

Southwest Corridor Plan

PCC Sylvania Light Rail Connection Options

Technical Memo
August 14, 2015



Overview

This technical memo presents new information related to connecting high capacity transit to the Portland Community College (PCC) Sylvania campus as part of the Southwest Corridor Plan. This information is intended to inform and aid the Southwest Corridor Steering Committee in making a recommendation on whether to continue study of a direct light rail connection to the PCC Sylvania campus. The Steering Committee recommendation is scheduled for October 2015.

Contents

In July 2015, the Southwest Corridor Steering Committee directed project staff to further investigate options for a direct light rail tunnel to the Sylvania campus. This memo reports on the outcomes of this analysis, which aimed to identify ways to reduce impacts, costs and risks while maintaining or improving performance. The Steering Committee also directed project staff to explore alternative connections to the campus, in case the eventual Southwest Corridor alignment is routed on Barbur Boulevard (whether light rail or bus rapid transit) and not directly to PCC. This memo reports on the outcomes of research and design work related to mechanized and pedestrian connection options from a station on SW Barbur Boulevard to the campus. This memo also includes new transit modeling results, comparing projected ridership differences between previously considered alignment options.

Following this overview, this memo explains the context and background events leading up to this memo, explains the steps taken to identify and explore alternative tunnel options, describes the tunnel options and summarizes their relative costs and benefits, reports on the outcome of investigations into a mechanized connection and an enhanced pedestrian connection to campus, and reviews next steps.

Summary of findings

The analysis found that, on the basis of cost and schedule, constructing a bored light rail tunnel connection to PCC Sylvania would provide a more efficient approach than the cut-and-cover tunnel considered by the Steering Committee in July 2015. In addition, a bored tunnel alignment may provide the most direct route connecting Barbur, PCC Sylvania and the Tigard Triangle, thus providing slightly improved travel times compared to a cut-and-cover tunnel. While a bored tunnel would result in property and traffic impacts, those impacts would be substantially less than from a cut-and-cover tunnel construction approach.

Given the challenges posed by a cut-and-cover tunnel—including difficulties with maintaining access and mitigating construction impacts to existing properties, the complex sequence of construction and engineering risk due to the depth of proposed tunnel—the analysis demonstrates that a bored tunnel connection PCC Sylvania is feasible and may be preferred.

Next steps

This technical information will be considered by the Southwest Corridor Steering Committee at their October 2015 meeting, along with a status report from staff on other efforts related to PCC Sylvania, such as the college's progress on envisioning future campus development and community input.

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 Draft Environmental Impact Statement, 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

Analysis of PCC Sylvania area

The Southwest Corridor project partners are taking a place-based approach to understanding the key issues associated with potential HCT and transportation investments as they relate to local concerns and community aspirations. Key issues memos analyzing potential HCT alignment options in South Portland, Hillsdale, and the PCC Sylvania areas were released in March and April 2015. The PCC Sylvania Key Issues memo provided analysis of three HCT alignment options.

A Barbur alignment with improved connection to PCC (**Barbur option**) would remain on or parallel to Barbur and serve the campus with an improved pedestrian and bike connection from a station in the vicinity of Barbur and SW 53rd Avenue. This option is possible for either BRT or light rail.

PCC via SW Capitol Highway (**Capitol BRT option**) would create a direct connection to the campus, departing Barbur at the Crossroads intersection and using Capitol and SW 49th Avenue to reach the PCC-Sylvania campus. This segment would include stations on the PCC campus and in the vicinity of Capitol and SW Comus Street, near Holly Farm Park and the Capitol Hill Library. The alignment would head west through campus and then run on a new structure stretching from SW Lesser Road across I-5 to the Tigard Triangle. This option is only possible for BRT due to the steep slopes approaching and departing the campus that exceed light rail capability.

PCC via cut-and-cover tunnel (**light rail tunnel option**) would create a direct connection to the campus, departing Barbur at 53rd Avenue and running in a cut-and-cover tunnel underneath 53rd toward an underground station near the northern edge of campus. The alignment would then run westward and emerge from the cut-and-cover tunnel near Lesser Road, then run on a new structure stretching from Lesser Road across I-5 to the Tigard Triangle. This option is only being considered for light rail, as it would cost significantly more than BRT via Capitol.

A number of other HCT alignment options were removed from further consideration by the Steering Committee in April and June 2014. During that refinement process, it was determined that a direct connection to the PCC Sylvania campus with light rail could only be achieved using a tunnel. A tunnel is necessary because of the steep slope and substantial elevation difference between the campus and the Tigard Triangle. Light rail operations cannot operate on overly steep grades, and so a light rail alignment to PCC Sylvania must already be underground and descending at the campus in order to drop down to the elevation in Tigard. A cut-and-cover tunnel was initially assumed due to its lower construction costs compared to a bored tunnel. 53rd Avenue was chosen as the route for the tunnel because it provides the shortest connection between Barbur and the central campus and would impact the fewest residences, compared to other streets.

