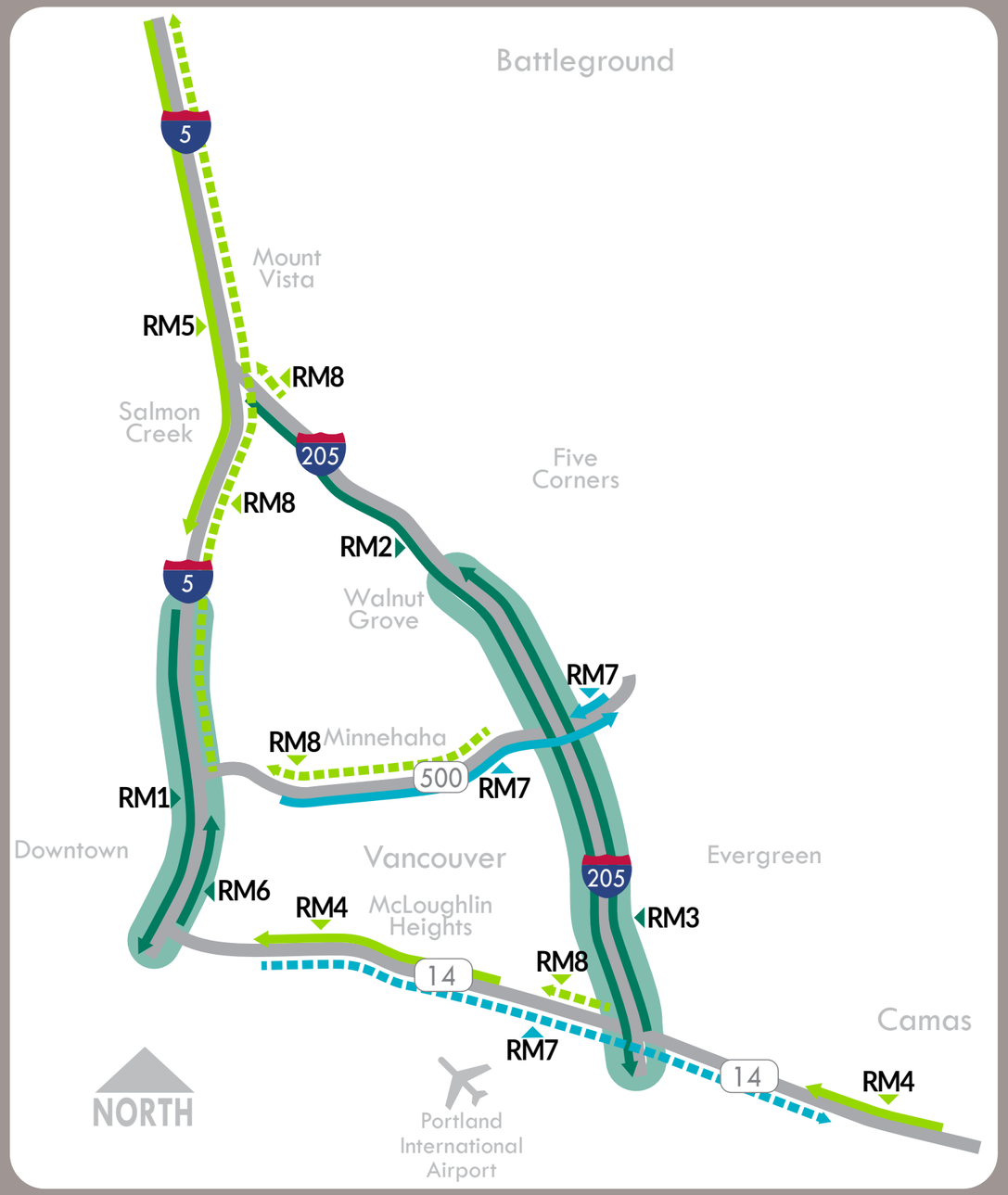
Eight VEHOPS strategies are recommended within Tiers 1 through 3. Strategies are shown on spot strategy map, I-205 dashboard and Appendix.

TABLE 4. UFCO STRATEGIES BY TIER

| | CORRIDOR | | DESCRIPTION |
|---|---|---|---|
| TIER 1 | I-5, I-205 | SC1 | **I-5 and I-205** – Create a safety corridor. |
| | I-5 | RM1 | **SB: 78th St to SR 14** – Meter entrance ramps. |
| | I-5 | RM6 | **NB: SR 14 to Fourth Plain Blvd** – Meter entrance ramps. |
| | I-5 | S13 | **SB: Mill Plain Blvd Entrance Ramp** – During ramp meter operation, allow use of the shoulder on the Mill Plain Blvd entrance ramp to I-5 SB. This project is part of the I-5 ATM project by WSDOT. |
| | I-5 | S16 | **SB: SR 14/City Center Entrance Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| | I-5 | S17 | **SB: SR 14/City Center Entrance Ramp** – Close the ramp to general traffic from City Center to I-5 SB during the morning peak commute hours. Becomes transit only ramp. |
| | I-5 | S20 | **SB: 99th St Park and Ride to I-5** – Prioritize transit access to I-5 by providing Transit Priority at the signals. |
| | I-5 | N16 | **NB: 78th St Exit Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| | I-205 | RM2 | **SB: 134th St to SR 14** – Meter entrance ramps. |
| | I-205 | RM3 | **NB: SR 14 to Padden Parkway** – Meter entrance ramps. |
| | SR 500 | E4 | **EB: SR 500 at I-205 Interchange** – Install VMS to warn drivers of back up at I-205 merge. |
| | SR 500 | E6 | **EB: 54th Ave Entrance Ramp to Andresen Rd Exit Ramp** – Construct an auxiliary lane. |
| | SR 500 | W3 | **WB: I-205 NB Exit Ramp** – Construct a barrier on WB SR 500 to prohibit WB SR 500 traffic from exiting to NB I-205. Traffic would still be able to travel from Gher Rd to I-205 NB. |
| | SR 500 | W4 | **WB: I-205 Southbound Entrance Ramp to Thurston Way Exit Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| | SR 500 | W8 | **WB: I-5 Southbound Exit Ramp** – Install VMS to warn drivers of back up at I-5 merge. |
| | SR 500 | W11 | **WB: 39th St at I-5 Northbound Ramp Terminal** – Construct a dedicated right turn lane for vehicles on 39th St turning right onto the I-5 NB entrance ramp. |
| | SR 500 | W13 | **WB: I-205 SB Exit Ramp to Vancouver Mall Dr and SR 500 WB Entrance Ramp** – Install static sign to provide advance information about lane assignment. |
| | SR 14 | E8 | **EB: I-205 Exit Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| | SR 14 | W4 | **WB: I-5 Exit Ramps** – Use ATM to provide advance information about real-time traffic conditions. |
| TIER 2 | ALL | RM8 | **Multi-Corridor** – Meter entrance ramps. |
| | I-5 | RM5 | **SB: Pioneer St to 99th St** – Meter entrance ramps. |
| | SR 500 | E7 | **EB: St. John's Rd Entrance Ramp to 42nd Ave Exit Ramp** – Construct an auxiliary lane. |
| | SR 500 | W2 | **WB: 112th Ave Entrance Ramp to I-205 Exit Ramp** – Add a right "exit only" lane to NB I-205 and create a left "exit only" lane to WB SR 500. |
| | SR 500 | W9 | **WB: I-5 NB Exit** – Install roundabouts at 39th St exit ramp |
| | SR 14 | RM4 | **SR 14 WB: 192nd Ave to 164th Ave and Lieser Rd to Columbia House Blvd** – Meter entrance ramps. |
| | SR 14 | E4 | **EB: Lieser Rd Entrance Ramp to I-205 Exit Ramp** – Construct an auxiliary lane. |
| TIER 3 | I-5 | S4 | **SB: SR 502 Entrance Ramp to I-205 Exit Ramp** – Construct an auxiliary lane SB from the SR 502 entrance ramp to the I-205 exit ramp. |
| | I-5 | S15 | **SB: Mill Plain Blvd Entrance Ramp to SR 14 Exit Ramp** – Allow use of the shoulder to provide a second auxiliary lane on I-5 SB between Mill Plain Blvd and SR 14. |
| | I-5 | N2 | **NB: SR 14 to Mill Plain Blvd Exit Ramp** – Construct an auxiliary lane. |
| | I-5 | N4 | **NB: SR 500 Exit Ramp** – Use ATM to provide advance information about real-time traffic conditions. |
| | I-5 | N7 | **NB: Hwy 99 Entrance Ramp to Main St Exit Ramp** – Add a fourth lane or time of day shoulder running. |
| | I-205 | S1 | **SB: 134th St Entrance Ramp** – Extend the SB acceleration lane. |
| | SR 500 | W6 | **WB: Andresen Rd Entrance Ramp to Stapleton Rd Exit Ramp** – Construct an auxiliary lane. |
| | SR 500 | W14 | **WB: 42nd Ave Entrance Ramp to St. John's Rd Exit Ramp** – Construct an auxiliary lane. |
| | SR 500, SR 14 | RM7 | **SR 500 EB: St. Johns Blvd to Gher Rd and SR 500 WB at Gher Rd** – Meter entrance ramps. |

Note: Yellow shading indicates strategy is programmed for construction

# SYSTEM STRATEGIES




# SPOT STRATEGIES

# STRATEGY INFO SHEETS

This section provides a collection of info sheets that can be used in a variety of different ways, depending on the user's needs. Strategy info sheets are provided for each of the strategies identified in this UFCO Plan and helps readers understand the important components of each.

In this chapter, the individual projects are presented by corridor and each corridor includes a dashboard that summarizes key information about the corridor:

- Corridor introduction
- UFCO project location map and summary table
- Corridor bottlenecks, congestion, and safety

As discussed earlier in this document, a comprehensive list of initial projects was narrowed to a collection of strategies for inclusion in this document. The strategy info sheets in this chapter include a description and schematic, along with summaries of traffic operations, safety, costs and other user benefits. The info sheets also include an assessment of impacts associated with each solution.

UFCO relied on the existing conditions information and institutional knowledge of the TAC to identify areas of need on each corridor. The strategies developed to help mitigate these needs were analyzed using traffic analysis software, readily available traffic data, and engineering judgement.

Table 5 and Figure 5 summarize all of the evaluated system strategies. Table 6 and Figure 6 on the following page summarize all of the evaluated spot location strategies. The strategies are listed in no particular order and do not include their opportunity tier found in the prior section.

TABLE 5. UFCO SYSTEM STRATEGIES

| ID | LOCATION | TIER | PAGE |
|---|---|---|---|
| | **System Strategies** | | |
| SC1 | I-5 and I-205 | 1 | 13 |
| RM1 | I-5 Southbound: 78th Street to SR 14 | 1 | 14 |
| RM2 | I-205 Southbound: 134th Street to SR 14 | 1 | 15 |
| RM3 | I-205 Northbound: SR 14 to Padden Parkway | 1 | 16 |
| RM4 | SR 14 Westbound: 192nd Avenue to 164th Avenue and Lieser Road to Columbia House Boulevard | 2 | 17 |
| RM5 | I-5 Southbound: Pioneer Street to 99th Street | 2 | 18 |
| RM6 | I-5 Northbound: SR 14 to Fourth Plain Boulevard | 1 | 19 |
| RM7 | SR 500 Eastbound: St. Johns Boulevard to Gher Rd and SR 500 Westbound at Gher Road | 3 | 20 |
| RM8 | Multi-Corridor | 2 | 21 |

FIGURE 5. UFCO SYSTEM STRATEGIES BY CORRIDOR

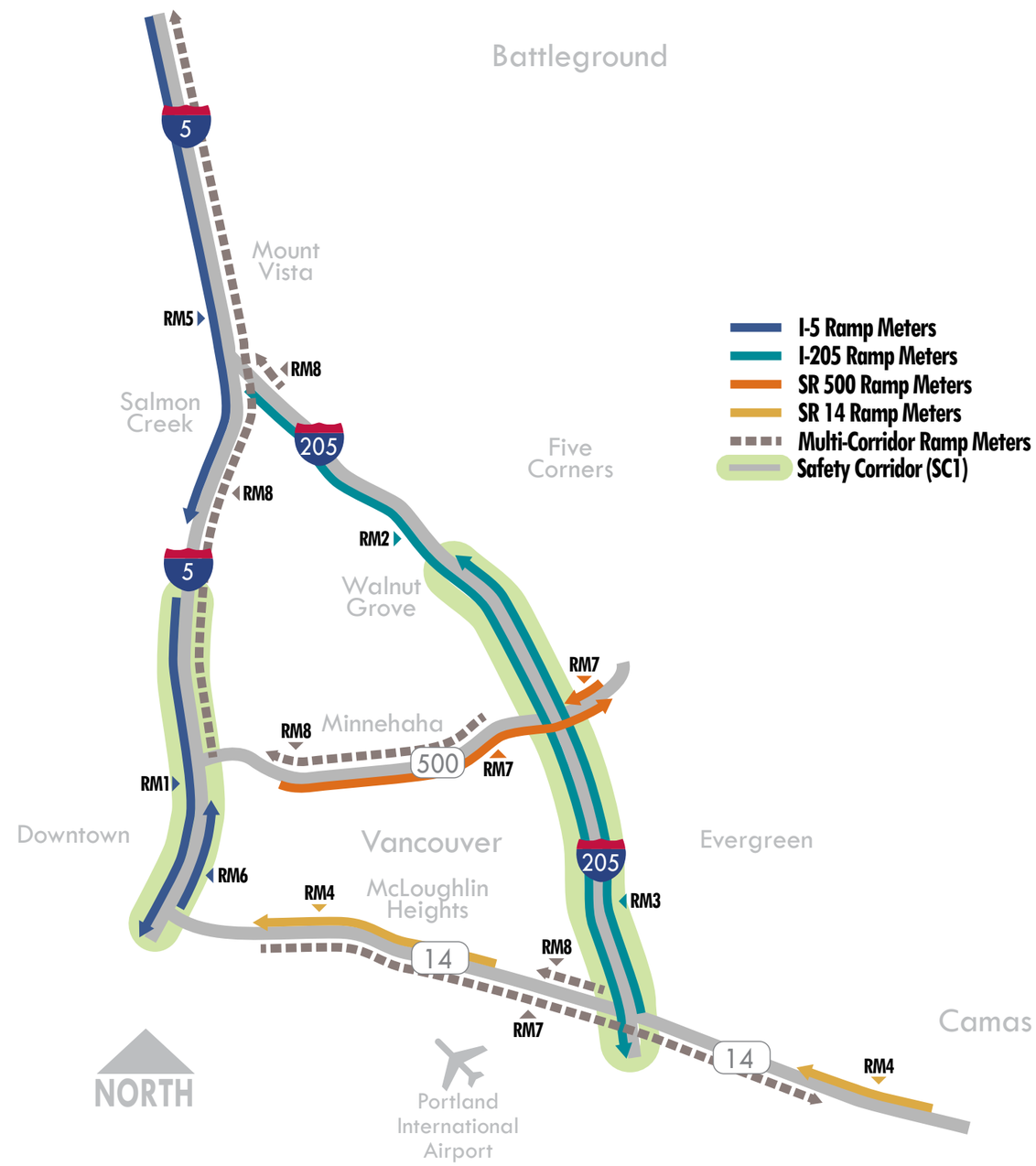


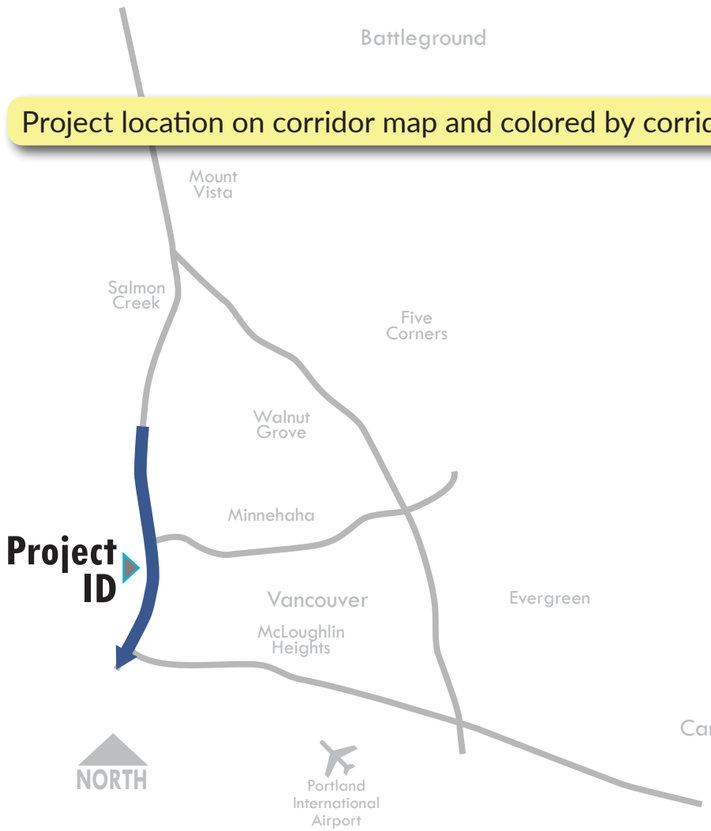
TABLE 6. UFCO SPOT STRATEGIES

| ID | LOCATION | TIER | PAGE |
|---|---|---|---|
| | **I-5 Spot Strategies** | | |
| S4 | Southbound: SR 502 Entrance Ramp to I-205 Exit Ramp | 3 | 23 |
| S13 | Southbound: Mill Plain Blvd Entrance Ramp | 1 | 24 |
| S15 | Southbound: Mill Plain Blvd Entrance Ramp to SR 14 Exit Ramp | 3 | 25 |
| S16 | Southbound: SR 14/City Center Entrance Ramp | 1 | 26 |
| S17 | Southbound: SR 14/City Center Entrance Ramp | 1 | 27 |
| S20 | Southbound: 99th St Park and Ride to I-5 | 1 | 28 |
| N2 | Northbound: SR 14 to Mill Plain Blvd Exit Ramp | 3 | 29 |
| N4 | Northbound: SR 500 Exit Ramp | 3 | 30 |
| N7 | Northbound: Hwy 99 Entrance Ramp to Main St Exit Ramp | 3 | 31 |
| N8 | Northbound: 78th St Exit Ramp | 4 | 32 |
| N16 | Northbound: 78th St Exit Ramp | 1 | 33 |
| | **I-205 Spot Strategies** | | |
| S1 | Southbound: 134th StEntrance Ramp | 3 | 35 |
| N15 | Northbound: Padden Pkwy to 72nd Ave | 4 | 36 |
| | **SR 500 Spot Strategies** | | |
| E4 | Eastbound: SR 500 at I-205 Interchange | 1 | 38 |
| E6 | Eastbound: 54th Ave Entrance Ramp to Andresen Rd Exit Ramp | 1 | 39 |
| E7 | Eastbound: St. John's Rd Entrance Ramp to 42nd Ave Exit Ramp | 2 | 40 |
| W2 | Westbound: 112th Ave Entrance Ramp to I-205 Exit Ramp | 2 | 41 |
| W3 | Westbound: I-205 Northbound Exit Ramp | 1 | 42 |
| W4 | Westbound: I-205 Southbound Entrance Ramp to Thurston Way Exit Ramp | 1 | 43 |
| W6 | Westbound: Andresen Rd Entrance Ramp to Stapleton Rd Exit Ramp | 3 | 44 |
| W8 | Westbound: I-5 Southbound Exit Ramp | 1 | 45 |
| W9 | Westbound: I-5 Northbound Exit | 2 | 46 |
| W11 | Westbound: 39th St at I-5 Northbound Ramp Terminal | 1 | 47 |
| W13 | Westbound: I-205 Southbound Exit Ramp to Vancouver Mall Dr & SR 500 Westbound Entrance Ramp | 1 | 48 |
| W14 | Westbound: 42nd Ave Entrance Ramp to St. John's Road Exit Ramp | 3 | 49 |
| | **SR 14 Spot Strategies** | | |
| E1 | Eastbound: Columbia Way Blvd and Marine Park Way Entrance Ramps | 4 | 51 |
| E2 | Eastbound: Shorewood Dr Exit and Entrance Ramps | 4 | 52 |
| E4 | Eastbound: Lieser Rd Entrance Ramp to I-205 Exit Ramp | 2 | 53 |
| E6 | Eastbound: Ellsworth Rd and I-205 Exit Ramps | 4 | 54 |
| E8 | Eastbound: I-205 Exit Ramp | 1 | 55 |
| W4 | Westbound: I-5 Exit Ramps | 1 | 56 |

FIGURE 6. UFCO SPOT STRATEGIES BY CORRIDOR

# HOW TO READ THE INFO SHEETS






Project location on corridor map and colored by corridor

## Purpose and Need

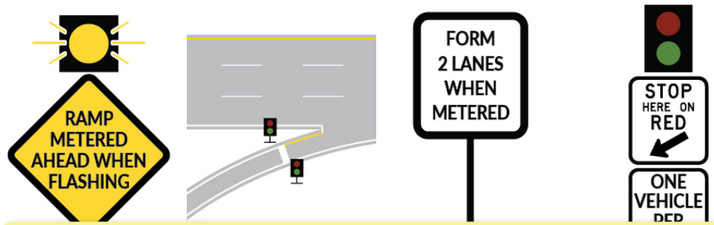
This section summarizes the following:

- The bottleneck location related to the proposed project,
- The nature and severity of congestion issues observed at the bottleneck location, and
- Any notable impacts this congestion may have on traffic patterns, safety, and travel speeds.

## Proposed Project and Benefit

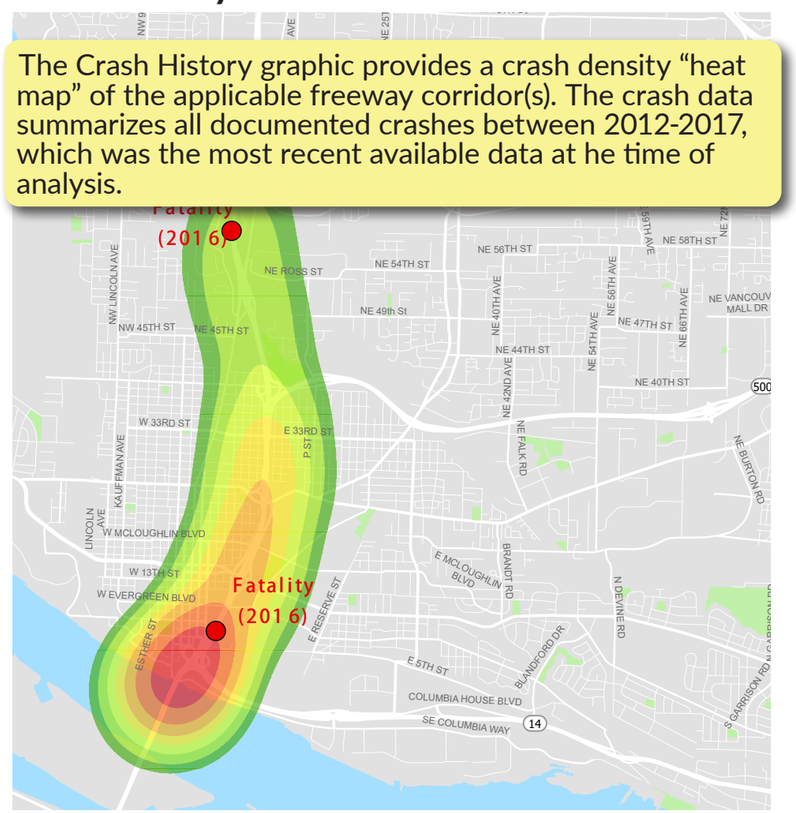
This section describes the proposed project and how it addresses the problem that is discussed in the Purpose and Need section.

## Project Concept Diagram




The Project Concept Diagram shows conceptual illustrations of the existing condition and the proposed project. In the illustration showing the proposed project concept, modifications from the existing condition are highlighted. New or reconfigured project elements are highlighted in solid color. Removed elements are indicated by colored crosshatching and a red "X."

## Crash History




The Crash History graphic provides a crash density "heat map" of the applicable freeway corridor(s). The crash data summarizes all documented crashes between 2012-2017, which was the most recent available data at he time of analysis.

## Improvement Metrics

Improvement Metrics measure how well the proposed strategy benefits important metrics.

### *Operations*

Where empirical analysis is available, a comparison of No Build and Build results is provided.

For projects using qualitative assessment, a summary of the expected benefits is provided based on typical benefits of a particular improvement strategy.

### *Safety*

This section provides an overview of any known safety issues that have been identified for the associated bottleneck location. This overview may include:

- Specific safety concerns at the bottleneck location,
- Factors contributing to identified safety concerns, and
- How the proposed project could improve safety.

### *Cost*

An estimate of total cost to implement the proposed project (including design and construction) in 2019 Dollars.

## FINDINGS

This section summarizes proposed impacts on traffic flow and safety at the bottleneck location. The Findings may also provide an overview of notable benefits or disadvantages associated with the proposed strategy.

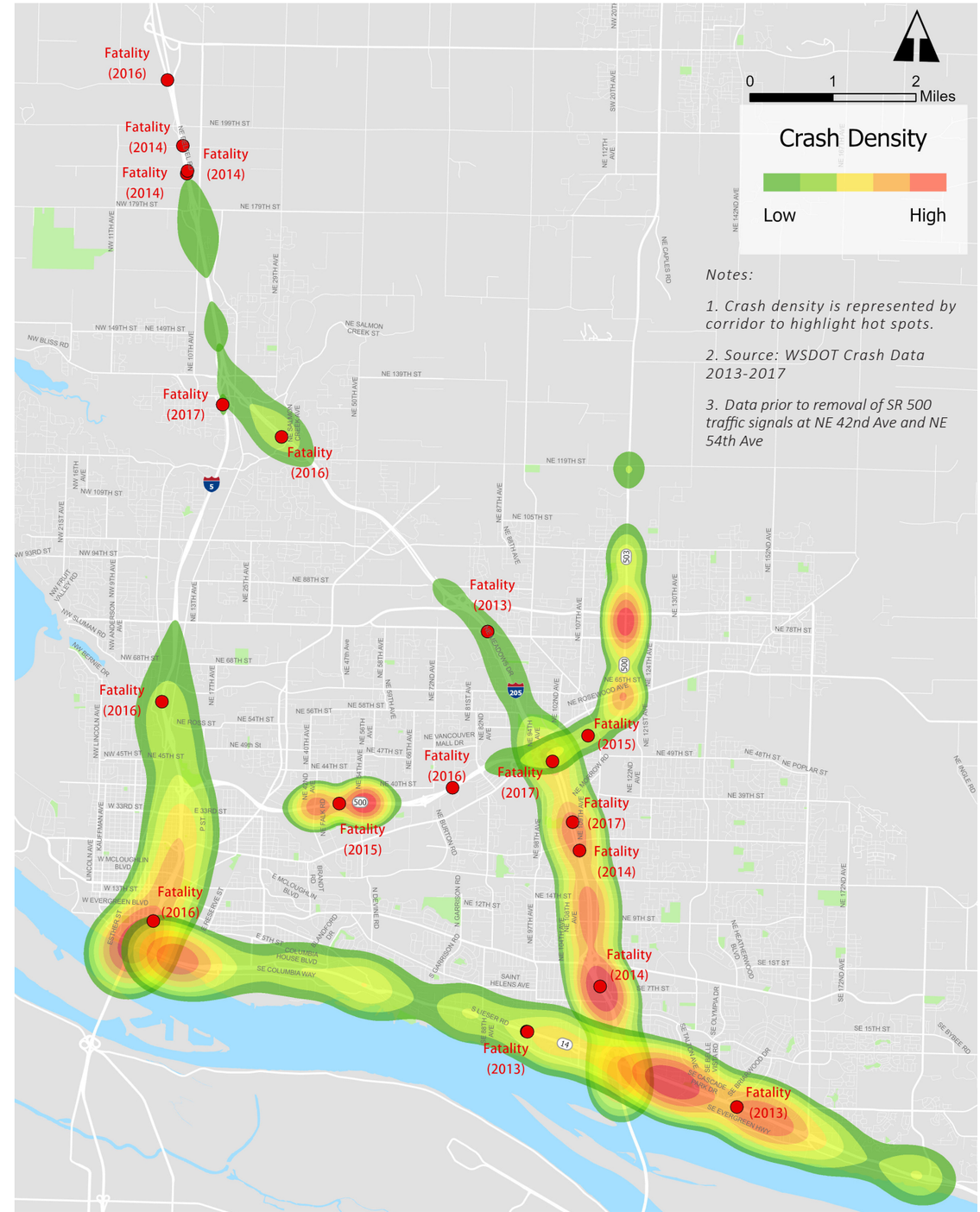
In addition to overall findings, other related projects may be listed, if applicable. Related projects may include strategies that could be completed in conjunction with the proposed project being presented, or projects already programmed for construction.

The implementation "Tier" is noted in this section. Priorities may change over time and unexpected opportunities may arise to fund particular projects. Agencies are free pursue strategies from any tier at any time.

# SYSTEM STRATEGY DASHBOARD

System strategies focus on maintaining the performance of the existing transportation system without adding capacity through addressing congestion and safety from a systems perspective, looking more at traffic system management and driver behavior strategies on a corridor. System strategies provide independent corridor benefits and can enhance the benefits of spot strategies or in some case reduce the need for a spot strategy.

| ID | LOCATION | PROJECT TYPE | TIER | PAGE |
|---|---|---|---|---|
| SC1 | I-5 and I-205 | Safety Corridor | 1 | 13 |
| RM1 | I-5 Southbound: 78th Street to SR 14 | Ramp Metering | 1 | 14 |
| RM2 | I-205 Southbound: 134th Street to SR 14 | Ramp Metering | 1 | 15 |
| RM3 | I-205 Northbound: SR 14 to Padden Parkway | Ramp Metering | 1 | 16 |
| RM4 | SR 14 Westbound: 192nd Avenue to 164th Avenue and Lieser Road to Columbia House Boulevard | Ramp Metering | 2 | 17 |
| RM5 | I-5 Southbound: Pioneer Street to 99th Street | Ramp Metering | 2 | 18 |
| RM6 | I-5 Northbound: SR 14 to Fourth Plain Boulevard | Ramp Metering | 1 | 19 |
| RM7 | SR 500 Eastbound: St. Johns Boulevard to Gher Rd and SR 500 Westbound at Gher Road | Ramp Metering | 3 | 20 |
| RM8 | Multi-Corridor | Ramp Metering | 2 | 21 |



# I-5 and I-205

*Safety Corridors*



## Project SC 1

## Purpose and Need

I-5 and I-205 both carry very high volumes of traffic at all hours of the day; the Mill Plain Boulevard interchange with I-5 in particular is the major access point for trucks to get to the Port of Vancouver. A vehicle breakdown in this segment deteriorates operations immediately, adversely affecting traffic flow.

## Proposed Project and Benefit

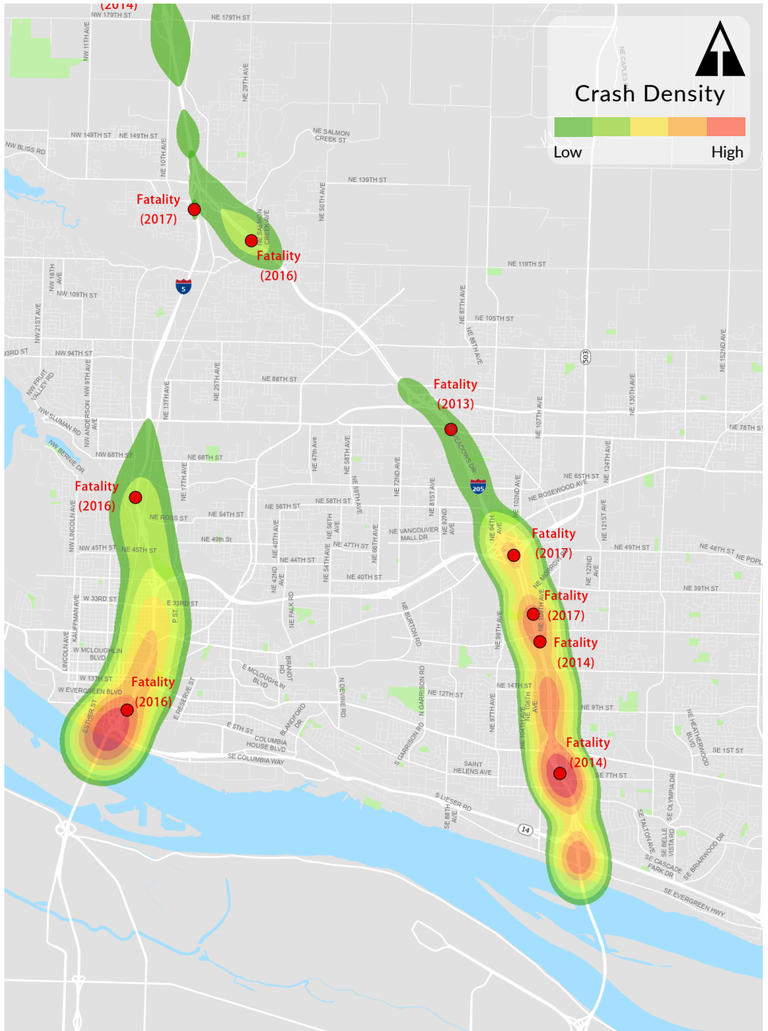
This project would create a safety corridor on I-5 between SR 14 and 78th Street and on I-205 between SR 14 and Padden Parkway. Partnering with the Washington State Patrol (WSP) and WSDOT, the project installs fender bender signage for damaged vehicles to be moved off the roadway. In the event of an incident, clearing the roadway rapidly ensures minimal effect on the traffic flow.

The Washington Traffic Safety Commission (WTSC), in cooperation with the WSDOT and the WSP, designates safety corridors at the request of local communities with the goal of reducing fatal and disabling collisions on roadways with significant safety needs. Once designated as a safety corridor, a roadway is eligible to receive WTSC funding for targeted education, engineering and enforcement efforts.

## Project Concept Diagram

## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### Operations

- Improved response time could reduce delay caused by crashes.
- Speed enforcement can reduce vehicle speed differential which will reduce weaving movements and increase traffic flow.

