Southwest Corridor Plan

Central Barbur
High Capacity Transit Options

Technical Modifications Memo
October 15, 2015

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Overview

This technical modifications memo presents information related to high capacity transit (HCT) alignment options in the area along Barbur Boulevard and I-5 between South Portland and the Portland/Tigard city limits. As more detailed designs have been developed for high capacity transit throughout the corridor, project staff has identified portions of the Barbur alignment where operating adjacent to I-5 could be considered. This memo is intended to inform and aid the Southwest Corridor Steering Committee in making a recommendation on which segments of the adjacent to I-5 alignment option to evaluate further. The Steering Committee recommendation is scheduled for December 2015.

Summary of findings

Based on the technical analysis included in this memo, project staff recommends continued study of both the adjacent to I-5 and Barbur Boulevard alignment options between SW 13th Avenue and Tigard. Project staff does not recommend further study of the adjacent to I-5 segment north of 13th Avenue due to its slower travel time and increased capital cost, property impacts and engineering risk relative to the equivalent Barbur Boulevard segment, as well as its potential impacts to Fulton Park.

Scope of this memo

This memo provides a summary of the technical analysis of the Barbur center-running and adjacent to I-5 alignment options, but does not attempt to address all of the factors covered in the key issues memos and evaluation reports. Instead, this technical memo focuses on station locations, capital cost, travel time and reliability, intersection performance for autos, property impacts, park impacts and engineering complexity.

A more comprehensive evaluation of the tradeoffs of the options will be undertaken in the future, including additional factors such as safety and security, station access, streetscape improvements and redevelopment potential, as well as more detailed traffic analysis. This future evaluation will include community outreach and public input from neighborhoods and businesses along Central Barbur.

Background

This section explains the context and background events leading up to this memo.

Southwest Corridor Plan process to date

The Southwest Corridor Plan is a package of transit, roadway, bicycle and pedestrian solutions that can help reduce congestion, improve circulation and enhance quality of life in this corridor. The Southwest Corridor Plan defines investments to help realize the local land use visions adopted by each community in the area. These visions include the City of Portland's *Barbur Concept Plan*, the *Tigard High Capacity Transit Land Use Plan*, *Linking Tualatin* and the *Sherwood Town Center Plan*. A major component of the Southwest Corridor Plan is the analysis and evaluation of both Bus Rapid Transit (BRT) and Light Rail Transit (LRT) travel modes for several potential routes alignments to link Central Portland, Southwest Portland, Tigard, and Tualatin.

Initial study of high capacity transit (HCT) in the Southwest Corridor began in 2009, with potential HCT destinations, routes and travel modes evaluated at a high level. Beginning in 2012, the Southwest Corridor partners worked to identify a set of collective investments that would help achieve local visions and link the Southwest Corridor communities with a more effective, reliable and safe regional transportation network. The project partners engaged the public on the investments that would make it easier, safer and more enjoyable to get around in their communities and studied the viability of different options for new transit to serve the whole Corridor. In 2013, the Southwest Corridor adopted a comprehensive Shared Investment Strategy that established a vision of investments in parks, trails, sidewalks, transit and roadways from Portland to Sherwood, Beaverton to Lake Oswego to support community goals. Some projects in the strategy are already underway; others require further study or funding for implementation.

From late 2013 through 2014, the Southwest Corridor Plan partners conducted a focused refinement study of the usage, community benefits, traffic impact and potential costs of high capacity transit options. In December 2014, the steering committee directed project staff to use these findings and further community input to develop a Preferred Package of transportation investments to support community land use goals. The Preferred Package will include the following components:

