OR 217 INTERCHANGE MANAGEMENT STUDY

OR 217 Interchange Management Study

Prepared for

Oregon Department of Transportation

And

Washington County
City of Beaverton
City of Tigard
Metro

Prepared by

DKS Associates
TRANSPORTATION SOLUTIONS

In association with

HHPR Harper Houf Peterson Righellis Inc.

CH2MHILL

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DKS Associates
TRANSPORTATION SOLUTIONS

Executive Summary

This effort is an innovative approach to transportation corridor planning that utilizes least cost planning strategies to investigate a range of potential improvements. The following sections in this chapter provide an overview of the study objectives, process, key findings, and an implementation guide.

The study was conducted in two phases as it sought to find low cost strategies that improve reliability, mobility, and safety on OR 217, primarily between US 26 and Greenburg Road (see Figure 1 for study area).

Background and Objectives

OR 217 connects I-5 and US-26, and is approximately seven miles in length. It is the primary access for two regional centers and a town center (Washington Square Regional Center, Beaverton Regional Center, and Tigard Town Center) and carries up to 120,000 vehicles per day, yet the facility is one of the least reliable freeways in the Portland Region.[1]

Along OR 217 there are numerous safety and mobility problems, including recurring bottlenecks, high crash rates, and unreliable travel times. Factors that lead to these problems include morning and evening peak period demand that exceeds capacity, lack of shoulders, and short weaving areas that create erratic changes to traffic speeds due to interchange spacing. Several interchanges are less than ¼-mile apart, which does not allow adequate space for the weaving that occurs between entering and exiting vehicles. There are approximately 200 crashes a year along OR 217, which equates to a crash occurring four out of every five weekdays.

A previous study addressed these mobility and safety problems with costly capital projects such as widening to six lanes, braiding ramps, and adding collector-distributor roadways.[2] These high-cost improvements total nearly $1 billion for the

[1] As documented by Portland State University using 2008 PORTAL data collected for all Portland area freeways (I-5, I-84, US 26, I-405, I-205, and OR 217). During the p.m. peak the southbound direction is the second least reliable facility, and in the a.m. the southbound and northbound directions are the second and third least reliable, respectively.

[2] Highway 217 Corridor Study, Metro, 2005.

corridor, and are generally over $100 million at key interchanges. Given existing and forecasted funding levels, these projects are not likely to be funded in the foreseeable future. The objective of this study was to identify and evaluate the types of lower cost, fundable projects that could feasibly be constructed for OR 217 today to increase reliability, mobility, and safety.

This approach is consistent with ODOT's goal to improve transportation operations by first addressing management techniques prior to building additional capacity to a highway.

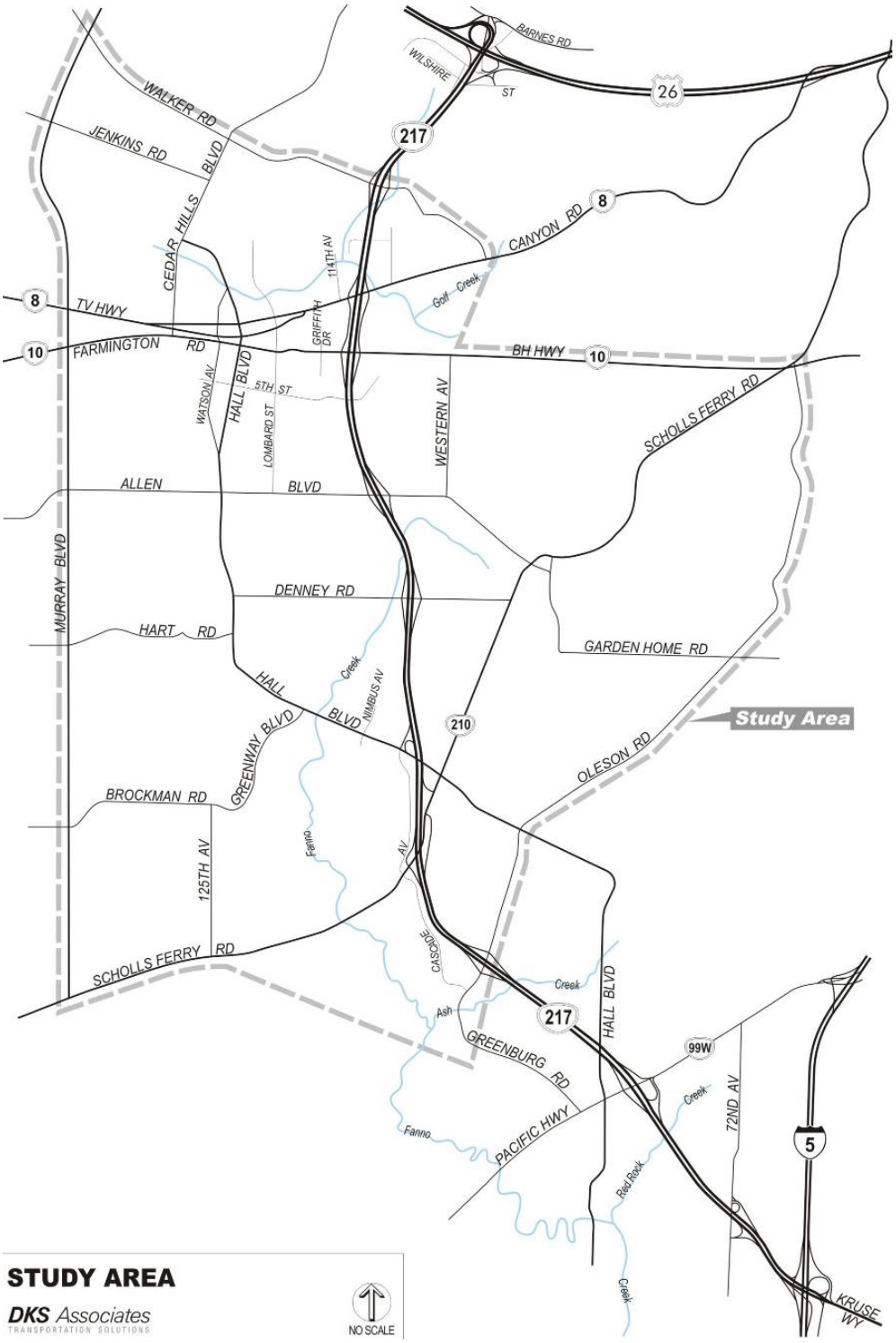


Figure 1: Study Area

Process

This evaluation of OR 217 takes a new approach to find projects that benefit the highway and can be implemented now.

The OR 217 Interchange Management Study was divided into two phases: Phase I being the concept exploration component, and Phase II being the refined feasibility study.

Phase I

Phase I began with a full day workshop attended by representatives from public agencies (ODOT, Washington County, City of Tigard, City of Beaverton, and Metro), as well as several technical experts in freeway design, freeway operations, and water resources. A background information packet was developed prior to the workshop, incorporating data and analysis describing the study area from readily available sources and past studies. The packet (which can be viewed in Appendix A) included information such as:

- General roadway characteristics
- Traffic volumes
- Traffic operations
- Speed-flow charts
- Crash data
- Interchange characteristics

Using the background information, the workshop served as a brainstorming session to create a list of possible projects that may address reliability and safety issues along OR 217. Approximately forty projects were developed as a result of the workshop, which were assigned into one of four categories:

- System Management Projects
- Ramp Management Projects with Associated Street Improvements
- Surface Street Improvement Projects
- Highway Interchange Modernization Projects

For each of the projects developed at the workshop, an initial analysis was completed which involved a planning-level cost estimate and an investigation of the potential benefits each project could create. The analysis was then reviewed with the Technical Advisory Committee (TAC), with the results presented to elected officials representing the area served by OR 217. Working with the elected officials helped determine whether any of the strategies offered enough potential benefit to justify moving forward for additional refinement, while still meeting the low cost objectives.

Based on the initial analysis, elected officials determined that select strategies from the systems management projects and the ramp management projects with associated street improvements best fulfilled the study criteria (low cost with reliability and safety benefits). A select group of projects were termed “Best in Class” and forwarded for further technical analysis.

The general findings for each project type are summarized below.

Photograph of p.m. peak traffic conditions near Greenburg Road on OR 217.

System Management Projects

Systems management projects work to optimize existing infrastructure. Projects such as targeted shoulder widening, traveler information, and variable speed systems, were explored. These options were typically some of the lowest cost projects, with potential to improve safety and reliability on OR 217.