July 2015 Steering Committee direction

In July 2015, the Southwest Corridor Steering Committee considered whether to continue further study of the Capitol BRT and light rail tunnel options. (The Barbur option remains under consideration and is expected to be evaluated in the federal Draft Environment Impact Statement.) The committee recommended continued study of the Capitol BRT option and rescheduling the decision regarding the light rail tunnel option to October 2015. In postponing the decision, the committee cited reasons to further study the light rail tunnel option but acknowledged its impacts and noted that the Sylvania campus master plan is outdated and existing plans do not anticipate HCT on campus.

To better inform the October decision, the Steering Committee requested that project staff expand on the options for connecting light rail to the PCC campus. Staff recommended actions that included:

- Continue to refine preliminary tunnel designs in order to better define tunnel impacts and potential mitigation.
- Continue to explore alternative mechanized connections between a Barbur station and the campus, such as a shuttle bus system or people mover, in the event that the option on Barbur is identified as the preferred alignment.

This memo reports on the findings of these actions, and provides transit modeling results analyzing projected ridership differences between the three alignment options (Barbur, Capitol BRT and light rail tunnel).

Tunnel refinement process

After the July 2015 Steering Committee meeting, project staff held a tunnel design workshop to confirm the previous assumptions made for a cut-and-cover (C&C) tunnel and to determine whether a bored tunnel held potential to reduce impacts for a comparable cost to construct. Workshop participants included staff from the City of Portland, Metro and TriMet, as well as consultants from David Evans and Associates (DEA) and McMillen Jacobs and Associates (MJA). The goals of the workshop were to revisit assumptions for C&C and bored tunnel options, and to ensure that the most cost effective and least impactful tunnel concept for a light rail connection to PCC was identified for Steering Committee consideration in October.

The workshop began with a review of all potential tunnel and other PCC connection alignments explored to date, in order to identify design constraints and risks. Participants identified three potentially feasible alignments for further exploration, including a long bored tunnel, a short bored tunnel, and a revised cut and cover tunnel, described below. Subsequently, DEA provided conceptual drawings for each alignment to MJA for further analysis of cost effectiveness, construction techniques, risks and feasibility.

Alternative Tunnel Options

Cut-and-cover tunnel options



Original light rail tunnel option

The light rail tunnel option originally considered by the Southwest Corridor Steering Committee in July 2015 utilized cut-and-cover construction, as it was believed this technique would be more cost effective than a tunnel constructed with a boring machine given its relatively short length. The tunnel portion of this alignment runs approximately 3,500 feet. The alignment begins at the north portal, located at 53rd Avenue and Barbur, and runs down the center of 53rd Avenue to the PCC campus. The south portal of the tunnel is located on PCC campus, east of Lesser Road, where the alignment would continue on a 1,400 foot long elevated structure over I-5 to the Tigard Triangle. The tunnel and a campus station would be constructed using the cut-and-cover technique.

This option would result in several substantial issues, most notably the likelihood of temporary or permanent displacements of residents, construction period traffic disruption, and complexities of the tunnel design and construction techniques resulting in longer and riskier construction.

Further investigation has determined that, beyond a certain depth, a C&C tunnel may be less cost effective than a bored tunnel. Also a C&C tunnel would likely be more impactful to the adjacent properties.

Revised cut-and-cover tunnel option

This option is largely consistent with the original option with an adjustment to construction technique. Unlike the original option, which would be constructed using a single open trench, the revised C&C tunnel would be constructed in eight total segments. Seven segments are located on 53rd Avenue between Barbur and PCC, each of which is a street block between intersections. The eighth segment is located on the PCC campus, between the light rail station and Lesser Road.

A mix of two construction techniques would be required to construct this option. One technique would utilize “open” C&C tunnel construction for each segment. Segments would be constructed one at a time, with secant pile bulkheads between each segment. The cut would remain open until the concrete box is constructed, then backfilled. Excavation would then proceed to the next segment.