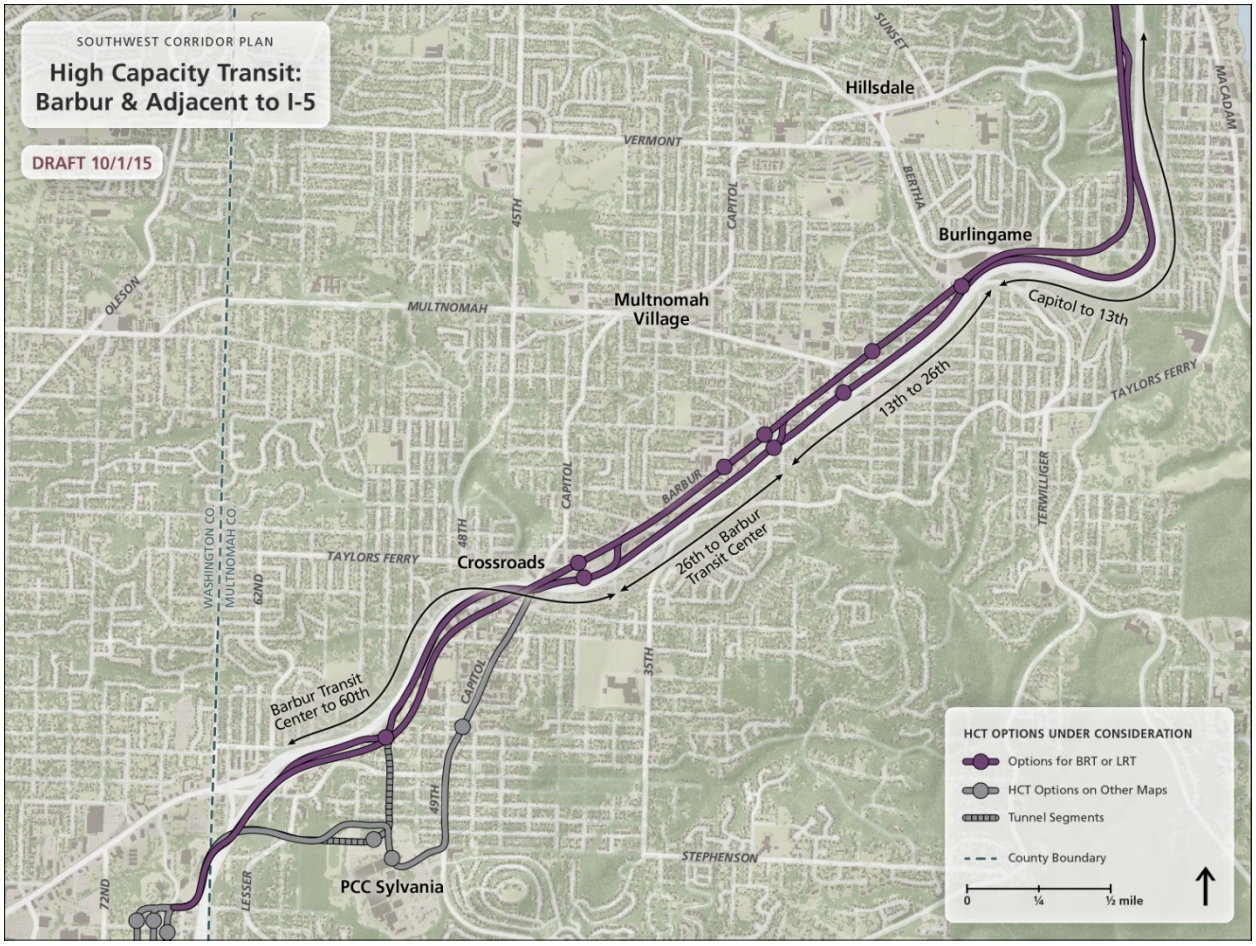
- ***HCT Preferred Alternatives:*** Preferred HCT alignments to study further in a federal Draft Environmental Impact Statement (DEIS), including travel mode, alignments, terminus, and associated roadway, bicycle, and pedestrian projects
- ***Corridor Connections:*** Potential funding source and timeframe for each of the roadway, bicycle, and pedestrian projects identified in the Shared Investment Strategy
- ***Land use and development strategy:*** Partnership agreements and other pre-development work to activate land use and place-making strategies identified in local land use visions

July 2015 Steering Committee decisions

In June 2014, the steering committee directed project staff to study the adjacent to I-5 option in more detail than had been covered in the initial refinement phase of the project. In a May 2015 technical modifications memo, project staff updated the steering committee on the additional analysis completed on the adjacent to I-5 options north of Crossroads (the Barbur/Capitol/I-5 intersection), and also recommended adding consideration of an adjacent to I-5 segment between the Barbur Transit Center and SW 60th Avenue and analyzing this segment in more detail. At their July 2015 meeting, the steering committee accepted this recommended technical modification. This memo provides further information on all of the adjacent to I-5 segments as a follow-up to the July 2015 decision.