Ramp Management Projects with Associated Street Improvements

These projects target improving operations on OR 217 by reducing conflict areas through the closure of ramps or interchanges with complementary off-highway street improvements. A variety of ramp closure combinations were investigated for these projects. As more ramps are closed, benefits to OR 217 increase, but so do the negative impacts of increased diverted traffic onto nearby surface streets and reduced access. The key to these projects was to identify options that balanced the benefit to OR 217 with the impact to adjacent surface streets.

Photograph of the northbound on-ramp at Allen Boulevard.

Select ramp management projects did show potential to improve safety, reliability, and mobility within low cost definitions.

Surface Street Improvement Projects

The surface street improvement projects focus on increased capacity on surface streets to improve conditions on OR 217. While each of these projects reduced delay on the surface streets, the benefit to OR 217 was typically localized and minimal. The cost estimates for these projects ranged from about $20 million to over $100 million.

Many of these projects can achieve significant benefits to surface streets, and meet the objectives of mobility and safety as part of local Transportation System Plans (TSPs). However, since the objective of this study is to address problems on OR 217, and not surface streets, these projects failed to meet the study goal of providing significant benefits on OR 217 at an affordable cost.

Highway Interchange Modernization Projects

The highway interchange modernization projects did not meet the low cost criteria of this study.

Phase II

Phase II focused on a refined assessment of the Best in Class strategies. Those strategies consisted of three projects from the systems management category and four from the ramp management projects with associated street improvements category (as shown in Table 1).

Table 1: OR 217 Interchange Management Study "Best in Class" Projects

Systems Management Projects	Ramp Management Projects with Associated Street Improvements
• Targeted Shoulder Widening • Traveler Information • Variable Speed System	• Wilshire full interchange closure • Denney full interchange closure • Wilshire + Walker full interchange closures • Wilshire + Walker + Denney full interchange closures

The refined analysis included a higher degree of cost estimate certainty, as well as surface street traffic analysis for each of the ramp closure options. The goal of the traffic analysis was to ensure appropriate surface street improvements were considered with each ramp closure strategy. In some cases these associated street improvements are placeholders for more refined projects to be developed later. The refinements to street improvements will emerge if a ramp management project advances. For the systems management strategies, additional system needs and requirements were further explored to serve as a preliminary concept of operations.

A public involvement component was also outlined as part of Phase II. The public involvement effort will focus on informing and educating the public about the nature of traffic problems on OR 217, current funding context, and near term project opportunities.

Next Steps

To successfully implement any of these projects, local buy-in is critical. Therefore, the elected officials' support will help determine whether to forward any of these projects to the next steps. For most of the systems management projects the next steps consist of detailing the operation concepts and beginning design. For the ramp management projects with associated street improvements, a public discussion and further analysis will be required before moving to the design phase.

Key Findings

All of the projects that progressed to Phase II in this study (meeting the project criteria of lower cost while improving reliability and safety) are consistent with ODOT's goal of first implementing operational projects to maximize the efficiency of a facility, before building additional capacity. These strategies offer high benefits on comparatively low cost projects that optimize the performance of existing infrastructure. These strategies each offer reliability and safety benefits to OR 217, and in general, individual projects could be implemented for less than $10 million. The degree of benefit varies based on the strategy.

The building blocks for preliminary project benefit assessment were obtained from ODOT. Table 2 shows the assumed costs for incidents and delay time commonly used that were applied to the estimates of delay and crash reductions associated with each project. The delay costs were increased slightly from the original ODOT "Value of Travel-Time" document to reflect gas price and general inflation increases. Savings achievable from reducing crashes and delay are a direct benefit the public. These savings do not go to ODOT.

Table 2: Cost of Crashes and Delay

Crash Type or Vehicle Delay	Cost of Single Crash	Cost of Delay per Hour
Property Damage Only	$15,000	--
Minor Injury	$47,900	--
Severe Injury or Fatality	$840,000	--
Passenger vehicle delay	--	$20
Commercial vehicle delay	--	$31

Source: The Value of Travel-Time: Estimates of the Hourly Value of Time for Vehicles in Oregon 2007. ODOT Long Range Planning Unit, June 2008.

Targeted Shoulder Widening

Narrow shoulders hinder the performance of a freeway. They slow emergency responders from getting to incident scenes, provide no space for stopped vehicles to avoid blocking traffic, and allow no space for errant vehicles to avoid secondary rear end collisions. With a Tualatin Valley Fire and Rescue station in the Washington Square Regional Center, less than ¼ mile from OR 217, the value of the close proximity of the station to OR 217 is lost when responders access the freeway and are forced into incident caused congestion with no alternate path (such as a shoulder). Every minute lost responding to an incident is costly, jeopardizing the health of those people involved in the accident as well as exacerbating congestion. A Portland State University study determined that if all Portland area delay causing incidents increased by one minute, the extra cost to the public would be approximately $1.4 million due to additional delay.[3] In several locations along OR 217 the outside shoulder is less than a lane wide (sometimes as narrow as three to four feet wide). When an incident occurs in one of these sections, the through capacity on the freeway is significantly reduced. In a two lane section, a one lane blockage actually results in a 65 percent reduction to capacity, not 50 percent.[4] This may seem counterintuitive, but the additional lost capacity is due to vehicles slowing down in the adjacent lane as they approach and pass the incident (gawking effect). Figure 2 shows that having an adequate shoulder can restore lost capacity during an incident by 35 to 45 percent.

An innovative aspect of the targeted shoulder widening strategy involves using a porous surface for the added shoulder area (see Figure 3). Porous asphalt has been used for neighborhood streets and porous aggregate has been used on coastal highway shoulders. However, porous surfaces have not yet been applied to an urban freeway shoulder in Oregon. A permeable surface reduces the water quality impacts by not adding additional water run-off to the system. While the shoulder would not be designed to operate as a regular travel lane, emergency vehicles and passenger vehicles could safely travel on it during incidents. An annual maintenance vacuuming would be required to prevent the porous layers from becoming blocked with small sediment.

[3] Bertini, Robert L. Michael Rose. Ahmed M El-Geneidy. Using Archived Data to Measure Operational Benefits of ITS Investments: Region 1 Incident Response Program. Portland State University. Sponsored by Oregon Department of Transportation, Transportation Northwest, US DOT, and FHWA. June 2004.

[4] Transportation Research Board. Highway Capacity Manual, 2000.