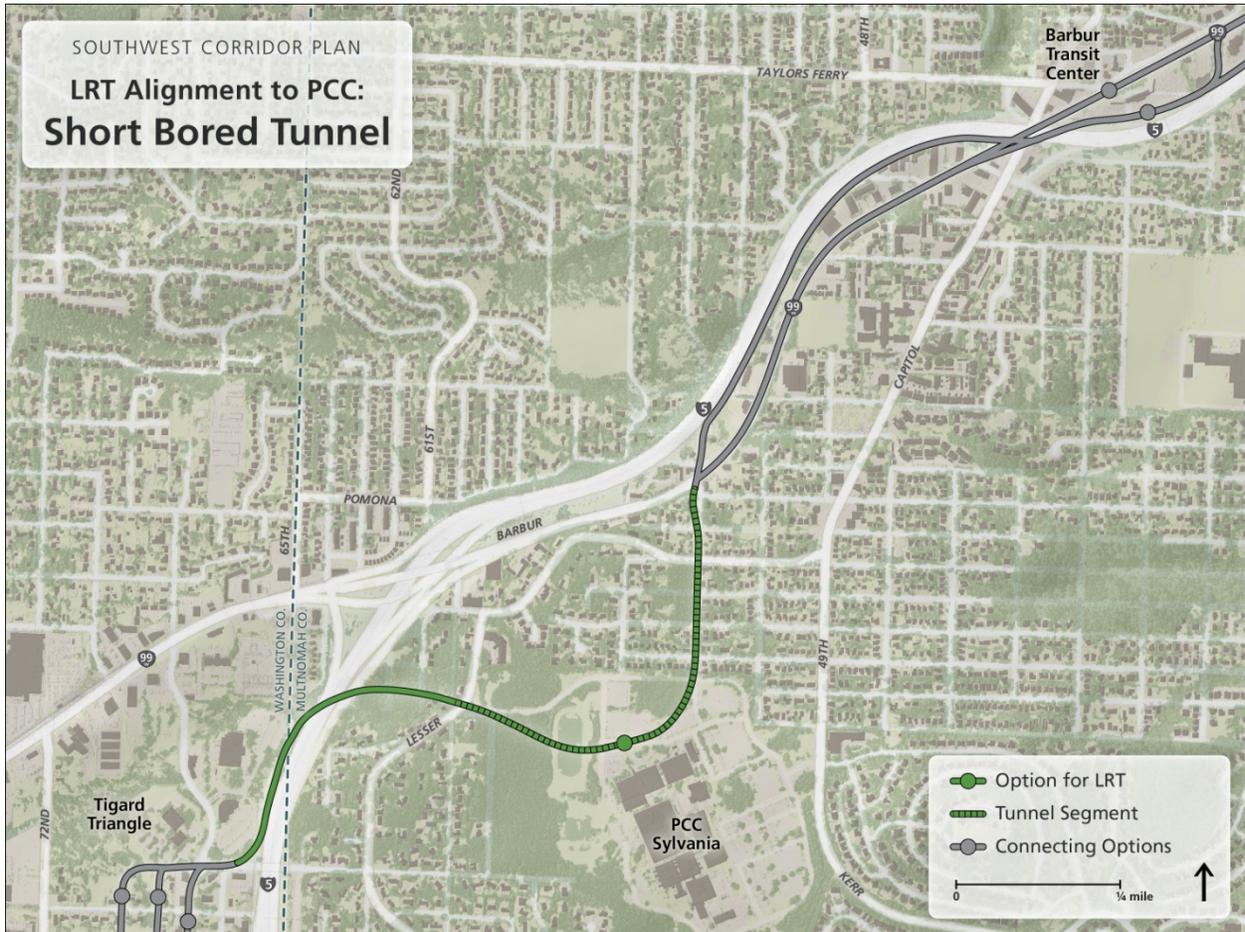
The other construction technique would be employed where 53rd Avenue intersects a cross street. For the intersections, a “lidded” C&C construction approach would be used to maintain cross street traffic and minimize impacts to residential access. This approach uses a “top down” method, where a lid is first constructed over the future tunnel location. After the lid is complete, tunnel excavation is conducted below the lid.

Given the proximity of the residences along 53rd Avenue to the C&C tunnel construction, significant impacts still would occur with this revised approach. Temporary utility relocations and traffic control measures would be necessary. In addition, removal of spoils excavated from the trenches and addition of concrete would require an estimated 41,000 truck trips total, throughout construction. Trucks would use 53rd Avenue as well as Capitol Highway, SW Vacuna Street and SW 51st Avenue.

The overall duration of C&C tunnel construction is estimated at 59 months. Residential access would be severely limited during that time, allowing only pedestrian access via a sidewalk connection. Due to the limited width of the 53rd Avenue right-of-way, and the likelihood of rocky soil conditions, tunnel construction would block all vehicular access to driveways within each segment during construction. There is a high potential for displacement of multiple property owners, primarily as a result of loss of access.

In addition, temporary or permanent through-street connections to 51st Avenue would need to be established on Arnold, Buddington, and Coronado streets to maintain residential access for properties with driveways located on those roadways.