At the July 2015 meeting, the steering committee also decided to remove all tunnels to Marquam Hill and Hillsdale, to continue studying the BRT option to serve PCC Sylvania directly via Capitol Highway, and to postpone the decision on the LRT tunnel to PCC Sylvania in order to provide more time for additional analysis and discussion.

Central Barbur options



For the purpose of this analysis, the Barbur and adjacent to I-5 alignment options have been separated into the following four segments:

- Capitol Highway to 13th Avenue
- 13th Avenue to 26th Way
- 26th Way to Barbur Transit Center
- Barbur Transit Center to 60th Avenue

Segment descriptions

Capitol Highway to 13th Avenue

No stations are currently under consideration in this segment.

For a Barbur alignment in this segment, HCT could be either center-running or on a structure adjacent to Barbur.

For an adjacent to I-5 alignment in this segment, HCT would depart from Barbur Boulevard just north of Capitol Highway in "The Woods," and run along the northwest side of I-5 to 13th Avenue, near the Burlingame Fred Meyers. From 13th to the south, HCT would continue running adjacent to I-5 at least until the Crossroads intersection of Barbur and Capitol. Due to steep grades, deep ravines, road crossings and freeway ramps, an adjacent to I-5 alignment in this segment would require a series of tunnels, structures and retaining walls and would likely impact Fulton Park, which would require Section 4(f) analysis. Because of the limited right-of-way between Fulton Park and I-5 (as narrow as 16 feet), impacts to the park would be difficult to avoid, especially while maintaining the space to potentially add a southbound climbing lane to I-5 through this area in the future.

13th Avenue to 26th Way

Two stations are currently under consideration in this segment, around SW 13th Avenue and SW 19th avenues for a Barbur alignment, and SW 13th and SW Spring Garden for an adjacent to I-5 alignment.

For a Barbur alignment in this segment, HCT would be center-running.

HCT could either continue running adjacent to I-5 from Capitol Highway (if it runs adjacent to I-5 in the Capitol to 13th segment), or depart from Barbur Boulevard at 13th Avenue and then run along the northwest side of I-5 to 26th Way. South of 26th, HCT would continue running adjacent to I-5 at least until the Crossroads intersection of Barbur and Capitol.

Due to a concentration of freeway ramps and roads crossing over I-5 near Multnomah Boulevard, the preferred station location at SW Capitol Hill Road and SW 19th Avenue would be infeasible for the adjacent to I-5 alignment. Instead, the station would likely need to be located farther south, just north of SW Spring Garden Street, which would be about a quarter mile from a 26th Way station.

26th Way to Barbur Transit Center

In addition to the Barbur Transit Center station, a station could be located either at SW 26th or SW 30th Avenue.HCT would either continue running adjacent to I-5 (if it runs adjacent to I-5 in the 13th to 26th segment), or depart from Barbur Boulevard at 26th Way and then run along the northwest side of I-5 to the Barbur Transit Center. To the south, HCT could cross over the Crossroads intersection and continue running adjacent to I-5, drop into the center of Barbur from a structure over Crossroads, or turn south onto Capitol Highway to serve PCC directly with BRT.

Barbur Transit Center to 60th Avenue

Two stations are currently under consideration in this segment, at Barbur Transit Center (SW 41st Avenue) and around SW 53rd Avenue.

HCT would either continue running adjacent to I-5 (if it runs adjacent to I-5 in the 26th to Barbur TC segment), or depart from Barbur just north of the Barbur Transit Center and then run along the southeast side of I-5 until 60th Avenue, where it would turn southwest to cross over I-5 into the Tigard Triangle. A 53rd Avenue station along this segment could be located just northwest of Barbur Boulevard in order to reduce the distance between the station and the PCC campus.

An adjacent to I-5 segment from Crossroads to 53rd Avenue could be included with a light rail tunnel to PCC, but has not been evaluated separately for the purpose of this memo.

Segment combinations

Several combinations of the four segments are possible, with various transition points between Barbur to adjacent to I-5, depending on mode and whether PCC Sylvania is served directly or indirectly.

HCT could shift from Barbur to adjacent to I-5 at: just north of Capitol Highway (in "The Woods"), 13th Avenue, 26th Way and just north of the Barbur Transit Center.