### Safety

- Potential for 69% reduction in crashes that occur secondary to a primary crash, which could improve safety throughout the corridor.
- Quick removal of abandoned or disabled vehicles will reduce potential fixed object collisions.

### Cost

## $2-$2.5 million

- Capitol costs are small for sign installation.
- Ongoing costs are minimal as supplemental for incident response and enforcement personnel.

## FINDINGS

- Decreased response time for incidents.
- Reduced delay related to incidents.
- Reduces collisions.
- High beneft-to-cost ratio.

**Tier 1**

# I-5 Southbound: 78th Street to SR 14

*Ramp Metering Phase 1*

## Purpose and Need

During peak morning travel times, the on-ramps to I-5 southbound become a choke point as several drivers try to merge onto the freeway simultaneously.

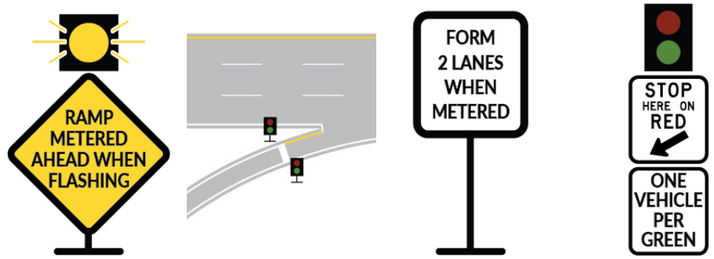
Ramp metering is a cost-effective proven strategy used in urban areas around the nation to improve traffic flow and safety. A recent study showed that a majority of ramps in Vancouver would benefit from ramp meters.

## Proposed Project and Benefit

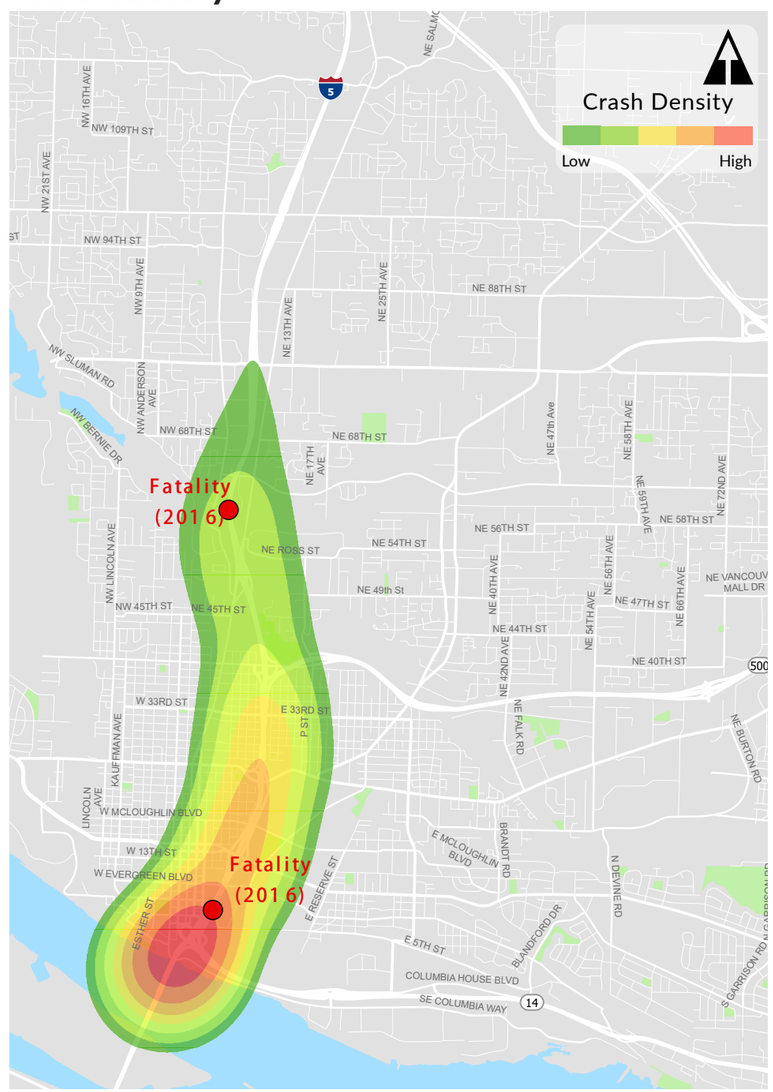
This project installs ramp meters on entrance ramps to I-5 southbound between 78th Street and SR 14. These ramp meters are programmed for installation by WSDOT.

Ramp meters are signals that control the frequency in which vehicles enter the flow of traffic on the freeways. It's a proven cost-effective strategy used in urban areas around the nation to reduce congestion and improve traffic flow and safety. Additionally, metering improves trip reliability during busy travel periods, and can help the freeway recover sooner with faster speeds following significant backups and delays caused by congestion or a blocking incident.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The ramp meters improve traffic flow at merge points resulting in a slight increase in average speed throughout the corridor and by 4 mph on the Columbia River Bridge resulting in improved traffic flow, reliability and volume throughput.

Mainline congestion experiences the greatest improvement at the end of the corridor due to the cumulative impact of multiple ramp meters

### Safety

The highest number of crashes occur on I-5 during the AM peak period when ramp meters would be operational, therefore crash reductions associated with ramp metering would be particularly beneficial for this corridor.

Ramp meters in this phase will also benefit the area of I-5 that experiences the highest number of crashes, as well as two fatalities that occurred during 2016.

### Cost

**$1-$2 million**

- Relatively low cost to implement and maintain 5 ramp meters necessary for this corridor.

## FINDINGS

- Minor increase in corridor speed and reduced travel times during congested periods.
- Largest speed increase is at the Interstate Bridge.
- Increased travel time reliability.
- 50% reduction in merge related crashes.
- Minimal environmental impacts related to construction.
- Reduced vehicle emissions.

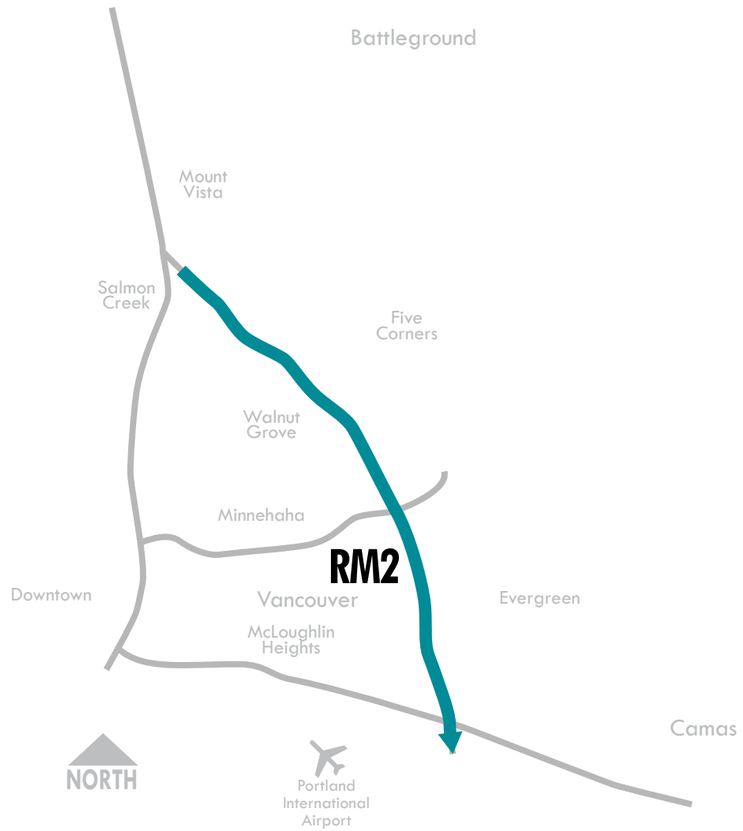
This strategy is part of WSDOT's larger Active Traffic Management system for I-5.

**Tier 1**

# I-205 Southbound: 134th Street to SR 14

*Ramp Metering Phase 2*






## Purpose and Need

During peak morning travel times, the on-ramps to I-205 southbound become a choke point as several drivers try to merge onto the freeway simultaneously.

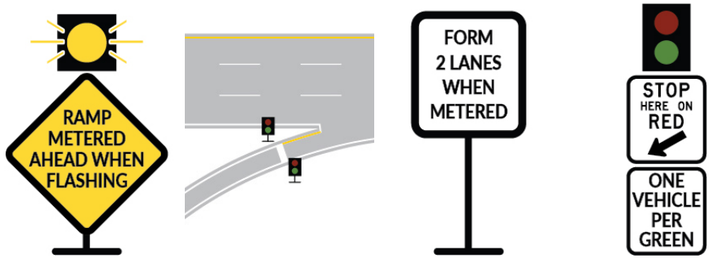
Ramp metering is a cost-effective proven strategy used in urban areas around the nation to improve traffic flow and safety. A recent study showed that a majority of ramps in Vancouver would benefit from ramp meters.

## Proposed Project and Benefit

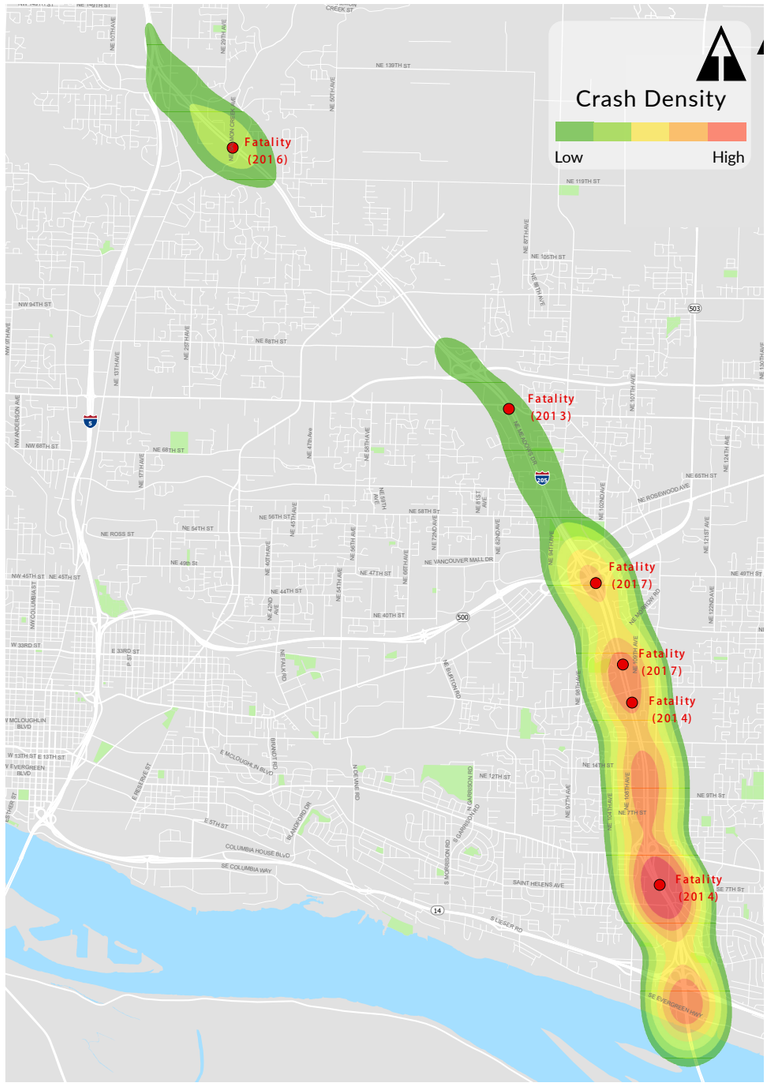
This project installs ramp meters on entrance ramps to southbound I-205 between 134th Street and SR 14. The ramp meters from Padden Parkway to Mill Plain Boulevard are programmed for installation by WSDOT.

Metering the ramp breaks up vehicle platoons and controls the rate at which vehicles enter and merge with traffic on the freeway. The gaps between merging vehicles created by the meters allow more efficient merging, instead of a large platoon attempting to merge and slowing down traffic.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The ramp meters improve traffic flow at merge points resulting in an average speeds increasing by almost two mph in the corridor and by around 30 mph in the vicinity of Padden Parkway.

Mainline congestion experiences the greatest improvement in segments with significant congestion in the No Build scenario, especially in the vicinity of Padden Parkway where speeds are below 20 mph without metering

### Safety

A significantly higher number of crashes occur during the AM peak period on I-205 as compared to off-peak periods, therefore crash reductions associated with ramp metering would be particularly beneficial for this corridor.

Ramp metering will be especially beneficial for the southern end of the corridor where crash densities are highest, near the SR 500, Mill Plain Boulevard, and SR 14 interchanges.

### Cost

**$1.4-$2.8 million**

- Relatively low cost to implement and maintain 7 ramp meters necessary for this corridor.

## FINDINGS

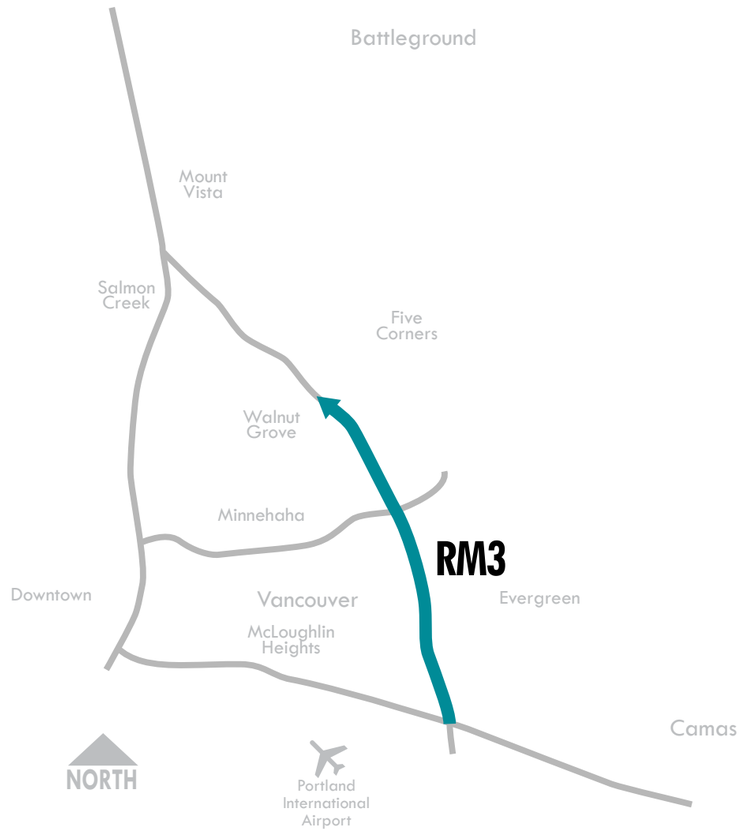
- Increase in corridor speed and reduced travel times during congested periods.
- Largest speed increase of 30 mph in vicinity of Padden Parkway.
- Increased travel time reliability.
- 50% reduction in merge related crashes.
- Minimal environmental impacts related to construction.
- Reduced vehicle emissions.

**Tier 1**

# I-205 Northbound: SR 14 to Padden Parkway

*Ramp Metering Phase 3*






## Purpose and Need

During peak evening travel times, the on-ramps to northbound I-205 become a choke point as several drivers try to merge onto the freeway simultaneously, especially in the rightmost lanes.

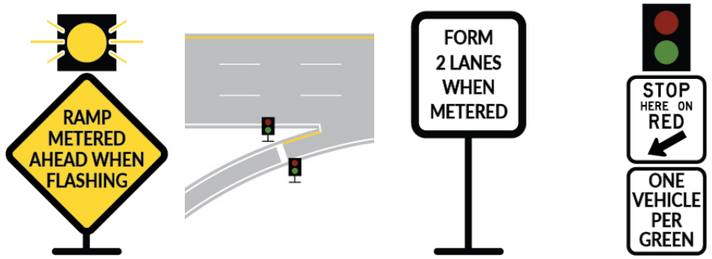
Ramp metering is a cost-effective proven strategy used in urban areas around the nation to improve traffic flow and safety. A recent study showed that a majority of ramps in Vancouver would benefit from ramp meters.

## Proposed Project and Benefit

This project installs ramp meters on entrance ramps to I-205 northbound between SR 14 and Padden Parkway. There is already a ramp meter at the entrance from SR 500. The ramp meter at Mill Plain Boulevard is programmed for installation by WSDOT.

Metering the ramp controls the rate at which vehicles enter and merge with traffic on the freeway. The gaps created allow only a few vehicles to merge at a time, instead of a large platoon attempting to merge and slowing down traffic

## Project Concept Diagram

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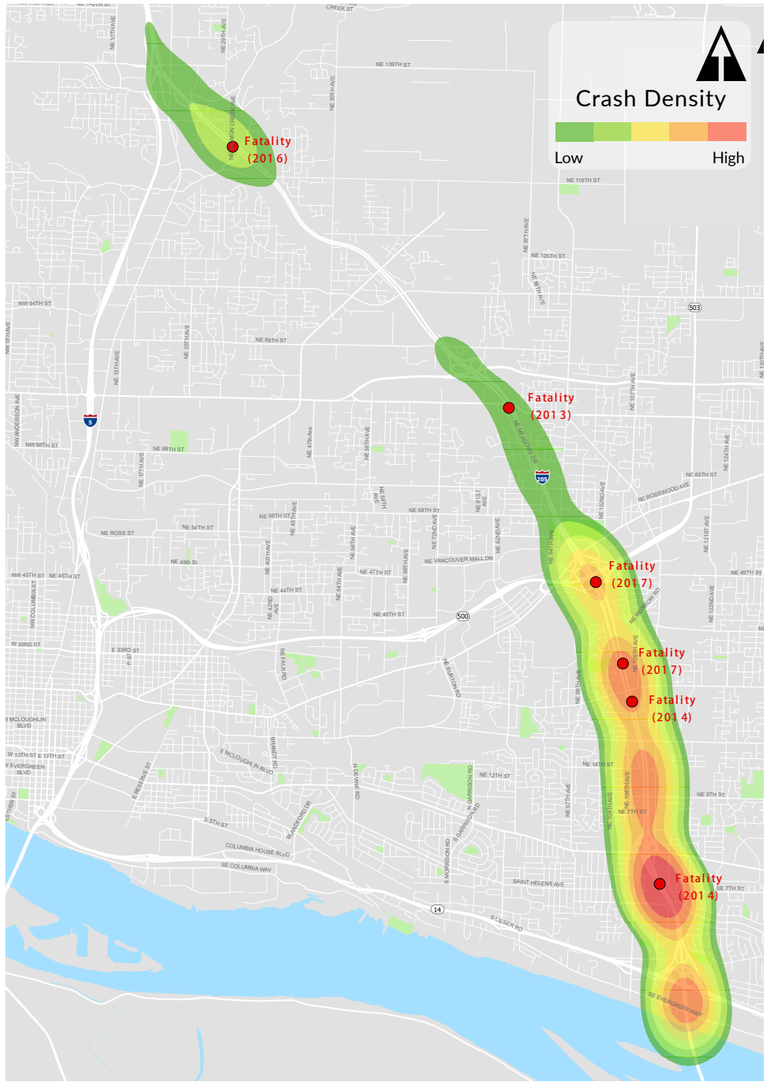



## Improvement Metrics

### Operations

The ramp meters improve traffic flow at merge points resulting in a slight increase in average speed throughout the corridor.

Mainline congestion experiences the greatest improvement in the segments directly following metered on-ramps due to the controlled flow and increased predictability of gaps for merging vehicles in the rightmost lanes.

### Safety

The highest number of crashes occur on I-205 during the PM peak period when ramp meters would be operational, therefore crash reductions associated with ramp metering would be particularly beneficial for this corridor.

Ramp metering will be especially beneficial for the southern end of the corridor where crash densities are highest, near the SR 500, Mill Plain Boulevard, and SR 14 interchanges.

### Cost

**$800,000-$1.6 million**

- Relatively low cost to implement and maintain 4 ramps necessary for this corridor.

## FINDINGS

- Minor increase in corridor speed and reduced travel times during congested periods.
- Increased travel time reliability.
- 50% reduction in merge related crashes.
- Minimal environmental impacts related to construction.
- Reduced vehicle emissions.

This strategy is partially funded.

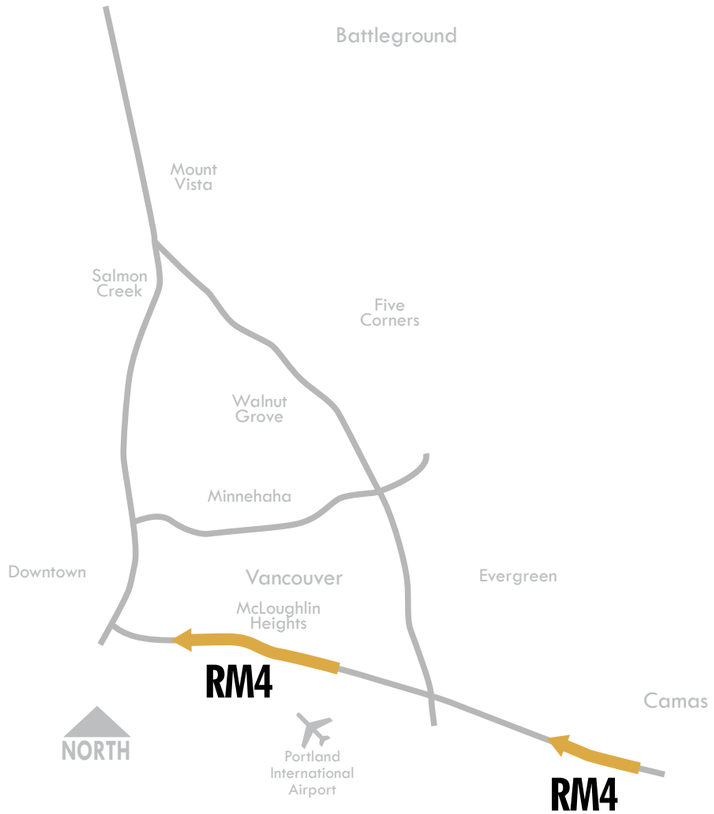
**Tier 1**

# SR 14 Westbound: 192nd Avenue to 164th Avenue and Lieser Road to Columbia House Boulevard

*Ramp Metering Phase 4*



**Project RM4**




## Purpose and Need

During the AM peak commute hours, traffic can stack up as vehicles travel to either I-205 or I-5 to head south into Oregon. The right lane of SR 14 stacks up in the right lane in advance of the I-205 exit ramp, and in the left lane in advance of the I-5 exit ramp.

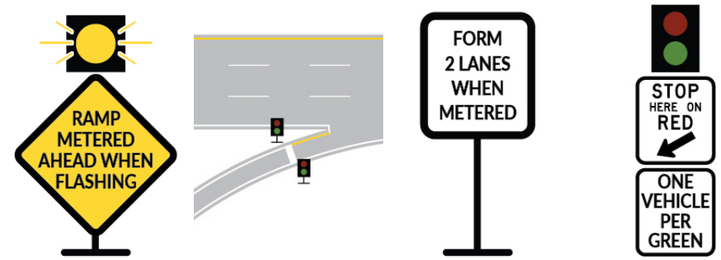
Ramp metering is a cost-effective proven strategy used in urban areas around the nation to improve traffic flow and safety. A recent study showed that a majority of ramps in Vancouver would benefit from ramp meters.

## Proposed Project and Benefit

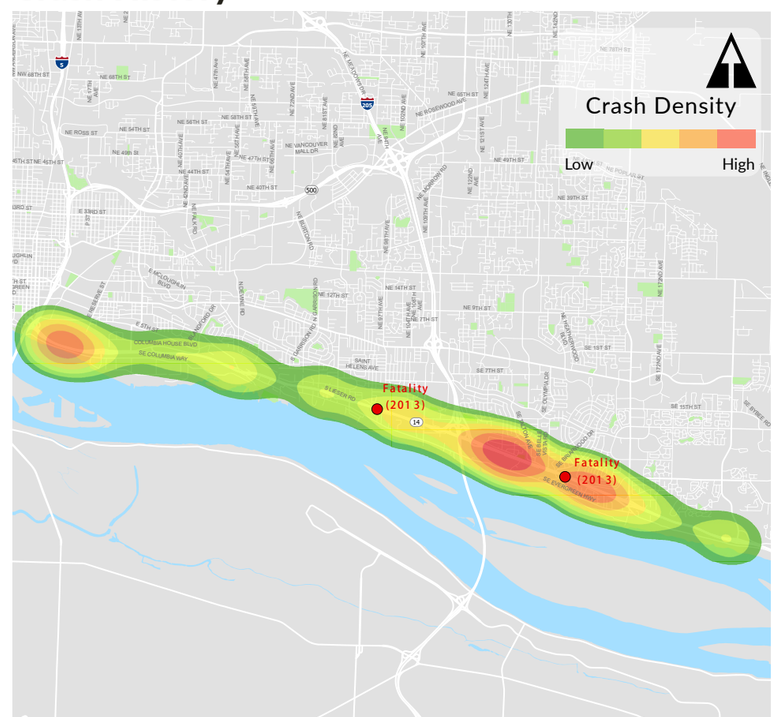
This project installs ramp meters on entrance ramps to SR 14 westbound between 192nd Avenue and 164th Avenue, as well as between Lieser Road and Columbia House Boulevard.

Metering the ramp controls the rate at which vehicles enter and merge with traffic on the freeway. The gaps created allow only a few vehicles to merge at a time, instead of a large platoon attempting to merge and slowing down traffic.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The ramp meters improve traffic flow at merge points resulting in a slight increase in average speed throughout in the corridor.

Mainline congestion experiences the greatest improvement on the western end of the corridor, surrounding the three interchanges just prior to the I-5 interchange.

### Safety

The highest number of crashes occur on SR 14 during the AM peak period when ramp meters would be operational, therefore crash reductions associated with ramp metering would be particularly beneficial for this corridor.

Ramp metering will be especially beneficial for the areas near the I-5, I-205, and 164th Avenue interchanges.

### Cost

**$800,000-$1.6 million**

- Relatively low cost to implement and maintain 4 ramp meters necessary for this corridor.

## FINDINGS

- Minor increase in corridor speed and reduced travel times during congested periods.
- Increased travel time reliability.
- 50% reduction in merge related crashes.
- Minimal environmental impacts related to construction.
- Reduced vehicle emissions.

This strategy is partially funded; ramps are planned for the 164th Avenue entrance ramp.

**Tier 2**

# I-5 Southbound: Pioneer Street to 99th Street

*Ramp Metering Phase 5*

## Purpose and Need

During peak AM commute hours, the on-ramps to I-5 southbound become a choke point as several drivers try to merge onto the freeway simultaneously.

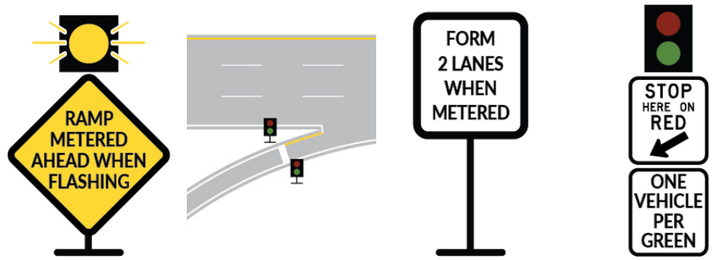
Ramp metering is a cost-effective proven strategy used in urban areas around the nation to improve traffic flow and safety. A recent study showed that a majority of ramps in Vancouver would benefit from ramp meters.

## Proposed Project and Benefit

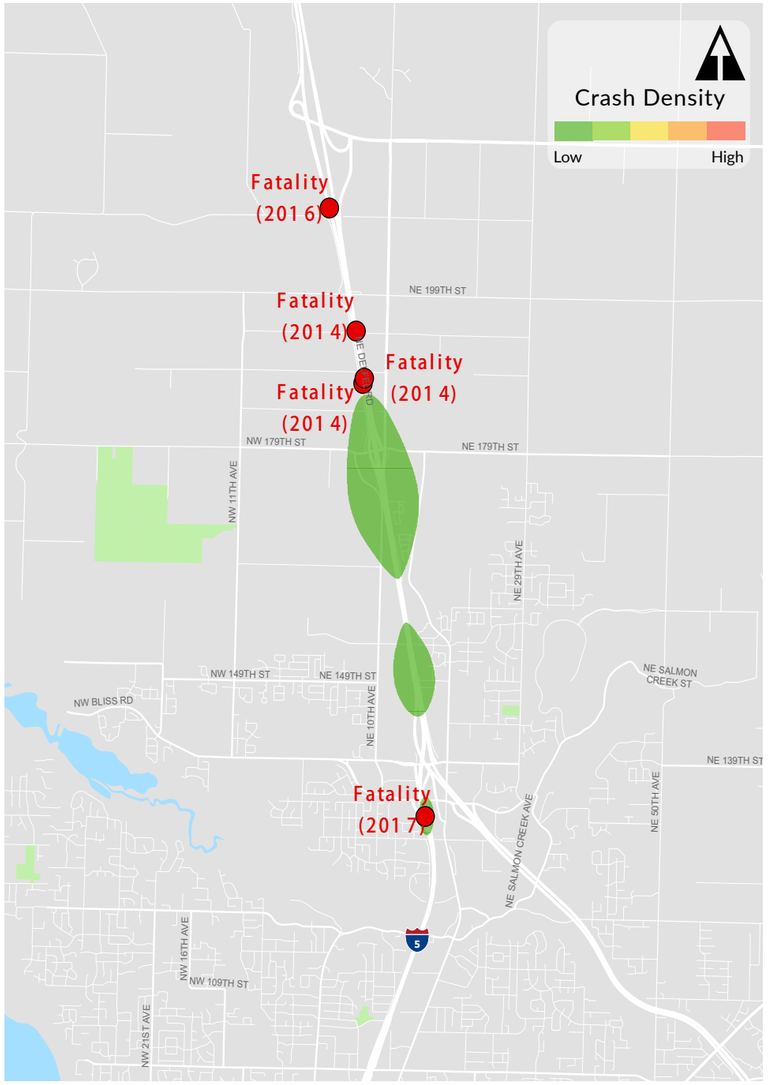
This project installs ramp meters on entrance ramps to I-5 southbound between Pioneer Street and 99th Street.

Metering the ramp controls the rate at which vehicles enter and merge with traffic on the freeway. The gaps created allow only a few vehicles to merge at a time, instead of a large platoon attempting to merge and slowing down traffic.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The ramp meters improve traffic flow at merge points resulting in a slight increase in average speed throughout the corridor

As this project is the completion of ramp metering throughout the I-5 southbound corridor, operational benefits are less impactful with the addition of metering the northern locations.

### Safety

Over half of the fatalities on the I-5 corridor occurred within the extents of this phase, though the overall density of crashes is minimal compared to the southern end.

Ramp metering would benefit safety significantly in this segment of I-5, as there is potential to reduce all crash types and severities by 50%.

### Cost

**$1-$2 million**

- Relatively low cost to implement and maintain 5 ramp meters necessary for this corridor.

## FINDINGS

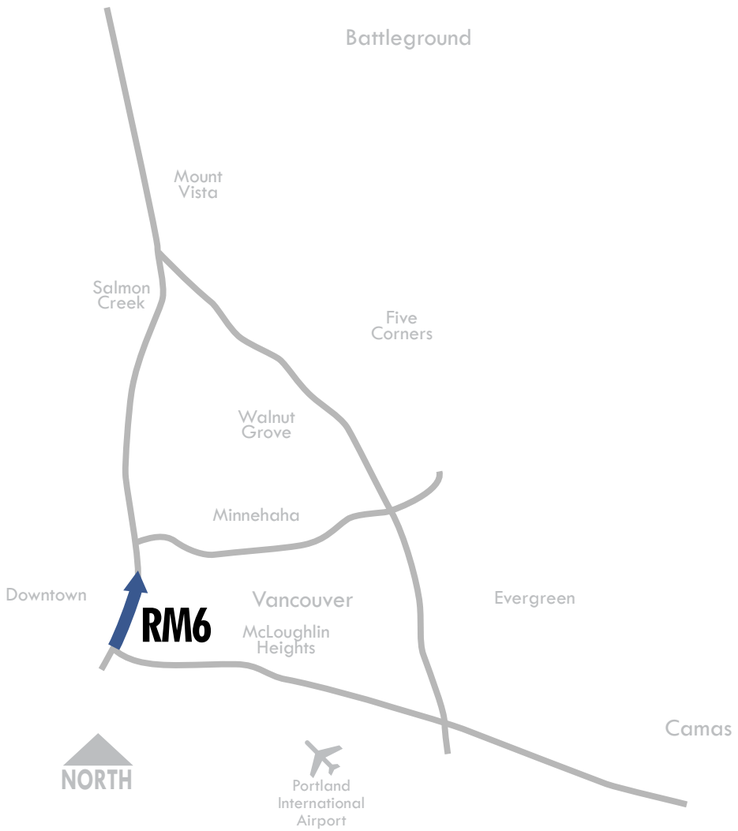
- Minor increase in corridor speed and reduced travel times during congested periods.
- Increased travel time reliability.
- 50% reduction in merge related crashes.
- Minimal environmental impacts related to construction.
- Reduced vehicle emissions.

**Tier 2**

# I-5 Northbound: SR 14 to Fourth Plain Boulevard

*Ramp Metering Phase 6*






## Purpose and Need

During peak commute hours, the on-ramps to I-5 northbound can become congested due to slowing on the mainline, mostly in the right lane.

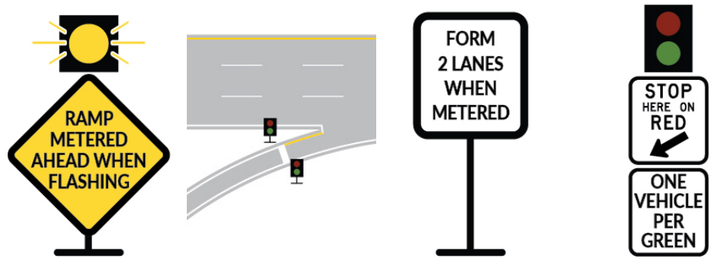
Ramp metering is a cost-effective proven strategy used in urban areas around the nation to improve traffic flow and safety. A recent study showed that a majority of ramps in Vancouver would benefit from ramp meters.