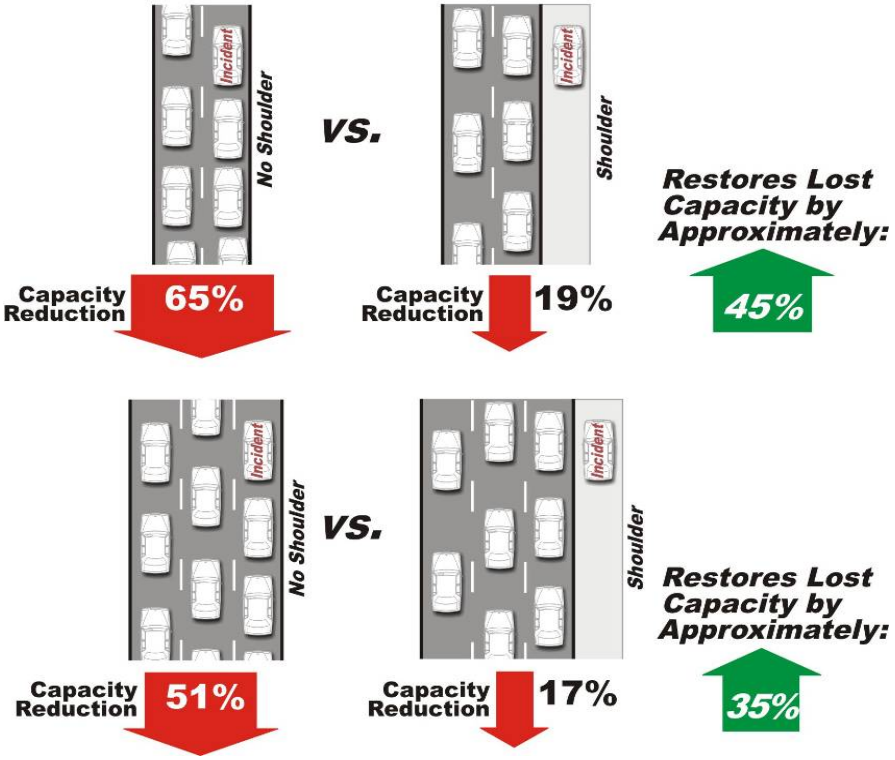


Figure 3: Illustration of lost capacity due to an incident

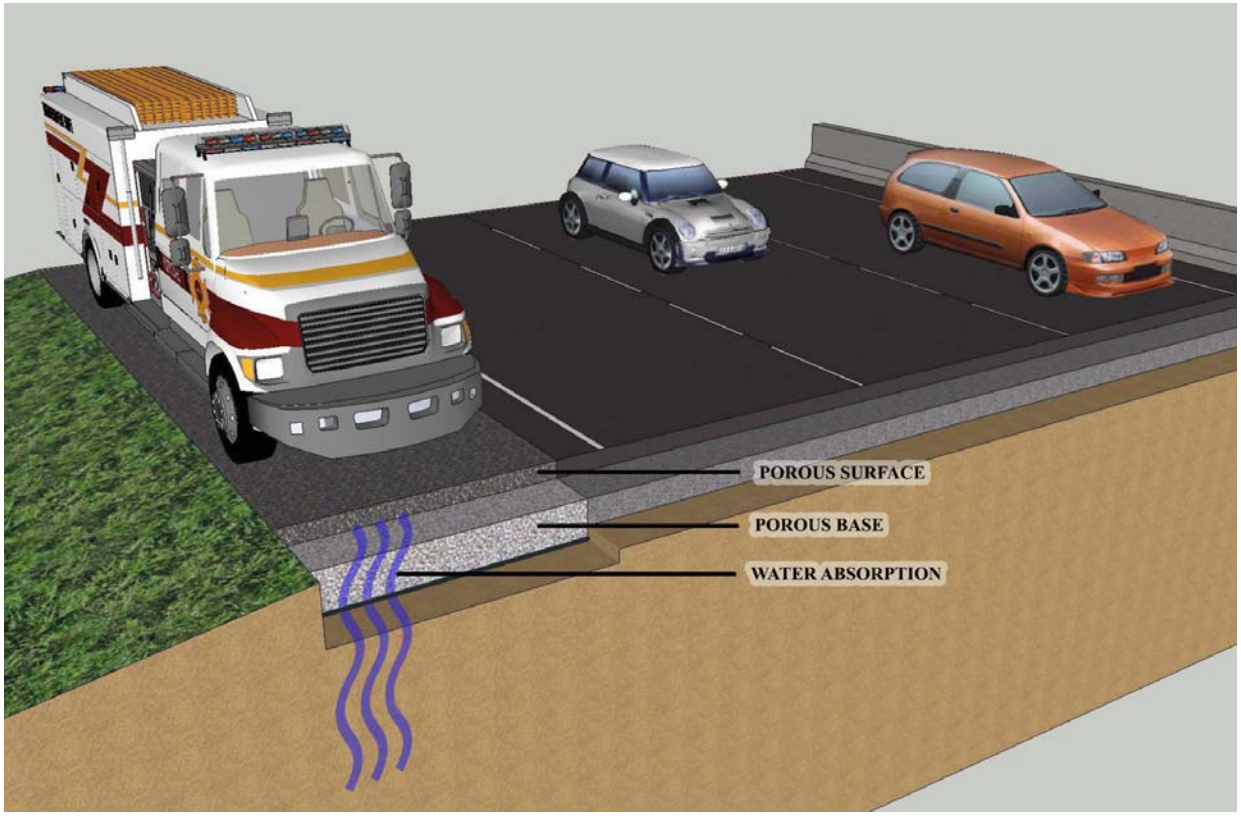


Figure 2: Targeted shoulder widening with a porous surface

Financial benefits are associated with both reduced delay costs and reduced crash costs. Six locations are being proposed for targeted shoulder widening (see **Error! Reference source not found.**). In each travel direction, there is approximate one incident every other week within the six areas being considered for the targeted shoulder widening. Peak period OR 217 travel times are already unreliable and incidents only exacerbate this condition. Providing shoulders in these areas will improve reliability of the freeway. Based on a conservative estimate of restoring 30 percent of lost capacity and reducing five percent of crashes in the targeted shoulder widening areas during an incident, each segment of

shoulder widening (on average) could save motorists up to $1 million in

Photograph of an area on OR 217 with little or no shoulder (left side of the photo with the arrow).

reduced delay and accident damages over a five-year period. Providing shoulder widening at all six locations could achieve savings to the public of nearly $6 million over the course of five years.
Additional benefit may be achieved once there is a continuous shoulder in place along OR 217. If the shoulder is continuous along OR 217, emergency vehicles would have a further reach of alternative access, improving incident response times and travel time reliability.

Traveler Information

The traveler information strategy would provide travel time information for OR 217 at key decision points (on arterials and the freeway), allowing drivers make the choice to either use OR 217 or an alternate route. Informing drivers of congested conditions before they decide to enter the freeway can improve the reliability of travel on OR 217, and can decrease primary and secondary incidents by reducing congestion.[5] Figure 4 shows examples of travel time information signs.

The greatest benefits of traveler information signs would be accrued during peak congestion periods. Previous studies show freeway daily traffic can decrease by 20 percent, and freeway delay time could improve by 50 percent during heavily congested periods.[6] Other studies show that up to 85 percent of travelers will change routes when en route delay information is available.[7] Benefits as sizeable as these are unlikely for OR 217 given the limitations of the surrounding network. However, even if delay is reduced by 20 percent during the p.m. peak period due to some drivers choosing alternate routes, modes, or trip times, five year savings of $8.1 million in cost of delay could be achieved.

[5] Active Traffic Management: The Next Step in Congestion Management. FHWA in cooperation with AASHTO and NCHRP. July 2007.
[6] Automated Work Zone Information System (AWIS) on Urban Freeway Rehabilitation: California Implementation. Lee, Eul-Bum, and Changmo Kim. TRB Publication. January 2006.
[7] Travel Time Messaging on Dynamic Message Signs – Houston, TX. Texas DOT and US DOT. May 2005.

Figure 4: Examples of signs showing travel time information. The top sign is an example of how information could be displayed on arterials, such as Canyon Road (pictured).

Variable Speed System

A variable speed system proactively manages vehicle speeds based on real time traffic information. The primary benefit of a variable speed system is to reduce rear end collisions, which account for 70 percent of all collisions on OR 217 (which is about two to three rear end collisions per week).[8] In regions where variable speed systems have been implemented, rear end collisions have decreased by 30 percent, overall crash rates decreased by 20 percent, and secondary crashes went down by 40 percent.[9] Reducing rear-end collisions improves reliability, safety, and mobility. For OR 217 that means two less crashes and associated travel delays per week.

Variable speed limits can also directly improve performance and reliability. The use of variable speed control can achieve improved throughput on a freeway during recurring congestion by lowering the speed limit. The optimal freeway capacity during congested operations is not achieved at 65, 60, or even 55 miles per hour. It is achieved at 40 to 45 miles per hour (as noted in Figure 5). While this may seem counter intuitive, the optimal volume of traffic served by a congested freeway is typically achieved at speeds lower than free flow. The key to improving throughput is to avoid unstable conditions that can occur at higher speeds as flow rates approach 2,000 vehicles per hour per lane.

[8] ODOT crash data for 2004-2008. Analyzed by DKS Associates.

[9] Innovative Traffic Control Technology and Practice in Europe. Tignor, Samuel, et al. Office of International Programs, US DOT. August 1999. Website: http://www.benefitcost.its.dot.gov/its/benecost.nsf

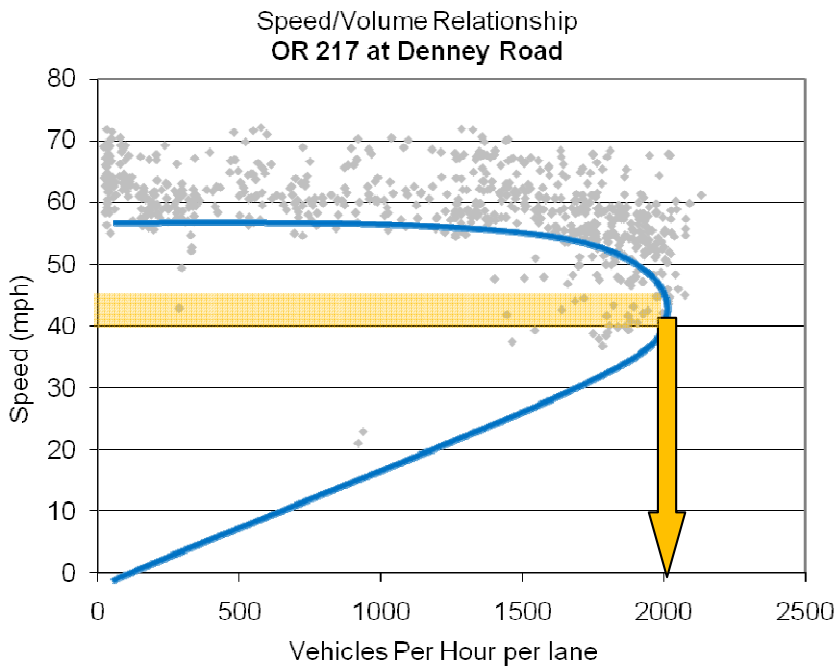


Figure 6: Flow rate on OR 217 by Denney Road

Breakdown conditions can be reduced by slowing traffic prior to the point of congestion to harmonize speeds in the congested environment. Recent studies[10] on this topic have concluded that higher levels of throughput can be obtained using variable speed control.