Short bored tunnel option



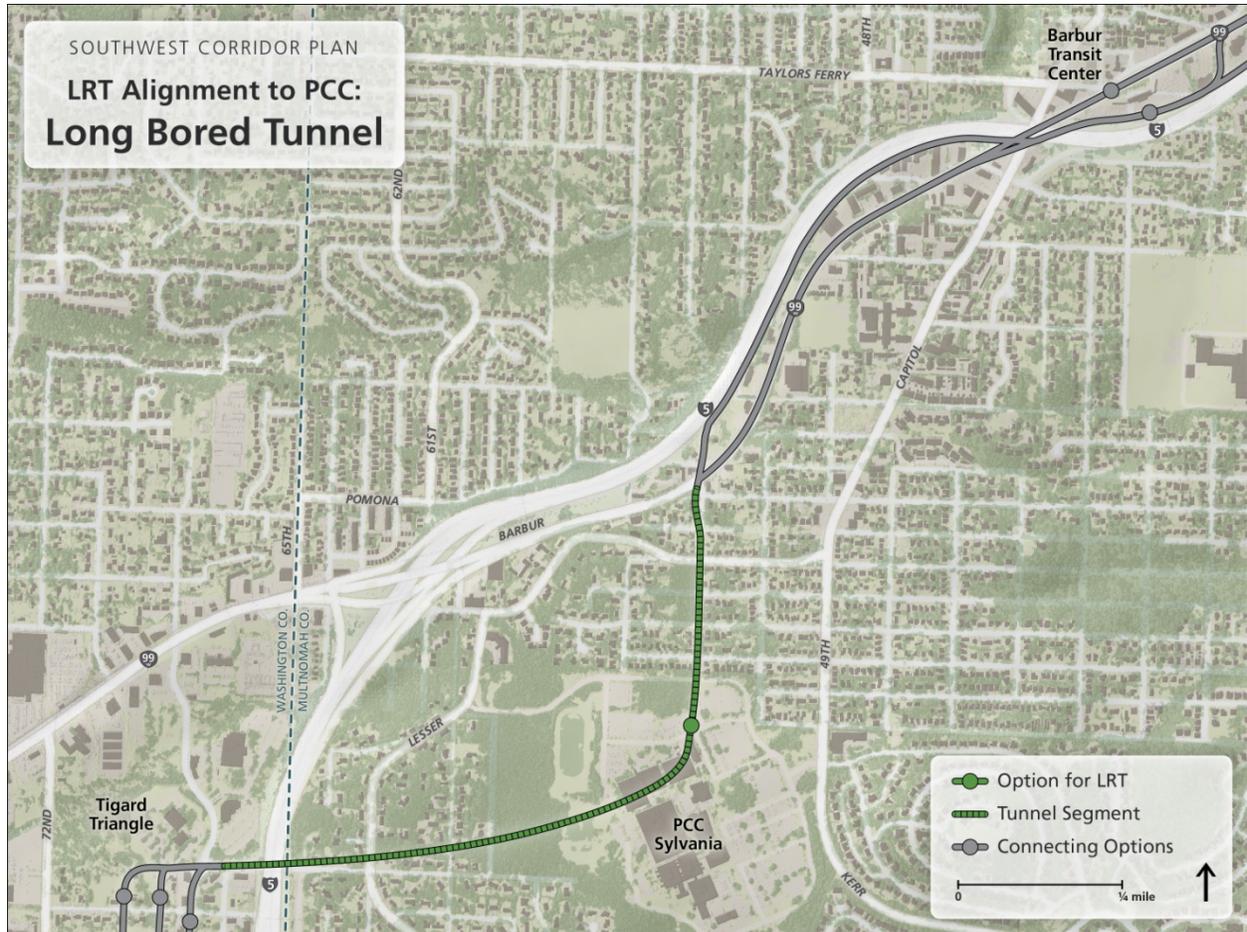
The short bored tunnel alignment utilizes an approximately 2,900 foot long bored tunnel between the north portal near 53rd Avenue and Barbur and the south portal, located west of Lesser Road. The length of the tunnel is reduced through the use of retaining walls at the south portal. Then, the alignment travels on a 1,400 foot elevated structure across I-5 to the Tigard Triangle. A station is located approximately 120 feet below PCC campus in relative proximity to the long bored tunnel station.

The construction means and methods and sequencing of activities are the same for both the long and short bored tunnel options. The project construction would begin with the contractor mobilizing to the PCC station location to begin shaft construction of the station cavern, while the north and south portal locations would be developed, while the tunnel boring machine (TBM) refurbishment was completed offsite.