## Proposed Project and Benefit

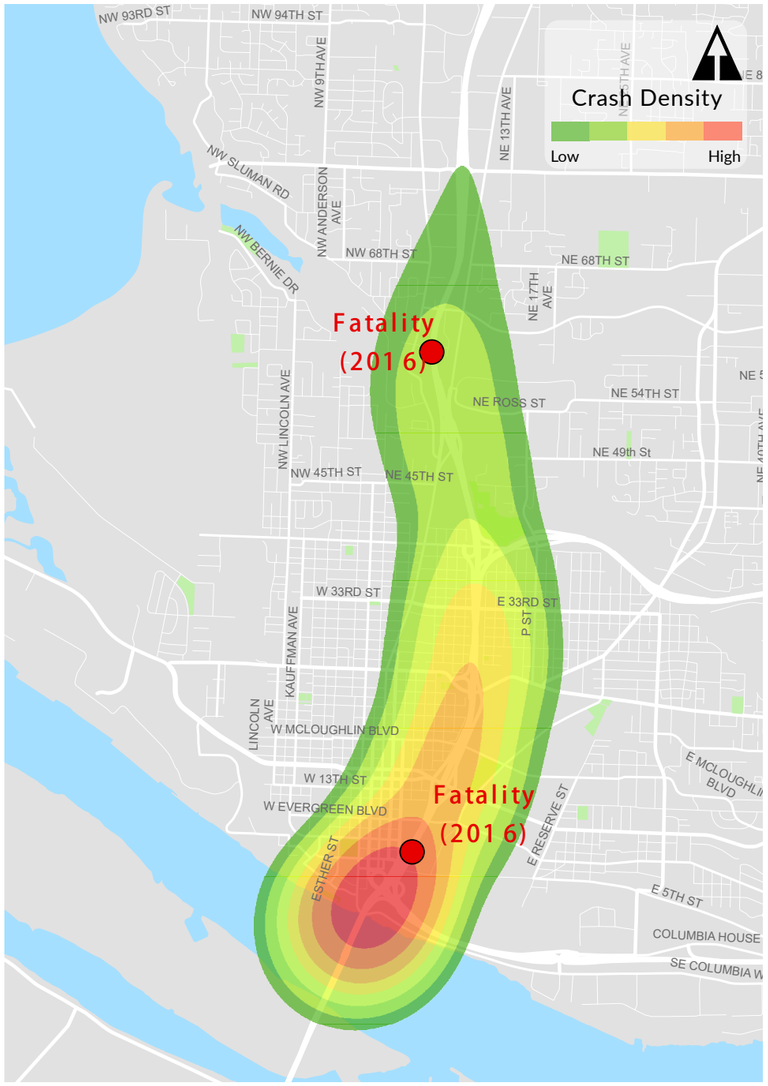
This project installs ramp meters on entrance ramps to I-5 northbound between SR 14 and Fourth Plain Boulevard

Ramp meters are signals that control the frequency in which vehicles enter the flow of traffic on the freeways. It's a proven cost-effective strategy used in urban areas around the nation to reduce congestion and improve traffic flow and safety. Additionally, metering improves trip reliability during busy travel periods, and can help the freeway recover sooner with faster speeds following significant backups and delays caused by congestion or a blocking incident.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The ramp meters improve traffic flow at merge points resulting in a slight increase in average speed throughout the corridor. Due to the low levels of congestion on this corridor during the PM peak hour, ramp meters do not have a significant impact on travel times overall throughout the corridor.

The greatest travel time improvements in this corridor are experienced near the Mill Plain Boulevard, Fourth Plain Boulevard, and SR 500 interchanges, which are known as high volume and high congestion corridors.

### Safety

A high number of crashes occur on I-5 during the PM peak period when ramp meters would be operational, therefore crash reductions associated with ramp metering would be particularly beneficial for this corridor.

Ramp meters in this phase will also benefit the area of I-5 that experiences the highest number of crashes, as well as one fatality, that occurred during 2016.

### Cost

**$600,000-$1.2 million**

- Relatively low cost to implement and maintain 3 ramp meters necessary for this corridor.

## FINDINGS

- Minor increase in corridor speed and reduced travel times during congested periods.
- Largest speed increase is around the Mill Plain Boulevard, Fourth Plain Boulevard, and SR 500 interchnages.
- Increased travel time reliability.
- 50% reduction in merge related crashes.
- Minimal environmental impacts related to construction.
- Reduced vehicle emissions.

**Tier 1**

# SR 500: St. Johns Boulevard to Gher Road (Eastbound) and Gher Road (Westbound)

*Ramp Metering Phase 7*

## Purpose and Need

Traffic in the eastbound and westbound directions on SR 500 experience congestion approaching the I-205 interchange resulting in slowdowns. Free-moving ramp traffic attempting to merge onto SR 500 further hinders the movement on the interstate, especially in the rightmost lanes..

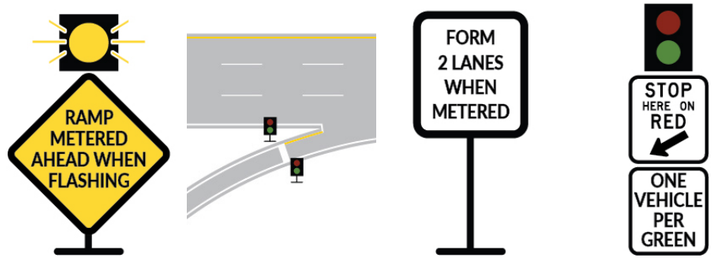
Ramp metering is a cost-effective proven strategy used in urban areas around the nation to improve traffic flow and safety. A recent study showed that a majority of ramps in Vancouver would benefit from ramp meters.

## Proposed Project and Benefit

This project installs ramp meters on the entrance ramps to SR 500 eastbound between St. Johns Boulevard and Gher Road. It also installs a ramp meter at the westbound entrance to SR 500 at Gher Road.

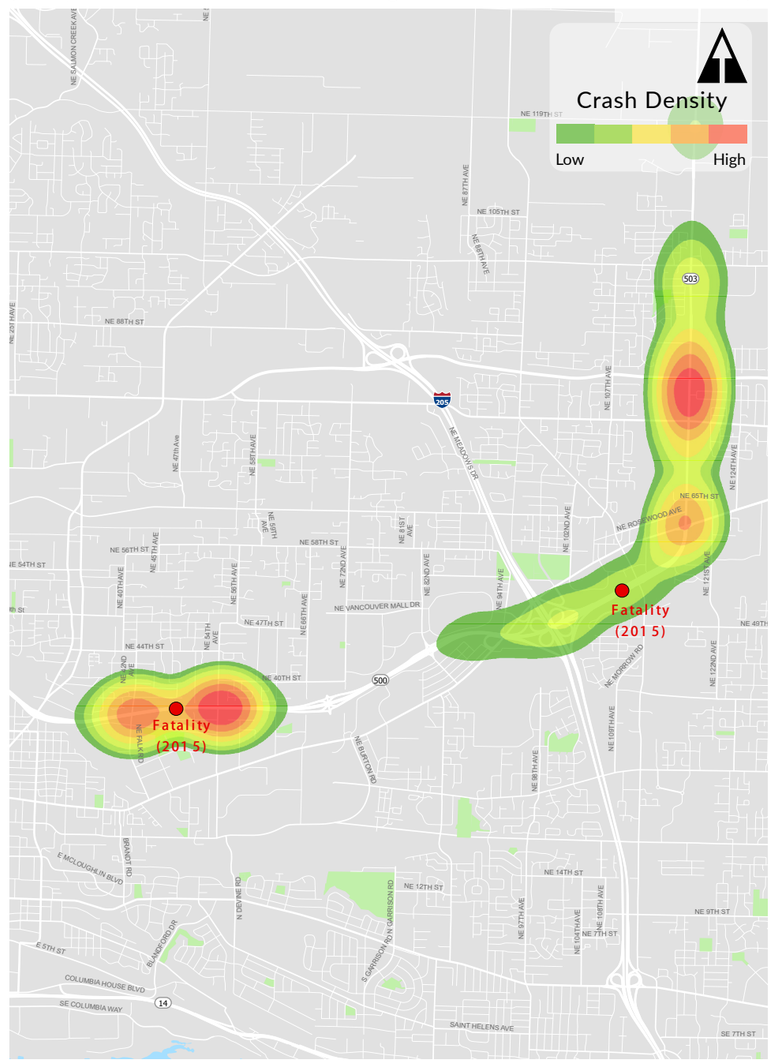
Metering ramps controls the rate at which vehicles enter and merge with traffic on the freeway. The gaps created allow only a few vehicles to merge at a time, instead of a large platoon attempting to merge and slowing down traffic.

## Project Concept Diagram




## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### Operations

The ramp meters improve traffic flow at merge points resulting in a slight increase in average speed throughout the corridor.

Mainline congestion experiences the greatest improvement in eastbound segments with signficiant congestion, especially in the vicinity of the I-205 interchange, where speeds were below 20 mph.

### Safety

The highest number of crashes occur on SR 500 during the PM peak period when the majority of the ramp meters in this phase would be operational, therefore crash reductions associated with ramp metering would be particularly beneficial for this corridor.

Ramp metering will be especially beneficial for the areas near the I-205 Intechange.

### Cost

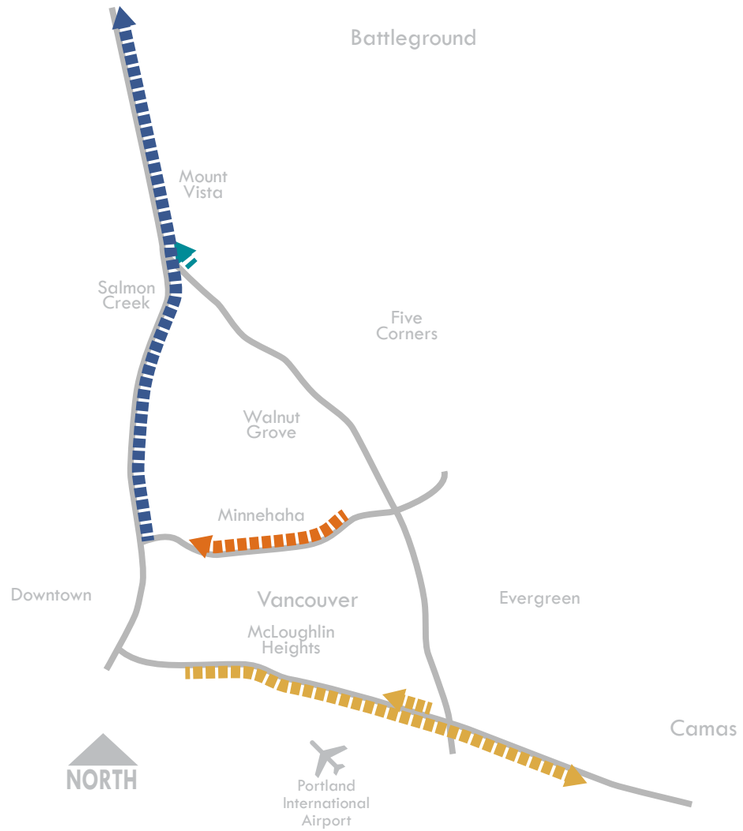
**$1.8-$3.6 million**

- Relatively low cost to implement and maintain 9 ramp meters necessary for this corridor.

## FINDINGS

- Minor increase in corridor speed and reduced travel times during congested periods.
- Largest speed increase is around the I-205 interchange.
- Increased travel time reliability.
- 50% reduction in merge related crashes.
- Minimal environmental impacts related to construction.
- Reduced vehicle emissions.

**Tier 3**




## Purpose and Need

Throughout any given day, the four major freeway corridors in Vancouver experience varying degrees of congestion, specifically at entrance ramp locations where traffic freely merges with mainline traffic. The resulting merge points creates friction on the freeways as vehicles position themselves in the appropriate lanes, look for gaps in traffic and attempt to safely merge, especially in the rightmost lanes.

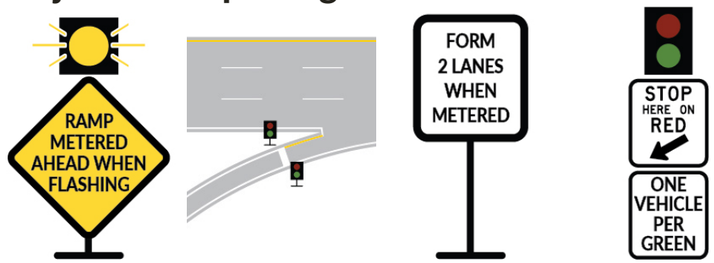
## Proposed Project and Benefit

These ramp meters along with the ramp metering in packages 1-7 complete ramp metering on the four major freeway corridors in Vancouver. This package adds ramp meters at the following entrance ramps:

- I-5 Northbound: 39th Street to SR 502
- I-205 Northbound at 139th Street
- SR 500 Westbound: Thurston Way to St. Johns Boulevard
- SR 14 Eastbound: Columbia House Boulevard to 164th Avenue
- SR 14 Westbound at Ellsworth Road

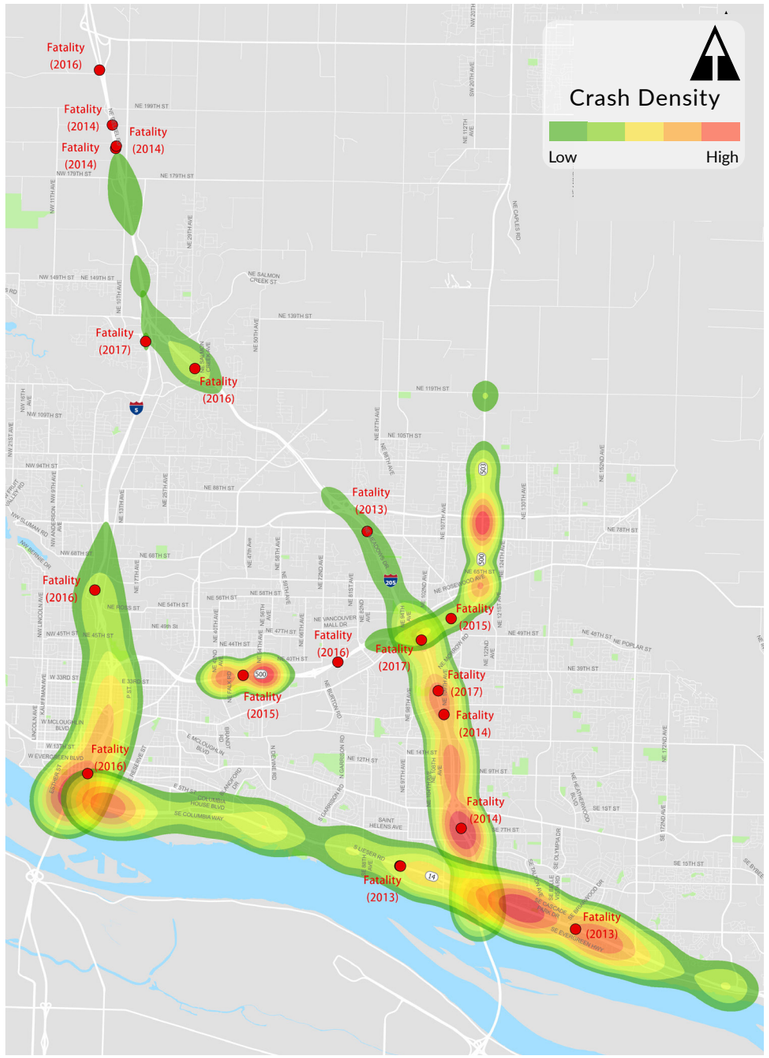
The gaps created allow only a few vehicles to merge at a time, instead of a large platoon attempting to merge and slowing down traffic.

## Project Concept Diagram




## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### *Operations*

The ramp meters improve traffic flow at merge points resulting in a slight increase in average speed, depending on the corridor.

Mainline congestion experiences the greatest improvement on SR 14 eastbound, where 5 ramp meters are added to the corridor.

### *Safety*

Filling in ramp meters at the remaining locations as specified in this phase would improve safety benefits throughout all corridors as mentioned in the previous phases.

### *Cost*

## $5.6-$11.2 million

- Low to medium cost to implement and maintain 28 ramp meters necessary for this corridor.

## FINDINGS

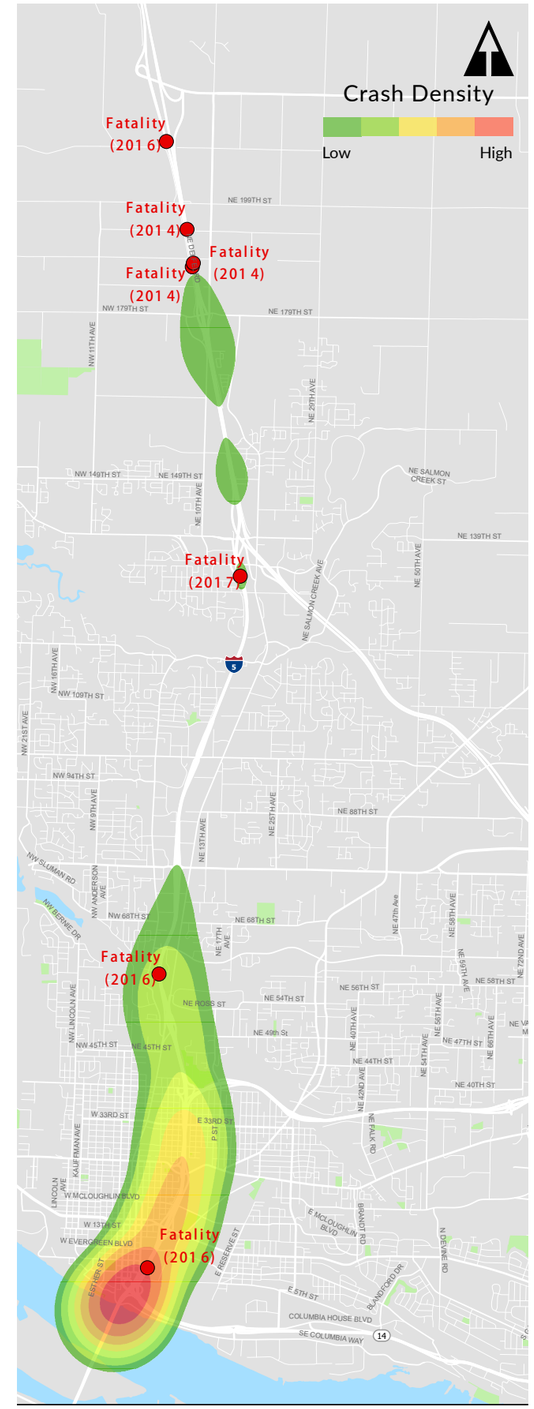
- Minor increase in corridor speed and reduced travel times during congested periods.
- Largest speed increase is on SR 14 eastbound.
- Increased travel time reliability.
- 50% reduction in merge related crashes.
- Minimal environmental impacts related to construction.
- Reduced vehicle emissions.

**Tier 2**

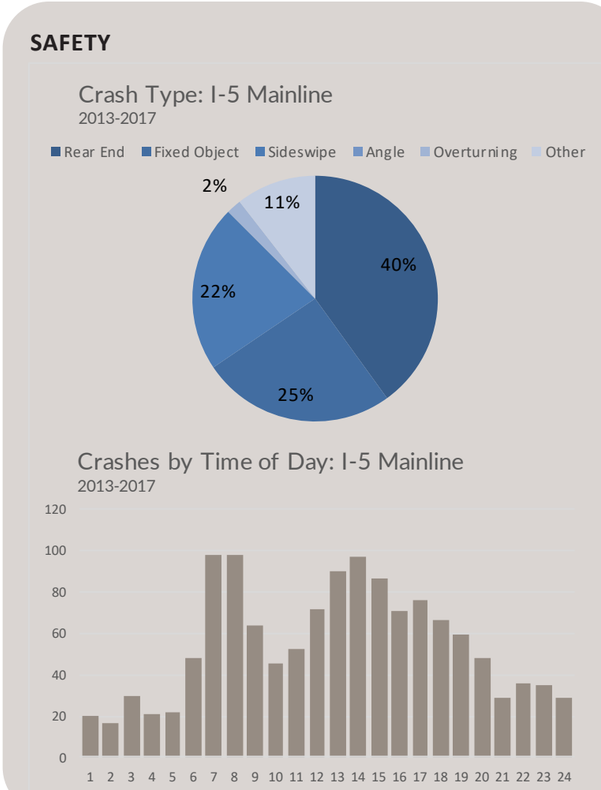
# I-5 CORRIDOR DASHBOARD

I-5 is the major spine running north and south connecting the region. It carries the highest number of vehicles and provides one of two routes over the Columbia River. This route is especially critical as it is the main route for freight and commuters who rely on the corridor to fulfill daily business needs.

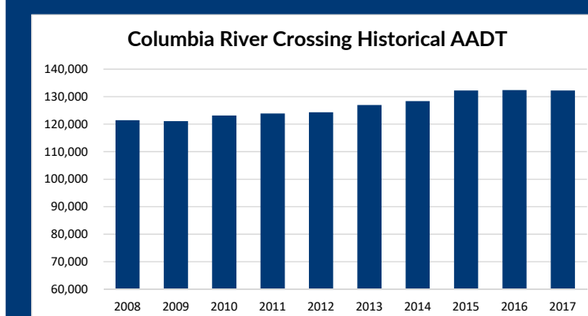
| ID | LOCATION | PROJECT TYPE | TIER | PAGE |
|---|---|---|---|---|
| S4 | Southbound: SR 502 Entrance Ramp to I-205 Exit Ramp | Auxiliary Lane | 3 | 23 |
| S13 | Southbound: Mill Plain Boulevard Entrance Ramp | Shoulder Use | 1 | 24 |
| S15 | Southbound: Mill Plain Boulevard Entrance Ramp to SR 14 Exit Ramp | Hard Shoulder Auxiliary Lane | 3 | 25 |
| S16 | Southbound: SR 14/ City Center Entrance Ramp | Queue Warning | 1 | 26 |
| S17 | Southbound: SR 14/ City Center Entrance Ramp | Time of Day Ramp Closure | 1 | 27 |
| S20 | Southbound: 99th Street Park and Ride to I-5 | Transit | 1 | 28 |
| N2 | Northbound: SR 14 to Mill Plain Boulevard Exit Ramp | Auxiliary Lane | 3 | 29 |
| N4 | Northbound: SR 500 Exit Ramp | Advance Signage | 3 | 30 |
| N7 | Northbound: Main Street Exit Ramp to Main Street Entrance Ramp | Travel Lane | 3 | 31 |
| N8 | Northbound: 78th Street Exit Ramp | Dual Right-Turn Lane | 4 | 32 |
| N16 | Northbound: 78th Street Exit Ramp | Advance Signage | 1 | 33 |




## SAFETY




## CONGESTION




***Existing Bottlenecks***

- AM – Southbound: Columbia River Bridge to Minnehaha St (6:00 AM – 10:00 AM)
- PM – Northbound: Columbia River Bridge to south of Study Area (1:00 PM – 8:00 PM)

# SOUTHBOUND: SR 502 Entrance Ramp to I-205 Exit Ramp

*Auxiliary Lane*

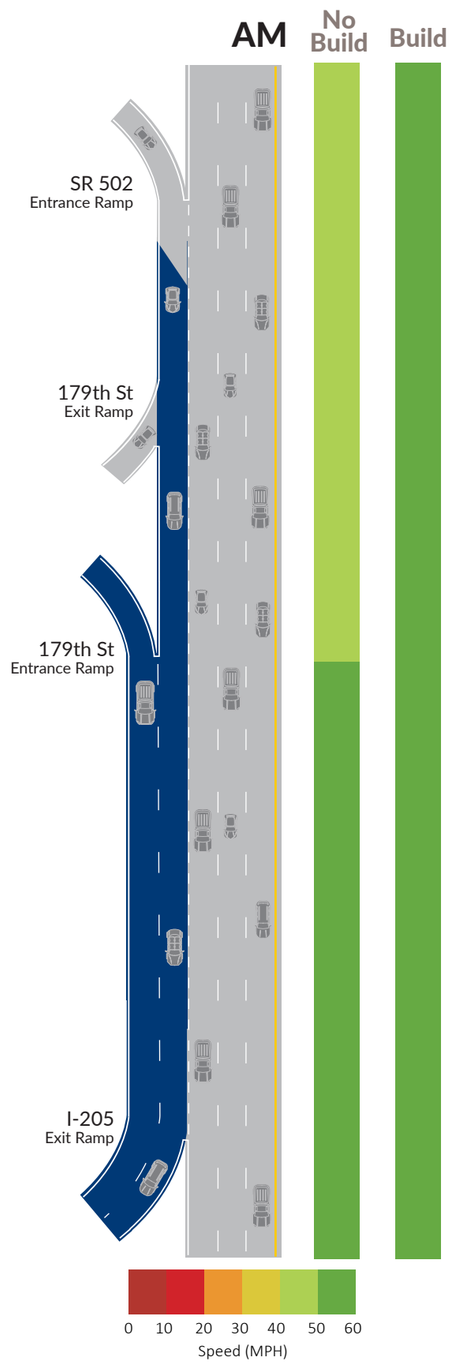
## Purpose and Need

Southbound traffic on I-5 approaching the I-5/I-205 split becomes congested. There are weaving movements that create friction on the mainline as vehicles position into the correct lane in advance of the split, either to remain on I-5 or exit to I-205.

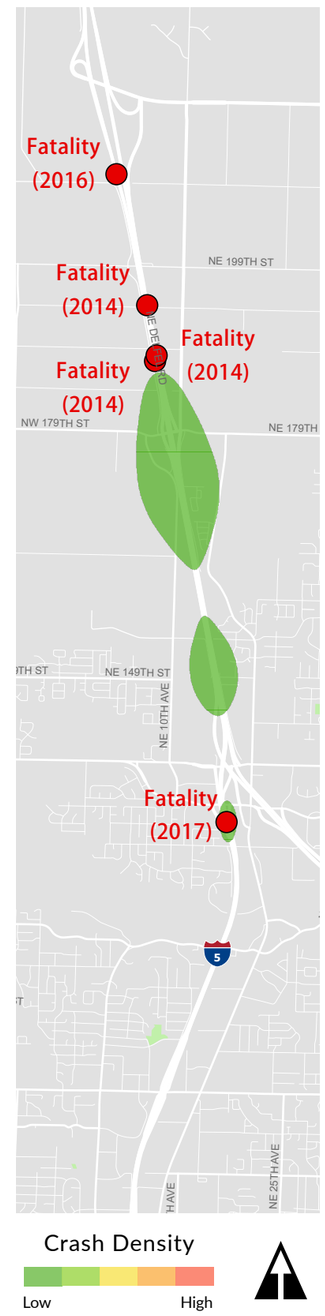
## Proposed Project and Benefit

This project constructs an auxiliary lane southbound from the SR 502 entrance ramp to the I-205 exit ramp. This would result in the current two-lane "one and a choice" exit ramp to I-205 becoming a two-lane "exit only" exit ramp. A second auxiliary lane in this weaving section may help better balance traffic volumes across the lanes providing improved travel flow and safety. The length of the proposed auxiliary lane would trigger the need for a soundwall review.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

With the auxiliary lane constructed, travel speeds are expected to increase by 5 mph during AM and PM peak hours. The v/c ratio also improves in the area of the second auxiliary lane.

### Safety

- 20% potential crash reduction.
- Allows vehicles to get up to mainline speed before merging.

### Cost

**$30-$40 million**

- Requires widening of existing structures
- Cost estimate does not include soundwall

## FINDINGS

The addition of an auxiliary lane back to SR 502 on I-5 southbound will give drivers more time to position into the correct lanes for the I-5/I-205 split. The additional space allows for smoother traffic flow and an increase in travel speeds. This strategy does convert the I-205 split into a two lane exit only split, which results in additional lane changes compared to today. This strategy may benefit from maintaining the existing exit and choice lane and providing a third lane from 179th Street to I-205. Due to the length of the proposed auxiliary lane (approximately 3.4 miles), a soundwall review is required. This is a relatively high cost strategy with limited benefits.

**Tier 3**

# SOUTHBOUND: Mill Plain Boulevard Entrance Ramp

*Shoulder Use*

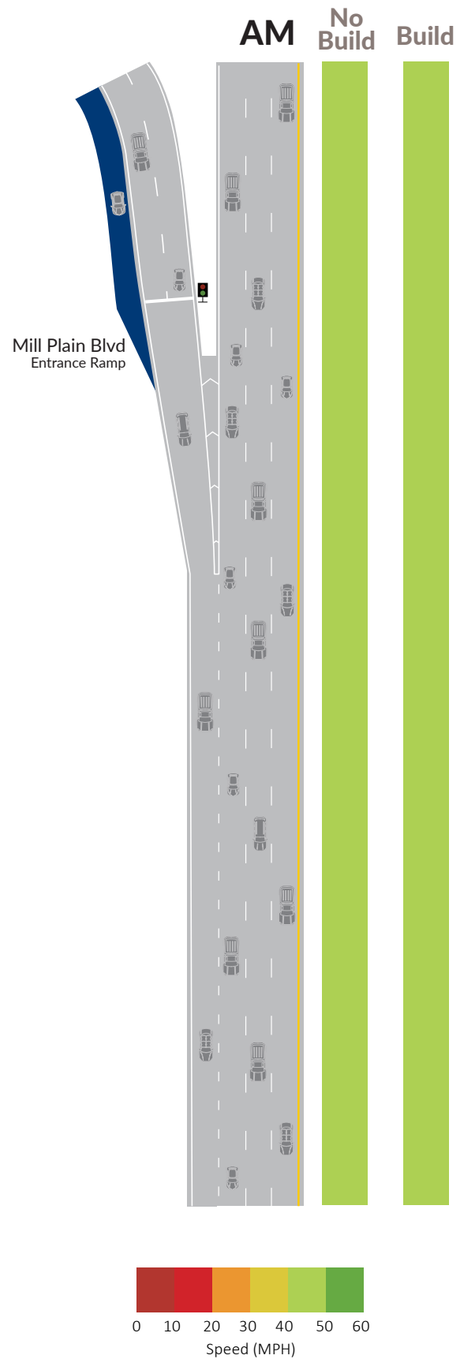
## Purpose and Need

During the morning peak hour, the Mill Plain Boulevard entrance ramp backs up on to Mill Plain Boulevard. A slow-moving queue on Mill Plain Boulevard needs to be avoided to ensure ease of I-5 southbound access to vehicles and heavy trucks from Port of Vancouver.

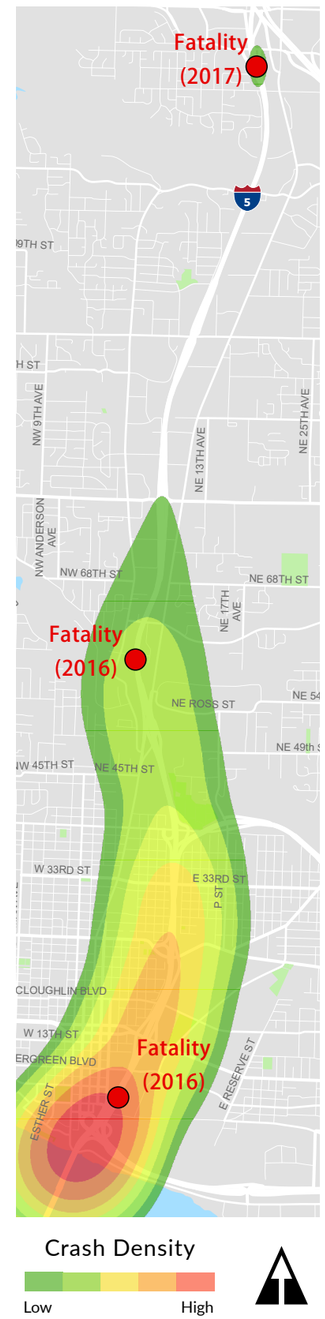
## Proposed Project and Benefit

During ramp meter operation, this project allows use of the shoulder on the Mill Plain Boulevard entrance ramp to I-5 southbound. This project is part of the I-5 Active Traffic Management project by WSDOT.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The additional storage should reduce the number and durations of ramp queuing backing onto to Mill Plain Boulevard.

### Safety

The additional storage should reduce the number and durations of ramp queuing backing onto to Mill Plain Boulevard, potentially reducing rear end collisions.

### Cost

**$100,000 - $500,000**

- Need to determine if there are ramp meter costs.

## FINDINGS

This strategy helps reduce potential queuing impacts from the planned ramp meter on Mill Plain Boulevard, which should provide some traffic operations improvement on Mill Plain Boulevard. This strategy should improve safety at the I-5 ramp during ramp meter operations. This strategy is part of WSDOT's I-5 Active Traffic Management program.

**Tier 1**

# SOUTHBOUND: Mill Plain Boulevard Entrance Ramp to SR 14 Exit Ramp

*Hard Shoulder Auxiliary Lane*

## Purpose and Need

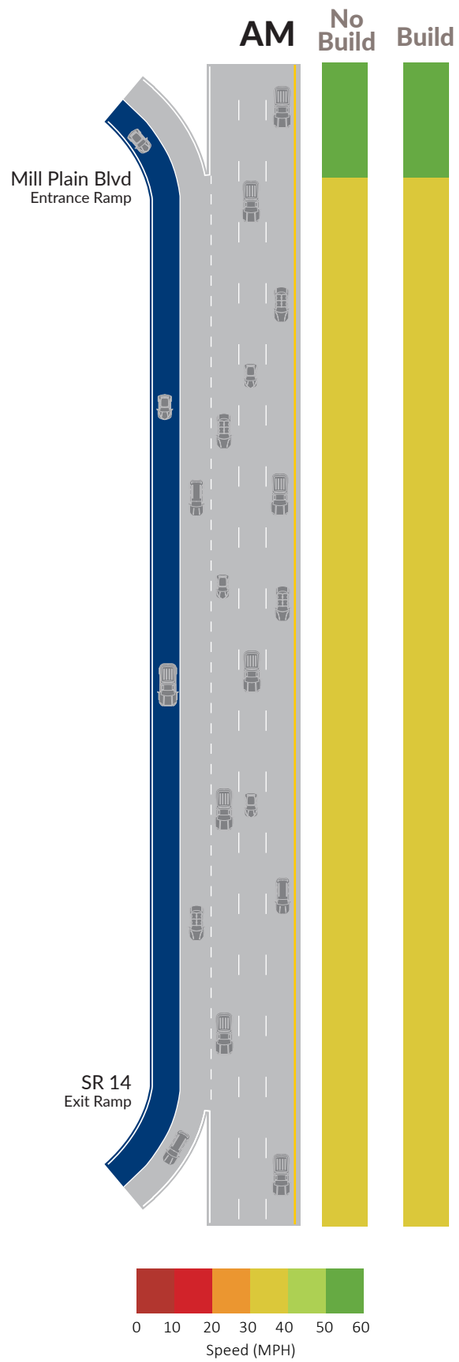
In the AM peak hours, the commuter traffic traveling southbound on I-5 experiences heavy congestion resulting in slowdowns. The I-5 Interstate Bridge bottleneck, combined with the considerable weaving movements between the Mill Plain Boulevard entrance ramp and SR 14 exit ramp, compounds the issue.