If PCC Sylvania is served indirectly with a station at 53rd Avenue, there are two options for a southern transition from adjacent to I-5 back to an in-street alignment: Crossroads (touching down to street level near SW Luradel Street from a structure over the Crossroads intersection) and 60th Avenue. For a light rail tunnel direct to the PCC-Sylvania campus, the southern transition could be at either Crossroads or 53rd Avenue. For BRT direct to PCC via Capitol Highway, the transition could be at either Crossroads or the Barbur Transit Center.

Although HCT could switch between Barbur and adjacent to I-5 more than once, each transition would reduce travel time and could result in increased property impacts and capital cost. Multiple transitions would have to be driven by substantial improvements in transit performance or avoidance of community or environmental impacts.

Future evaluation of the adjacent to I-5 alignment option will include more detailed information on the relative performance of these many different segment combinations. For the purpose of this memo, adjacent to I-5 has been evaluated on a segment-by-segment basis only. As a result, the differences in cost, travel time and property impacts that are provided in the following section do not correspond to the total difference between running adjacent to I-5 and in Barbur, but rather the difference for each particular segment.

Comparative performance of options

The following table highlights where there are differences between adjacent to I-5 and Barbur for each of the four segments based on station locations, capital cost, travel time and reliability, traffic, property impacts, park impacts and engineering complexity.

	Capitol to 13th	13th to 26th	26th to Barbur TC	Barbur TC to 60th[1]
Station locations *differences in station cross-street*	No difference	19th/Capitol Hill station infeasible for adjacent to I-5. Instead, station would shift south to Spring Garden St.	No difference (Barbur alignment station could be located at 30th instead of 26th)	No difference
Capital cost *includes Barbur Streetscape Plan improvements*	Adjacent to I-5 would cost $99 million more than Barbur.	Adjacent to I-5 would cost $69 million more than Barbur.	Adjacent to I-5 would cost $14 million less than Barbur.	Adjacent to I-5 would cost $59 to $61 million less than Barbur.
Travel time and reliability	Adjacent to I-5 would be 13 seconds slower than Barbur. Separated right-of-way with fewer intersections would improve reliability.	Adjacent to I-5 would be 15 seconds faster than Barbur. Separated right-of-way with fewer intersections would improve reliability.	Adjacent to I-5 would be 5 seconds slower than Barbur. Separated right-of-way with fewer intersections would improve reliability.	Adjacent to I-5 would be similar to Barbur for LRT, and 5 seconds faster for BRT than Barbur. Separated right-of-way with fewer intersections would improve reliability.
Traffic	Adjacent to I-5 would avoid existing traffic bottleneck at Terwilliger Blvd.; Barbur could avoid this with grade-separated structure	Adjacent to I-5 would not avoid any significant existing bottlenecks.	Adjacent to I-5 would avoid complicated intersection at Crossroads.	Adjacent to I-5 would avoid complicated intersection at Crossroads.
Property impacts *based on total area of property impacts*	Adjacent to I-5 would have 52% more square feet of property impacts.	Adjacent to I-5 would have49% fewer square feet of property impacts.	Adjacent to I-5 would have 36% fewer square feet of property impacts.	Adjacent to I-5 would have 79% more square feet of property impacts.
Park impacts	Adjacent to I-5 alignment would impact Fulton Park	No difference	No difference	No difference
Engineering complexity	Adjacent to I-5 would require a series of tunnels, bridges and retaining walls in areas known for slope movement and landslide susceptibility.	Adjacent to I-5 alignment would be elevated to pass over existing ramps and bridges at 26th.	Adjacent to I-5 alignment would be elevated to pass over Crossroads intersection.	Adjacent to I-5 alignment would be elevated to pass over Crossroads intersection.

[1] Assumes indirect access to PCC-Sylvania via station at Barbur and 53rd. The comparison between Barbur and adjacent to I-5 in this segment would be different if connecting to a light rail tunnel to the Sylvania campus, and could be explored in more detail in a future evaluation.

Staff Recommendations

Based on information presented in the above table, project staff does not recommend further study of the segment of the adjacent to I-5 alignment north of 13th Avenue. This segment provides little to no benefit over the Barbur alignment in terms of transit performance while resulting in higher construction cost, impacts and risk. The main advantage of running adjacent to I-5 in this segment would be avoiding the traffic bottleneck at Terwilliger Boulevard. However, a structure over this intersection could also be incorporated in the Barbur Boulevard alignment, likely at a lower cost than the additional $99 million required to be adjacent to I-5 in this segment.