Figure 6 shows the relationship between optimal flow rates (the "performance" curve) and safe flow rates (the "safety" curve). The performance curve assumes that vehicles are traveling at the given speed limit. However, the distance between vehicles necessary to maintain a given flow rate may be too short to stop in time if the vehicle in front suddenly stops, slows, or swerves. The safety curve shows that flow decreases with speed if vehicles maintain safe spacing (to avoid rear end collisions). The performance curve shows that flow increases with speed up to about 40 to 50 miles per hour and then falls off with higher speeds in congested environments. At that point, breakdown can occur and flow can become erratic (stop-and-go driving conditions). The crossing point of the two curves is around 40 mph, which maximizes flow rates without compromising safety. These speeds and flow rates can be obtained using variable speed limits.

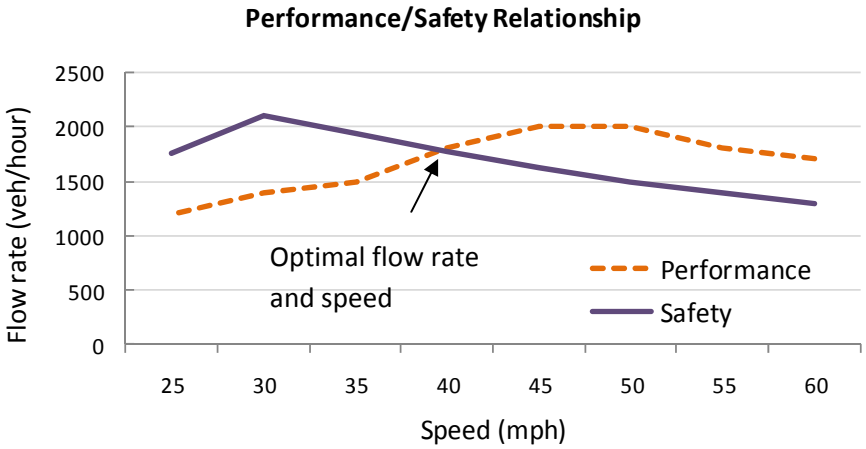


Figure 5: Balancing safety and optimal flow rates

[10] *Assessment of Variable Speed Limit Implementation Issues*, Northwestern University Transportation Center. 2005.

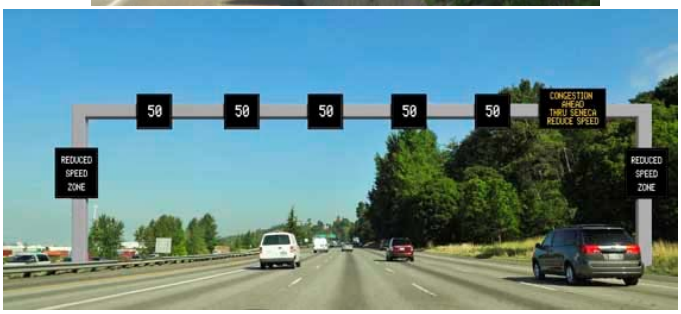


Figure 7: Post mounted system (above) and gantry mounted system (below)

A variable speed system is an innovative technique that is relatively new to the United States, but widely used in European countries with success. Recently, a variable speed system was implemented on three freeways in the Seattle area (I-5, I-90, and SR-520). Figure 7 shows two concepts for implementation (post mounted and gantry mounted variable speed signs). A post mounted system would cost roughly $10 to $15 million and offers greater flexibility in phasing options; depending on available funding, one direction of the variable speed system could be implemented before the other direction, further lowering the initial cost.

Conservative estimates of a 20 percent reduction in rear-end crashes and a 5 percent reduction in delay on OR 217 was used to estimate benefits (about one less crash on OR 217 every two weeks). Over a five-year period, savings of crashes and delay to the public would be approximately $6.6 million.[11]

Ramp Management Projects with Associated Street Improvements

These strategies offer significant potential to improve freeway operational performance in the near term. One of the main problems on OR 217 is the short spacing between interchanges. Interchanges are spaced approximately six-tenths of a mile apart, which creates even shorter weaving segments that range from about a tenth of a mile to one-half of a mile in length. The close spacing is due to the historical development of OR 217 and its access during times when traffic volumes were a fraction of what they are today. Standard urban freeway construction, if it were built today, would place interchanges three miles apart with overcrossings (no ramps) between every interchange.[12]

This short spacing creates bottlenecks and high crash locations as drivers change lanes from entrance ramps to the mainline, weaving with drivers moving from the mainline to exit lanes (Figure 8 illustrates a weaving area). In these locations vehicles come virtually to a halt. Each of the ramp management strategies considered eliminates at least one weaving location.

[11] Cost savings were estimated based on ODOT costs shown in
as well as delay costs due to incidents.

[12] Oregon Highway Plan Including Amendments November 1999 through January 2006. Oregon Department of Transportation. Appendix C.

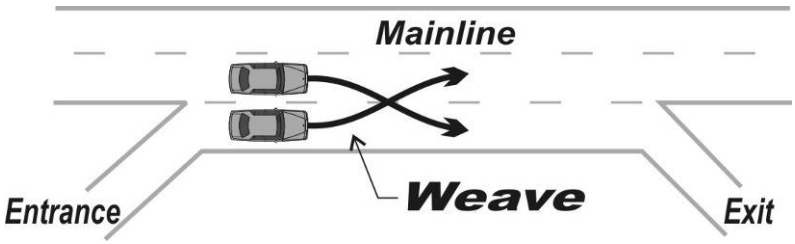


Figure 8: Schematic of a weaving area

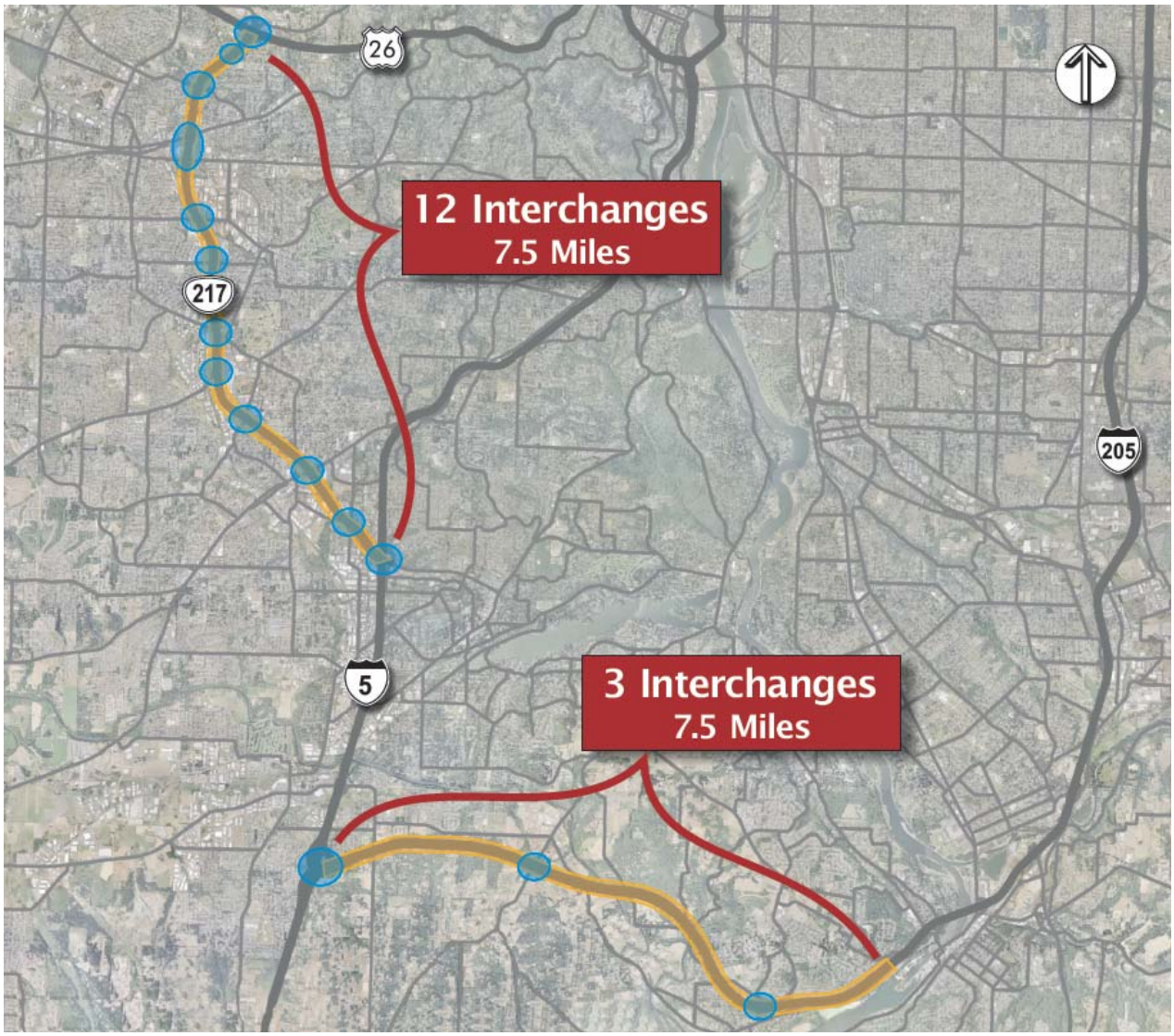
Closing ramps offers both performance and safety benefits, which improve flow rates for the highway. Comparing OR 217 to the southern portion of I-205 (from I-5 to West Linn), which has more space between interchanges, I-205 can accommodate 10 to 15 percent more traffic than OR 217. Figure 9 shows a map that compares the interchange spacing on these two facilities. Figure 10 shows the flow rate comparison between OR 217 in an area with 0.15 miles between interchanges, and I-205 in an area with 2 miles between interchanges.