## Proposed Project and Benefit

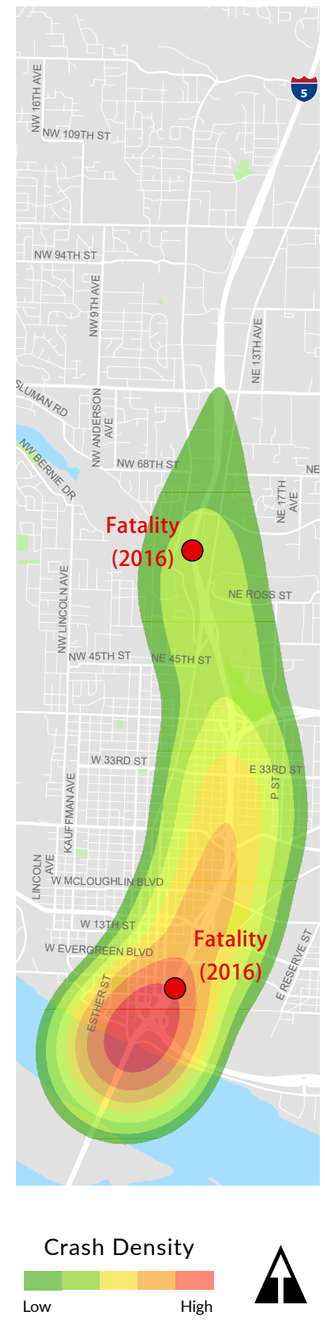
This project would provide an auxiliary lane between Mill Plain Boulevard and the SR 14 exit ramp via hard shoulder running. There is limited right of way to construct another traffic lane, so the existing shoulder paired with some limited widening would be used to run traffic during peak travel hours. In the non-peak hours the shoulder reverts to its normal function.

The auxiliary lane reduces the amount of weaving conflicts by providing additional time and distance for traffic to find gaps and safely weave over lanes. It also allows traffic destined for eastbound SR 14 to bypass the congestion backing up from the I-5 Interstate Bridge.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The use of the existing shoulder may result in a slight increase in speeds. The operational benefits of this project are reduced by the planned I-5 Active Traffic Management project.

### Safety

- 20% potential crash reduction.
- Allows vehicles to get up to mainline speed before merging.
- The additional auxiliary lane should reduce the number and durations of ramp queuing backing onto to Mill Plain Boulevard potentially reducing rear end crashes.

### Cost

**$500,000-$1 million**

- Anticipate the need for some widening.
- Ramp meter planned for this location (project I-5 S13) will reduce benefit of added auxiliary lane.
- Full rebuild of shoulder would be approximately $20-$30 million.

## FINDINGS

This strategy looks to utilize the shoulder to improve traffic operations for vehicles entering at Mill Plain Boulevard and exiting to SR 14. These drivers do not need to enter the mainline traffic flow on I-5 in order to exit at SR 14. By removing that traffic from the mainline weaving section, it will help increase gap for other traffic entering and exiting I-5. Using the shoulder keeps cost lower but is anticipated to require some pavement widening to provide a 12 foot shoulder for the full length.

There is also a separate planned project (strategy I-5 S13) that is part of WSDOT's I-5 Active Traffic Management program to improve traffic flow in this section, reducing the need for this strategy.

**Tier 3**

# SOUTHBOUND: Mill Plain Boulevard Entrance Ramp to SR 14/City Center Entrance Ramp

*Advance Signage*



**Project I-5 S16**

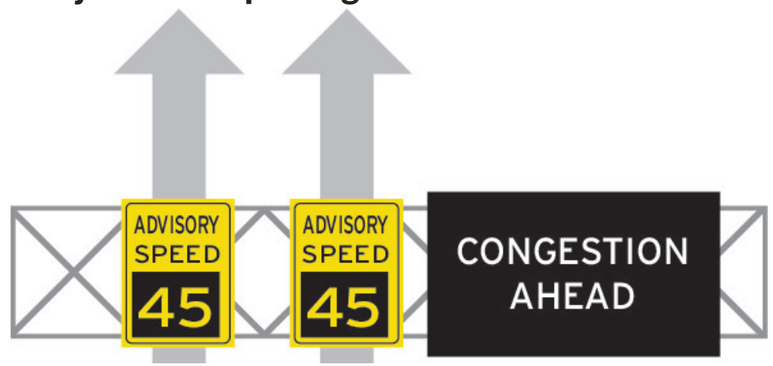
## Purpose and Need

The City Center Ramp to I-5 southbound connects downtown Vancouver to the freeway. SR 14 westbound also connects to the City Center ramp via a loop ramp and both streams of traffic combine before entering the freeway. There is an existing ramp meter and a short entrance ramp that can queue back in the morning to Washington Street and onto SR 14.

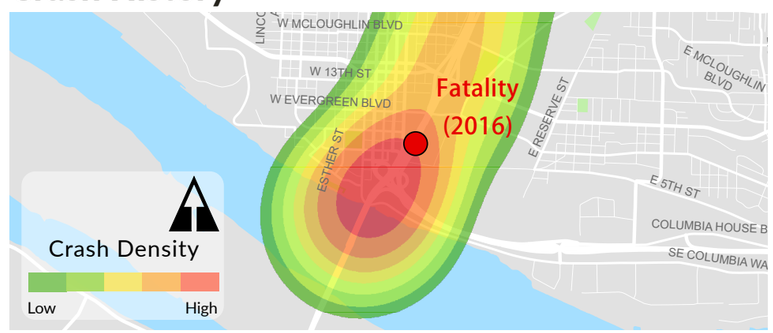
## Proposed Project and Benefit

This project utilizes Active Traffic Management principles to provide advance information about real-time traffic conditions such as speed limit, queue warning. It would provide integrated corridor management. This strategy is part of WSDOT's I-5 Active Traffic Management program.

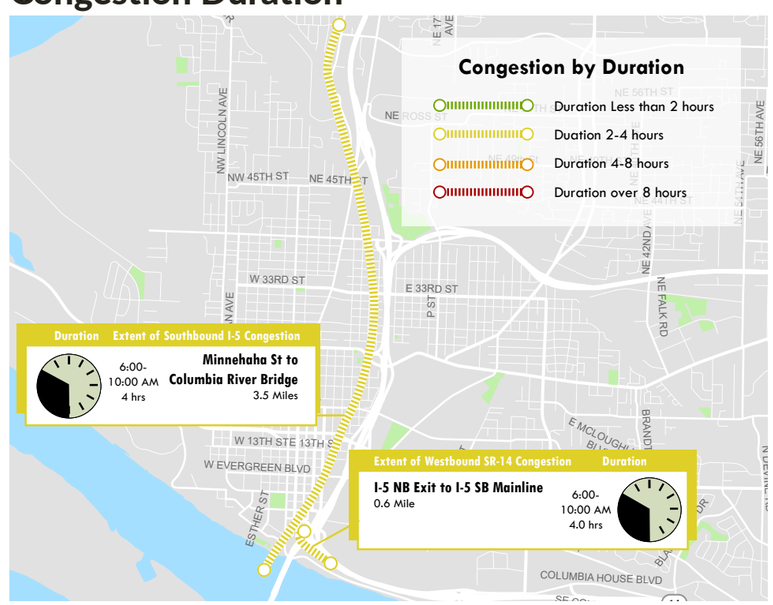
## Project Concept Diagram




## Crash History




## Congestion Duration




## Improvement Metrics

### Operations

ATM systems help reduce delay (by 3 to 15 percent) and improve travel time by promoting more uniform driver behavior, smoothing the flow of traffic and reducing traffic incidents.

### Safety

- 35% potential crash reduction.
- VAS and VMS are designed to warn drivers of unexpected queuing or slowing ahead, therefore reducing the potential for crashes that result from large speed variances between vehicles.
- Beneficial to all crash types of all severity.
- Queue warning will provide drivers with advanced warning of traffic queues and reduce rear end crashes.

### Cost

**$2-$3 million**

## FINDINGS

The SR 14 entrance ramp and bridgehead is consistently congested for at least 4 hours per day and can have congestion at any time. Adding Active Traffic Management through variable speed and queue warning signage approaching this congestion point will warn drivers of downstream congestion that may not be visible.

The system will promote more uniform speeds and reduce the frequency of hard braking and potential for rear-end/back of queue collisions. This strategy is part of WSDOT's large Active Traffic Management system for I-5.

**Tier 1**

# SOUTHBOUND: SR 14/City Center Entrance Ramp

*Time of Day Ramp Closure*

## Purpose and Need

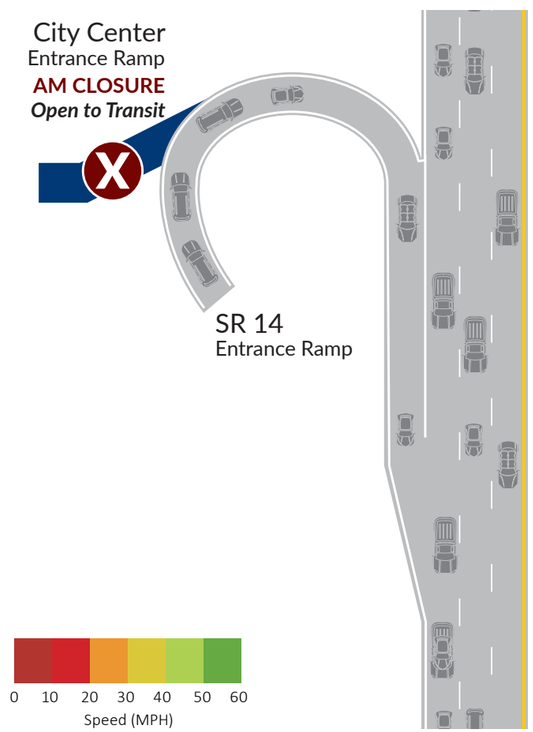
In the AM peak hours, the commuter traffic traveling southbound on I-5 experiences heavy congestion resulting in slowdowns. The I-5 Interstate Bridge bottleneck, combined with the considerable weaving movements between the Mill Plain Boulevard entrance ramp and SR 14 exit ramp, compounds the issue.

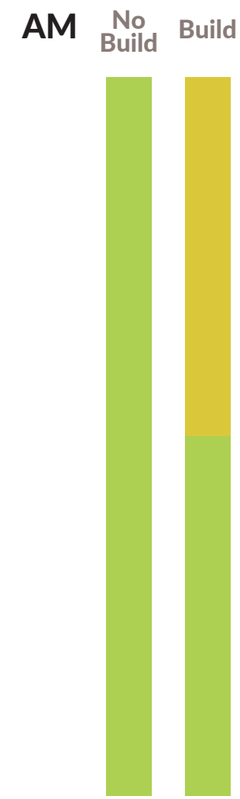
## Proposed Project and Benefit

This project closes the ramp from City Center (except transit) during the AM peak hours. Closing the ramp allows the SR 14 traffic to use both the lanes on the ramp, thus reducing the extent of congestion on SR 14 and the queuing onto the closely spaced local downtown street system.

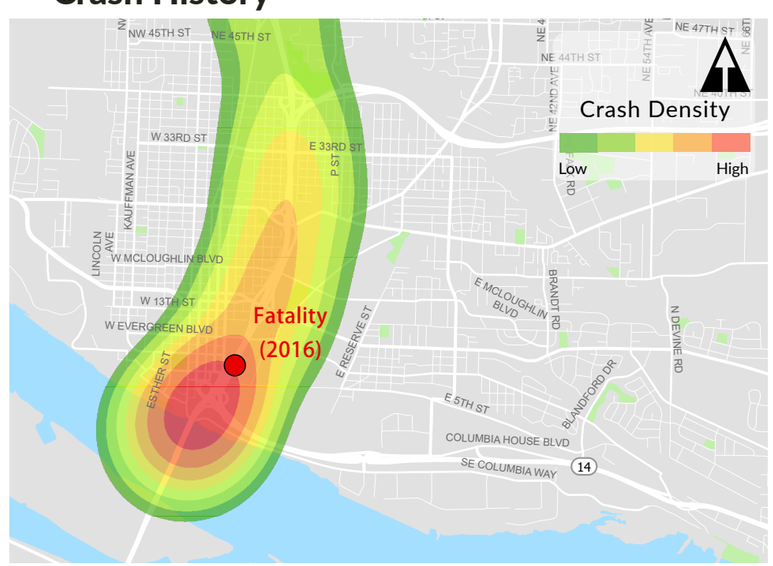
The resulting reduction in volume on the ramp leads to more efficient operation of the ramp meter. Vehicles trying to access I-5 southbound from downtown would navigate northward through the city streets and use the Mill Plain Boulevard entrance ramp.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The AM peak period closure of the City Center entrance ramp results in minor speed increases on the mainline across the Interstate Bridge. Downtown streets feeding the I-5 entrance ramp are expected to see lower volumes with improved travel speed and improved reliability for general traffic and transit. Conditions may worsen at the Fourth Plain Boulevard I-5 entrance ramps as some users divert to those ramps. The SR 14 entrance ramp merge onto I-5 is expected to remain congested in the Build condition.

### Safety

- Slight reduction in merging volume may reduce merge related crashes
- Increased upstream congestion may offset any crash reductions in the merge area

### Cost

**$100,000-$500,000**

## FINDINGS

Closing the City Center entrance ramp to all vehicles but transit provides reduced queuing and improved operations on westbound SR 14 and downtown streets approaching I-5. Transit operations will also be improved with reduced delays and increased reliability.

Vehicles unable to access I-5 southbound from downtown would navigate northward through the city streets and use the Mill Plain Boulevard entrance ramp. This increased congestion on Mill Plain Boulevard results in a reduction in travel speed on I-5 southbound between Mill Plain Boulevard and SR 14. This strategy is part of WSDOT's larger Active Traffic Management system for I-5.

**Tier 1**

# SOUTHBOUND: 99th Street Park and Ride to I-5

*Transit Enhancements*

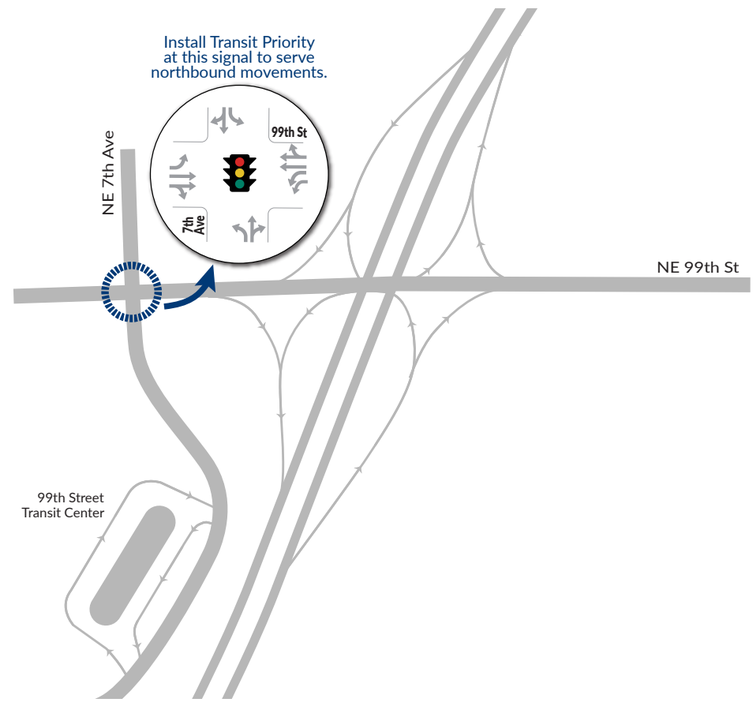
## Purpose and Need

The 99th Street Transit Center is a major hub for C-Tran buses. To get on to the freeway, buses have to go through two traffic signals on 7th Avenue, and a third on 99th Street, prolonging the travel time to get to I-5 southbound. The congestion on the ramp further compounds the issue.

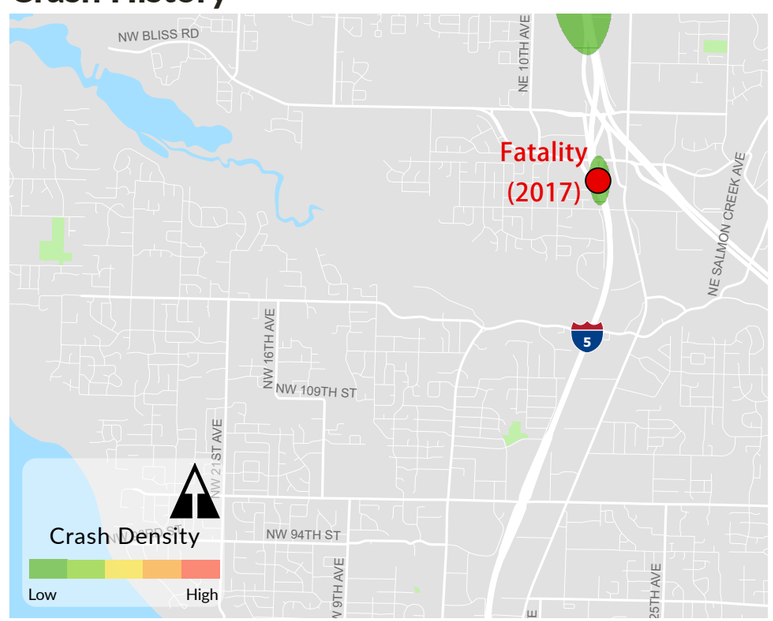
## Proposed Project and Benefit

This project prioritizes transit access to the freeway through . The project could implement one or more of the following: Bus Only Lane, Transit Priority at the signals, or Queue Jumps. Making transit travel smoother and more efficient encourages commuters to use it more often, making it the mode of choice.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

Today bus drivers sometimes coordinate departure to avoid having northbound through buses block right turning buses on NE 7th Avenue at NE 99th Street. Adding transit signal priority will eliminate the need for that coordination and improve bus travel time and reliability for buses entering and existing the 99th Street Transit Center, specifically in the off-peak hours.

### Safety

The transit priority reduces bus delays, helping to reduce queuing and potential blocking of travel lanes.

### Cost

**$100,000-$300,000**

- Cost reflects transit signal priority timing adjustments only.

## FINDINGS

Providing transit signal priority at the intersection of NE 99th Street and NE 7th Avenue will help clear northbound through buses from the shared through and right-turn lane quicker, reducing delay for both the through buses and right turning buses. The signal priority will also help buses turning left from NE 99th Street onto NE 7th Avenue to access the 99th Street Transit Center.

This relatively low cost strategy will help make transit travel smoother and more efficient encourages commuters to use it more often, making it the mode of choice. The majority of the operational benefits would be experienced in the off-peak condition.

**Tier 1**

# NORTHBOUND: SR 14 to Mill Plain Boulevard Exit Ramp

*Hard Shoulder Auxiliary Lane*

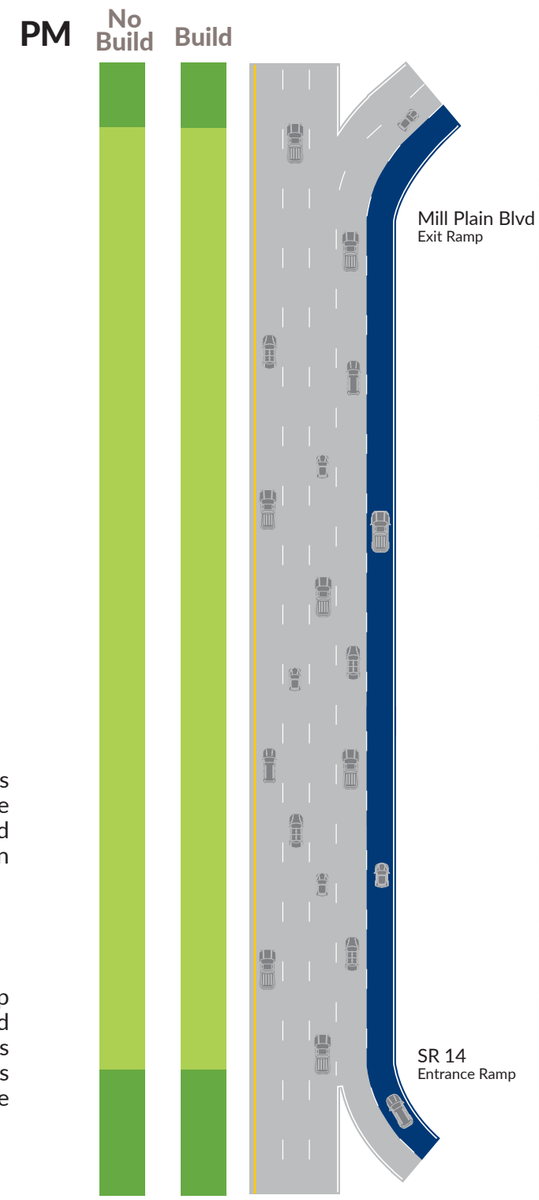
## Purpose and Need

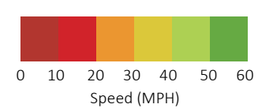
In the evening peak hours, the freeway experiences higher traffic volumes as commuters make their way home. The section of I-5 has considerable weaving movements between traffic entering from SR 14 westbound and traffic exiting I-5 to go on to Mill Plain Boulevard, which creates friction with the mainline traffic.

## Proposed Project and Benefit

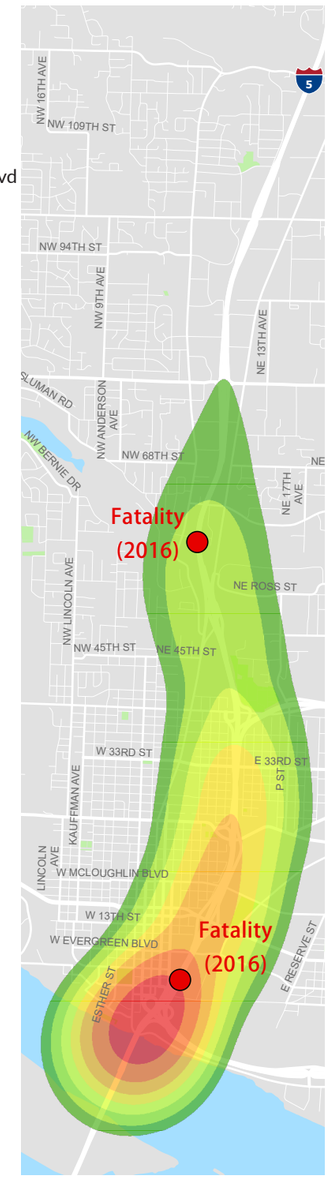
Converting the shoulder to an auxiliary lane dedicated to ramp-to-ramp traffic in this weaving section reduces the friction created by entering and exiting vehicles. Reducing the weaving conflicts in this segment improves the mainline traffic flow on I-5. Moreover, the auxiliary lane allows vehicles going from ramp-to-ramp a direct path that does not interact with mainline traffic on I-5.

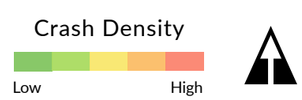
## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

The addition of an auxiliary lane is expected to result in a slight increase in speed on the mainline. The V/C ratio is expected to decrease, however in the PM peak period, congested segments are expected to remain congested.

### Safety

- 20% potential crash reduction.
- Allows vehicles to get up to mainline speed before merging.
- The additional auxiliary lane reduces weaving movements and associated crashes.

### Cost

**$4-$6 million**

## FINDINGS

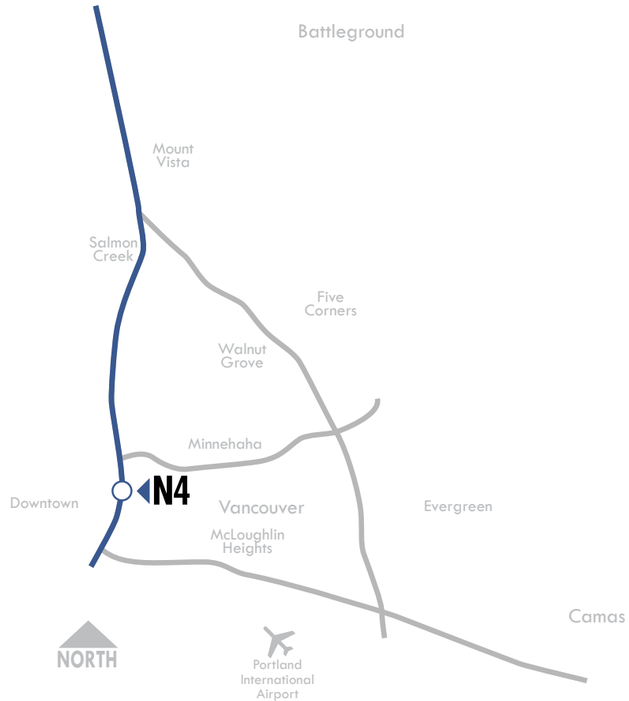
Converting the shoulder to an auxiliary lane dedicated to ramp to ramp traffic in this weaving section reduces the weaving movements between entering and exiting vehicles on I-5 and reduces the interaction between ramp to ramp traffic and mainline I-5 traffic. This results in reduced weaving and a slight increase in travel speeds on I-5.

**Tier 3**

# NORTHBOUND: SR 500 Exit Ramp

*Advance Signage*





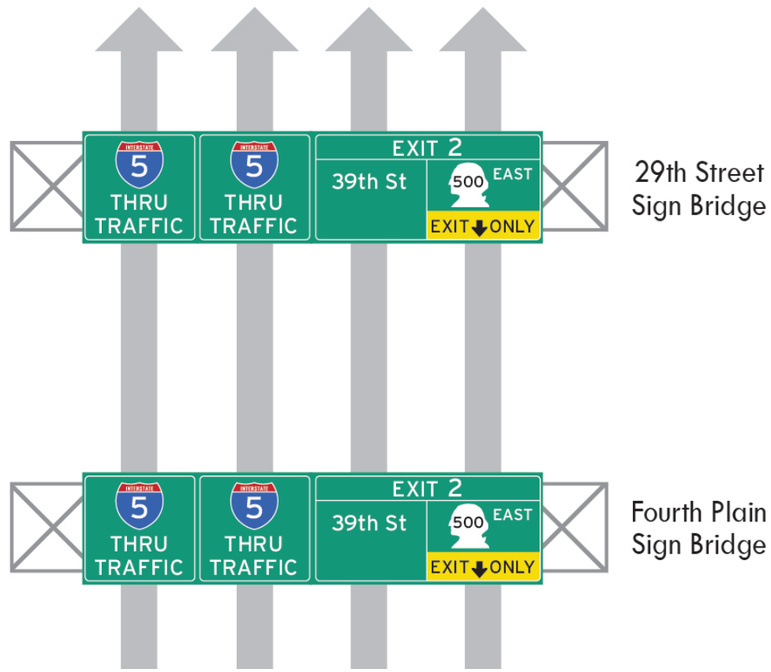

## Purpose and Need

In the PM peak hours, traffic northbound on I-5 experiences congestion resulting in slowdowns. Because SR 500 is a major state route, it carries heavy volumes during this time and a significant portion of traffic exits I-5 at this location. The weaving segments create friction with the mainline and on the exit ramp.

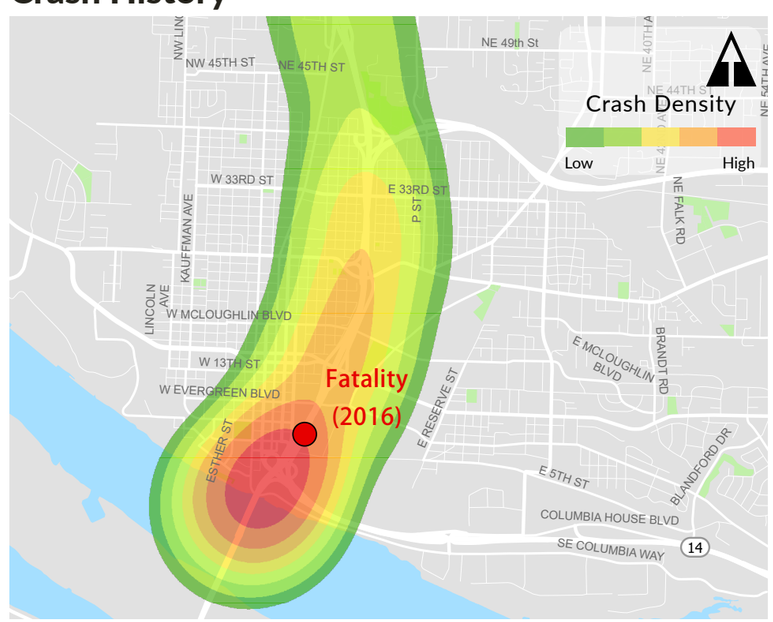
## Proposed Project and Benefit

This project installs advance signage to indicate the appropriate lane position for downstream maneuvers. Advance signs reduce last-minute lane changing maneuvers and result in smoother traffic flow, easing the congestion.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

Improved route information should provide improved lane balance and less lane changing providing improved traffic flow.

### Safety

Improved route information should provide improved decision making and lane balance, providing more time and space for lane changing. This is expected to help eliminate abrupt lane changes by providing advance wayfinding signage.

### Cost

**$1-$1.5 million**

- Assumes use of existing structures.

## FINDINGS

This segment of I-5 experiences congestion during peak periods due to overloading of the outside (right) lanes exiting to SR 500. Providing advanced signage, identifying which lanes are best for through traffic vs. exiting traffic, should provide for better balance of traffic volumes in each lane. This improves traffic flow and stability, reducing last minute lane changes which can contribute to crashes.

**Tier 3**

# NORTHBOUND: Main Street Exit Ramp to Main Street Entrance Ramp

*Travel Lane*

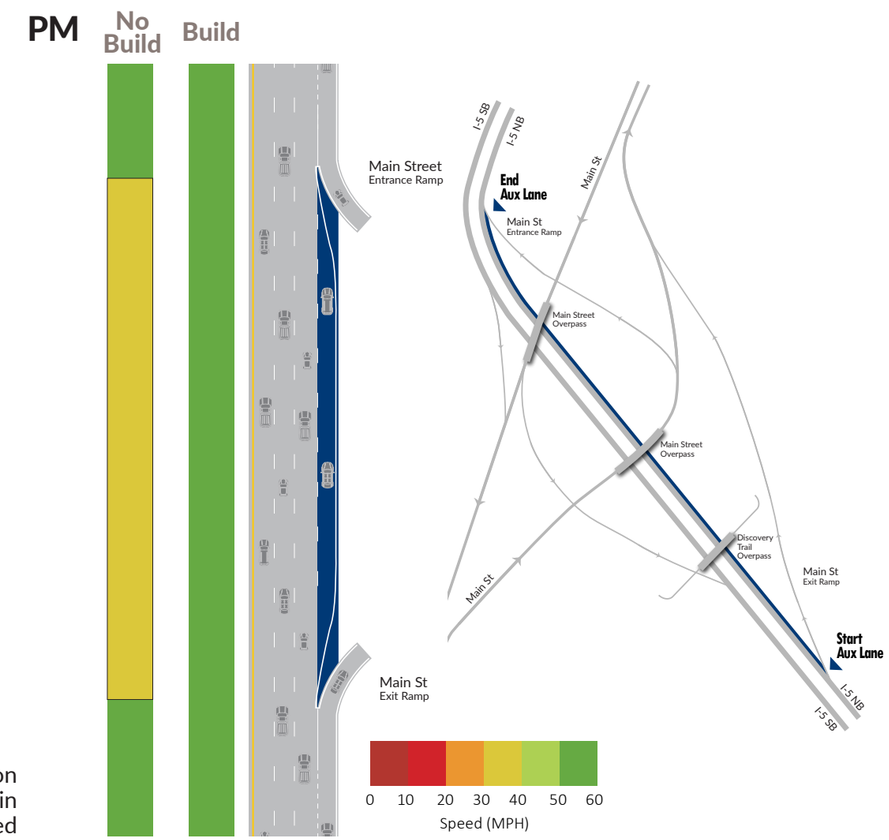
## Purpose and Need

By year 2040, I-5 northbound is projected to experience congestion upstream and downstream of the Main Street interchange, resulting in slowdowns on the mainline. Traffic volumes in this area have increased rapidly in the last few years, and congestion may increase more quickly than anticipated.

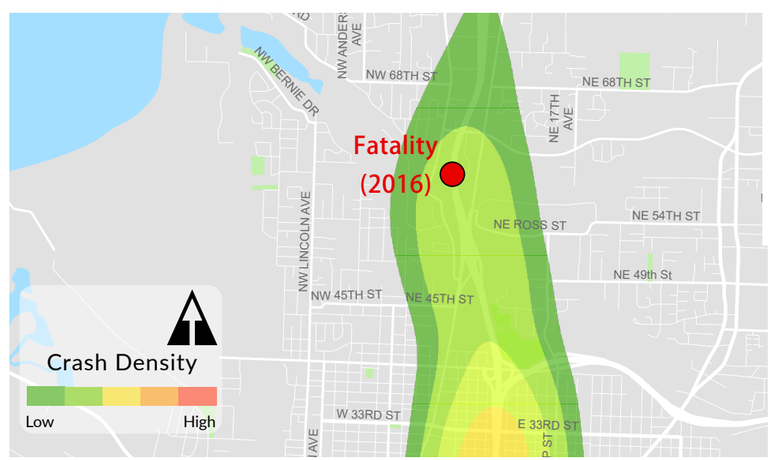
## Proposed Project and Benefit

This project adds a fourth lane on of I-5 northbound between the Main Street exit ramp and entrance ramp. An additional travel lane reduces potential for congestion that is anticipated in the future and increases freeway throughput.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

In the PM peak hour, the demand on the freeway between the Main Street exit and entrance ramps is expected to exceed availability capacity in the "no build" condition; it improves to a D/C of 0.81 with the additional lane. There is expected to be a travel speed increase of 10 to 12 mph in the PM peak hour with negligible change in the morning.