Project staff recommends further study of the adjacent to I-5 segments south of 13th Avenue. In these segments, running adjacent to I-5 could provide an advantage over the Barbur alignment in terms of cost, travel time, traffic or property impacts, but these technical considerations must be weighed alongside other issues such as station access, driveway impacts, redevelopment potential, safety and security, and streetscape improvements. More detailed analysis and a more comprehensive evaluation would support discussion of the trade-offs between running in the center of Barbur and adjacent to I-5.

Motor Vehicle Traffic Analysis

A traffic analysis of the Barbur option was performed to study the impacts of median-running high capacity transit on motor vehicle traffic operations. The Appendix summarizes the findings of this analysis. The analysis indicates that HCT alignments in Barbur are viable and would not cause unacceptable motor vehicle traffic operation relative to the adopted regional and statewide mobility target.

Additional traffic analysis to evaluate Barbur when there is an incident on I-5, with and without HCT. This analysis is expected to be completed by the end of 2015.

Next steps

In December 2015 the steering committee will decide which Central Barbur alignment segments to study further. Further discussion of the trade-offs between the adjacent to I-5 and Barbur alignment options will begin in 2016, and could continue into the environmental review process.

In December 2015 the steering committee will also decide which HCT alignment and terminus options in Tigard and Tualatin to study further and will select a preferred southern terminus. In February 2016 the steering committee will decide whether to pursue light rail or bus rapid transit as the preferred mode and whether to continue studying a light rail tunnel to PCC-Sylvania. The HCT mode, terminus and alignments will then be included in a draft Preferred Package of transportation investments to support community land use goals throughout the Southwest Corridor. This draft Preferred Package will be open

to public review before a steering committee decision on the final Preferred Package, schedule for April 2016.

Throughout 2016, the project partners will evolve details of the proposed HCT system from conceptual to preliminary design. Comprehensive environmental review of the Preferred Package, which would likely begin in 2017, will encompass substantial advancement of HCT design, including details on roadway widening, lane conversions, property impacts and any tunnel construction. Construction of the HCT line could begin as early as 2021.

Appendix: Traffic analysis

A traffic analysis was performed to study the impacts of median-running high capacity transit (HCT) in Barbur Boulevard on motor vehicle traffic operations. The corridor was analyzed for the AM and PM peaks. Traffic counts were performed at all driveways and intersections in the corridor, and movements that would be restricted by the addition of a median were rerouted as right turn/U-turn combinations as appropriate. The analysis considers the operational effects of these U-turns, which are assumed to only be permitted at signalized intersections, increased sides street phase splits due to the increased walk time of the wider roadway cross-section, the increased number of traffic signals required to facilitate safe HCT operation, and the effects of improved transit ridership including increased pedestrian calls at signals.

The following tables summarize the initial findings of the analysis. More detailed information including methodology, scenario descriptions and assumptions, and additional performance measures including level of service and queuing will be available in the final traffic report in late 2015.

The analysis found that during the PM peak all intersections except Barbur & Terwilliger would operate within the mobility target for the year 2035, for both the No Build and Build scenarios. Barbur & Terwilliger would operate comparably in the No Build and Build scenarios. Travel times for motor vehicles would increase along the corridor in the Build scenario primarily due to the addition of new traffic signals.

During the AM peak all but two intersections, Barbur & 53rd Ave. and Barbur & Capitol Highway (Crossroads), would perform within the mobility target for 2035 under Build scenarios. Both intersections that would exceed mobility target are close to performing within the target, and could potentially be mitigated to operate within the standard if a Barbur alignment is chosen.

While there are many details beyond mobility targets that will require addressing, including but not limited to approval for new traffic signals, turn lane lengths and detailed signal timing parameters, this analysis indicates that Barbur is likely a viable HCT alternative and that the addition of HCT would not cause unacceptable motor vehicle traffic operation relative to the adopted regional and statewide mobility target. Additional work related to the comparative operations of Barbur when there is an incident on I-5 is underway and expected to be completed by the end of 2015.