Photograph of southbound p.m. peak congestion near Canyon Road.

ODOT's number one concern for freeway traffic is safety. Adequate spacing between interchanges has proven to increase safety benefits. The Federal Highway Administration (FHWA) conducted studies regarding the relationship between interchange spacing and safety.[13] FHWA investigated several locations where new interchanges were inserted between existing interchanges, thereby decreasing the spacing by about half the original distance. In all cases, fatal and injury crashes increased when interchange spacing decreased. The level of increase depended on the traffic volume and before and after interchange spacing.

Photograph of a short weaving segment on OR 217

[13] FHWA-HRT-07-031 Safety Assessment of Interchange Spacing on Urban Freeways. Joe Bared and Wei Zhang.



Note: I-205 was recently expanded to three lanes in each direction between I-5 and Stafford Road. However, the comparison data used in this study was based on data collected while I-205 was two lanes in each direction.

Figure 9: Map comparing interchange spacing on OR 217 to I-205

Figure 11 shows the potential impacts of short interchange spacing. Based on an FHWA study, after a new interchange was inserted on a facility (and interchange spacing reduced by half the original distance), fatal and injury crashes increased by about 1.5 times the original amount. Working in reverse, this means that removing an interchange can decrease fatal and injury crashes by about 30 percent. When safety data for OR 217 is compared to I-205, a crash rate reduction of 25 percent could be achieved by providing better interchange spacing on OR 217 (this comparison was based on closing three interchanges north of Hall Boulevard).

Removing interchanges is an innovative approach to improving the highway's safety and performance. If interchanges are removed, it will be extremely important for drivers to sense that the highway's safety

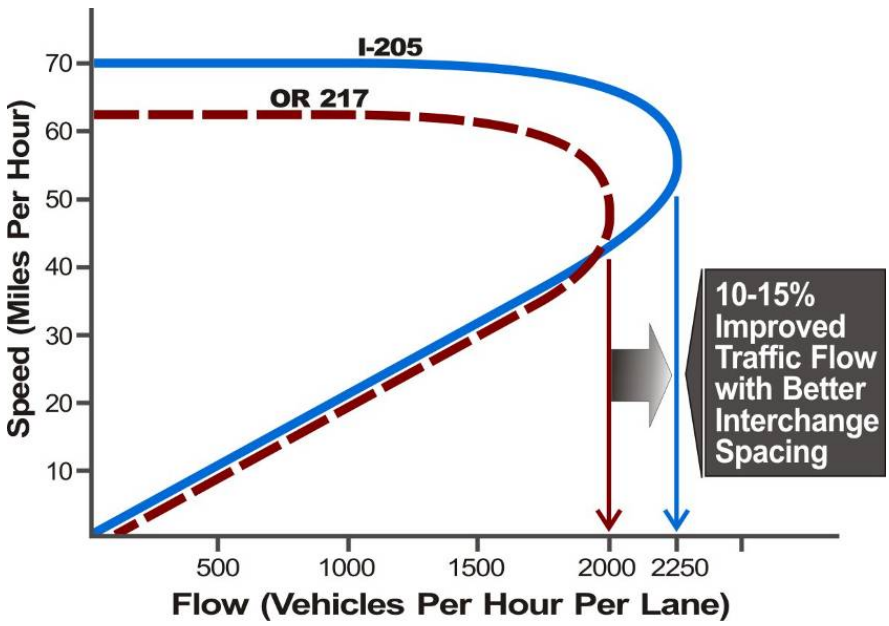


Figure 10: Comparison of flow rates between two similar Portland freeways, with different interchange spacing

and performance improved. In addition to improvements to the highway, complementary street improvements accompany each of the ramp closure options as appropriate to create a balanced transportation system.

To arrive at a reasonable set of alternatives, all interchanges were investigated on OR 217 in combinations of all-day closures for single ramps, multiple ramps, single interchanges, and multiple interchange closures. Detailed findings for all ramp management scenarios are included in Appendices B and C.

Four ramp management projects with associated street improvements appear to have an appropriate balance of improving OR 217, while not creating too much of an impact on the surface streets. These scenarios each offer varying degrees of benefits, depending on how many interchanges are closed. In general, each interchange closure option eliminates weaving sections, which improves safety. Traffic volumes are also reduced on segments of OR 217 (by up to 13 percent) reducing corridor delay (as well as traffic reductions on key cross streets).

In cases where one full interchange is closed, five-year benefits to the public measured by reduced delay and accident damages avoided range from $1.9 to $4.9 million. In cases where two or three interchanges are closed, five-year benefits range from $4.7 to $7.6 million.

Associated street improvements for each scenario are listed in Table 4. These concept level cost estimates were identified initially based upon agency standards. More detailed and refined costs will be developed during a

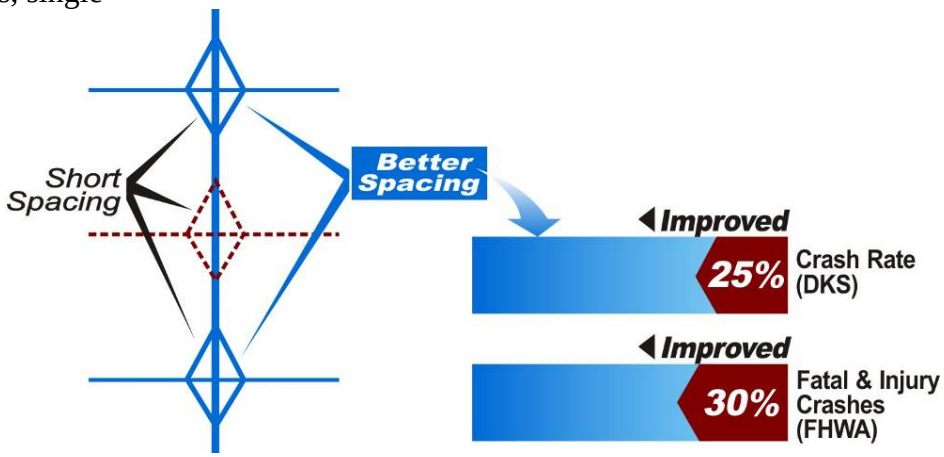


Figure 11: Safety improvements from better (shorter) interchange spacing

future project development phase.

The local street improvements that have been identified in the ramp management projects are listed in local TSPs as unfunded needs. Most of these improvements have also been identified in the Regional Transportation Plan (RTP) as needs for the local transportation system.

In addition, the ramp management scenarios have the potential to eliminate the need for expensive capital projects identified in previous studies. For example, if the Denney and or Walker interchanges are closed, future braided ramps identified in the previous corridor plan would no longer be necessary.

The following paragraphs summarize the four scenarios determined to best meet the criteria of this study.

Why Consider: Closing Denney Full Interchange

Closing the Denney interchange (shown in Figure 12) eliminates four weaving locations through key system bottlenecks and moderate to high crash locations between Allen Boulevard and Hall Boulevard. One of the worst weaving sections is eliminated with this alternative: southbound OR 217 between Allen Boulevard and Denney Road (only 200 feet long). Traffic volume reductions on OR 217 would range from about two to seven percent.