### Safety

- 26% potential crash reduction.
- Allows vehicles to get up to mainline speed before merging.
- Reduced traffic density reduces potential for crashes.

### Cost

**$30-$40 million**

- Topography and existing bridge structures.
- Will require reduced shoulders.

## FINDINGS

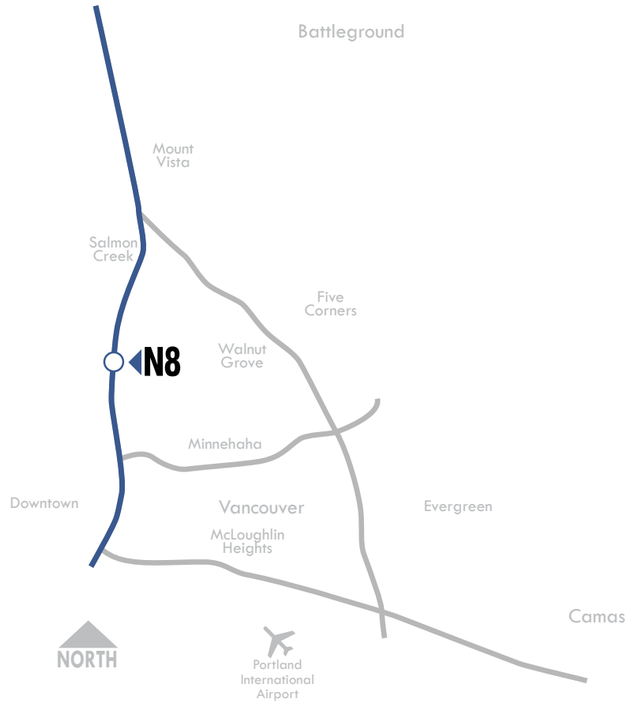
The addition of an extra through lane reduces future congestion and increases travel speeds by approximately 10 to 12 mph in the PM peak hour. This strategy is not needed in the near term but does provide a high operational benefit in year 2040. The right shoulder would be reduced on northbound I-5 for this strategy due to existing overpass structures limiting the ability to widen the freeway.

**Tier 3**

# NORTHBOUND: 78th Street Exit Ramp

*Dual Right-Turn Lane*





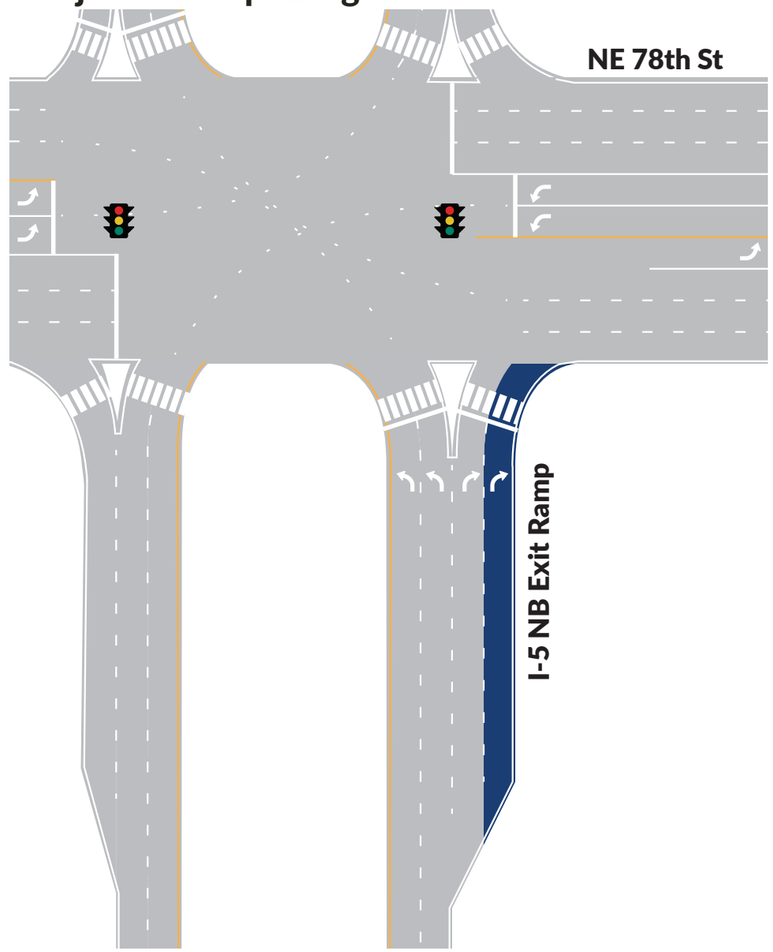

## Purpose and Need

In the PM peak hours, the 78th Street exit ramp has a high right-turn volume onto eastbound 78th Street. In the peak hour, traffic on the ramp queues up at the signal and the queue backs up the ramp onto the I-5 mainline, creating friction near the diverge area, increasing congestion and safety concerns.

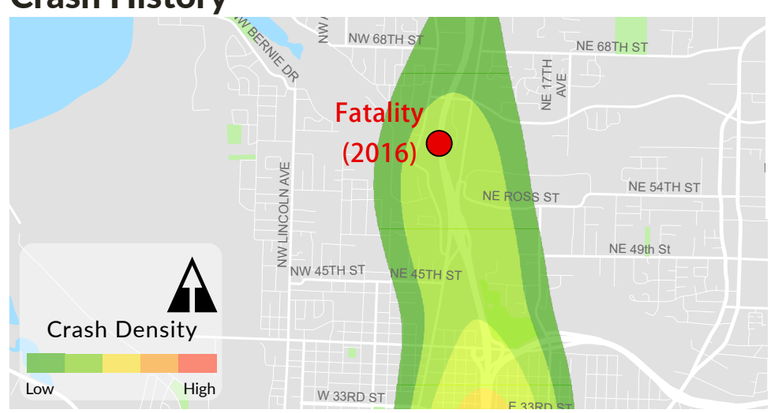
## Proposed Project and Benefit

This project installs a dual right turn lane at the I-5 northbound 78th Street ramp terminal. Adding the second right-turn lane onto 78th Street provides only a moderate reduction in queue length based on isolated intersection analysis. This indicated that the congestion may be due to downstream congestion blocking on 78th Street.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

Adding the second right-turn lane onto 78th Street from the I-5 southbound ramp provides only a moderate reduction in queue length based on isolated intersection analysis. This indicates that the ramp congestion may be due to downstream congestion and blocking on 78th Street.

### Safety

Reduced potential for queue backing onto I-5 reducing the potential for rear end crashes.

### Cost

**$10-$12 million**

- Project may require additional ROW and signal modifications.

## FINDINGS

In the PM peak hours, the 78th Street exit ramp has a high right-turn volume onto eastbound 78th Street. In the peak hour, traffic on the ramp queues up at the signal and the queue backs up the ramp onto the I-5 mainline, creating friction near the diverge area, increasing congestion and safety concerns.

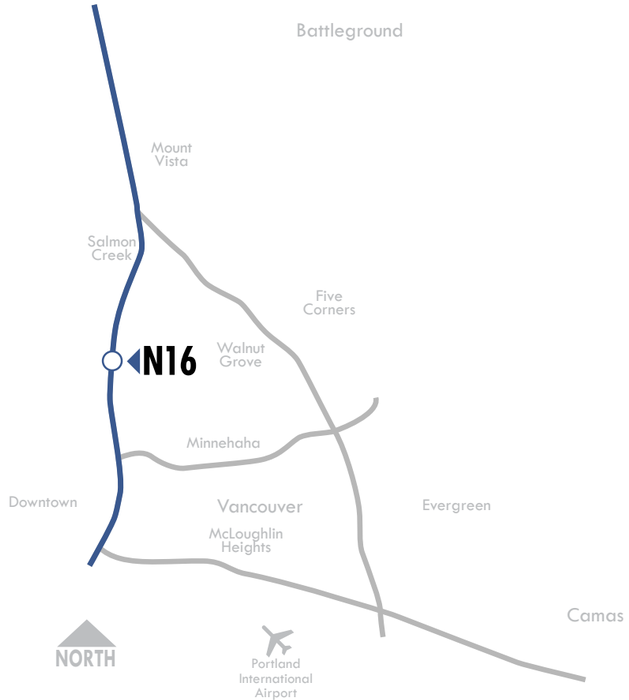
Adding the second right-turn lane onto 78th Street from the I-5 northbound ramp provides only a moderate reduction in queue length based on isolated intersection analysis. Addressing congestion and queuing on 78th Street at the Highway 99 signal and the rest of the 78th Street cooridor in combination with this strategy may provide improved operational and safety benefits.

**Tier 4**

# NORTHBOUND: 78th Street Exit Ramp

*Advance Signage*





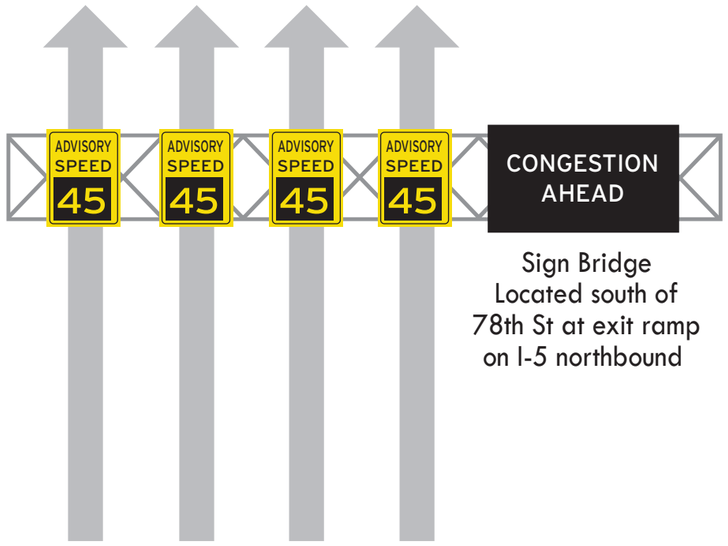

## Purpose and Need

In the evening peak hours, the 78th Street exit ramp from I-5 northbound experiences heavy congestion resulting in queuing and slowing that can extend onto mainline I-5. The queuing of vehicles which can result in increased rear-end crashes.

## Proposed Project and Benefit

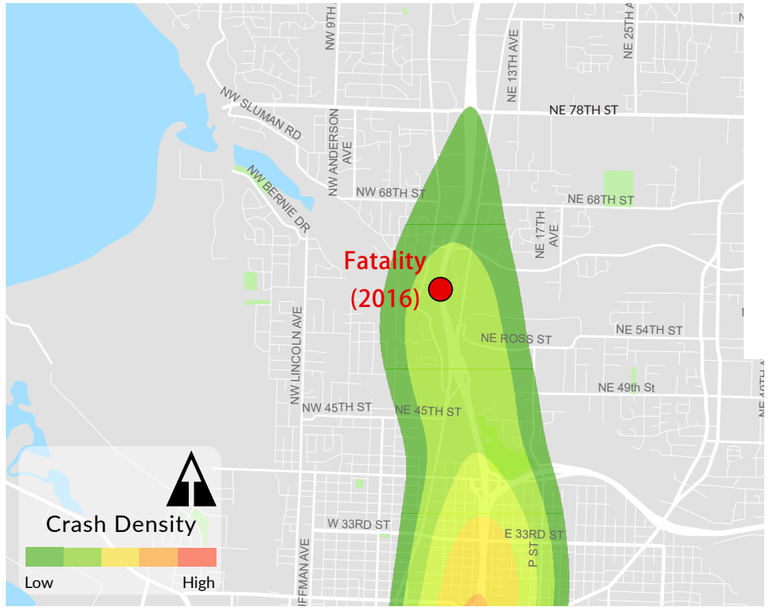
This strategy installs variable speed signs and advance queue warning signs to prepare drivers for the presence of queued vehicles ahead in the right lanes. This strategy increases driver awareness of slowing traffic conditions, in turn decreasing the probability of rear-end crashes.

## Project Concept Diagram




Sign Bridge Located south of 78th St at exit ramp on I-5 northbound

## Crash History




## Improvement Metrics

### Operations

ATM systems help reduce delay (by 3 to 15 percent) and improve travel time by promoting more uniform driver behavior, smoothing the flow of traffic and reducing traffic incidents.

### Safety

- 35% potential crash reduction.
- VAS and VMS are designed to warn drivers of unexpected queuing or slowing ahead, therefore reducing the potential for crashes that result from large speed variances between vehicles.
- Beneficial to all crash types of all severity.

### Cost

## $2-$3 million

- Assuming 4 VAS signs and 1 VMS sign.
- Could do a cantilever sign with full-color VMS for both speed and queue warning.
- Include a dump loop to preempt signal.

## FINDINGS

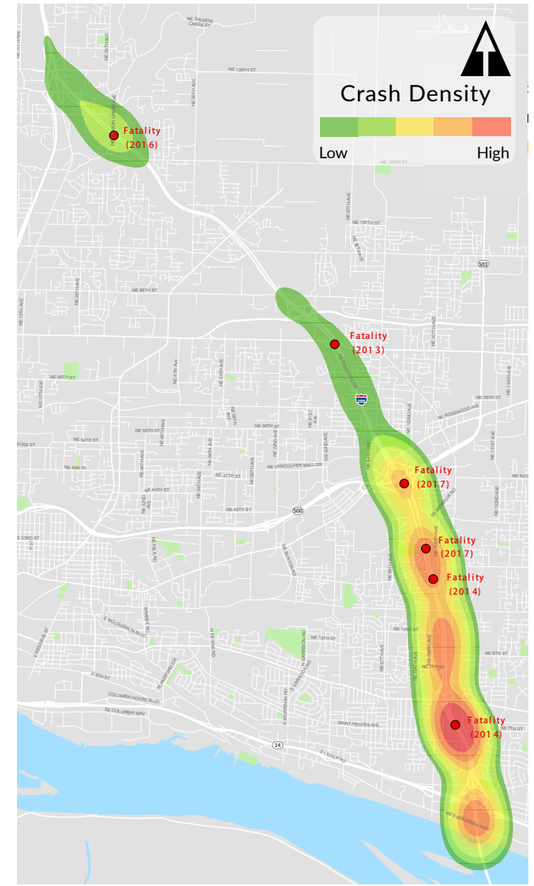
The addition of variable speed signs and advanced queue warning will increase driver awareness of slowing traffic conditions, resulting in fewer hard braking events and reduced rear-end/back of queue crashes. The increased driver awareness of slowing in the right lanes should also provide for smoother traffic flow and through traffic will know to move to the left.

**Tier 1**

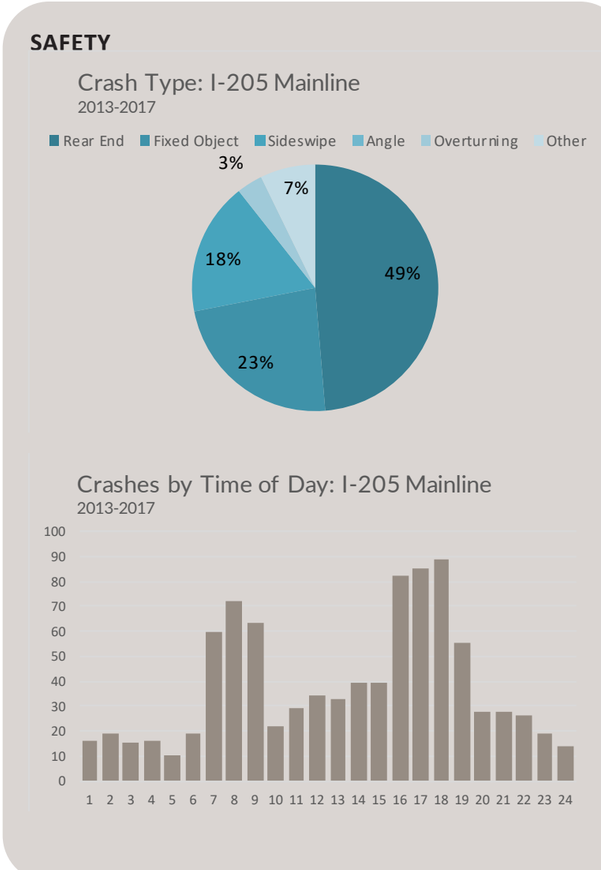
# I-205 CORRIDOR DASHBOARD

I-205 is one of two routes over the Columbia River in the Portland metro region. I-205 begins south of the study area in Oregon and provides a parallel route to I-5 in the region. The freeway extends north and connects back to I-5 near Salmon Creek and provides acces from Vancouver to Portland International Airport, making it a corridor of economic importance in the region.

| ID | LOCATION | PROJECT TYPE | TIER | PAGE |
|---|---|---|---|---|
| S1 | Southbound: 134th Street Entrance Ramp | Acceleration Lane | 3 | 35 |
| N15 | Northbound: Padden Parkway to 72nd Avenue | Slip Ramp | 4 | 36 |
| VEHOPS Projects | | | | |
| S4 | Southbound: Padden Parkway Entrance Ramp to SR 500 Exit Ramp | Auxiliary Lane | See Appendix for VEHOPs project sheets | |
| S10 | Southbound: SR 500 Entrance Ramp to Mill Plain Boulevard Exit Ramp | Auxiliary Lane | | |
| N1 | Northbound: SR 14 Exit Ramp | Ramp Restriping | | |
| N2 | Northbound: Westbound SR 14 Exit Ramp | Braided Ramps | | |
| N3 | Northbound: Eastbound SR 14 Exit Ramp | Dual Lane Exit Ramp | | |
| N4 | Northbound: SR 14 Entrance Ramp | Dual Lane Entrance Ramp | | |
| N6 | Northbound: Mill Plain Boulevard Entrance Ramp to SR 500 Exit Ramp | Auxiliary Lane | | |
| N10 | Northbound: SR 500 Entrance Ramp to Padden Parkway Exit Ramp | Auxiliary Lane | | |




## SAFETY




## CONGESTION

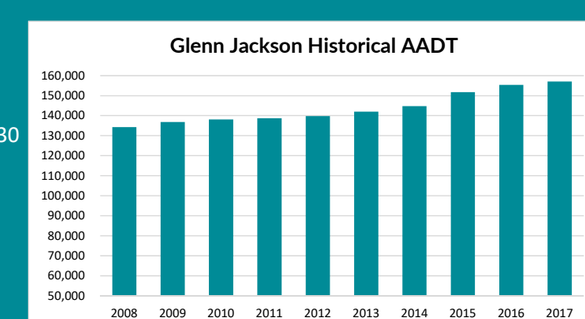
***Existing Bottlenecks***

Southbound

- NE Padden Pkwy to NE 78th St (6:00 – 9:00 AM)
- NE 58th Ave to SR 14 (7:00 – 9:30 AM)
- SR 14 to NE Airport Way (7:00 – 9:30 AM & 4:30 – 6:30 PM)

Northbound

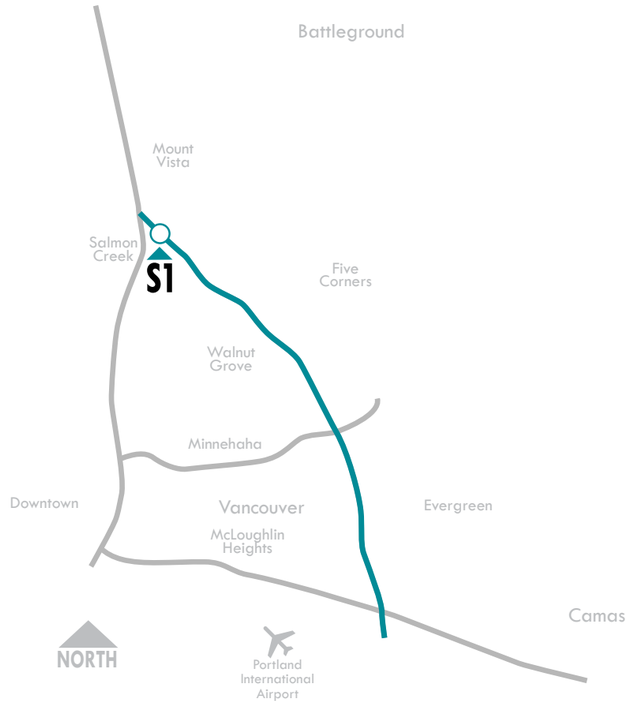
- NE Airport Way to Mill Plain Blvd (3:30 – 7:00 PM)
- NE 9th St to SR 500 (3:00 –7:00 PM)
- SR 500 to Padden Pkwy (3:30 – 7:00 PM)



# SOUTHBOUND: 134th Street Entrance Ramp

*Acceleration Lane*





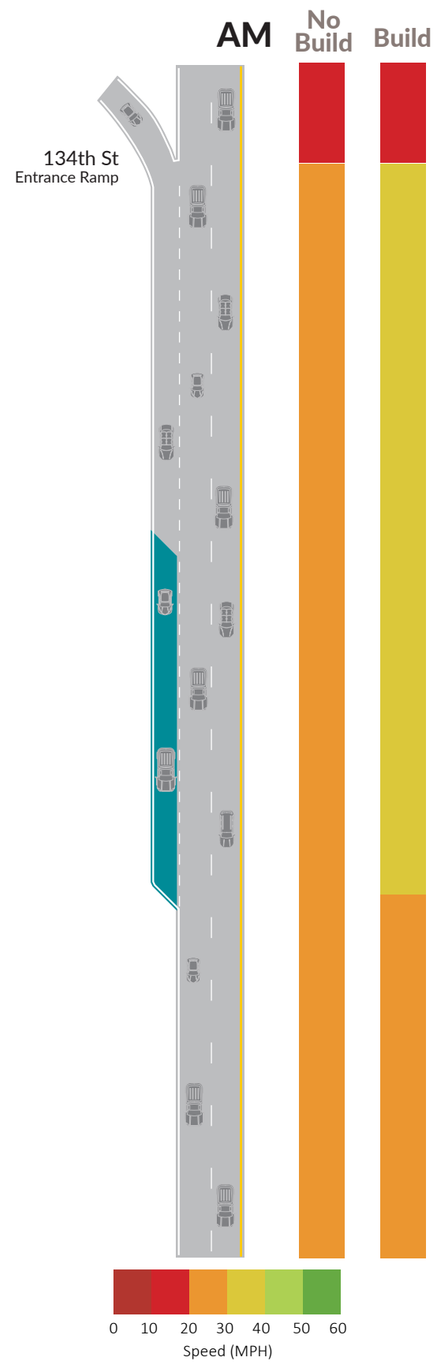

## Purpose and Need

In the morning peak hours, traffic traveling southbound on I-205 towards Portland can experience congestion which queues back into the merge area of the 134th Street entrance ramp. The slowing and congestion can result in abrupt merging at the end of the entrance ramp as drivers take longer to match the changing speed on I-205.

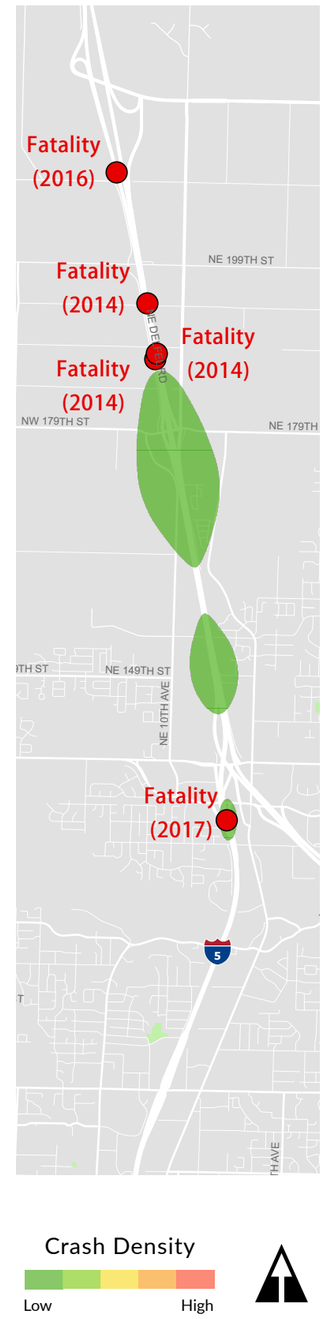
## Proposed Project and Benefit

This project extends the acceleration length of the 134th Street entrance ramp to I-205 southbound. The additional time and space allows vehicles to match the mainline freeway speeds, reducing friction and providing for smoother traffic flow.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### Operations

Extending the acceleration lane lengths shows a minor increase in freeway speeds (1 mph) and no significant change to overall freeway operations. The freeway demand is expected to continue to exceed the available capacity even with the extended acceleration lane.

### Safety

- 12% potential crash reduction in the acceleration area.
- Increase number of opportunities for safe lane changes.
- Allows vehicles to get up to speed before merging (acceleration lanes).
- Reduce speed variability.

### Cost

**$4-$5 million**

- May require reduced shoulder width, structural or ROW impacts.

## FINDINGS

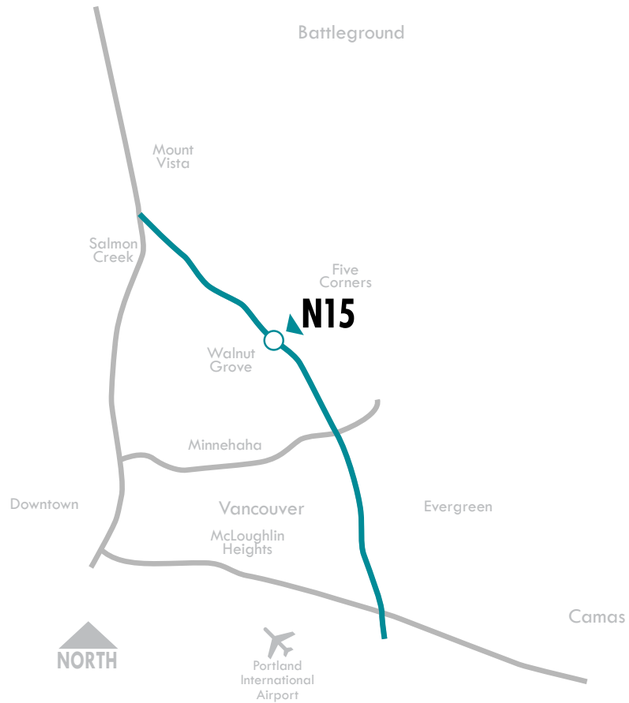
Extending the acceleration lane provides more distance for merging into slow and congested traffic during the morning peak. This provides for safer merging and provides some minor improvement in traffic flow. However, the mainline remains congested.

**Tier 3**

# NORTHBOUND: Padden Parkway to 72nd Avenue

*Slip Ramp*






## Purpose and Need

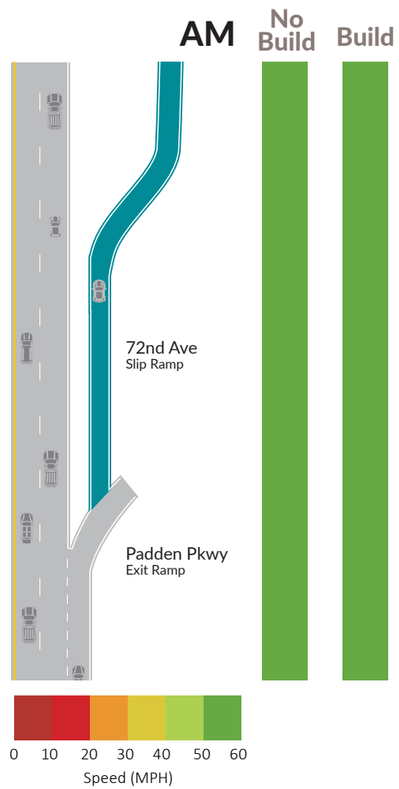
There is no direct access to 72nd Avenue from I-205. The lack of a direct connection requires drivers to use indirect surface street routes to reach this growing north/south arterial roadway. These indirect routes increase congestion of the surface roadways.

## Proposed Project and Benefit

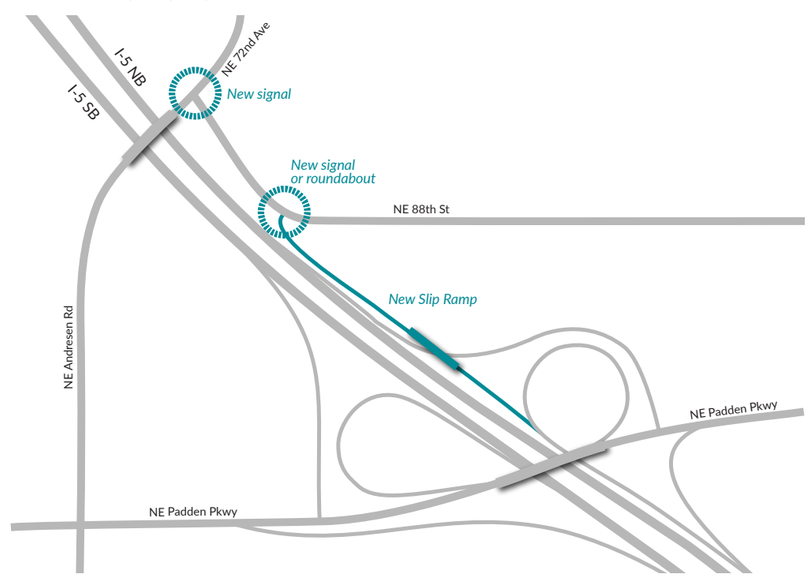
This strategy provides direct access from I-205 northbound to 72nd Avenue by way of a new slip ramp from the existing Padden Parkway exit ramp, which connects to 72nd Avenue via 88th Street.

A signal will be needed at the intersection of 72nd Avenue and 88th Street. A roundabout or signal would be beneficial in reducing delays on the new exit ramp at its intersection with 88th Street. This strategy provides a more direct route for north/south arterial travel and reduces traffic demand on SR 500/SR 503 and Padden Parkway.

## Project Concept Diagram




## Crash History




## Improvement Metrics

### *Operations*

No notable change to freeway operations are anticipated. The strategy does provide more direct route for some drivers and with the addition of a signal at the intersection of 72nd Avenue and 88th Street, reduces turn delays at the intersection. Through traffic on 72nd Avenue would experience some additional delay from the signal.

### *Safety*

Provides for a more direct route to 72nd Avenue reducing vehicle maneuvers and associated crash potential.

### *Cost*

**$25-$40 million**

- May require ROW.
- More detail analysis need to confirm constructability and cost due to topography.

## FINDINGS

A more direct access is provided for some drivers, which will reduce traffic demand on Padden Parkway and SR 500/SR 503 with no impact to I-205 operations. With the more direct path, turn movements and associated crash potential should be reduced.

A new signal will be needed at intersection of 72nd Avenue and 88th Street, and a signal would help reduce ramp delays at the ramps intersection with 88th Street. The topography of this area will make design challenging and more detailed design will be needed to confirm cost and constructability.

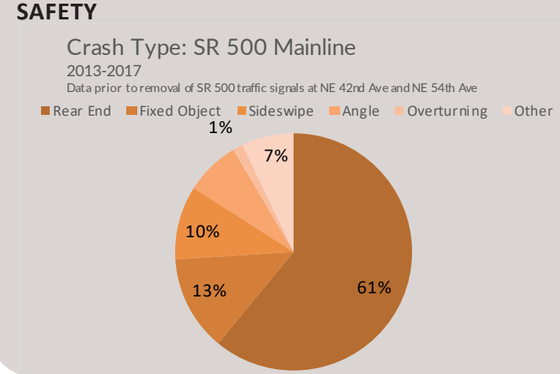
**Tier 4**

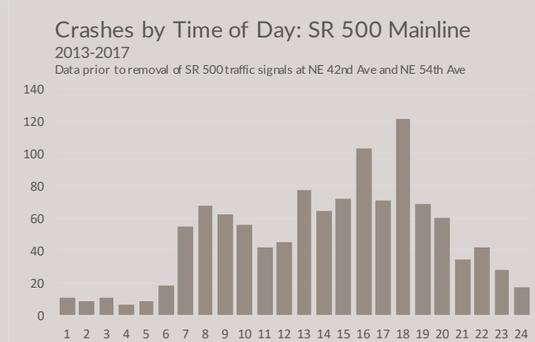
# SR 500 CORRIDOR DASHBOARD

SR 500 acts mostly as a commuter route for Vancouver residents, extending from I-5 east to Fourth Plain Boulevard and SR 503. It is most congested at its junctions with I-5, I-205 and SR 503, especially in the peak commute hours. The highway is located adjacent to high density urban lands. The urban mix includes high and low density residential, commercial,retail and greenspace. Two significant retail areas are located near this section of SR 500 at Andresen Road and Thurston Way.

| ID | LOCATION | PROJECT TYPE | TIER | PAGE |
|---|---|---|---|---|
| E4 | Eastbound: SR 500 at I-205 Interchange | Variable Message Signs | 1 | 38 |
| E6 | Eastbound: Stapleton Road Entrance Ramp to Andresen Road Exit Ramp | Auxiliary Lane | 1 | 39 |
| E7 | Eastbound: St. John's Road Entrance Ramp to 42nd Ave Exit Ramp | Auxiliary Lane | 2 | 40 |
| W2 | Westbound: Gher Road Entrance Ramp to I-205 Exit Ramp | Dual Lane Exit Ramp | 2 | 41 |
| W3 | Westbound: I-205 Northbound Exit Ramp | Barrier Separation | 1 | 42 |
| W4 | Westbound: I-205 Southbound Entrance Ramp to Thurston Way Exit Ramp | Advance Signage | 1 | 43 |
| W6 | Westbound: Andresen Road Entrance Ramp to Stapleton Road Exit Ramp | Auxiliary Lane | 3 | 44 |
| W8 | Westbound: I-5 Southbound Exit Ramp | Variable Message Signs | 1 | 45 |
| W9 | Westbound: I-5 Northbound Exit Ramp | Route Enhancement | 2 | 46 |
| W11 | Westbound: 39th Street at I-5 Northbound Ramp Terminal | Dedicated Right-Turn Lane | 1 | 47 |
| W13 | Westbound: I-205 Southbound Exit Ramp to Vancouver Mall Drive and SR 500 Westbound Entrance Ramp | Advance Signage | 1 | 48 |
| W14 | Westbound: 42nd Ave Entrance Ramp to St. John's Road Exit Ramp | Auxiliary Lane | 3 | 49 |

## SAFETY




## CONGESTION

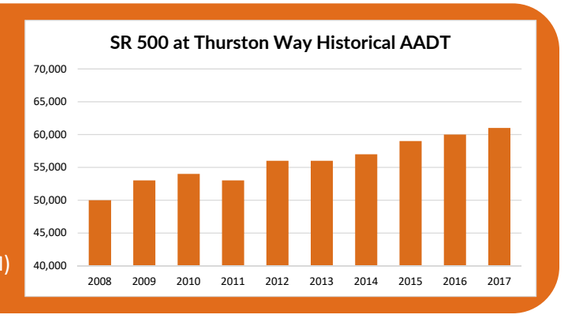
***Existing Bottlenecks***

Westbound

- Fourth Plain Blvd to NE 112th/Gher Rd (6:00 – 7:30 AM)
- Approaching I-5 (6:30 – 8:30 AM)

Eastbound

- I-205 EB Entrance to NE 112th/Gher Rd (3:30 – 6:30 PM)
- NE 112th/Gher Rd to Fourth Plain Blvd (7:00 AM – 10:00 PM)



# EASTBOUND: SR 500 at I-205 Interchange

*Variable Message Signs*

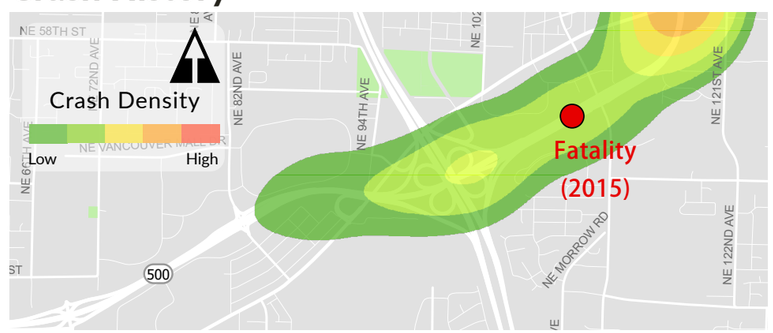
## Purpose and Need

In the PM peak hours, traffic traveling eastbound on SR 500 towards I-205 experiences heavy congestion. This is a freeway-to-freeway interchange with high traffic volumes that create significant queuing of vehicles which can result in increased rear-end crashes.