The TBM would be launched from the north portal location at 53rd Avenue, while the station excavation was occurring. Hauling activities from the portal would take place at the 53rd Avenue staging area located northwest of Barbur. The TBM would proceed to the station location and then to Lesser Road. Once the first tunnel is complete, the TBM would return to the north portal to begin boring the second tunnel. Overall construction duration is estimated to be 51 months for the short bored tunnel. Trucks are required to move the excavation materials and bring concrete to the site. It is estimated a total of

36,000 truck trips will be needed for the short bored tunnel. Trucks trips would primarily occur at the intersection of 53rd Avenue and Barbur. Significant traffic control measures would be needed to accommodate these truck trips. However, trucks would not need to travel along 53rd Avenue or adjacent residential streets, but may need to travel on Lesser Road. In addition, the location of the north portal could be relocated to the northwest, potentially passing under Barbur to minimize impacts to the intersection at 53rd Avenue. Additional exploration would be needed to compare potential costs and construction issues with benefits of relocating the portal.

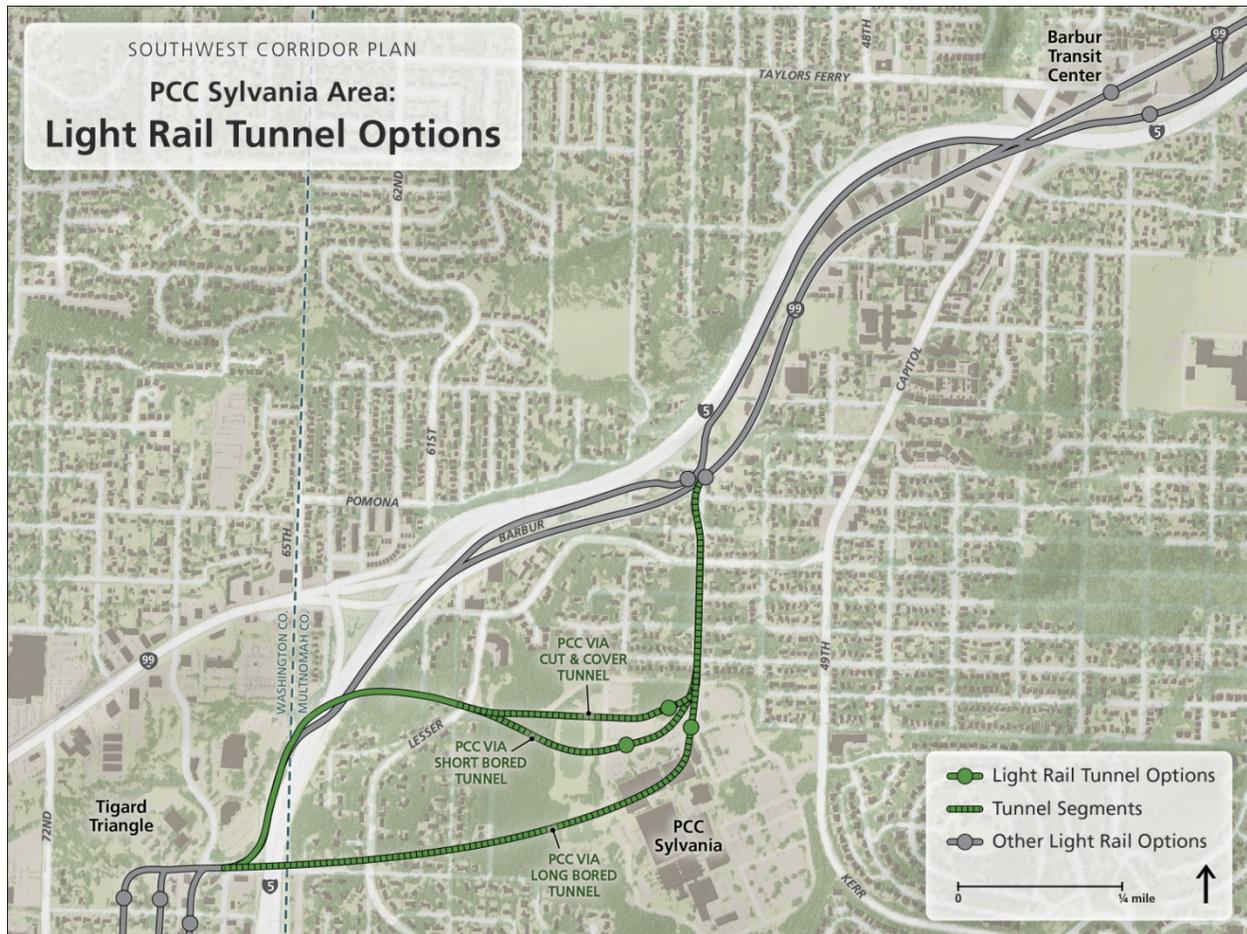
Long bored tunnel option



The long bored tunnel alignment utilizes an approximately 5,200 foot long bored tunnel that travels from the north portal location at 53rd Avenue and Barbur, to a station located roughly 150 feet below the PCC campus, before proceeding directly to the Tigard Triangle. This tunnel alignment passes under I-5, locating the south portal to the west of I-5 near SW Atlanta Street, eliminating the need for the 1,400 foot long elevated structure used by the other options and its related property impacts.