During the p.m. peak hour, some traffic would shift to individual surface streets, mostly south of Beaverton Hillsdale Highway, with an even distribution on the east and west side of OR 217 (Scholls Ferry Road, Allen Boulevard, and Hall Boulevard).

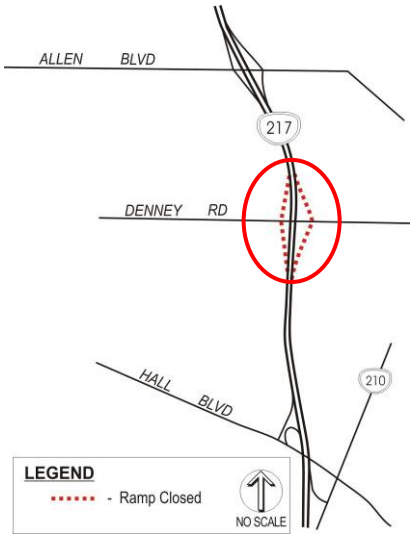


Figure 12: Denney Interchange Closure

Associated street improvements would mitigate impacts to surface streets (see Table 4). Expected five-year benefits to the public of $4.9 million could be achieved due to crash and delay reduction (that includes a reduction of 50 to 60 crashes per five year period, and a reduction of 115,000 to 125,000 hours of delay during the peak hours over a five year period).

Why Consider: Closing Wilshire Full Interchange

Closing this interchange (shown in Figure 13) eliminates two weaving locations and lessens the complexity of a major bottleneck and high crash location on OR 217 southbound between US 26 and Walker Road. Traffic volumes decrease by about one to four percent on OR 217 in the southbound direction through a major bottleneck area.

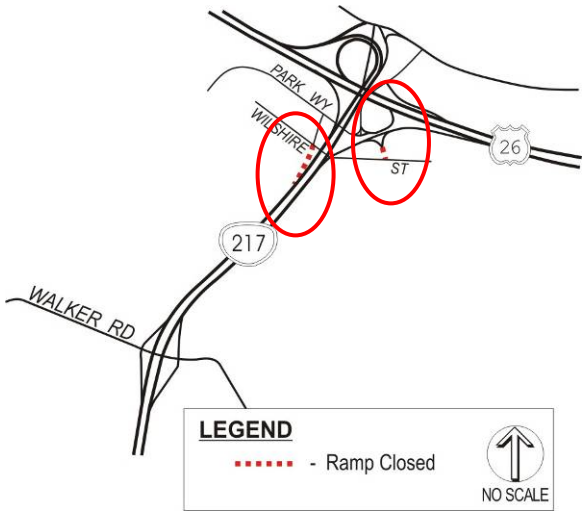


Figure 13: Wilshire Interchange Closure

There is a small shift in traffic to surface streets with this scenario. During the peak hour, streets such as Vista Drive and Scenic Drive (in neighborhoods east of OR 217) may see an additional one to two vehicles per minute. There are reductions of traffic on other neighborhood streets near the ramps.

Further evaluation of the potential neighborhood impacts resulting from traffic diversion east of OR 217 would be conducted if this alternative advances to project development. This evaluation would identify needed refinements to the transportation network in those areas. Expected five year benefits to the public of $1.9 million could be achieved due to crash reduction and delay reduction (that includes a reduction of 20 to 30 crashes per five year period, and a reduction of 40,000 to 50,000 hours of delay during the peak hours over a five year period).

Photograph of a neighborhood street near the Wilshire interchange.

Why Consider: Closing Wilshire + Walker Full Interchanges

For this alternative the decision was made to close not just the Walker interchange by itself, but the Walker and Wilshire interchanges together. That was done to reduce neighborhood cut through impacts associated with diverted Walker interchange trips using the neighborhood routes approaching the Wilshire interchange. Closing both the Wilshire and Walker full interchanges (shown in Figure 14) eliminates four weaving locations. In the southbound direction, three of the weaving locations are at key

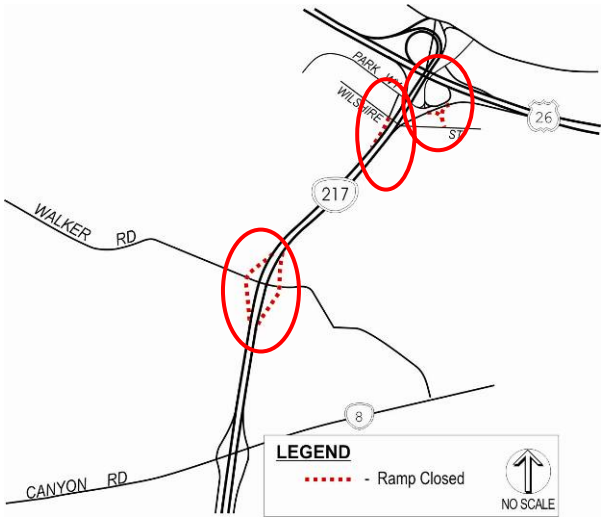


Figure 14: Wilshire and Walker Full Interchange Closures

bottleneck locations and high crash areas. Traffic volumes decrease by about three to 11 percent on OR 217, with up to a seven percent reduction of delay on OR 217.

During the p.m. peak hour, some traffic would shift to individual surfaces streets, mostly east of OR 217 along 110th Avenue, Walker Road, and Western Avenue. A series of street improvements were identified to consider along with the closures to address this traffic shift (see Table 4). A frontage road concept was one example of the improvements identified to reduce these impacts. Further evaluation of the potential neighborhood impacts resulting from traffic diversion would be conducted if this concept advances to project development, to identify needed refinements to the transportation network in those areas.

Associated surface street projects would mitigate impacts to surface streets. Expected five year benefits to the public of $4.7 million could be achieved due to crash and delay reduction (that includes a reduction of 40-50 crashes per five year period, and a reduction of 120,000 to 130,000 hours of delay during the peak hours over a five year period).

Why Consider: Closing Wilshire + Walker + Denney Full Interchanges

Combining all three interchange closure concepts was also considered. Closing three interchanges, shown in Figure 15 (Wilshire, Walker, and Denney), eliminates eight weaving locations through key bottleneck and high crash areas. Traffic volumes decrease by about four to 13 percent on OR 217 and delay improves by up to six percent. This scenario has the heaviest shift in traffic to local surrounding streets out of the four ramp management scenarios that were advanced for detailed study. A list of street improvements was identified as possible enhancements to address this shift. The resulting interchange spacing is vastly improved compared to existing conditions. This concept provides about one mile between interchange ramps from US 26 to Canyon Road and Allen Boulevard to Hall Boulevard/Scholls Ferry Road.

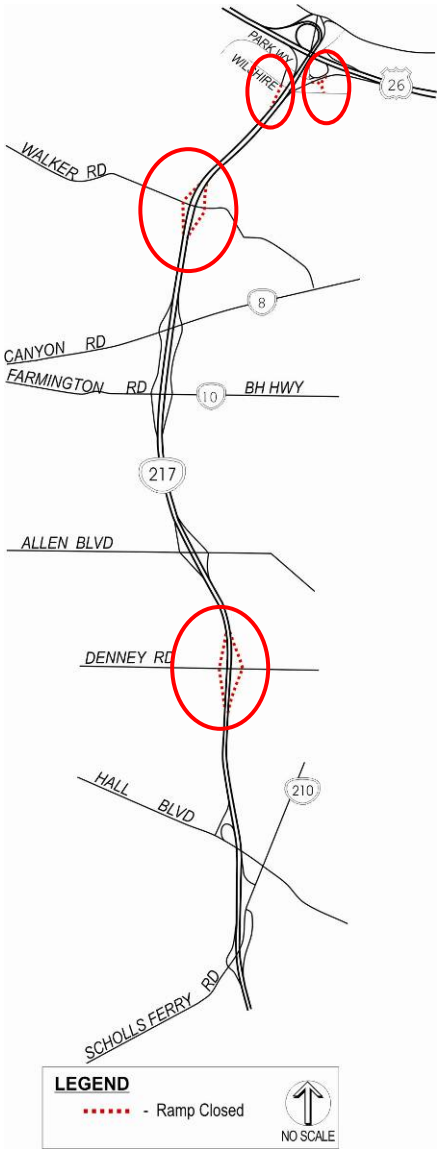


Figure 15: Wilshire, Walker and Denney Interchange Closures

During the p.m. peak, traffic would shift to individual surface streets. A series of street improvements were identified to consider along with the closures to address this traffic shift (see Table 4). If the concept advances to project development, further evaluation of the potential neighborhood impacts resulting from traffic diversion would be conducted to identify needed refinements to the transportation network in those areas (including the concept of a frontage road northbound between Canyon Road and Walker Road).