## Proposed Project and Benefit

This project installs advance queue warning signs to prepare drivers for the presence of queued vehicles ahead. The advanced signing increases driver awareness of upcoming traffic slowing and congestion, in turn decreasing the probability of rear-end crashes. Will need to provide interconnect to queue warning sign at Fourth Plain Boulevard.

## Crash History




## Improvement Metrics

### Operations

ATM systems help reduce delay (by 3 to 15 percent) and improve travel time by promoting more uniform driver behavior, smoothing the flow of traffic and reducing traffic incidents.

### Safety

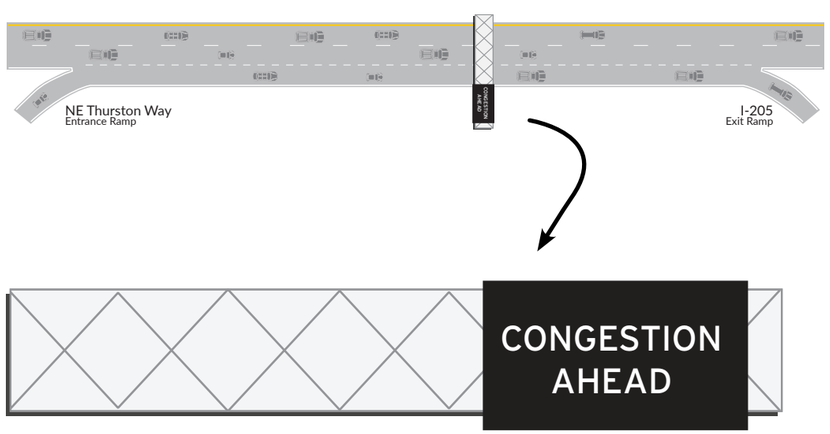
- 35% potential crash reduction.
- VAS and VMS are designed to warn drivers of unexpected queuing or slowing ahead, therefore reducing the potential for crashes that result from large speed variances between vehicles.
- Beneficial to all crash types of all severity.

### Cost

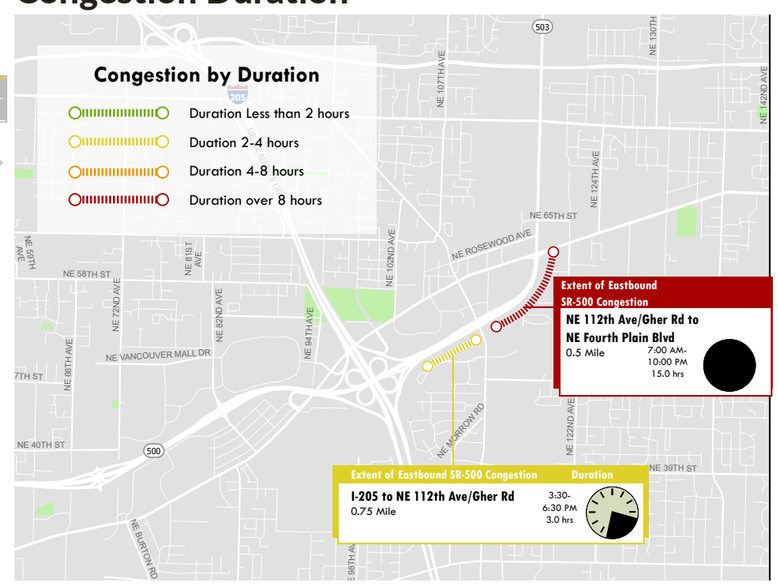
**$1-$2 million**

- Assuming 1 VMS sign

## Project Concept Diagram




## Congestion Duration




## FINDINGS

The addition of advanced queue warning will increase driver awareness of slowing traffic conditions, resulting in fewer hard braking events and reduced rear-end/back-of-queue crashes. The increased driver awareness of slowing may also help smooth traffic flow through the I-205 interchange as drivers approach the congestion and queuing generated from the NE Fourth Plain Boulevard traffic signal.

This strategy can also serve as a phase to a larger an Active Traffic Management system for SR 500.

**Tier 1**

# EASTBOUND: Stapleton Road Entrance Ramp to Andresen Road Exit Ramp

*Auxiliary Lane*

## Purpose and Need

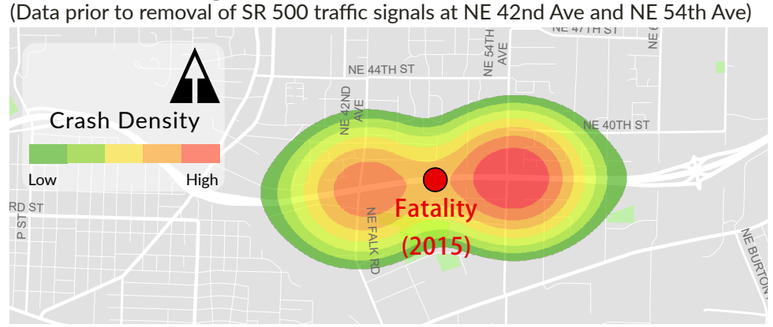
In the PM peak hours, eastbound traffic on SR 500 experiences congestion where traffic merges from the Stapleton Road entrance ramp. This causes a speed differential between the SR 500 mainline and entrance ramp traffic. Traffic volumes have increased in recent years, and are projected to continue this growth.

## Proposed Project and Benefit

This project constructs an auxiliary lane eastbound on SR 500 from the Stapleton Road Entrance Ramp to the Andresen Road exit ramp.

## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### Operations

Overall travel speeds will improve slightly due to more stable travel flow resulting from the increased acceleration and deceleration distance provided by the auxiliary lane. The auxiliary lane also provides additional capacity to accommodate future traffic growth.

### Safety

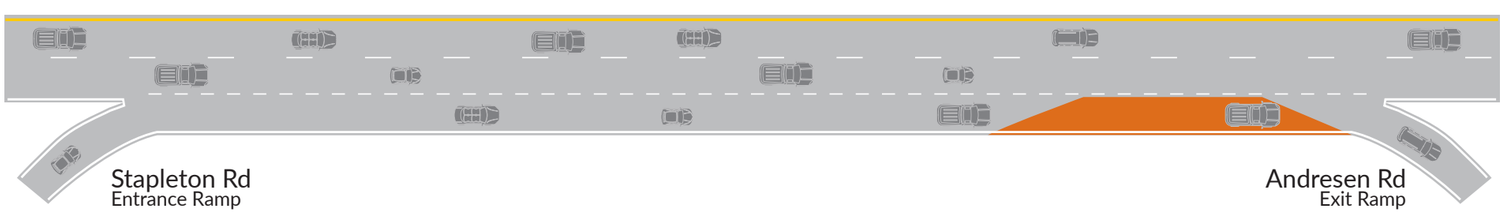
- 20% potential crash reduction.
- Increase number of opportunities for safe lane changes.
- Allows vehicles to get up to speed before merging with mainline.
- Reduce speed variability.

### Cost

**$100,000-$1 million**

- Low end cost assumes project is completed with repaving project.
- Auxiliary lane is not long enough to trigger a soundwall review.

## Project Concept Diagram



## FINDINGS

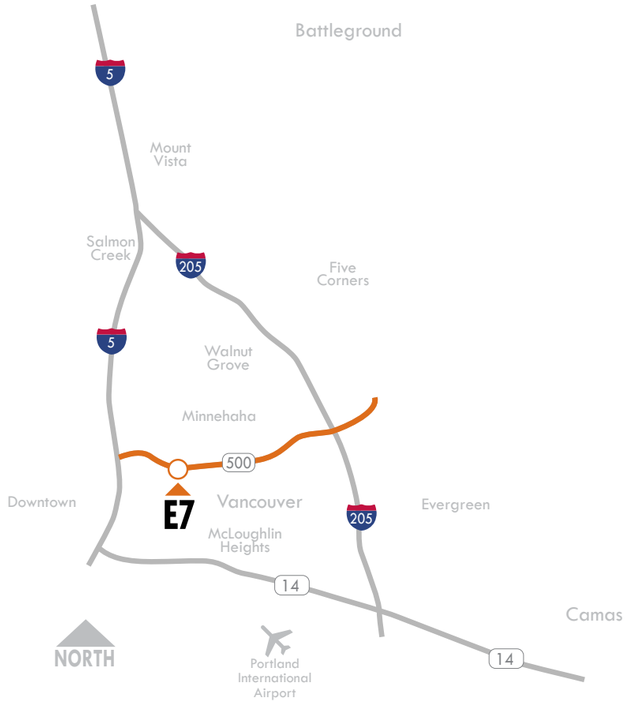
Adding an auxiliary lane on SR 500 eastbound between Andresen Road and Stapleton Road will provide more distance and time for driver to maneuver on and off of SR 500. The improved traffic flow should reduce speed variability on SR 500 and reduce lane change related crashes. The auxiliary lane also provides additional capacity to accommodate future traffic growth.

**Tier 1**

# EASTBOUND: St. Johns Boulevard Entrance Ramp to Falk Road Exit Ramp

*Auxiliary Lane*






## Purpose and Need

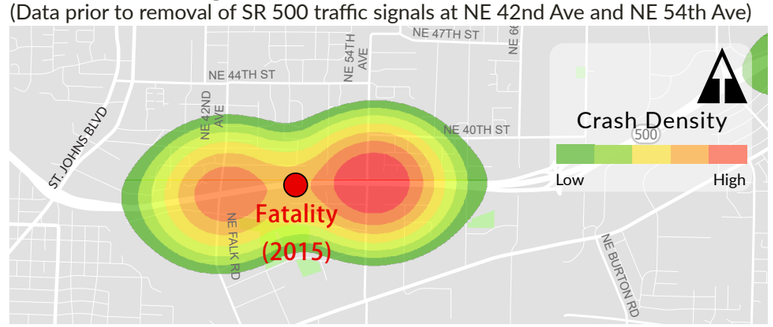
In the PM peak hours, eastbound traffic on SR 500 experiences congestion where traffic merges from the St. John's Road entrance ramp. This causes a speed differential between the SR 500 mainline and entrance ramp traffic. Traffic volumes have increased rapidly in recent years, and are projected to continue this growth.

## Proposed Project and Benefit

This project constructs an auxiliary lane eastbound on SR 500 from the St. John's Road entrance ramp to the Falk Road exit ramp.

## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### Operations

The auxiliary lane provides additional acceleration and deceleration length for the ramps improving travel speed on SR 500 and providing for smoother traffic flow and less adjusting of traffic speeds as drivers enter and exit SR 500. Travel speeds are forecast to improve by 10 to 12 mph.

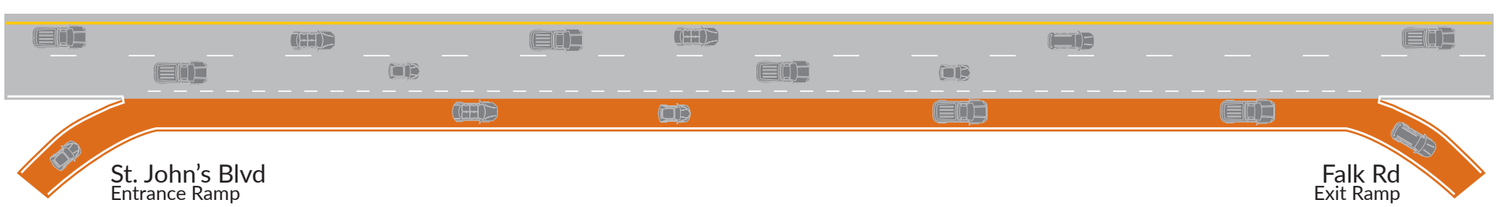
### Safety

- 20% potential crash reduction.
- Increase number of opportunities for safe lane changes.
- Allows vehicles to get up to speed before merging with mainline.
- Reduce speed variability.

### Cost

**$8-$10 million**

## Project Concept Diagram




## PM

## FINDINGS

The addition of an auxiliary lane between St. Johns Boulevard and Falk Road will provide additional distance and time for vehicles entering and exiting SR 500 resulting in more stable traffic flow on SR 500 and an increase in mainline travel speed of 10 to 12 mph. The more stable traffic flow should also reduce sudden lane maneuvers and hard braking helping to improve safety on this segment of SR 500.

**Tier 2**

# WESTBOUND: Gher Road Entrance Ramp to I-205 Northbound Exit Ramp

*Dual Lane Exit Ramp*

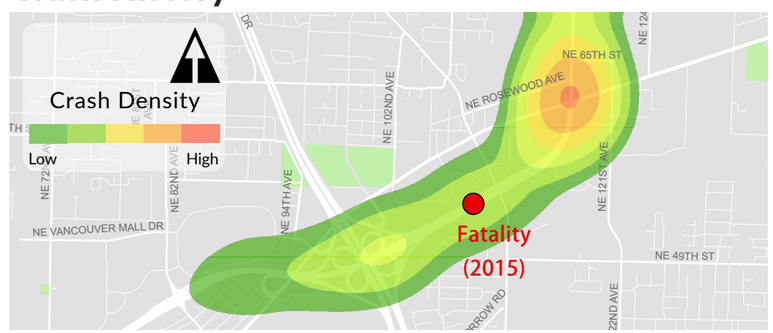
## Purpose and Need

During the AM peak hours, a high volume of traffic enters SR 500 westbound from Gher Road, only to exit to I-205 northbound at the SR 500/I-205 cloverleaf interchange. The Gher Road entrance ramp is two lanes which becomes a single lane before entering SR 500. This adds delay and reduces speeds.

## Proposed Project and Benefit

This project add an "exit only" lane between Gher Road and the I-205 northbound exit ramp. A dedicated lane to exit will maintain two lanes on the Gher Road entrance ramp all the way to I-205 northbound, reducing the occurrence of weaving on this segment of SR 500.

## Crash History




## Improvement Metrics

### Operations

In the AM peak hour, speeds are expected to increase by 10 mph due to the auxiliary lane. The increased capacity allows traffic demand to be served more efficiently. In the PM peak hour, traffic speeds are free flowing in both the No Build and Build condition.

### Safety

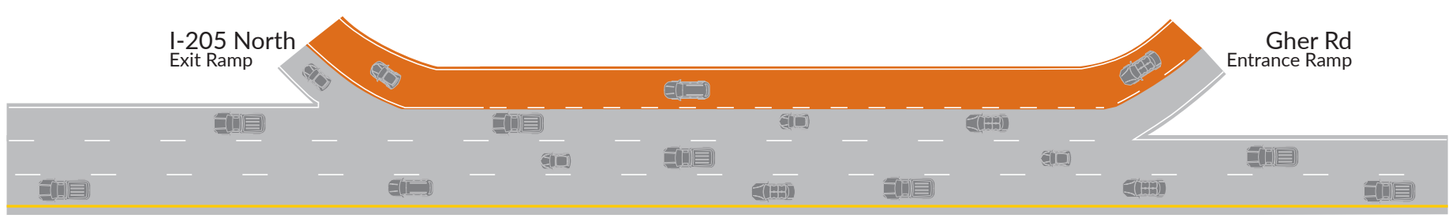
- 21% potential crash reduction.
- Provides additional storage for larger vehicles and smaller vehicles to exit at the same time.
- Reduce intensive lane changing maneuvers with limited space of one lane.

### Cost

**$4-$5 million**

- No adjacent right-of-way impacts are expected

## Project Concept Diagram




## AM

## FINDINGS

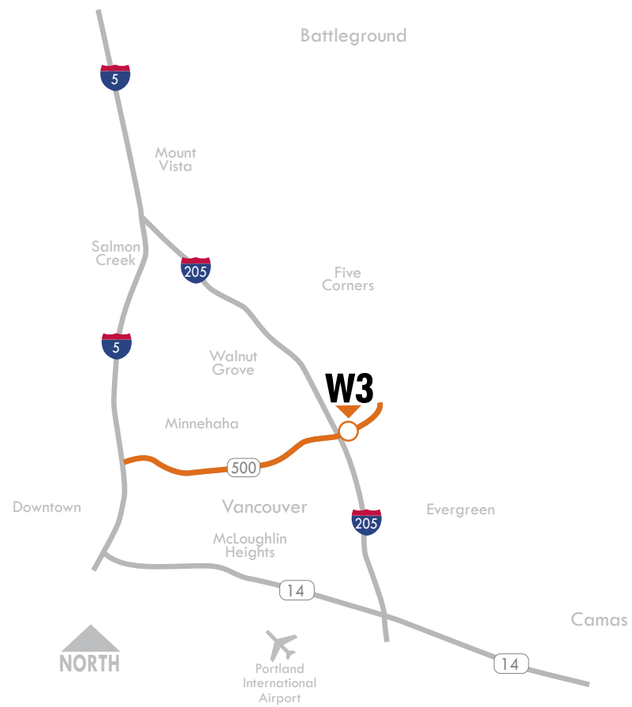
The addition of another travel lane between the Gher Road entrance ramp and I-205 northbound exit ramp to serve traffic going directly between those two ramps benefits the SR 500 westbound mainline. The additional travel lane improves traffic speeds in the AM peak period and reducs the amount of weaving and lane changes occurring in this segment of SR 500.

**Tier 2**

# WESTBOUND: I-205 Northbound Exit Ramp

*Ramp Access*





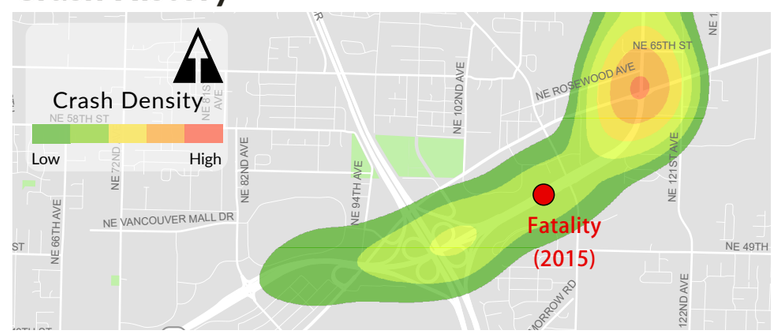

## Purpose and Need

During the peak hours, vehicles enter westbound on SR 500 from NE Gher Road only to exit to I-205 North at the adjacent SR 500/I-205 interchange. The two-lane NE Gher Road entrance ramp transitions from two lanes to a single lane before merging with westbound SR 500. This weaving segment creates friction on the mainline.

## Proposed Project and Benefit

This project constructs a barrier preventing vehicles on SR 500 westbound from exiting to I-205 northbound. Vehicles entering from Gher Road will be able to both merge with SR 500 and take the exit to I-205 northbound. This strategy would eliminate all the weaving movements between Gher Road and the I-205 northbound exit. Drivers that currently use SR 500 westbound to get to I-205 northbound would take alternate routes, most likely the underutilized I-205 northbound ramp from Fourth Plain Boulevard.

## Crash History




## Improvement Metrics

### Operations

In the AM peak hour, the physical separation results in speed increases of approximately 10 to 20 mph on SR 500 in this segment. The increased capacity allows traffic demand to be served efficiently in the Build condition. In the PM peak hour, traffic speeds are free flowing in both the No Build and Build condition. This strategy does shorten the weaving section between the Gher Road entrance and the I-205 northbound entrance and southbound exit. This strategy could result in increased traffic on the local system.

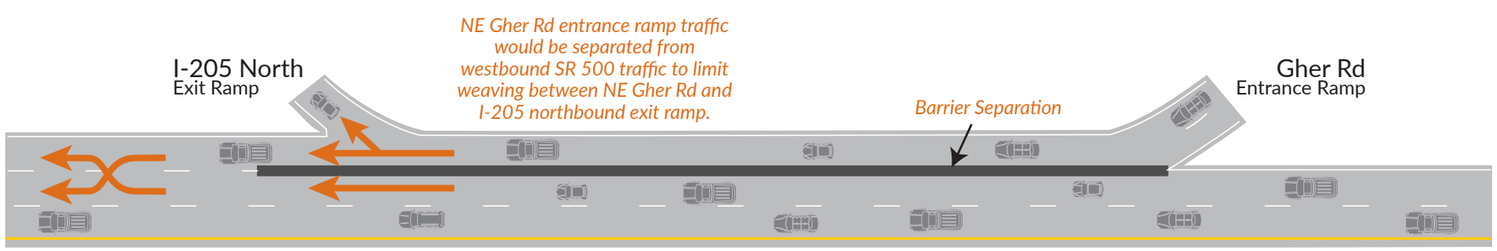
### Safety

Reduces ane changes from westbound SR 500 and merges onto northbound I-205.

### Cost

**$1-$2 million**

## Project Concept Diagram



## FINDINGS

This strategy has similar operational goals as Strategy W2, but performs better due to the elimination of the weaving section between Gher Road and I-205 northbound. The barrier separation reduces lane changing and conflict points on SR 500 better than strategy W2.

Drivers that currently use SR 500 westbound to get to I-205 northbound would take alternate routes, most likely the underutilized I-205 northbound ramp from Fourth Plain Boulevard. This will likely result in more traffic on the local system and potentially create the need for additional local improvements. This strategy does shorten the weaving section between Gher Road entrance and I-205 northbound entrance and southbound exit. This strategy has a lower cost than W2.

**Tier 1**

# WESTBOUND: I-205 Southbound Entrance Ramp to Thurston Way Exit Ramp

*Advance Signage*

## Purpose and Need

The Thurston Way exit from SR 500 westbound is a dual lane exit; both lanes are dedicated exits and are marked on the pavement. However, a lot of weaving movements are observed here, which are often abrupt, adding delay and creating friction near the exit ramp.

## Proposed Project and Benefit

This project provides overhead signage to give drivers advance warning about lane information so that drivers move into the appropriate lanes. Advance signage has the potential to reduce crashes by providing drivers with additional time to make necessary lane changes and route selection decisions. This helps to prevent abrupt lane-changing maneuvers at the exit to Thurston Way.

## Crash History

## Improvement Metrics

### Operations

Improved route information should provide improved lane balance and less lane changing, resulting in improved traffic flow.

### Safety

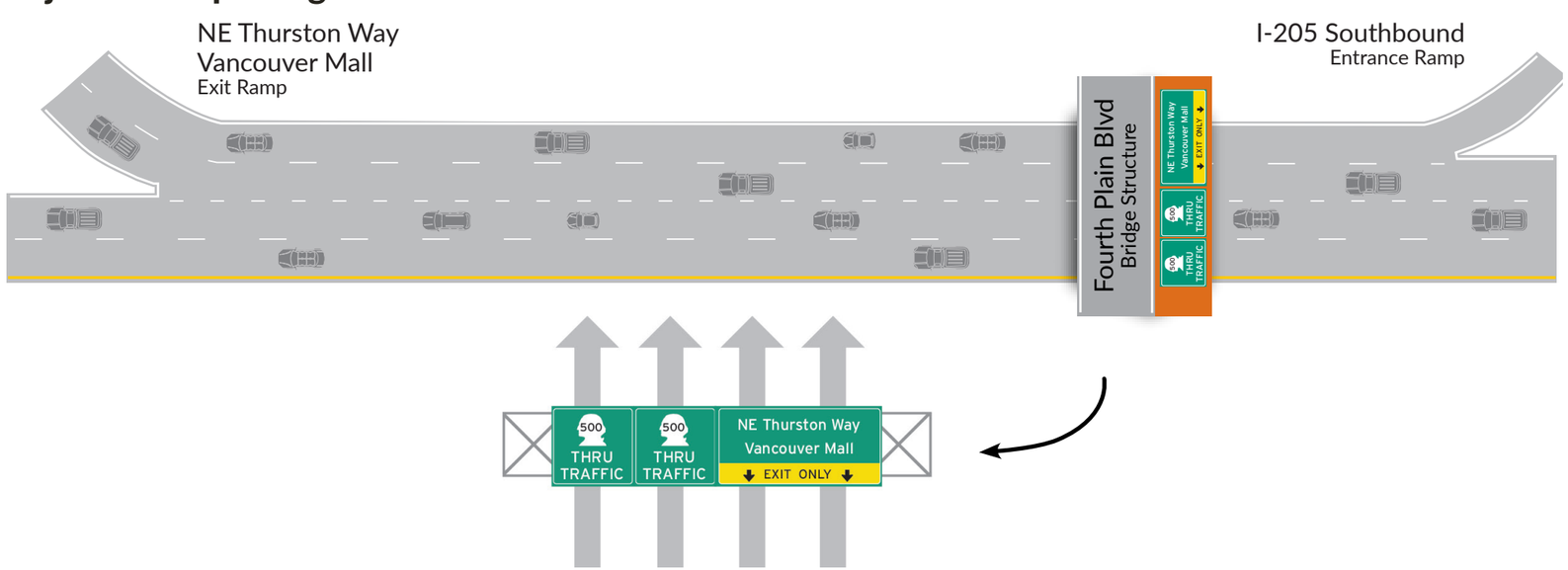
- Improved route information should provide improved decision making and lane balance, providing more time and space for lane changing.
- By providing advance wayfinding signage, abrupt lane changes are expected to be reduced.

### Cost

**$1 million**

- No adjacent right-of-way impacts are expected.
- Cost assumes mounting signs to existing structure (Fourth Plain Boulevard)

## Project Concept Diagram




## FINDINGS

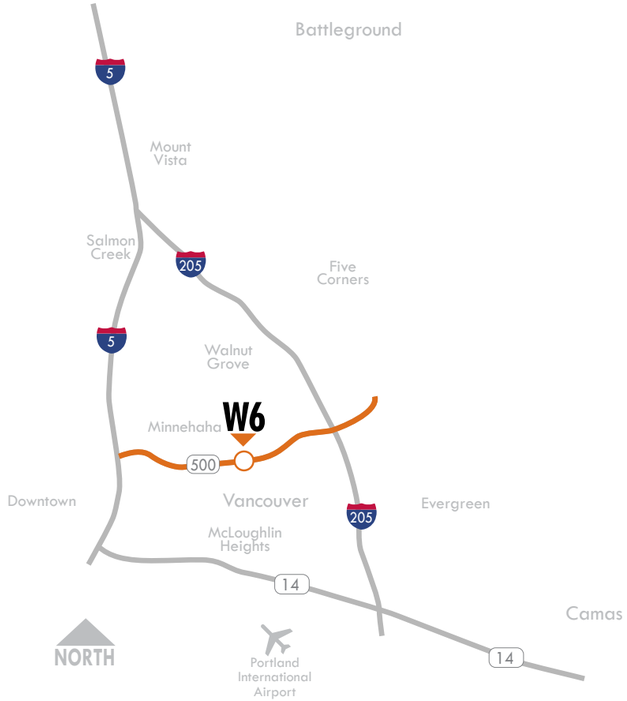
Driver traversing this segment of SR 500 have been observed making late lane changes indicating potential confusion about which lane they need to use to stay on SR 500 or get off to Thurston Way. Providing advanced signage identifying which lanes are best for through traffic vs. exiting traffic should provide for better balance of traffic volumes in each lane. This improves traffic flow and stability, reducing last minute lane changes that can contribute to crashes.

**Tier 1**

# WESTBOUND: Andresen Road Entrance Ramp to 54th Avenue Exit Ramp

*Auxiliary Lane*






## Purpose and Need

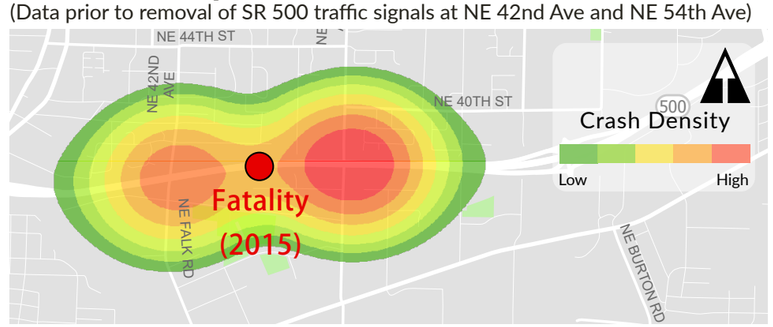
In the PM peak hours, westbound traffic on SR 500 experiences heavy congestion resulting in slowdowns. Traffic volumes have increased rapidly in the last few years, and are projected to continue this growth in the near future.

## Proposed Project and Benefit

This project constructs an auxiliary lane on westbound SR 500 from the Andresen Road entrance ramp to 54th Avenue exit ramp. The addition of an auxiliary lane allows more distance and time for weaving (merging/diverging) to occur in a separate lane and not on the mainline.

## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### Operations

Travel speed between the No Build and Build are similar for this strategy. The Build does have additional capacity to accommodate more future traffic growth than the No Build condition. The additional distance for weaving should provide for more stable traffic flow.

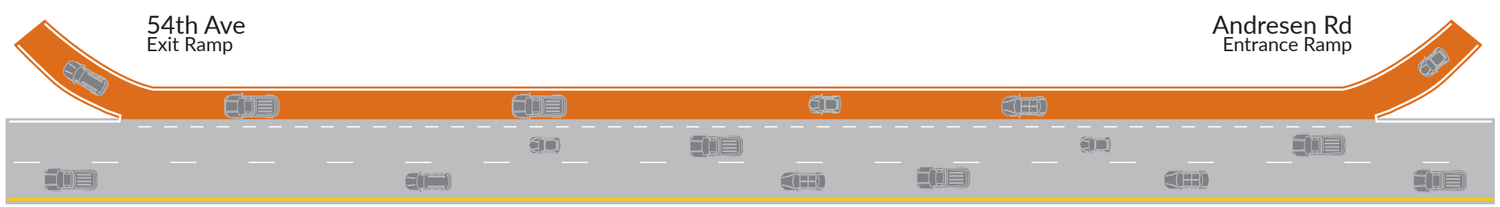
### Safety

- 20% potential crash reduction
- Increases opportunities for safe lane changes.
- Reduces speed variability.
- Provides additional storage for larger vehicles and smaller vehicles to exit at the same time.

### Cost

**$5-$7 million**

## Project Concept Diagram



## FINDINGS

Adding an auxiliary lane on westbound SR 500 from the Andresen Road entrance ramp to 54th Avenue exit ramp provides minimal change to travel speeds but does provide increased distance and time for lane changing as vehicles enter and exit SR 500.

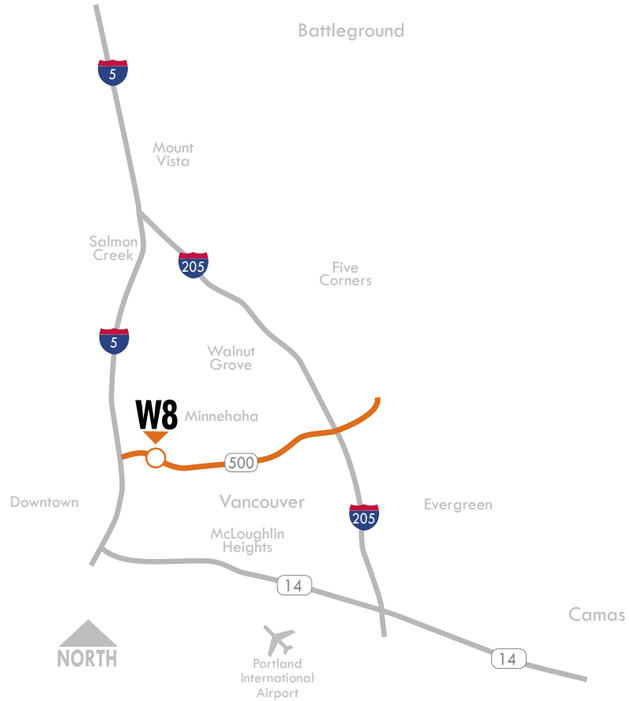
By reducing the frequency of abrupt lane changes and improved safety. The auxiliary lane also provides additional maneuvering capacity to accommodate future traffic growth.