Overall construction duration is estimated to be 54 months for the long bored tunnel. It is estimated a total of 42,000 truck trips will be needed for the long bored tunnel. Similar to the short bored tunnel, traffic control measures would be needed, and the relocation of the north portal can be explored to help mitigate the impacts at the intersection of 53rd Avenue and Barbur.

Comparative performance of options



While travel time and ridership for each option has not yet been analyzed, it is believed the long bored tunnel would have the shortest travel time, as it contains the fewest curves, and therefore would be the most direct route between 53rd Avenue/ Barbur, and the Tigard Triangle. Even with revised construction techniques, the C&C tunnel would have more significant impacts to adjacent properties due to the traffic control needs, access limitations, duration and sequence of construction, and increased need for noise and vibration mitigation due to proximity of homes to the 53rd Avenue right-of-way. In comparison, a bored tunnel would result in fewer impacts and would lessen residential displacement.

The long and short bored tunnel options are not without risk. A used and refurbished TBM may not be available, so it may be necessary to purchase a new machine at a higher cost. The portal locations would require additional review to address traffic control for hauling excavated spoils. The feasibility of boring under I-5 in the long bored tunnel option also requires further review.

The C&C tunnel option appears to have a longer construction duration, higher capital costs, and higher impacts to the community. In comparison, both the short and long bored tunnel options are more cost effective and reduce impacts to the community. A bored tunnel provides the most efficient approach to

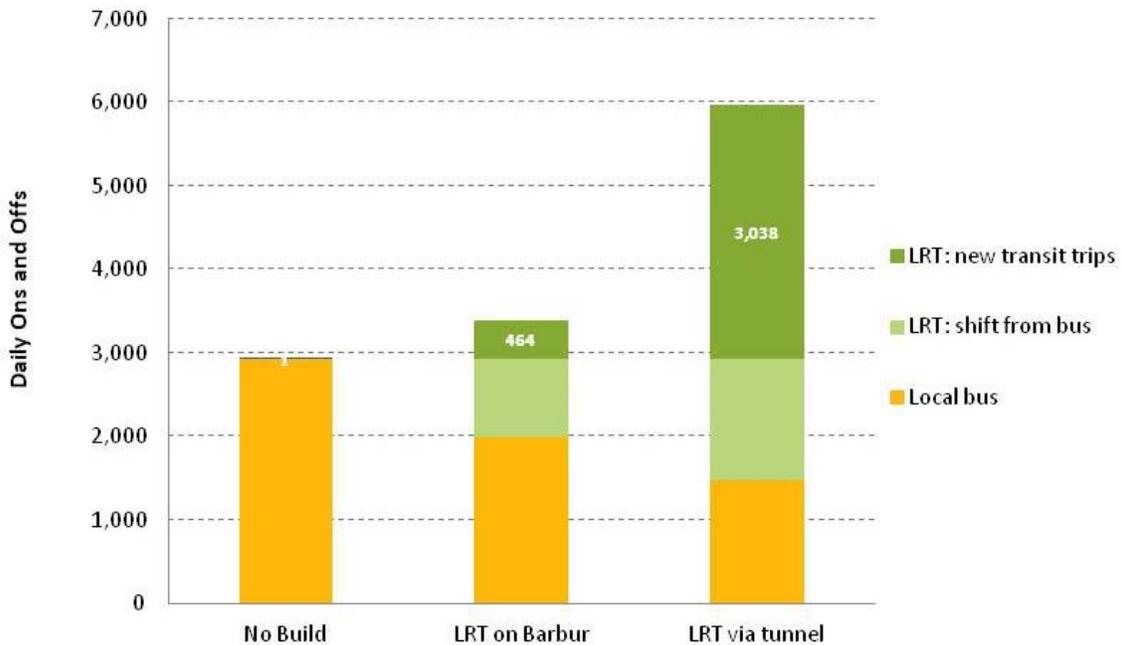
providing a greater length of the LRT alignment, when compared to the C&C tunnel. A summary is provided in the following table.