Associated street improvement projects would help mitigate impacts to surface streets. Expected five year benefits to the public of $7.6 million could be achieved due to crash and delay reduction (that includes a reduction of 100 to 110 crashes per five year period, and a reduction of 140,000 to 150,000 hours of delay during the peak hours over a five year period).

Summary of Options

This study creates a menu of projects that benefit OR 217. All projects are compatible with each other. Depending on the available funding and public's readiness for innovative components, projects can advance in a one to three year timeframe. These projects can meet the objectives of safety, performance, and reliability at a fundable cost. If selected for further study, public involvement, and design would be undertaken.

Table 3 lists the menu of systems management options. The locations of these projects are shown in Figure 16. For a complete discussion of each project (purpose, concept design, proposed locations, cost estimates, and benefits), see Chapter 4.

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The targeted shoulder widening projects focus on locations with high crash rates, locations that provide direct access for

Table 3: System management project options

Project No.	Systems Management	Cost Estimate* (millions)
TARGETED SHOULDER WIDENING		
1	Southbound from Scholls Ferry Rd to Greenburg Rd	$2.1
2	Northbound from Scholls Ferry Rd to Denney Rd	$5.0
3	Northbound from Greenburg Rd to Scholls Ferry Rd	$2.5
4	Southbound from Denney Rd to Hall Blvd	$2.4
5	Southbound from Allen Blvd to Denney Rd	$2.6
6	Southbound from Beaverton Hillsdale Hwy to Allen	$8.2
	All six locations	$22.8
TRAVELER INFORMATION		
1	US 26 westbound – 1 sign	$1.0
2	I-5 southbound – 1 sign	$1.0
3	Washington Square Regional Center – 5 signs	$2.5
4	Beaverton Regional Center – 3 signs	$1.5
	All 10 signs	$6.0
VARIABLE SPEED SYSTEM		
n/a	Post Mounted – Both sides of the roadway	$10 to $15

Source: DKS Associates and HHPR
*Cost estimate in 2010 dollars

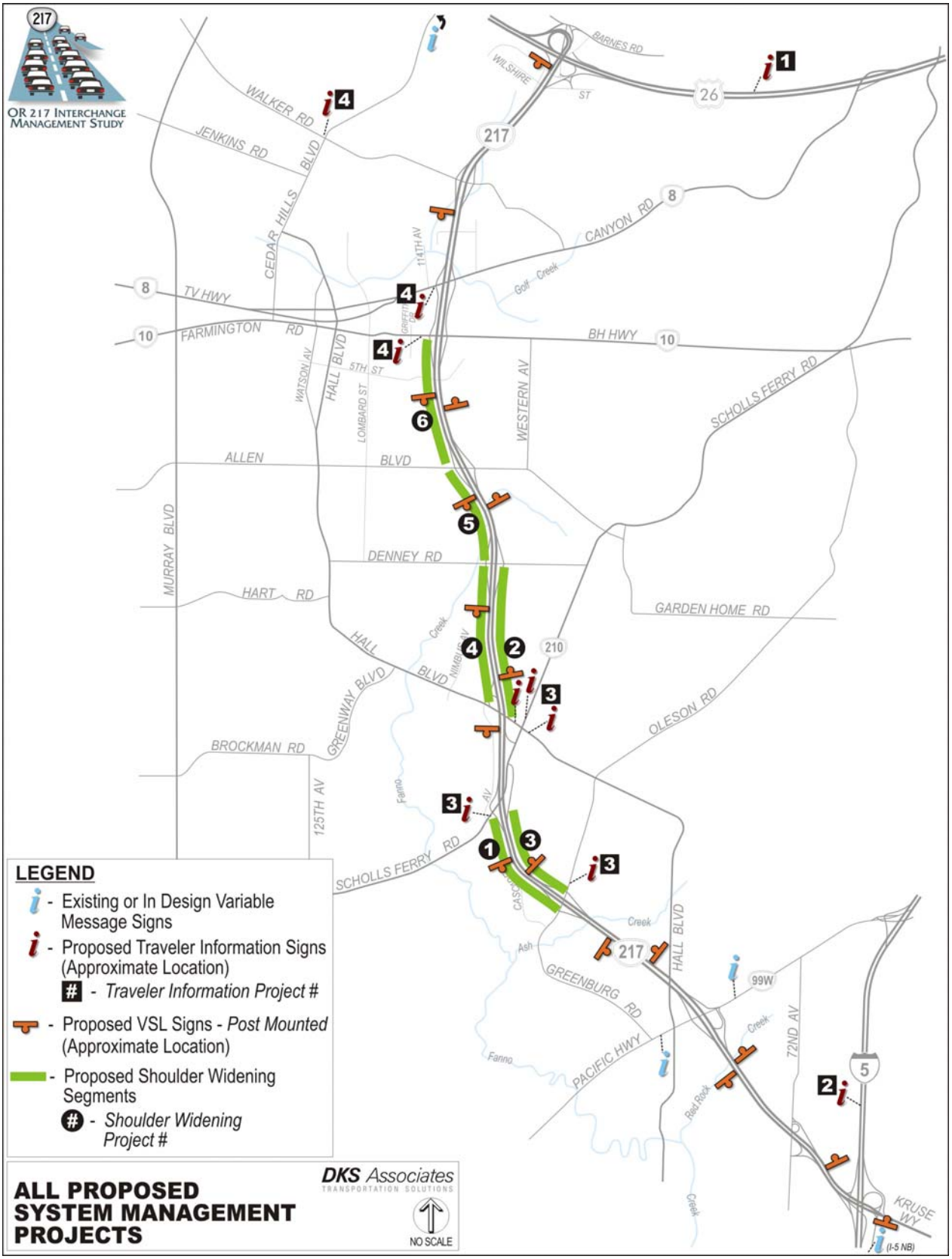

Figure 16: Map of proposed systems management projects

emergency vehicles, and locations that avoid structural and wetland issues. Projects #5 and #6 have a higher degree of risk due to wetland and floodplain issues. Each location could be implemented individually, or several of them could be grouped together.

The traveler information projects are based on origin-destination data, focusing on trip combinations and sites with the greatest number of trips. ODOT has several traveler information sign projects in design for the I-5 and 99W area. The proposed projects would create a complete system for the OR217 corridor. Similar to the targeted shoulder widening, these sign locations could be implemented individually, or grouped together depending on available funding.

Table 4 lists the ramp management projects with associated street improvements. These projects are all compatible with the systems management projects shown in Figure 16. It should be noted that the cost of a ramp closure is a small part of the overall cost of each ramp management strategy. The rest of the cost is allocated to potential street improvements. In nearly every case, the street improvements identified are already included as local needs in TSPs and the RTP that do not have funding allocated yet.

Photograph of current construction in the Walker Road area of OR 217.

Photograph of the existing ramp metering system at all on-ramps for OR 217.

Photograph of the Denney Road overpass.

Table 4: Ramp Management Projects with Associated Street Improvements

Project	Location of Associated Improvement	Part of a TSP or RTP?	Cost Estimate* (millions)
Close Denney (full interchange)	Hall/OR 217 off-ramp – Add southbound right turn lane	Yes	$2.8
	Scholls/Denney – optimize signal timing	Yes	$0.1
	Scholls/Nimbus – add 2nd southbound left turn lane	Yes	$2.3
	Add southbound auxiliary lane from Allen to Hall	No	$5.7
	Denney Interchange closure	No	$0.4
Close Wilshire (full interchange)	Wilshire Interchange closure	No	$0.4
Close Wilshire + Walker (full interchanges)	Hall/OR 217 off-ramp – Add southbound right turn lane	Yes	$2.8
	Hall/Allen – Add 2nd northbound left turn lane	Yes	$4.9
	Northbound Frontage Road: Canyon to Walker	No	$5.9
	Canyon at OR 217 – add a second dedicated northbound left turn lane	No	$1.5
	Wilshire and Walker Interchange closures	No	$0.8
Close Wilshire + Walker + Denney (full interchanges)	Hall/OR 217 off-ramp – Add southbound right turn lane	Yes	$2.8
	Scholls/Denney – optimize signal timing	Yes	$0.1
	Scholls/Nimbus – add 2nd southbound left turn lane	Yes	$2.3
	Add southbound auxiliary lane from Allen to Hall	No	$5.7
	Hall/Allen – Add 2nd northbound left turn lane	Yes	$4.9
	BH/OR 217 NB ramp – add 2nd northbound left	Yes	$2.5
	Farmington/Hall – optimize signal timing (Adaptive signal timing in-process)	Yes	$0.1
	Scholls/OR 217 NB on-ramp – Add a 2nd northbound left turn lane (two exclusive northbound left turn lanes)**	Yes	$3.9
	Northbound Frontage Road: Canyon to Walker	No	$5.9
	Canyon at OR 217 – add a second dedicated northbound left turn lane	No	$1.5
	Wilshire, Walker, and Denney Interchange closures	No	$1.2

Source: DKS Associates and HHPR
*Cost estimate in 2010 dollars
**Noted in the top 5 percent of SPIS (Safety Priority Index System) locations by ODOT.