**Tier 3**

# WESTBOUND: I-5 Southbound Exit Ramp

*Variable Message Signs*





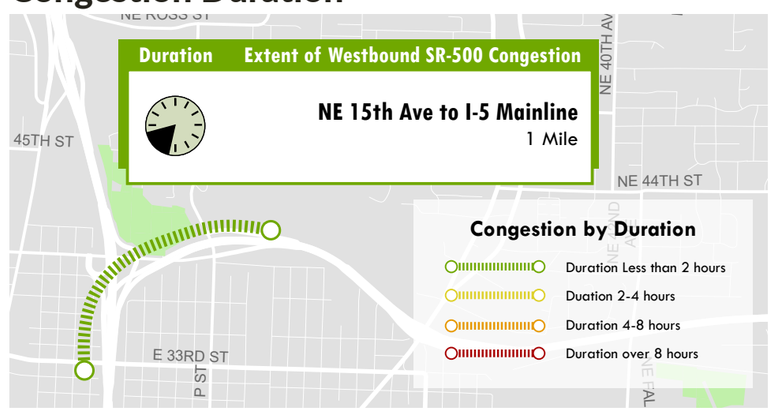

## Purpose and Need

In the morning peak hours, I-5 southbound has heavy congestion approaching the Columbia River. This congestion extend back and onto SR 500 westbound creating queuing on SR 500. The queue can surprise some drivers resulting in hard braking as drivers reach the back of the queue.

## Proposed Project and Benefit

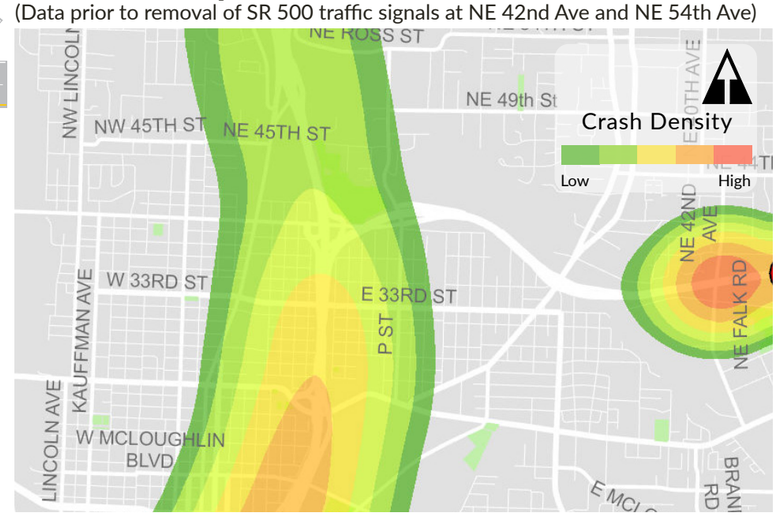
This project installs a VMS ramp meter queue warning on SR 500 east of the 15th Avenue interchange. The signs will warn drivers about the presence of upcoming ramp meters in order to slow driver down. This project is part of the planned I-5 Active Traffic Management project by WSDOT.

## Congestion Duration

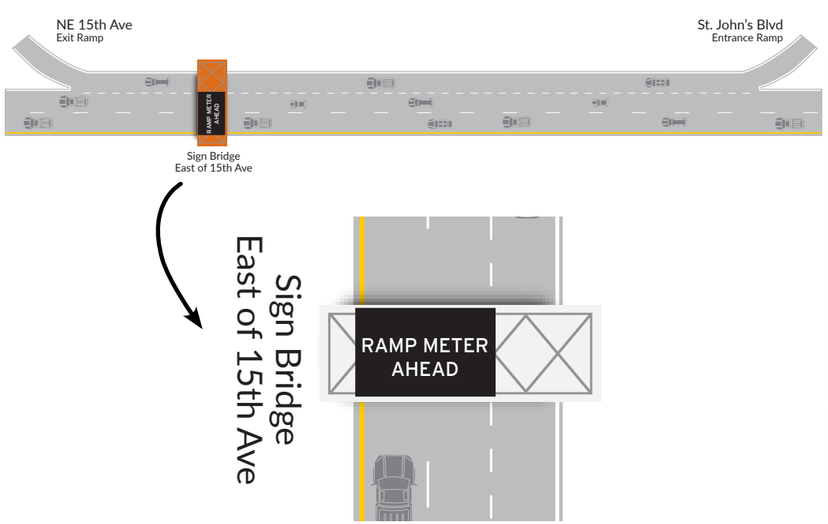



## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Project Concept Diagram




## Improvement Metrics

### Operations

ATM systems help reduce delay (by 3 to 15 percent) and improve travel time by promoting more uniform driver behavior, smoothing the flow of traffic and reducing traffic incidents.

### Safety

- 35% potential crash reduction.
- VAS and VMS are designed to warn drivers of unexpected queuing or slowing ahead, therefore reducing the potential for crashes that result from large speed variances between vehicles.
- Beneficial to all crash types of all severity.

### Cost

**$200,000-$1 million**

- Assuming 1 VMS sign.

## FINDINGS

The SR 500 westbound ramp to I-5 southbound is consistently congested for at over 2 hours per day and can have congestion at any time. Adding Active Traffic Management through queue warning signage approaching this congestion point will warn drivers of downstream congestion that may not be visible due to presence of ramp meters onto I-5. The system will promote more uniform speeds and reduce the frequency of hard braking and potential for rear-end/ back of queue collisions.

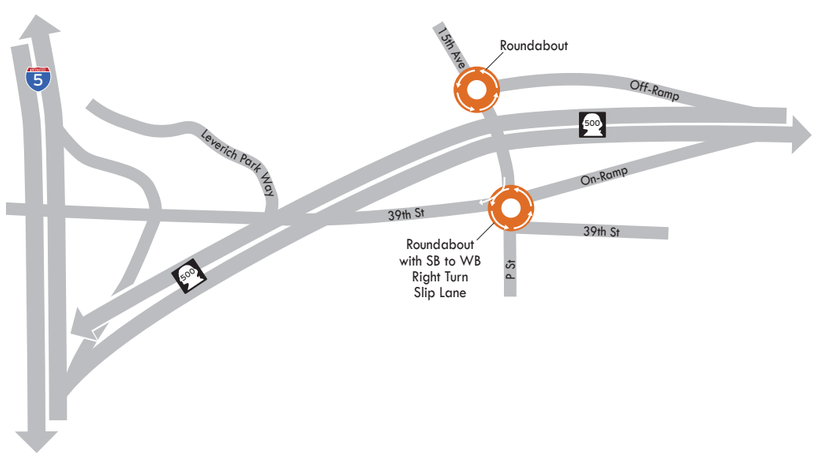
This strategy is part of WSDOT's larger planned Active Traffic Management system.

**Tier 1**

# WESTBOUND: I-5 Northbound Exit Ramp

*Route Enhancements*

## Project Concept Diagram




## Purpose and Need

Currently there is no freeway ramp from SR 500 westbound to I-5 northbound. Westbound traffic has to exit SR 500 at NE 15th Avenue, turn through two signalized intersection and take E 39th Street to get onto I-5 northbound. This travel pattern results in high traffic volumes on E 39th Street with congestion and queuing on NE 15th Avenue and E 39th Street.

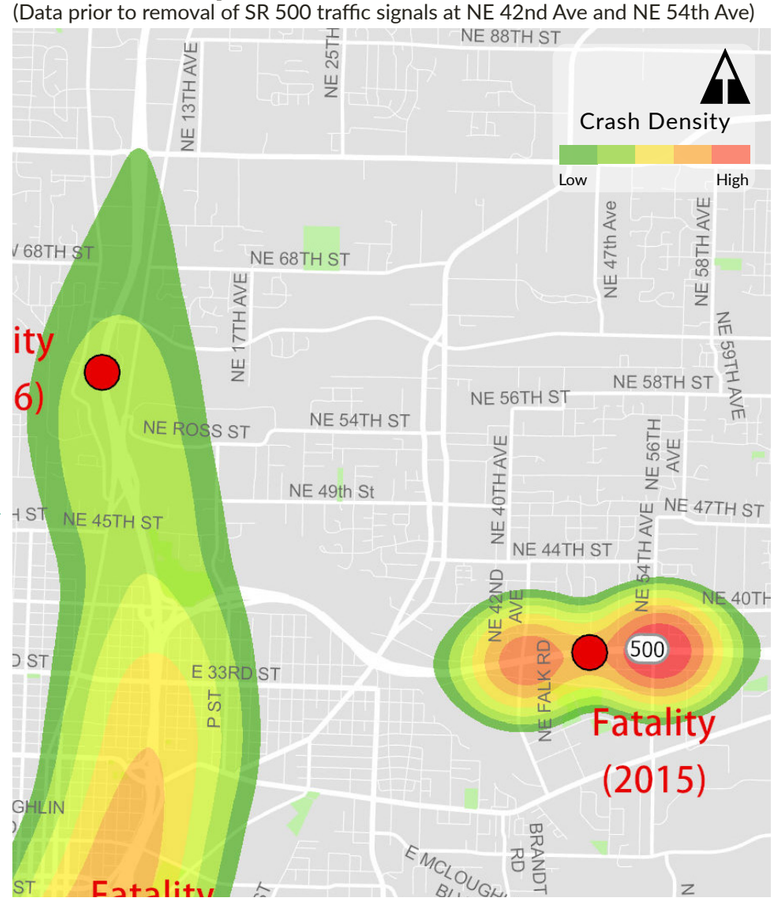
The queueing on westbound 39th Street at the I-5 ramps affects the operations of the two SR 500 ramp terminal signals on 15th Avenue. This congestion adds further delays to traffic going to I-5.

## Proposed Project and Benefit

The proposed project would convert the signalized ramp terminals at NE 15th Avenue to single lane roundabouts with a southbound right-turn slip lane from NE 15th Avenue to E 39th Street. This change in traffic control is expected to improve the flow and access between SR 500 westbound and I-5 northbound.

## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### Operations

The conversion of the NE 15th Avenue ramp terminal signals to single lane roundabouts reduces delay and queueing at the ramp terminals and along the route between SR 500 westbound and I-5 northbound.

In the AM peak period, the eastbound queue on 39th Street approaching the eastbound SR 500 ramp is reduced by over 200 feet. In the PM peak period the queue on the westbound SR 500 exit ramp is reduced by approximately 200 feet.

### Safety

- 24% potential crash reduction.
- Geometry encourages lower speeds and reduces potential for high severity crashes.
- Promote a continuous flow of traffic.
- One-way travel throughout the roundabout eliminates potential for T-bone and head on collisions

### Cost

**$7-$9 million**

- Overall cost depends on number and location of roundabouts being installed, as well as incorporation with existing traffic control at nearby intersections.

## FINDINGS

The proposed project would convert the signalized ramp terminals at NE 15th Avenue to single lane roundabouts with a southbound right-turn slip lane from NE 15th Avenue to E 39th Street. This improves travel time for drivers going from SR 500 westbound to I-205 northbound in the AM and PM peak periods. The continuous flow of the roundabouts promotes slower speeds and reduces the potential for high severity crashes. Queuing on NE 15th Avenue and E 39th Street is reduced.

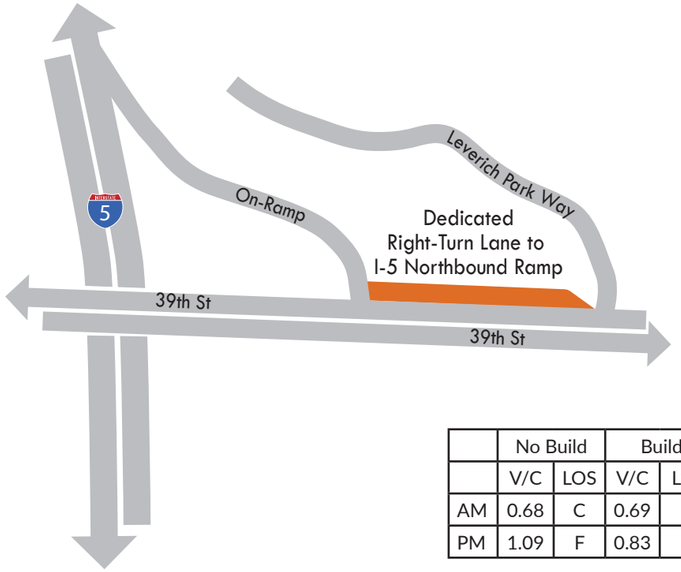
This project would be most effective in combination with strategy I-5 W11, which installs a dedicated westbound right-turn lane for vehicles on E 39th Street turning right onto the I-5 northbound ramp.

**Tier 2**

# WESTBOUND: 39th Street at I-5 Northbound Ramp Terminal

*Dedicated Right-Turn Lane*

## Project Concept Diagram




| | No Build | | Build | |
|---|---|---|---|---|
| | V/C | LOS | V/C | LOS |
| AM | 0.68 | C | 0.69 | B |
| PM | 1.09 | F | 0.83 | C |

## Purpose and Need

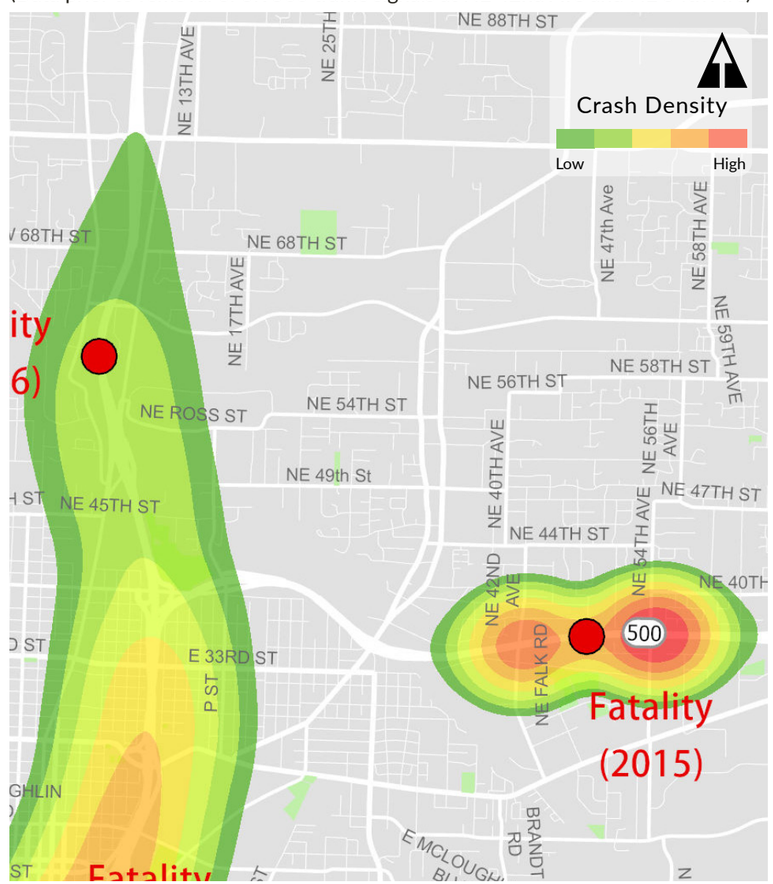
Currently there is no freeway ramp from SR 500 westbound to I-5 northbound. Westbound traffic has to exit SR 500 at NE 15th Avenue, turn through two signalized intersection and take E 39th Street to get onto I-5 northbound. This travel pattern results in high traffic volumes on E 39th Street with congestion and queuing on E 39th Street. This congestion adds further delays to traffic going to I-5.

## Proposed Project and Benefit

This project installs a dedicated westbound right-turn lane for vehicles on E 39th Street turning right onto the I-5 northbound ramp. The dedicated right-turn lane separates the traffic turning right onto the I-5 ramp from the through traffic allowing traffic to get to I-5 northbound faster and more reliably and reduces the queueing on E 39th Street.

## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### Operations

The addition of a dedicated westbound right-turn lane allows the I-5 northbound ramp terminal signal to operate more efficiently by allowing right turns to turn on red. The westbound Level of Service (LOS) improves from LOS F to LOS C with delay reduced by over two minutes in the PM peak hour. AM peak hour operations are also improved queuing on E 39th Street is reduced.

### Safety

- 9% potential crash reduction.
- Provides extra distance for deceleration prior to right turn onto freeway ramp.
- Increases storage for vehicles that are stopped and waiting for the opportunity to complete a turn.

### Cost

**$500,000-$1.5 million**

- Assumes 325 ft dedicated right-turn lane.
- Potential additional cost due if impacts to Leverich Park.

## FINDINGS

This project installs a dedicated westbound right-turn lane for vehicles on E 39th Street turning right onto the I-5 northbound ramp. This improves travel time for drivers going from SR 500 westbound to I-205 northbound by over two minutes in the PM peak period. Overall operation of the signal at the I-205 northbound ramps improves from LOS F to LOS C in the PM peak hour with queuing reduced in the AM and PM peak hours.

Potential impacts to Leverich Park were not evaluated at this time. The environmental impacts to Leverich Park would need to be evaluated during design refinement.

**Tier 1**

# WESTBOUND: I-205 Southbound Exit Ramp to Vancouver Mall Drive/SR 500 Westbound

*Restriping and Signage*



**Project SR 500 W13**

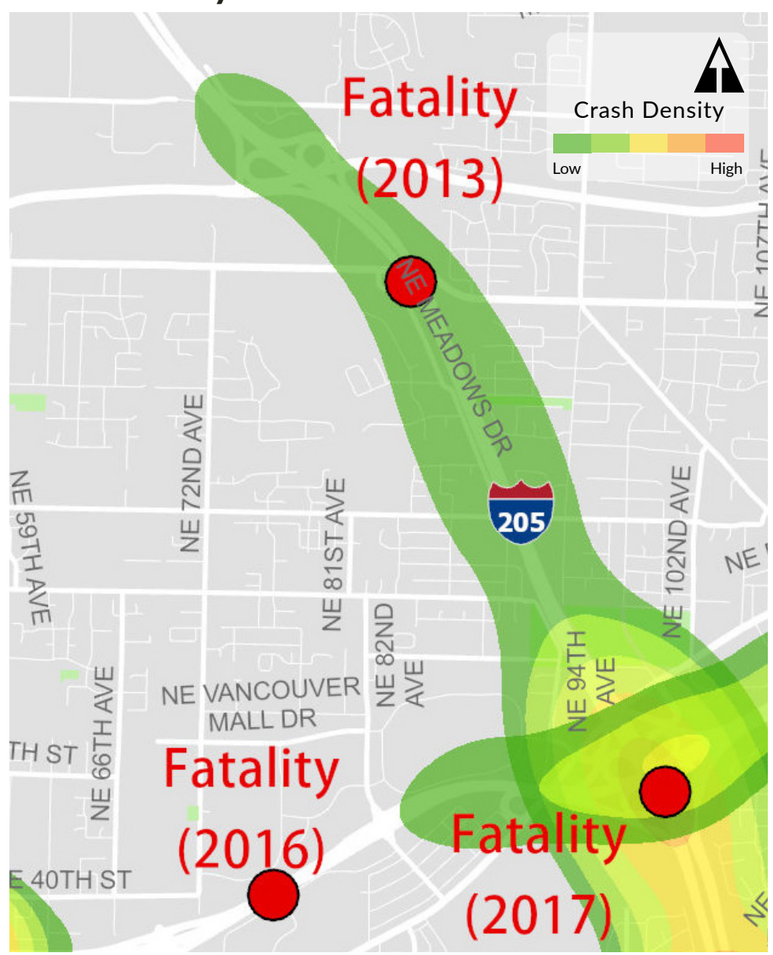
## Purpose and Need

As drivers exit I-205 southbound at the SR 500 interchange, they currently need to move into the right lane of the exit ramp to get to SR 500 westbound and Vancouver Mall. The left lane is designated for SR 500 eastbound. The current signing and lane striping can create drive confusion and poor lane utilization. The weaving between the Vancouver Mall Drive exit ramp and the SR 500 westbound loop ramp entrance can compound driver confusion.

## Proposed Project and Benefit

This project installs revised wayfinding/directional signage in advance of the Vancouver Mall Drive and SR 500 entrance diverge and converts the lane striping to allow both ramp lanes to provide access to SR 500 westbound. This configuration should minimize driver confusion, abrupt lane-changing maneuvers and improve safety.

## Crash History




## Improvement Metrics

### Operations

Improved route information should provide improved lane balance and less lane changing providing improved traffic flow.

### Safety

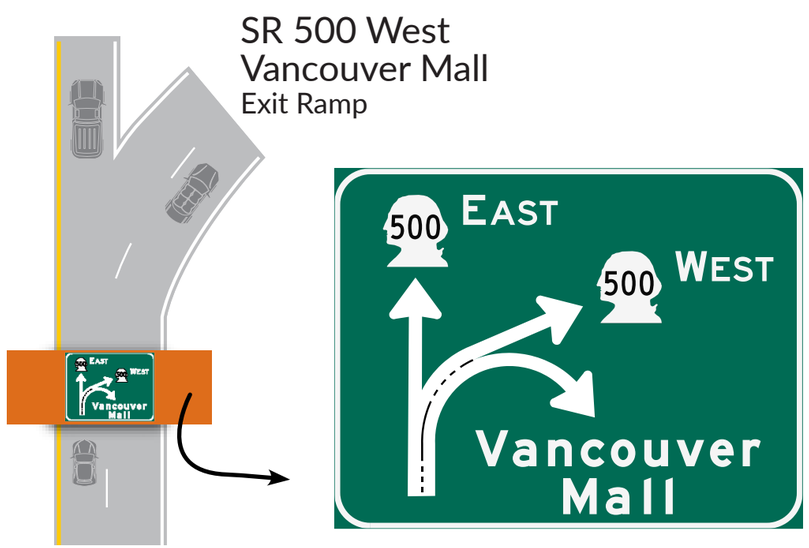
- Improved route information should provide improved decision making and lane balance, providing more time and space for lane changing.
- Reduces abrupt lane changes by providing advance wayfinding signage.

### Cost

**$100,000-$200,000**

- Cost estimate is for signs only; pavement markings are already planned as part of a 2020 WSDOT project.

## Project Concept Diagram




## FINDINGS

As drivers exit I-205 southbound at the SR 500 interchange, the current signing and lane striping can create driver confusion and poor lane utilization. This project installs revised wayfinding/directional signage in advance of the Vancouver Mall Drive and SR 500 entrance diverge and converts the lane striping to allow both ramp lanes to provide access to SR 500 westbound. This configuration should minimize driver confusion, abrupt lane-changing maneuvers and improve safety.

**Tier 1**

# WESTBOUND: 42nd Ave Entrance Ramp to St. John's Road Exit Ramp

*Auxiliary Lane*

## Purpose and Need

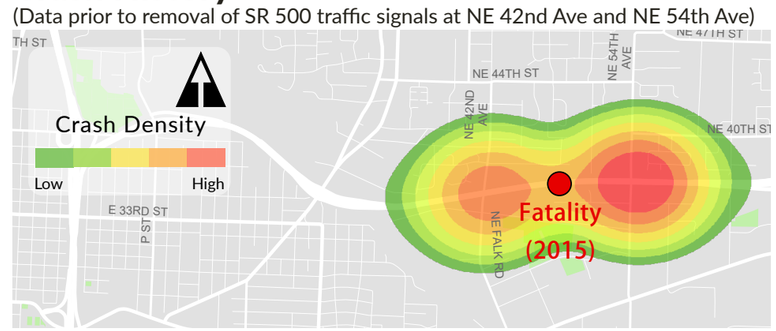
Since the traffic signal at 42nd Avenue and SR 500 were removed, a steady flow of uninterrupted traffic travels on SR 500. There is a short acceleration length at the 42nd Avenue entrance ramp and a high volume of traffic exiting at the St. Johns Boulevard exit ramp immediately downstream. The segment between these two ramps experiences a speed differential between the left and right travel lanes.

## Proposed Project and Benefit

This project constructs an auxiliary lane on westbound SR 500 from the 42nd Avenue entrance ramp to the St. Johns Boulevard exit ramp. The addition of an auxiliary lane allows more distance for weaving (merging/diverging) to occur in a separate lane and not on the mainline.

## Crash History

(Data prior to removal of SR 500 traffic signals at NE 42nd Ave and NE 54th Ave)




## Improvement Metrics

### Operations

The V/C ratio improves by adding an auxiliary lane, during both peak hours of the day. There is minimal difference in speed.

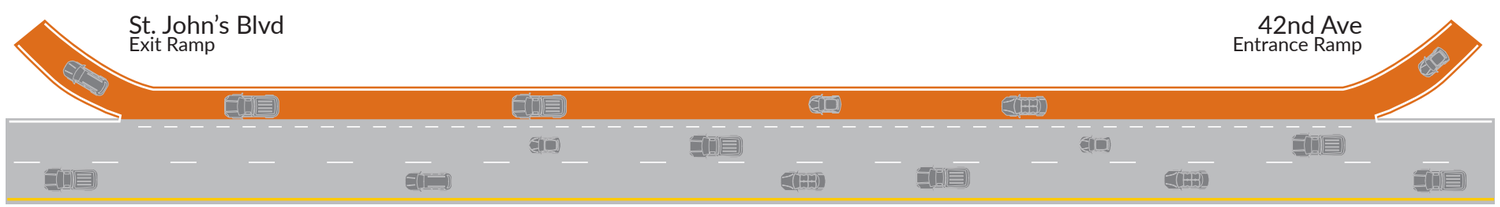
### Safety

- 20% potential crash reduction.
- Increase number of opportunities for safe lane changes.
- Allows vehicles to get up to speed before merging with mainline.
- Reduce speed variability.

### Cost

**$5-$7 million**

## Project Concept Diagram



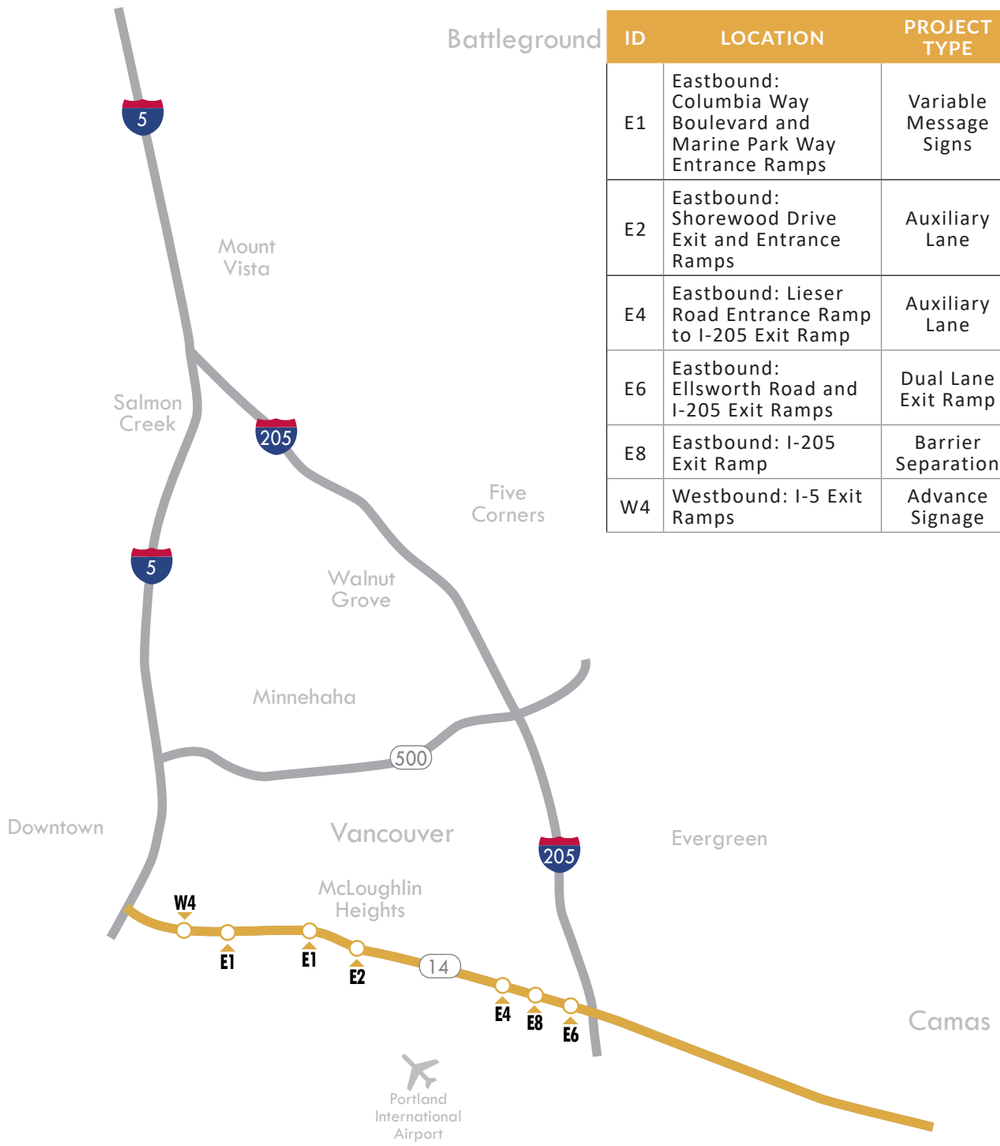
## FINDINGS

Adding an auxiliary lane on SR 500 westbound between 42nd Avenue and St Johns Boulevard will provide more distance and time for driver to maneuver on and off of SR 500. The improved traffic flow should reduce speed variability on SR 500 and reduce lane change related crashes. The auxiliary lane also provides additional capacity to accommodate future traffic growth.

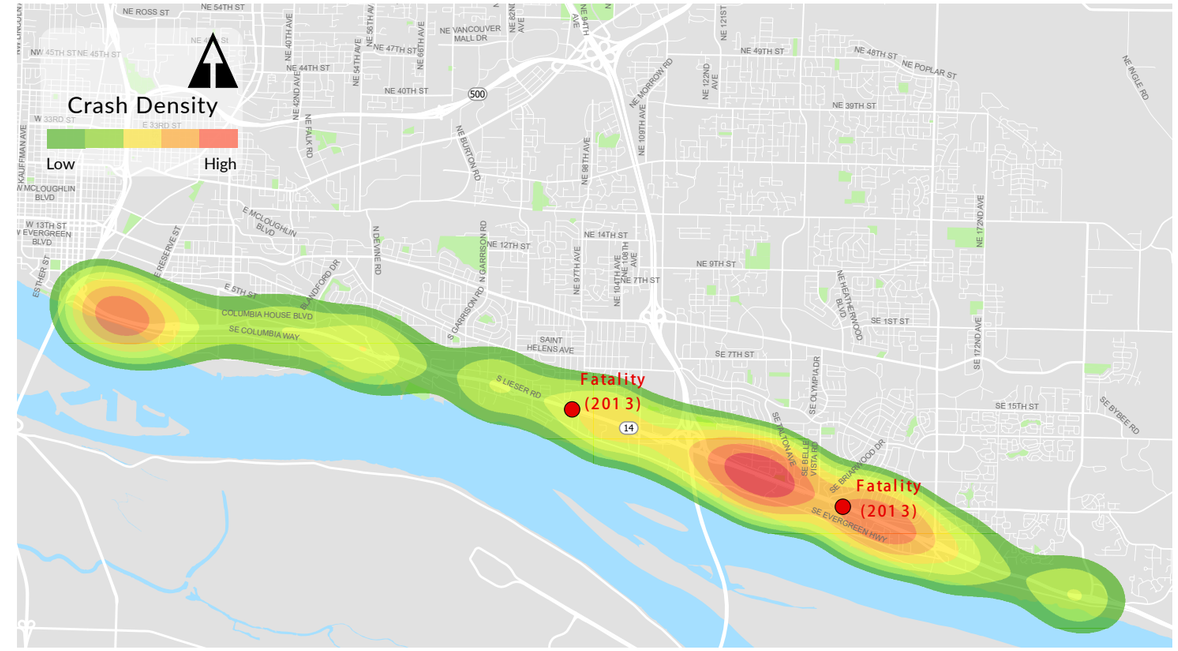
**Tier 3**

# SR 14 CORRIDOR DASHBOARD

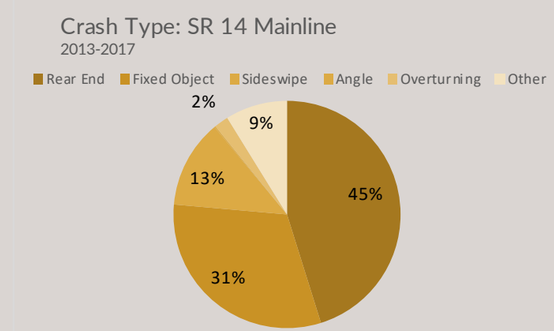
SR 14 connects Vancouver, Camas and Washougal to communities and tourist destinations east in the Columbia River Gorge National Scenic Area. There are significant pockets of industrial uses, particularly in Camas, Washougal, and between the western end of the corridor and the DuBois Park neighborhood Continuing growth in east Vancouver and Camas will likely add to travel demand on SR 14, whose right of way is contstrained by topography, residential neighborhoods, and an existing rail line to the south.