Relative Comparison of Tunnel Alternatives

Item	Cut and Cover Tunnel Options	Short Bored Tunnel Option	Long Bored Tunnel Option
Total length (feet)	3,500	2,900	5,200
Cost effectiveness	Least	Better than C&C	Better than C&C
Total project duration	59 months	51 months	53 months
Est. # of dump trucks	33,000	35,000	40,000
Est. # of concrete trucks	8,000	1,200	2,100
Property impacts	Highest	Lower than C&C	Lower than C&C

Tunnel vs. Barbur

Since the release of the PCC Sylvania Key Issues memo in April, project staff have modeled the number of future daily HCT boardings (ons and offs) on light rail at a PCC station. This information was projected for the year 2035. Total HCT line ridership and systemwide ridership were also modeled. Light rail on Barbur would result in 43,500 daily line riders and 15,700 new daily system riders in the year 2035. A direct light rail tunnel to PCC Sylvania with an on campus station would result in 46,200 daily line riders and 17,800 new daily system riders. The results are shown in the below figure.



As the figure shows, a light rail tunnel option would result in the most new riders and the biggest shift from bus to rail ridership. The figure also shows that a station on campus would result in significantly more new riders than a Barbur option, regardless of mode.

Alternative Mechanized Connections

Other approaches to connect the PCC campus to a station at 53rd Avenue and Barbur were explored, to provide an alternative to a tunnel. By reviewing several precedents around the world, a range of potential “people mover” options were identified. These options will be further explored to determine feasibility, potential routes and destination. All options assume streetscape enhancements on 53rd Avenue, between the station and campus, as described below.

- **Enhanced local bus service:** As a component of TriMet’s Southwest Service Enhancement Plan, Route 44 service, which links Barbur Transit Center and PCC Sylvania, will become frequent service, running every 15 minutes all day, every day. This service improvement could be further bolstered at key times. The plan also includes extending Route 44 south to Bridgeport Village.
- **Moving sidewalks:** This option would connect the station to campus via escalators. This option is not considered feasible due to the ½ mile distance to be traveled, would not fit the neighborhood character and would create conflicts with driveways and cross-street traffic. In addition, there are concerns with maintenance and operational reliability given the Pacific Northwest climate.
- **Bus shuttles:** This option would connect PCC Sylvania to the 53rd Avenue station, Barbur Transit Center and/or the Tigard Triangle. This option has relatively low capital costs, but requires additional operations and maintenance. Operations would be subject to schedule and may result in idle time in the off-peak hours.
- **Autonomous vehicles/shuttle:** This option would connect PCC to the 53rd Avenue station, Barbur Transit Center and/or the Tigard Triangle. This option has relatively low capital costs and operations and maintenance needs. The system would operate on the local street network, within mixed traffic, at low speeds. The system could be housed on-site and arrive on-demand. However, the technology is very new and is currently being tested, and changes in state and local laws may be necessary to allow for autonomous operation.
- **Personal Rapid Transit:** This option would provide a dedicated guideway shuttle between campus and the 53rd Avenue station, Barbur Transit Center and/or the Tigard Triangle. A guideway could utilize tracks similar to light rail (see picture of Metromover in Miami) or be constructed as a paved surface (such as Ultra PRT in London) that uses curbs to guide the vehicle. Autonomous features can provide on-demand service, both decreasing travel times and limiting idle time in the off-peak hours, while lowering operations and maintenance expenses. While PRT is intriguing for longer distances, it requires a higher capital investment than other options. A tracked guideway would require signalized intersections at all crossings, while a paved guideway with curbs would require elevated structures to avoid intersection conflicts.



Alternative Pedestrian and Bicycle Connection

If the Southwest Corridor Plan opts for a HCT alignment that remains on Barbur, a station near 53rd Avenue is likely. This local roadway provides the shortest access to the campus from Barbur and represents the most likely route for pedestrians and bicyclists to travel between HCT and PCC Sylvania. However, 53rd Avenue traverses a steep grade, only a portion is currently paved and it lacks sidewalks. Investment would be necessary to create a walk/bike connection that is usable to the general public.

Earlier in 2015, Metro contracted with the Mayer/Reed design studio to explore concepts for a new 53rd Avenue streetscape, focusing on enhanced pedestrian and bicycle facilities while continuing to serve local traffic. The goal of this effort was to provide the existing neighborhood and decision-makers with information on how an enhanced connection might function and how the improvements might encourage future transit usage by PCC Sylvania students.