Implementation Guide

These projects can be implemented in two to three years, assuming funding is acquired and agency partners collaborate together. In general, the systems management projects could be implemented in 15 to 24 months, with the ramp management projects implemented over a longer timeframe of at least 18 to 36 months. Figures 17 and 18 show sample implementation timelines for each of the systems management projects. The ramp management projects with associated street improvements would have similar components, but a longer timeframe to incorporate a public discussion during project development. Until the public involvement component is investigated, it is difficult to establish an accurate timeframe.

Photograph of p.m. peak traffic, looking northbound from the Walker Road overpass.

Acquire Funding

In order to begin project implementation, additional project funding must be obtained. Approximately $413,000 in MTIP funding is available, as well as an estimated $200,000 to $300,000 in unused funds remaining from the $735,000 earmark received for OR 217. Washington County has requested an additional $4 million in FFY2011 Appropriations funding for OR 217 through Representative Wu, but receipt of these funds is uncertain. The $600,000 to $700,000 in projected available funds, would be sufficient to start, or perhaps complete design work on one of the proposed projects, but is not sufficient to actually construct any improvement. Additional funding would need to be pursued through some combination of federal, state, regional, and/or local funding sources.

Photograph looking under the Cabot Road overpass for the northbound traffic shoulder. This is where the northbound frontage road between Canyon and Walker would be constructed.

Public Involvement/Outreach

To successfully implement these projects, community members and other stakeholders will need to be involved during the development and implementation of each project. Components of public outreach may include: public information through written materials and online information, stakeholder interviews, open houses or meetings, and educational programs promoting correct use and compliance.

The public involvement program would vary for each of the project types, as shown in Table 5. The next step in this study process would identify barriers or concerns that community members may have regarding the projects. This would be advanced through stakeholder interviews or meetings with existing business and community groups. The project management team can use that information to develop outreach methods to refine the selected project and build a public

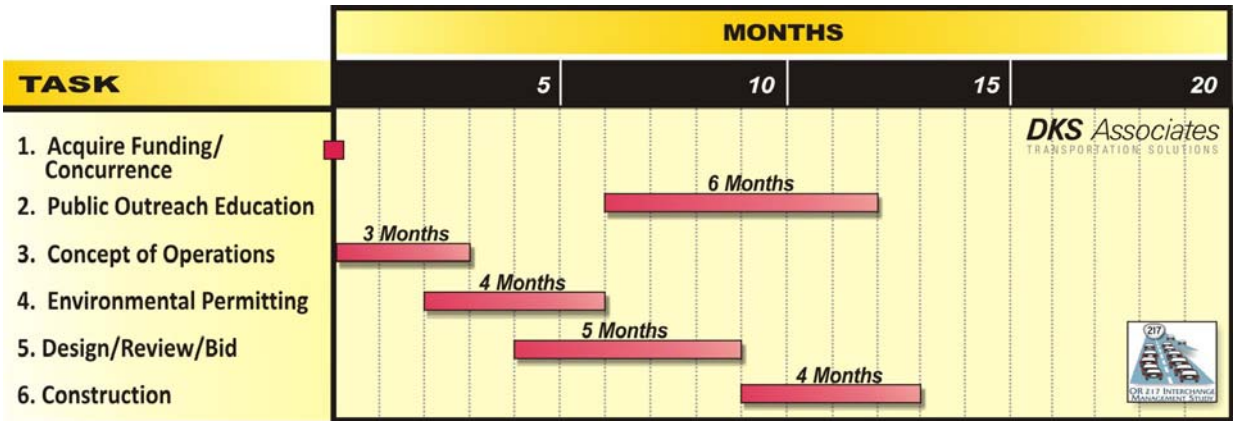

Figure 17: Implementation guide for targeted shoulder widening

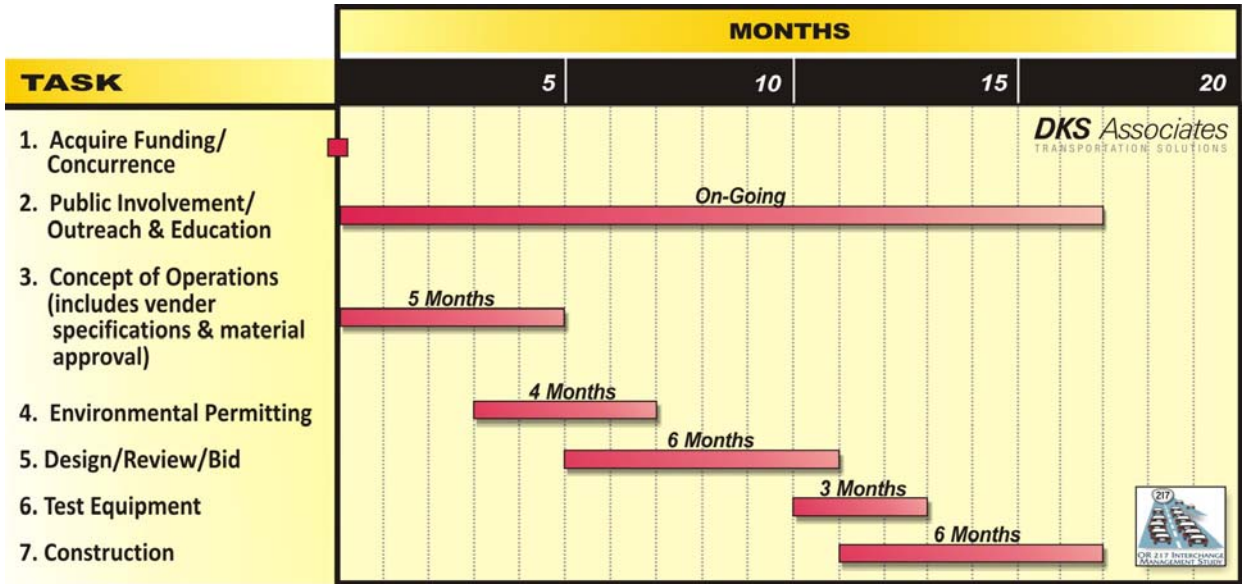

Figure 18: Implementation guide for variable speed systems and traveler information signs

Table 5: Likely Level of Public Involvement for Implementation of Near-Term Strategies

Project	Public Involvement Activities
Target Shoulder Widening	• Public information about costs and operations
Traveler Information Signs	• Public information about costs and operations
Variable Speed System	• Public information about costs and operations • Educate public before system opens
Ramp Management With Associated Street Improvements	• Extensive public involvement in prioritizing ramp closures and local street improvements • Focus on key freight users of on-ramps, large employers, chambers, and neighborhood groups

Note: Any project would be supported by a public involvement plan that is consistent with federal and state policy.

involvement strategy around the possible options. In later project phases, public outreach would be used to educate system users about the objectives of each project and how each system operates.

It is important to note that a full public conversation around ramp closures would be necessary before a ramp closure scenario option advances. This particular scenario set would require significant involvement of the community and key stakeholders in decision making around implementation to be successful. The other systems management projects could likely be implemented with a more limited public involvement and outreach effort.

Concept of Operations

The purpose of a concept of operations is to address system expectations before moving to the design phase. In addition to outlining the system expectations, the concept of operations may also include vender specifications and material approval.

A concept of operations would be required for each project before beginning the design phase. The concept of operation is a document that outlines the system expectations from each of the stakeholders. Stakeholders include users, agencies, owners, operators, maintainers, managers, and developers. Questions regarding system capabilities and system concepts, as well as operational scenarios will be addressed in this document.

Design

Each project would require a design phase. This phase includes designing plans, reviewing plans, and releasing the project for bid.

Testing

In some projects, product testing may be required when field devices are being used. The testing can either be completed by the manufacturer or the agency, but new devices would require testing before being installed.

Construction

The construction phase includes mobilization and constructing the actual project. During this phase, additional engineering may be required. For the costs provided in each option and element, it was assumed they would be constructed individually; therefore, some cost efficiency would be gained by packaging and pooling multiple options together. Furthermore, the sooner some of these elements could be put into bid, the higher the likelihood that costs (bids) could be lower due to current economic conditions. Given these conditions, improved mobility and construction jobs are positive factors in economic development.