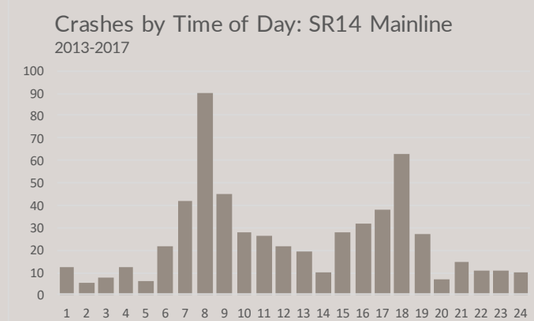



| ID | LOCATION | PROJECT TYPE | TIER | PAGE |
|---|---|---|---|---|
| E1 | Eastbound: Columbia Way Boulevard and Marine Park Way Entrance Ramps | Variable Message Signs | 4 | 51 |
| E2 | Eastbound: Shorewood Drive Exit and Entrance Ramps | Auxiliary Lane | 4 | 52 |
| E4 | Eastbound: Lieser Road Entrance Ramp to I-205 Exit Ramp | Auxiliary Lane | 2 | 53 |
| E6 | Eastbound: Ellsworth Road and I-205 Exit Ramps | Dual Lane Exit Ramp | 4 | 54 |
| E8 | Eastbound: I-205 Exit Ramp | Barrier Separation | 1 | 55 |
| W4 | Westbound: I-5 Exit Ramps | Advance Signage | 1 | 56 |




## SAFETY




## CONGESTION

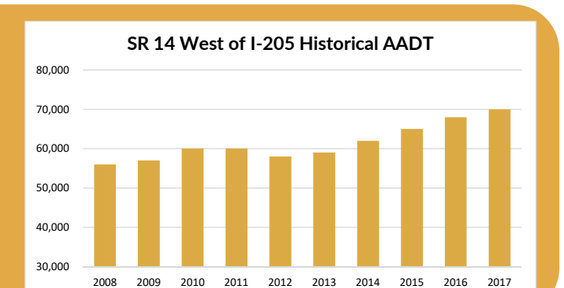
***Existing Bottlenecks***

Westbound

- SE 183rd Ave to I-205 (6:30 – 9:30 AM)
- I-205 NB Exit to I-5 SB Exit (6:00 – 10:00 AM)

Eastbound

- I-205 EB Entrance to SE 152nd Ave (4:00 – 7:00 PM)

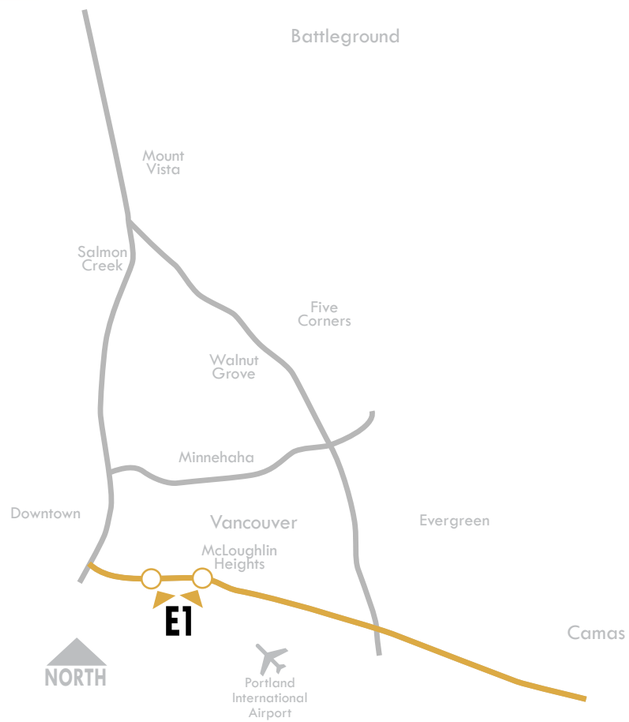


# EASTBOUND: Columbia Way Boulevard and Marine Park Way Entrance Ramps

*Acceleration Lanes*



**Project SR 14 E1**



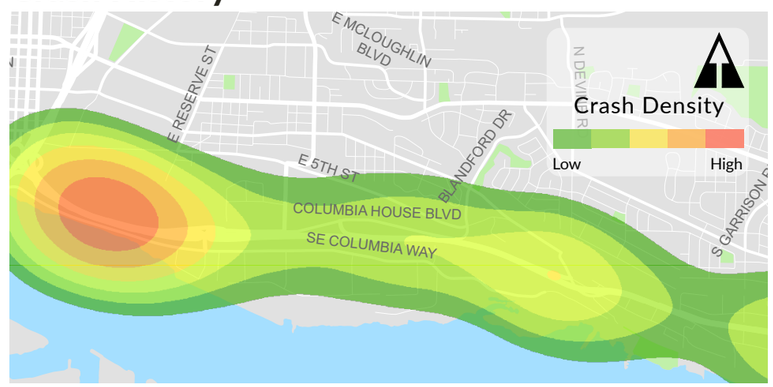

## Purpose and Need

In the PM peak hours, traffic heading eastbound on SR 14 experiences congestion at the merge points of the Columbia Way Boulevard and Marine Park Way entrance ramps. Abrupt merging movements at the end of the entrance ramps compounds the issue. Traffic traveling to SR 14 eastbound from Marine Park Way must travel through a narrow and height-restricted tunnel immediately before a sharp turn onto the entrance ramp with limited sight distance.

## Proposed Project and Benefit

This project extends the two entrance ramps from Columbia Shores Boulevard and Marine Park Way to 1000 feet. A longer acceleration distance allows vehicles to accelerate to freeway mainline speed before merging, and works to spread out the merging movements, reducing the friction on the entrance ramps.

## Crash History




## Improvement Metrics

### Operations

Extending the acceleration lane lengths does not show an increase in freeway speeds and no significant change to overall freeway operations. In the PM peak, oversaturated segments remain oversaturated.

### Safety

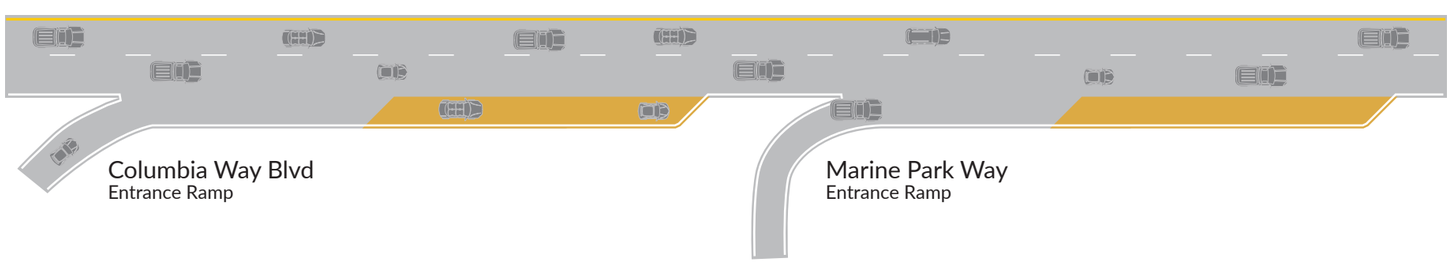
- 12% potential crash reduction in each entrance ramp acceleration area.
- Increases number of opportunities for safe lane changes
- Allows vehicles to get up to speed before merging (acceleration lanes)
- Reduces speed variability
- Marine Park Way entrance ramp access is narrow, height-restricted and has limited sight distance entering the freeway.

### Cost

**$3-$4 million**

- Limited right-of-way due to adjacent BNSF rail line.

## Project Concept Diagram



## FINDINGS

The benefits of this project are not quantifiable using the standard empirical methods (HCS analysis). However, it is reasonable to expect a reduction in the friction on the freeway due to the additional time provided for drivers to merge with the mainline.

This particular segment of freeway experiences vehicles entering the mainline via ramps with short acceleration lengths. The Marine Park Way entrance ramp has limited sight lines and an abrupt entrance to the SR 14 eastbound mainline. Upstream of the Columbia Shores Boulevard entrance ramp, high volumes of traffic are entering SR 14 eastbound from I-5. This creates a speed differential between the mainline and entrance ramp traffic. The greatest benefit on extending the acceleration lengths would be improved safety.

**Tier 4**

# EASTBOUND: Shorewood Drive Exit and Entrance Ramps

*Acceleration and Deceleration Lanes*

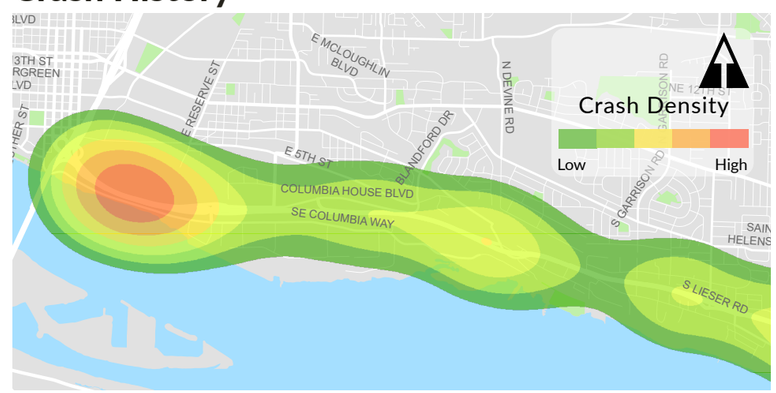
## Purpose and Need

The Shorewood Drive exit ramp culminates in a STOP-controlled intersection just a few hundred feet from the ramp diverge from the SR 14 mainline. Vehicles exiting must rapidly decelerate, which adds to the congestion and increases the likelihood of rear-end crashes. At the entrance ramp, vehicles are often unable to reach the freeway speed before merging, compounding the issue.

## Proposed Project and Benefit

This project extends the eastbound acceleration and deceleration lanes at the Shorewood Drive ramps to 1000 feet. Longer acceleration and deceleration lanes facilitate safe and gradual speed transitions to and from the mainline, minimizing any negative impacts of such maneuvers on freeway operations.

## Crash History




## Improvement Metrics

### Operations

Extending the acceleration lane lengths does not show an increase in freeway speeds and no significant change to overall freeway operations. In the PM peak period, oversaturated segments remain oversaturated.

### Safety

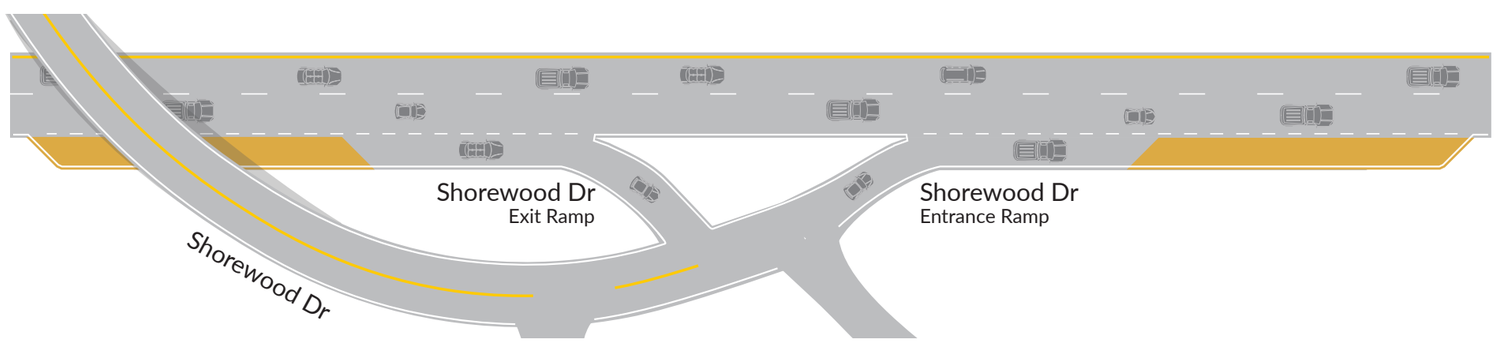
- 84.5% potential crash reduction in each deceleration area.
- 12% potential crash reduction in each acceleration area.
- Increase number of opportunities for safe lane changes.
- Allows vehicles to get up to speed before merging (acceleration lanes).
- Allows vehicles to slow down before approaching end of off-ramp (deceleration lane).
- Reduce speed variability.

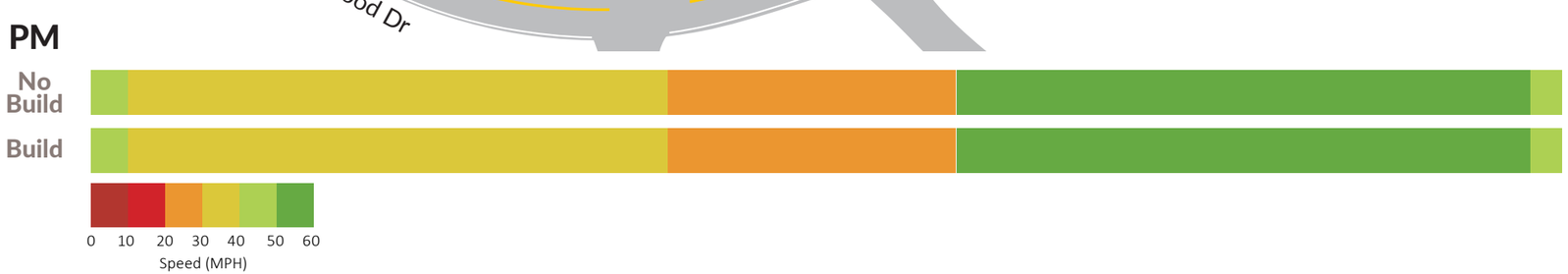
### Cost

**$4-$6 million**

- Limited right-of-way due to adjacent BNSF rail line.

## Project Concept Diagram




## FINDINGS

The benefits of this project are not quantifiable using the standard empirical methods (HCS analysis). However, it is reasonable to expect a reduction in the friction on the freeway due to the additional time provided for drivers to merge with the mainline.

This particular segment of freeway experiences vehicles exiting and entering the mainline via ramps with short deceleration and acceleration lengths. This creates a speed differential between the mainline and ramp traffic. The greatest benefit on extending the deceleration and acceleration lengths would be improved safety.

**Tier 4**

# EASTBOUND: Lieser Rd Entrance Ramp to I-205 Exit Ramp

*Auxiliary Lane*

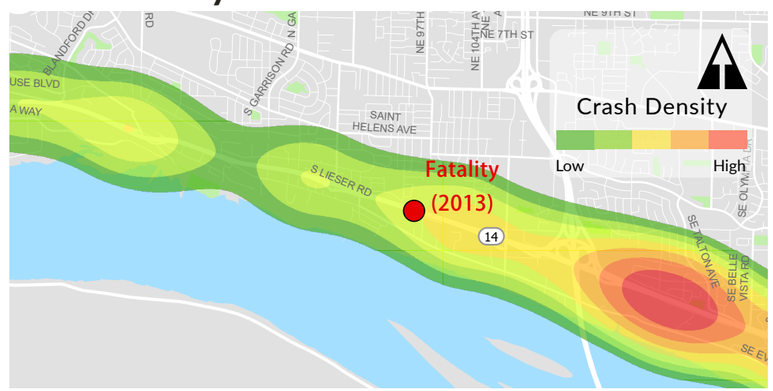
## Purpose and Need

The I-205/SR 14 junction is a major freeway-to-freeway interchange with a large portion of traffic exiting SR 14 to get on to I-205. Traffic volumes have increased in the last few years, and are projected to continue this growth in the future, resulting in congestion and queuing on SR 14 eastbound approaching I-205 in the AM and PM peak period by 2040.

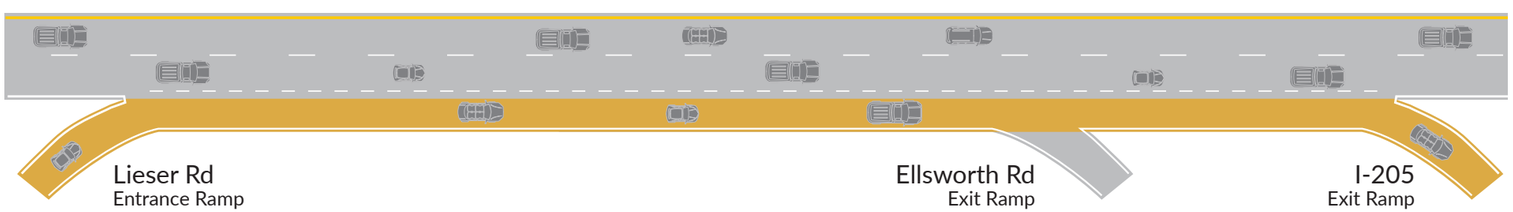
## Proposed Project and Benefit

This project adds an auxiliary lane to SR 14 eastbound between the Lieser Road entrance ramp to the I-205 exit ramp, maintaining the Ellsworth Road exit ramp in between. An additional travel lane mitigates the congestion and increases freeway throughput. The length of the proposed auxiliary lane would trigger the need for a soundwall review.

## Crash History




## Project Concept Diagram




## PM

## Improvement Metrics

### Operations

The addition of an auxiliary lane could increase travel speeds by about 10 mph in the AM peak period and about 20 mph in the PM peak period. The V/C ratio is also reduced due to the additional lane. The PM peak period is expected to benefit the most; oversaturated conditions in the "no build" at the location improve to below capacity with the addition of an auxiliary lane.

### Safety

- 20% potential crash reduction.
- Increases number of opportunities for safe lane changes
- Allows vehicles to get up to speed before merging (acceleration lanes)
- Allows vehicles to slow down before approaching end of off-ramp (deceleration lane)
- Reduces speed variability.

### Cost

**$8-$10 million**

- Cost estimate does not include soundwall.

## FINDINGS

Traffic volumes on SR 14 eastbound are expected to increase in the future with a high proportion of traffic existing at I-205. This growth will overload the freeway by 2040 creating congestion on SR 14 eastbound from the I-205 southbound exit in the PM peak period.

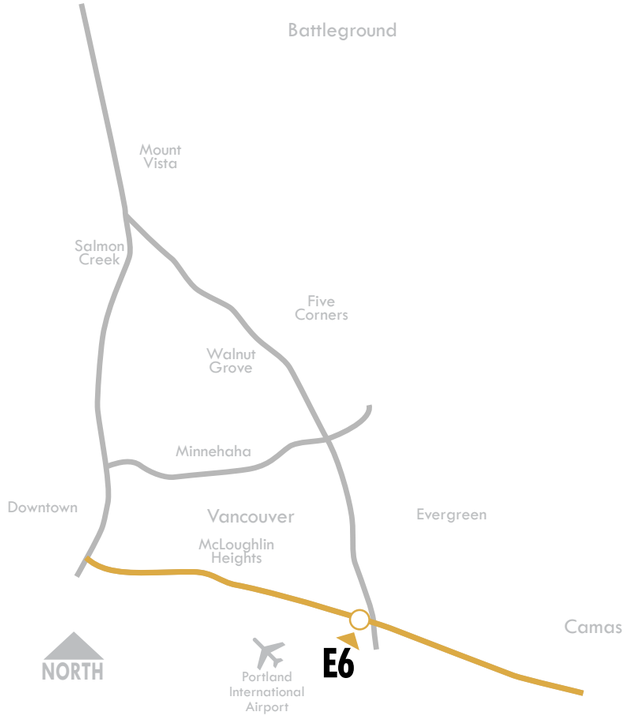
The addition of an auxiliary lane from Lieser Road to the I-205 southbound exit will provide increased capacity and better separate traffic destine to I-205 from through traffic on SR 14 resulting in increased travel speed, better reliability and less hard braking. Due to the length of the proposed auxiliary lane (approximately 3,825 feet), a soundwall review is required. This strategy addresses the operations and safety needs at this location more effectively than strategy S14 E6, but at a higher cost.

**Tier 2**

# EASTBOUND: Ellsworth Road and I-205 Exit Ramps

*Ramp Consolidation*





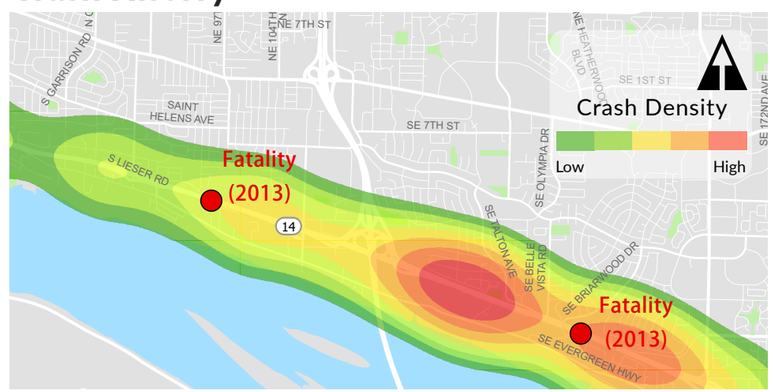

## Purpose and Need

The eastbound SR 14 junction with I-205 is a major freeway-to-freeway interchange with a large portion of traffic exiting SR 14 to get on to either I-205 northbound or southbound. Traffic volumes have increased in the last few years, and are projected to continue this growth in the future, resulting in congestion and queuing on SR 14 eastbound approaching I-205 in the AM and PM peak periods by 2040.

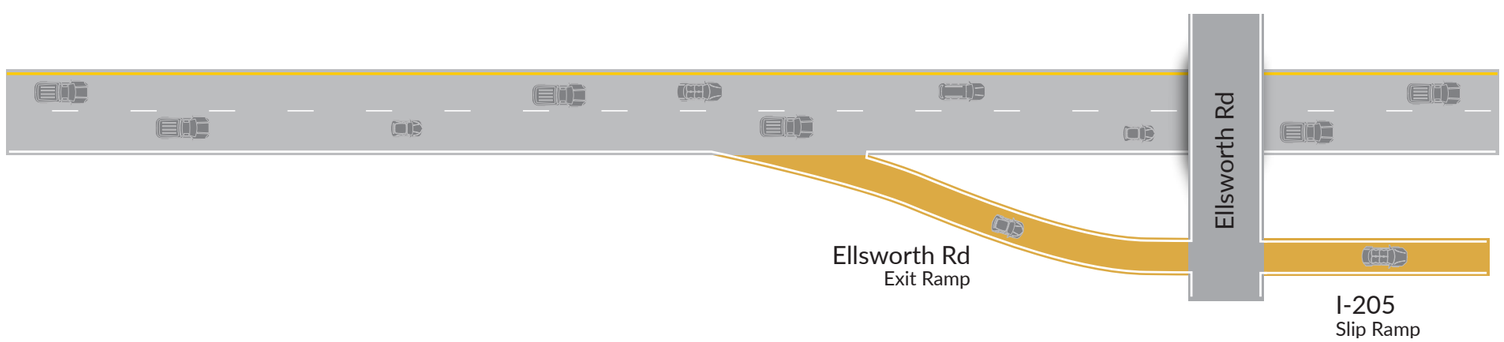
## Proposed Project and Benefit

This project consolidates the exit ramps to Ellsworth Road and I-205, altering the road geometry to have just one diverge point instead of two. This concept minimizes abrupt lane-changing maneuvers and reduces friction on the mainline.

## Crash History




## Project Concept Diagram



## Improvement Metrics

### Operations

There are relatively minor benefits observed with the ramp consolidation in the AM peak period, with the most notable benefits expected to occur in the PM peak period. In the PM peak period, travel speeds are expected to increase by about 5 mph when compared to the "no build" condition.

### Safety

Consolidating the two closely spaced exit ramps into one could reduce the number of lane changes and associated collisions, such as sideswipe.

### Cost

**$4-$5 million**

## FINDINGS

Traffic volumes on SR 14 eastbound are expected to increase in the future with a high proportion of traffic existing at I-205. This growth with overload the freeway by 2040 creating congestion and queuing on SR 14 eastbound from the I-205 southbound exit in the PM peak period.

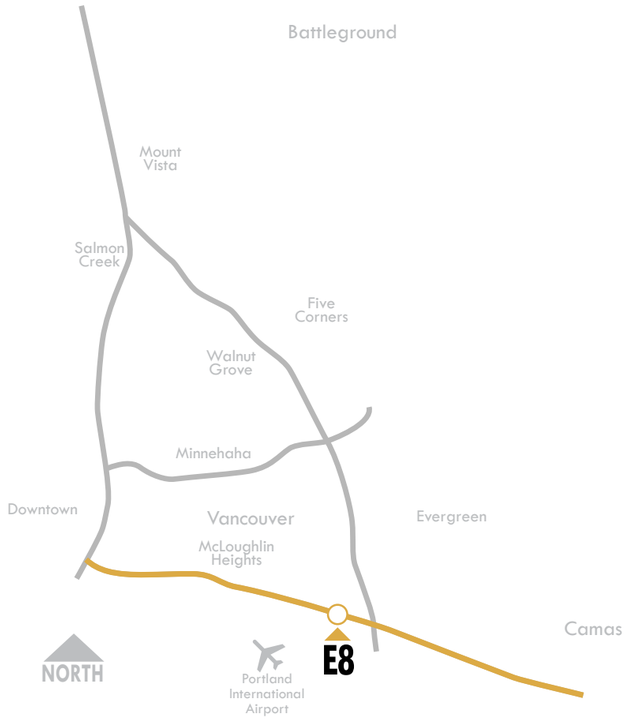
Consolidating the Ellsworth Road and I-205 southbound ramps to one exit will help reduce lane changing and weaving on SR 14 and provide additional ramp queue storage if traffic were to back up from I-205. This strategy provide a slight increase in PM peak hour travel speeds and potential safer traffic flow by reducing lane changes. SR 14 would remain congested in the year 2040 PM peak. Strategy SR 14 E4 addresses the operations and safety needs at this location more effectively than this strategy, but at a higher cost.

**Tier 4**

# EASTBOUND: I-205 Exit Ramp

*Advance Signage*





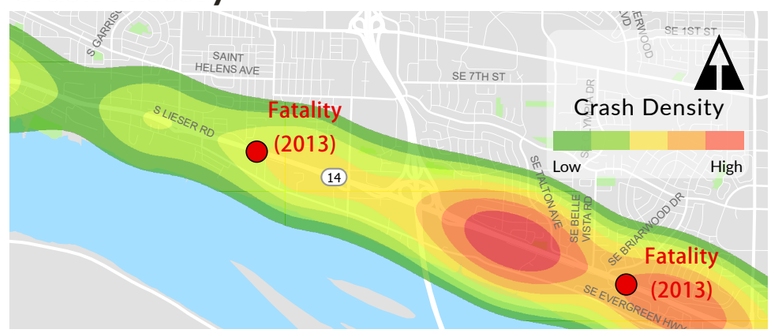

## Purpose and Need

The eastbound SR 14 junction with I-205 is a major freeway-to-freeway interchange with a large portion of traffic exiting SR 14 to get on to either I-205 northbound or southbound. Traffic volumes have increased in the last few years, and are projected to continue this growth in the future, resulting in congestion and queuing on SR 14 in the PM peak period by 2040.

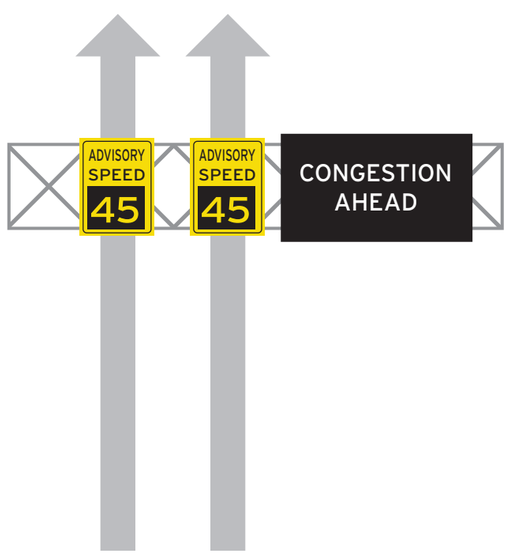
## Proposed Project and Benefit

This project installs variable speed signs (VSS) and queue warning signs on the SR 14 eastbound approaching the I-205 interchange. The signs will warn drivers about the presence of a slow-moving traffic and queuing on SR 14.

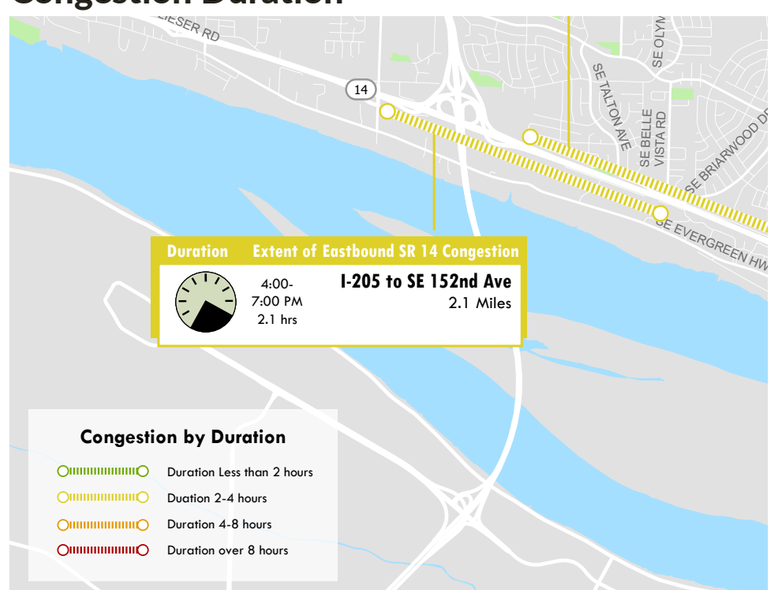
## Crash History




## Project Concept Diagram




## Congestion Duration




## Improvement Metrics

### Operations

ATM systems help reduce delay (by 3 to 15 percent) and improve travel time by promoting more uniform driver behavior, smoothing the flow of traffic and reducing traffic incidents.

### Safety

- 35% potential crash reduction.
- VAS and VMS are designed to warn drivers of unexpected queuing or slowing ahead, therefore reducing the potential for crashes that result from large speed variances between vehicles.
- Beneficial to all crash types of all severity.

### Cost

**$1-$1.5 million**

## FINDINGS

SR 14 eastbound approaching the I-205 interchange is expected to see increases in traffic demand in future years with congestion and queuing by 2040. Adding Active Traffic Management through variable speed and queue warning signage approaching this congestion point will warn drivers of downstream congestion that may not be visible. The system will promote more uniform speeds and reduce the frequency of hard braking and potential for rear-end/back of queue collisions.

This strategy could be incorporated into a larger ATM system for SR 14 and the region.

**Tier 1**

# WESTBOUND: I-5 Exit Ramps

*Advance Signage*

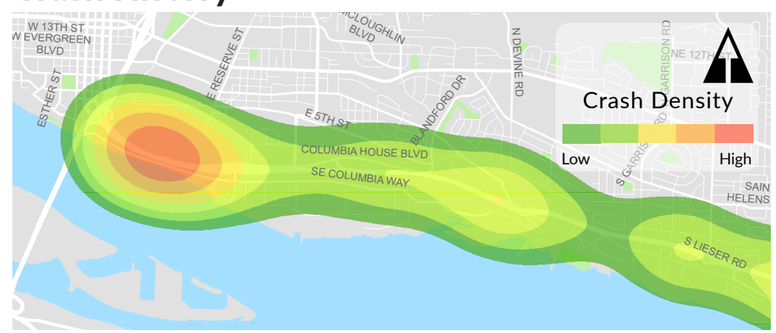
## Purpose and Need

During the AM peak hours, traffic traveling from westbound SR 14 to I-5 southbound experiences multiple hours of congestion and queuing at the loop ramp terminal. The ramp is currently metered and backs up onto SR 14, creating a sudden speed differential as vehicles approach I-5.

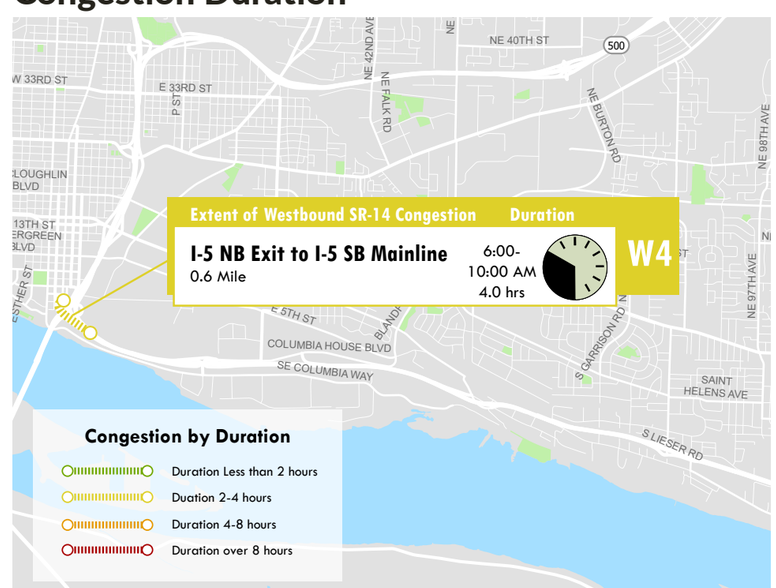
## Proposed Project and Benefit

This project installs variable speed signs (VSS) and queue warning signs on the SR 14 westbound approaching the I-5 interchange. The signs will warn drivers about the presence of a slow-moving traffic and queuing on SR 14.

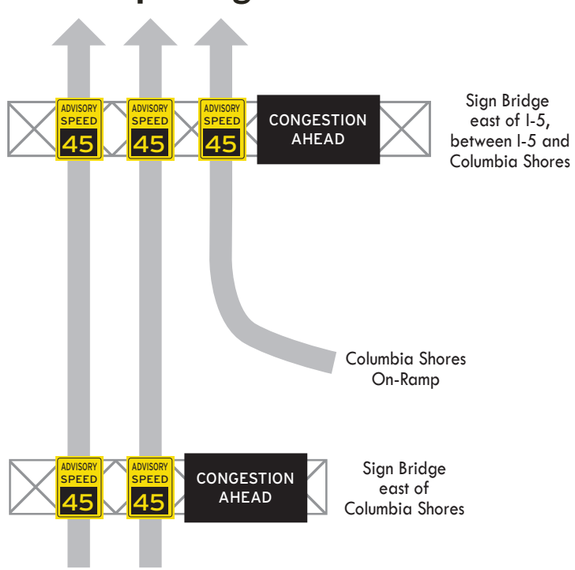
## Crash History




## Congestion Duration




## Project Concept Diagram




## Improvement Metrics

### Operations

ATM systems help reduce delay (by 3 to 15 percent) and improve travel time by promoting more uniform driver behavior, smoothing the flow of traffic and reducing traffic incidents.

### Safety

- 35% potential crash reduction.
- VAS and VMS are designed to warn drivers of unexpected queuing or slowing ahead, therefore reducing the potential for crashes that result from large speed variances between vehicles.
- Beneficial to all crash types of all severity.

### Cost

**$2-$3 million**

- Relatively low cost to implement and maintain
- Right of way may be needed

## FINDINGS

The SR 14 westbound ramp to I-5 southbound is consistently congested for over 2 hours per day in the morning and can have congestion at any time. Adding Active Traffic Management through variable speed and queue warning signage approaching this congestion point will warn drivers of downstream congestion that may not be visible. The system will promote more uniform speeds and reduce the frequency of hard braking and potential for rear-end/back of queue collisions.

This strategy is part of WSDOT's larger Active Traffic Management system for I-5.

**Tier 1**