PM Peak V/C Ratio at Signalized Intersections	Target	2015 Existing	2035 No-Build	2035 Build w/ Lane Conversions*	2035 Build w/o Lane Conversions
99-W & 69th Avenue/68th Parkway	0.99	0.94	0.99	0.94	0.97
Barbur & 64th Avenue/I-5 on-ramp	0.99	0.93	0.97	0.91	0.95
Barbur & 60th Avenue	0.99	0.82	0.84	0.69	0.83
60th Avenue & I-5 off-ramp					
Barbur & 53rd Avenue	0.99	0.72	0.80	0.89	0.85
Barbur & Capitol Highway (Crossroads)	0.99	0.75	0.80	0.92	0.89
Barbur & Taylors Ferry Road	0.99	0.99	0.97	0.91	0.94
Barbur & Barbur TC Exit (signalized)	0.99	0.56	0.58	0.62	0.61
Barbur & 30th Avenue	0.99	0.66	0.66	0.75	0.76
Barbur & 24th Avenue/I-5 off-ramp	0.99	0.66	0.67	0.71	0.74
Barbur & 22nd Avenue	0.99	not signalized		0.85	0.90
Barbur & 19th Avenue/Capitol Hill Road	0.99	0.84	0.88	0.89	0.93
Barbur & SW 13th Avenue	0.99	not signalized		0.62	0.62
SW Bertha Boulevard & 13th Avenue	0.99	0.71	0.73	0.70	0.68
Barbur & Bertha Boulevard/I-5 ramps	0.99	0.80	0.90	0.80	0.83
Barbur & Terwilliger Boulevard	0.99	**1.01**	**1.11**	**1.12**	**1.11**
Barbur & 3rd Avenue	0.99	0.65	0.76	not signalized	
Barbur & 2nd Avenue	0.99	not signalized		0.62	0.64

* Lane conversions considered between approximately SW 55th Avenue and SW Huber Street.

PM Peak along Barbur Blvd. Corridor Motor Vehicle Travel Times (minutes)	2035 No-Build	2035 Build w/ Lane Conversions*	2035 Build w/o Lane Conversions
NB Barbur (69th Ave to Miles St/3rd Ave)	10.5	11.6	11.9
SB Barbur (Miles St/3rd Ave to 69th Ave)	10.9	11.3	11.5

* Lane conversions considered between approximately SW 55th Avenue and SW Huber Street.

AM Peak V/C Ratio at Signalized Intersections	Target	2015 Existing	2035 No-Build	2035 Build w/ Lane Conversions*	2035 Build w/o Lane Conversions
99-W & 69th Avenue/68th Parkway	0.99	0.86	0.93	0.92	0.94
Barbur & 64th Avenue/I-5 on-ramp	0.99	0.70	0.81	0.78	0.79
Barbur & 60th Avenue	0.99	0.90	0.91	0.81	0.91
60th Avenue & I-5 off-ramp					
Barbur & 53rd Avenue	0.99	**1.00**	0.95	**1.02**	**1.00**
Barbur & Capitol Highway (Crossroads)	0.99	0.97	0.98	**1.01**	**1.01**
Barbur & Taylors Ferry Road	0.99	0.81	0.82	0.72	0.76
Barbur & Barbur TC Exit (signalized)	0.99	0.64	0.63	0.61	0.65
Barbur & 30th Avenue	0.99	0.73	0.77	0.76	0.80
Barbur & 24th Avenue/I-5 off-ramp	0.99	0.87	0.91	0.90	0.93
Barbur & 22nd Avenue	0.99	not signalized		0.74	0.77
Barbur & 19th Avenue/Capitol Hill Road	0.99	0.95	0.94	0.93	0.96
Barbur & SW 13th Avenue	0.99	not signalized		0.56	0.60
SW Bertha Boulevard & 13th Avenue	0.99	0.76	0.79	0.60	0.60
Barbur & Bertha Boulevard/I-5 ramps	0.99	0.94	0.98	0.83	0.89
Barbur & Terwilliger Boulevard	0.99	**1.00**	**1.01**	0.95	0.98
Barbur & 3rd Avenue	0.99	0.90	0.99	not signalized	
Barbur & 2nd Avenue	0.99	not signalized		0.58	0.63

* Lane conversions considered between approximately SW 55th Avenue and SW Huber Street.

AM Peak along Barbur Blvd. Corridor Motor Vehicle Travel Times (minutes)	2035 No-Build	2035 Build w/ Lane Conversions*	2035 Build w/o Lane Conversions
NB Barbur (69th Ave to Miles St/3rd Ave)	10.4	11.1	11.7
SB Barbur (Miles St/3rd Ave to 69th Ave)	10.1	11.0	11.1

* Lane conversions considered between approximately SW 55th Avenue and SW Huber Street.