The initial work on the design concepts started with outreach. Mayer-Reed and Metro staff performed the following outreach with support from the City of Portland and TriMet:

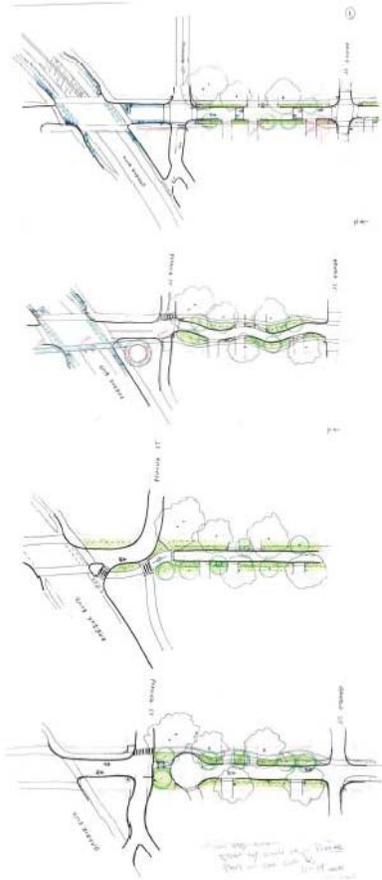
- Discussion with PCC Sylvania staff to understand the unique issues that the campus has dealt with related to off-campus parking and thoughts around access from 53rd Avenue.
- Attended Far SW Neighborhood Association meeting to hear concerns and answer questions about potential HCT alignment options and the impacts of each on the neighborhood.
- Met with the City of Portland Bureau of Transportation and Bureau of Planning to respond to initial design concepts and highlight possible conflict points with City design standards and various engineering concerns.
- Met a second time with the City of Portland to highlight changes based on their initial input and verify that the concepts generated were viable for presentation to the public.

These refined concepts (see following page) were used for further discussions with PCC, the City and surrounding neighborhoods, including a second Far SW Neighborhood Association meeting to present the finalized design concepts and gather feedback on the ideas presented. The neighborhood members present asked several questions and seemed to be amenable to the concept, as proposed. Staff informed the neighborhood members that this was not a final design, merely a concept to utilize moving forward.

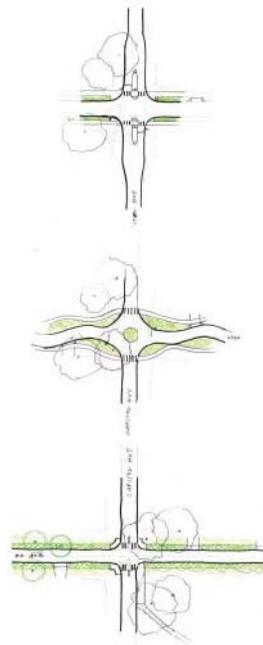
The refined concepts will continue to be used in ongoing conversations with stakeholders related to connecting HCT to the Sylvania campus. The refined concepts will likely be evolved into preliminary designs during the DEIS phase of the Southwest Corridor Plan, with advanced design only undertaken if a Barbur HCT alignment is selected.

Mayer-Reed Concepts for Enhanced SW 53rd Avenue

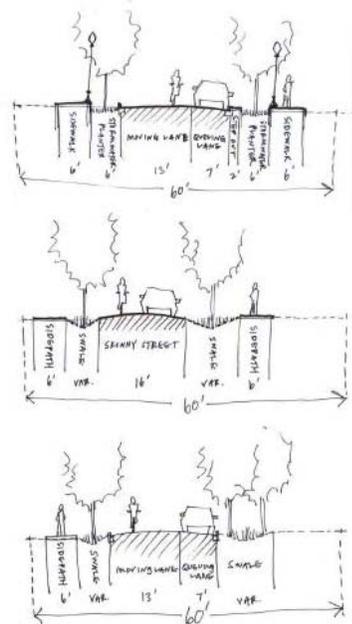
Conceptual designs for the connection from Barbur Blvd to Capitol Hwy



Conceptual renderings of SW 53rd / Capitol intersection with safer crossing



Conceptual cross-sections of SW 53rd Ave



Next steps

Project staff will release a second memo related to the October decision no later than September 11, 2015. That memo will report on the status of the further investigation into a light rail connection to PCC Sylvania, focusing on the recommended actions not covered in this technical memo:

- Development of campus visioning by PCC
- Sharing of student and staff travel data by PCC
- Engagement with the neighborhoods surrounding the campus as well as the college community
- Definition of a formal partnership with PCC

The Steering Committee will then make a recommendation for public review of whether to continue studying a light rail tunnel to PCC Sylvania and, if so, which alignment option. This decision will take place at the October Steering Committee meeting, scheduled for October 12, location TBD.

In December 2015, the steering committee will make recommendations for public review on continued study of HCT alignment options in Tigard and Tualatin, the preferred HCT terminus, and whether bus rapid transit or light rail is the preferred HCT travel mode.

Steering committee members and the public will have several months in early 2016 to discuss the draft Preferred Package resulting from these 2015 decisions. The final Preferred Package is anticipated to be adopted in spring 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 would likely begin in 2017, which 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.